



*Certified Health &  
Nutrition Counselor  
Course  
Instruction Manual*

---

By:

**Brenda R. Generali, C.N.C.  
Founder, JLS  
Certified Nutritional Consultant  
Certified Iridologist  
Certified Herbalist  
Nature's Sunshine Manager**

**JOYFUL LIVING SERVICES**  
P.O. Box 485  
Weimar, CA 95736-0485

**Phones:** 530-878-1119 & 800-704-9800  
**Fax:** 530-878-1119

**E-mail:** [iridology@netzero.net](mailto:iridology@netzero.net)  
**URL:** <http://www.joyfullivingservices.com>

Copyright 2011



*Certified Health &  
Nutrition Counselor  
Course  
Rules & Conditions*

1. To be a part of this course you need to print each session. Be sure to write your name, telephone, e-mail address, and shipping address at the top of each page of the **Question and Answer page before you e-mail or fax it back to us for grading. You will receive a Question and Answer session at the end of each session. Fax it back to us at 530-878-1119 or e-mail it to us at [iridology@netzero.net](mailto:iridology@netzero.net)** There is no time limit as to when the Question and Answer session must be completed. However, we do recommend that you complete each session within the week you receive it so you do not get behind in the study.
2. To be eligible for Certification you must complete all 16 sessions of the course. You also need to let us know that you want to become certified. At the end of the 16 sessions you will be given a test. You must give correct answers to 80% of the questions in **the Test**. Scores are **not** averaged for an overall grade.
3. You must not loan, sell or reproduce this online course in any form. **To do so is cause for expulsion from certification from Joyful Living Services.** This provision is to protect the integrity of the certification. Such protection is further assured by periodic rotating and changing of the questions.
4. You must not edit or share the instruction sessions or test. You must e-mail or fax your Question and Answer session to us as well as the final test where they are maintained as part of your permanent file.
5. In the event of failure: If you should fail the final test, you may repeat the test after a wait of 30 days. There will be a re-examination fee of \$15.00 to cover the costs of new materials, regrading and filing. Should you fail on this second attempt, you must then wait 60 days before making a third attempt. These mandatory delays are for the purpose of continuing study and preparation on your part.
6. When you have completed all sixteen sessions and question and answers, you will receive a bound final test. You must fill out the box at the bottom of the First Page of the Test Packet and have it notarized. There is a notarization form provided.
7. There is no time limit on the completion of this Online Course. Most candidates are full-time practitioners with little time to be able to rush through this course. So please take your time and get it correct the first time.
8. You may drop the online course at any time by notifying us. No refunds will be given if the course is dropped in the middle of any given month.
9. If you have any questions at any time, please e-mail your questions to [iridology@netzero.net](mailto:iridology@netzero.net), fax them to 530-878-1119, or call us at 530-878-1119. We will answer your questions and spend as much time as necessary to help answer your questions.
10. The time you need to study and answer the questions for each session will vary on the amount of iridology you already know and understand and the amount of information we decide to send you. Each session can take you anywhere from one-half to three hours but should not take you longer than three hours to study and answer the question and answer.

NOTE: Joyful Living Services reserves the right to change the test questions for any test repeated.

NOTE: All information regarding a candidate's grades, or the fact of any failures, is kept strictly confidential and is not released to any person.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 1:**

- **COURSE OVERVIEW**
- **COURSE DEFINITION**
- **INTRODUCTION TO NUTRITION**
- **NATURAL FOODS**

### **Course Overview**

This course runs for 16 weeks. It contains 16 lessons on the web as an online course. You will be e-mailed notification every week that the next lesson is ready for you to download. You will receive a certificate at the end of this course. There will be weekly homework and there will be a test at the end of the course. The homework and test will be graded and returned to you. They will need to be mailed, faxed, or e-mailed to us. Each week offers a different subject. You will have one week to study the lesson and turn in your homework IF you choose to follow our timeline. This course is on your own time so you can complete the lessons at your own pace. If you are going on vacation, are ill, or don't have the time every week to read the lesson and complete the homework, you will not be penalized. Because this course is online and is on your own time, you are responsible for turning in your homework when it is complete. You will receive your certificate once all the homework has been turned in and once your final exam is graded and passed. You will then be listed on our web site to receive referrals from us if you choose.

### **Course Definition**

The science of nutrition is the study of the nutrients in food and the body's handling of these nutrients. You are made entirely of what you have eaten. Your skin, which has reliably covered you from the time you were born, is not the same skin that covered you seven years ago, it is made entirely of new cells. The fat beneath your skin is not the same fat that was there a year ago. Your oldest red blood cell is only 120 days old, and the entire lining of your digestive tract is renewed every three days. To maintain your "self", you must continually replenish the energy you burn and replace the cells you lose. This course is designed to teach you about proper nutrition and the role it plays in your health and the health of others.

### **Introduction to Nutrition**

You are a collection of molecules that move. All these moving parts are arranged into patterns of extraordinary complexity and order – cells, tissues, and organs. The arrangement is constant, but its parts are continuously being replaced by a process using nutrients, and using energy derived from nutrients. Your skin, which has reliably covered you from the time you were born, is not the same skin that covered you seven years ago, it is made entirely of new cells. The fat beneath your skin is not the same fat that was there a year ago. Your oldest red blood cell is only 120 days old, and the entire lining of your digestive tract is renewed every three days. To maintain your "self", you must continually replenish the energy you burn and replace the cells you lose.

All these pieces have come from your food. You are made entirely of what you have eaten. Amazingly, though, whether you ate spaghetti or apple pie last night, the nutrients supplied by these foods are handled the same way by your body, so that in the end there is no way to know which food you ate. Only if the spaghetti and the apple pie, together with the other foods you choose to eat, do not contain the nutrients you need, do you fail to function as well as you might. For optimum health, you need not only adequate amounts of the essential nutrients but, ideally, an assortment of nutrients in good proportion to each other. The science of nutrition is the study of the nutrients in food and the body's handling of these nutrients.

### **Science of Nutrition**

The science of nutrition is the study of nutrients and of their ingestion, digestion, absorption, transport, metabolism, interaction, storage, and excretion. A broader definition includes the study of the environment and of human behavior as it relates to these processes.

### **Nutrient**

A nutrient is a substance obtained from food and used in the body to promote growth, maintenance, and/or repair. The essential nutrients are those that the body cannot make for itself in sufficient quantity but has to obtain from food.

## Six Classes of Nutrients

- Carbohydrate
- Fat
- Protein
- Vitamins
- Minerals
- Water

## The Nutrients

Almost any food you eat is composed of dozens or even hundreds of different kinds of materials, atoms and molecules – tinier by far than the smallest things that can be seen with the most powerful microscope. The complete chemical analysis of a food such as spinach shows that it is composed mostly of water (95 percent) and that most of the solid materials are organic compounds: carbohydrate, fat, and protein. If you could remove these materials, you would find a tiny residue of minerals, vitamins, and other materials. Water, carbohydrate, fat, protein, vitamins, and some of the minerals are nutrients. Some of the other materials are not.

A complete chemical analysis of your body would show that it is made of similar materials. If you weigh 150 pounds, your body contains about 90 pounds of water and (if 150 pounds is the ideal weight for you) about 30 pounds of fat. The other 30 pounds are mostly protein, carbohydrate, related organic compounds made from them, and the major minerals of your bones: calcium and phosphorus. Vitamins, other minerals, and incidental extras constitute a fraction of a pound. Thus you, like spinach, are composed largely of nutrients.

If you burn a food such as spinach in air, it disappears. The water evaporates, and all the organic compounds are oxidized to gas (carbon dioxide) and water vapor, leaving only a residue of ash (minerals). This leads us to a definition of the word organic.

An organic compound is one that contains carbon atoms. The first organic compounds known were natural products synthesized by plants or animals; indeed, it used to be thought that only living things contributed organic compounds to our world. The term has since been expanded to include all carbon compounds, whatever their origin. Actually, in a sense, all organic compounds are produced by living things. Some of them, like petroleum (which comes from the remains of microorganisms, plants, and animals that grew in prehistoric times), began and ended their lives millions of years ago. Others are produced by plants and animals that are alive today. Still others come from laboratories where chemists (who are also living things) produce them in the test tube.

In any case, four of the six classes of nutrients – carbohydrate, fat, protein, and vitamins – are organic, while the other two (minerals and water) are not. On being oxidized during metabolism, three of these four (carbohydrate, fat, and protein) provide energy the body can use. In contrast, minerals and water are inorganic and are not oxidized in the human body to yield energy (they can oxidize, however, as iron does when it rusts).

At this point it is clear that molecules account both for your body's structure and for its activities. You are made of atoms taken from some of the molecules of food and rearranged into the molecules of your body. You are able to go about your various pursuits thanks to the energy released when other food molecules are taken apart.

## Oxidation

Oxidation is often a reaction in which atoms from a molecule are combined with oxygen, usually resulting in the release of energy. Chemical oxidation of nutrients differs from oxidative combustion (burning) in that the energy released is largely chemical and mechanical, rather than heat and light energy.

## Metabolism

Metabolism is the set of processes by which nutrients are rearranged into body structures or broken down to yield energy.

## The Energy Nutrients

You can metabolize all four classes of organic nutrients, but derive energy from only three. These three are the energy nutrients. They are vital to life, for without continual replenishment of the energy you spend daily, you would soon die. When oxidized in the body, the energy nutrients break down; that is, their carbon and hydrogen atoms (and others) come apart and are combined with oxygen, yielding carbon dioxide and water, waste minerals that must be excreted.

If you burn a pot full of food on the stove, the same kind of thing happens. Heat is released together with carbon dioxide and water vapor, and you are left with a ruined pot, blackened with the carbon and mineral residue from the food. But when you oxidize food in your body, the energy is not all released as heat. (You aren't

left with a black carbon residue, either!) Some energy is transferred into other compounds (including fat) that compose the structures of your body cells, and some of the energy that holds the atoms of the energy nutrients together is used as fuel for your activities.

The amount of energy the energy nutrients release can be measured in calories (or more properly, kilocalories), which are familiar to everyone as those things that make foods “fattening.” The calorie content of the food thus depends on how much carbohydrate, fat, and protein it contains. If you don’t use these nutrients immediately after you eat them, your body rearranges them (and the energy they contain) into storage compounds such as body fat and puts them away for later. Thus an excess intake of any of the three energy nutrients can lead to overweight. Too much meat (a protein-rich food) is just as fattening as too many potatoes (a carbohydrate-rich food).

It is important not to forget the organic compound found in some beverages: alcohol. Alcohol is not properly called a nutrient by the definition given earlier, because it doesn’t promote growth, maintenance, or repair in the body. Still, people do consume it, and it shares several characteristics with the energy nutrients. Like them, it is metabolized in the body to yield energy. When taken in excess of energy need, it, too, is converted to body fat and stored. But when alcohol contributes a substantial portion of the energy in a person’s diet, its effects are damaging.

Practically all foods contain mixtures of all three energy nutrients, although they are sometimes classified by the predominant nutrient. Thus it is not correct to speak of meat as a protein or of bread as a carbohydrate; they are foods rich in these nutrients. A protein-rich food like beef actually contains a lot of fat as well as protein; a carbohydrate-rich food like corn also contains fat and protein. Only a few foods are exceptions to this rule, the common ones being sugar (which is pure carbohydrate) and oil (which is almost pure fat).

The energy nutrients are (by molecular standards) tremendous in size. A single molecule of carbohydrate may be composed of 300 sugar (glucose) units, each containing 24 atoms, for a total of some 7,000 atoms. Fats and proteins are similar in size. Even when they are broken down during digestion, they are absorbed as sizable units – and these are often reassembled back into macromolecules in the cells. Only if they are oxidized for fuel do they diminish in size to tiny molecules of carbon dioxide and water (three atoms each). When this occurs, they release tremendous quantities of energy for your use.

Furthermore, you eat (by molecular standards) tremendous quantities of the three energy nutrients. Some people eat a hundred or more grams a day of each. If you could purify the carbohydrate, fat, and protein in your daily diet, they would fill two or three measuring cups.

### **Energy Nutrients**

The energy nutrients are:

- Carbohydrate
- Fat
- Protein

### **Calorie**

A calorie is a unit in which energy is measured. Technically, a calorie is the amount of heat necessary to raise the temperature of a gram of water one-degree Centigrade. Food energy is measured in kilocalories (thousands of calories), abbreviated kcalories or kcal, or capitalized: Calories. Most people, even nutritionists, speak of these units simply as calories, but on paper they should be prefaced by a k. (the pronunciation of kcalories ignores the k, but some people when speaking pronounce it “KAY-calories” or “KAY-cal.”)

### **Carbohydrate, Fat and Protein**

Carbohydrate, fat, and protein are large, organic molecules.

### **Macromolecule**

A macromolecule is a huge molecule, composed of hundreds or thousands of atoms. (A molecule of water, by contrast, is composed of only three atoms: 2 Hs and 1 O.)

### **Grams**

Most people don’t think of foods in terms of grams. It’s easy to learn to do so, though, and a good idea for those who plan to work with foods in the future. The United States and Canada are both in the process of a shift from the old British system of measurement to the metric system, so grams can be expected to become more and more a part of our lives. Food scientists already use 100 grams of foods as standard sizes for analysis, so 100 grams is a good size to learn to visualize. For a start, remember first that 100 grams is (very roughly) the weight of a normal serving (1/2 cup) of most vegetables or ½ cup of milk or juice. Second,

remember that a teaspoon of any dry powder such as sugar, salt, or flour weight (very roughly) 5 grams.

### **The Vitamins**

The vitamins, the next class of nutrients, differ profoundly from the first three classes in almost every way: in their size and shape, in the roles they play in the body, and in the amounts you consume. Perhaps the only characteristics they share with the first three classes of nutrients are that they are vital to life, they are organic, and they are available in food.

The vitamins are organic compounds generally much smaller than the energy nutrients. Their use in the body is not to be metabolized for energy; in fact, if they do happen to be broken down, they yield no usable energy. Their role is to serve as helpers, making possible the processes by which the other nutrients are digested, absorbed, and metabolized or built into body structures. There are 15 different vitamins, each with its own special roles to play.

The fact that vitamins are organic has several consequences. For one thing, vitamins are destructible. They can be broken down, oxidized, altered in shape. They must therefore be handled with care. The body makes special provisions to absorb and transport them, providing many of them with custom-made protein carriers. A vitamin may be useful in one form here and another there, so special metabolic equipment is provided that can subtly alter the characteristics of a vitamin to allow it to perform a particular task.

The destructibility of vitamins also has implications for food handlers and cooks. You are well advised, when working with food, to keep in mind that excessive acid, alkali, air, heat, or light can destroy them.

The vitamins are divided into two classes: some are soluble in water (the B vitamins and vitamin C) and others in fat (vitamins A, D, E, and K). This fact has many implications for the kinds of foods that are found in, and the ways the body absorbs, transports, stores, and excretes them.

#### The Fat-Soluble Vitamins

- Vitamin A
- Vitamin D
- Vitamin E
- Vitamin K

#### The Water-Soluble Vitamins

- B Vitamins - Thiamin
- B Vitamins - Riboflavin
- B Vitamins - Niacin
- B Vitamins - Vitamin B<sub>6</sub>
- B Vitamins - Vitamin B<sub>12</sub>
- B Vitamins - Folic Acid
- B Vitamins - Biotin
- B Vitamins - Pantothenic Acid
- Vitamin C

### **The Minerals**

The minerals are inorganic compounds, smaller than vitamins and found in even simpler forms in foods. Sodium, for example, can exist as a single charge atom (ion), tiny in comparison to starch, which may be composed of hundreds or thousands of atoms. Some minerals may be put together into orderly arrays in such structures as bones and teeth – but only with the help of the body's lively metabolic machinery, which itself is composed of protein and assisted by vitamins and some minerals. When minerals are withdrawn from bone and excreted, they yield no energy. When they float about in the fluids of the body, they give the fluids certain characteristics, but they are not metabolized – arranged and rearranged – in the complicated ways or in the same extent as the energy nutrients are. You consume small amounts of minerals daily, roughly similar to the amounts of vitamins in your diet. There are 21 different minerals important in nutrition.

### The Major Minerals

- Calcium
- Phosphorus
- Potassium
- Sodium
- Chloride
- Magnesium
- Sulfur

### The Trace Minerals

- Iron
- Iodine
- Zinc
- Chromium
- Selenium
- Fluoride
- Cobalt
- Molybdenum
- Copper
- Manganese
- Vanadium
- Tin
- Silicon
- Nickel

The minerals are elements, whereas the other nutrients are all compounds. This means the minerals cannot lose their identity; they exist “forever,” like the carbon, hydrogen, and oxygen of which the energy nutrients are composed. When you cook a food containing vitamins and minerals, the vitamins can come apart or be altered in shape as their elements undergo rearrangement. Thus the vitamins can “disappear” (lose their chemical identity), but the minerals remain unchanged. Calcium, for example, enters the body as an ion with two positive charges. It may be combined with any of a number of negative ions (phosphate, sulfate, and the like) to form salts in foods, or it may become part of a large, organic molecule, but it never loses its identity as calcium. Iron may vary, in the sense that it may exist in two different ionic states, but it, too, retains its identity and cycles repeatedly within and through living things.

Because they are indestructible, minerals in food need not be handled with the very special care that vitamins need. You do need to make sure, however, not to soak them out of food or throw them away in cooking water.

### **Water**

Water, indispensable and abundant, forms the major part of every body tissue. It is often ignored – because, like air, it is everywhere and we take it for granted. Water is inorganic, a single molecule being composed of three atoms (H<sub>2</sub>O). The amounts you must consume relative to the other nutrients are enormous: two to three liters (about two to three quarts) a day. That’s 2,000 to 3,000 grams, nearly ten times the amount of the energy nutrients you need. Of course, you need not drink water as such in these quantities; it comes abundantly in foods and beverages.

Water provides the medium in which nearly all the body’s activities are conducted. It participates in many of the body’s metabolic reactions, and supplies the medium for transporting vital minerals to cells and waste products away from them.

In addition to the obvious dietary source – water itself – virtually all foods contain water. In addition, water is generated from the energy nutrients in foods. Daily water intake from these three sources, which amounts to about 2-1/2 liters or quarts a day, normally balances perfectly with daily water excretion, which takes place by way of four routes – urination, evaporation from the lungs, losses in the feces, and evaporation from the skin.

### **Dietary Guidelines and Suggestions for Food Choices**

- Eat a variety of foods daily. Include these foods every day: fruits and vegetables; whole grain and enriched breads and cereals; milk and milk products; meats, fish, poultry, and eggs; dried peas and beans.
- Maintain ideal weight. Increase physical activity; reduce kcalories by eating fewer fatty foods and sweets and less sugar, and by avoiding too much alcohol; lose weight gradually.
- Avoid too much fat, saturated fat, and cholesterol. Choose low-fat protein sources such as lean meats, fish, poultry, dried peas and beans; use eggs and organ meats in moderation; limit intake of fats on and in foods; trim fats from meats; broil, bake, or boil – don't fry; read food labels for fat contents.
- Eat foods with adequate starch and fiber. Substitute starches for fats and sugars; select whole-grain breads and cereals, fruits and vegetables, dried beans and peas, and nuts to increase fiber and starch intake.
- Avoid too much sugar. Use less sugar, syrup, and honey; reduce concentrated sweets like candy, soft drinks, cookies, and the like; select fresh fruits or fruits canned in light syrup or their own juices; read food labels – sucrose, glucose, dextrose, maltose, lactose, fructose, syrups, and honey are all sugars; eat sugar less often to reduce dental caries.
- Avoid too much sodium. Reduce salt in cooking; add little or no salt at the table; limit salty foods like potato chips, pretzels, salted nuts, popcorn, condiments, cheese, pickled foods, and cured meats; read food labels for sodium or salt contents especially in processed and snack foods.
- If you drink alcohol, do so in moderation. For individuals who drink – limit all alcoholic beverages (including wine, beer, liquors, and so on) to one or two drinks per day. NOTE: use of alcoholic beverages during pregnancy can result in the development of birth defects and mental retardation called Fetal Alcohol Syndrome.

### **Natural Foods**

Organic foods are grown in soil fertilized only with natural waste materials such as manure and compost (rotted vegetables matter and garbage). Like “chemical” fertilizers, these materials are composed of chemicals, and they support the growth and health of plants only to the extent that they provide the chemicals the plants need: potassium, nitrogen, phosphate, and others. There may be fringe benefits to the use of natural fertilizers like compost. For example, such fertilizers affect the structure (tilth) of the soil to give a mechanical advantage to the plant. Moreover, organic material returned to the soil is recycled in the natural way. It might otherwise be burned (polluting the air) or dumped to wash into the rivers, lakes, and oceans (polluting the water). The recycling aspect may be one of the most significant differences between organic and conventional farming, and its chief advantage may be not to the nutrition of the individual consume but to the ecology.



## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 2:

### • THE CARBOHYDRATES: SUGAR, STARCH, AND FIBER

#### The Carbohydrates: Sugar, Starch, and Fiber

Most of us would like to feel good all the time. The enjoyment available in a day, no matter what the day may bring, can be tremendous if our bodies and minds are tuned for it. The feeling of well being that comes with energy, alertness, clear thinking, and confidence is so rewarding that if you know how to produce it, you will probably make the necessary effort.

It would be an exaggeration to say that good eating habits alone produce this feeling of well being. If you try to think of what makes you feel good, you can come up with several answers. Being in love, for example, is certainly one. Facing and solving a personal problem is another. Being well rested helps, and so does exercise. Being clean is still another help; a cold shower after heavy work or exercise can be bracing and exhilarating. Sparkling weather, clean air, beautiful scenery, and pleasant company – all these play a part.

Even among the best of these pleasures, however, some limits are set by your nutritional state. You can feel really good only when your blood sugar (glucose) level is right. If that condition isn't met, neither the most beautiful mountaintop nor the most stimulating companion can compensate.

The health and functioning of every cell in your body depend on blood glucose to a greater or lesser extent. Ordinarily the cells of your brain and nervous system depend solely on this sugar for their energy. The brain cells are continually active, even while you're asleep, so they are continually drawing on the supply of glucose in the fluid surrounding them and it permits them to use other fuels as well. They oxidize glucose for the energy they need to perform their functions. To maintain the supply, a continuous flow of blood moves past these cells, replenishing the glucose as the cells use it up.

#### **Caution**

Because the brain and other nerves ordinarily cannot obtain energy without glucose, they are especially vulnerable to a temporary deficit in the blood glucose supply. When the brain is deprived of energy, mental processes are affected. The body's attempts to compensate may lead to other symptoms – weakness, trembling, anxiety, dizziness, and nausea. Hypoglycemia – too little glucose in the blood – can cause these symptoms.

The symptoms of anxiety, dizziness, weakness, and the rest can be caused by a number of conditions other than hypoglycemia, however, such as oxygen deprivation to the brain. They may also be caused psychologically, by an anxiety state. Even such a serious condition as multiple sclerosis can be mistaken for hypoglycemia by the unwary diagnostician. Thus we laypersons, who are not trained in the diagnosis of conditions that present similar symptoms, are extremely unwise if we try to diagnose ourselves. The point of introducing blood glucose by talking about hypoglycemia is not to persuade you that you have the condition, but to show how indispensable glucose is to your feeling of well being. A little knowledge is a dangerous thing. Don't self-diagnose.

#### **Hypoglycemia**

(HIGH-po-glich-SEEM-ee-uh) is when there is a too-low blood glucose concentration. Hypoglycemia may arise briefly in any normal person or can be a symptom of a number of disease conditions.

- Hypo = too little
- glyce = glucose
- emia = in the blood

The body has an amazing ability to adapt to changing conditions by altering its own chemistry to maintain an internal balance. It maintains your temperature within a degree, and your blood glucose level with equal precision. An awareness of how blood glucose is maintained can enable you to cooperate with your body in the best interest of both of you.

#### **Homeostasis**

(HOME-ee-oh-STAY-sis) is defined as the maintenance of relatively constant internal conditions in body systems by corrective responses to forces that, unopposed, would cause unacceptably large changes in those conditions. A homeostatic system is not static. It is constantly changing, but within tolerable limits.

- Homeo = the same
- Stasis = staying

#### **The Constancy of the Blood Glucose Level**

When you wake up in the morning, your blood probably contains between 70 and 120 milligrams (mg)

of glucose in each 100 milliliters (ml) of blood. This range, which is known as the fasting blood glucose concentration, is normal and is accompanied by a feeling of alertness and well being (provided that nothing else is wrong, of course – that you don't have the flu, for example). If you don't eat, the blood glucose level gradually falls as the cells all over your body keeps drawing on the diminishing supply. At 60 or 65 milligrams per 100 milliliters, the low end of the normal range, a feeling of hunger is often experienced. The normal response to this sensation is to eat; then the blood glucose level rises again.

### **Milligram**

A milligram (mg) is 1/1,000 of a gram; a milliliter (ml) is 1/1,000 of a liter. Blood concentrations of many substances are measured in milligrams per 100 milliliters (mg/100 ml.).

- Milli = 1,000

It is important that the blood glucose level should not rise too high, and the body protects itself against this eventuality. The first organ to respond to raised blood glucose is the pancreas, which detects the excess and puts out a message about it; then liver and muscle cells receive the message, remove the glucose from the blood, and store it.

Special cells of the pancreas are sensitive to the blood glucose concentration. When it rises, they respond by secreting more of the hormone insulin into the blood. As the circulating insulin bathes the body's other cells, they take up glucose from the blood. Most of the cells can only use the glucose for energy right away, but the liver and muscle cells have the ability to store it for later use; they assemble the small glucose units into long chains of glycogen. The liver cells also convert glucose to fat for export to other body cells. Fat cells can conserve the energy of glucose in this form.

After you have eaten, then, your blood glucose concentration has returned to normal, and any excess glucose has been put in storage. During the hours that follow, before you eat again, the stored liver glycogen (but not the stored fat) can replenish the glucose supply as the brain and other body cells use it to meet their energy needs. Normally, only glycogen from the liver, not from the muscle, can return glucose units to the blood; muscle cells only use them internally.

One of the hormones that can call glucose out of the liver cells is the famous "fight-or-flight" hormone, epinephrine. Epinephrine is produced quickly when you are under stress, ensuring that all your body cells have energy fuel in emergencies. At ordinary times other hormones guarantee that liver glycogen returns glucose to the blood whenever it is needed for maintenance.

### **Hormone**

A hormone is a chemical messenger. Hormones are secreted in response to altered conditions by a variety of glands in the body. Each affects one or more specific target tissues or organs and elicits specific responses to restore normal conditions.

### **Insulin**

Insulin (IN-suh-lin) is a hormone secreted by the pancreas in response to (among other things) increased blood glucose concentration.

### **Glycogen**

Glycogen (GLIGH-co-gen) is a storage form of glucose in liver and muscle.

- glyco = glucose
- gen = gives rise to

### **Epinephrine**

Epinephrine used to be called adrenaline (uh-DREN-uh-lin). Another hormone that brings glucose forth from storage is glucagon (GLOO-kuh-gon). Glucagon is produced by the alpha cells of the pancreas.

Muscle glycogen, too, can be dismantled to glucose, but this glucose is used primarily within the muscle cells themselves, where it serves as an important fuel for muscle action. Long-distance runners know that adequate stores of muscle glycogen can make a crucial difference in their endurance toward the end of a race. Before an event, the athlete is well advised to eat meals high in carbohydrate. If there is an extraordinary need for blood glucose and the liver supply has run low, muscle glycogen can break down to an intermediate product, lactate, which enters the blood. The liver picks it up, converts it to glucose, and releases it once again. Thus muscle glycogen can contribute indirectly to the blood glucose supply if necessary.

The maintenance of a normal blood glucose level thus depends ordinarily on two processes. When the level gets too low, it can be replenished quickly either from liver glycogen stores or from food. When

the level gets too high, insulin is secreted to siphon the excess into storage. (There is more to this story. Insulin performs other roles, too. This description is intended only to give you a sense of how the body maintains its blood glucose level.)

The way you eat can help your body keep a happy medium between the extremes. Two guidelines apply. First, when you are hungry, you should eat without waiting until you are famished. Second, when you do eat, you should eat a balanced meal, including some protein and fat as well as complex carbohydrate. The fat slows down the digestion and absorption of carbohydrate, so that it trickles gradually into the blood, providing a steady, ongoing supply. The protein elicits the secretion of glucagon, which is antagonistic to insulin and damps its effect. The protein also provides a more slowly digested alternative source of blood glucose for use in case the glycogen reserves are used up.

### **Diabetes**

A question people often wonder about in relation to blood glucose is, What is diabetes? Diabetes is a disease, most probably hereditary, characterized either by a deficiency of insulin in the circulating blood or by a surplus of ineffective insulin. Either the pancreas becomes unable to synthesize insulin (Type I diabetes) or the cells are not able to respond to the insulin that is supposed to stimulate them to take up glucose (Type II). In either case, blood glucose rises too high when the person with diabetes eats foods or drinks beverages containing carbohydrate.

When the blood glucose rises too high, and insulin fails to bring it back down to normal, the body brings a second control mechanism into play. The kidneys, through which blood flows each time it passes through the lower body, serve as a filter to remove unwanted materials from the blood and funnel them into the urinary bladder for excretion. Blood glucose levels above about 170-mg/100 ml trigger a compensatory action of the kidneys that causes the excess glucose to spill into the urine.

An early symptom of diabetes is excessive hunger (perhaps the brain cells don't get a prompt message when glucose is present in the body). Another is excessive thirst, because the kidneys excrete water to get rid of the excess blood glucose. The person with diabetes who learns to use nutrition knowledge to manage the disease may be able to live a nearly normal life in spite of this defect in carbohydrate metabolism.

### **Regulation of Blood Glucose Concentration**

1. High blood glucose stimulates pancreas to release insulin.
2. Insulin stimulates the uptake of glucose into cells. Liver and muscle cells store it as glycogen. Liver cells also convert it to fat, and fat cells store it in that form.
3. Later, low blood glucose is raised when liver glycogen is reconverted to glucose and released into the blood. (Other hormones are involved as well.)

### **The Sugars**

Practically all your energy comes from the food you eat, about half from carbohydrate and half from protein and fat. In fact, one of the principal roles of carbohydrate in the diet is to supply energy in the form of blood glucose. Starch is the most significant contributor of glucose to people's diets, but any of the sugars can supply it, too. There are actually six common sugars found in foods:

1. Glucose
2. Fructose
3. Galactose
4. Sucrose
5. Lactose
6. Maltose

A number of other sugars are familiar to the users of special dietary products, notably the sugar alcohols:

1. Maltitol
2. Mannitol
3. Sorbitol
4. Xylitol

### **Glucose**

Glucose is not especially sweet tasting; a pinch of the purified sugar on your tongue gives only the faintest taste sensation. However, it is absorbed with extraordinary rapidity into the bloodstream. If a diabetic person has become unconscious with extreme hypoglycemia (for example, from an overdose of insulin), a quick way to supply the needed blood glucose is to tip his head to one side and to drip a water solution of glucose into his cheek pocket. The glucose will be absorbed directly into his bloodstream.

## Fructose

If you have ever sampled pure powdered fructose, you will not be surprised to learn that it is the sweetest of the sugars. Curiously, fructose has exactly the same chemical formula as glucose, but its structure is quite different. The different arrangements of the atoms in these two sugars stimulate the taste buds on your tongue in different ways.

Fructose can be absorbed directly into the bloodstream. When the blood circulates past the liver, the fructose is taken up into the liver cells, where enzymes rearrange the atoms to make compounds indistinguishable from those derived from glucose and sometimes to make glucose itself. Thus the effect of fructose on the body is very similar to the effect of glucose.

Food chemists have studied sweet-tasting substances, such as fructose, and have identified the exact arrangement of atoms that stimulates the sweet-taste receptors in the tongue. All sweet-tasting substances share this structure, including the artificial sweeteners saccharin, cyclamate, and aspartame.

## Galactose

Glucose and fructose are the only monosaccharides of importance in foods. A third, galactose, is seldom found free in nature but occurs as part of the disaccharide lactose.

## Sucrose

The other three common sugars are disaccharides – pairs of monosaccharides linked together. Glucose is found in all three; the second member of the pair is either fructose, galactose, or another glucose.

Sucrose, table sugar, is the most familiar of the three disaccharides. Sugar cane and sugar beets are two sources from which it is purified and granulated to various extents to provide the brown, white, and powdered sugars available in the supermarket. Because it contains fructose in an accessible position, it is a very sweet sugar.

When you eat a food containing sucrose, enzymes in your digestive tract hydrolyze the sucrose to yield glucose and fructose. These monosaccharides are absorbed, and the fructose may be converted to glucose in the liver. (Alternatively, the fructose may be broken down to smaller compounds identical to those derived from glucose.) Thus one molecule of sucrose can ultimately yield two of glucose.

### Caution

You can see from this description that it ultimately makes no difference whether you eat these monosaccharides hitched together as table sugar or already broken apart. In either case they will end up as monosaccharides in the body. People who think that the “natural sugar” honey is chemically different from purified table sugar fail to understand this point.

It so happens that honey, like table sugar, contains glucose and fructose. The only difference is that in table sugar, they are hitched together while in honey they are not. Like table sugar, honey is concentrated to the point where it contains very few impurities, even such desirable ones as vitamins and minerals. In fact, being a liquid, honey is denser than its crystalline sister and so contains more calories per spoon.

To say that honey is no more nutritious than sugar, however, is not to say that there are no differences among sugar sources. Consider a piece of fruit, like an orange. From the fruit you could receive the same monosaccharides and the same calories as from sugar or honey. But the packaging is different. The fruit's sugars are diluted in a large volume of water, which contains valuable trace minerals and vitamins, and the flesh and skin of the fruit are supported by fibers that also offer health value.

From these two comparisons you can see that the really significant difference between sugar sources is not between “natural” and “purified” sugar but between concentrated sweets and the dilute, naturally occurring sugars that sweeten nutritious foods. You can suspect an exaggerated nutrition claim when you hear the assertion that a product is more nutritious because it contains honey.

A popular fad diet, the fructose diet, claims to be a wonderfully effective means of losing weight. Purified fructose, according to its proponents, is a “natural sugar” that gives you energy without accumulating as body fat. The diet plan requires that you buy packages of purified fructose and use this sugar in place of the “unnatural sugar” sucrose, which causes ugly weight gain. In light of what has just been said about honey versus oranges, it should be clear that there is nothing more natural about purified, crystalline fructose than about purified, crystalline sucrose. Be skeptical whenever you hear the assertion that purified fructose (or any other sugar, for that matter) is more natural than table sugar.

Sucrose is the principal energy-nutrient ingredient of carbonated beverages, candy, cakes, frostings, cookies, and other concentrated sweets.

#### Vitamins and Minerals Supplied by Some Sugar Sources

	Calcium (mg)	Iron (mg)	Vitamin A (IU)	Thiamin (mg)	Riboflavin (mg)	Vitamin C (mg)
1 tbsp sugar (white granulated)	0	Trace	0	0	0	0
1 tbsp honey (strained or extracted)	1	0.1	0	Trace	0.01	Trace
<b>Possible Daily nutrient need</b>	<b>1,000</b>	<b>18</b>	<b>5,000</b>	<b>1.5</b>	<b>1.7</b>	<b>60</b>

#### Lactose

Lactose is the principal carbohydrate found in milk, comprising about 5 percent of its weight. A human baby is born with the digestive enzymes necessary to hydrolyze lactose into its two monosaccharide parts, glucose and galactose, so that they can be absorbed. The galactose is then converted to glucose in the liver, so each molecule of lactose yields two molecules of glucose to supply energy for the baby's growth and activity. Babies can digest lactose at birth, but they don't develop the ability to digest starch until they are several months old. This is one of the many reasons why milk is such a good food for babies; it provides a simple, easily digested carbohydrate in the right amount to supply energy to meet their needs.

Some individuals lose the ability to digest lactose and become lactose-intolerant. When such a person drinks milk, the unhydrolyzed lactose in the intestine becomes food for intestinal bacteria instead. The multiplying bacteria produce gas and irritate the intestine, making the person sick with nausea and diarrhea. Lactose intolerance arises predictably at around the age of four in certain races – in fact, in the majority of the world's people: Native American, Asian, African, Mediterranean, and Middle Eastern peoples. It can also appear temporarily in anyone who is ill, making the person unable to tolerate milk for a while. Lactose intolerance is not the same as the commonly observed milk allergy, which is caused by an immune reaction to the protein in milk.

#### Maltose

The third disaccharide is found at only one stage in the life of a plant. When the seed is formed, it is packed with starch – glucose units strung together in long arrays – to be used as fuel for the germination process. When the seed begins to sprout, an enzyme cleaves the starch between pairs of glucose units, making maltose. Another enzyme then splits the maltose units into glucose units, and other enzymes degrade these still further, releasing energy for the sprouting of the plant's shoot and root. By the time the young plant has put forth leaves, all the starch in the seed has been used up, but the leaves can now capture the sun's light to garner additional energy for growth. Thus the sugar maltose is present briefly during the early germination process, as the starch is being broken down. The malt found in beer contains maltose formed as the starch in the grains breaks down. (The alcohol is produced by yeast in a process known as fermentation.)

As you might predict, when you eat or drink a food source of maltose, your digestive enzymes hydrolyze the maltose into two glucose units, which are then absorbed into the blood. Thus, maltose, like the other disaccharides, contributes glucose to the body.

In summary, then, the major simple carbohydrates, or sugars, are found in the following table. Glucose, fructose, maltose, and sucrose are from plants; lactose and its component galactose, from milk.

#### The Major Simple Carbohydrates

<b>Monosaccharides</b>	<b>Disaccharides</b>
Glucose	Maltose
Fructose	Sucrose
Galactose (found only in lactose)	Lactose

#### The Chemist's View of Complex Carbohydrates

While the sugars contain three monosaccharides in different combinations, the polysaccharides are composed almost entirely of only one – glucose. The differences between them have to do with the ways glucose is combined into the large molecules of starch, glycogen, and cellulose.

## **Starch**

In the plant, starch serves a function similar to that served by the glycogen in your liver. It is a storage form of glucose needed for the plant's first growth. (When you eat the plant, of course, you get the glucose to use for your own purposes.)

All starchy foods are in fact plant foods. Seeds are the richest food source; 70 percent of their weight is starch. Many human societies have a staple grain from which 50 to 80 percent of their members' food energy is derived. Rice is the staple grain of Asia. In Canada, the United States, and Europe the staple grain is wheat. If you consider all the food products made from wheat – bread (and other baked goods made from wheat flour), cereals, and pasta – you will realize how all pervasive this grain is in the food supply. Corn is the staple grain of much of South America and of the southern United States; the Mexicans use corn in their tortillas. The staple grains of other peoples include millet, rye, barley, and oats. In each society a bread, meal, or flour is made from the grain, then used for many purposes. These staple foods are the major source of food energy for the world's people supporting human life and activity.

A second important source of starch is the bean and pea family, including such dry beans found in the supermarket as butter beans, kidney beans, "baked" beans, black-eyed peas (cowpeas), chickpeas (garbanzo beans), and soybeans. These vegetables are about 40 percent starch by weight and also contain a significant amount of protein. A third major source of starch is the tubers, such as the potato, yam, and cassava. These serve as the primary starch sources in many non-Western societies.

When you eat any of these foods, the starch molecules are taken apart by enzymes in your mouth and intestine. The enzymes hydrolyze the starch molecules to yield glucose units, which are absorbed across the intestinal wall into the blood. One to four hours after a meal, all the starch has been digested and is circulating to the cells as glucose.

## **Glycogen**

Glycogen is not found in plants and is stored in animal meats only to a limited extent. It is not, therefore, of major importance as a nutrient, although it performs an important role in the body, as already described. Glycogen is more complex and more highly branched than starch, a structure permitting rapid breakdown. When the hormonal message "Break down glycogen" arrives at a liver or muscle cell, enzymes can attack all the branches simultaneously, producing a surge of energy for emergency action.

## **Cellulose**

The third polysaccharide of importance in nutrition is cellulose. Cellulose, like starch, is found abundantly in plants and is composed of glucose units connected in long chains. However, the bonds holding its glucose units together are different. This difference is of major importance for humans, because each type of bond requires a different enzyme to hydrolyze it. The human digestive tract is supplied with abundant enzymes to hydrolyze the bonds in starch, but has none that can attack the bonds in cellulose. As a result, starch is digestible for humans and cellulose is not. Cellulose passes through the digestive tract largely unchanged, which explains the different roles of these two major plant polysaccharides. Starch is the most abundant energy source in the staple foods of the world, whereas cellulose provides no energy for humans at all.

Cellulose is, however, one of the fibers, and the fibers are important to health in their own right. In recent years, cellulose and other plant fibers have received increasing attention as the public has learned of their value. Researchers are still actively trying to determine what they do and do not do, and there is much disagreement about their role, but clearly they are important.

## **Alternative Sweeteners**

Among alternative sweeteners familiar to people who use special dietary products are the sugar alcohols – among them, mannitol, sorbitol, xylitol, and maltitol. These carbohydrates are either absorbed more slowly or metabolized differently than the sugars and so may be suitable for use by people who must restrict their intakes of ordinary sweets.

### **Mannitol**

Mannitol is the least satisfactory of the alternative sweeteners just named. It is considerably less sweet than sucrose, so sizable amounts have to be used when it is substituted for sucrose. Because it lingers unabsorbed in the intestine for a long time, it is available to intestinal bacteria for their energy. As they use it, they multiply, attracting water, and produce irritating waste, causing diarrhea. It is therefore not much used as an alternative sweetener.

### **Sorbitol**

Sorbitol has been popular as a sweetener for sugar-free gums and candies, but it too, has drawbacks.

It is only half as sweet as sucrose, so twice as many kcalories have to be used to deliver a given amount of sweetness. Also, like mannitol, it causes diarrhea. Advantages are that it is absorbed very slowly, so that it has little or no effect on blood glucose; and little or no insulin is needed to make it available to the body's cells. Thus people with diabetes, who have either no insulin or ineffective insulin, may benefit from using small amounts of sorbitol. Its threshold for causing diarrhea is higher than mannitol's; so of the two, sorbitol is preferred.

### **Xylitol**

Xylitol has also been popular, especially in chewing gum, because it has been reported to help prevent dental caries. (It not only doesn't support caries-producing bacteria; it actually inhibits their growth.) Like all the sugar alcohols, it has as many kcalories per gram as sucrose, but it is as sweet as fructose, so that less can be used. Xylitol occurs in foods, and some xylitol is produced in the body during normal metabolic processes; so it is not a foreign substance. Xylitol is widely used in many western European countries and in Canada; however, reports that it may cause tumors in animals have led to the voluntary curtailing of its use by U.S. food producers.

### **Maltitol**

Maltitol has a sweetness equal to about 90 percent that of sucrose. It is used in some carbonated beverages and canned fruits, and in Japanese bakery products and other sweets intended not to cause tooth decay. At first thought not to be absorbed from the GI tract, maltitol was recommended for use in food products for dieters and people with diabetes. This claim is doubtful; the sugar probably does have kcalorie value. Manufacturing maltitol from maltose is expensive and limits its use; using maltose directly costs less.

### **Caution**

The person who wishes to cut kcalories should be aware that the sugar alcohols do contain kcalories, just as many per gram as sucrose. In spite of this fact, products that contain them are labeled "sugar-free." The reason they are suitable for people who must limit their intakes of ordinary sweets is because the body handles them differently, not because they are kcalorie-free. The person who is limiting kcalories must limit sugar alcohols just as carefully as sugars.

### **Fructose**

Another sweetener of possible usefulness to people with abnormal carbohydrate metabolism is fructose, already discussed. It is twice as sweet as sucrose, and it neither requires nor stimulates insulin secretion, so it has been advocated as an alternative sweetener for use by people with diabetes and hypoglycemia. Many authorities oppose the use of fructose by people with diabetes, however, because it may tend to increase their already raised blood lipid levels. Because fructose, like sucrose, contains 4 kcalories per gram, however, it is not useful as a weight-loss aid.

### **Artificial Sweeteners**

The artificial sweeteners are compounds, developed or discovered by chemists, that "fool" the taste buds into conveying a sweet taste to the brain, but convey negligible or no kcalories the body can use. Foremost among those in present use in the United States and Canada are aspartame, cyclamate, and saccharin.

Cyclamate's use was banned some years ago in the United States because of a possible threat of cancer; but cyclamate is still used in Canada. The reverse is true of saccharin; it is no longer available over the counter in Canada because of a possible link to cancer, but is still in wide use in the United States, though it must carry a warning label. Aspartame ("Nutra Sweet" or "Equal") is a relative newcomer among the artificial sweeteners and has an unsullied reputation so far.

### **Miniglossary of Artificial Sweeteners**

- **Aspartame (aspartyl-phenylalanine methyl ester)** - Aspartame is a dipeptide that tastes remarkably like sugar but is 200 times sweeter than sucrose. Aspartame, also called "Nutra Sweet," is blended with lactose and with an anticaking agent and is sold commercially as "Equal." It turns sour when heated and so cannot be used for cooking or baking, but is effective in warm and cold beverages and in and on warm and cold foods. Unlike saccharin, it has no bitter aftertaste, and so may prove more acceptable to consumers.
- **Cyclamate** - Cyclamate is a zero-kcalorie sweetener used in Canada but banned in the United States.
- **Saccharin (sodium saccharine)** - Saccharin was discovered in 1879 and used in the United States since that time, a zero-kcalorie sweetener that is at least 200 times sweeter than sucrose; banned in Canada.

## **The Fibers**

Many of the fibers are carbohydrates. Besides cellulose, already mentioned, two other carbohydrates – pectin and hemicellulose – are classed as fibers. Another material classified as fiber is lignin, a noncarbohydrate. Still others are the gums and mucilages often used as thickening agents in prepared foods.

Although cellulose and other fibers are not attacked by human enzymes, some fibers, notably hemicellulose, can be digested by bacteria in the human digestive tract, and can yield products similar to those the body obtains from the so-called available carbohydrates. These products may be absorbed by the body or excreted as waste. Food fibers are therefore not all kcalorie-free.

## **Beneficial Effects of Fiber**

Based on the experience of researchers in Africa, the “fiber hypothesis” suggests that consumption of unrefined, high-fiber carbohydrate foods protect against many Western diseases. Rural Africans naturally consume a diet very high in fiber and show a low incidence of these chronic conditions. Some researchers, however, stress that it may be the higher Eastern intake of salt, sugar, and animal fat rather than the absence of fiber that is responsible for these conditions.

Fiber may also play a role in weight control. According to the “fiber hypothesis,” obesity is not seen in those parts of the world where large amounts of fiber are eaten. Foods high in fiber tend to be low in fat and simple sugars. High-fiber breads have fewer kcalories per pound than refined breads. High-fiber foods, because of their water-holding capacity, satisfy hunger readily. Many of the diet aids on the market today are composed of bulk-inducing fibers such as methylcellulose.

Fiber in the gastrointestinal tract functions like a sponge, holding water, binding minerals, and binding acidic materials such as the bile salts used by the body to prepare fat for digestion. The major impact of dietary fiber is on the colon, the last part of the gastrointestinal tract, where colon cancer and diverticular disease can arise, but the addition of fibrous foods to the diet increases the bulk of food all along the intestine.

Some of the ways in which food fibers are thought to prevent disease states are:

1. By promoting weight loss.
2. By attracting water into the digestive tract.
3. By preventing increased abdominal pressure.
4. By preventing formation of small fecal stones.
5. By exercising the muscles of the digestive tract.
6. By speeding up the passage of food materials through the digestive tract.
7. By binding lipids such as cholesterol and carrying them out of the body.
8. By binding the bile salts.
9. By modulating the body's response to glucose.

However, not all the fibers have similar effects. For example, wheat bran, which is composed mostly of cellulose, has no cholesterol-lowering effect, whereas oat bran and the fiber of apples (pectin) do lower blood cholesterol. On the other hand, wheat bran seems to be one of the most effective stool-softening fibers, especially if a certain particle size is used. Fibers that form gels in water (pectin, guar) prolong the time of transit of materials through the intestine, whereas insoluble fibers (cellulose) tend to decrease the time.

Diverticular disease is very common in Europe and North America but relatively rare among rural Africans. In this disease there is usually high pressure in the intestine and a prolonged transit time. Fiber has recognized medical value in treating diverticular disease because it reduces both pressure and transit time.

Although fiber is considered to be a nonnutritive substance, it does influence the metabolism of certain nutrients.



## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 3:**

### **• THE LIPIDS: FATS AND OILS**

Most people are conditioned to believe that slim is beautiful. The less fat you carry on your frame, the lovelier (sexier, healthier) you are thought to be. On the other hand, your body fat does things for you that would be hard to do without. If you carry neither too much nor too little body fat, you will enjoy the benefits provided by your body's stores of this very important nutrient.

#### **The Importance of Fat**

The fats – more properly called the lipids – are actually a family of compounds that include both fats and oils. Both fats and oils occur in your body, and both help to keep it healthy. Natural oils in the skin provide a radiant complexion; in the scalp they help nourish the hair and make it glossy. The layer of fat beneath the skin, being a poor conductor of heat, insulates the body from extremes of temperature. A pad of hard fat beneath each kidney protects it from being jarred and damaged, even during a motorcycle ride on a bumpy road. The soft fat in the breast of a woman protects her mammary glands from heat and cold and cushions them against shock. The fat that lies embedded in the muscle tissue shares with muscle glycogen the task of providing energy when the muscles are active.

An uninterrupted flow of energy is so vital to life that in a pinch any other function is sacrificed to maintain it. If a growing child is fed too little food, for example, the food she does consume will be used for energy to keep her heart and lungs going, but her growth will come to a standstill. To go totally without an energy supply, even for a few minutes, would be to die. The urgency of the need for energy has ensured, over the course of evolution, that all creatures have built-in reserves to protect themselves from ever being deprived of it. Session 2 described one provision against this sort of emergency – the stores of glycogen in the liver that can return glucose to the blood whenever the supply runs short.

However, the liver cells can store only a limited amount of energy as glycogen; once this is depleted, the body must receive new food or start degrading body protein to continue making glucose. Unlike the liver, the body's fat mass has a virtually unlimited storage capacity, and fat supplies two-thirds of the body's ongoing energy need. During a prolonged period of food deprivation, fat stores may make an even greater contribution to energy needs.

A person who fasts (drinking only water to flush out metabolic wastes) will rapidly oxidize body fat. A pound of body fat provides 3,500 kcalories; so a fasting person who expends 2,000 kcalories a day can lose a maximum of 4 pounds of body fat each week. (Actually, the person loses some lean tissue, too, because of the brain's need for glucose, which fat can't supply; so he loses fat at a slower rate than this.) In conditions of enforced starvation – say, during a siege or a famine – the fatter person survives longer because of this energy reserve.

#### **Adipose Cells**

Fat cells are often called adipose (ADD-ih-poce) cells.

1 pound body fat = 3,500 kcal

#### **Globule**

Within the fat cell, lipid is stored in a globule. This globule can enlarge indefinitely, and the fat cell membrane will grow to accommodate its swollen contents.

If you happen to be acquainted with a polar bear, you may be aware that the same thing is true for him. As he lumbers about on his iceberg, great masses of fat ripple beneath his thick fur coat. When he hibernates, he oxidizes that fat, extracting tens of thousands of kcalories from it to maintain his body temperature and to fuel other metabolic processes while he sleeps. Come spring, he is a hundred or more pounds thinner than when he went to sleep.

Although fat provides energy in a fast, it cannot provide it in the form of glucose, the substance needed for energy by the brain and nerves. After a long period of glucose deprivation, these cells develop the ability to derive about half of their energy from a special form of fat known as ketones, but they still require glucose as well. With the available glycogen long gone, they demand this glucose from the only alternative source – protein. And since no protein is coming in from food, the only supply is in the muscles and other lean tissues of the body. These tissues give up their protein and atrophy, bringing on weakness, loss of function, and ultimately – when half the body protein has been used up – death. Death from loss of lean body tissue will occur even in a fat person if he fasts too long.

## **Ketones (KEE-tones)**

A condensation product of fat metabolism produced when carbohydrate is not available.

## **Atrophy (ATT-ro-fee)**

To waste away.

A = without

Trophy = growth

To sum up the roles of body fat, it helps maintain the health of the skin and hair, protects body organs from temperature extremes and mechanical shock. And provides a continuous fuel supply, helping to keep the body's lean tissue from being depleted. It is oxidized for energy by many body tissues, and when it is being used in the absence of glucose, it forms ketones that can meet about half the energy needs of the brain and nervous system. Protein released from wasting muscle and other lean tissue provides the other half.

Not only is fat important in the body; it is also important in foods. Many of the compounds that give foods their flavor and aroma are found in fats and oils; they are fat-soluble. Four vitamins – A, D, E, and K – are also soluble in fat. Understanding this fact provides insight into many different areas of nutrition.

As you know, fats and oils tend to separate from water and watery substances. The oil floats to the top when salad dressing stands. As hot meat drippings cool, the fat separates and hardens on top of the other juices. You can probably think of many other examples of this phenomenon. Whenever a fatty liquid and a watery liquid separate in this manner, the other compounds must go with either the fat or the water. The nutritional significance of this is evident if you think what happens when the fat is removed from a food; many of the fat-soluble compounds are also removed. Significant among these are flavors and vitamins.

## **Fat Solubility**

Oil and water separate; fat-soluble compounds stay dissolved in the oil, water-soluble compounds in the water.

In general, foods from which the fat or oil has been removed lack much of their original flavor, aroma, and fat-soluble vitamin content. Chicken meat skinned before cooking, for example, is so tasteless that it is hard to guess what kind of meat it is. If cooked with the skin it soaks up both fat and flavor. Foods cooked with fat are tasty and aromatic; the “good food” smell comes from the fat, too. It is the fat that makes the delicious aromas associated with bacon, ham, hamburger, and other meats, as well as onions being fried, french fries, and stir-fried Chinese vegetables. Milk when skimmed loses much of its buttery flavor; and even more importantly, it loses all its vitamins A and D. To provide milk with the desired amounts of these nutrients, vitamins A and D are added to it, hence the “vitamin A and D fortified” label you see on skim milk. (Vitamin D is also added to whole milk, because its natural vitamin D level is low.)

## **Fortification**

Fortification actually involves adding back more vitamin D than was in the whole milk originally.

## **Kcalorie**

Remember, fat is a more concentrated energy source than the other energy nutrients: 1 g carbohydrate or protein = 4 kcal; but 1 g fat = 9 kcal.

An additional feature is lost when fat is removed; kcalories. A medium pork chop with the fat trimmed to within a half-inch of the lean contains 260 kcalories; with the fat trimmed off completely, it contains 130 kcalories. A baked potato with butter and sour cream (1 tablespoon each) has 260 kcalories; plain, it has 90. So it goes. The single most effective step you can take to reduce the energy (kcalorie) value of the food is to eat it without fat.

<b>Food Examples</b>	
Pork chop with ½-inch fat	260 kcal
Pork chop with fat trimmed off	130 kcal
Potato with 1 tbsp butter and 1 tbsp sour cream	260 kcal
Plain potato	90 kcal
Whole milk, 1 c	170 kcal
Skim milk, 1 c	80 kcal

When we speak of fats, we are usually speaking of triglycerides. Almost all the lipids in the diet (95 percent) are triglycerides. The other two classes of dietary lipids are the phospholipids (lecithin is one) and the sterols (among them, cholesterol)

### **The Essential Fatty Acids (EFA's)**

Linoleic acid is an essential nutrient. When linoleic acid is missing from the diet, the skin reddens and becomes irritated, infections and dehydration become more likely, and the liver develops abnormalities. In infants, growth failure also occurs. Adding linoleic acid back to the diet clears up these symptoms. It turns out that what the body cells need is arachidonic acid, and that the body can make this compound if linoleic acid is supplied in the diet. Linolenic acid, thought to be derived from linoleic acid, is needed, too. Linoleic acid has thus come to be known as "the" essential fatty acid, on the assumption that the other needed fatty acids can be synthesized from it. Some evidence suggests, however, that at least some linolenic acid must also be supplied by the diet.

### **Dermatitis (derm-uh-TIGHT-us)**

Dermatitis is the reddening and irritation of the skin.

Derma = skin

It is = infection or inflammation

### **Essential Fatty Acid**

The essential fatty acid is linoleic acid. The essential fatty acids (as some authorities name them) are linoleic, linolenic, and arachidonic acids.

The body's cells are equipped with many enzymes that can convert one compound to another. To make body fat or oil – triglycerides – all the enzymes need is a usable food source containing the atoms triglycerides are composed of: carbon, hydrogen, and oxygen. Glucose does perfectly well. In fact, given an excess of blood glucose (and a filled glycogen storage space), this is precisely what some enzymes use. They cleave the glucose to make the 2-carbon compound acetic acid, and then combine many acetic acid molecules, with the appropriate alterations, to make long-chain fatty acids. (This is why most fatty acid carbon chains come in even numbers.) But the cells do not possess an enzyme that can arrange the double bonding of linoleic acid, so linoleic acid must be supplied in the foods we eat.

Thus, as mentioned, linoleic acid has been called "the essential fatty acid"; but arachidonic acid can alleviate the deficiency symptoms and, to a limited extent, linolenic acid also helps. The three together are known as "the essential fatty acids," sometimes abbreviated EFA. Nearly all diets supply enough EFA to meet the requirement. Deficiencies are usually seen only in infants fed a formula that lacks EFA and in hospital patients who have been fed through a vein for prolonged periods a formula that provides no EFA. Even in an otherwise totally fat-free diet, only one teaspoon (5 grams) of corn oil would be sufficient to supply the needed amount of EFA for an adult.

### **Psychosomatic**

Psychosomatic is a term applied to any condition of the body that originates in the mind.

Psyche = mind and soul

Soma = body

### **Caution:**

The relief of a skin rash by linoleic acid might suggest to the unwary observer that all skin rashes indicate a deficiency of this nutrient. Not so. More than a hundred body compounds besides linoleic acid are needed to ensure the health of the skin, including other oils, vitamins, minerals, and hormones. A deficiency of any of these or an imbalance among them can cause a rash. The lack of some compound might be at fault, but the compound might also be present in excess, or might be improperly handled by the skin cells. Bacterial and viral infections, allergies, physical agents such as radiation, and chemical irritants also cause rashes. There can even be a psychosomatic cause, as when excessive nervous activity in the brain generates a hormone imbalance that affects the skin. For these reasons, when you notice a symptom such as a rash, you can only know that a problem exists; you have no clue as to the cause.

In dealing with nutrition, it is important to remember the distinction being made here – the distinction between a symptom and a disease. A symptom can be alleviated (soothing oils can be applied to irritated skin to make it feel better, for example), but until you have diagnosed the disease, you cannot achieve a cure. The rule for nutritional deficiency symptoms is that, if a certain nutrient clears up the symptom, then a deficiency of that nutrient may have been the cause. (To be certain, you would have to remove the nutrient and see the symptom reappear, then reintroduce the nutrient and see the symptom disappear; and you would have to do the experiment "blind.")

The field of nutrition is littered with misunderstandings about the interpretations of symptoms. People may think that if you are going bald, you need pantothenic acid; that if you have wrinkles, you need vitamin C; that if your hair is turning gray, you need zinc; and (yes) that if you have a skin rash, you need linoleic acid. None of these statements is true; in fact, they are all preposterous. When someone tries to persuade you of any such relationships between symptoms and nutrients, beware.

## **The Prostaglandins**

Linoleic acid and its relatives also produce prostaglandins – hormonelike compounds – in many body organs, and the prostaglandins have a multitude of diverse effects. Only recently discovered, they do not have names like other hormones (insulin and epinephrine), but are designated by letters and numbers – E<sub>1</sub>, E<sub>2</sub>, and so forth. One prostaglandin dilates and/or constricts blood vessels. Another alters transmission of nerve impulses. Still another modulates the body tissues' responses to other hormones. Others act on the kidney, affecting its water excretion. Another, in breast milk, helps to protect the infant's digestive tract against injury. About 100 different prostaglandins are known to be produced in the body.

## **Prostaglandins**

Prostaglandins are hormone-like compounds produced in the body from the essential fatty acids; so named because the first one to be discovered was found in association with the prostate gland.

## **Processed Fat**

Ever since researchers first began to realize that saturated fats were linked to heart disease and that polyunsaturated fats might not be, advertisers have been proclaiming their oils and margarines as "high in polyunsaturates." Indeed, margarines made from vegetable oils and plant foods such as peanut butter do contain unsaturated fatty acids, and this is why they spread and melt more easily than foods that contain saturated fats.

Unfortunately, however, although you may gain something in health from polyunsaturated fats, you lose something in keeping quality. The more double bonds there are in a fatty acid, the more easily oxygen can destroy it. An oxygen molecule attacks the double bond and combines with the carbons at that site to yield two aldehydes. Aldehydes smell bad, giving a clue that the product has spoiled. (Other types of spoilage, due to microbial growth, can occur, too.) In general, unsaturated fatty acids are less stable than their saturated counterparts.

Marketers of fat-containing products have three alternative ways of dealing with the problem of spoilage, none perfect. They may keep their products tightly sealed away from oxygen and under refrigeration – an expensive storage system. The consumer then has to do the same, and most people prefer not to buy products that spoil readily. Marketers may also protect their products by adding preservatives such as antioxidants, but these additives, though probably not harmful, are unpopular. Finally, they may increase the products' stability by processing the fat (hardening or hydrogenating it).

Hydrogenation makes fat more solid, which is often desirable. Margarine made from vegetable oils is solid at room temperature because the oils have been partially hydrogenated, and this makes it easy to work with. Hydrogenation, however, diminishes the margarine's polyunsaturated fat content and possibly, therefore, its health value. Moreover, new evidence suggests that there may be other concerns about hydrogenated oils.

If a vegetable oil is fully hydrogenated – that is, if hydrogen is added at all its double bonds – it becomes indistinguishable from a saturated fat of the same length. If, however, the oil is partially hydrogenated, then a change takes place at some of the double bonds where hydrogen was not added: their configuration changes from *cis* to *trans*. One effect of this change is to create a more solid product, but double bonds are still left in the fatty acids; so the manufacturer can still say the product is unsaturated or polyunsaturated. But *trans* fatty acids are not made by the body's cells, and they are rare in foods. It is not clear that our bodies are equipped to deal with large quantities of *trans* fatty acids; the presence of these unusual molecules in our cells and tissues may create problems. As yet, this issue is poorly understood.

Some researchers believe that the presence of *trans*-fatty acids in processed fat may make consumers of that fat prone to develop certain kinds of cancer. However, so many dietary factors are implicated in cancer causation that it is hard to sort them all out or to decide which are significant and which are not. Probably consumers' total fat consumption is more significant than their consumption of *trans*-fatty acids.

While the evidence on processed fats is still being collected, consumers can, if they wish, apply the principle of dilution. Rather than margarine, for example, you can mix warm butter with vegetable oil in equal amounts, producing a spread that is cheaper than butter, spreads well, has the same degree of polyunsaturation as margarine but more linoleic acid, and contains no *trans*-fatty acids. As for peanut butter, it is possible to find unhydrogenated varieties on the shelf. The peanut mash and the oil may separate in these products, but you can stir them back together before using them or pour off the oil for a product lower in calories.

Ultimately, if fat processors wish to produce margarines free of trans-fatty acids, they can use an alternative process that hydrogenates double bonds without producing the cis-to-trans shift. This process is a little more expensive and technically more difficult than the one presently in use, so it has not yet been employed on a wide scale.

### **Degree of Unsaturation**

One way to determine the degree of unsaturation of a fat is to perform a chemical test using iodine to obtain the "iodine number." The higher the iodine number, the greater the degree of unsaturation. Common oils, with their iodine numbers, are:

- Safflower oil, about 140
- Most other vegetable oils, about 110-120
- Soft margins, about 90
- Olive oil, about 75
- Hard margarines, about 70
- Butter, about 25-40
- Coconut and palm "oil," about 10-15

If you mix safflower oil with butter, half-and-half, you get a spread that is soft like margarine but has no trans-fatty acids.

### **Hydrophobic or Lipophilic**

Hydrophobic or lipophilic are water-fearing substances known to chemists.

Hydro = water

Phobia = fear

Lipo = lipid

Phile = friend

### **Hydrophilic**

Water loving substances are hydrophilic.

### **Enzyme**

An enzyme is a large protein molecule that facilitates the making or breaking of chemical bonds (in this case the breaking, for digestion).

### **Bile**

Bile is the emulsifying compound manufactured by the liver, stored in the gallbladder, and released into the small intestine when fat is present there. Bile contains no enzymes. It appears sometimes in acid form and sometimes in salt form.

### **How the Body Handles Fat**

The body has a problem in digesting and using fats – how to get at them. Substances that are soluble in fat are called water fearing, and among these substances are, of course, the fats themselves. Fats are neutral; they carry no net charge. In any compartment of the digestive tract they tend to float to the top, clumping together and separating themselves as far as possible from the watery digestive juices. Water molecules, although they too have no net charge, are polar; that is, they have a positive side and a negative side. Enzymes have positively and negatively charged groups on their surfaces, and so they mix comfortably with the ions in water – they are water loving. What the body needs to help mix them together is a substance that is friendly with both water-fearing and water-loving substances. The bile acids meet that need.

Manufactured by the liver and stored in the gallbladder until needed, the bile acids are released into the intestine whenever fat arrives there. Not surprisingly, they are made largely from lipids themselves. The system seems to have been designed for maximum efficiency. The more fat you eat, the more is available to manufacture the bile acids needed to prepare the fat for digestion.

Each molecule of bile acid has at one end an ionized group that is attracted to water and at the other end a fatty acid chain that has an affinity to fat. Just as a skilled hostess who wants you to mix with people at her party will take your hand, draw you away from the company of your old friends, and leave you shaking hands with a new acquaintance, so a molecule of bile acid will attach itself to a lipid molecule in a droplet and draw it into the surrounding solution where it can meet an enzyme. The process is known as emulsification.

## **Emulsify (ee-MULL-suh-fye)**

To emulsify is to disperse and stabilize fat droplets in a watery solution.

## **Emulsification of Fat by Bile**

Detergents work the same way (they are also emulsifiers), which is why they are so effective in removing grease spots from clothes. Molecule by molecule, the grease is dissolved out of the spot and suspended in the water, where it can be rinsed away. You can guess where the manufacturers of “detergents with enzymes” got their idea.

Now, after all this preparation, the enzymes can get at the triglycerides. The enzymes digest each triglyceride by removing two of its fatty acids, leaving a monoglyceride, or by removing all three of them, leaving a molecule of glycerol. As with the carbohydrates, the digestive process requires the participation of water. Finally, the monoglycerides, glycerol, and fatty acids form tiny, spherical complexes with the bile acids and pass into the cells of the intestinal wall.

The products of lipid digestion are then released for transport through the body. Some of the larger ones are packaged in protein for this purpose. The protein-wrapped packages, called lipoproteins, are the subject of intensive research as laboratory sleuths seek to detect their structure and their relationships to heart and artery disease.

## **Micelles (MY-cells)**

Micelles are complexes that are so small that they can fit between the tiny, hair-like microvilli of a single intestinal cell (emulsified fat particles are 100 times larger in diameter).

## **Phospholipid**

A phospholipid is a compound similar to a triglyceride but having choline or another phosphorus-containing acid in place of one of the fatty acids.

## **The Phospholipids**

The previous pages have described one of the three classes of lipids, the triglycerides. The other two classes, the phospholipids and sterols, comprise only 5 percent of the lipids in the diet, but they are nonetheless interesting and important. Among the phospholipids, the best known is lecithin (actually, there are several lecithins).

Like the triglycerides, the lecithins and the other phospholipids have a backbone of glycerol; they are different because they have only two fatty acids attached to them. In place of the third fatty acid is a molecule of choline or a similar compound containing phosphorus (P) and nitrogen (N) atoms.

“Lecithin” periodically receives noisy attention in the popular press, being credited with great good deeds. You may hear that it is a major constituent of cell membranes (true) and that the functioning of all cells depends on the integrity of their membranes (true). The enzyme lecithinase in the intestine takes lecithin apart before it passes into the body fluids, so the lecithin you eat does not reach the body tissues intact. The lecithin you need for building cell membranes and for other functions is made from scratch by the liver.

Lecithins and other phospholipids are important constituents of cell membranes. They also act as emulsifying agents, helping to keep other fats in solution in the blood and body fluids. The structure of lecithin reveals how they can do this; the choline part of the molecule, with its plus and minus charges, is water-soluble, while the fatty acid part is fat-soluble.

## **The Sterols: Cholesterol**

A student observing the chemical structure of cholesterol for the first time once remarked, “Would you believe pentamethyl hydroxy chicken wire?” He was not far wrong; chemists do remarkable “terminologizing.” According to them, cholesterol is a member of the cyclopentanoperhydrophenanthrene family, whose particular designation is 3-hydroxy-5, 6-cholesterene.

## **Sterol**

A sterol is a compound composed of C, H, and O atoms arranged in rings like those of cholesterol, with any of a variety of side chains attached.

## **Cholesterol**

Cholesterol is one of the sterols. All the carbons in cholesterol come from acetyl CoA, which in turn can be derived from many other body compounds, glucose and fatty acids among them.

Cholesterol is not at all an unusual type of molecule. There are dozens of similar ones in the body; all are interesting and important. Among them are the bile acids, the sex hormones (such as testosterone), the adrenal hormones (such as cortisone), and vitamin D.

Like the lecithins, cholesterol is needed metabolically but is not an essential nutrient. Your liver is manufacturing it now, as you read, at the rate of perhaps 50,000,000,000,000,000 molecules per second. The raw materials that the liver uses to make cholesterol can all be taken from glucose or saturated fatty acids. (Another way of saying the same thing is that cholesterol can be made from either carbohydrate or fat.)

After manufacture, cholesterol either leaves the liver or is transformed into related compounds like the hormones just mentioned. The cholesterol that leaves the liver has three possible destinations:

1. It may be made into bile and move into the intestine, and some may then be excreted in the feces.
2. It may be deposited in body tissues.
3. It may wind up accumulating in arteries and causing artery disease.

### **How Cholesterol is Excreted**

Some of the cholesterol the liver makes becomes part of the bile salts, and these are released into the intestine to emulsify fat. After doing their job, some of them reenter the body with absorbed products of fat digestion. The cholesterol is thus recycled – back to the liver, once again into bile salts, back to the intestine, again into the body, and once more back to the liver.

Once out of the intestine, however, some of the bile salts can be trapped by certain kinds of dietary fibers, which carry them out of the body with the feces. The excretion of bile salts reduces the total amount of cholesterol remaining in the body.

### **How Cholesterol is Deposited in the Body**

Some cholesterol leaves the liver packaged with other lipids for transport to the body tissues. These packages are the lipoproteins. The blood carries them through all the body's arteries, and any tissue can extract lipids from them; some cells take them up whole. More than nine-tenths of all the body's cholesterol is located in the cells, where it performs vital structural and metabolic functions. To pass into the cells, lipids must first cross the artery walls, and it is in connection with the artery walls that they may be implicated in artery disease.

### **Lipoproteins**

Lipoproteins are made by both the intestine and the liver.

### **The fats in Foods**

It seems more than likely that dietary fat (triglycerides) and possibly cholesterol are among the contributing factors in heart and artery disease. Cholesterol accumulates in arteries, and is manufactured largely from fragments derived from saturated fat. Thus, limiting your consumption of fat will do no harm, and it may do some good. And on the assumption that some of the body's cholesterol may come from the diet, it may make sense to limit your cholesterol intake as well.

At the turn of the century in this country, people were eating about 125 grams of fat per day, on the average, according to a survey of the period 1909-1913. By 1972, they were eating more, 159 grams of fat each; but by 1975, they had reduced their intake somewhat and were eating 147 grams a day.

This downturn in the consumption of total fat is welcomed by nutritionists. We would like to believe that it has come about at least partly as a result of an intensive campaign to show the public the relationship between dietary fat and the development of cardiovascular disease. Another benefit is that a lowered fat consumption may mean a reduced risk of certain kinds of cancer, for fat has been implicated in the causation of this disease as well. In the meantime, there is still much concern over the fact that fat consumption today is one-sixth higher than it was in the 1913 survey and that, until recently, heart and blood vessel diseases and cancers had also been increasing.

Food disappearance studies and diet surveys have both produced the same finding. People probably do eat about 40 to 50 percent of their kcalories as fat – more, perhaps, than they should. Those who wish to reduce and alter their dietary fat intakes need to know where the fats are found in food.

The following table shows the lists that contain fat, with their portion sizes. Items on the milk list contain protein, carbohydrate, and fat. Items on the meat list contain protein and fat (legumes contain carbohydrate as well). Items on the fat list contain fat only.

The listing of milk's three fat levels emphasizes the importance of being aware of the fat content of 23

milk. Users of the exchange system learn to think of skim milk as milk, and of low fat and whole milk as milk with added fat.

A person studying the meat list for the first time may be surprised to note how many fat kcalories are in meat. An ounce of lean meat supplies 28 kcalories from its protein and 27 kcalories from its fat. An ounce of high-fat meat supplies the same number of kcalories – 28 – from protein, but 72 kcalories from fat. Two tablespoons of peanut butter, also with 28 kcalories from protein, supply 140 kcalories from fat! Thus, meat, which is often thought of as a protein food, actually contains more fat energy than protein energy, and excess consumption of meat often accounts for the excess weight meat eaters tend to gain.

Note that the unit by which meat is measured in this system is a single ounce. To use the system you need to be aware of the number of ounces in typical servings. An egg, in this system, is equivalent to 1 ounce of meat. A hamburger is usually 3 or 4 ounces. A dinner steak may be 6 or 8 ounces or even larger.

Foods Containing Fat		
Milk List	1 c skim milk contains	0 g fat
	1 c 2% milk contains	5 g fat
	1 c whole milk contains	10 g fat
Meat List	1 oz lean meat contains	3 g fat
	1 oz medium-fat meat contains	5 <sup>1/2</sup> g fat
	1 oz high-fat meat contains	8 g fat
	2 tbsp peanut butter contains	15 <sup>1/2</sup> g fat
Fat List	1 tsp butter or margarine (or any other serving of food on the fat list) contributes	5 g fat

### How to Estimate Fat Intake

The values presented in the table below provide a way to estimate the amount of fat eaten at a meal or in a day. Two reminders are needed. First, fat is often hidden in cooked vegetables; as a rule of thumb, vegetables served with butter or margarine can be assumed to contain one fat exchange per half-cup serving. Second, some baked goods also contain appreciable fat.

		Fat-Containing Exchanges	Fat (g)
Breakfast	1 egg fried in 1 tsp fat	1 meat + 1-1/2 fat	10-1/2 g
	1 slice toast with 1 tsp margarine	1 fat	5 g
Lunch	2 slices bread		
	2 tbsp peanut butter	1 meat + 2-1/2 fat	15-1/2 g
	2 tsp jelly		
Dinner	1 c milk	2 fat	10 g
	6-oz steak	6 meat + 6 fat	48 g
	½ c green beans served with 1 tsp margarine	1 fat	5 g
	1 c mashed potato served with 1 tsp margarine	1 fat	5 g
Dessert	2-inch diameter biscuit	1 fat	5 g
	¾ c strawberries		
	1 tbsp heavy cream	1 fat	5 g
	6 tsp sugar		
<b>Total</b>			<b>109 g fat (rounded off)</b>
The day's meals thus supplied about 981 kcalories from fat (9 x 109). The day's total from all these foods was about 1,930 kcalories, so the eater consumed about 50 percent of her kcalories from fat.			

To focus on the members of the fat list for a moment, everyone knows that butter, margarine, and oil belong there, but it can be a surprise to discover that bacon, olives, and avocados are also on that list. These foods are listed together because the amount of lipid they contain makes them essentially contributors of pure fat. An eighth of an avocado or one slice of bacon contains as much fat as a pat of butter, and like butter,



these foods contain negligible protein and carbohydrate. Hence, when you eat them, you are not eating protein-rich foods; you are eating fat-rich foods.

### **Saturated Fat and Cholesterol in Foods**

The fat in milk is mostly saturated fat; the cholesterol content is 25 milligrams per cup of whole milk or 7 milligrams per cup of skim milk. Thus, choosing skim in place of whole milk reduces your intakes of both saturated fat and cholesterol.

The fats in meats and eggs are mostly saturated; those in poultry and fish have a better balance between saturated and polyunsaturated fats. As for cholesterol, the foods that contain the highest amounts are such organs as liver and kidneys and such shellfish as lobster, oysters, and shrimp. Lower but still detectable levels of cholesterol are contained in beef, ham, lamb, veal, and pork, followed by poultry and fish. As a general rule, a meat-eater wishing to reduce both saturated fat and cholesterol intake could accomplish these objectives by eating less meat and more poultry and fish (except shellfish). A vegetarian who uses animal products could shift to skim milk and low-fat cheeses, and could limit butter and egg intake. Pure vegetarians eat a diet very low in fat and consume no cholesterol, because plant foods do not contain it.

Eggs contain about 240 milligrams of cholesterol each all of it in the yolk. For a person trying to adhere strictly to a low-cholesterol diet, the use of eggs has to be curtailed. For most people trying to lower blood cholesterol, however, it is not as effective to limit cholesterol intake as to limit saturated fat intake. Evidence on the blood-cholesterol-raising effect of eggs has been contradictory. Some experiments have seemed to show that subjects could eat several eggs a day for days at a time without their blood cholesterol's changing. Others have seemed to show that blood levels would rise if enough eggs were eaten. In any case, eggs are an inexpensive, high quality protein source, and should probably not be eliminated from most people's diets, only cut back.

The degree of saturation of a fat determines how hard it is at a given temperature. Thus, you can tell one fat is more saturated than another if it is harder, say, at room temperature. Chicken fat, for example, is softer than pork fat, which is softer than beef tallow. Of the three, beef tallow is the most saturated and chicken fat the least saturated. Polyunsaturated fats melt more readily. Generally speaking, vegetable and fish oils are rich in polyunsaturates, whereas the harder fats – animal fats – are more saturated.

### **U.S. Dietary Goals for a Low-Cholesterol Diet**

A low-cholesterol diet might allow only 300-mg cholesterol a day or less.

### **Saturated Fats**

Saturated fats have a high melting point and are solid at room or body temperature.

### **Polyunsaturated Fats**

Polyunsaturated fats have a low melting point and are liquid at room or body temperature.

#### **Caution:**

If you wish to make choices consistent with the Goals or Guidelines, you should learn how to read food labels. But beware. Words like vegetable fat and unsaturated fat can be used to mislead you. Not all vegetable oils are polyunsaturated. Coconut oil, for example, is often used in nondairy creamers, and coconut oil is a saturated fat. Vegetable oils that are hydrogenated may have lost their polyunsaturated character. Another exception to the rule is olive oil, widely used in salad dressings and in Greek and Italian foods. The predominant fatty acid in olive oil is the monounsaturated fatty acid oleic acid. Thus, olive oil can claim to be unsaturated but not to be polyunsaturated.

Each culture has its own favorite food sources of fats and oils. In Canada, rapeseed oil is widely used. The peoples of the Mediterranean (Greeks, Italians, and Spaniards) rely heavily on olive oil, and Asians use the polyunsaturated oil of soybeans. Jewish cookery traditionally employs chicken fat, whereas U.S. Southerners rely heavily on pork fat – lard and bacon. Elsewhere in the United States, butter and margarine are widely used, and with the popularity of fast foods, vegetable oil use has also been increasing.

### **Nondairy Creamer**

Nondairy creamer contains vegetable fat. Ingredients: corn syrup solids, hydrogenated vegetable oils (palm kernel, coconut). Here's the truth. Notice, too, that sugar is listed first!

### **Artificial Fat: Sucrose Polyester**

Artificial fat is beginning to attract public attention, although it is not yet on the market. Invented in the last 1960s, sucrose polyester (SPE) is a synthetic combination of sucrose and fatty acids that looks, feels, and tastes like food fat. Unlike either sucrose or fatty acids alone, however, sucrose polyester is

indigestible; the body has no way to take it apart. It can therefore be substituted for fats in meals without adding calories or promoting a rise in consumers' blood fat levels.

Tests with animals and human beings so far indicate that SPE is safe. Most human subjects are unable to tell the difference between SPE margarine and regular margarine, or between SPE oil and regular oil. Obese subjects find it as satisfying as regular fat in meals and appear not to increase their calorie intakes to compensate for the calories they lose by not having regular fat.

Undesirable side effects of SPE use have yet to be discovered. It might, for example, carry fat-soluble vitamins out of the body with it, causing deficiencies. Further tests will tell. But given that high blood cholesterol and obesity are two of our major health problems, SPE is being viewed with hope as a possible help in the treatment of both.

### **Saturated Fat Consumption of Blacks**

The saturated fat consumption of blacks is cause for special concern among health authorities, who note a high incidence of heart disease, both atherosclerosis and high blood pressure, among these people. This high rate of heart disease may be diet-related, genetically caused, or both. High blood pressure is related to salt (sodium) intake in some people; thus the Dietary Goals and the Guidelines recommended limiting salt intake, a matter that will be taken up in session 10.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 4:**

### **• PROTEIN: AMINO ACIDS**

Everybody knows that protein is important. It is advertised on every cereal box; it is said to “build strong bodies,” and to provide “super go power.” In fact, as you will see, protein has been so overemphasized that many people eat more than enough, sometimes at the expense of other nutrients that are equally important. An understanding of the quantity and quality of protein needed in the diet will help put it in its proper place as only one – although a very important one – of the nutrients needed in correct proportions to achieve a balanced diet.

A protein is a chemical compound that contains the same atoms as carbohydrate and lipid – carbon, hydrogen, and oxygen – but protein also contains nitrogen atoms.

The human body contains an estimated 10,000 to 50,000 different kinds of proteins. Of these thousands only about 1,000 have been identified, and only about 10 are described in this session.

#### **Enzymes: A Function of Protein**

Enzymes and what they do are so fundamental to all life processes that it seems worthwhile to introduce an analogy to clarify two important characteristics they all share. Enzymes are comparable to the ministers and judges who respectively make and dissolve human matrimonial bonds. When two individuals come to a minister to be married, the couple leaves with a new bond between them. They are joined together – but the minister is only momentarily involved in the process and remains unchanged. One minister can therefore perform thousands of marriage ceremonies. Similarly, a judge, who facilitates the separation of married couples, may decree many divorces before he dies or retires.

The minister represents enzymes that synthesize larger compounds from smaller ones – the synthesases, which build body structures. The judge represents enzymes that hydrolyze larger compounds to smaller ones – the proteases, lipases, carbohydrates, disaccharidases, and others. Maltase is a disaccharidase.

The first point to be learned is that some enzymes put compounds together and others take them apart. Since you yourself are a very put-together kind of organism, superbly organized out of billions of molecules designed to make muscle, bone, skin, eyes, and blood cells, you can imagine how numerous and active in your body are the enzymes that put things together. (Only a naïve student thinks of enzymes as being solely digestive enzymes – those that take things apart.)

The second point is that enzymes are not themselves affected in the process of facilitating chemical reactions. They are catalysts. Biologists and chemists define an enzyme as a protein catalyst.

What makes you unique and distinct from any other human being is minute differences in your body proteins (enzymes, antibodies, and others). These differences are determined by the amino acid sequences of your proteins, which are written into the genetic code of the DNA you inherited from your parents and ancestors. Each person receives at conception a unique combination of genes (DNA codes for protein sequences).

Perhaps you have realized by now that the protein story moves in a circle. All enzymes are proteins. All proteins are made of amino acids. Amino acids have to be put together to make proteins. Enzymes put together the amino acids. Only living systems work with such self-renewal. A broken toaster cannot be fixed by another toaster; a car cannot make another car. Only living creatures and the parts they are composed of – the cells – can duplicate themselves.

To follow the circle in nutrition, start with a person eating proteins. The proteins are broken down by proteins (enzymes) into amino acids. The amino acids enter the cells of the body, where proteins (enzymes) put them together in long chains with sequences specified by DNA. The chains fold and become enzymes themselves. These enzymes may then be used to break apart other compounds or to put other compounds together. Day by day, billion reactions by billion reactions, these processes repeat themselves and life goes on.

#### **Protein Synthesis**

The instructions for making every protein in a person's body are transmitted in the genetic information he or she receives at conception. This body of knowledge is filed away in the nucleus of every cell. The master file is the DNA (deoxyribonucleic acid), which never leaves the nucleus. The DNA is identical in every cell and is specific for each individual. Each specialized cell has access to the total inherited information but calls on only the instructions needed for its own functions.

To inform the cell of the proper sequence of amino acids for a needed protein, a “photocopy” of the

appropriate portion of DNA is made. This copy is messenger RNA (ribonucleic acid), which is able to escape through the nuclear membrane. In the cell fluid it seeks out and attaches itself to one of the ribosomes (a protein-making machine, itself composed of RNA and protein). Thus situated, the messenger RNA presents the sequence in which the amino acids should be linked into a protein strand.

Meanwhile, another form of RNA, called transfer RNA, collects amino acids from the cell fluid and brings them to the messenger. For each of the 22 amino acids there is a specific kind of transfer RNA. Thousands of these transfer RNAs, with their loads of amino acids, cluster around the ribosomes, like vegetable-laden trucks around a farmer's market awaiting their turn to unload. When an amino acid is called for by the messenger, the transfer RNA carrying it snaps into position. Then the next and the next and the next loaded transfer RNAs move into place. Thus the amino acids are lined up in the right sequence. Then an enzyme bonds them together.

Finally, the completed protein strand is released, the messenger is degraded, and the transfer RNAs are freed to return for another load. It takes many words to describe the events, but in the cell, 40 to 100 amino acids can be added to a growing protein strand in only a second.

1. DNA is in the nucleus of each cell.
2. DNA makes a copy of the portion of itself that has the instructions for the protein the cell needs.
3. RNA leaves the nucleus.
4. RNA attaches itself to the protein-making machinery of the cell.
5. Transfer RNAs carry their amino acids to the messenger RNA, where they are snapped into place.
6. The completed protein strand is released.

### **Protein Quality**

The role of protein in food is not to provide body proteins directly but to supply the amino acids from which the body can make its own proteins. Since the body can make glycine and serine for itself, the proteins in the diet need not contain these two amino acids. But there are some amino acids the body cannot make at all, and some it cannot make fast enough to meet its need. (This is because the body does not possess the genes for the enzymes that could synthesize these amino acids, or because the enzymes it does make work too slowly.) These are the essential amino acids. Either amino acids are essential for adults; histidine is also essential for infants.

To make body protein, a cell must have all the needed amino acids available simultaneously. The first important characteristic of dietary protein is, therefore, that it should supply at least the eight essential amino acids and enough nitrogen for the synthesis of the others.

A complete protein is a protein that contains all of the essential amino acids in amounts adequate for human use; it may or may not contain all the others. A high-quality protein is not merely complete, but contains the essential amino acids in amounts proportional to the body's need for them, and is digestible, so that these amino acids reach the body's cells in the needed amounts.

Ideally, dietary protein supplies each amino acid in the amount needed for protein synthesis in the body. If one amino acid is supplied in an amount smaller than is needed, the total amount of protein that can be synthesized from the others will be limited. By analogy, suppose that a signmaker plans to make 100 identical signs, each saying LEFT TURN ONLY. He needs 200 Ls, 200 Ns, 200 Ts, and 100 of each of the other letters. If he has only 20 Ls, he can make only 10 signs, even if all the other letters are available in unlimited quantities. The Ls limit the number of signs that can be made. Furthermore, the signmaker has no place to keep leftover letters (the body has no storage place for extra amino acids), so if he doesn't get some more Ls right away, he will have to throw away all his other letters.

When the body uses a protein of poor quality, it wastes many of the amino acids. Enzymes strip off their nitrogen-containing amino groups and fix them into the compound urea, which is excreted in the urine. The carbon skeletons that remain are used to make glucose or fat, or are oxidized for energy; the nitrogen is not stored in the body. The amount of urea excreted is thus a measure of the number of amino acids not retained in body proteins.

The quality of dietary protein, then, depends partly on whether the protein supplies all the essential amino acids and, more importantly, on the extent to which it supplies them in the needed proportions and in a digestible form. An excellent protein by these standards is egg protein, whose nitrogen tends to be retained in the body. Egg protein has been designated the reference protein and has been assigned a biological value of 100 by the Food and Agriculture Organization of the United Nations, which sets world standards.

In the world where food is scarce and where many people's diets contain marginal or inadequate amounts of protein, it is important to know which foods contain the highest-quality protein. It is possible to determine the amino acid composition of any protein relatively inexpensively, but unfortunately, chemical scoring

does not always reflect accurately the way the body will use a protein. If a protein can't be digested to small fragments – amino acids, dipeptides, and tripeptides – then its amino acids will not pass across the intestinal wall into the blood, but will be lost in the feces.

### **Fluid Balances**

Proteins help maintain the water balance. There are three principal compartments for fluids in the body: the space in the blood vessels, the spaces between the cells, and the spaces within the cells. In normal, healthy people, each of these compartments contains the proper amount of fluid. Fluid can flow back and forth across the boundaries between them, but whenever the volume of fluid deviates, it is rapidly brought back to normal. Protein (with certain minerals) helps to maintain water at the proper volume in each compartment.

#### **Space in the Blood Vessels**

The space in the blood vessels is the intravascular space; the space between the cells is the intercellular or interstitial space; the space inside the cells is the intracellular space.

Intra = inside

Inter = between

Interstice = space between

### **Edema (uh-DEEM-uh)**

Edema is the accumulation of fluid in the interstitial spaces. Edema in the abdomen is ascites (uh-SITE-eez).

### **Diuretic (dye-yoo-RET-ic)**

A diuretic is a drug that stimulates increased renal water excretion.

Renal = kidney

### **Acid-Base Balance**

The acid-base balance is the balance maintained in the body between too much and too little acid. Blood pH, for example, is regulated normally between 7.38 and 7.42.

### **pH**

pH is the concentration of  $H^+$  ions. The lower the pH, the stronger the acid. Thus pH 2 is a strong acid; pH 6 a weak acid (pH 7 is neutral). A pH above 7 is alkaline, or basic (a solution in which acid-accepting ions such as  $OH^-$  predominate).

### **Antibodies and Hormones**

Other major proteins found in the blood – the antibodies – act against disease agents. When a body is invaded by a virus – whether it is one that causes flu, smallpox, measles, or the common cold – the virus enters the cells and multiplies there. One virus may produce a hundred replicas of itself within an hour or so. These burst out and invade a hundred different cells, soon yielding ten thousand virus particles, which invade ten thousand cells. After several hours there may be a million viruses and then a hundred million and so on. If they were left free to do their worst, they would soon overwhelm the body with the disease they cause.

The antibodies, giant protein molecules circulating in the blood, present a defense against viruses, bacteria, and other “foreign agents.” Each type of antibody molecule is different and specific, able to combine with and inactivate a specific foreign protein such as that in a virus coat or bacterial cell membrane. The antibodies work so efficiently that in a normal healthy individual the many disease agents that attempt to attack never have a chance to get started. If a million bacterial cells are injected into the skin of a healthy person, fewer than ten are likely to survive for five hours.

Once the body has manufactured antibodies against a particular disease agent (such as the measles virus), the cells never forget how to produce them. The next time that virus invades the body, the antibodies will respond even more quickly. Thus the body acquires immunity against the diseases it is exposed to, by virtue of the molecular memory of the antibody-producing cells.

Hormones are also carried by the blood, and some are made of amino acids. Among them are the thyroid hormone and insulin. The thyroid hormone regulates the body's metabolic rate – the rate of the chemical reactions that yield energy. Insulin regulates the concentration of the blood glucose and its transportation into cells, upon which the functioning of the brain and the nervous system depend.

## **Development of Immunity**

1. Body is challenged with foreign invaders.
2. Body makes code for manufacturing antibody.
3. Code makes antibody.
4. Antibody inactivates foreign invader.
5. Code remains to make antibodies faster the next time this foreign invader attacks.

## **Transport Proteins**

A special group of the body's proteins specializes in moving nutrients and other molecules in and out of cells. Examples of well-known transport proteins are the glucose, potassium, and sodium pumps. The first two transport glucose and potassium into cells faster than they can leak out; the sodium pump transports sodium out of cells faster than it can leak in.

The mineral iron is a nutrient whose handling in the body illustrates especially well how precisely proteins operate. On moving into a cell of the intestinal wall, iron is captured by a protein residing in the cell, which will not let go of it unless the iron is needed in the body. Iron leaving the cell to enter the bloodstream is attached to a carrier protein. The carrier, in turn, can pass iron on to a storage protein in the bone marrow or other tissues, which will hold it until it is called for. Then, when it is needed, iron is incorporated into the structure of still another protein in the red blood cells, where it assists in oxygen transport, or into a muscle protein, which helps muscle cells oxidize their energy fuels. At least one protein is similarly involved in the body's handling of calcium. One of this proteins many roles is to relay to cells a sort of message conveyed from other parts of the body by calcium ions.

## **Acidosis**

Acidosis is too much acid in the blood and body fluids.

## **Alkalosis**

Alkalosis is too much base in the blood and body fluids.

## **Lethal**

Lethal means, "causing death".

## **Sequester (see-KWESS-ter)**

To hide away or take out of circulation.

## **Buffer**

A buffer is a compound that can reversibly combine with H<sup>+</sup> ions to help maintain a constant pH.

## **Antibody**

An antibody is a large protein of the blood and body fluids, produced in response to invasion of the body by unfamiliar molecules (mostly proteins); it inactivates the invaders and so protects the body.

## **Helper Nutrients**

The thyroid hormone contains iodine; insulin contains zinc; these minerals are helper nutrients.

## **Blood Clotting**

Blood is unique and wonderful in its ability to remain a liquid tissue even though it carries so many large molecules and cells through the circulatory system. But blood can also turn solid within seconds when the integrity of that system is disturbed. (If it did not clot, a single pinprick could drain your entire body of all its blood, just as a tiny hole in a bucket makes the bucket forever useless for holding water.) When you cut yourself, a rapid chain of events leads to the production of fibrin, a stringy, insoluble mass of protein fibers that plugs the cut and stops the leak. Later, more slowly, a scar forms to replace the clot and permanently heal the cut.

## **Connective Tissue**

Proteins help make scar tissue, bones, and teeth. When the construction of a bone or a tooth begins, bone-building cells first lay down a scaffolding made of a protein collagen. Later, they lay down crystals of calcium, phosphorus, fluoride, and other minerals on this matrix to form the hardened bone. When a bone breaks, the bone-building cells begin mending the break by molding a collagen matrix then lay down the bony material. Collagen is also the mending material in torn tissue, forming scars to hold the separated parts together. It is the material of ligaments and tendons and is a strengthening glue between the cells of the artery walls that helps enable them to withstand the pressure of surging heartbeats.

**Visual Pigments**

The light-sensitive pigments in the cells of the retina are molecules of the protein opsin. Opsin responds to light by changing its shape, thus initiating the nerve impulses that convey the sense of sight to the higher centers of the brain.

**Ferritin**

The protein residing in the intestinal wall cells is ferritin; the carrier protein, transferrin; the storage protein, ferritin again; the red-blood-cell protein, hemoglobin; and the muscle-cell protein, myoglobin.

**Calmodulin**

Calmodulin is the protein that relays calcium's messages.

The chain of events is as follows:

1. A phospholipid (thromboplastin) is released from blood platelets (small, cell-fragment-like structures in the blood).
2. Thromboplastin catalyzes the conversion of prothrombin (a precursor protein made in the liver that circulates in the blood) to thrombin.
3. Thrombin then catalyzes the conversion of fibrinogen (another circulating precursor protein) to fibrin.

Thrombo = clot

Fibr = fibers

Ogen = gives rise to

**Vitamin K**

Vitamin K is involved in the production of prothrombin and calcium, which is needed for the blood to clot and are helper nutrients.

**Collagen**

Collagen is the protein material of which scars, tendons, ligaments, and the foundations of bones and teeth are made.

Kolla = glue

**Vitamin C**

Vitamin C (needed to form collagen) and minerals (to calcify bones and teeth) are helper nutrients.

**Opsin**

Opsin is the protein of the visual pigments. Vitamin A is a helper nutrient, attached to opsin to form the pigment rhodopsin.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 5:**

### **• DIGESTION, ABSORPTION, AND TRANSPORT**

Lynn, age one, is playing with her mother's necklace of glass beads. As one-year-olds do, she puts it in her mouth and chews on it. The necklace breaks, and Lynn puts the beads into her mouth one by one and swallows them. An hour later her mother finds her with only a few of the hundred beads left on the table. In a panic, her mother calls the doctor. "Doctor," she says, "my daughter has just swallowed a necklace!" "Don't panic," says the doctor. "What was the necklace made of?" "Glass beads," says the mother. "That's all right then," says the doctor. "You'll get them back. Just watch her diapers for a day or so."

One of the beauties of the digestive tract is that it is selective. Materials that are nutritive for the body are broken down into particles that can be assimilated into the bloodstream. Those that are not are left undigested and pass out the other end of the digestive tract. In a sense, the human body is doughnut-shaped, and the digestive tract is the hole through the doughnut. You can drop beads through the hole indefinitely, and they will never enter the body of the doughnut. Two days after Lynn swallowed them, her mother has recovered and restrung all the beads – and is again wearing the necklace.

#### **The Problems of Digestion**

Should you ever accidentally swallow a necklace, you would be protected from any serious consequences by the design of your digestive tract. The system solves many problems for you without your having to make any conscious effort. In fact, the digestive tract is the body's ingenious way of getting the nutrients ready for absorption. Let's consider the problems that are involved:

1. Human beings breathe as well as eat and drink through their mouths. Air taken in through the mouth must go to the lungs; food and liquid must go to the stomach. The throat must be arranged so that food and liquid do not travel to the lungs.
2. Below the lungs lies the diaphragm, a dome of muscle that separates the upper half of the major body cavity from the lower half. Food must be conducted through this wall to reach the abdomen.
3. To pass smoothly through the system, the food must be ground to a paste and must be lubricated with water. Too much water would cause the paste to flow too rapidly; too little would compact it too much, which could cause it to stop moving. The amount of water should be regulated to keep the intestinal contents at the right consistency.
4. When digestive enzymes are working on food, it should be very finely divided and suspended in a watery solution so that every particle will be accessible. Once digestion is complete and all the needed nutrients have been absorbed out of the tract into the body, only a residue remains, which is excreted. It would be both wasteful and messy to excrete large quantities of water with this residue, so some water should be withdrawn, leaving a paste just solid enough to be smooth and easy to pass.
5. The materials within the tract should be kept moving, slowly but steadily, at a pace that permits all reactions to reach completion. The materials should not be allowed to back up, except when a poison or like substance has been swallowed. At such a time the flow should reverse, to get rid of the poison by the shortest possible route (upward). If infection sets in farther down the tract, the flow should be accelerated, to speed its passage out of the body (downward).
6. The enzymes of the digestive tract are designed to digest carbohydrate, fat, and protein. The walls of the tract, being composed of living cells, are made of the same materials. These cells need protection against the action of the powerful juices that they secrete.
7. Once waste matter has reached the end of the tract, it must be excreted, but it would be inconvenient and embarrassing if this function occurred continuously. Provision must be made for periodic, voluntary evacuation when convenient.

The following sections show how the body solves these problems, with elegance and efficiency.

#### **Anatomy of the Digestive Tract**

The gastrointestinal (GI) tract is a flexible muscular tube measuring about 26 feet in length from the mouth to the anus. The voyage of the glass beads traces the path followed by food from one end to the other.

When Lynn swallowed the beads, they first slid across her epiglottis, bypassing the entrance to her lungs. This is the body's solution to problem 1: whenever you swallow, the epiglottis closes off your air passages so that you do not choke.

Next the beads slid down the esophagus, which conducted them through the diaphragm (problem 2) to the stomach. There they were retained for a while. The cardiac sphincter at the entrance to the stomach closed behind them so that they could not slip back (problem 5). Then one by one they popped through the pylorus into the small intestine, and the pylorus, too, closed behind them. At the top of the small intestine they

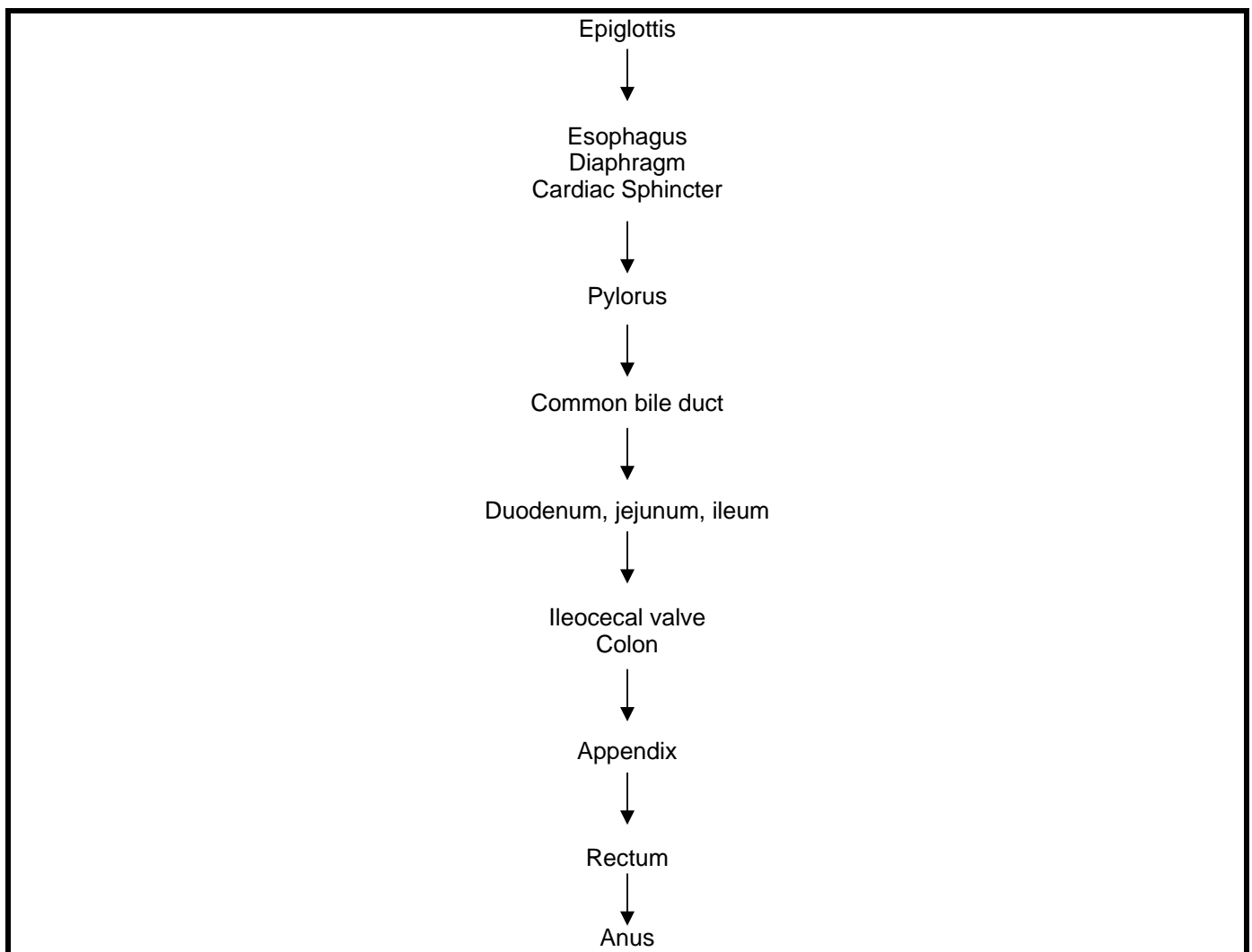


bypassed the opening (entrance only, no exit) from a duct (the common bile duct), which was dripping fluids (problem 3) into the small intestine from two organs outside the GI tract – the gallbladder and the pancreas. They traveled on down the small intestine through its three segments – the duodenum, the jejunum, and the ileum – a total of 20 feet of tubing coiled within the abdomen.

Having traveled through these segments of the small intestine, the beads arrived at another sphincter (problem 5 again) – the ileocecal valve, at the beginning of the large intestine (colon) in the lower right-hand side of the abdomen. As the beads entered the colon they passed another opening. Had they slipped into this opening they would have ended up in the appendix, a blind sac about the size of your little finger. They bypassed it, however, and traveled along the large intestine up the right-hand side of the abdomen, across the front to the left-hand side, down to the lower left-hand side, and finally below the other folds of the intestines to the back side of the body, above the rectum.

During passage through the colon, water was withdrawn, leaving semi-solid waste (problem 4). The beads were held back by the strong muscles of the rectum. When it was time to defecate, this muscle relaxed (problem 7), and the last sphincter in the system, the anus, opened to allow their passage.

To sum up, the path followed by the beads is as shown in the box below. This is not a very complex route, considering all that happens on the way.



### GI Tract

The GI tract is the gastrointestinal tract or alimentary canal; the principal organs are the stomach and intestines.

Gastro = stomach

Aliment = food

## **The Involuntary Muscles and the Glands**

You are usually unaware of all the activity that goes on between the time you swallow and the time you defecate. As is the case with so much else that goes on in the body, the muscles and glands of the digestive tract meet internal needs without your having to exert any conscious effort to get the work done.

Chewing and swallowing are under conscious control, but even in the mouth there are some automatic processes you have no control over. The salivary glands squirt just enough saliva to moisten each mouthful of food so that it can pass easily down your esophagus (problem 3). After a mouthful of food has been swallowed, it is called a bolus.

At the top of the esophagus, peristalsis begins. The entire GI tract is ringed with muscles that can squeeze it tightly. Within these rings of muscle lie longitudinal muscles. When the rings tighten and the long muscles relax, the tube is constricted. When the rings relax and the long muscles tighten the tube bulges. These actions follow each other so that the intestinal contents are continuously pushed along (problem 5). (If you have ever watched a lump of food pass along the body of a snake, you have a good picture of how these muscles work.) The waves of contraction ripple through the GI tract all the time, at the rate of about three a minute, whether or not you have just eaten a meal. Peristalsis, along with the sphincter muscles that surround the tract at key places, prevents anything from backing up.

The intestines not only push but also periodically squeeze their contents at intervals – as if you had put a string around them and pulled it tight. This motion called segmentation, forces their contents backward a few inches, mixing them and allowing the digestive juices and the absorbing cells of the walls to make better contact with them.

Four major sphincter muscles divide the tract into its principal divisions. The cardiac sphincter prevents reflux of the stomach contents into the esophagus. The pyloric sphincter, which stays closed most of the time, prevents backup of the intestinal contents into the stomach and also holds the bolus in the stomach long enough so that it can be thoroughly mixed with gastric juice and liquefied. At the end of the small intestine, the ileocecal valve performs a similar function. Finally, the tightness of the rectal muscle is a kind of safety device; together with the anus, it prevents elimination until you choose to perform it voluntarily (problem 7).

Besides forcing the bolus along, the muscles of the GI tract help to liquefy it so that the digestive enzymes will have access to all the nutrients in it. The first step in this process takes place in the mouth, where chewing, the addition of saliva, and the action of the tongue reduce the food to a coarse mash suitable for swallowing. A further mixing and kneading action then takes place in the stomach.

Of all parts of the GI tract, the stomach has the thickest walls and strongest muscles; in addition to the circular and longitudinal muscles, it has a third layer of transverse muscles that also alternately contract and relax. While these three sets of muscles are all at work forcing the bolus downward, the pyloric sphincter usually remains tightly closed, preventing the bolus from passing into the duodenum. Meanwhile, the gastric glands release juices that mix with the bolus. As a result, the bolus is churned and forced down, hits the pylorus, and bounces back. When the bolus is thoroughly liquefied, the pylorus opens briefly, about three times a minute, to allow small portions through. From this point on, the intestinal contents are called chyme. They no longer resemble food in the least.

### **Gastric Glands**

Gastric glands are exocrine glands in the stomach wall that secrete gastric juice into the stomach.  
Gastro = stomach

### **Chyme (KIME)**

Chyme is the semiliquid mass of partly digested food expelled by the stomach into the duodenum

### **Organs that Secrete Digestive Juices**

1. Salivary glands
2. Gastric glands (stomach)
3. Pancreas
4. Liver
5. Intestinal glands
- 6.

### **Gland**

A gland is a cell or group of cells that secretes materials for special uses in the body. Glands may be exocrine glands, secreting their materials “out” (into the digestive tract or onto the surface of the skin) or

endocrine glands, secreting their materials “in” (into the blood).

Exo = outside

Endo = inside

Krine = to separate

## Salivary Glands

The salivary glands are exocrine glands.

## Bolus (BOH-lus)

A bolus is the portion of food swallowed at one time.

## Peristalsis (peri-STALL-sis)

Peristalsis is successive waves of involuntary muscular contraction passing along the walls of the intestine.

Peri = around

Stellein = wrap

## Segmentation

Segmentation is a periodic squeezing or partitioning of the intestine by its circular muscles.

### Miniglossary of GI Terms

- **Epiglottis (epp-ee-GLOTT-iss)** - The Epiglottis is the cartilage in the throat that guards the entrance to the trachea and prevents fluid or food from entering it when a person swallows.  
Epi = upon (over)  
Glottis = back of tongue
- **Trachea (TRAKE-ee-uh)** - The trachea is the windpipe.
- **Esophagus (e-SOFF-uh-gus)** - The esophagus is the food pipe.
- **Cardiac Sphincter (CARD-ee-ack SFINK-ter)** - The cardiac sphincter is the sphincter muscle at the junction between the esophagus and the stomach.  
Cardiac = the heart
- **Sphincter** - A sphincter is a circular muscle surrounding and able to close a body opening.  
Sphincter = band (binder)
- **Pylorus (pie-LORE-us)** - The pylorus is a sphincter muscle separating the stomach from the small intestine.  
Pylorus = gatekeeper
- **Duodenum (doo-oh-DEEN-um, doo-ODD-num)** - The duodenum is the top portion of the small intestine (about “12 fingers’ breadth” long, in ancient terminology).  
Duodecim = twelve
- **Jejunum (je-JOON-um)** - The jejunum is the first two-fifths of the small intestine beyond the duodenum.
- **Ileum (ILL-ee-um)** - The ileum is the last segment of the small intestine.
- **Ileocecal (ill-ee-oh-SEEK-ul) valve** - The Ileocecal valve is a sphincter muscle separating the small and large intestines.
- **Colon (COAL-un)** - The colon is the large intestine. Its segments are the ascending colon, the transverse colon, the descending colon, and the sigmoid colon.  
Sigmoid = shaped like the letter S (sigma in Greek)
- **Appendix** - The appendix is a narrow blind sac extending from the beginning of the colon; a vestigial organ with no known function.
- **Rectum** - The rectum is the muscular terminal part of the intestine, from the sigmoid colon to the anus.
- **Anus (AY-nus)** - The anus is the terminal sphincter muscle of the GI tract.

## The Process of Digestion

One person eats nothing but vegetables, fruits, and nuts; another, nothing but meat, milk, and potatoes. How is it that they wind up with essentially the same body composition? It all comes down to the fact, of course, that the body renders food – whatever it is to start with – into the basic units that carbohydrate, fat, and protein are composed of. The body absorbs these units and builds its tissues from them. The final problem of the GI tract is to digest the food.

For this purpose five different body organs secrete digestive juices; the salivary glands, the stomach, the small intestine, the liver, and the pancreas. Each of the juices has a turn to mix with the intestinal contents and promote their breakdown to small units that can be absorbed into the body.

Saliva contains not only water and salts, but also amylase, an enzyme that breaks bonds in the straight chains of starch. The digestion of starch thus begins in your mouth. In fact, you can taste the change if you choose. Starch has very little taste, but some maltose is released, conveying a subtly sweet flavor that you may associate with malted milk. If you hold a piece of starchy food like white bread in your mouth without swallowing it, you can taste it getting sweeter as the enzyme acts on it. Saliva also protects the tooth surfaces and linings of the mouth, esophagus, and stomach from attack by molecules that might harm them.

### Digestion in the Mouth

Carbohydrate	Starch/amylase/maltose
Fat	No chemical action
Protein	No chemical action
Vitamins	No chemical action
Minerals	No chemical action
Water	Added
Fiber	No chemical action

Gastric juice is composed of water, enzymes, and hydrochloric acid. The acid is so strong (pH 2 or below) that if it chances to reflux into the mouth, it burns the throat. The strong acidity of the stomach prevents bacterial growth and kills most bacteria that enter the body with food. It would kill the cells of the stomach as well, but for their natural defenses. To protect themselves from gastric juice, the cells of the stomach wall secrete mucus, a thick, slimy, white polysaccharide that coats the cells, protecting them from the acid and enzymes that would otherwise digest them (problem 6).

## Saliva

Saliva is the secretion of the salivary glands; the principal enzyme is salivary amylase.

### Amylase (AM-uh-lace)

Amylase is an enzyme that hydrolyzes amylose (a form of starch). An older name for salivary amylase is ptyalin (TY-uh-lin).

### Hydrolyze (HIGH-dro-lize)

To hydrolyze is to split by hydrolysis.

### Caution:

It should be noted here that the strong acidity of the stomach is a desirable condition – television commercials for antacids notwithstanding. A person who overeats or who bolts her food is likely to suffer from indigestion. The muscular reaction of the stomach to unchewed lumps or to being overfilled may be so violent as to cause regurgitation (reverse peristalsis, another solution to problem 5). When this happens, the overeater may taste the stomach acid in her mouth and think she is suffering from “acid indigestion.” Responding to TV commercials, she may take antacids to neutralize the stomach acid. The consequence of this action is a demand on the stomach to secrete more acid to counteract the neutralizer and enable the digestive enzymes to do their work. So the consumer ends up with the same amount of acid in her stomach but has had to work against an antacid to produce it.

Antacids are not designed to relieve the digestive discomfort of the hasty eater. Their proper use is to correct an abnormal condition, such as that of the ulcer patient whose stomach or duodenal lining has been attacked by acid. Antacid misuse is similar to the misuse of diuretics. To avoid falling into the same trap as our misguided consumer, remember that what such a person needs to do is to chew food more thoroughly, eat it more slowly, and possibly eat less at a sitting.

## Gastric Juice

Gastric juice is the secretion of the gastric glands. The principal enzymes are rennin (curdles milk protein, casein, and prepares it for pepsin action), pepsin (acts on proteins), and lipase (acts on emulsified fats).

## A pH of 2

A pH of 2 is 1,000 times stronger than a pH of 5.

## Mucus (MYOO-cuss)

Mucus is a muco-polysaccharide (relative of carbohydrate) secreted by cells of the stomach wall. The cellular lining of the stomach with its coat of mucus is known as the mucous membrane. (The noun is mucus; the adjective is mucous.)

## Pepsin

Pepsin is a gastric protease. It circulates as a precursor, pepsinogen, and is converted to pepsin by the action of stomach acid.

All proteins are responsive to acidity; the stomach enzymes work most efficiently in a fluid of pH 2 or lower. However, salivary amylase, which is swallowed with the food, does not work in acid this strong, so the digestion of starch gradually ceases as the acid penetrates the bolus. In fact, salivary amylase becomes just another protein to be digested; its amino acids end up being absorbed and recycled into other body proteins.

The major digestive event in the stomach is the hydrolysis of proteins. Both the enzyme pepsin and the stomach acid itself act as catalysts for this reaction. Minor events are the hydrolysis of some fat by a gastric lipase, the hydrolysis of sucrose (to a very small extent) by the stomach acid, and the attachment of a protein carrier to vitamin B<sub>12</sub>.

Digestion in the Stomach	
Carbohydrate	Minor action
Fat	Minor action
Protein	Pepsin/HCL/Smaller polypeptides
Vitamins	Minor action
Minerals	No chemical action
Water	Added
Fiber	No chemical action

## Intestinal Juice

Intestinal juice is the secretion of the intestinal glands; contains enzymes for the digestion of carbohydrate and protein and a minor enzyme for fat digestion

## Pancreatic (pank-ree-AT-ic) Juice

Pancreatic juice is the exocrine secretion of the pancreas, containing enzymes for the digestion of carbohydrate, fat, and protein. (The pancreas also has an endocrine function, the secretion of insulin and other hormones.) Juice flows from the pancreas into the small intestine through the pancreatic duct.

By the time food has left the stomach, digestion of all three energy nutrients has begun. But the action really gets going in the small intestine, where three more digestive juices are contributed. Glands situated in the intestinal wall secrete a watery juice containing all three kinds of digestive enzymes – carbohydrases, lipases, and proteases – and others as well. In addition, both the pancreas and the liver make contributions by way of ducts leading into the duodenum. The pancreatic juice also contains enzymes of all three kinds, plus others.

Food evidently needs to be digested completely. The sharing of the task by several organs underscores the body's determination to get the job done. If the pancreas fails, the intestine can still do its share; if the intestine fails, the pancreas can substitute, at least in part. Such distribution of labor is seen in nature whenever the job to be done is absolutely vital, as it is in this case.

In addition to enzymes, the pancreatic juice contains sodium bicarbonate. The pancreatic juice joins the intestinal contents just after they leave the stomach, and the bicarbonate neutralizes the acidic chyme as it enters the small intestine. From this point on, the contents of the digestive tract are at a neutral or slightly alkaline pH. The enzymes of both the intestine and the pancreas work best at this pH.

Bile, a secretion from the liver, also flows into the duodenum. The liver secretes this material continually, but it is needed only when fat is present in the intestine. The bile is concentrated and stored in the gallbladder, which squirts it into the duodenum on request. Bile is not an enzyme but an emulsifier; it brings fats into suspension in water so that enzymes can work on them. Thanks to all these secretions, all the energy nutrients are digested in the small intestine.

### When the Pancreas Fails

When the pancreas fails, fat digestion is seriously impaired, since the intestine has no major lipase.

### Bicarbonate

Bicarbonate is an alkaline secretion of the pancreas, part of the pancreatic juice. (Bicarbonate also occurs widely in all cell fluids.)

### Bile

Bile is an exocrine secretion of the liver (the liver also performs a multitude of metabolic functions). Bile flows from the liver into the gallbladder, where it is stored until needed.

### Gallbladder

The gallbladder is the organ that stores and concentrates bile. When it receives the signal that fat is present in the duodenum, the gallbladder contracts and squirts bile down the bile duct.

### Digestion in the Small Intestine

Carbohydrate	All carbohydrates/Enzymes/Monosaccharides
Fat	All fats/Bile/Emulsified fats
Protein	Emulsified fats/Enzymes/Monoglycerides or glycerol and fatty acids
Vitamins	No chemical action
Minerals	No chemical action
Water	Added
Fiber	No chemical action

### Caution:

Most proteins are broken down to dipeptides, tripeptides, and amino acids before they are absorbed. With this in mind, you will be in a position to refute certain untrue claims made about foods – for instance, “Don’t eat Food A. It contains an enzyme B that will harm you.” Any enzyme you eat becomes but one among thousands of different proteins in your digestive tract. Except for the digestive enzymes whose design prevents them from being digested while they work, enzymes you eat are simply proteins that are broken down to amino acids identical to those from the other proteins you eat. Your body cannot tell the source of a particular amino acid any more than it can tell where its vitamin C comes from. Don’t be fooled by claims that imply that enzymes you eat will not be digested by the body.

### Intestinal Flora

The bacterial inhabitants of the GI tract are known as the intestinal flora.

Flora = plant growth

### Minerals and Vitamins

Some minerals and vitamins are slightly altered during digestion. Iron is reduced in the stomach acid to its ferrous state; Vitamin B<sub>12</sub> is picked up by a carrier, intrinsic factor.

The intestine, being neutral, permits the growth of bacteria. In fact, a healthy small intestine supports a thriving bacterial population that normally does the body no harm and may actually do some good. Bacteria in the GI tract produce a variety of vitamins; two of them (biotin and vitamin K) may, on occasion, be of significance to the person surrounding the GI tract. (For example, we sometimes rely on some of the vitamin K our bacteria have produced for us.) Provided that the normal intestinal flora are thriving, infectious bacteria have a hard time getting established and launching an attack on the system.

The small intestine – and in fact the entire GI tract – also manufactures and maintains a strong arsenal of defenses against foreign invaders. Several different kinds of defending cells are present there and confer specific immunity against intestinal diseases.

The story of how food is broken down into nutrients that can be absorbed is now nearly complete. All that remains is to recall what is left in the GI tract. The three energy nutrients – carbohydrate, fat, and protein – are the only ones that must be disassembled to basic building blocks before they are absorbed. The other nutrients – vitamins, minerals, and water – are mostly absorbable as is. The function of undigested residues, such as some fibers, is not to be absorbed but rather to remain in the digestive tract, mainly to provide a semisolid mass that can stimulate the muscles of the tract so that they will remain strong and perform peristalsis efficiently. Fiber also retains water, keeping the stools soft, and carries bile acids, sterols, and fat with it out of the body.

### Absorption in the Small Intestine

Carbohydrate	Almost completely absorbed (as basic units)
Fat	Almost completely absorbed (as basic units)
Protein	Almost completely absorbed (as basic units)
Vitamins	Almost completely absorbed
Minerals	Mostly absorbed
Water	Remains
Fiber	Remains

The process of absorbing the nutrients into the body presents its own problems, to be discussed in the next section. For the moment, let us assume that the digested nutrients simply disappear from the GI tract as soon as they are ready. Virtually all are gone by the time the contents of the GI tract reach the end of the small intestine. Little remains but water, a few dissolved salts and body secretions, undigested materials such as fiber, and an occasionally glass bead. These enter the large intestine (colon).

In the colon, intestinal bacteria degrade some of the fiber to simpler compounds. The colon itself actively retrieves from its contents the materials that the conservative body is designed to recycle – much of the water and the dissolved salts (problem 4).

### Absorption in the Colon

Minerals	Reabsorbed
Water	Some reabsorbed
Fiber	Some digested by bacteria; some remains

### The Problem of Absorption

**Problem:** Given an elaborate production in which 1,000 actors are on stage at once, provide a means by which all can exit simultaneously. This is the problem of absorption. Within three or four hours after you have eaten a dinner of beans and rice (or spinach lasagna, or steak and potatoes) with vegetable, salad, beverage, and dessert, your body must find a way to absorb some two hundred thousand million, million, million amino acid molecules one by one, and an equivalent number of monosaccharide, monoglyceride, glycerol, fatty acid, vitamin, and mineral molecules as well.

For the stage production, the manager might design multiple wings that all the actors could crowd into, a dozen at a time. A mechanical genius might somehow design moving wings that would actively engulf the actors as they approached. The absorptive system is no such fantasy; in 20 feet of small intestine it provides a surface whose extent is comparable to a quarter of a football field in area where the nutrient molecules can make contact and be absorbed. To remove them rapidly and provide room for more to be absorbed, a rush of circulation continuously bathes the underside of these surfaces, washing away the absorbed nutrients and carrying them to the liver and other parts of the body.

### The Absorptive System

The small intestine is a tube about 20 feet long and an inch or so across. Its inner surface looks smooth and slippery, but viewed through a microscope, it turns out to be wrinkled into hundreds of folds. Each fold is covered with thousands of nipple-like projections, as numerous as the hairs on velvet fabric. Each of these intestinal projections is a villus. A single villus, magnified still more, turns out to be composed of hundreds of cells, each covered with microscopic hairs, the microvilli.

The villi are in constant motion. Each villus is lined by a thin sheet of muscle, so that it can wave, squirm, and wriggle like the tentacles of a sea anemone. Any nutrient molecule small enough to be absorbed is trapped in the microvilli and drawn into the cells beneath them. Some partially digested nutrients are caught in the microvilli, digested further by enzymes there, and then absorbed into the cells.

Once a molecule has entered a cell in the villus, the next problem is to transport it to its destination elsewhere in the body. Everyone knows that the bloodstream performs this function, but you may be surprised to learn that there is a second transport system – the lymphatic system. Both of these systems supply vessels to each villus. When a nutrient molecule has crossed the cell of a villus, it may enter either the lymph or the blood. In either case, the nutrients end up in the blood, at least for a while.

### **Villi (VILL-ee, VILL-eye)**

Villi are singular villus, which are fingerlike projections from the folds of the small intestine.

### **Microvilli (MY-cro-VILL-ee, MY-cro-VILL-eye)**

Microvilli are singular microvillus, which are projections from the membranes of the cells of the villi.

### **Surface Features of the Small Intestinal Wall**

1. Five folds in each wall of the small intestine. Each is covered with villi.
2. Two villi. Each villus is composed of several hundred cells.
3. Three cells of a single villus. Each cell is coated with microvilli.

### **Lymph (LIMF)**

Lymph is the body's interstitial fluid, between the cells and outside the vascular system. Lymph consists of all the constituents of blood that can escape from the vascular system; it circulates in a loosely organized system of vessels and ducts known as the lymphatic system.

### **A Closer Look at the Intestinal Cells**

The cells of the villi are among the most amazing in the body, for they recognize, select, and regulate the absorption of the nutrients the body needs. (Thanks to these cells, glass beads never enter the body proper to lodge in inconvenient places, but the cells can make far more sophisticated distinctions than this.) A close look at these cells is worthwhile, because it will help to explode a number of common misconceptions about nutrition.

Each cell of a villus is coated with thousands of microvilli, which project from its membrane. In these microvilli and in the membrane lie hundreds of different kinds of enzymes and “pumps,” which recognize and act on different nutrients. For example, the enzyme lactase, which breaks apart the disaccharide lactose (milk sugar), lies within the cells' microvilli. The presence of lactase at the cell surface ensures the efficient absorption of this sugar, because as soon as it is broken into its component parts (glucose and galactose), those parts are easily contacted by the nearby pumps, which move them into the interior of the cell. This arrangement makes it easy for a newborn infant to absorb and use milk sugar, even though his gastrointestinal tract may in some ways still be immature.

Enzymes for cleaving dipeptides and tripeptides also lie in the surface structures of the intestinal cells. Whole proteins – long polypeptides – are digested to chains a few amino acids in length out in the fluid of the intestine, but once they have been rendered into dipeptides and tripeptides, these fragments are contacted and trapped by the microvilli, where the last steps of digestion occur. The cells' enzymes then can deliver the final products – amino acids – directly to the pumps, which carry them into the interior of the cells.

There is nothing random about this process. The anatomical arrangement guarantees not only digestion but also delivery of its products into the body. Digestion and absorption are coordinated.

An additional refinement of the system for digesting and absorbing protein gives a further reason for not tampering with it. The amino acid transport systems are not specific for individual amino acids but for groups of them. For example, there is one pump for the basic amino acids and another for the neutral ones. Each group of amino acids with similar structures shares a transport system. This means that competition can occur. The amino acids within a group can interfere with each other's absorption.

Normally, no problems arise with this arrangement. Food proteins deliver balanced assortments of amino acids to the GI tract, digestion occurs slowly, fragments are delivered in leisurely fashion to the microvilli, and the final steps of digestion and absorption occur without much mutual interference. If, however, a person takes pure amino acids rather than protein, the competition for carriers is more severe, and some amino acids are lost. If the person still more foolishly presumes to decide that she needs certain specific amino acids and takes an overdose of one, she may precipitate a deficiency of the others that share its carrier. If the lost amino acids are essential ones, the net effect will be to reduce her total supply of usable protein.



**Caution:**

Some people believe that eating predigested protein (amino acid preparations such as the “liquid protein” products sold to dieters) saves the body the work of having to digest protein, so that the digestive system won’t “wear out” so easily. Nothing could be further from the truth. As a matter of fact, whole proteins are better absorbed and utilized, even by the body of a very sick, malnourished person, than are hydrolyzed amino acid mixtures. This surprising finding has come to light through actual experiments, not through the exercise of reasoning from what was known before. It has proven wrong the claims of advertisers who try to sell hydrolyzed amino acid preparations to athletes, sick people, dieters, and others. The “best” protein is food protein.

When hydrolyzed proteins (that is, predigested mixtures of amino acids) are consumed, there can be no coordination of digestion and absorption. The amino acids arrive en masse, presenting the intestine with the problem of trying to absorb them all at once. At first, floating free in the intestinal fluid, they exert an attractive force (remember that charged molecules attract water), so that excess fluid is drawn into the GI tract, causing at least discomfort, and at worst cramping, nausea, and diarrhea. On the other hand, when whole food proteins are delivered to the intestine they are systematically and gradually cleaved to pieces that can be digested and absorbed in sequence. The amino acids that flow into the body also arrive in sequence, perhaps even in the sequence needed to build protein in the cells.

In general, it is unwise to try to second-guess the body. It has evolved over millions of years to derive its nutrients efficiently from foods. How could we presume, after five minutes of listening to a salesman or fad diet promoter, that we can improve on this natural capacity?

This is not to say that some food proteins can’t be improved by amino acid supplementation. A plant protein of very poor quality may be better utilized by the body if the limiting amino acids are added to it. In this instance, adding amino acids provides a balance closer to what the body needs. This theory has been scientifically tested and confirmed – for example, in growth experiments on children.

The preceding discussion has illuminated some aspects of the absorption of carbohydrates and protein but has said nothing about lipids. The absorption of lipids differs in that pumps are not involved. Cell membranes dissolve lipids easily because they are made largely of lipid themselves. After the triglycerides have been digested to monoglycerides or to glycerol and fatty acids, for example, they simply diffuse across the cell membrane. The cell retains them by reassembling them.

As you can see, the cells of the intestinal tract wall are beautifully designed to perform their functions. Further refinement of the system is that the cells of successive portions of the tract are specialized for different absorptive functions. The nutrients that are ready for absorption early are absorbed near the top of the tract; those that take longer to be digested are absorbed farther down. Thus the top portion of the duodenum is specialized for the absorption of calcium and several B vitamins, such as thiamin and riboflavin; the jejunum accomplishes most of the absorption of triglycerides; and vitamin B12 is absorbed at the end of the ileum. Medical and health professionals who deal with digestion learn the specialized absorptive functions of different parts of the GI tract so that, when one part becomes dysfunctional, the diet can be adjusted accordingly.

The rate at which the nutrients travel through the GI tract is finely adjusted to maximize their availability to the appropriate absorptive segment of the tract when they are ready. The lowly “gut” turns out to be one of the most elegantly designed organ systems in your body.

**Release of Absorbed Nutrients**

Once inside the intestinal cells, the products of digestion must be released for transport to the rest of the body. The water-soluble nutrients (including the smaller products of lipid digestion) are released directly into the bloodstream. For the larger lipids and the fat-soluble vitamins, however, access directly into the capillaries is impossible because they are insoluble in water. The cells assemble the monoglycerides and long-chain fatty acids into larger molecules, triglycerides. These triglycerides and the other large lipids (cholesterol and the phospholipids) are then wrapped in protein to form chylomicrons. Finally, the cells release the chylomicrons into the lymphatic system. They can then glide through the lymph spaces until they move to a point of entry into the bloodstream near the heart.

## Transport of Nutrients into Blood

### Water-soluble nutrients

#### Carbohydrates

Monosaccharides

Directly into blood

#### Lipids

Glycerol

Directly into blood

Short-chain fatty acids

Directly into blood

Medium-chain fatty acids

Directly into blood

#### Proteins

Amino acids

Directly into blood

#### Vitamins

Vitamins B and C

Directly into blood

#### Minerals

Directly into blood

### Fat-soluble nutrients

#### Lipids

Long-chain fatty acids

Made into triglycerides

Monoglycerides

Made into triglycerides

Triglycerides (in lipoproteins)

To lymph, then blood

Cholesterol (in lipoproteins)

To lymph, then blood

Phospholipids (in lipoproteins)

To lymph, then blood

#### Vitamins

Vitamins A, D, E, K

To lymph, then blood

## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 6:

### • Metabolism, Feasting, Fasting, and Energy Balance

When you eat too much you get fat; when you eat too little you get thin. Everybody knows these simple facts, but nobody knows exactly how to account for them. The mission of this session is to shed some light on what we do know and to provide answers to some of the questions people often ask about diets.

- What makes a person gain weight?
- Are carbohydrate-rich foods more fattening than other foods?
- What's the best fuel for an athlete?
- What's the best way to lose weight?
- Is fasting dangerous?
- Are low-carbohydrate diets dangerous?

The answers to these and many other questions lie in an understanding of metabolism. Metabolism could be defined as the way the body handles the energy nutrients.

### Metabolism

Metabolism is the sum total of all the chemical reactions that go on in living cells.

Meta = among

Bole = change

### Starting Points

The first four sessions introduced the energy nutrients – carbohydrate, fat, and protein – as they are found in foods and in the human body. Session 5 followed the nutrients through digestion to the simpler units they are composed of and showed these units disappearing into the blood. Four of these units will be followed here:

1. **Carbohydrate** – During digestion, all available carbohydrates are broken down to monosaccharides and absorbed into the blood. Fructose and galactose are then mostly taken into liver cells and converted to glucose or to very similar compounds. To follow carbohydrate through metabolism we will simply follow glucose.
2. **Lipids** – Most of the dietary lipids are triglycerides. The basic units these are composed of are glycerol and fatty acids. To follow lipids through metabolism we will follow glycerol and fatty acids.
3. **Protein** – Protein is ultimately digested to amino acids; these are the units we will follow through metabolism.

### Building Body Compounds

You already know what may happen to some of these basic units when their energy is not needed by the cells. They may be stored “as is,” and then used to build body compounds. Glucose units may be strung together to make glycogen chains. Glycerol and fatty acids may be assembled into triglycerides. Amino acids may be used to make proteins. These building reactions, in which simple compounds are put together to form larger, more complex structures, involve doing work and so require energy. They are called anabolic reactions, and are always represented by “up” arrows in diagrams such as those in this session.

### Anabolism (an-ABB-o-lism)

Anabolisms are reactions in which small molecules are put together to build larger ones. Anabolic reactions consume energy and often involve reduction.

Ana = up

### Catabolism (cuh-TAB-o-lism)

Catabolisms are reactions in which large molecules are broken down to smaller ones. Catabolic reactions release energy and often involve oxidation.

### Pyruvate (PIE-roo-vate)

Pyruvate is pyruvic acid; a 3-carbon compound derived from glucose and certain amino acids in metabolism. The term pyruvate means a salt of pyruvic acid. (Throughout this course the ending ate is used interchangeably with ic acid; for our purposes they mean the same thing.)

## **Glycolysis (gligh-COLL-uh-sis)**

Glycolysis is the metabolic breakdown of glucose to pyruvate.

Glyco = glucose

Lysis = breakdown

## **Breaking Down Nutrients for Energy**

If the body needs energy, it may break apart any or all of these four units into smaller fragments. The breakdown reactions are called catabolic reactions. They release energy. Much of the body's catabolic work is done by enzymes in the liver cells, and all the reactions described in this session can take place there.

At this point, it must be recalled that although glucose, glycerol, fatty acids, and amino acids are the basic units we get from food, they are composed of still smaller units, the atoms. During metabolism, the body actually separates these atoms from one another.

The main point to notice in the follow discussion is that compounds that have a 3-carbon skeleton can be used to make the vital nutrient glucose. Those that have 2-carbon skeletons cannot.

What happens to these compounds inside of cells can be best understood by starting with glucose. Two new names appear – pyruvate (3 Cs) and Acetyl-CoA (2 Cs) – and the rest of the story falls into place around them.

## **Glucose**

In breaking down, glucose first splits in half, releasing energy. One product is the 3-carbon compound pyruvate, and the other is a 3-carbon compound that is converted to pyruvate, so that two identical halves result from this step.

Should a cell “change its mind” after splitting glucose to pyruvate, it could reverse this step. It could put the two halves back together to make glucose again.

If the cell still needs energy, however, it breaks the pyruvate molecules apart further, cleaving a carbon from each. The lone carbon is combined with oxygen to make carbon dioxide, which is released into the blood, circulated to the lungs, and breathed out. The 2-carbon compound that remains is acetate (Acetyl-CoA).

Should the cell change its mind at this point and want to retrieve the shed carbons and remake glucose, it could not do so. The step from pyruvate to Acetyl-CoA is metabolically irreversible. It is a one-way step.

The carbon removed from the pyruvate ends up being combined with oxygen to make carbon dioxide. The person had to breathe oxygen into the lungs, had to attach it to a carrier (hemoglobin) in the red blood cells, and had to bring it to the metabolizing cells to make it available for this purpose. Everyone knows you need to breathe harder when you are using energy faster (exercising), but not everyone “sees” what's happening. Energy nutrients are being broken down to provide that energy, and oxygen is always ultimately involved in the oxidation process.

Finally, Acetyl-CoA may be split, yielding two more carbon dioxide molecules. The energy released in this step powers most of the cell's activities. In short, the main steps in the metabolism of glucose are glucose to pyruvate to Acetyl-CoA to carbon dioxide. Notice (again) that only the first step is reversible. The process by which Acetyl-CoA splits and releases its energy is known as the TCA cycle.

## **CoA (coh-AY)**

As pyruvate loses a carbon and becomes a 2-carbon compound (acetate, or acetic acid), a molecule of CoA is attached to it, making Acetyl-CoA (ASS-uh-teel, or uh-SEET-ul, co-AY).

## **TCA (tricarboxylic acid) or Krebs Cycle**

The reactions by which the complete oxidation of Acetyl-CoA is accomplished are those of the TCA (tricarboxylic acid) or Krebs cycle (named for the biochemist who elucidated them) and oxidative phosphorylation. The net result is that Acetyl-CoA splits, the carbons combine with oxygen, and the energy originally in the Acetyl-CoA becomes available for the body's use.

## Glucose Breakdown

These are the processes by which energy from glucose is made available to do the cells' work. Many chemical reactions are involved. Ultimately, glucose is completely disassembled to single-carbon fragments, the fragments are combined with oxygen to form carbon dioxide, and most of the freed energy is used to make other compounds such as ATP, glycogen, and fat. ATP is a short-term energy-carrying compound. Glycogen and fat are longer-term energy-storage deposits.

### **Caution:**

Most people spend their entire lives without ever making the acquaintance of pyruvate and acetyl CoA, yet chemists and nutritionists can become quite excited talking about them. The behavior of these two compounds explains the most interesting and important aspects of nutrition and makes it possible to answer questions like those asked at the outset. Are carbohydrate-rich foods more fattening than other foods? What's the best energy fuel for an athlete? What's the best way to lose weight? Is fasting dangerous? Are low-carbohydrate diets dangerous?

A person who understands the basics of metabolism can choose what fuel to burn for various purposes. The enlightened athlete knows, for example, that in some athletic events the muscles use fat and glucose, while in others, they require glucose only. The enlightened dieter knows how to encourage the use of fat rather than muscle-protein kcalories during a weight-loss program. It all hinges on which fuels can be converted to glucose and which cannot. The parts of protein and fat that can be converted to pyruvate (3 Cs) can provide glucose for the body; those that are converted to Acetyl-CoA cannot provide glucose. And glucose is all-important.

## Glycerol and Fatty Acids

The glycerol (3 Cs) is easily converted to pyruvate (also 3 Cs, but with a different arrangement of Hs and OHs on the Cs), and then may go either "up" to form glucose or "down" to form acetyl CoA and finally carbon dioxide. The three fatty acids are taken apart two carbons at a time to make Acetyl-CoA. Because the arrow from pyruvate to Acetyl-CoA goes one way (down) only, the fatty acids cannot be used to make glucose.

The significance of this is that fat, for the most part, cannot normally provide energy for the organs (brain, nervous system) that require glucose as fuel. Remember that almost all dietary lipid is triglyceride, and that the typical triglyceride consists of a molecule of glycerol (3 Cs) and three fatty acids (each about 18 Cs on the average, or about 54 Cs in all). True, the glycerol can yield glucose, but that represents only 3 out of 57 parts of the fat molecule – about 5 percent of its weight. Thus, fat is a very poor, inefficient source of glucose by itself. About 95 percent of it cannot be converted to glucose at all.

## ATP (adenosine triphosphate)

The body as a whole stores its excess energy in special storage organs; the liver and muscle (as glycogen) and the fat cells (as fat). However, each cell also has to have a ready supply of "instant energy." This is like storing money in the bank but also keeping pocket money in cash. The cells' cash is adenosine triphosphate (ATP).

When the cell needs energy, each ATP molecule releases one phosphate group. The packet of energy in the broken bond is used, and the phosphate stays in the fluid of the cell along with the adenosine diphosphate (ADP) that is left. Whenever ATP is broken apart like this, its energy is used to do some work for the cell.

As the cell gradually uses up its energy, the amount of ATP falls, and that of ADP rises. The increased amount of ADP generates a signal that the cell needs energy; so units such as glucose, available in the blood from food, are taken into the cell and broken down to carbon dioxide, water, and energy. The cell deposits the released energy in another high-energy bond, hooking phosphate back onto ADP, reforming ATP. Thus balance is restored.

If no energy units from food are available, glucose and fat drawn from body stores supply the energy to rebuild ATP. In the extreme case of starvation, even body proteins are dismantled in response to the low ATP levels of the cells. Thus "bank" energy is converted to "cash" energy.

An abundance of ATP in the cells also serves as a signal. It tells the liver to route any remaining energy units to storage. Thus "cash" energy can be put back in the "bank."

## Amino Acids

Ideally, amino acids will be used to replace needed body proteins, and will not be catabolized at all. But if they are needed for energy, they enter the metabolic pathway. They are stripped of their nitrogen and then catabolized in a variety of ways. The end result is that about half of the amino acids can be converted to pyruvate; the other half go either to Acetyl-CoA or directly into the TCA cycle. Those that can be used to make pyruvate can provide glucose for the body. Thus protein, unlike fat, is a fairly good source of glucose when carbohydrate is not available; about 50 percent of it can be used this way.

Amino acids break down when energy needs are not met by carbohydrate and fat, as just described, but they also break down in the same way under another set of conditions: when surplus kcalories and protein are consumed. Surplus protein cannot be stored in the body as such; it has to be converted to other compounds. If you eat more protein than you can use at a given time, the excess amino acids soon lose their nitrogens, and most are converted to acetyl CoA (either directly or indirectly, through pyruvate). This Acetyl-CoA is not broken down further, because energy is not needed. Instead, it is strung together into chains – fatty acids – and stored in body fat. Thus even the so-called “lean” nutrient, protein, can make you fat if you eat too much of it.

### **Caution:**

The high-protein dieter objects to the statement above, saying, “Protein makes you thin!” In fact, many weight-loss diets are based on high protein intakes, making the claim that “Protein will give you energy but will not make you fat.” Eat all you want – just stay away from fattening carbohydrates.”

The secret of these diets, when they do seem to promote weight loss is that meals without carbohydrate are in truth so unappetizing that people who ingest them eat much less total food than they normally do. Try eating your breakfast of bacon, eggs, toast, and juice without the toast and juice. Have a ham and cheese sandwich without the bread, and a steak, potatoes, and pea dinner without the potatoes and peas. You'll be surprised how quickly you lose your enthusiasm for the permitted foods. (Some people report, after eating nothing but bacon, eggs, ham, cheese, and steak for a few days, that they start dreaming of toast and juice!)

This method of weight loss may sound fine to the person who wants to lose pounds fast, but the next few sections of this course should convince any sane dieter otherwise. Meanwhile, it should now be clear that protein, in and of itself, is not nonfattening. People who eat huge portions of meat, even lean meat, and other protein-rich foods may wonder why they have a weight problem. It may be those very foods that are causing the trouble.

There is a message for the athlete in these metabolic facts about protein, too. Excess protein is not a muscle-building food; it's a fat-building food. To the extent that protein is used for energy, carbohydrate would do the job just as well. In other words, there is no point to loading up on protein for any reason.

## How Amino Acids Enter the Metabolic Path

About half of the amino acids can convert to pyruvate (and therefore glucose); about half convert to acetyl CoA or go directly into the TCA cycle (and therefore cannot yield glucose).

### **Gluconeogenesis (gloo-co-nee-o-GEN-uh-sis)**

The making of glucose from protein or fat is gluconeogenesis. About 5 percent of fat (the glycerol portion of triglycerides) and about 50 percent of protein (the glucogenic amino acids) can be converted to glucose.)

Gluko = glucose

Neo = new

Genesis = making

### **Deamination**

Deamination is the removal of the amino ( $\text{NH}_2$ ) group from a compound such as an amino acid.

### **Urea (you-REE-uh)**

Urea is the principal nitrogen-excretion product of metabolism. Two ammonia fragments are combined with a carbon-oxygen group to form urea.

### **What happens to the Nitrogen?**

When amino acids are degraded for energy or to make fat, the first step is removal of their nitrogen-containing amino groups, a reaction called deamination. The product is ammonia; chemically identical to the ammonia in the bottled cleaning solutions used in hospitals and in industry. It is a strong-smelling and extremely potent poison.

A small amount of ammonia is always being produced by liver deamination reactions. Some of this ammonia is captured by liver enzymes and used to synthesize other amino acids, but what cannot be used is quickly combined with a carbon-oxygen fragment to make urea, an inert and less toxic compound.

Urea is released from the liver cells into the blood, where it circulates until it passes through the kidneys. One of the functions of the kidneys is to remove urea from the blood for excretion in the urine. Urea is the body's principal vehicle for excreting unused nitrogen; water is required to keep it in solution and excrete it. This explains why people who consume a high-protein diet must drink more water than usual.

### **Putting It All Together**

After a normal meal, if you do not overeat, the body handles the nutrients in the following fashion.

- The carbohydrate yields glucose; some is stored as glycogen, and some is taken into brain and other cells and broken down through pyruvate and acetyl CoA to provide energy.
- The protein yields amino acids, and some are used to build body protein. However, if there is a surplus or if not enough carbohydrate and fat are present to meet energy needs, some amino acids are broken down through the same pathways as glucose to provide energy.
- The fat yields glycerol and fatty acids; some are put together and stored as fat, and others are broken down to acetyl CoA and provide energy.
- A few hours after the meal, the stored glycogen and fat begin to be released from storage to provide more glucose, glycerol, and fatty acids to keep the energy flow going.
- When all the energy supplied from the last meal has been used up and reserves of these compounds are running low, it is time to eat again.

The average person consumes more than a million kcalories a year and expends more than 99 percent of them, maintaining a stable weight for years on end. This remarkable achievement, which many people manage without even thinking about it, could be called the economy of maintenance. The body's energy budget is balanced. Some people, however, eat too little and get thin; others eat too much and get fat. The possible reasons why they do are explored in Session 7; the metabolic consequences are discussed here.

### **The Economy of Feasting**

The following will show how metabolism favors fat formation when you eat too much of any energy nutrient.

- Surplus carbohydrate (glucose) is first stored as glycogen, but there is a limit to the capacity of the glycogen-storing cells. Once glycogen stores are filled, the overflow is routed to fat. Fat cells enlarge as they fill with fat, and the body's fat-storing capacity seems to be able to expand indefinitely. Thus excess carbohydrate can contribute to obesity.
- In the same way, surplus dietary fat can contribute to the fat stores in the body. It may break down to fragments such as acetyl CoA, but if energy flow is already rapid enough to meet the demand, these fragments will not be broken down further. Instead, they will be routed to the assembly of triglycerides and stored in the fat cells.
- Finally, surplus protein may encounter the same fate. If not needed to build body protein or to meet present energy needs, amino acids will lose their nitrogens and be converted through the intermediates, pyruvate and acetyl CoA, to triglycerides. These, too, swell the fat cells and increase body weight.

### **The Economy of Fasting**

Even when you are asleep and totally relaxed, the cells of many organs are hard at work spending energy. In fact, the work that you are aware of, that you do with your muscles during waking hours represents only about a third of the total energy you spend in a day. The rest is the metabolic work of the cells, for which they constantly require fuel.

The body's top priority is to meet these energy needs, and its normal way of doing so is by periodic refueling – that is, by eating. When food is withdrawn, the body must find other fuel sources in its own tissues. If people choose not to eat, we say they are fasting; if they have no choice (as in a famine), we say they are starving; but there is no metabolic difference between the two. In either case the body is forced to switch to a wasting metabolism, drawing on its reserves of carbohydrate and fat and, within a day or so, on its vital protein tissues as well.

Fuel must be delivered to every cell. As the fast begins, glucose from the liver's stored glycogen and fatty acids from the body's stored fat are both flowing into cells, breaking down to yield acetyl CoA, and delivering energy to power the cells' work. Several hours later, however, most of the glucose is used up, and the liver glycogen is being exhausted.

At this point, most of the cells are depending on fatty acids to continue providing their fuel. But the brain cells cannot; they still need glucose. (It is their major energy fuel, and even if other energy fuel is available, glucose has to be present to permit their energy-metabolizing machinery to work.) Normally the nervous system (brain and nerves) consumes about two-thirds of the total glucose used each day – about 400 to 600 kcalories' worth.

The brain's special requirement for glucose poses a problem for the fasting body. The body can use its stores of fat, which may be quite generous, to furnish most of its cells with energy, but for the brain and nerves it must supply energy in the form of glucose. This is why body protein tissues, such as muscle, always break down to some extent during fasting. Only those amino acids that yield 3-carbon pyruvate can be used to make glucose; and to obtain them, whole proteins must be broken down. The other amino acids, that cannot be used to make glucose, then have to be disposed of. This is an expensive way to gain glucose, but to extract a molecule of glycerol from a triglyceride obligates the body to dispose of some 50 or 60 carbons' worth of fatty acids, which is even more expensive. In the first few days of a fast, body protein provides about 90 percent of the needed glucose, and glycerol about 10 percent. If body protein loss were to continue at this rate, death would ensue within three weeks.

As the fast continues, the body adapts by producing an alternate energy source, ketones, by condensing together Acetyl-CoA fragments derived from fatty acids. Normally produced and used in only small quantities, ketones can serve as fuel for some brain cells. Ketone production rises until, at the end of several weeks, it is meeting about half or more of the nervous system's energy needs. Still, many areas of the brain rely exclusively on glucose, and body protein continues to be sacrificed to produce it.

### **Ketone (KEE-tone)**

A ketone is a compound formed during the incomplete oxidation of fatty acids. Ketones contain a C=O group between other carbons; when they also contain a COOH (acid) group, they are called keto-acids. Small amounts of ketones are a normal part of the blood chemistry, but when their concentration rises, they spill into the urine. The combination of high blood ketones (ketonemia) and ketones in the urine (ketonuria) is termed ketosis.

### **Fasting**

Living on (body) fat and (body) protein.

### **Fasting (early)**

Protein is supplying glucose. Amino acids that can't generate glucose are degraded for energy.

### **Fasting (late)**

Protein breakdown supplies some glucose for the brain. Ketone production helps to support brain function.

### **Low-Carbohydrate Diet**

Living on (dietary and body) fat and protein almost exclusively.

### **Juice Fasting**

Living on (dietary) carbohydrate and (body) fat.

### **Protein-Sparing Fast**

Living on (dietary) protein, (body) fat, and (body) protein.

### **Caution:**

During fasting, appetite is suppressed. It has been thought that ketosis caused loss of appetite. The theory was that it would be an advantage to a person in a famine to have no appetite, because the search for food would be a waste of energy. When the person finds food and eats carbohydrate again, the body shifts out of ketosis, the hunger center gets the message that food is again available, and appetite returns. This hypothetical chain of events has served as justification for weight-loss routines, such as fasting and fad diets, that cause ketosis. However, it may be that any kind of food restriction, with or without ketosis, leads a person to adapt by losing appetite. An ordinal low-kcalorie diet can induce the same effect.

While the body is shifting to the use of ketones, it simultaneously reduces its energy output and conserves both its fat and lean tissue. As the lean (protein-containing) organ tissue shrinks in mass, it performs less metabolic work, reducing energy needs. As the muscles waste, they do less work, enhancing this effect. Because of the slowed metabolism, the loss of fat falls to a bare minimum – less, in fact, than the fat that would be lost on the low-kcalorie diet. Thus, although weight loss during fasting may be quite dramatic, fat loss may be less than when at least some food is supplied.



The adaptations just described – slowing of energy output and reduction in fat loss – occur in the starving child, the fasting religious person, and the malnourished hospital patient, and help to prolong their lives. The physical symptoms of marasmus include:

- Wasting
- Slowed metabolism
- Lowered body temperature
- Reduced resistance to disease

The body's adaptations to fasting are sufficient to maintain life for a long period. Mental alertness need not be diminished, and even physical energy may remain unimpaired for a surprisingly long time. Still, fasting is not without its hazards, as physician-supervised fasting has revealed. Among the multitude of changes that take place in the body are:

- Sodium and potassium depletion
- An increase in body uric acid
- A rise in blood cholesterol
- A decrease in thyroid hormone

The same alternations are seen in low-carbohydrate dieting. Renewed food intake, especially of carbohydrate, results in dramatic changes in the body's salt and water balance, accounting for most of the wide swings in body weight seen in people on fasts or low-carbohydrate diets.

### **The Low-Carbohydrate Diet**

An economy similar to that of fasting prevails if a low-carbohydrate diet is consumed. Advocates of the low-carbohydrate diet would have you believe there is something magical about ketosis, something that promotes faster weight loss than a regular low-kcalorie diet. In fact, the low-carbohydrate diet presents the same problem as a fast. Once the body's available glycogen reserves are spent; the only significant remaining source of energy in the form of glucose is protein. The low-carbohydrate diet provides a little protein from food, but some must still be taken from body tissue. The onset of ketosis is the signal that this wasting process has begun.

In a diet that provides fewer than about 900 kcalories (for the average-sized adult), it is pointless to supply any protein at all, because the protein will only be used to provide energy, as carbohydrate would be used. Body protein is lost at the same rate in adults on such a diet whether or not they are given any food protein.

#### **Caution:**

One conclusion to draw from this is that a person who diets at the level of 900 kcalories a day might as well eat carbohydrate without protein, to spare body protein and allow efficient use of body fat. Carbohydrate-containing foods are less expensive than protein-rich foods, and both will serve the same purpose – supplying glucose. This is the choice made by the person on a juice fast, for the only energy nutrient juices contain is carbohydrate. But a wise conclusion is that such a diet is unnecessarily low in kcalories, even dangerously so. The person who wishes to lose body fat will select a balanced diet of 1,200 or more kcalories, one containing carbohydrate, fat, and protein. At this level, body protein will be spared, ketosis need not occur, vital lean tissues (including both muscle and brain) will not starve, and only the unwanted fat will be lost.

People are attracted to the low-carbohydrate diet because of the dramatic weight loss it brings about within the first few days. They would be disillusioned if they realized that much of this weight loss is a loss of glycogen and protein, and with them, quantities of water and important minerals. A dieter who boasts of losing seven pounds in two days on a low-carbohydrate diet must be unaware that at best, a pound or two is fat and five or six pounds are lean tissue, water, and minerals. Once "off" the diet, the dieter's body will avidly devour and retain these needed materials, and the weight will zoom back to within a few pounds of the starting point.

A warning is suggested by these facts. Beware of those who promote quick-weight-loss schemes. Learn to distinguish between loss of fat and loss of weight.

### **The Protein-Sparing Fast**

A variant on fasting is the technique of ingesting only protein. The hope is that the protein will spare lean tissue and that the person will break down his own body fat at a maximal rate to meet his other energy needs. The protein, together with the body's lean tissues, are used to provide glucose. The idea sounded good when it was first suggested for use with very obese people, but it has met with mixed results. It seems effective only after considerable lean tissue has already been lost, at which time the body may be conserving itself quite efficiently anyway, and the fast has not been shown more effective than a mixture of protein and carbohydrate. Furthermore, it doesn't seem to "stick" very well; most people regain the lost weight.

Thus the protein sparing fast has to be judged at best a very moderate success and at worst a failure, for the ultimate criterion of success in any weight-loss program is maintenance of the new low weight.

The idea of a protein sparing fast originated with some responsible physicians who experimented carefully with it, using whole foods naturally rich in protein, such as fish and lean beef. Unfortunately, the idea was then seized upon and misused with the publication of a popular book, *The Last Chance Diet*, in 1977. Fad dieters, usually without any medical supervision, drank liquid protein potions prepared from low-quality sources, and lost dramatic amounts of weight – including, of course, lean tissue, water, and vital minerals. These “predigested” liquid proteins are of “notably lower quality” than food proteins, and cause dangerous alterations in heart rhythm. Within the year, 11 deaths had been ascribed to the fast, and the FDA had issued a stringent warning about liquid protein preparations. Since then, many more have died on the fast, due to sudden stopping of the heart caused probably by mineral losses.

The term protein sparing has also been used in another connection. Malnourished hospital patients also lose body protein, and this is especially likely, and especially dangerous, if they are simultaneously fighting infection. Physicians make every effort to prevent the loss of vital lean tissue by supplying amino acids as well as glucose in some form – through a vein if the patient can’t eat. The effort to provide protein-sparing therapy in these circumstances should not be confused with the profiteering of faddists who promote the protein sparing fast.

### **Moderate Weight Loss**

The body’s cells and the enzymes within them make it their task to convert the energy nutrients you eat into those you need. They are extraordinarily versatile. They relieve you of having to compute exactly how much carbohydrate, fat, and protein to eat at each meal. As you have seen, they can convert either carbohydrate (glucose) or protein to fat. To some extent, they can convert protein to glucose. To a very limited extent, they can even convert fat (the glycerol portion) to glucose. But a grossly unbalanced diet or one that is severely limited in kcalories imposes hardships on the body. If kcalorie intake is too low or if carbohydrate and protein kcalories are undersupplied, the body is forced to degrade its own lean tissue to meet its glucose need.

Someone who wants to lose body fat must reconcile himself to the hard fact that there is a limit to the rate at which this tissue will break down. The maximum rate, except for a very large, very active person, is one to two pounds a week. To achieve weight loss that actually reflects body-fat loss, the most effective means is to adopt a balanced, low-kcalorie diet supplying all three energy nutrients in reasonable amounts while increasing energy expenditure by getting more exercise. In effect, this means adjusting the energy budget so that intake is 500 to 1,000 kcalories per day less than output. A person who wants to gain weight needs to make the opposite adjustment.

It might seem that the effort to lose or gain weight would involve tedious counting of kcalories, but this is not the case. The next two sections show how kcalorie input and kcalorie output can be estimated and balanced to achieve weight loss, gain, or maintenance.

### **Low-Kcalorie Diet**

Living on food and body fat

#### **1 Pound = 3,500 kcalories**

A pound of body fat (adipose tissue) is actually composed of a mixture of fat, protein, and water and yields 3,500 kcalories on oxidation. A pound of pure fat (454 grams) would yield 4,086 kcalories at 9 kcalories per gram.

### **Calorimetry (cal-o-RIM-uh-tree)**

A calorimetry is the measurement of energy as heat.

Calor = heat

Metron = measure

- 1 gram carbohydrate = 4 kcalories
- 1 gram fat = 9 kcalories
- 1 gram protein = 4 kcalories
- 1 gram alcohol = 7 kcalories

### **Direct Calorimetry**

When an organic substance such as food is burned, the energy in the chemical bonds that held its carbons and hydrogens together is released in the form of heat. The amount of heat released can be measured; this direct measure of the amount of energy that was stored in the food’s chemical bonds is termed direct calorimetry.

## Indirect Calorimetry

As the chemical bonds in food are broken the carbons (C) and hydrogens (H) combine with oxygen (O) to form carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O). Measuring the amount of oxygen consumed in the process gives an indirect measure of the amount of energy released termed indirect calorimetry.

## Estimating kCalorie Intake from Food

To find out how many kcalories are in food, a laboratory scientist can burn the food in a bomb calorimeter. This device can reveal kcalorie values in two ways. Either it directly measures the heat given off (and kcalories are units of energy defined in terms of heat) or it measures the amount of oxygen consumed in the burning, an indirect measure of the kcalories produced.

The number of kcalories in a food as determined by direct calorimetry, however, is higher than the number of kcalories that same food would give to the human body. This apparent discrepancy is explained by the fact that the body does not metabolize all the food all the way to carbon dioxide and water as the calorimeter does. When the calorimeter-derived values are corrected for this discrepancy, they state accurately the number of kcalories a food provides to the body, thus permitting researchers to make useful tables presenting the energy values of foods.

Another way to arrive at food energy values is to compute them from the amounts of protein, fat, and carbohydrate (and alcohol, if present) found in them.

But looking up every food in kcalorie charts is boring and inconvenient, and only the most motivated will persist at it for long. For the rest of us who may want to keep track of kcalories, some acquaintance with and exchange system, provides a simpler method. With some practice, you can look at any plate of food and “see” the number of kcalories on it. Only seven values need to be learned as a start towards gaining this new skill.

### Food kCalorie Values

1 c skim milk (for whole milk, add 2 fat)	80 kcal
½ c vegetable	25 kcal
1 portion fruit	40 kcal
1 portion bread or starchy vegetable	70 kcal
1 oz lean meat (for medium-fat meat add ½ fat) (for high-fat meat add 1 fat)	55 kcal
1 fat (1 tsp. fat or oil)	45 kcal
1 tsp. sugar	20 kcal

### **Caution:**

Before leaving the subject of the energy in food it is only fair to mention another way of thinking about energy in relation to food. We normally ask, “How many kcalories are in that food?” Dr. Jean Mayer, formerly professor of nutrition at Harvard School of Public Health, has pointed out that the average consumer in the United States uses three times as much energy to bring food to the table as the average citizen of developing countries uses for all purposes. It’s a complicated thought, because more than just electric or gas heat in your kitchen goes into the production of a food. Foods that cost little energy in your kitchen may cost incredible amounts of energy in the field or in processing.

Along the same lines, the nutrition educator Dr. Isobel Contento suggests that we should be teaching people to understand the “energy costs, ecological consequences, and moral implications of their food choices; to analyze the impact of the food system on society as a whole; and to act self-reliantly in providing nourishing meals for themselves and others.” In view of the contrast between a third world in which starvation is rampant, and the domestic scene in which the aluminum container for a 1-kcalorie diet soda costs 400 kcalories to produce, perhaps our awareness does indeed need to be raised.

## Estimating kCalorie Output by the Body

Counting the kcalories in your food tells you your energy income, but to balance your budget you also need to know your expenditure. How can you count the kcalories you expend in a day? One way is to assume you are a “typical citizen” of the United States or Canada, and to use the numbers their governments use as standards for population studies.

### Government Recommendations

The U.S. Committee on RDA and the Canadian Ministry of Health and Welfare have published recommended energy intakes for various age-sex groups in their populations. These are useful for population studies, but the range of energy needs for any one group is so broad that it is impossible even to guess an individual's need from them without knowing something about the person's lifestyle. The U.S. recommendation for a woman, for example, assumes she is 20 years old, 5 feet 4 inches tall, weighs about 120 pounds, and typically engages in light activity. A woman who fits all these descriptors is said to need between 1,700 and 2,500 kcalories a day to maintain her weight. The man used, as a reference figure is 20 years old, 5 feet 10 inches tall, weighs 154 pounds, engages in light activity, and need 2,500 to 3,300 kcalories a day. Taller people need proportionately more and shorter people proportionately fewer, kcalories to balance their energy budgets. Older people generally need fewer kcalories, with the number diminishing about 5 percent per decade beyond 30. Light activity, for both women and men, means sleeping or lying down for eight hours a day, sitting for seven hours, standing for five, walking for two, and spending two hours a day in light physical activity.

Although very few people fit these descriptions exactly, most fall close to the mean. The total span of needs is broad. For adults it is believed that an 800-kcalorie range covers most individuals, but some have energy needs outside this range. Clearly, it is impossible to pinpoint any person's energy need within such a wide range without knowing more.

### 530 Kcalorie Meal

1 c milk (80) plus 2 fat (90)	170 kcal
½ c beans	25
1 small potato (1 starchy vegetable)	70
1 pat butter (1 fat)	45
4 oz fish (4 lean meat, assuming no fat is added), at 55 kcal/oz	220
Lemon wedge	0
<b>TOTAL KCAL:</b>	<b>530 kcal</b>

### Diet Record Method

To obtain an individualized estimate of your energy needs, the best means would be to monitor your food intake and body weight over a period of time in which your activities are typical of your lifestyle. If you keep a strictly accurate record of all the food and beverages you consume for a week or two, and if your weight does not change during that time, you can assume that your energy budget is balanced. Records have to be kept for at least a week, however, because intakes fluctuate from day to day. (On about half the days you eat less, on the other half more, kcalories than the average.) If during a week you gain a pound of fat, you can deduce that you expended 3,500 kcalories less than you consumed, or an average of 500 kcalories per day for the seven days.

### Energy Balance: Weight Loss and Gain

In the average person, a deficit of 500 kcalories a day brings about loss of body fat at the rate of a pound a week; of 1,000 kcalories, two pounds a week. Extraordinarily active people, by virtue of their high-energy expenditures, or extremely obese persons, by virtue of the metabolic demands made by the sheer bulk of their body cells and the energy cost of moving their bodies, can lose weight faster. For those who are only moderately obese, the maximum possible rate of fat loss is one to two pounds a week, which for most people means an intake of about 1,000 to 1,500 kcalories a day. Below 1,200, the dieter will be losing lean tissue, and at such a restricted kcalorie level, the diet planner is hard put to achieve adequacy for all the vitamins and minerals. (The person of below-average height will need to adjust these numbers in proportion to his or her height.)

These principles are simple, but putting them into practice is more difficult than you might imagine. Obesity and underweight are complex problems with social and psychological ramifications, as well as the metabolic ones just described. The next session deals with the factors that contribute to the problems of overweight and underweight and then provides some practical pointers for the person who wants to lose or gain weight.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 7:**

### **• Overweight and Underweight**

Obesity is a major malnutrition problem. It is one of the most important and least understood areas in the science of nutrition. Everyone knows roughly what it is. If you are too fat, you are overweight; if much too fat, you are obese. But why and how obesity occurs and what can be done about it are matters for much speculation, debate, and frustration. For the obese person who has earnestly tried every known means of losing weight only to fail, frustration can turn to despair.

Less well recognized is the problem of underweight, which can be equally mysterious. A “skinny” person finds it hard to gain a pound as a fat person does to lose one.

This session emphasizes the problems of overweight and obesity, partly because they have been more intensively studied and partly because they are a more widespread health problem in the developed countries. This does not imply that the underweight person faces a less difficult problem. The concluding section shows that what we know about the one extreme sometimes applies equally well to the other. Two subjects are not covered fully in this session but are reserved for Session 14: anorexia nervosa and bulimia.

Overweight and underweight both result from unbalanced energy budgets. The overweight person has consumed more food energy (kcalories) than he has expended and has banked the surplus in his fat cells. The underweight person has not consumed enough and so has depleted his fat stores. Energy itself doesn't weight anything and can't be seen, but when it exists in the form of chemical bonds in nutrients or body fat, the material that it holds together is both heavy and visible.

The amount of fat you might deposit or withdraw from “savings” on any given day depends on your energy balance for that day – the amount you consume (energy-in) versus the amount you expend (energy-out). As Session 6 shows, you can reduce your fat deposits by withdrawing more energy from them than you put in. A pound of body fat stores 3,500 kcalories. To lose a pound of body fat you must experience a deficit; you must take in 3,500 kcalories less than you expend. To lose that pound in a week, you need to achieve an average deficit of 500 kcalories a day.

### **Ideal Weight**

Ideal weight is a misnomer; not the desirable but the average weight given in insurance tables for persons of a given sex and height in the United States – not necessarily ideal for a given individual.

### **Fatfold Test**

A fatfold test is a clinical test of body fatness in which the thickness of a fold of skin on the back of the arm (triceps), below the shoulder blade (subscapular), or in other places is measured with an instrument called a caliper. The older, less preferred, term for this is skinfold test.

### **Frame Size**

The frame size is the size of a person's bones and musculature. A person with a large frame should weight more than one with a small frame.

### **Ideal Weight and Body Fatness**

How fat is too fat? And how thin is too thin? It isn't always possible to tell from the bathroom scales, because body weight says nothing about body composition. The relative amounts of lean and fat tissue vary widely from one person to the next. A dancer or an athlete, whose muscles are well developed and whose bones have become dense from constant stress, may weigh much more than a sedentary person with a similar figure. What is needed is a measure of body fatness – not of body weight. Ideally, by a very rough approximation, fat makes up about 18 percent of a man's body weight and about 22 percent of a woman's, with the remainder contributed by water (55 to 60 percent), muscle and other lean tissue (10 to 20 percent), and bone minerals (6 to 8 percent). But there is no easy way to look inside a person to see the bones and muscles.

Several laboratory techniques for estimating body fatness have been developed. One way is to determine the body's density (weight compared with volume). Lean tissue is denser than fat tissue, so the more dense a person's body is, the more lean tissue it must contain. Weight is easy to measure with a scale, but volume measurement involves submerging the whole body in water and measuring the amount of water displaced; this requires a large tank and takes up too much space to be practical for use in say, a doctor's office. Another way is to inject a water-soluble substance that is easy to detect and measure, and allow it to penetrate into the lean tissue (it will not mix into the fat tissues). A blood sample taken soon after will show the extent to which the substance has been diluted, providing an estimate of the amount of lean tissue.

A direct measure of the amount of body fat can be obtained by lifting a fold of skin from the back of the arm, from the back, or from other body surfaces and measuring its thickness with a caliper that applies a fixed amount of pressure. The fat under the skin in these regions is roughly proportional to total body fat. A fold over an inch thick indicates overfatness; under a half-inch reflect underweight. This technique – the fatfold test – is a practical diagnostic tool in the hands of trained people and is in increasingly wide use.

A still simpler test is the mirror test. Undress and stand before a mirror. If you look too fat, you may be too fat. (A notoriously poor judge of this, however, is the teenage girl, who often thinks any amount of fat, no matter how small, is a serious blemish. It may be that she needs to change her self-image – not to go on a diet.)

The scales are not necessarily an accurate indicator of body fatness, then, but you most probably use them anyway. After weighing yourself, you turn to the tables published by the insurance companies. You then discover that for a person your height and sex, three weight ranges are suggested: one for a small frame, one for medium, and one for large. Don't forget your shoes: you are assumed to be wearing one-inch heels. (Thus a person who stands 5 feet 10 inches tall in bare feet would look up the range for a person 5 feet 11 inches.) Finally, if you weigh yourself nude, you must adjust for clothing (the tables assume 5 pounds for clothes). All these steps involve a lot of guesswork. How do you decide on your frame size, for example?

### How to Determine Your Body Frame by Elbow Breadth

To make a simple approximation of your frame size: Extend your arm and bend the forearm upward at a 90-degree angle. Keep the fingers straight and turn the inside of your wrist away from the body. Place the thumb and index finger of your other hand on the two prominent bones on either side of your elbow. Measure the space between your fingers against a ruler or a tape measure. Compare the measurements with the following standards.

These standards represent the elbow measurements for medium-framed men and women of various heights. Measurements smaller than those listed indicate you have a small frame and larger measurements indicate a large frame.

	Men	
Height in 1-in Heels		Elbow Breadth
5 ft 2 in to 5 ft 3 in		2 ½ to 2 7/8 in
5 ft 4 in to 5 ft 7 in		2 5/8 to 2 7/8 in
5 ft 8 in to 5 ft 11 in		2 ¾ to 3 in
6 ft 0 in to 6 ft 3 in		2 ¾ to 3 1/8 in
6 ft 4 in and over		2 7/8 to 3 ¼ in
	Women	
Height in 1-in Heels		Elbow Breadth
4 ft 10 in to 4 ft 11 in		2 ¼ to 2 ½ in
5 ft 0 in to 5 ft 3 in		2 ¼ to 2 ½ in
5 ft 4 in to 5 ft 7 in		2 3/8 to 2 5/8 in
5 ft 8 in to 5 ft 11 in		2 3/8 to 2 5/8 in
6 ft 0 in and over		2 ½ to 2 ¾ in

After finding the applicable weight, you have to apply the most important judgment factor of all. Ask yourself whether the weight range you have singled out is really ideal for you. At what weight are you most healthy? Does your family tend to be most healthy at the heavier, or lighter, end of the weight ranges? A recent reinterpretation of the insurance company statistics suggests that many people are healthiest at weight slightly above those thought to be ideal in the past.

Ideal weight probably changes with age. Many people typically become less active as they grow older. Their muscles get smaller, and their bones decrease in density. Thus a person who at 25 was lean and muscular might weight the same at 65 and yet have become considerably fatter. Such a person should either gradually lose weight as time goes on or, preferably, maintain a program of vigorous physical activity to preserve muscle mass and bone strength. Not much is known about ideal weights at older ages, but clearly, people do tend to gain about 20 to 30 pounds during adulthood. Perhaps for a person who maintains muscle mass, this weight gain may be consistent with good health if it does not precipitate high blood pressure.

With all their limitations, the weight tables are often used to draw arbitrary lines between too much and too little body weight. A person who is more than 10 percent above the weight on the table is considered overweight; if 20 percent or more, obese. (Some authorities say obesity is 15 percent above the table weight, some say 25 percent.) Similarly, a person who is more than 10 percent below the table weight is considered underweight.

### **Overweight**

Overweight is when body weight is more than 10 percent above average (insurance company table) weight.

### **Obesity**

Obesity is excessive body fatness; often loosely defined as a condition of being overweight by 15 or 20 percent or more.

### **Underweight**

Underweight is when body weight is more than 10 percent below normal or average weight.

### **Juvenile-Onset Obesity**

This is obesity arising in childhood; also called developmental obesity.

### **Adult-Onset Obesity**

This is obesity arising after adolescence; sometimes called reactive obesity if it appears to arise in response to a specific traumatic life event.

### **The Problem of Obesity**

However you define it, obesity does occur to an alarming extent and is increasing in the developed countries. For example, in the United States some 10 to 25 percent of all teenagers and some 25 to 50 percent of all adults are obese.

Some people become fat in childhood, and others later on. Few of either type lose the excess weight. There is no specific age that divides juvenile-onset obesity from adult-onset obesity, but as the terms imply, there is a distinction between the two types. A child who is obese will develop sturdy muscles and bones as she grows, to support her excess weight. Thus as an adult she will have more lean body mass and more body fat than the average person and will likely always be stocky, even after losing her excess fat. People who become obese, as children are also less likely to be able to reduce successfully than people whom become obese as adults.

Research on fat cells suggests a possible reason why early-onset obesity is especially resistant to treatment. Simply stated, early overfeeding is thought by some researchers to stimulate fat cells so that they increase abnormally in number. The number of fat cells is thought to become fixed by adulthood; if it is, then a gain in weight thereafter can take place only through and increase in the size of the fat cells. A person with an abnormally large number of fat cells is thought likely to be abnormally hungry and to overeat for that reason. On the other hand, a person who gains weight in adulthood supposedly has a normal number of fat cells and needs only to reduce the size of the cells.

This theory has been heavily criticized on several groups. Fat cells are hard to count, and researchers disagree as to whether new cells are being formed at certain periods or small, empty fat cells are being recruited as new storage cells. Even the critics agree, however, that there are certain periods in life when body fat increases more rapidly than lean tissue: early infancy (up to about two years), again during preadolescence (and throughout adolescence in girls), and possibly again during the third trimester of pregnancy. These are critical periods, in the sense that some developmental events that take place at these times are irreversible. Prevention of obesity would be most important during these times. There is also agreement that fat is hard to lose no matter when it is gained.

### **Hazards of Obesity**

Insurance companies report that fat people die younger from a host of causes including heart attacks, strokes, and complications of diabetes. In fact, gaining weight often appears to precipitate diabetes. Fat people more often suffer high levels of blood fat, hypertension, coronary heart disease, post-surgical complications, gynecological irregularities, and the toxemia of pregnancy. The burden of extra fat strains the skeletal system, causing arthritis – especially in the knees, hips, and lower spine. The muscles that support the belly may give way, resulting in abdominal hernias. When the leg muscles are abnormally fatty, they fail to contract efficiently to help blood return from the leg veins to the heart; blood collects in the leg veins, which swell, harden, and become varicose. Extra fat in and around the chest interferes with breathing, sometimes causing severe respiratory problems. Gout is more common and even the accident rate is greater for the severely obese.



Beyond all these hazards is the risk incurred by millions of obese people throughout much of their lives – the risk of ill-advised, misguided dieting. Some fad diets are more hazardous to health than obesity itself. One survey of 29,000 claims, treatments, and theories for losing weight found fewer than 6 percent of them effective – and 13 percent dangerous.

Once a person becomes obese, the situation tends to perpetuate itself. When fat cells enlarge, they become sluggish in responding to insulin, the hormone that promotes the making and storage of fat. The excess glucose remains in the bloodstream longer than normal and stimulates the insulin-producing cells of the pancreas to multiply and secrete more insulin. When the fat cells finally respond, they store more fat than normal in response to the raised insulin level. As if this were not enough, the enlarged fat cells are also less sensitive to other hormones that promote fat breakdown. Weight loss restores insulin levels to normal, but it first has to be achieved against these odds.

Not only physical but also social and economic disadvantages plague the fat person, who is less often sought after for marriage, pays higher insurance premiums, meets discrimination when applying for a job, can't find attractive clothes so easily, and is limited in choice of sports. Fat girls have only a third the chance of being accepted into college than lean girls have. The fat child often suffers ridicule from his classmates and the unbearable humiliation of having the captain choose him last for the team.

The many disadvantages justify our calling obesity a severe physical handicap. However, it is unlike other handicaps in two important ways. First, mortality risk is not linearly related to excess weight. Instead, there is a threshold at which risk dramatically increases. Being only a few pounds above this threshold weight may cause blood pressure, blood glucose, and blood lipids to zoom upwards. Second, obesity is reversible, and if it is corrected in time, some of its risks are, too. Mortality rates (from insurance data) are no higher for the formerly obese than for the never obese.

Ideally a person would never have to struggle with the problem of obesity, because he would never have become obese to begin with. Preventive efforts are needed, especially in vulnerable groups: infants, preadolescents, adolescents, and women before they are pregnant. (This is in no way meant to imply that a woman who is pregnant should attempt to lose weight. Weight loss during pregnancy requires skilled medical supervision if it is done at all.) Where prevention has failed, treatment is urgently needed. But how to treat? Before turning to the matters of diet, drugs, exercise, and other means of attacking the problem, it is necessary to try to figure out what causes obesity.

### **“Pull” versus “Push” Theories of Obesity**

The “pull” theory of obesity proposes that a subtle disorder inside the person increases food intake either by affecting signals transmitted to a “satiety center” or by altering the sensitivity of the satiety center to such signals. The “push” theory proposes that the obese person “force-feeds” himself, over-eating for non-physiological reasons.

### **Longitudinal Study**

A longitudinal study is one in which the subjects are studied over time – for example, in 1960 and again in 1970 and in 1980.

### **Causes of Obesity**

Kcalories are not stored in fat until the body's energy needs have been met. Excess body fat can accumulate only when kcalories are eaten beyond those needed for the day's metabolic, muscular, and digestive activities. To put it bluntly, obesity results from overeating.

In fact, however, this statement neither explains the cause of obesity nor suggests a cure. Why do people overeat? Is it a hunger problem? An appetite problem? A satiety problem? Is it genetic? Metabolic? Environmental? Is it a matter of habits learned in early childhood? Is it psychological? Might all these facts play a role? To tell the truth, we do not know the cause.

In general, two schools of thought address this problem. One attributes it to inside-the-body causes the other to environmental factors. One currently popular inside-the-body theory is the so-called set-point theory. Noting that many people who lose weight on reducing diets subsequently return to their original weight, some researchers have suggested that the body “wants” to maintain a certain amount of fat and regulates eating behaviors and hormonal actions to defend its “set point.” While this theory is compelling in its simplicity, there is at present little scientific evidence supporting its reality in humans.

The other point of view is that obesity is environmentally determined. Proponents of this view hold that we overeat because we are pushed to do so by factors in our surroundings – foremost among them, the availability of a multitude of delectable foods. The two views are not mutually exclusive, and research with animals suggests that both are possible. Some obesity may arise from one, some from the other, cause. The two possibilities were humorously illustrated years ago by two obesity researchers (the “pull” versus “push” theories of obesity definition above); there is no reason why they should not both be operating, even in the same person.

The inside-the-body idea is supported by the fact that animal strains do exist that are genetically fat, and they tend to be fat in any environment – that is, no matter what kind or variety of food is offered. The environmental obesity model is supported by experiments with “cafeteria rats.” Ordinary rats, fed regular rat chow, are of normal weight (for rats), but if those very same rats are offered free access to a wide variety of tempting, rich, highly palatable foods, they greatly overeat and become obese.

It seems likely that both environmental and hereditary factors influence obesity in humans. The average adult in our society gains about 30 pounds between the ages of 20 and 50, but people in non-Western societies do not. This suggests that all people may have inherited the capacity or tendency to gain weight, but that our surroundings have allowed it to be realized, while conditions in other countries prevent it.

One way to test whether human obesity is inherited is to study identical twins raised in different families, one family fat and the other thin. If genes determine fatness, then both twins will become equally fat or thin. But if the environment is responsible, the twins will resemble their respective families. Another approach is to study adopted children, to see whether they resemble their natural or adoptive parents. Studies of both kinds suggest that the tendency to obesity is inherited, but that the environment is influential in the sense that it can prevent or permit the development of obesity when the potential is there.

Inheritance of the tendency to obesity is probably very complex and governed by many different genes. To complicate the situation further, these genes probably occur with different frequencies in different populations.

A related question is, “Do fat babies become fat adults?” Ten years ago, most nutrition experts might have answered “Yes (probably).” Today, however, the results of several longitudinal studies are available that suggest the answer “Not necessarily; some do, some don’t.” Clearly, not all fat babies are fated to become fat adults; many grow up elegantly thin. Nor is a thin baby immune to becoming fat later on.

Still, if obesity is not programmed in by inheritance or by early, critical developmental events, it nonetheless seems to persist from childhood in many instances. Many researchers have the impression that early food habits exert a powerful influence on lifelong tendencies to overeat. Food centered families encourage such behaviors as overeating at mealtimes, rapid eating, excessive snacking, and eating to meet needs other than hunger. Children readily imitate overeating parents, and their behavior at the table tends to persist outside the home. Obese children have been observed to take more bites of food per interval of time and to chew them less thoroughly than their nonobese schoolmates.

People who eat small but frequent meals may tend to store less fat than those who eat large meals at irregular intervals. Thus families that allow their children to skip meals may be promoting obesity.

## **Hunger**

Hunger is the physiological need to eat; a negative, unpleasant sensation.

## **Appetite**

Appetite is the desire to eat, which normally accompanies hunger; by itself a pleasant sensation.

## **Satiety (sat-EYE-uh-tee)**

Satiety is the feeling of fullness or satisfaction at the end of a meal, which prompts a person to stop eating.

## **Glucostatic Theory**

This is a theory of hunger regulation: the theory that blood levels of glucose determine when people eat.

Glucose = glucose

Stasis = staying the same

## **Lipostatic Theory**

This is a theory that the body’s total fat stores are fixed and that when they are depleted, eating behavior is turned on.

Lipo = fat

## **Purinergetic Theory**

This is a theory that circulating purines regulate eating behavior.

Erg = driving force

## **Hunger and Appetite Regulation**

Whatever sets the stage for excess fat accumulation, the fat is gained because we put food into our mouths. A vast amount of research has been devoted to finding out what stimulates and governs eating behavior. Why do we start to eat? Why do we eat as much as we do? Why do we stop?

An important distinction was made early between hunger, appetite, and satiety. Hunger is said to be physiological – an inborn instinct – whereas appetite is psychological – a learned response to food. The two are not the same. We have all experienced appetite without hunger: “I’m not hungry, but I’d love to have a piece.” The too-thin person may often experience the reverse, hunger without appetite: “I know I’m hungry, but I don’t feel like eating.” Hunger is a negative experience (and we may eat in order to avoid it); appetite is positive. As for satiety, which signals that it is time to stop eating, it vies with hunger and appetite for the distinction of being recognized as the primary regulator of eating behavior. One view holds that eating behavior is turned “on” all the time, except when the satiety signal turns it off. But the exact nature of the satiety signal is not known.

The stomach participates in signaling satiety. Nerves responsive to stretch of the stomach wall fire when the stomach is full, transmitting a message to the brain. Even animals without stomachs get hungry, though, so it is clear that an empty stomach is not the only cue to hunger.

Whether hunger, appetite, or satiety regulates eating behavior (and there are other possibilities discussed below), two questions arise. First, what molecular or other messengers make us feel these sensations? Second, where in the body are they received? Many theories have been put forth to answer the first question. The glucostatic theory of hunger regulation proposes that the blood glucose level determines whether we are hungry or sated; the lipostatic theory states that the size of our fat stores dictates how much we eat; and the purinergetic theory proposes that the circulating levels of purines, molecules found in DNA and RNA, govern hunger. Careful measurement of blood levels of glucose show that it does not account for the starting and stopping of eating, however, and glucose researchers are now pursuing the possibility that exhaustion of liver glycogen may somehow convey the signal. “Eat.” If fat stores regulate hunger in some way, the messenger they send to the brain to do so has yet to be identified. As for the purinergetic theory, its proponents confess that they proposed it “somewhat tongue in cheek”; it is new, and the other three are old, familiar, and frustratingly unsatisfactory to account for what is observed.

The theories just described (at least the first two) have been discussed and researched for several decades. Newer ideas as to what molecules might be the regulators of eating behavior include the endogenous opiates and a variety of hormones. It has long been known that the GI tract produces several hormones that serve to notify the pancreas, the gallbladder, and the intestine that food is present and must be dealt with. A flurry of findings during the early 1980” brought forth many reports that these same hormones, now numbering some 20 or 30, are also produced in the brain after meals. Perhaps, in the brain, they signal satiety.

That brings us to the second question: where in the brain are these messages received (whatever they are)? One brain area stands out as a regulator for food behavior – the hypothalamus – but it is not the only one involved. At one time, it was thought that the front-central hypothalamus was the “satiety center,” and that the sides were the “hunger centers.” Now, however, that idea has been exposed as an oversimplification. The hypothalamus integrates many kinds of signals received from the rest of the body, including information about the blood’s temperature, sodium content, and glucose content. It is certainly important in regulating eating, because damage to the hypothalamus produces derangements in eating behavior and body weight – in some cases causing severe weight loss, in others vast overeating. In the person with a normal hypothalamus, however, eating behavior seems to be a response not to a single signal arriving at some one location in the hypothalamus but to a whole host of signals. Somehow these many inputs become integrated into a “final common path” – the act of eating.

## **Thermogenic Theory**

Related to body weight regulation, there is also a thermogenic theory – but this deals with how energy is spent, not how hunger is regulated. The thermogenic theory suggests that the amount of heat generated in response to food determines how much fat is stored.

Thermo = heat

Genic = arising from

## **Cholecystokinin (COAL-ee-sis-to-KINE-in)**

Among the hormones produced in the brain as well as the GI tract after meals are cholecystokinin, the messenger that communicates the arrival of fat to the gallbladder and pancreas, and calcitonin, a hormone that responds to blood calcium levels.

## **Hypothalamus (high-po-THALL-uh-mus)**

The hypothalamus is a brain center that integrates signals about the blood's temperature, glucose content, and other conditions.

## **The Behavior of Eating**

The word behavior has been used many times in this discussion as if it were a simple thing that everybody understands, but the study of behavior offers unique insight into the problem of overeating by viewing it as a conditioned response to a variety of stimuli.

To begin with, certain behavior patterns, whether innate or learned, occur appropriately in response to certain stimuli. For example, dogs salivate in response to the smell of food – but, as everyone knows, they can “learn” (be conditioned) to respond to the same way to the sound of a bell. As another example, an appropriate self-care behavior of animals is grooming, which can involve quite a complex pattern of motions – licking, scratching, nibbling the fur – but grooming behavior can suddenly appear unexpectedly at an inappropriate time. In the midst of a hostile confrontation, for example, one contestant will suddenly stop posturing and begin to groom himself intensively as if the wrong switch had been accidentally pushed. It is possible that people also displace one behavior with another when they are threatened. Rather than grooming, the behavior selected may be eating – and if this response occurs often enough, the consequence is obesity.

Displacement may explain some cases of obesity, but even if it doesn't the view given here is useful. It presents a picture of eating as a sort of package of behavior that can be triggered by any of many different stimuli. Some researchers focus on “external cues” as the triggers; others on “stressors,” with connection to the production of endogenous opiates.

## **Displacement Activity**

Biologists give the name displacement activity to the substitution of one behavior for another under stress.

## **External Cue Theory**

This is the theory that some people eat in response to such external factors as the presence of food or the time of day rather than to such internal facts as hunger.

## **External Cues**

Some obese people are unconscious eaters. Rather than responding only to internal, visceral hunger cues, they seem to respond helplessly to such external factors as the time of day (“It's time to eat”) or the availability, sign, and taste of food. This is the basis of the external cue theory.

Of interest in this connection is the report of an experiment in which lean and fat people were housed in a metabolic ward and were offered their meals in monotonous liquid form from a feeding machine. The lean people ate enough to maintain their weight, but the fat people drastically reduced their food intake and lost weight. When calories were added to the formula, the lean people adjusted their intake to continue maintaining weight as if they had an internal calorie counter. The obese people were unaware of the change, continued drinking the same amount of formula as before, and stopped losing weight. External cues were the only signals the obese people had to go by, and they responded the same way to the same environmental situation, regardless of how many calories they were getting.

For the person who responds to external cues, today's environment provides abundant stimuli to promote eating behavior. Restaurants, TV commercials, the display of food in our markets, vending machines in every office building and gas station – all prompt us to eat and drink high calorie foods. There are no “vegetable houses” on our main streets, only steak houses. Kitchen appliances such as the hamburger cooker and the doughnut maker make high-kcalorie foods easy to prepare and thus quickly available.

## **Arousal**

The term arousal has been used several times. The general meaning is self-evident, but in the sense, in which it is used here, it refers to heightened activity of certain brain centers associated with excitement and anxiety.

## **Stressors and Arousal**

Anything that excites or disturbs the equilibrium of an organism can be termed a stressor. The terms stressor and stress response have specific meanings, but they are being used differently by some researchers today to apply to many of the subjects being discussed here. "Stressors" include pain, anxiety, arousal, excitement, and even the presence of food.

The brain seems to respond to many of these stimuli by producing endogenous opiates. They soothe pain and lessen arousal, and they have two effects on energy balance. They enhance appetite for palatable foods, and they reduce activity. Combine these effects with a tendency to be supersensitive to particular stressors anyway, and you are all the more likely to gain weight in response to stress.

The psychiatrist Dr. Hilde Bruch, who has devoted as much attention to the human hunger drive as Freud did to the sex drive, sees other links between eating behavior and human experience. She states that hunger and appetite are understandably mixed up together because both are intimately connected to deep emotional needs. Two factors that she finds most important in this connection are the fear of starvation and "the universal experience in the early life of every individual that food intake requires the cooperation of another person." Feeding behavior is a response not only to hunger or appetite but also to complex human sensations such as "yearning, craving, addiction, or compulsion."

Others agree that food is widely used for nonnutritive purposes, especially in a culture like ours where food is abundant. An emotionally insecure person might eat as a substitute for seeking love or friendship. Eating is less threatening than calling a friend and risking rejection. Often, especially in adolescent girls, eating is used to relieve boredom or to ward off depression. Some obese people respond to anxiety, or in fact to any kind of arousal, by eating. Significantly, however, if they are able to give a name to their aroused condition, thereby gaining a feeling that they have some control over it, they are not as likely to overeat.

Stress may act in another way to promote obesity. The hormones secreted in response to physical stress favor the rapid metabolism of energy stores (glycogen and fat) to fragments such as glucose and fatty acids that can be used to fuel the muscular activity of fight or flight. Under emotional stress the same hormones are secreted and blood concentrations of these same fuels rise. If a person fails to use the fuel in violent physical exertion, the body has no alternative but to turn many of these fragments to fat. If glucose has been used this way, and transferred into fat, then the lowered glucose level or exhausted glycogen will signal hunger, and the person will eat again soon after.

Stress eating may appear in different patterns; some people eat excessively at night, while others characteristically go on an eating binge during an emotional crisis. The overly thin often react oppositely. Stress causes them to reject food and thus become thinner. It is not yet known why these behaviors occur, but clearly investigations of the chemical, hormonal, and neural mechanisms involved in the body's responses to different stimuli hold much promise for a future understanding of eating behavior.

## **Inactivity**

The many possible causes of obesity mentioned so far all relate to the input side of the energy equation. What about output? A person may be obese because he eats too much, but another possibility is that he spends too little energy. It is probably that the most important single contributor to the obesity problem in our country is underactivity. The control of hunger/appetite actually works quite well in active people and only fails when activity falls below a certain minimum level. Obese people under close observation are often seen to eat less than lean people, but they are sometimes so extraordinarily inactive that they still manage to have a calorie surplus. One authority has noted that normal people actually swim 35 minutes during "an hour of swimming," whereas obese people swim only 7 minutes during that hour. Most of their time is spent sitting, standing, or lying in the sun.

## **Individuality**

No two people are alike either physically or psychologically, and the causes of obesity may be as varied as the people who are obese. Many causes may contribute to the problem in a single person. Given this complexity, it is obvious that there is no panacea. The top priority should be prevention, but where prevention has failed the treatment of obesity must involve a simultaneous attack on many fronts.

## **Treatments of Obesity: Poor Choices**

The only means of reducing body fat is to shift the energy budget so that energy-in is less than energy-out. This is most effectively done by eating less and exercising more. A later section in this session addresses appropriate strategies for losing weight, but because rumors of other means fly about, they will first be dispensed with briefly.

**Caution:**

This cruel fact is one many of you would like to circumvent. Isn't there an easier way? No, the hard truth is that the only way to lose body fat is to eat fewer calories than you spend. Magical alternatives that have been offered time and again over the centuries – ways to “shrink the stomach,” to eat “negative calories,” to “eat all you want and lose weight” – they prove to be born of wishful thinking. They are effective only when they directly affect the calorie balance. The success of these plans is not in their achievements but in their popularity. They sell easily to susceptible people who want something for nothing, who become enthusiastic practitioners (but only briefly), and who pass on the word to the next person. This type of reaction reflects a human characteristic that for all our scientific rationality we have failed to outgrow. We love magic. Many writers of fad diet books and sellers of fraudulent diet pills and formulas use this characteristic to their advantage. Watch out for such frauds. A sign of their presence is the appeal they make to magical thinking and the promise of something for nothing.

**Diuretic (dye-you-RET-ic)**

A diuretic is a drug that promotes water excretion.

Dia = through

Ure = urine

**Water Pills**

For the obese person, the idea that excess weight is due to water accumulation may be an attractive one. Indeed, temporary water retention, seen in many women around the time of the menstrual period, may make a difference of several pounds on the scale. Oral contraceptives may have the same effect. (They may also promote actual fat gain in some women. A woman who has this problem should consult her physician about switching brands.) In cases of severe swelling of the belly, as much as 20 pounds of excess body water may accumulate.

If water retention is a problem, it can be diagnosed by a physician, who will prescribe a diuretic (water pill) and possibly a mild degree of salt restriction. But the obese – that is, overfat – subject has a smaller percentage of body water than the person of normal weight does. If she takes a self-prescribed diuretic, she has done nothing to solve her fat problem, although she may lose a few pounds on the scale for half a day and suffer from dehydration.

**Diet Pills, Starch Blockers, and Glucomannan**

Some doctors prescribe amphetamines (“speed”) to help with weight loss. (The best known are dexedrine and benzedrine.) These reduce appetite – but only temporarily. Typically the appetite returns to normal after a week or two, the lost weight (and often more) is regained, and the user then has the problem of trying to get off the drug without gaining more weight. It is generally agreed that these drugs cause a dangerous dependency and are of little or no usefulness in treating obesity.

A multitude of other drugs are presently under investigation: hormones and hormone-like compounds, inhibitors of nutrient absorption; inhibitors of fat synthesis, promoters of fat breakdown, other modifiers of metabolism – in short, every kind of agent that researchers can imagine might be effective in any way against obesity. Tests in humans of any of these would be premature at present, and results in animals are not encouraging. Side effects, in many cases, are severe. In short, at present, no known drug is both safe and effective, and many are hazardous. Even diet pills, long thought safe and widely used, have been shown not to be safe for all users. Two cases of serious illness have been ascribed to taking of diet pills containing phenylpropanolamine. The only effective appetite-reducing agent to which tolerance does not develop in time is cigarette smoking – and that, of course, entails hazards of its own too numerous to mention.

Among popular drugs recently on the market, starch blockers not long ago attracted a lot of attention. They sounded like a dieter's dream come true – eat your favorite carbohydrate foods and derive no calories from them. Unfortunately, although the principle seems sound enough, it doesn't work out in practice. It has been known since 1943 that uncooked wheat and kidney beans contained inhibitors of the starch-digesting enzyme amylase. The inhibitor from kidney beans has been purified and fed to rats; with the result that they excreted some starch and gained less weight than controls. However, tests on humans have shown no inhibition of starch digestion whatsoever.

Nevertheless, 100 different starch blocker preparations were on the market as of the end of 1982, at the peak of their success people were swallowing over a million pills a day. Some people were even stockpiling the pills, expecting that the FDA soon would ban them. As expected, FDA has prohibited their being marketed; they have been found to cause nausea, vomiting, diarrhea and stomach pains, and not to block starch digestion.

People who don't want to use starch blockers are trying glucomannan, a preparation derived from vegetable (konjac tuber) used in Japanese cuisine. The Japanese are said to have used konjac for weight control for 1,500 years – but in a controlled experiment reported in 1982, glucomannan was ineffective.

Some day a pill may be developed that is effective against overeating and obesity. None of those described here is a likely candidate. One that may be promising is the opiate antagonist naloxone, which blocks stress-induced eating in animals, and possibly also in humans. Extensive testing will be required to determine whether naloxone can be safely used for this purpose.

Perhaps the most promising anti-obesity agent presently being tested is the artificial fat (sucrose polyester). It remains to be seen, however, whether long-term use will facilitate permanent weight loss or whether, like artificial sweeteners, sucrose polyester will become a mere addition to the diet.

### **Cellulite (SELL-you-leet)**

Cellulite is supposedly a lumpy form of fat; actually, a fraud. The skin sometimes appears lumpy in fatty areas of the body because strands of connective tissue attach the skin to underlying structures. These points of attachment may pull tight where the fat is thick, making lumps appear between them. The fat itself is not different from fat anywhere else in the body. So, if you lose the fat there, you lose the lumpy appearance.

### **Health Spas**

One of the biggest moneymaking schemes that profits from people's desires to lose weight the easy way is the health spa. The spa can be used to advantage. People who really exercise there reap the expected benefits. But health spas can be extremely costly, and most of their gimmicks offer no real health advantage other than the psychological boost the consumer herself supplies. Hot baths do not speed up the basal metabolic rate so that pounds can be lost in hours. Steam and sauna baths do not melt the fat off the body, although they may dehydrate a person so that his weight on the scales changes dramatically. Machines intended to jiggle parts of the body while the person leans passively on them provide pleasant stimulation but no exercise and so no expenditure of kcalories.

Some people believe there are two kinds of body fat: regular fat and "cellulite." Cellulite is supposed to be hard and lumpy fat that yields to being "burned up" only if it is first broken up by methods like the massage or the machine typical of the health spa. The notion that there is such a thing as cellulite received wide publicity with the publication of a book by a certain Madame R of Paris, which sold widely during the 1970s. The Journal of the American Medical Association has published the statement that cellulite is a hoax.

### **Hormones**

Because hormones are powerful body chemicals and many affect fat metabolism, it has long been hoped that a hormone might be found that would promote weight loss. Several have been tried. With testing, all have proven ineffective and often hazardous as well. Thyroid hormone, in particular, causes loss of lean body mass and heart problems except when medically prescribed for the correction of a thyroid deficiency – and thyroid deficiency is very seldom the cause of obesity.

Among the hormones advertised as promoting weight loss is HCG (human chorionic gonadotropin), a hormone extracted from the urine of pregnant women. HCG has legitimate uses; for example, it can stimulate ovulation in a woman who has had difficulty becoming pregnant. But it has no effect on weight loss and does not reduce hunger. A rash of "clinics" run by "doctors" that sprang up on the West Coast during the 1970s advertised tremendous success using HCG in the treatment of obesity. These outfits seem to have had one element in common. They prescribed an extremely rigid low-kcalorie diet, which accounted for their apparent effectiveness. The American Medical Association and the California Medical Association have concluded that the claims made for HCG are groundless and that the side effects are unknown and probably dangerous.

### **Surgery**

Sheer desperation prompts some obese people to request surgery. One operation, bypass surgery, involves removing or disconnecting a portion of the small intestine to reduce absorption. Another involves stapling the stomach to make it smaller.

After a bypass operation, the person can continue overeating but will absorb considerably fewer kcalories. Side effects from this procedure are many and highly undesirable, including liver failure, massive and frequent diarrhea, urinary stones, intestinal infection, and malnutrition. Reports of mortality range from 2 to 10 percent. Still, in the United States, surgery has been reported to be effective more than half the time for treating the massively obese where all other methods have failed. It should probably be attempted only in otherwise healthy and cooperative people under 30 who weigh more than 300 pounds and who have tried everything else.

Gastric stapling is in increasing use in preference to bypass surgery, because it forces the person to eat less rather than causing malabsorption. Still, although the theory is pleasingly simple, stapling involves hazards in practice; stomach tissue is damaged, scars are formed, staples pull loose. The person contemplating surgery should think long and hard before submitting to it.

### Weight-Loss Diets Compared

With a balanced perspective on foods and a sense of what's important in diet planning and what's not, you can evaluate the many different diets people consume. Here's a summary of the questions you might ask. Start with 100 points and subtract if any of these criteria are not met:

1. Does the diet provide a reasonable number of kcalories (enough to maintain weight; not too many; and if a reduction diet, not fewer than 1,200 kcalories for the average-sized person)? If not, give it a minus 10.
2. Does it provide enough, but not too much, protein (at least the recommended intake or RDA but not more than twice that much)? If not, minus 10.
3. Does it provide enough fat for satiety but not so much fat as to go against current recommendations (say, between 20 and 35 percent of the kcalories from fat)? If not, minus 10.
4. Does it provide enough carbohydrate to space protein and prevent ketosis (100 grams of carbohydrate for the average-sized person)? Is it mostly complex carbohydrate (not more than 20 percent of the kcalories as concentrated sugar)? If no to either, minus 5, if no to both, minus 10.
5. Does it offer a balanced assortment of vitamins and minerals from whole food sources in all four-food groups? If a food group is omitted (for example, meats), is a suitable substitute provided? The four food groups are milk/milk products; meat/fish/poultry/eggs/legumes; fruits/vegetables; grains. For each food group omitted and not adequately substituted for, minus 10 points
6. Does it offer variety, in the sense that different foods can be selected each day? If you'd class it as "monotonous," give it a minus 10.
7. Does it consist of ordinary foods that are available locally (for example, in the main grocery stores) at the prices people normally pay? Or does the dieter have to buy special, expensive, or unusual foods to adhere to the diet? If you'd class it as "bizarre" or "requiring unusual foods," minus 10.

Diet Name	KCalories	Protein	Fat	Carbohydrate	Food Groups	Variety	Ordinary Foods	Total Score
Atkin's	Yes	Minus 10	Minus 10	Minus 10	Minus 30	Minus 10	Yes	30 Points
Banana-Milk	Minus 10	Minus 10	Minus 10	Yes	Minus 20	Minus 10	Yes	40 Points
Beverly Hills	Minus 10	Minus 10	Minus 10	Minus 10	Minus 30	Minus 10	Minus 10	10 Points
Scarsdale	Yes	Minus 10	Minus 10	Minus 5	Minus 10	Yes	Yes	65 Points
Cambridge	Minus 10	Minus 10	Minus 10	Minus 10	Minus 40	Minus 10	Minus 10	0 Points
Fasting	Minus 10	Minus 10	Minus 10	Minus 10	Minus 40	Minus 10	Minus 10	0 Points
High Roughage	Yes	Yes	Yes	Yes	Minus 5	Yes	Minus 5	90 Points
I Love NY	Minus 5	Yes	Yes	Yes	Yes	Yes	Yes	95 Points
Kempner's Rice	Yes	Minus 10	Minus 10	Yes	Minus 20	Minus 10	Yes	30 Points
Magic Mayo (Grapefruit)	Minus 10	Minus 10	Minus 10	Minus 10	Minus 20	Minus 10	Yes	30 Points
New Canadian	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100 Points
Simeons' HCG	Minus 10	Minus 10	Minus 10	Minus 10	Minus 25	Yes	Minus 10	25 Points
Dr. Stillman	?	Minus 10	Minus 10	Yes	Minus 20	Minus 10	Yes	50 Points
UCLA Diet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100 Points
Weight Watchers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100 Points



## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 8:

### • The Water-Soluble Vitamins: B Vitamins and Vitamin C

A television commercial broadcast widely some years ago shows a middle-aged businessman shuffling weakly out of his bedroom with his bathrobe slung loosely around his sagging paunch. He sinks into his chair at the breakfast table and wearily lifts the morning paper to screen his face from the daylight and from his bright-eyed, energetic wife. As she placed his coffee cup before him, she observes sympathetically, "Sweetie, you look so tired. Did you forget to take your vitamin pill today?" (Fadeout, with the voice of the announcer saying, "Are you tired in the morning? Do you hate to face the day? What you need is Brand A Vitamins.") Repeat: The same man, transformed, trim and bouncy, waltzes into the breakfast nook, pirouettes gaily around the tables, kisses his wife affectionately, takes two hasty sips of coffee, and strides humming out the door. She turns cheerfully to the camera and smiles, "Brand A Vitamins have done wonders for my Harry."

True? No. Poor Harry. If he tries to live on only coffee and vitamins, he will remain a wreck. Like all organic nutrients found in foods, the B vitamins are composed of carbon, hydrogen, oxygen, and other atoms linked together by chemical bonds. Of course, these bonds contain energy, but that energy cannot be used to fuel activities or to do the body's work. The energy Harry needs comes from carbohydrate, fat, and protein; the vitamins will only help him burn the fuel if he has the fuel to burn.

It is true; however, that without B vitamins you would certainly feel tired. You would lack energy. Why is this? Some of the B vitamins serve as helpers to the enzymes that release energy from the three energy nutrients – carbohydrate, fat, and protein. The B vitamins stand alongside the metabolic pathways and help to keep the disassembly lines moving. In an industrial plant they would be called expeditors. Some of them help manufacture the red blood cells, which carry oxygen to the body's tissues; the oxygen must be present for oxidation and energy release to occur.

So long as B vitamins are present, their presence is not felt. Only when they are missing does their absence manifest itself as a lack of energy. A child who learned this defined vitamins on a test as "what if you don't eat you get sick." The definition is one of the most insightful we've seen.

#### **Water-Soluble Vitamins**

The B vitamins and vitamin C are entitled to individual attention, but the whole array of them is presented here first to show you the "forest" in which they are the trees. They come together in foods, they work together in the body, and there is much to be learned from viewing them as a group.

First of all, together with vitamin C, the B vitamins form a natural group of nutrients known as the water-soluble vitamins. They are present in the watery compartment of foods, and they distribute into the water-filled compartments of the body. They can easily be excreted in the urine if their blood concentration rises too high – in contrast to the fat-soluble vitamins, which tend to be hidden away in storage places. As a consequence, the water-soluble vitamins are less likely to reach toxic levels (a plus), but are also more easily depleted (a minus), than the fat-soluble vitamins.

#### **Caution:**

The B vitamin riboflavin is a yellow compound so bright that it is easy to see in a water solution. Since excesses of the B vitamin are excreted, bright yellow urine may signify the presence of this vitamin. If you are in the habit of taking a multivitamin supplement "to avoid deficiencies" and your diet is otherwise adequate in riboflavin, you may notice this effect.

Some vitamin supplements are inexpensive, but others are absurdly costly. Most people do need them. As you read on, you may discover that it is easy to make your diet adequate by eating nutritious foods alone. If you do consume an adequate diet, the following statement may apply to you. Overdosing with B vitamins will do nothing for you but increase the dollar value of your urine.

#### **In summary, the water-soluble vitamins are:**

- Carried in the bloodstream.
- Excreted in urine.
- Needed in frequent small doses.
- Unlikely to be toxic.

## The B Vitamins: Coenzymes

Each of the B vitamins is part of an enzyme helper known as a coenzyme. A coenzyme is a small nonprotein molecule that associates closely with an enzyme. Some coenzymes form part of the enzyme structure, in which case they are known as prosthetic groups; others are associated more loosely with the enzymes. Some participate in the reaction being performed and are chemically altered in the process, but they are always regenerated sooner or later. Others are unaltered but form part of the active site of the enzymes. Thus although there are differences in details, one thing is true of all. Without the coenzymes, the enzymes cannot function.

The consequences of a failure of metabolic enzymes can be catastrophic, as you will realize if you study the central pathway of metabolism by which glucose is broken down. The nicknames for some of the coenzymes that keep the processes going (NAD<sup>+</sup>, TPP, FAD, and CoA) are listed beside the reactions they facilitate; the vitamin names are given below.

### B-Vitamin Terminology

Many of the vitamins have both names and numbers, a mixture of terminologies that confuses newcomers to the study of nutrition. As of 1979, a single set of names for the vitamins had been agreed on and was published, and those names are used in this course. Still, to read the many worthwhile writings published prior to 1979, you have to be aware of the alternative names:

<u>Correct Name</u>	<u>Other Names Commonly Used</u>
Thiamin	Vitamin B <sub>1</sub>
Riboflavin	Vitamin B <sub>2</sub>
Niacin	Nicotinic acid, nicotinamide, niacinamide
Vitamin B <sub>6</sub>	Pyridoxine, pyridoxal, pyridoxamine
Folacin	Folate, folic acid
Vitamin B <sub>12</sub>	Cobalamin
Pantothenic acid	(None)
Biotin	(None)

Look at the first step. Some of the enzymes involved in the breakdown of glucose to pyruvate require the coenzyme NAD<sup>+</sup>. Part of this molecule is a structure the body cannot make. Hence it must be obtained from the diet; it is an essential nutrient (Session 1).

In other words, to take glucose apart the cells must have certain enzymes. For the enzymes to work, they must have the coenzymes NAD<sup>+</sup>. To make NAD<sup>+</sup>, the cells must be supplied with niacin (or a closely related compound they can alter to make niacin). The rest of the coenzyme they can make without outside help.

The next step in glucose catabolism is the breakdown of pyruvate to Acetyl-CoA. The enzymes involved in this step require NAD<sup>+</sup> plus another coenzyme, TPP. The cells can manufacture the TPP they need from thiamin, but thiamin is a compound they cannot synthesize; so it must be supplied in the diet. Thiamin is the vitamin part.

Another coenzyme needed for this step is coenzyme A, or CoA for short. As you have probably guessed, the cells can make CoA except for an essential part of it that must be obtained in the diet. This essential part – the vitamin part – is pantothenic acid.

The next step in glucose catabolism is breakdown of Acetyl-CoA to carbon dioxide. The enzymes involved in this process require two of the three coenzymes mentioned above – NAD<sup>+</sup> and coenzyme A – and, in addition, another – FAD. Again, FAD is synthesized in the body, but part of its structure, the vitamin riboflavin, must be obtained in the diet.

Now suppose the body's cells lack one of these B vitamins – niacin, for example. Without niacin, the cells cannot make NAD<sup>+</sup>. Without NAD<sup>+</sup>, the enzymes involved in every step of the glucose-to-energy pathway will fail to function. Since it is from these steps that energy is made available for all the body's activities, everything will begin to grind to a halt. This is no exaggeration. The symptoms of niacin deficiency are the devastating "four Ds": dermatitis, which reflects a failure of the skin to maintain itself; dementia (insanity), a failure of the nervous system; diarrhea, a failure of digestion and absorption; and death. These are only the most obvious, observable symptoms. Every organ in the body, being dependent on the energy pathways, is profoundly affected by niacin deficiency. As you can see, niacin is a little like the horseshoe nail for want of which a war was lost.

### **Mother Goose**

For want of a nail, a horseshoe was lost.  
For want of a horseshoe, a horse was lost.  
For want of a horse, a soldier was lost.  
For want of a soldier, a battle was lost.  
For want of a battle, the war was lost,  
And all for the want of a horseshoe nail!

The complete breakdown of amino acids and fat, as well as that of glucose, depends on the coenzymes just described. You may remember that a major product of the breakdown of amino acids and fat is Acetyl-CoA and that this product is processed in exactly the same way as the Acetyl-CoA from glucose. Thus the release of energy from all foods depends on the same vitamins.

Not only the breakdown (catabolism) but also the building (anabolism) of compounds in the body requires coenzymes. For example, one step in the manufacture of a nonessential amino acid is the step in which the nitrogen-containing amino group is attached to a carbon skeleton – a process called transamination. Enzymes performing this function require a coenzyme made from the essential nutrient vitamin B6.

Two other B vitamins – Folacin and vitamin B<sub>12</sub> – are together involved in building the units that form part of DNA. Folacin aids directly in the synthesis of one of the purines, and vitamin B<sub>12</sub> indirectly in the synthesis of the Folacin coenzymes. Whenever a cell divides, it must make a whole new copy of its DNA; thus these two coenzymes are necessary for making all new cells. They also serve other functions.

Finally, biotin, another B vitamin, serves as a helper in many reactions in which single-carbon groups are shifted from one structure to another. Many reactions involve this activity, including those of fatty acid synthesis and the reaction that converts pyruvate into a compound used in the TCA cycle.

In summary, these eight B vitamins play many specific roles in helping the enzymes to perform thousands of different molecular conversions in the body. They are active in carbohydrate, fat and protein metabolism and in the making of DNA and thus new cells. They are found in every cell and must be present continuously for the cells to function, as they should. It must now be abundantly clear why poor Harry needs the B vitamins to make him feel well, even though without food they do nothing for him. No matter what he eats, he needs B vitamins to help him process it.

### **Coenzyme (co-EN-zime)**

A coenzyme is a small molecule that works with an enzyme to promote the enzyme's activity. Many coenzymes have B vitamins as part of their structure.

Co = with

### **Prosthetic (pros-THET-ic) Group**

A prosthetic group is a coenzyme that is physically part of (attached to) its enzyme.

Prosth = in addition to

### **Active Site**

An active site is that part of the enzyme surface on which the reaction takes place.

### **Niacin (NIGH-uh-sin)**

Niacin is a B vitamin. Niacin can be eaten preformed or can be made in the body from tryptophan, one of the amino acids.

### **Precursor**

A precursor is a compound that can be converted to a nutrient in the body. Thus tryptophan is a precursor of niacin.

### **Thiamin (THIGH-uh-min)**

Thiamin is a B vitamin.

### **Pantothenic (PAN-to-THEN-ic) Acid**

Pantothenic Acid is a B vitamin.

### **Riboflavin (RIBE-o-flay-vin)**

Riboflavin is a B vitamin.

## Transamination

Transamination is the transfer of an amino group from one compound to another, as when nonessential amino acids are manufactured in the body.

## Vitamin B<sub>6</sub>

Vitamin B<sub>6</sub> is a family of compounds – pyridoxine, pyridoxal, and pyridoxamine – that act as part of the coenzymes in amino acid metabolism. The step that begins the breakdown of stored glycogen to glucose also depends on these coenzymes; and a crucial step in the making of the iron-containing portion of hemoglobin for red blood cells does, too.

## Folacin (FOLL-uh-sin)

Folacin is a B vitamin that acts as part of the coenzyme in the manufacture of new DNA and new cells; it transfers single-carbon groups.

## Vitamin B<sub>12</sub>

Vitamin B<sub>12</sub> is a vitamin whose coenzyme helps make the active forms of Folacin.

## Biotin (BY-o-tin)

Biotin is a B vitamin, a coenzyme involved in shifting single-carbon (CO<sub>2</sub>) groups, necessary for fat synthesis and other metabolic reactions. The TCA cycle intermediate produced with the help of biotin is oxaloacetate.

## B Vitamins and Prescription Drugs

Like the coenzymes, drugs are small but potent molecules and they often work in the body by altering the actions of its proteins. However, although the body is equipped by eons of evolutionary time to accommodate the vitamins and to use them appropriately, it has had no such long experience with drugs. Most of the prescription drugs are new compounds, synthesized in the laboratory, which affect body functions in ways that may be useful to fight disease. But many drugs have side effects. While they work in one area to counteract the disease process or to correct an abnormality, they may also work in other areas to interfere with normal body processes. Sometimes they interfere with the action of the B vitamins.

For example, a potent drug that inhibits the growth of the tuberculosis bacterium, nicknamed INH, has saved countless lives because of its efficacy against tuberculosis. But INH is also a vitamin B<sub>6</sub> antagonist; it binds and inactivates the vitamin, inducing a deficiency. Whenever INH is used to treat tuberculosis, supplements of vitamin B<sub>6</sub> must be given to protect the patient from deficiency.

Another example is aspirin, the most frequently prescribed pain reliever. It is very effective against pain, but it also interferes with the binding of Folacin to carrier proteins and increases Folacin excretion. (It has an impact on vitamin C and iron nutrition, too.) This doesn't imply that aspirin should never be used but rather that people using drugs and physicians prescribing them should be aware that they might affect nutrition.

### **Caution:**

It is important for someone new to the study of nutrition to be reminded at this point that this is a course about healthy people. The nutrient needs of people who are ill or who are using large amounts of drugs – including nonprescription drugs like alcohol – are not discussed here. Nor are the special needs of people with inborn genetic defects that may greatly increase their individual needs for certain nutrients. The statements about recommended intakes and about foods that provide the recommended amounts apply to most people, normally, but there are exceptions that are outside our province.

## B-Vitamin Deficiency

Removing a number of “horseshoe nails” can have such disastrous and far-reaching effects that it is difficult to imagine or predict the results. Oddly enough, although we know a great deal about their individual molecular functions, we are unable to say precisely why a deficiency of one B vitamin produces the disease beriberi whereas the deficiency of another produces pellagra. We do know, however, that with the deficiency of any B vitamin, many body systems become deranged, and similar symptoms may appear.

A deficiency of any one B vitamin seldom shows up in isolation. After all, people do not eat nutrients singly; they eat foods, which contain mixtures of nutrients. If a major class of foods is missing from the diet, the nutrients contributed by that class of foods would all be lacking to varying extents. In only two cases, dietary deficiencies associated with single B vitamins have been observed on a large scale in human populations, and diseases have been named for them. One of these diseases, beriberi, was first observed in the Far East when the custom of polishing rice became widespread. Rice contributed 80 percent of the kcalories consumed by the people of those areas, and rice hulls were their principal source of thiamin. When the hulls were

removed, beriberi spread like wildfire. It was believed to be an epidemic, and medical researchers wasted much time and energy seeking a microbial cause before they realized that the problem was not what was present in the food but what was absent from it.

The other disease, pellagra, became widespread in the U.S. South in the early part of this century, in people who subsisted on a low-protein diet whose staple grain was corn. This diet was unusual in that it supplied neither enough niacin nor enough of its amino acid precursor tryptophan to make up the deficiency.

Even in these cases, the deficiencies were not pure. When foods were provided containing the one vitamin known to be needed, the other vitamins that may have been in short supply came as part of the package

### **Beriberi**

Beriberi is the thiamin-deficiency disease which pointed the way to discovery of the first vitamin, thiamin.

### **Pellagra (pell-AY-gra)**

Pellagra is the niacin-deficiency disease.

Pellis = skin

Agra = seizure

Once vitamin research was well under way and other B vitamins had been discovered, the clarification of their function was often greatly helped by laboratory experiments in which animals or human volunteers were fed diets devoid of one vitamin. The effect of the deficiency of that vitamin could then be studied to determine what functions it normally performed. Other deficiency diseases were discovered in this way and have since been observed to occur outside the laboratory.

The following table sums up a few of the better-established facts about B vitamin deficiencies. A look at the table will make another generalization possible. Different body systems depend to different extents on these vitamins. Processes in nerves and in their responding tissues, the muscles, depend heavily on glucose metabolism and hence on thiamin; thus paralysis sets in when this nutrient is lacking. The replacement of red blood cells and GI tract cells occurs at a rapid pace and involves much making of DNA; the making of new cells depends on a Folacin coenzymes and the making of this coenzyme depends on vitamin B<sub>12</sub>, so two of the first symptoms of a deficiency of either of these nutrients are a type of anemia and GI deterioration. But again, each nutrient is important in all systems, and these lists of symptoms are far from complete.

The skin and the tongue appear to be especially sensitive to vitamin B deficiencies, but you should not that the listing of these items in the table gives them undue emphasis. Remember that in a medical examination these are two body parts that are visible. If the skin is degenerating, other tissues beneath it may be, too. Similarly, the mouth and tongue are the visible part of the digestive system; if they are abnormal, there may well be an abnormality throughout the GI tract. What is really happening in the vitamin deficiency happens inside the cells of the body; what the doctor sees and reports are its outward manifestations.

### **Caution:**

It is more and more apparent that you cannot observe a symptom and automatically jump to a conclusion regarding its cause. The warning was given earlier (in Session 3) that skin rashes are a symptom, not a disease. As you have seen, deficiencies of linoleic acid, riboflavin, niacin, and vitamin B<sub>6</sub> can all cause rashes. A deficiency of vitamin A can, too. Because skin is on the outside, where you and your doctor can easily look at it, it is a useful indicator of things-going-wrong-in-cells. But by itself a skin symptom tells you nothing about its possible cause.

The same is true of anemia. We often think of anemia as being caused by an iron deficiency, and often it is. But anemia can also be caused by a Folacin or vitamin B<sub>12</sub> deficiency, by digestive tract failure to absorb any of these nutrients, or by such nonnutritional causes as infections, parasites, cancer, or loss of blood. So be careful. You can often recognize a false claim by the implication that a specific nutrient will always cure a given symptom.

A person who feels chronically tired may be tempted to diagnose herself as having anemia. Knowing only enough to associate iron deficiency with this condition, she may decide to take an iron supplement. But the iron supplement will relieve her tiredness only if the symptom is caused by iron-deficiency anemia. If she has a Folacin deficiency (and Folacin deficiency is probably the most widespread vitamin deficiency in the world), taking iron will only prolong the period in which she receives no relief. If she is better informed, she may decide to take a vitamin supplement with iron, covering the possibility of a vitamin deficiency. But now she is forgetting that there may be a nonnutritional cause of her symptom. If the cause of her tiredness is actually hidden blood loss due to cancer, the postponement of a diagnosis may be equivalent to suicide.

## Deficiency Syndrome

Vitamin	Disease	Area Affected	Main Effects	Technical Terms
Thiamin	Beriberi	Nervous system  Muscles  Cardiovascular System	Mental confusion Peripheral paralysis Weakness Wasting Painful calf muscles Edema Enlarged heart Death from cardiac failure	
Riboflavin	Ariboflavinosis	Facial skin   Eyes	Dermatitis around nose and lips Cracking of corners of mouth Hypersensitivity to light Reddening of cornea	Cheilosis kee-LOH-sis  Photophobia
Niacin	Pellagra	Skin  Tongue GI Tract Nervous system	Bilateral symmetrical dermatitis, especially on body parts exposed to sun Loss of surface features, swelling, edema Diarrhea Irritability Mental confusion, progressing to psychosis or delirium	Glossitis gloss-EYE-tis
Vitamin B <sub>6</sub>	(No name)	Skin   Tongue Nervous system	Dermatitis Cracking of corners of mouth Irritation of sweat glands Smoothness-atrophy of surface structures Abnormal brain wave pattern Convulsions	Cheilosis  Glossitis
Folacin	(No name)	Tongue GI Tract Blood	Smoothness, swelling, cracks Diarrhea Anemia (characterized by large cells)	Glossitis  Macrocytic anemia
Vitamin B <sub>12</sub>	Pernicious anemia	Blood Nervous system	Anemia (characterized by large cells) Degeneration of peripheral nerves	Macrocytic anemia
Pantothenic Acid	(No name)	GI Tract Nervous system	Vomiting, GI distress Insomnia, fatigue	
Biotin	(No name)	Skin Nervous system GI tract Cardiovascular system	Scaly dermatitis, drying, loss of hair Depression, lassitude, muscle pains Anorexia, nausea Abnormal heart action	

### Fortification

Fortification is the addition of nutrients to a food, often in amounts much larger than might be found naturally in that food.

### Enrichment

Enrichment is now considered synonymous with fortification; previously, the addition of four specific nutrients – iron, thiamin, riboflavin, and niacin – to refined breads and cereals in amounts approximately equivalent to those originally present in the whole grain.

Major, epidemic-like deficiency diseases such as pellagra and beriberi are no longer seen in the United States and Canada, but lesser deficiencies of nutrients, including the B vitamins, sometimes are observed. They occur in people whose food choices are poor because of poverty, ignorance, illness, or poor health habits like alcohol abuse. They are especially likely if the staple grain food is refined, as were most bread and cereal products chosen by U.S. consumers during the 1930s and before. One way to protect these people is to add nutrients to their staple food, a process known as fortification or enrichment. The enrichment of refined breads and cereal, required by law in most Eastern states since the late 1940s and in many Western states since the early 1970s, has increased many people's iron and B-vitamin intakes.

## **The B Vitamins in Foods**

The preceding sections have shown both the great importances of the B vitamins in promoting normal, healthy functioning of all body system and the severe consequences of deficiency. Now you may want to know how to be sure you are getting enough of these vitamin nutrients. This section offers some practical pointers regarding food intake.

### **Thiamin**

The recommended daily thiamin intake for adults is about 1.5 milligrams for men and about 1.0 for women (plus an extra half-milligram during pregnancy). Infants require about half a milligram and children about three-fourths.

### **Riboflavin**

The recommended daily riboflavin intake for adults is about 1.4 to 1.8 milligrams for men and about 1.1 to 1.3 for women (plus about 0.3 milligrams during pregnancy), depending on how much energy they expend daily. (Like thiamin, riboflavin needs can be stated in terms of milligrams per 1,000 kcalories.) Young children's needs begin at about 1 milligram a day and rise rapidly during their growing years. Teenagers, because they are very active, need more riboflavin than adults do.

### **Niacin**

Recommended niacin intakes are stated in "equivalents," a term that requires explanation. Niacin is unique among the B vitamins because it can be obtained from another nutrient source – protein. The amino acid tryptophan can be converted to niacin in the body: 60 milligrams of tryptophan yields 1 milligram of niacin. Thus a food containing 1 milligram of niacin and 60 milligrams of tryptophan contains the equivalent of 2 milligrams of niacin, or 2-milligram equivalents.

Recommended daily intakes for men are about 15 to 20-milligram equivalents and for women about 12 to 15 (plus 2 to 5 milligram equivalents during pregnancy and lactation). Infants', children's, and teenagers' needs are proportional not to their size but to their energy output.

### **To obtain a rough approximation of your niacin intake:**

1. Calculate total protein consumed (g).
2. Subtract your recommended protein intake to obtain "leftover" protein usable to make niacin (g).
3. Divide by 100 to obtain the amount of tryptophan in this protein (g).
4. Multiply by 1,000 to express this amount of tryptophan in milligrams (mg).
5. Divide by 60 to get niacin equivalents (mg).
6. Finally, add the amount of niacin obtained preformed in the diet (mg).

### **Vitamin B<sub>6</sub>**

Because the vitamin B<sub>6</sub> coenzymes play many roles in amino acid metabolism, dietary needs are roughly proportional to protein intakes. Adults need about 2 milligrams a day; this is enough to handle 100 grams of protein. Pregnant and lactating women need about half a milligram more. Infants probably receive enough vitamin B<sub>6</sub> either from breast milk or cows milk formula. There is some possibility that older people have a greater need for vitamin B<sub>6</sub> than young adults do.

### **Folacin**

Folacin occurs in foods in both bound and free forms; the free form is better absorbed. The U.S. recommendation for adults is stated in terms of all forms of Folacin and is 400 micrograms a day. The need for Folacin rises dramatically during pregnancy, more than the need for any other nutrient; the RDA table doubles the Folacin recommendation to 800 micrograms a day during pregnancy.

### **Vitamin B<sub>12</sub>**

According to the U.S. recommendations, adults need about 3 micrograms of vitamin B<sub>12</sub> a day (plus 1 microgram during pregnancy).

### **Pantothenic Acid and Biotin**

The six best-known B vitamins have already been discussed. Two other B vitamins – pantothenic acid and biotin – are needed for the synthesis of coenzymes that are active in a multitude of body systems. These are just as important as the vitamins discussed so far, but both pantothenic acid and biotin are widespread in foods, and there seems to be no danger that people who consume a variety of foods will suffer deficiencies.

## Non-B Vitamins

Trios of compounds sometimes called B vitamins are inositol, choline, and lipoic acid. These are not essential nutrients for humans, although deficiencies can be induced in laboratory animals in order to study their functions. Like the B vitamins described above, they serve as coenzymes in metabolism. Even if they were essential for humans, supplements would be unnecessary, because they are abundant in foods.

When used as drugs, choline and its relative lecithin have some important beneficial effects on several disease conditions that affect memory and muscular coordination. These particular diseases are responsive, not because they are caused by deficiencies of choline or lecithin, but because large doses of these nutrients act in a different way altogether from normal doses.

The beneficial effects of choline and lecithin on these diseases have led to many false claims – “Lecithin improves memory” and the like – with a consequent rush to buy and consume bottles of it. As a result, medical practitioners have been able to witness and report on the effects of over-doses of these compounds. They can cause not only short-term discomforts such as GI distress, sweating, salivation, and anorexia, but also long-term health hazards from disturbance of the nervous and cardiovascular systems.

### **Caution:**

If you read or hear a report of a substance having a beneficial or harmful effect, it is an oversimplification to conclude that the substance is “good” or “bad.” You must ask what dose was used. Two corollaries to this statement must be the following:

- A substance that is poisonous at a high concentration may be an essential nutrient at a lower concentration.
- A nutrient needed at a low concentration may be toxic at a high concentration.

In addition to choline, inositol, and lipoic acid, other substances have been mistaken for essential nutrients for humans because they are needed for growth by bacteria or other forms of life. These substances include:

- PABA (para-aminobenzoic acid).
- Ubiquinone

Other names you may hear are “Vitamin B<sub>5</sub>” (another name for pantothenic acid), “Vitamin B<sub>15</sub>” (a hoax), “Vitamin B<sub>17</sub>” (laetrile and not a vitamin), “Vitamin B<sub>T</sub>” (carnitine, an important piece of cell machinery but not a vitamin), and more. There is another water-soluble vitamin, however, of great interest and importance – vitamin C.

## Vitamin C

Two hundred years ago, any man who joined the crew of a seagoing ship knew he had only half a chance of returning alive – not because he might be slain by pirates or die in a storm but because he might contract the dread disease scurvy. As many as two-thirds of a ship’s men might die of scurvy on a long voyage. Only ships that sailed on short voyages, especially around the Mediterranean Sea, were safe from this disease. It was not known at the time that the special hazard of long ocean voyages was that the ship’s cook used up his provisions of fresh fruits and vegetables early and relied for the duration of the voyage on cereals and live animals brought along as provisions.

The first nutrition experiment conducted on human beings was devised in 1747 to find a cure for scurvy. Dr. James Lind, a British physician, divided 12 sailors with scurvy into six pairs. Each pair received a different supplemental ration: vinegar, sulfuric acid, seawater, orange, lemon, or none. The ones receiving the citrus fruits were cured within a short time. Sadly, it was 50 years before the British Navy made use of Lind’s experiment by requiring all vessels to carry sufficient limes for every sailor to have limejuice daily. British sailors were still nicknamed “limeys” as a result of this tradition.

The antiscorvy “something” in limes and other foods was dubbed the antiscorbutic factor. Nearly 200 years later, the factor was isolated from lemon juice and found to be a six-carbon compound similar to glucose. It was named ascorbic acid. Shortly thereafter it was synthesized, and today hundreds of millions of vitamin C pills are produced in pharmaceutical laboratories each year and sold for a few dollars a bottle.

Human needs for vitamin C are the subject of much disagreement among experts. The publication of Linus Pauling’s controversial book *Vitamin C and the Common Cold* thrust this vitamin into the limelight in 1970 and persuaded thousands of readers that they should be taking doses much higher than the 45 or 60 milligrams a day cited as adequate in published recommended intakes. Highly respected nutritionists and other scientists have taken positions at both extremes on this issue. The controversy over the common cold has largely died down in the popular press, but the question of how much is enough is still being hotly debated.



There is also a controversy over the risks of taking large doses of vitamin C. Some argue for megadoses on the grounds that the risks of excess are negligible but the risk of deficiency are great. Others argue against megadoses because the risk of deficiency is negligible but the risks of toxicity are great! Both positions are based on reasoning from small amounts of evidence and large numbers of words.

We face a difficult task in trying to sort out what is known about vitamin C, what is likely to be shown true, and what claims are clearly unfounded.

### **Scurvy**

Scurvy is the vitamin C deficiency disease.

### **Antiscorbutic Factor**

The antiscorbutic factor is the original name for vitamin C.

Anti = against

Scorbutic = causing scurvy

### **Ascorbic Acid**

Ascorbic Acid is one of the two active forms of vitamin C. Many people consistently (and incorrectly) refer to all vitamin C by this name.

A = without

Scorbic = having scurvy

### **Megadoses**

Doses of 10 to 30 or more times the recommended intake of a nutrient are termed megadoses. In the case of vitamin C, any amount of 1-g (1,000-mg) is considered a megadose.

### **Metabolic Roles of Vitamin C**

Vitamin C is a mysterious vitamin. Like all the vitamins, it is a small organic compound needed by human beings in minute amounts daily. Being organic, it is convertible to several different forms, two of which are active. Like the B vitamins, it is water-soluble, and so it is excreted rapidly when excesses are taken. But unlike the B vitamins (which for the most part have clearly defined roles as coenzymes), vitamin C acts in ways that are imperfectly understood. It plays many different important roles in the body, and the secret may be that its mode of action is different in each case. In some settings it may act as a coenzyme or cofactor, assisting a specific enzyme in the performance of its job. In others, it may act in a more general way – for example, as an antioxidant. Often the conclusion reached by investigators studying vitamin C is that it has to “be present” for certain reactions to occur but that the mechanism of its action will require further research.

### **Collagen Formation**

The best-understood metabolic role of vitamin C is its function in helping to form the protein collagen. Brief mention was made of this protein in Session 4; it is the single most important protein of connective tissue. It serves as the matrix on which bone is formed. It forms scars; when you have been wounded, collagen glues the separated tissue faces together. The cement that holds cells together is largely made of collagen; this function is especially important in the artery walls, which must expand and contract with each beat of the heart, and in the walls of the capillaries, which are thin and fragile and must withstand a pulse of blood every second or so without giving way.

Collagen, like all proteins, is formed by the stringing together of a chain of amino acids. An amino acid used in abundance to make collagen is proline. After proline is added to the chain, an enzyme adds an OH group to it, making hydroxyproline. This step, which completes the manufacture of collagen, requires oxygen and a special form of iron – the ferrous ion. This iron has a tendency to convert to another form (ferric ion), which the enzyme can't use. Vitamin C stands by to catch ferric ions and reconvert them to the ferrous form so that the enzyme can keep on working.

### **Antioxidant Action**

Chemists call the two forms of iron just described oxidized and reduced iron. The oxidized (ferric) form has lost three electrons; the reduced (ferrous) form has lost two. Any substance that can donate electrons to another is a reducing agent; when it donates its electrons it reduces another compound and simultaneously becomes oxidized itself. Vitamin C is such a compound.

The technicalities of oxidation-reduction reactions are not within our province, and the object of mentioning them is only to make one point clear. Many substances found in foods and important in the body can be altered or even destroyed by oxidation. (An example in Session 3 was oils that turn rancid when exposed to air.)

Vitamin C - because it can be oxidized itself —can protect other substances from this destruction. Vitamin C is like a bodyguard for oxidizable substances; it stands ready to sacrifice its own life to save theirs. Unemotionally, the chemists call such a bodyguard an antioxidant.

Because of its antioxidant property, vitamin C is sometimes added to food products, not only to improve their nutritional value but also to protect important constituents from oxidation. In the intestines, it protects ferrous iron in this way. In the cells and body fluids, it probably helps to protect other molecules – including the fat-soluble compounds vitamin A, vitamin E, and the polyunsaturated fatty acids – by maintaining their watery neighborhood in the appropriately reduced state. Vitamin E and the polyunsaturated fatty acids are important constituents of cell membranes, and these membranes house much of the cells' machinery. This machinery must be meticulously maintained so that the cells can live and work and so that they will discriminate successfully among the things that should cross their membranes and those that should be excluded. Vitamin C – perhaps by way of its ability to alternate between the oxidized and the reduced state – helps maintain these vital functions.

### **The Absorption of Iron**

Vitamin C eaten at the same time as iron helps to promote the absorption of the iron. It is not yet known how the vitamin performs this service, but one intriguing possibility is entitled to an explanation.

You can pick up a screw with a screwdriver – unless the screwdriver is magnetic. Even then, the screw may fall off at the slightest jolt. You can pick up a screw with a pair of pliers, but then you have to hold it tightly or it will fall out of their grip. But if you have a magnetic pair of pliers, you can hold the screw so securely that the only problem may be that you can't let it go. A chelating agent is the molecular equivalent of a magnetized pair of pliers, and vitamin C is an outstanding example of such a molecule. These molecules are especially good at holding onto positive ions such as ferrous iron. Vitamin C can grab and hold such an ion because it has two negative arms. Thus vitamin C can not only reduce iron but can also surround it. The resulting complex is more easily absorbed by the intestinal cells than iron alone.

It is now well known that eating foods containing vitamin C at the same meal with foods containing iron can double or triple the absorption of iron from those foods. This strategy is highly recommended for women and for children, whose calorie intakes are not large enough to guarantee that they will get enough iron from the foods they typically eat.

### **Amino Acid Metabolism**

Vitamin C is involved in the metabolism of several amino acids. In at least some instances it probably functions as it does during collagen formation, by keeping iron in a reduced state to aid an enzyme in adding OH groups to other compounds. Some of these amino acids may end up being converted to hormones of great importance in body functioning, among them norepinephrine and thyroxine.

The adrenal glands contain a higher concentration of vitamin C than any other organ in the body, and during stress they release large quantities of the vitamin together with the stress hormones epinephrine and norepinephrine. What the vitamin has to do with the stress reaction is unclear, but it is known that stress increases vitamin C needs.

Vitamin C is also needed for the synthesis of thyroxine, which regulates the rate of metabolism. The metabolic rate speeds up under extreme stress and also when you need to produce more heat – for example, in fever or cold weather. Thus infections and exposure to cold increase your needs for vitamin C. Perhaps its involvement in the fever response to infection explains the vitamin's possible effects on cold prevention and symptom reduction.

In scurvy, protein metabolism may be altered, resulting in negative nitrogen balance. No one knows why this occurs, but the involvement of vitamin C with amino acids provides a notable example of the way nutrients of different classes cooperate with one another to maintain health.

### **Vitamin C Deficiency**

In both the United States and Canada, vitamin C deficiency is still seen, despite the past century's explosion of nutrition knowledge. In the United States, the Ten-State Survey showed evidence of unacceptable serum levels of vitamin C in about 15 percent of all age groups studied, with symptoms of outright scurvy showing up in 4 percent. The more recent National Food Consumption Survey showed intakes below two-thirds of the RDA for 20 to 30 percent of all persons surveyed. Especially in infants, teenagers, and people of 60 years of age, intakes of vitamin C were much lower than the RDA (less than 50 percent). In Canada, many Eskimos and Indians and some members of the general population have deficiency symptoms. Evidently we all need to be alerted to the symptoms that can result and to make efforts to obtain enough of this vitamin.

With an adequate intake, the body maintains a fixed pool of vitamin C and rapidly excretes any excess in the urine. With an inadequate intake, the pool becomes depleted at a rate of about 3 percent a day. Obvious deficiency symptoms don't begin to appear until the pool has been reduced to about a fifth of its optimal size, and this may take two months or more to occur. Thus the first sign of a developing vitamin C deficiency is a lowered serum or plasma vitamin C concentration. A low intake as revealed by the diet history is the cue that prompts the diagnostician to request a clinical test to measure the body's vitamin C levels.

As the pool size continues to fall, latent scurvy appears. Two of the earliest signs have to do with the role of the vitamin in maintaining capillary integrity. The gums around teeth bleed easily, and capillaries under the skin break spontaneously producing pinpoint hemorrhages. If the vitamin levels continue to fall, the symptoms of overt scurvy appear. Failure to promote normal collagen synthesis causes further hemorrhaging. Muscles, including the heart muscle, may degenerate. The skin becomes rough, brown, scaly, and dry. Wounds fail to heal because scar tissue will not form. Bone rebuilding is not maintained; the ends of the long bones become softened, malformed, and painful, and fractures appear. The teeth may become loose in the jawbone and fillings may loosen and fall out. Anemia is frequently seen, and infections are common. There are also characteristic psychological signs, including hysteria and depression. Sudden death is likely, perhaps because of massive bleeding into the joints and body cavities.

Once diagnosed, scurvy is readily reversed by vitamin C. It can be cured within about 5 days. Moderate doses in the neighborhood of 100 milligrams per day are all that are needed.

### **Recommended Intakes of Vitamin C**

It is important to remember that recommended allowances for vitamin C, like those for all the nutrients, are amounts intended to maintain health in healthy people, not to restore health in sick people. Unusual circumstances may increase nutrient needs. In the case of vitamin C, a variety of stresses deplete the body pool and may make intakes higher than 50 milligrams or so desirable. Among the stresses known to increase vitamin C needs are infections; burns; extremely high or low temperatures; toxic levels of heavy metals such as lead, mercury, and cadmium; and the chronic use of certain medications, including aspirin, barbiturates, and oral contraceptives. After a major operation (such as removal of a breast) or extensive burns, when a tremendous amount of scar tissue must form during healing, the amount needed may be as high as 1,000 milligrams (1 gram) a day or even more.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 9:**

### **• The Fat-Soluble Vitamins: A, D, E, and K**

Has it ever occurred to you how remarkable it is that you can see things? As an infant you were enchanted with the power this gave you. You closed your eyes and the world disappeared. You opened them and made everything come back again. Later you forgot the wonder of this, but the fact remains that your ability to see brings everything into being for you, more so than any of your other senses. Light reaching your eyes puts you in touch with things outside your body, from your friend sitting near you to stars in other galaxies.

Has it ever occurred to you how extraordinary it is that a child grows? From a mere nothing, a speck so tiny that it is invisible to the naked eye, each person develops into a full-size human being with arms and legs, teeth and fingernails, a beating heart and tingling nerves. Years go into the making of an adult human being, with each day bringing changes so gradual they seem undetectable. Only if you are absent during a part of this process do you notice it on your return and remark to a child, "My, how you've grown!"

And when did you last think about your breathing? In, out, in, out, day and night, year after year, you take in the oxygen you need and release it disposing of the used-up carbons whose energy moves you and keeps you alive. The nutrients discussed in this session – vitamins A, D, E, and K – are vital for these and other processes that you make often take for granted.

### **The Roles of Vitamin A**

Vitamin A has the distinction of being the first fat-soluble vitamin to be recognized. It may also be one of the most versatile, because of its role in several important body processes.

#### **Vision**

At the place where light hits the retina of the eye, profoundly informative communication occurs between the environment and the person. The eye receives the light and transforms it into signals that travel to the interior of the brain. There a mental picture forms of what the light conveys. For this to happen, the eye must perform a remarkable transformation of light energy into nerve impulses. The transformers are the molecules of pigment (rhodopsin, iodopsin, and others) in the cells of the retina. A portion of each pigment molecule is retinal, a compound the body can synthesize only if vitamin A or its relatives are supplied by the diet.

A mechanical genius could not have designed such a system better. Light itself cannot be conducted through the solid material of the brain, so it is changed into signals transmitted by nerves. But light comes in different colors (wavelengths), which convey needed information. To keep the colors sorted out, the eye uses different light-sensitive cells (cones) to receive them. Blue light is absorbed by one set of cells, green by another, and yellow-red by a third. By day, combinations of these give the full range of color vision. By night, the light entering the eye is of low intensity, and the set of cells (rods) that can receive this light are of one kind only; so by night a person can normally discern only the presence of light but not its color.

The pigment molecules inside the cells absorb the light. Each pigment molecule is composed of a protein called opsin bonded to a molecule of retinal. When a particle of light (a photon) enters the eye, it is absorbed into the retinal molecule, which responds by changing shape (it actually changes color too, becoming bleached). In its altered form retinal cannot remain bonded to opsin and so is released. This disturbs the shape of the opsin molecule.

This shape change disturbs the cell membrane, permitting charged ions to enter and leave the cell. The cell hyperpolarizes (that is, the electrical charge across its membrane changes), and an electrical impulse travels along the cell's length. At the other end of the cell, the impulse is transmitted to a nerve cell, which conveys it deeper into the brain. Thus the message is sent.

Meanwhile, back in the retina and once again in the dark, the changed molecule of retinal is converted back to its original form and rejoined to opsin to regenerate the pigment rhodopsin. Many molecules of retinal are involved in this process. There are about 6 to 7 million cone cells and 100 million rod cells in the retina, and each contains about 30 million molecules of visual pigment. Repeated small losses incurred by visual activity necessitate the constant replenishment of retinal from the blood, which brings a new supply from the body stores. Ultimately, vitamin A and its relatives in food are the sources of all the retinal in the pigments of the eye.

Bright light seen suddenly, when the eyes are dark-adapted, destroys much more retinal than light seen by day, for three reasons. First, the pupil is wide-open at night, to allow as much light as possible to enter the eye. Second a shadowing pigment that protects the rods by day withdraws at night, leaving them exposed. Third, there are many more rods than cones. Hence if a bright light suddenly shines at night through the

wide-open pupil onto the unprotected rods, much of the pigment in them is bleached and momentarily inactivated. More retinal than usual is freed, and more is lost. A moment passes before the pigments regenerate and sight returns. You no doubt remember being “blinded” on occasion by a flashlight shining directly into your eyes. People who must do a lot of night driving, facing headlights from oncoming cars, thus need an increased amount of vitamin A.

The eye is not designed for night driving or, in general, for accommodating itself to bright light at night. The mechanisms of vision evolved over millions of years, before humankind had harnessed electricity and lit up the night with headlights, beacons, and streetlights. In nature, animals in the wilderness have no need to adapt to sudden flashes of bright light at night, because they occur so seldom.

Vitamin A is undeniably an important nutrient, if for no other reason than that it plays a vital role in vision. But only one-thousandth of the vitamin A in the body is in the retina. The vitamin does other things as well.

### **Retina (RET-in-uh)**

The layer of light sensitive cells lining the back of the inside of the eye; consists of rods and cones.

### **Pigment**

A molecule capable of absorbing certain wavelengths of light, so that it reflects only those that we receive as a certain color.

### **Rhodopsin (ro-DOP-sin)**

The light-sensitive pigment of the rods in the retina.

### **Iodopsin (eye-o-DOP-sin)**

The light-sensitive pigment of the cones in the retina. Both rhodopsin and iodopsin contain retinal; the proteins are different.

### **Retinal (RET-in-al)**

The aldehyde form of vitamin A, active in the eye.

### **Cones**

The cells of the retina that respond to bright light and are responsible for color vision.

### **Rods**

The cells of the retina that respond to dim light and convey black-and-white vision.

### **Opsin (OP-sin)**

The protein portion of the visual pigment molecule.

### **Photon (FOE-ton)**

A particle of light energy. Depending on its wavelength, a photon conveys different colors of light.

### **Maintenance of Linings**

Fortunately for you, your mucosa are all intact. You may not properly appreciate what these membranes do for you, but consider how important it is that each of these surfaces should be smooth; the linings of the mouth, stomach, and intestines; the linings of the lungs and the passages leading to them; the linings of the urinary bladder and urethra; the linings of the uterus and vagina; the linings of the eyelids and sinus passageways. The cells of all these surfaces – epithelial cells – secrete a smooth and slippery substance (mucus) that coats and protects them from invasive microorganisms and other harmful particles. The mucous lining of the stomach also shields its cells from digestion by the gastric juices. In the upper part of the lungs, these cells possess little whiplike hairs (cilia), which continuously sweep the coating of mucus up and out, so that any foreign particles that chance to get in are carried away by the flow. (When you clear your throat and swallow, you are excreting this waste by way of your digestive tract.) In the vagina, similar cells sweep the mucus down and out. During an infection in any of these location, these surface cells secrete more mucus and become more active, so that a noticeable discharge occurs; when you cough it up, blow your nose, or wash it away, you help to rid your body of the infective agent.

Vitamin A plays a role in maintaining the integrity of the mucous membranes. When vitamin A is not present, the cells cannot produce the carbohydrate normally found in mucus (they produce a protein called keratin instead). Within the body, the mucous membranes line an area larger than a quarter of a football field; so this function of vitamin A accounts for most of the body's vitamin A need. As you might predict, greater losses of vitamin A occur during infection than under normal conditions.

Vitamin A is also essential for healthy skin, another one or two square meters of body surface. Thus all surfaces, both inside and out, are maintained with the help of vitamin A. It has still another role to play during growth.

### **Mucosa (myoo-COH-suh)**

The membranes composed of cells that line the surfaces of body tissues.

### **Urethra (you-REE-thruh)**

The tube through which urine from the bladder passes out of the body. The cells on the surface are known as epithelial (ip-I-THEE-lee-ul) cells.

### **Mucus (adjective mucous)**

A substance secreted by the epithelial cells of the mucosa; muco-polysaccharide.

### **Keratin (KERR-uh-tin)**

A water-insoluble protein; the normal protein of hair and nails. Keratin may be produced under abnormal conditions by cells that normally produce mucus.

### **Bone Growth**

"Growth is when everything gets bigger all together" is a child's definition. Certainly that is how it looks from the outside. Actually, however, the organs and body parts all grow at different rates with different timings. The brain, for instance, reaches 90 percent of its adult size by the time a child is two, but the testes are still baby-size when a male enters his teens. Furthermore, body parts do not just "get bigger"; bones are a case in point.

To enlarge the interior of a brick fireplace, the first thing you have to do is remove some of the old bricks. Similarly, to make a bone larger requires remodeling. To convert a small bone into a large bone, the bone-remodeling cells must "undo" some parts of the small bone as they go.

Vitamin A is required for the undoing. Some of the cells involved in bone formation are packed with sacs of degradative enzymes that can take apart the structures of bone. With the help of vitamin A in a sensitively regulated process, these cells release their enzymes, which eat away at selected sites in the bone, removing the parts that are not needed, as the bone grows longer. (A similar process occurs when a tadpole loses its tail and becomes a frog. As you know, the tail doesn't simply fall off; rather it is reabsorbed, "growing" shorter and shorter until it disappears. As a fetus you also had a tail and lost it, a process that depended on vitamin A.)

Vitamin A's roles in promoting good night vision, the health of mucous membranes and skin, and the growth of bone are well known. Others include parts it plays in:

- Reproduction.
- Maintaining the stability of cell membranes.
- Helping the adrenal glands to synthesize a hormone (corticosterone).
- Helping to ensure a normal output of the hormone thyroxin from the thyroid gland.
- Helping to maintain nerve cell sheaths.
- Assisting in immune reactions.
- Helping to manufacture red blood cells.
- Many others.

Vitamin A research still in progress is yielding many new details of how this nutrient functions in the body. Three different forms of vitamin A are active in the body; retinol (an alcohol), retinal (an aldehyde), and retinoic acid. Each has its own special binding proteins in the cells in which it works. There is also a special zinc-containing binding protein to pick up vitamin A from the liver, where it is stored, and to carry it in the blood. Cells that will receive and use vitamin A also have special receptors for it, as if it were fragile, and had to be passed carefully from hand to hand without being dropped.

Each form of vitamin A triggers specific reactions in cells that are set up to respond to it. Retinol and retinoic acid, for example, act like hormones; they travel into cells, cross the nuclear membrane, and interact with DNA, causing certain genes to express their coded instructions and make specific proteins.

## **Lysosomes (LYE-so-zomes)**

Sacs of degradative enzymes.

Lyso = to break

Soma = body

## **Vitamin A Deficiency**

Either zinc deficiency or vitamin A deficiency can cause the symptoms of vitamin A deficiency, because zinc is part of the protein that mobilizes vitamin A from the liver. Zinc is also part of the enzyme that converts retinol to retinal in the eye. If zinc status is adequate, vitamin A deficiency depends on the adequacy of vitamin A stores.

Up to a year's supply of vitamin A may be stored in the body, 90 percent of it in the liver. If you stop eating good food sources of the vitamin, deficiency symptoms will not begin to appear until after your stores are depleted. Then, however, the consequences are profound and severe.

<b>Area Affected</b>	<b>Main Effect</b>	<b>Technical Name for Symptoms</b>
<b>Eye</b>		
<b>Retina</b>	Night blindness.	
<b>Membranes</b>	Failure to secrete mucopolysaccharide causes changes in epithelial tissue and hyperkeratinization.	
<b>General</b>	Drying (mildest form). Irreversible drying and degeneration of the cornea, causing blindness (most severe).	Xerosis Keratomalacia
<b>Skin</b>	Hair follicles plug with keratin, forming white lumps.	Hyperkeratosis
<b>GI tract</b>	Changes in lining; diarrhea.	
<b>Respiratory tract</b>	Changes in lining; infections.	
<b>Urogenital tract</b>	Changes in lining favor calcium deposition, resulting in kidney stones and bladder disorders. Infections of bladder and kidney. Infections of vagina.	
<b>Bones</b>	Bone growth ceases; shapes of bones change.	
<b>Teeth</b>	Enamel-forming cells malfunction; teeth develop cracks and tend to decay; dentin-forming cells atrophy.	
<b>Nervous System</b>	Brain and spinal cord grow too fast for stunted skull and spine; injury to brain and nerves cause paralysis.	
<b>Immune System</b>	Depression of immune reactions.	
<b>Blood</b>	Anemia, often masked by dehydration.	

## **Enamel**

The hard mineral coating on the outside of the tooth composed of calcium compounds embedded in a fine network of keratin fibers.

## **Dentin**

The softer material underlying the enamel of the tooth, composed of calcium compounds embedded in a network of collagen fibers.

## **Impaired Night Vision**

If the blood bathing the cells of the retina does not supply sufficient retinal to rapidly regenerate visual pigments bleached by light, then a flash of bright light at night will be followed by a prolonged spell of night blindness. This is one of the first detectable signs of vitamin A deficiency. Because night blindness is easy to test, it aids in diagnosis of the condition. (Of course it is only a symptom, and may indicate some condition other than vitamin A deficiency.)

## **Night Blindness**

Slow recovery of vision after flashes of light at night; an early symptom of vitamin A deficiency.

## **Roughened Surfaces**

Instead of staying smooth and well rounded and producing normal mucus, the epithelial cells flatten and harden with vitamin A deficiency, losing their protective mucous coating and filling with keratin instead. In the eye this process leads to drying and hardening of the cornea, which may progress to permanent blindness. In the mouth, drying and hardening of the salivary glands makes them susceptible to infection; failure of mucous secretion in the mouth may lead to loss of appetite. Mucous secretion in the stomach and intestines is reduced, hindering normal digestion and absorption of nutrients, causing diarrhea, and so indirectly worsening the deficiency. Infections of the respiratory tract, the urinary tract, and the vagina are also made more likely by vitamin A deficiency. On the outer body surface, the cells also harden and flatten, making the skin dry, rough, scaly, and hard. Around each hair follicle an accumulation of hard material makes a lump.

## **Keratinization**

The epithelial cells fill with keratin in a process known as keratinization. The progression of this condition to the extreme is hyperkeratosis.

Hyper = too much

## **Xerophthalmia (zer-off-THAL-mee-uh)**

IN the eye, the symptoms of vitamin A deficiency are collectively known as xerophthalmia.

Xero = dry

Ophthalm = eye

## **Keratomalacia**

An early sign is cerosis (drying of the cornea); the latest and most severe stage is keratomalacia (total blindness).

Malacia = softening, weakening

## **Cornea (KOR-nee-uh)**

The transparent membrane covering the outside of the front of the eye.

## **Follicular Hyperkeratosis**

The accumulation of this hard material, keratin, around each hair follicle is follicular hyperkeratosis.

## **Follicle (FOLL-I-cul)**

A group of cells in the skin from which a hair grows.

## **Abnormal Growth**

Because growth and development of the brain and eyes are most rapid in the unborn and in the very young, the effects of vitamin A deficiency are most severe at and around the time of birth. For example, in a child of one or two, stunted growth of the skull may cause crowding of the brain (which is growing rapidly at that age) mimicking the signs of a brain tumor. Tooth growth may also be abnormal. Crooked teeth in a child may reflect a vitamin A deficiency suffered by its mother while its jawbones were forming during her pregnancy. Damage to the eyes is also most pronounced in the young, with blindness the result in thousands of cases of vitamin A deficiency throughout the world. Among nutrition problems afflicting the young of the world, vitamin A deficiency is second in extent only to protein-kcalorie malnutrition.

In the United States as well, the problem of vitamin A deficiency is all too common. The Ten-State Survey revealed that a third of the children under six who were examined had less than the recommended vitamin A intakes. Spanish-Americans and blacks exhibited the most pronounced evidence of deficiency. In the more recent Nation-wide Food Consumption Survey, similarly, about a third of the population surveyed has intakes below two-thirds of the RDA. Some subgroups of the Canadian population are also deficient, notably Canadian and Eskimo women, especially during their pregnancies.

A major source of vitamin A is vegetables, and a probable reason for widespread deficits of vitamin A in children is their refusal to eat vegetables. A section of Session 14 emphasizes the importance of encouraging children to like vegetables and suggests practical ways to ease their acceptance.

## **Retinol-Binding Protein (RBP)**

The protein that carries retinol in the blood. Measurement of RBP is a sensitive indicator of vitamin A status.



**Caution:**

Naiveté on the part of the well intentioned can cause more harm than good, a result often observed when attempts are made to remedy the problem of malnutrition in the underdeveloped countries. Awareness of the way nutrients function in the body and of their interdependence must precede efforts to correct malnutrition problems, as the case of vitamin A illustrates.

Vitamin A depends on proteins, notably the retinol-binding protein, and on the mineral zinc for its functions and transport in the body. In protein-kcalorie malnutrition, when vitamin A stores are also low, there is a balance of a kind. But when protein is given without supplemental vitamin A, protein carriers that are synthesized in response deplete the liver of the last available stores of vitamin A, thus precipitating a deficiency. Administration of protein has been observed to cause an epidemic of blindness, and when skim milk was offered by UNICEF to children in Brazil. Vitamin A capsules were supplied with the milk, but the parents often ate the capsules or sold them, giving only the milk to the children.

The mineral zinc is also needed, both to free vitamin A from liver storage for transport, and to help an enzyme in the retina to convert retinol to retinal. An apparent vitamin A deficiency may reflect an underlying zinc deficiency that must first be corrected. These examples illustrate the point that whenever nutrition help is given, knowledge must accompany that help.

**Vitamin A Toxicity**

Vitamin A toxicity occurs when all the binding proteins for vitamin A are swamped and free vitamin A attacks the cells. Such effects are not likely if you depend on foods for your nutrients, but if you take pills or supplements containing the vitamin, toxicity is a real possibility. Overdoses have serious effects on the same body systems that exhibit symptoms in vitamin A deficiency. Children are most likely to be affected, because they need less, they are smaller and more sensitive to overdoses, and it is easy to give them too much in pill form or in other concentrates. The availability of breakfast cereals, instant meals, fortified milk, and chewable candy-like vitamins, each containing 100 percent of the recommended daily intake of vitamin A, makes it possible for a well-meaning parent to provide several times the daily allowance of the vitamin to a child in a few hours. Serious toxicity is seen in small infants when they are given more than ten times the recommended amount every day for weeks at a time. A child herself may also overdose. Liking vitamin pills and thinking of them as candy, she may eat several.

There is a wide range of vitamin A intakes in which neither deficiency nor toxicity symptoms appear. Recommended intakes in both the United States and Canada are set at about double the minimum necessary to prevent deficiency. Doubtless, many people need not consume amounts this high. The exact upper limit of safety can't be determined exactly, because people's tolerances to overdoses vary. Probably the amount of added vitamin A that anyone can tolerate depends on the length of time he takes it and on how much of the vitamin has already accumulated in his body stores before he begins the overdose. Alcohol use makes vitamin A toxicity more likely.

In one case, toxic effects were reported in a person who took daily doses 10 times the recommended intake for only one month; but in others it may take 40 times the recommended intake for several months to elicit symptoms of toxicity. The National Nutrition Consortium advises that adults should avoid intakes of more than 5 to 10 times the recommended amounts to ensure safety. In general, it makes sense to get your vitamin A from natural, mostly plant, sources.

It is possible to suffer toxicity symptoms only when excess amounts of the preformed vitamin from animal foods or supplements are taken. The precursor, beta-carotene, which is available from plant foods, is not converted to vitamin A rapidly enough in the body to cause toxicity but is instead, stored in fat depots as carotene. Being yellow in color, it may accumulate under the skin to such an extent that the overdoser actually turns yellow.

**Preformed Vitamin A**

Vitamin A in its active form.

**Precursor**

A compound that can be converted into active vitamin A.

**Beta-Carotene**

A vitamin A precursor found in plants.

## Osteoclasts

The cells that destroy bone during its growth. Those that build bone are osteoblasts.

Osteo = bone

Clast = break

Blast = build

## Jaundice (JAWN-diss)

Yellowing of the skin; a symptom of liver disease, in which bile and related pigments spill into the bloodstream.

Disease	Area Affected	Main Effects
<b>Hypervitaminosis A</b>	Bones	Increased activity of osteoclasts causes decalcification, joint pain, fragility, stunted growth, thickening of long bones; pressure increases inside skull, mimicking brain tumor.
	Blood	Red blood cells lose hemoglobin and potassium; menstruation ceases; clotting time slows; bleeding is easily induced.
	Immune System	Stimulation of immune reactions.
	Nervous System	Loss of appetite, irritability, fatigue, restlessness, headache, nausea, vomiting, muscle weakness, interference with thyroxin.
	GI tract	Nausea, vomiting, abdominal pain, diarrhea, weight loss.
	Skin	Dryness, itching, peeling, rashes, dry scaling lips, loss of hair, brittle nails.
	Liver	Jaundice, enlargement, massive accumulation of fat and vitamin A.
	Spleen	Enlargement
<b>Hypercarotenemia</b>	Skin	Yellow color

### **Caution:**

Adolescents should be warned that massive doses of vitamin A taken internally will have no beneficial effect on acne but may cause the miseries in the table above. The belief that vitamin A cures acne arises from the knowledge that it is needed for the health of the skin. As with all nutrients, however, the vitamin promotes health when enough is supplied; more than enough has no further beneficial effects.

However, a relative of vitamin A, vitamin A acid, does sometimes help relieve the symptoms of acne when applied directly to the skin surface. The acid helps loosen the plugs that may accumulate in pores, allowing the skin to cleanse itself naturally. Such a treatment should of course be undertaken only on a doctor's recommendation.

Some of vitamin A's relatives may have a preventive role with respect to cancer. Retinol itself is not one of these, but this doesn't stop gullible people from taking massive doses of vitamin A in the hope of preventing cancer. It is expected that more cases of vitamin A toxicity will be reported in the years to come.

## Vitamin A in Foods

Vitamin A terminology is in a period of transition. Vitamin A occurs in a number of different forms, and these convert to the active forms in the body with different efficiencies. In animal foods, vitamin A occurs as retinol-like compounds, which convert, to retinol and its relatives in the body with high efficiency. In plant foods, no biologically active, preformed vitamin A occurs, but plant pigments known as carotenoids can be converted to vitamin A in the body with a lower efficiency. The most active of the carotenoids is beta-carotene. When beta-carotene is split, it yields two molecules, which are converted to retinol.

The active form of vitamin A used for reference is retinol, and the recommended amounts of vitamin A are stated in terms of retinol equivalents (RE). As of 1980, both US and Canadian authorities were using this terminology and were recommending 1,000 RE per day for adult men and 800 RE for women.

## Retinol

One of the active forms of vitamin A, similar to retinal. Retinol is an alcohol; retinal is an aldehyde.

## RE (retinol equivalent)

A measure of vitamin A activity; the amount of retinol that a vitamin A compound will yield after conversion in the body.

The amounts of vitamin A found in foods, however, are often still reported using an older system of measurement, international units (IU), which are based on some assumptions now known to be not completely

correct. In the future, tables of food composition will report the vitamin A activity in foods in RE. Until they do, you will have to do some computing if you wish to use a table of food values expressed in IU to estimate your vitamin A intake. You will have to remember both terms, RE and IU, and the fact that 1 RE is roughly equivalent to 3.33 IU of vitamin A from animal tissues or 10 IU from plant tissues.

### **IU (international unit)**

A measure of vitamin activity, determined by such biological methods as feeding a given compound to vitamin-deprived animals and measuring the number of units of growth produced. This system was used to measure vitamin A before chemical analysis of the vitamin A compounds and their precursors were possible.

**1 RE = 3.33 IU from animal foods or 10 IU from plant foods.  
(ON the average, 1 RE = about 5 IU)**

The major vitamin A contributors among foods are almost all brightly colored – green, yellow, orange, and red. Any plant food with significant vitamin A activity must have some color, since the vitamin and its plant precursor carotene are colored compounds themselves (vitamin A is a pale yellow; carotene is a rich, deep yellow, almost orange). The dark-green, leafy vegetables contain abundant amounts of the green pigment chlorophyll, which masks the carotene in them. A skilled hostess or restaurateur knows that an attractive meal includes foods of different colors that complement one another, but may not be aware that such a meal probably ensures a good supply of vitamin A as well.

On the other hand, food with a yellow or orange color does not invariably contain vitamin A or carotene. Many of the compounds that give foods their colors, such as the yellow and red xanthophylls, are unrelated to vitamin A and have no nutritional value.

On the third hand, if a plant food is white or colorless, you can be sure it contains little or no vitamin A.

About half of the vitamin A activity in foods consumed in the United States comes from fruits and vegetables, and half of this comes from the dark leafy greens (not iceberg lettuce or green beans) and the rich yellow or deep orange vegetables, such as squash, carrots, and sweet potatoes (not corn). The other half comes from milk, cheese, butter, and other dairy products; eggs; and meats. Since Vitamin A is fat-soluble, it is lost when milk is skimmed. Skim milk is often fortified with 2,000 IU (or about 40 percent of the intake recommended for men) of vitamin A per quart to compensate. The butter substitute, margarine, is usually fortified with 15,000 IU (4,500 RE) per pound. Milks and margarines may also be fortified with vitamin D; read the label to find out.

The safest and easiest way to meet your vitamin A needs, then, is to consume generous servings of a variety of dark-green and deep-orange vegetables and fruits. A one-cup serving of carrots, sweet potatoes, or dark greens such as spinach would provide such liberal amounts of carotenoids that, even allowing for inefficiency absorption and conversion, intake would be sufficient. Alternatively, a diet including more or larger servings of medium sources would ensure an ample intake. No doubt you can find food sources of the vitamin that appeal to you and can easily calculate the minimum amounts you should eat to meet your needs.

The fruit and vegetable family is, of course, one of the four food groups. Its importance for meeting vitamin A needs is reflected in the recommendation that adults have at least four servings a day, including “at least one dark-green or deep-orange” item every other day.

Fast foods are notable for the lack of vitamin A. Anyone who dines frequently on hamburgers, French fries, shakes, and the like is advised to emphasize vegetables heavily – and not just salads – at other meals.

One animal food notable for its vitamin A content is liver. A moment’s reflection should reveal the reason for this. Vitamin A not needed for immediate use is stored in the liver. Some nutritionists recommend that people include a serving of liver in their diets every week or two, partly for this reason.

People sometimes wonder if vitamin A toxicity can result from using liver too frequently. This problem has never been observed except in the arctic, where explorers who have eaten large quantities of polar bear liver have become ill with symptoms suggesting vitamin A toxicity. Liver is an extremely nutritious food, and its periodic use is highly recommended.

### **Chlorophyll**

Chlorophyll is the green pigment of plants, which absorbs photons and transfers their energy to other molecules, initiating photosynthesis.

## **Photosynthesis**

Photosynthesis is the synthesis of carbohydrates by plants from carbon dioxide and water, using the sun's energy.

## **Folacin**

Recall that Folacin, too, is found most abundantly in dark-green vegetables.

## **The Roles of Vitamin D**

Vitamin A helps to remodel bones; vitamin D helps to mineralize them. It is a member of a large and cooperative bone-making and maintenance team made up of nutrients and other compounds, including vitamin C; the hormones parathormone and calcitonin; the protein collagen, which underlies and supports bone; and the minerals calcium, phosphorus, magnesium, fluoride, and others, which compose the inorganic part of bone.

Blood calcium is very active metabolically. It has been estimated that about a fourth of the calcium in the blood is exchanged with bone calcium every minute. The special function of vitamin D is to help make calcium and phosphorus available in the blood that bathes the bones, to be deposited as the bones harden (mineralize).

Vitamin D raises blood concentrations of these minerals in three ways: by stimulating their absorption from the GI tract; by helping to withdraw calcium from bones into the blood; and by stimulating calcium retention by the kidneys. The star of the show is calcium itself; vitamin D is a director.

A description of how calcium moves from food into the blood and into and out of bone is reserved for Session 10, where a closer view of the whole system is provided. The object here is to make you aware of the importance of vitamin D, the risks of deficiency and toxicity, and the ways in which the vitamin can be obtained.

Vitamin D is different from all the other nutrients in that the body can synthesize it with the help of sunlight. Therefore, in a sense, vitamin D is not an essential nutrient. Given enough sun, you need consume not vitamin D at all in the foods you eat. Rather, it is like a hormone – a compound manufactured by one organ of the body that has effects on another. And like certain hormones, it can actually enter a cell, cross the nuclear membrane, attach to specific receptors on the DNA or its protein wrapping, and promote the synthesis of specific proteins.

The liver manufactures a vitamin D precursor, which is released into the blood and circulates to the skin. When ultraviolet rays from the sun hit this compound, it is converted to previtamin D<sub>3</sub>, which works its way back into the interior of the body. Slowly, then, over the next 36 hours, the previtamin is converted with the help of the body's heat to vitamin D<sub>3</sub>. Two more steps occur before the vitamin becomes fully active. First, the liver adds an OH group, and then the kidney adds another OH group at specific locations to produce the active vitamin. (This is why diseases affecting either the liver or the kidney exhibit symptoms of bone deterioration.) Active vitamin D then promotes the making of several proteins that help with calcium transport into the intestinal cell, and assists them in their action. It also has specific attachment sites in the brain, parathyroid glands, bone, and kidney, where it is thought to regulate the production of proteins that manage calcium homeostasis. In the pancreas, it affects insulin secretion.

There are two ways to meet your vitamin D needs. You can synthesize it yourself with the help of sunlight, or you can eat foods containing the preformed vitamin – chiefly animal foods.

## **7-dehydrocholesterol**

The precursor of vitamin D made in the liver is 7-dehydrocholesterol, which is made from cholesterol. This is one of the body's many "good" uses for cholesterol. The technical name for the final product, active vitamin D, is 1,25-dihydroxycholecalciferol – dihydroxy vitamin D for short.

## **Mineralization (Calcification)**

Mineralization is the process in which calcium, phosphorus, and other minerals crystallize on the collagen matrix of a growing bone, hardening the bone.

## **Vitamin D Deficiency and Toxicity**

Both inadequate and excessive vitamin D intakes take their toll in the United States and Canada, despite the fact that the vitamin has been known for decades to be essential for growth and toxic in excess. The Ten-State Survey conducted in the late 1960s revealed that nearly 4 percent of the children under six who were examined showed evidence of vitamin D deficiency, with several cases of overt rickets. (The more recent Nationwide Food Consumption Survey did not assess vitamin D.) The National Nutrition Survey in Canada revealed low intakes of vitamin D in women and children but no overt cases of rickets – although they may exist in persons not tested. Worldwide, rickets still afflicts large numbers of children.

The symptoms of an inadequate intake of vitamin D are those of calcium deficiency. The bones fail to calcify normally and may be so weak that they become bent when they have to support the body's weight. A child with rickets who is old enough to walk characteristically develops bowed legs, often the most obvious sign of the disease.

Adult rickets, or osteomalacia, occurs most often in women who have low calcium intakes and little exposure to sun, and who go through repeated pregnancies and periods of lactation. The bones of the legs may soften to such an extent that a girl who grows up tall and straight becomes bent, bowlegged, and stooped by the end of her second or third pregnancy.

Vitamin D deficiency depresses calcium absorption and results in low blood calcium levels and abnormal mineralization of bone. An excess of the vitamin does the opposite. It increases calcium absorption, causing abnormally high concentrations of the mineral in the blood, and promotes return of bone calcium into the blood as well. The excess calcium in the blood tends to precipitate in the soft tissue, forming stones. This is especially likely to happen in the kidneys, which concentrate calcium in the effort to excrete it. Calcification or hardening of the blood vessels may also occur and is especially dangerous in the major arteries of the heart and lungs, where it can cause death.

The range of safe intakes of vitamin D is narrower than that of vitamin A. Half the recommended intake is too little, but over a few times the recommended intake may be too much. Intakes of 100 micrograms per day cause high blood calcium levels in infants, and some infants are sensitive to lower doses than this. Intakes of 250 micrograms per day for four months or 5,000 micrograms per day for two weeks cause toxicity in children and, if further prolonged, in adults. The amounts of vitamin D found in foods available in the United States and Canada are well within these limits, but pills containing the vitamin in concentrated form should definitely be kept out of the reach of children.

### **Rickets**

Rickets is the vitamin D-deficiency disease in children. A rare type of rickets, not caused by vitamin D deficiency, is known as vitamin D refractory rickets.

### **Osteomalacia (os-tee-o-mal-AY-shuh)**

This is the vitamin D deficiency disease in adults. Osteomalacia may also occur in calcium deficiency.

Osteo = bone

Mal = bad (soft)

### **Pigeon Breast**

Bowing of the ribs causes the symptom known as pigeon breast.

### **Rachitic (ra-KIT-ik) Rosary**

The beads that form on the ribs resemble rosary beads; thus this symptom is known as rachitic rosary (the rosary of rickets)

### **Fontanel**

The fontanel is the open space in the top of a baby's skull before the skull bones have grown together.

### **Thorax**

The part of the body between the neck and the abdomen.

### **Alkaline Phosphatase**

An enzyme in the blood.

### **Vitamin D Conversion**

Vitamin D activity was previously expressed in international units (IU) but as of 1980 is expressed in micrograms of cholecalciferol. To convert, use the factor:

100 IU = 2.5 ug

400 IU = 10 ug

### **Vitamin D RDA**

The RDA for vitamin D for adults over 22 is 5-ug cholecalciferol (200 IU). Canadian Dietary Standard: 2.5-ug cholecalciferol.

## Vitamin D Deficiency

<b>Rickets</b>	Bones	<p>Faulty calcification, resulting in misshapen bones (bowing of legs) and retarded growth</p> <p>Enlargement of ends of long bones (knees, wrists)</p> <p>Deformities of ribs (bowed, with beads or knobs)</p> <p>Delayed closing of fontanel, resulting in rapid enlargement of head</p>
	Blood	Decreased calcium and/or phosphorus
	Teeth	Slow eruption; teeth not well-formed; tendency to decay
	Muscles	Lax muscles resulting in protrusion of abdomen
	Excretory system	Increased calcium in stools, decreased calcium in urine
	Glandular system	Abnormally high secretion of parathyroid hormone
<b>Osteomalacia</b>	Bones	Softening effect; deformities of limbs, spine, thorax, and pelvis; demineralization; pain in pelvis, lower back and legs; bone fractures
	Blood	Decreased calcium and/or phosphorus, increased alkaline phosphatase
	Muscles	Involuntary twitching, muscle spasms
<b>Hypervitaminosis D</b>	Bones	Increased calcium withdrawal
	Blood	Increased calcium and phosphorus concentration
	Nervous system	Loss of appetite, headache, excessive thirst, irritability
	Excretory system	Increased excretion of calcium in urine; kidney stones; irreversible renal damage
	Tissues	Calcification of soft tissues (blood vessels, kidneys, lungs), death

## Sun Exposure

Exposure to sun should be reasonable. Excessive exposure may cause skin cancer.

## Vitamin D from Sun and Foods

In rapidly growing children, an intake of close to 10 micrograms (400 IU) of vitamin D a day is recommended; mature adults need half as much. Only a few animal foods supply significant amounts of the vitamin, notably eggs, liver, and some fish, and even these vary greatly, depending on the animal's exposure to sun

and on its consumption of the vitamin in its foods. Neither cow's milk nor human breast milk supplies enough vitamin D to reliably meet human needs; hence cow's milk is fortified, and infants must be given either fortified formula or supplements. The fortification of milk with 400 IU per quart (360 IU per liter in Canada) is the best guarantee that children will meet their vitamin D needs and underscores the importance of milk in children's diets.

Significant amounts of vitamin D can be made with the help of sunlight. It is generally agreed that most adults, especially in the sunnier regions, need not make special efforts to obtain vitamin D in food. If children are taken out in the sun for a while each day at noon, they will receive a protective dose of vitamin D. However, people who are not outdoors much or who live in northern or predominantly cloudy or smoggy areas are advised to make sure their milk is fortified with vitamin D, to drink at least 2 cups a day, and to make frequent use of eggs and periodic use of liver in menu planning.

Darker-skinned people make less vitamin D on limited exposure to the sun. By 3 hours of exposure, however, vitamin D synthesis in strongly pigmented skin arrives at the same plateau as that at 30 minutes in fair skin. The difference may account for the fact that darker-skinned people in northern, smoggy cities are more prone to rickets. The experiments revealing these findings also suggest that overexposure to sun cannot cause vitamin D toxicity, because synthesis of vitamin D is limited to a fixed maximum on each exposure.

### **The Roles of Vitamin E**

Vitamin E is an antioxidant like vitamin C, but fat-soluble. If there is plenty of vitamin E in the membranes of cells exposed to an oxidant, chances are this vitamin will take the brunt of the oxidative attack, protecting the lipids and other vulnerable components of the membranes. Vitamin E is especially effective in preventing the oxidation of the polyunsaturated fatty acids (PUFA), but it protects all other lipids (for example, vitamin A) as well.

One of the most important places in the body in which vitamin E exerts its antioxidant effect is in the lungs, where the exposure of cells to oxygen is maximal. At least two kinds of cells benefit from the vitamin's protection: the red blood cells that pass through the lungs, and the cells of the lung tissue itself. The vitamin acts to:

- Detoxify oxidizing radicals that arise during normal metabolism.
- Stabilize cell membranes.
- Regulate oxidation reactions.
- Protect vitamin A and polyunsaturated fatty acids from oxidation.

Lungs are sometimes also exposed to air pollutants that are strong oxidizing agents, such as nitrogen dioxide or ozone. Ozone causes peroxidation of the cell membrane lipids. A product of this peroxidation can be measured in expired air, and some people produce more of the product when exercising in air contaminated with ozone. Vitamin E supplements restore the normal level, suggesting that vitamin E acts as a scavenger of free radicals.

Follow-up studies using animals have investigated the possibility that peroxidation can occur not only in lungs, but also in liver and adrenal tissue. In these locations, too, vitamin E seems to exert a protective effect.

The role of vitamin E in protecting red blood cell membranes has led researchers to ask whether it might protect white blood cells as well, and perhaps participate in the body's immune defenses. In deed, deficiency of vitamin E suppresses the immune system and supplementation stimulates it in several species of animals. The effect may be direct, by way of the vitamin's action in the membranes of the white blood cells when they interact with antigens, or may be indirect by way of PUFA and prostaglandins.

### **Oxidant**

A compound (such as oxygen itself) that oxidizes other compounds.

### **Radicals**

Unstable molecular intermediates that arise during oxidation reactions. They are highly reactive and readily oxidize other molecules with which they come in contact.

### **Peroxidation**

Production of unstable molecules containing more than the usual amount of oxygen. Hydrogen peroxide,  $\text{H}_2\text{O}_2$ , for example, may be produced from water,  $\text{H}_2\text{O}$ .

### **Scavenger**

A clean-up agent; for example, a garbage collector or an animal that feeds on refuse and waste. Some similar roles are played by an enzyme containing the trace element selenium. See Session 11.

## **Vitamin E Deficiency**

Studies related to vitamin E's effects have seldom revealed any carryover of animal findings to humans. In fact, of 12 possible diseases associated with vitamin E deficiency in animals, only one has been demonstrated in human beings. When the blood concentration of vitamin E falls below a certain critical level, the red blood cells tend to break open and spill their contents, probably due to oxidation of the polyunsaturated fatty acids (PUFA) in their membranes.

Except to correct erythrocyte hemolysis, no need for vitamin E supplements has been demonstrated in normal human beings under normal environmental conditions. However, abnormal environmental conditions such as air pollution may increase human vitamin E needs. Also, a great many diseases can affect people's vitamin E needs. Among individuals who benefit from vitamin E supplementation are:

- Premature infants, because the transfer of vitamin E across the placenta becomes maximal only right before full-term delivery.
- Infants, children, or adults who can't absorb fats and oils because of liver, pancreas, or gallbladder disease; GI surgery; or inherited diseases.
- Individuals with certain blood disorders.

Two other conditions seen in humans appear to be remediable by large doses of vitamin E. One, a harmless breast disease, is characterized by painful lumps in the breasts, which can be relieved with vitamin E therapy. The other, a leg problem, causes pain on walking and cramps in the calves at night, and also responds to vitamin E therapy.

Vitamin E does not prevent or cure muscular dystrophy in humans. Hereditary muscular dystrophy is a disease afflicting children, who usually die at an early age when their respiratory muscles deteriorate. Nutritional muscular dystrophy, however, is the muscular weakness produced in many animals by a deficiency of vitamin E. This deficiency leads to atrophy of the muscles; it can be cured by reintroducing vitamin E into the diet.

## **Erythrocyte (eh-REETH-ro-cite)**

The breaking open of red blood cells.

Red blood cell.

Erythro = red

Cyte = cell

## **Hemolysis (he-MOLL-uh-sis)**

The vitamin E deficiency disease in human beings. Bursting of red blood cells.

Hemo = blood

Lysis = breaking

## **Diseases Possibly Remediable by Vitamin E**

Both diseases have unwieldy names. One is fibrocystic breast disease, the other is intermittent claudication.

Caution: Other very serious conditions can cause lumps in the breasts and cramps in the legs. Don't self-diagnose; see a doctor.

Fibr = fibrous lumps

Cystic = in sacs

Intermittent = at intervals

Claudicare = to limp

## **Muscular Dystrophy (DIS-tro-fee)**

A hereditary disease in which the muscles gradually weaken; its most debilitating effects arise in the lungs.

## **Nutritional Muscular Dystrophy**

A vitamin E deficiency disease of animals, characterized by gradual paralysis of the muscles.

## **Vitamin E Toxicity**

All kinds of people take vitamin E supplements for all kinds of reasons. As a result, many signs of toxicity are now known or suspected, including disturbances of the action of many hormones, interference with vitamin K, alteration of the mechanism of blood clotting, alteration of blood lipid levels, impairment of white blood cell activity, GI distress, and many, many more. Doses of 100 IU, or certainly of 300 IU, should be considered megadoses and should only be taken on a physician's advice, with caution, or not at all.



## **Vitamin E Intakes and Food Sources**

Vitamin E is a kind of alcohol, namely a tocopherol. Several tocopherols occur in foods, the most active is alpha-tocopherol. Alpha-tocopherol occurs in two mirror-image forms, D and L (remember D and L sugars in Session 2), of which the D form is more active. Different forms of vitamin E differ in their activity; to reconcile them the recommended intake is, as of 1980, expressed in terms of “the amount of vitamin E activity equivalent to that of 10 milligrams of D-alpha-tocopherol.” Many people were surprised when, in 1980, the RDA for vitamin E appeared to have dropped from the 15 units recommended in 1974 to 10 units. Actually, the units changed, and 15 of the old units give the same activity as 10 of the new ones. The amount of vitamin E recommended is the same.

A person's need for vitamin E is higher if the amount of PUFA he consumes is higher. Fortunately, vitamin E and the polyunsaturates tend to occur together in the same foods.

Vitamin E is widespread in foods. About 60 percent of the vitamin E in the diet comes directly or indirectly from vegetable oils in the form of margarine, salad dressings, and shortenings; another 10 percent comes from fruits and vegetables; smaller percentages come from grains and other products. Soybean oil and wheat germ oil have especially high concentrations of vitamin E; cottonseed, corn, and safflower oils rank second, with a tablespoon of any of these supplying more than 10 milligrams (more than the RDA) of the vitamin. Other oils contain less (for example, peanut oil supplies about half as much per tablespoon). Animal fats such as butter and milk fat have negligible amounts of vitamin E.

Vitamin E is readily destroyed by heat processing and oxidation, so fresh or lightly processed foods are preferable as sources of this vitamin. The processed and convenience foods often used by the elderly and nursing homes may contribute to a vitamin E deficiency if their use continues over several years.

## **Tocopherol (tuh-KOFF-er-all)**

A kind of alcohol. Alpha-tocopherol is one of several forms of tocopherol, and D-alpha-tocopherol is the “right-handed” version.

## **Vitamin E RDA**

The RDA for vitamin E for adults is:

10 mg for men

8 mg for women

## **Vitamin K**

Vitamin K seems to act primarily in the blood clotting system. There, its presence can make the difference between life and death. At least 13 different proteins and the mineral calcium are involved in making a blood clot, and vitamin K is essential for the synthesis of at least 4 of these proteins, among them prothrombin, the precursor of the protein thrombin.

When any of these factors is lacking, blood cannot clot and hemorrhagic disease results; if an artery or vein is cut or broken under these circumstances, bleeding goes unchecked. (As usual, this is not to say that the cause of hemorrhaging is always vitamin K deficiency. Another cause is hemophilia, which is not curable by vitamin K.) Deficiency of vitamin K may occur under abnormal circumstances when absorption of fat is impaired (that is, when bile production is faulty, or in diarrhea). The vitamin is sometimes administered before operations to reduce bleeding in surgery but is of value at this time if the vitamin K deficiency exists. Toxicity is not common but can result when water-soluble substitutes for vitamin K are given, especially to infants or to pregnant women. Toxicity symptoms include red cell hemolysis, jaundice, and brain damage.

Vitamin K can be made within your GI tract – but not by you. In your intestinal tract there are billions of bacteria, which normally live in perfect harmony with you, doing their thing while you do yours. One of their “things” is synthesizing vitamin K that you can absorb. You are not dependent on bacterial synthesis for your vitamin K, however, since many foods also contain ample amounts of the vitamin, notably green leafy vegetables, members of the cabbage family, and milk.

The body resists vitamin K deficiency and it is seldom seen except when an unusual combination of circumstances conspire to bring it about. When it does occur, however, it can be fatal. The scenario goes like this: a patient is in the hospital; he has been given antibiotics to prevent or overcome infection, and he is being fed a formula diet that does not include vitamin K. The antibiotics have killed his intestinal bacteria, and his vitamin K stores are depleted. Now he goes into surgery, and when he bleeds, his blood fails to clot normally, so he bleeds to death. The combination of antibiotics, unsupplemented formula diet, and surgery raises a warning flag and requires that clotting time be checked before surgery is performed.

Brand new babies are commonly susceptible to a vitamin K deficiency, for two reasons. First, a baby is born with a sterile digestive tract; he has his first contact with intestinal bacteria as he passes down his mother's birth canal, and it takes the bacteria a day or so to establish themselves in the baby's intestines. Second, a baby may not be fed at the very outset (and breast milk is a poorer source of vitamin K than cow's milk). A dose of vitamin K (usually in a water-soluble form similar but not identical to the natural vitamin) may therefore be given at birth to prevent hemorrhagic disease of the newborn; it must be administered carefully to avoid toxic overdosing. People taking sulfa drugs, which destroy intestinal bacteria, may also become deficient in vitamin K.

**Vitamin K**

K stands for the Danish word koagulation (coagulation or clotting)

**Hemorrhagic (hem-o-RAJ-ik) Disease**

The vitamin K deficiency disease.

**Hemophilia**

A hereditary disease having no relation to vitamin K but caused by a genetic defect that renders the blood unable to clot because of lack of ability to synthesize certain clotting factors.

**Jaundice**

Yellowing of the skin, due to spillover of bile pigments from the liver into the general circulation.

**Intestinal Flora**

The bacterial inhabitants of the digestive tract.

Flora – plant inhabitants

**Sterile**

Free of microorganisms, such as bacteria.

**Menadione (men-uh-DYE-own)**

The synthetic substitute usually given for vitamin K.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 10:**

### **• Water and the Major Minerals**

Water and dissolved minerals provide the medium in which nearly all of the body's reactions take place, participate in many of these reactions, and supply the means for transporting vital materials to cells and waste products away from them. Every cell in the body is bathed in a fluid of the exact composition that is best for it. Each of these fluids is constantly undergoing loss and replacement of its constituent parts as cells withdraw nutrients and oxygen from them and excrete carbon dioxide and other waste materials into them. Yet the composition of the body fluids in each compartment remains remarkably constant at all times. Every important constituent of body fluids is similarly regulated. The interstitial fluid, for example, always has a high concentration of sodium and chloride ions and lower concentrations of about eight other major ions. The intracellular fluid always has high potassium and phosphate concentrations and lower concentrations of other ions. These special fluids regulate the functioning of cells; the cells in turn regulate the composition and amount of the fluids. The entire system of cells and fluids remains in a delicate but firmly maintained state of dynamic equilibrium.

The maintenance of this balance is so important that it is credited with our ability and that of other animals to live on land. It is thought that we had single-celled ancestors that depended on the seawater they lived in to provide nutrients and oxygen and to carry away their waste. We have managed over the course of our 2-billion-year evolutionary history to internalize the ocean – to continue bathing our cells in a warm nutritive fluid that keeps them alive. The amounts of salts in our body fluids, and their temperature, are believed to be the same as in the ocean – not as it is now, but as it was at the time when our ancestors emerged onto land. The ocean has since become saltier, but we still carry the ancient ocean within us.

This session first introduces you to water itself; then to the minerals that contribute to salt balance, and then to the body's other major minerals.

#### **Salt**

Salt does not refer only to sodium chloride but also to ionic compounds.

#### **Water in the Body**

Water in the body is a river coursing through the arteries, capillaries, and veins, carrying a heavy traffic of nutrients and waste products. Water molecules also nestle inside the body's giant proteins, glycogen, and other macromolecules, helping to form their structure. It constitutes about 55 to 60 percent of an adult's body weight.

Water also serves many other functions:

- It participates actively in many chemical reactions.
- It serves as the solvent for minerals, vitamins, amino acids, glucose, and a multitude of other small molecules.
- It acts as a lubricant around joints.
- It serves as a shock absorber inside the eyes, spinal cord, and amniotic sac in pregnancy.
- It aids in the body's temperature maintenance.

#### **The Constancy of Total Body Water**

The total amount of water in the body remains constant, thanks to the delicate balancing mechanisms that regulate intake and excretion.

Thirst governs water intake; when you need water, you drink. The evidence from experiments with thirst points to the possibility that several mechanisms operate in its regulation. One is in the mouth itself. When the blood is too salty (having lost water but not salts), water is withdrawn from the salivary glands into the blood. The mouth becomes dry as a result, and you drink to wet your mouth. Another thirst mechanism is in a brain center, where cells sample and monitor the salt concentration in the blood. When they find it too high, they initiate impulses that travel to brain centers that in turn stimulate drinking behavior. The stomach may also play a role. Thirsty animals drink until nerves in their stomachs, known as stretch receptors, are stimulated enough to turn off the drinking. More must be learned about these mechanisms, but it is clear from what we know already that thirst is finely adjusted to provide a water intake that exactly meets the need.

#### **Water**

Water follows salt, moving in the direction of higher osmotic pressure.

## **Hypothalamus (hy-po-THAL-a-mus)**

The brain center described here is the hypothalamus.

The mechanism of water excretion involves the brain and the kidneys. The cells of the hypothalamus, which monitor salt concentration in the blood, stimulate the pituitary gland to release a hormone, ADH, whenever the body's salt concentration is too high. ADH stimulates the kidneys to hold back (actually, reabsorb) water, so that it recirculates rather than being excreted. Thus the more water you need, the less you excrete. There are also cells in the kidney itself that are responsive to the salt concentration in the blood passing through them. When they sense a too-high salt concentration, they too release a substance. By a roundabout route, this substance also causes the kidneys to retain more water. This substance is the enzyme renin (REEN-in). Again, the effect is that when more water is needed, less is excreted.

These renal excretion mechanisms cannot work by themselves to maintain water balance unless you drink enough water. This is because the body must excrete a minimum amount of water each day --the amount necessary to carry away the waste products generated by the day's metabolic activities. Above this amount (a minimum of about 500 milliliters a day), the amounts of water you excrete can be adjusted to balance your intake. The urine merely becomes more dilute. Hence drinking plenty of water is never a bad idea.

## **ADH (antidiuretic hormone)**

ADH is a hormone that is released by the pituitary gland in response to high osmotic pressure of the blood. The kidney responds by reabsorbing water.

In addition to the obvious dietary source, water itself, nearly all foods contain water. In addition, water is generated from the energy nutrients in foods. Daily water intake from these three sources totals on the average about 2-1/2 liters (about 2-1/2 quarts). Similarly, in addition to the water excreted via the kidneys, some water is lost from the lungs as vapor, some in feces, and some from the skin. The losses of all of these also total about 2-1/2 liters a day on the average.

## **Liter**

A liter is roughly the same size as a quart. A U.S. quart is a little smaller and a Canadian (imperial) quart a little bigger than a liter.

## **The Water Supply**

When you draw water from the tap into a glass and drink it, it is not only water that you are drinking. Chlorine may have been added to it, to kill microorganisms that might otherwise convey disease. Fluoride may have been added to it, if your community has adopted fluoridation. In addition, it contains naturally occurring minerals, toxic heavy metals, live microorganisms, and a miscellany of organic compounds. Most people in the more developed countries take their water supply for granted and assume that is pure and safe. At the same time, they may be very much concerned over the presence of incidental additives in food. Actually, water may contain "incidental additives" of greater significance to human health than those in foods.

The quality of water varies, depending on the source. To learn about the water in your area, you may want to consult your local health department. The variables affecting water quality fall into four groups: minerals, heavy metals, microorganisms, and organic compounds. In addition, there are important questions to ask about water quantity.

## **Minerals in the Water Supply**

The entire 20-odd major and trace minerals discussed in this session and the next are present in various ground waters in different concentrations. Often they make significant contributions as nutrients to the health of the people who drink the water. Few communities have yet analyzed their water supplies completely enough to state which mineral needs they may be helping to meet, but most at least have information about the major minerals.

The distinction between hard and soft water, which has some important health implications, is based on three of these minerals. Hard water usually comes from shallow ground, and it contains high concentrations of the cations calcium and magnesium. Soft water usually comes from deep in the earth, and its principal cation is sodium. Well water is hard or soft, depending on the area. Most people distinguish between these two types of water in terms of their practical experience. Soft water dissolves soap better and leaves less of a ring on the tub; hard water leaves a residue of rocklike crystals in the teakettle after a while, and turns clothes gray in the wash. Hence consumers often consider soft water to be the more desirable and may even purchase water-softening equipment, which removes magnesium and calcium and replaces them with sodium. However, as far as we know today, hard water seems to support health better.

Soft water can add appreciable sodium to people's diets, and it appears to contribute to a higher incidence of high blood pressure and heart disease in areas where it is used. The National Academy of Sciences has suggested a standard for public water allowing no more than 100 milligrams of sodium per liter. This limit would ensure that the water supply would add not more than 10 percent of the average person's total sodium intake. The American Heart Association has recommended a more conservative standard of 20 milligrams per liter, to protect heart and kidney patients whose sodium intakes must be restricted. At present, about half the U.S. population drinks water containing more than 20 milligrams per liter. Where snowy roads are salted, the salt running off into the water supply may raise its sodium content considerably higher than this.

Soft water also dissolves certain metals, such as cadmium and lead, from pipes. Cadmium is not an essential nutrient. In fact, it can harm the body, affecting at least some enzymes by displacing zinc from its normal sites of action. Cadmium has been found in high concentrations in the kidneys and urine of patients with high blood pressure and is suspected of having some causal connection with the condition. A normal intake of zinc may protect against cadmium-induced high blood pressure. Lead is another toxic metal, and the body seems to absorb it more readily from soft than from hard water – possibly because the calcium in hard water protects against its absorption.

**Caution:**

The examples just given show that the choice to install a water softener in your home may be unwise, especially if your family is heart disease prone. (One family we know solves the problem by connecting the water softener only to the hot-water line, then using hot water for washing and bathing, and only cold water for cooking and drinking.) These examples also show that the minerals in water interact in unpredictable ways. Someday we may be able to fortify our water with the ideal amounts of minerals for human consumption. But before that time arrives, we have much to learn about what is in the water already and what is ideal for humans.

**Toxic Metals in the Water Supply**

In the wilderness, water cycles rapidly through living systems, undergoing a natural purifying process in every cycle. Animal waste excreted into the earth is filtered out by the soil before the water arrives underground. Pollutants entering rivers quickly disappear back into the earth as the rivers flow along, leaving the water pure. But neither the earth nor its rivers can purify completely the heavily polluted water expelled as city sewage or industrial waste. Water leaving a factory may contain concentrations of toxic metals so high that some are still present when it is recycled to become drinking water. And if the water is cycled through the same factory again, it will contain still higher concentrations the next time around.

Human technology bears the burden of purifying water contaminated by human technology. The Public Health Service sets drinking water standards (upper limits for the amounts of toxic metals permitted in water), and public law distributes the responsibility for adhering to these standards among the industries and the water-processing plants.

The metals of greatest concern are mercury, cadmium, and lead. These metals may be absorbed in to the body, where they change cell membrane structure, alter enzyme or coenzyme functions, or even change the structure of the genetic material, DNA, causing cancer or birth defects. If they happen to alter the DNA in the germ cells (eggs or sperm), the changes (mutations) will become hereditary. When combined into complexes with organic compounds, these metals may be absorbed especially rapidly and may damage body tissue even more.

Mercury is one of the rarer elements in the earth's crust, but has been mined extensively for industrial use; and so it is present in our environment in unnaturally high concentrations. Much of it ends up in the water supply as mercury compounds. By far the most toxic of these is methyl mercury, which is efficiently (90 percent) absorbed in the GI tract and accumulates in red blood cells, the brain, and the nerves. In pregnant women, methyl mercury becomes concentrated in the growing fetus. Thus it can cause mental and physical defects in the newborn even though the mother has shown no symptoms.

Nerve damage occurs with mercury intakes as low as 300 micrograms per day, so the Food and Drug Administration (FDA) has set a limit of one-tenth that amount on the mercury levels in foods and drugs. (Monitoring mercury concentrations in water is a task of the public health agencies, such as the Environmental Protection Agency.) Two serious outbreaks of mercury poisoning have occurred in Japan, where people have eaten fish that grew near industrial plants that discharged mercury wastes into the water. Rising levels of environmental mercury have been observed in other industrial countries, including the United States.

Cadmium has its most toxic effects in the kidney, causing chronic renal disease; in the lungs, causing emphysema; and in the bones, causing osteoporosis and osteomalacia. It has been in commercial use since 1910 and has caused severe outbreaks of disease in Japan. Cadmium in contaminated water can be

absorbed into vegetables and grains and so can find its way into human consumers of these foods.

Lead, another highly toxic material, enters the water supply mostly by being captured in rain falling from atmospheres polluted with automobile exhaust. It is a metabolic poison that interferes with the action of several enzymes. Symptoms of mild lead poisoning include lowered hemoglobin, intestinal cramps, fatigue, and kidney abnormalities. These may be reversible if exposure stops. More severe exposure causes irreversible nerve damage, paralysis, mental retardation in children, abortions, and death.

These are only three examples of metal pollutants, but they are enough to illustrate how the purity of the water supply can be threatened by industrial use. Both government and consumer environmental protection groups have to be vigilant in detecting, reporting, and preventing dangerous levels of contamination, because our water is a vital resource.

### **Microorganisms in the Water Supply**

Many harmless, even beneficial, bacteria dwell in the human digestive tract and are excreted into sewage. If these were the only inhabitants of sewage, there would be no concern about their presence in drinking water. But disease organisms are also excreted into sewage, and others are introduced into it by flies and other carriers. Before a sewage treatment plant releases its effluent into the water supply, it must reduce the bacterial count enough so that the further dilution that follows will make recycled water safe for human use.

An efficient secondary sewage plant may remove 99 percent of the bacteria in the water, which sounds pretty good for a start. But there are typically 10 million bacteria in a milliliter (1/5-teaspoon) of sewage. After 99 percent removal there will still be 100,000 bacteria left in each milliliter. Chlorination then kills another 99 percent, leaving 1,000 bacteria per milliliter. Most of these are harmless, and the few that are harmful can be diluted below the danger point if the water leaving the plant enters a large river. Alternatively, the facility may give the water tertiary treatment, sprinkling it over a large land area so that it will be filtered before reentering the general water supply.

High standards for sewage treatment in the developed countries ensure that most people have potable water, but for the rest of the world, microbial contamination remains the primary cause of human diseases and epidemics. Two of the most basic public health needs of the world's people are safe drinking water and an acceptable standard of waste disposal.

### **Sewage Treatment**

The first step in sewage treatment allows the solids to settle out. This is primary treatment. Secondary treatment removes the suspended matter, including bacteria and some viruses. Tertiary treatment removes dissolved compounds, both organic and inorganic.

### **Potable (POTE-uh-bul)**

Suitable for drinking.

Potare = to drink

### **Organic Compounds in the Water Supply**

The fourth class of substances that may occur in water are the organic compounds from sewage, insecticides, petroleum-based and other industries, and other sources. Research on these substances is less than 20 years old, and few of them have been identified, but many are known to be toxic. Some cause birth defects, some are carcinogenic, some cause permanent alterations of the inherited genetic material. Many contain chlorine, and some may be formed during the chlorination of water. No information is available on the risks now presented by water containing these compounds; standards are only now being established, and new filtering systems may be called for if public water exceeds these standards. The study of organics in the water supply is an increasingly important research area.

In some regions, consumers have become sufficiently alarmed about their local water supplies to turn to buying bottled water for their personal consumption. The choice is an individual matter. However, in buying water, as in buying any other product, the consumer needs to be alert to fraudulent claims. Mineral waters from "famous spas" offer no known health advantages and may be undesirably high in sodium. On the other hand, bottled water sold in the United States must be tested by the producers once a year for safety and must meet standards set by the FDA for its contents of many chemical substances.

### **Water Quantity**

The matter of water quantity still must be discussed. Is there enough to meet our needs? Water is an abundant natural resource, and until recently its availability has been unquestioned. But the use of water in the

industrial countries is putting a strain on the supply. Used by agriculture for irrigating and by industry for transporting, dissolving, washing, rinsing, cooling, flushing away waste, and many other purposes, water in huge quantities is diverted from its original, ordinary uses. Processed and fast foods cost much more, in water, than do whole foods from the farm. In the future the water supply may limit human progress. It has been estimated, for example, that if the U.S. population increases by another 20 percent or so, the water supply will be unable to continue meeting all the demands placed on it. We will therefore have to compromise our living standards in order to meet the top-priority need for safe, pure water for human use.

This course is about individual nutrition and has dealt little with the economic and ecological problems of worldwide supply and demand. This discussion of water brings those problems into the foreground. To continue surviving and to maintain a desirable quality of life in an increasingly crowded and complicated world may mean making some hard choices in the near future.

## The Body's Salts

Session 1 listed the major minerals; the following table shows the amounts found in the body. As you can see, the most prevalent are calcium and phosphorus, the chief minerals of bone (discussed later). Four of the major minerals – potassium, sodium, chlorine, and (again) phosphorus – strongly influence the water balance. These form salts that are abundant in the body fluids.

Major Minerals	Amount in grams	Trace Minerals	Amount in grams
Calcium	1,150	Iron	2.4
Phosphorus	600	Manganese	0.18
Potassium	210	Copper	0.09
Sulfur	150	Iodide	0.024
Sodium	90		
Chloride	90		
Magnesium	30		

In the table above, the amounts of minerals are in a 60-kilogram human body. The major minerals are those present in amounts larger than 5 grams (a teaspoon). A pound is about 454 grams; thus only calcium and phosphorus appear in amounts larger than a pound. There are more than a dozen trace minerals, although only four are shown here.

To understand how cells regulate the amount of water they contain; it is necessary to take a closer look at the minerals as ions, the form in which cells use them for water regulation. Cell membranes are freely permeable to water molecules, which are neutral, and which flow in and out of cells all the time. Yet the cells never lose all their water nor do they overflow. Along the evolutionary path they have contrived a method of keeping their water constant; they do this beautifully by employing the salts to assist them. They make use of the principle that water follows salt.

Chemists use the term salt to include many inorganic substances, not just ordinary table salt. The chemist refers to table salt as sodium chloride, NaCl. In this salt, sodium and chlorine atoms are bound together by strong electrostatic forces in a rigid crystalline structure. Outwardly, the crystals exhibit no electrical charge. However, when dissolved in water, the rigid structure relaxes. Some of the sodium moves about freely as positively charged ions, and some of the chloride also dissociates and moves about as negatively charged ions. The salt thus reveals itself as a compound composed of charged particles. The positive ions are cations; the negative anions.

A salt that partly dissociates in water, as sodium chloride does, is known as an electrolyte. Since the fluids of the body are composed of water and partly dissociated salts, they are electrolyte solutions.

Electrolyte solutions are always electrostatically balanced. There is no such thing as a test tube filled with sodium ions. Sodium ions are always positively charged, and they cannot exist apart from negatively charged ions. Therefore, in any fluid with dissolved electrolytes there will always be the same number of positive and negative ions. If an anion enters a cell, a cation must accompany it or another anion must leave so that electroneutrality will be maintained.

## Salt

A compound composed of charged particles (ions). Exceptions: a compound in which the cations are  $H^+$  is an acid; a compound in which the anions are  $OH^-$  is a base.

**Cation (CAT-eye-un)**

A positively charged ion.

**Anion (AN-eye-un)**

A negatively charged ion.

Na = sodium

Cl = chlorine

**Chloride**

The ionic form of chlorine.

**Dissociation**

Physical separation of the ions in an ionic compound. A salt that partly dissociates in water is an electrolyte.

**Electrolyte Solution**

A solution that can conduct electricity.

**Water Balance**

We stated above that water follows salt. More precisely, there is a force that moves water into a place where a solute, such as sodium chloride, is concentrated. This force is known as the osmotic pressure of a solution. Water flows toward the higher osmotic pressure. The substances dissolved in the water that create this pressure are the solutes (SOLL-yutes). This force can operate only if the divider separating the two fluid solutions is permeable to water but not permeable (or less freely permeable) to the solute.

You have seen this force at work if you have ever salted a lettuce salad an hour before eating it. When you come back to the salad, the lettuce was wilted and there was water in the salad bowl. The high concentration of salt (and therefore low concentration of water) on the outside of the lettuce cells caused water to move out of the cells. They collapsed (the lettuce wilted), and the water puddled in the salad dish. Sugar would have caused the same reaction. There is one way you could have prevented this (here's a cooking lesson for the novice). You could have coated the lettuce lightly with oil before salting it or put salad dressing on it. The oil would have acted as a barrier against the salt, keeping it from attracting water out of the lettuce.

The divider between the water inside and outside a cell is the cell membrane. The cell cannot pump water directly across its membrane, but it does have proteins in its membrane that can attach to sodium ions and move them from one side of the membrane to the other. When these sodium pumps are active, they pump out sodium faster than it can diffuse into the cell. Water follows the sodium. When potassium pumps are active, they pump in potassium, and water follows this ion. By maintaining a certain amount of sodium outside and potassium inside, the cell can exactly regulate the amount of water it contains.

**Electrolyte Solutions**

Other terms used to describe electrolyte solutions: isotonic (having the same osmotic pressure as a reference solution), hypertonic (having a higher osmotic pressure than a reference solution), and hypotonic (having a lower osmotic pressure than a reference solution). The salty water on the outside of the lettuce cells is hypertonic to the water inside the cells, so it attracts water out of the cells. Saline (salt) solutions used in the hospital are made isotonic to human blood.

**Semipermeable**

The cell membrane is semipermeable – that is, more permeable to some substances (such as water) than to others (such as sodium and potassium). This is the condition necessary for osmotic pressure to operate.

**Acid-Base Balance**

The body uses its ions not only to help maintain water balance but also to help regulate the acidity (pH) of its fluids. Some of the electrolyte mixtures in the body fluids, as well as the proteins, protect the body against changes in acidity by acting as buffers – substances that act to neutralize newly introduced acids or bases.

Surprisingly, although one person may eat more or less of certain minerals than other person, the body's total content of electrolytes remains very nearly constant. The job of regulating the body's salt population is largely delegated to the kidneys, under the supervision of several monitoring systems, notably the adrenal and pituitary glands. The net effect of all the homeostatic balancing systems is to help ensure that output balances intake. A person who eats a lot of table salt, for example, excretes more sodium and chloride in his urine than one who eats only a little. Thus, except for a transient rise immediately after ingestion, the body's total electrolytes 96



remain constant, and it is the composition of the urine that is affected by what you eat.

Some foods are classed as acid-formers, others as base-formers, depending on the amount of acid they donate to the urine after their metabolism. It has been thought (but it is not clear) that their acid-forming or base-forming nature derives partly from the balance of mineral salts they contain. The distinction becomes important when kidney stones form; because excesses of many metabolites flow through the kidneys on their way to being excreted (some are excluded from absorption and leave the body with the feces). Some stones tend to form in acid, others in basic solutions, so when a person has a tendency to form kidney stones, she is advised to eat the foods least likely to aggravate that tendency. She is instructed, then, to eat either an acid-ash or an alkaline-ash diet.

<b>Acid Forming Foods</b>	<b>Base-Forming Foods</b>
Meat, fish poultry	Milk
Eggs	Vegetables
Cheese	Fruits (except cranberries, prunes, and plums)
Grains (breads and cereals)	
Fruits (cranberries, prunes, and plums only)	

Diseases of the kidney more serious than stones impair the body's ability to regulate its fluid and electrolyte balances. To keep the renal patient alive, in addition to many medical procedures, the physician may order adjustment of the patient's electrolyte input from food. The burden then falls on the dietitian to calculate a diet that precisely specifies sodium, potassium, calcium, water, and many other constituents.

It is not known whether any regulating system other than the kidneys governs the body's salt contents. We have thirst, to govern our intake of water, but do we have a salt hunger to govern our intake of sodium? Salt hunger is well known in plant-eating animals like cattle, which will travel long distances to a salt lick when they have been depleted of sodium. The tongue, in both animals and humans, is equipped with taste receptors that respond only to the salty taste. Animals know instinctively when to seek this stimulus, but humans may seek it when they have no need. Future research may determine whether a true salt hunger operates in humans.

### **Buffer**

A substance or mixture capable in solution of neutralizing both acids and bases and thereby capable of maintaining the original acidity of the solution.

### **Renal Calculi (REE-nul CAL-kyoo-lie)**

Kidney stones are deposits of mineral and other salts that have crystallized within the kidney. Technically, they are termed renal calculi.

Renal = of the kidney

Calculus = a small stone

### **Acid Ash Diet**

A diet of acid-forming foods (foods that, if burned to ash, would be found to contain acid-forming minerals). Such a diet contributes to acidity of the urine, because the kidney collects the excess acid-forming minerals into the urine for excretion.

### **Alkaline Ash Diet**

A diet of base-forming foods.

### **Taste Receptors**

There are four kinds of taste receptors on the tongue: those sensitive to salt, sweet, sour, and bitter flavors.

### **Water and Salt Imbalances**

The activity of the kidneys in regulating the body's contents of sodium and water is remarkable. Sodium is absorbed easily from the intestinal tract, then travels in the blood, where it ultimately passes through the kidneys. The kidneys filter all the sodium out, then with great precision return to the bloodstream the exact amount needed. Normally, the amount excreted equals the amount ingested that day. About 30 to 45 percent of the body's sodium is thought to be stored on the surface of the bone crystals, where it is easy to recover if the blood level drops.

When the blood level of sodium rises, as it does after a person eats heavily salted foods, the thirst receptors in the brain are stimulated. The fluid intake increases to make the sodium-to-water ratio constant. Then the extra water is excreted by the kidneys along with the extra sodium.

Thus you are well protected from imbalances of water and electrolytes. Technically, these kinds of imbalances are known as fluid-and-electrolyte imbalances. However, you may be thrown into situations for which your kidneys, thirst instinct, and cell membranes cannot compensate. This is the case when large amounts of fluid and electrolytes are suddenly lost. Vomiting, diarrhea, heavy sweating, burns, wounds, and the like may incur such great fluid losses that a medical emergency results.

The details of electrolyte balance are among the most important ones that medical students must learn. Mastery of these details is appropriately left to them and to their medical associates. For the general reader and the student of nutrition, it is necessary only to appreciate the importance of this balance and the principles by which it is maintained and to be aware of the situations that threaten it. When any of these gets out of control, the appropriate action is to call the doctor. Water and salts, which we take for granted and usually ignore, are more vital to life than any of the other nutrients considered in this course.

### **Sodium, Other Minerals, and High Blood Pressure**

The body has to maintain a certain blood pressure to sustain the lives of its cells. The pressure of the blood against the walls of the arteries ensures that fluids carrying nutrients and oxygen move out of the arteries into the tissues to deliver their cargo. By the time blood reaches the veins, much of its fluid has exited, and the concentration of cells and solutes in the remaining blood is at a maximum. Fluids from the tissues, attracted by the concentrated plasma, then seep back into the veins, now carrying carbon dioxide and other waste materials. Thus the cells' needs for supply and removal of materials are met. The blood pressure also helps ensure good filtration of wastes into the urine as blood passes through the kidneys.

When the blood pressure falls, the lives of all the body's cells are threatened. The kidneys detect the lowered pressure and immediately set in motion a mechanism to raise the blood pressure again.

Normally, this response of the kidneys is highly adaptive. In dehydration, for example, a "water deficiency" exists. By constricting the blood vessels and conserving water and sodium, the kidney-initiated mechanism ensures that blood pressure is maintained until more water can be drunk.

Sometimes, however, the kidneys are fooled. They experience a "water deficiency" when there is none. Then they raise the blood pressure with harmful effects – a maladaptive response. Most often, the cause is atherosclerosis (hardening of the arteries), which deprives the kidneys of water just as if there were a water deficiency. In response to poor circulation of blood fluid, the kidneys raise the blood pressure and the heart has to pump extra hard to push the extra fluid around against resistant arteries. Added weight (obesity) raises the pressure further, and the extra adipose tissue means miles of extra capillaries through which the blood must be pumped. The combination of high blood pressure, obesity, and hardened arteries is deadly.

In 10 percent of cases, hypertension is caused by recognized kidney disease, and is called secondary hypertension, but in 90 percent, the cause is unknown. The vast majority of cases are called essential hypertension, meaning that the disease process must be primary.

The mineral sodium has been implicated so strongly in the causation of high blood pressure that many people have been led to believe it alone is to blame. Findings such as these incriminate sodium (but withhold judgment for a moment):

1. Populations with high intakes of sodium have more high blood pressure (for example, the Japanese).
2. Populations that eat little or no salt have normal blood pressure (even some vegetarian groups in our society).
3. Severely restricting sodium reduces high blood pressure; adding sodium back to the diet restores high blood pressure.
4. A nationwide program to control blood pressure, including sodium reduction, has seemed to lower blood pressure in many individuals.
5. People in areas with soft water have higher (average) blood pressure than people in areas with hard water.
6. Genetically sodium-sensitive strains of animals are known; their blood pressure is greatly affected by dietary sodium, some humans (perhaps 20 percent) are genetically sensitive also.

Blood pressure regulation is not simple, however. Other factors are involved. Items 1 and 2, above, show correlations, not evidence of cause. With respect to Item 3, people with normal blood pressure usually do not show an increase when fed large amounts of salt. With respect to Item 4, drugs were used to lower blood pressure, and the independent effect of sodium restriction, if any, is unknown. As for Item 5, who is to say that it is the sodium in soft water that accounts for the difference? Perhaps it is some other mineral; or perhaps the minerals in hard water protect against high blood pressure.

The only findings that seem to hold up strongly are that some people are sensitive to sodium and tend to have high blood pressure, and that they can lower it by reducing their salt intakes. Since not all those people know who they are (and you can't tell by "feel" when you have high blood pressure) some authorities contend that the whole population should be encouraged to reduce its salt intakes. The government's Dietary Goals, the Dietary Guidelines for Americans and the Canadian government's guidelines all recommend reducing sodium intakes based on this assumption.

We'll come back to sodium shortly, but first, what are the other diet-related factors that affect blood pressure? Obesity is one, as already mentioned. Several other minerals are also involved – notably, potassium, calcium, magnesium, and cadmium.

When sodium is retained in the body, potassium is traded for it. Even subjects with normal blood pressure, if fed very large quantities of sodium, ultimately show a rise in blood pressure – but at the same time, their potassium excretion is increasing. Fed potassium simultaneously with the sodium, they do not have a rise in blood pressure.

Population studies show sodium being traded for potassium in a different sense. People who eat many foods high in sodium (processed foods, for example), necessarily eat fewer potassium-containing foods (such as fruits and whole vegetables) at the same time.

Calcium and magnesium are implicated because of the hard water versus soft water observation already mentioned above. It has also been reported that calcium in the blood is low in people with high blood pressure. The contaminant cadmium is leached from pipes into water, especially soft water, and may contribute to high blood pressure. Other factors mentioned have been chloride, alcohol, and protein.

Still, the use of highly salted foods probably contributes to hypertension for those who have a genetic tendency to develop it anyway. How many people this represents is a much-debated question, but one in five seems to be a conservative estimate. Black Americans are significantly more at risk than other groups. It is possible that, by the age of 65, as many as three out of four people have high blood pressure. This being the case, perhaps we should all curtail our sodium intakes, as the authorities mentioned earlier suggest.

There is certainly no sodium shortage in the diet. Foods almost always include more salt than is needed. Intakes vary widely, especially because of cultural differences in diets. Orientals, who liberally use soy sauce and monosodium glutamate (MSG or accent) for flavoring, consume about 30 to 40 grams of salt per day; most people in the United States average about 6 to 18 grams per day. Vegetarians, depending on their food preferences, can consume much less.

The Dietary Guidelines recommend that we limit our sodium intake to not more than 5 grams of added salt a day (that is, salt added by manufacturers and consumers above and beyond that already in the food as grown). In practice, this would mean avoiding highly salted foods and removing the salt shaker from the table.

Persons who wish to avoid salt need to know that what they pour from the salt shaker may be only a third of the total salt they consume. One-fourth to one-half comes from processed food, to which salt is added as a preservative and flavoring agent. This makes eating something of a guessing game because labels do not necessarily declare the sodium contents of foods. The serious sodium-avoider must stay away from fast-food places and Oriental restaurants and stop using many canned, frozen, and instant foods at home. (On a positive side, unprocessed, whole foods are lower in sodium – and higher in potassium – than most people realize.)

Processed foods don't always taste salty. Most people are surprised to learn that a serving of cornflakes contains more sodium than a serving of cocktail peanuts – and that a serving of chocolate pudding contains still more.

Avoiding sodium is hard to do, not only because sodium is often hidden, but also because foods are far less tasty without salt. With practice, however, people can learn to enjoy the flavors of many unsalted foods and, where species are needed, to make liberal use of sodium-free spices like those listed in the table below. If you persist long enough (say, two months) in eating a low-salt diet, your taste threshold for salt will actually change so that your preferred level is lower.

In summary, the person who wishes to use diet to prevent high blood pressure should probably not only reduce sodium intake but emphasize positive actions as well:

- Eat plenty of fresh fruits and vegetables, because they are rich in potassium.
- Be sure to eat a balanced diet, including good food sources of calcium and magnesium.
- Maintain ideal weight.
- Be moderate in the use of alcohol.

## Hypertension

High blood pressure. People sometimes confuse hypertension with stress, but hypertension is an internal and stress an external condition. Stress may cause hypertension in sensitive people, however.

## Secondary Hypertension

Secondary hypertension is high blood pressure caused by kidney disease (10 percent of cases). Primary, or essential, hypertension is of unknown origin (90 percent of cases) and can cause kidney disease.

## “High” Blood Pressure

“High” blood pressure is defined differently for different purposes. Here, if the higher of the two numbers is over 140 or if the lower is over 90, it is considered to be too high.

## Blood Pressure Regulation

Renin from the kidney splits the plasma protein angiotensinogen to form angiotensin I; in the presence of another enzyme, angiotensin I is activated to angiotensin II, which acts as a vasoconstrictor and also stimulates aldosterone secretion. The net effect is to raise blood pressure.

## Salt

5 grams salt is about 2 grams sodium

1 gram salt = 1/5 tsp.

Estimated safe and adequate daily dietary intake of sodium (Committee on RDA) 1.1-3.3 grams (1,100-3,300 mg)

## To Avoid Too Much Sodium:

- Learn to enjoy the unsalted flavors of foods.
- Cook with only small amounts of added salt.
- Add little or no salt to food at the table.
- Cut down on:
  - Foods prepared in brine, such as pickles, olives, and sauerkraut.
  - Salty or smoked meats, such as bologna, corned or chipped beef, frankfurters, ham, luncheon meats, salt pork, sausage, smoked tongue.
  - Salty or smoked fish, such as anchovies, caviar, salted and dried cod, herring, sardines, smoked salmon.
  - Snack items such as potato chips, pretzels, salted popcorn, and salted nuts and crackers.
  - Bouillon cubes; seasoned salts (including sea salt); soy, Worcestershire, and barbecue sauces.
  - Cheeses, especially processed types.
  - Canned and instant soups.
  - Prepared horseradish, catsup, and mustard.

## Read Labels

You may be surprised to learn that some processed foods that contain no table salt and don't taste salty have lots of sodium. Look for the word soda or sodium or the symbol Na on labels. Examples are sodium bicarbonate (baking soda), monosodium glutamate, most baking powders, disodium phosphate, sodium alginate, sodium benzoate, sodium hydroxide, sodium propionate, sodium sulfite, and sodium saccharin. – USDA

## Sodium-Free Spices and Flavorings

Allspice	Onion Powder
Almond Extract	Paprika
Bay Leaves	Parsley
Caraway Seeds	Pepper
Cinnamon	Peppermint Extract
Curry Powder	Pimiento
Garlic	Rosemary
Garlic Powder	Sage
Ginger	Sesame Seeds
Lemon Extract	Thyme
Mace	Turmeric
Maple Extract	Vanilla Extract
Marjoram	Vinegar
Mustard Powder	Walnut Extract
Nutmeg	

## Calcium

Unlike sodium, calcium is not so abundant in the diet, and deficiencies are widespread in human societies. The price you pay for neglecting to obtain enough calcium throughout early and middle life is extensive degeneration of the skeleton in old age – adult bone loss, which leads to crippling deformities, irreparable fractures, and even death. Nearly all people suffer some bone loss as they grow older, and it causes serious fractures in about one of every three people over 65. It is therefore urgent to understand the necessity of obtaining adequate calcium in food from the early years on throughout adulthood.

The urgency of obtaining enough calcium has to be learned through education, because the body sends no signals saying it is deficient. Most nutrient deficiencies make themselves known by way of symptoms that can be felt or seen, such as pain, skin lesions, tiredness, and the like. But a developing calcium deficiency is utterly silent; it becomes apparent only when a hip or pelvic bone suddenly shatters into fragments that cannot be reassembled. No evidence of a developing calcium deficiency can be found in a blood sample, because blood calcium remains normal no matter what the bone content may be. Nor does depletion of bone calcium show up in an x-ray until it is so far advanced as to be virtually irreversible.

There is a lacy network of calcium-containing crystals inside the bones. These are the deposits in the body's calcium bank, which are drawn on whenever the supply from the day's diet runs short. Invested in savings during the milk drinking years of childhood, these calcium deposits provide a nearly inexhaustible fund of calcium; 99 percent of the body's calcium is stored in the bones.

The other 1- percent of the body's calcium is in the blood and body fluids, where its concentration is tightly controlled by a system of hormones and vitamin D. Whenever the blood calcium concentration rises too high, these agents promote its deposit into bone. Whenever the blood concentration falls too low, the regulatory system acts in three locations to correct it:

- Intestine: increase calcium absorption.
- Bone: increase calcium release.
- Kidney: reduce calcium excretion.

Thus blood calcium returns to normal.

To say that food calcium never affects blood calcium is not to say that blood calcium never changes. In fact, sometimes blood calcium does rise above normal, causing a condition known as calcium rigor. When this happens, the muscle fibers contract and cannot relax. Similarly, calcium levels may fall below normal in the blood, causing calcium tetany – also characterized by uncontrolled contraction of muscle tissue, due to a change in the stimulation of nerve cells. These conditions do not reflect a dietary lack or excess of calcium; they are caused by a lack of vitamin D or by glandular malfunctions that result in abnormal amounts of the hormones that regulate blood calcium concentration.

On the other hand, a chronic dietary deficiency of calcium or a chronic deficiency due to poor absorption over the course of years can diminish the savings account in the bones. Because this is an important concept, we repeat: it is the bones, not the blood, that are depleted by calcium deficiency.

## Calcium Regulators

The regulators are hormones from the thyroid and parathyroid glands, as well as vitamin D. One, parathormone, raises blood calcium. Others, calcitonin and thyrocalcitonin, lower it by inhibiting release of calcium from bone. The hormone-like vitamin D raises blood calcium by acting at the three sites listed.

## Calcium Rigor

Harness or stillness of the muscles caused by high blood calcium.

## Calcium Tetany

Intermittent spasms of the extremities due to nervous and muscular excitability caused by low blood calcium.

## Roles of Calcium

The calcium that circulates in the body fluids plays many roles. Some calcium is found in close association with cell membranes, where it appears to be essential for their integrity. It helps to regulate the transport of other ions into and out of cells. It is essential for muscle action and so helps maintain the heartbeat. Calcium must be present between nerve and nerve, and between nerve and muscle, for the transmission of nerve impulses; and when it enters cells, it delivers important messages to intracellular receptors.

Calcium must also be present if blood clotting is to occur, because it is one of the 14 factors directly involved in this process. (The other 13 are proteins; vitamin K is needed, too, for the synthesis of some of these proteins.) Calcium also acts as a cofactor for several enzymes.

As for the calcium in bone, it plays two important roles. One, as already mentioned, is to serve as a bank to prevent alteration of the all-important blood calcium concentration. And the bones, of course, hold the body upright and serve as attachment points for muscles, making motion possible.

### **Cofactor**

A mineral element that, like a coenzyme, works with an enzyme to facilitate a chemical reaction.

### **Calmodulin (cal-MOD-YOU-lin)**

Calcium is over 1,000 times more concentrated outside of cells than inside, and normally, it can't get in. When it does, however (for example when an electrical impulse arrives along a nerve, altering the membrane), it finds molecules of the protein calmodulin waiting inside. Calcium binds to calmodulin, changing its shape. Now, calmodulin activates other proteins, which take action. Thus calcium has "delivered" the message transmitted along the nerve, and the appropriate action is taken (calcium, meanwhile, is rapidly expelled from the cell by membrane pumps).

Calcium is abundant; so is calmodulin. The reaction is one of the fastest in the body. Even hormones cannot work so fast.

### **Calcium Deficiency**

The disease rickets has been mentioned in connection with vitamin D deficiency. Often in rickets the amount of calcium in the diet is adequate, but it passes through the intestinal tract without being absorbed into the body, leaving the bones undersupplied. Vitamin D deficiency, by depressing the production of the calcium-binding protein, is the most common cause of rickets. In children, the failure to deposit sufficient calcium in bone causes growth retardation, bowed legs, and other skeletal abnormalities. In adults, the disease may set in after a normal childhood during which calcium intake and absorption were adequate, and after the skeleton has become fully calcified. Prolonged inadequate calcium uptake during adulthood, often due to vitamin D deficiency, may cause the gradual and insidious removal of calcium from the bones. The result is altered composition or reduced density of the bones in old age, which makes them fragile.

Many older people are severely afflicted with osteoporosis. The causes seem to be multiple, but inadequate storage of calcium during the growing years is a factor always in the background. This fact underscores the importance of prevention: drink plenty of milk while you are young to have strong bones in later life, and continue drinking milk throughout adulthood, to avoid losing calcium.

A net calcium loss occurs in many adults, especially women after menopause or hysterectomy, suggesting that hormonal changes are responsible. Many minerals and vitamins are required to form and stabilize the structure of bones, including magnesium, fluoride, vitamin A, and others. Any of these may be essential for preventing osteoporosis. One obvious line of defense, however, is to maintain a lifelong adequate intake of calcium.

### **Rickets**

The calcium deficiency (or vitamin D deficiency) disease in children.

### **Osteomalacia**

Altered composition of the bones is reflected in osteomalacia, the condition in which the bones become soft. Osteomalacia is sometimes called adult rickets.

### **Osteoporosis (oss-tee-oh-pore-OH-sis)**

Reduced density of the bones results in osteoporosis – literally, porous bones. Session 15 shows that exercise, too, is important in the prevention of osteoporosis.

### **Food Sources of Calcium**

The recommended intake of calcium, arrived at by way of balance studies, is 700 to 800 milligrams (0.7 to 0.8 grams) per day for adults in both the United States and Canada. Adults can stay in balance on intakes lower than this if they adapt over a long period of time to lower intakes, and the World Health Organization recommends only 400 to 500 milligrams per day for adults. However, high protein intakes increase calcium excretion, and in the United States and Canada, where diets are rich in protein, 700 to 800 milligrams for adults and 1,200 for pregnant and lactating women seems to be a protective recommendation. Authorities are considering raising this recommendation to 1,000, or even 1,200, milligrams a day for women over 50.

Calcium is found almost exclusively in a single class of foods – milk and milk products. For this reason, if for no other, members of this group must be included in the diet daily or wise substitutions must be made. Because a cup of milk contains almost 300 milligrams of calcium, an intake of 2 cups of milk provides a good start towards meeting the amount recommended for an adult for a day. A pregnant or lactating woman should have 3 to 4 cups; and an older woman, 3 cups. The other dietary food that contains comparable amounts of calcium is cheese.

One slice of cheese (1 ounce) contains about two-thirds as much calcium as a cup of milk. (Cottage cheese, however, is a poor source.) For people who don't drink enough milk, dark-green leafy vegetables have been thought to be an important calcium source, but the calcium binder – oxalate – renders the calcium in most greens except broccoli unabsorbable. (Greens are still a valuable source of riboflavin, folacin, vitamin A, iron, and other nutrients, however.)

The absurdity of attempting to meet calcium needs in any way other than by consuming two or more servings a day of these foods can be demonstrated by listing the amounts of some other foods you would have to consume instead:

- 6 heads of iceberg lettuce
- 10 cups of cooked green beans
- 12 oranges or eggs
- 20 cups of strawberries

For most people, then, the obvious way to meet calcium needs is to include milk and milk products in the diet daily. This is especially important for pregnant and lactating women, older women, and children in the growing years (their calcium balance must be positive to permit good skeletal growth). Adults concerned with feeding children who dislike milk may find it helpful to learn how to conceal milk in foods. Ice cream, ice milk, and yogurt are acceptable substitutes for regular milk, and puddings, custards, and baked goods can be prepared in such a way that they also contain appreciable amounts of milk. Powdered skim milk, which is an excellent and inexpensive source of protein, calcium, and other nutrients, can be added to many foods (such as cookies and meatloaf) in preparation. For children with a milk allergy, a calcium-rich substitute such as fortified soymilk must be found. Butter and cream contain negligible calcium, because calcium is not soluble in fat.

The word daily should be stressed with respect to food sources of calcium. Because of its limited ability to absorb calcium, the body cannot handle massive doses periodically but instead needs frequent opportunities to take in small amounts.

Many factors affect calcium absorption. The stomach's acidity favors it by helping to keep calcium soluble. Vitamin D aids in calcium absorption by helping to make the necessary calcium-binding protein. (It is no accident that milk is chosen as the vehicle for fortification with vitamin D.) The lactose in milk also seems to facilitate calcium absorption by a mechanism as yet unknown. Calcium levels are lower in breast milk than in cow's milk, but babies absorb calcium better from breast milk, possibly because of its higher lactose content.

Some foods contain binders that combine chemically with calcium (and other minerals such as iron and zinc) to prevent their absorption, carrying them out of the body with other wastes. For example, phytic acid renders the calcium, iron, and zinc in certain foods unavailable; oxalic acid binds calcium and iron; and uronic acid binds calcium. Phytic acid is found in whole grains; oxalic acid in beets, rhubarb, and dark green leafy vegetables; and uronic acid in the fiber of grains, fruits, and vegetables. Fiber in general seems to hinder calcium absorption, so the higher the diet is in fiber, the higher it should be in calcium. This fact in no way affects the overall value of high-fiber foods. Whole grains, legumes, greens, other vegetables, and fruits are nutritious for so many reasons that no one should hesitate to include them in menu planning.

### **Milk Allergy**

The most common food allergy; caused by the protein in raw milk. Milk allergy is sometimes overcome by cooking the milk to denature the protein, sometimes "cured" by abstinence from and gradual reintroduction to milk.

### **Binders**

Chemical compounds occurring in foods that can combine with nutrients (especially minerals) to form complexes the body cannot absorb. Phytic (FIGHT-ic) and oxalic (ox-AL-ic) acids are examples of such binders.

**Caution:**

The amount of calcium recommended for the daily diet is so great that it won't fit in a single pill that can be swallowed. To make it absorbable, the manufacturers combine the calcium into a large organic salt such as calcium gluconate or calcium lactate, making an extremely bulky pill. To get 600 milligrams of calcium in this salt you would have to take six pills that might each be the diameter of a quarter and the thickness of four quarters. You therefore never find significant amounts of calcium in vitamin-mineral supplements of the type that are to be taken once a day. Many vitamin-mineral supplements do contain some calcium, however.

There are two ways to read a label. One is to read what it contains, and the other is to read how much. A list of the ingredients in a pill that contains calcium might mislead unaware consumers into believing that their calcium needs would be met by the pill. However, often the label lists the calcium content of each pill as 20 milligrams. Only when you compare this amount with the recommended intake (800 milligrams) do you realize that you would have to take 40 of these pills a day to meet your calcium needs. This discussion should remind you that you should always use a yardstick when reading nutrient amounts of labels.

It is important to remember, too, that pills do not supply the relative amounts of nutrients that are in the best balance for your overall health. A typical calcium supplement, for example, is labeled with the instructions to take six a day. Yet six of these pills a day supply less than 50 percent of the recommended intake of calcium and 500 percent of the vitamin D – and vitamin D is toxic in excess. (Vitamin D is added to the pill to enhance the absorption of calcium.)

In contrast, 2 cups of skim milk fortified with vitamins A and D would supply the following percentages of the nutrients an adult man needs: calcium, 60 percent; vitamin D, 50 percent; protein, 40 percent; vitamin A, 50 percent; thiamin, 12 percent; and riboflavin, 50 percent; plus 24 grams of carbohydrate in the form of lactose. Calcium absorption is enhanced by several of these other nutrients. Once again, a point made previously is relevant; there are fringe benefits to eating a nutrient in a natural food as opposed to a purified nutrient preparation.

### **The Four Food Group Plan Recommends Daily Milk Servings**

Children under 9	2-3 cups
Children 9-12	3+ cups
Teenagers	4+ cups
Adults	2 cups
Pregnant women	3+ cups
Lactating women	4+ cups
Older women	3 cups

The body is able to regulate its absorption of calcium by altering its production of the calcium-binding protein. More of this protein is made if more calcium is needed. Thus you will absorb more when you need more. This system is most obviously reflected in the increased absorption by a pregnant woman, who absorbs 50 percent of the calcium from the milk she drinks instead of only 30 percent, as she formerly did. Thus her body's calcium intake almost doubles, even if her food intake does not change at all. Similarly, growing children absorb 50 to 60 percent of ingested calcium; when their growth slows or stops (and their bones no longer demand a net increase in calcium content each day), their absorption falls to the adult level of about 30 percent.

### **Child Can't or Won't Drink Milk**

<b>If allergic to cow's milk protein</b>	<b>If lactose-intolerant</b>	<b>If unexplained intolerance or dislike</b>
Boiled Milk	Enzyme-treated milk	Emphasis on foods containing the nutrients of milk
And/or	And/or	Last resort
Milk cooked into foods	Smaller portions of milk more often	Nutrient supplements
And/or	And/or	
Goat's milk	Yogurt and other fermented dairy products	

An important relationship exists between calcium and phosphorus. Each is better absorbed if they are ingested together. Authorities differ on the ratio that might best favor health, but it seems probable that most would agree on a 1:1 ratio; perhaps any ratio from 3:1 to 1:3 is all right.



Protein also affects calcium status, as already mentioned, but not by affecting absorption. The higher the diet is in protein, the greater the amount of calcium excreted. This is why people in the United States and Canada are told to ingest more calcium than people in countries whose protein intakes are lower.

**Caution:**

A generalization that has been gaining strength throughout this course is supported by the information given here about calcium. A balanced diet that supplies a variety of foods is the best guarantee of adequacy for all essential nutrients. All food groups should be included, and none should be overused. Calcium is found lacking wherever milk is under-emphasized in the diet – whether through ignorance, simple dislike, lactose intolerance, or allergy. By contrast, iron is found lacking whenever milk is overemphasized, as session 11 shows.

**Phosphorus**

Phosphorus is a mineral in second largest quantity in the body. About 85 percent of it is found combined with calcium in the crystals of the bones and teeth. There it occurs as calcium phosphate, one of the compounds in the crystals that give strength and rigidity to these structures.

The concentration of phosphorus in blood plasma is less than half that of calcium; 3.5 milligrams per 100 milliliters of plasma. But as part of one of the body's major acids (phosphoric acid), it is found in all body cells. It is a part of DNA and RNA, the genetic code material present in every cell. Thus phosphorus is necessary for all growth, because DNA and RNA provide the instructions for new cells to be formed.

Phosphorus also plays many key roles in energy transfers occurring during cellular metabolism. Many enzymes and the B vitamins become active only when a phosphate group is attached. (The B vitamins, you will recall, play major roles in energy metabolism.) ATP itself, the energy carrier of the cells, contains three phosphate groups and uses these groups to do its work.

Some lipids contain phosphorus as part of their structure. These phospholipids help to transport other lipids in the blood; they also reside in cell membranes, where they affect transport of nutrients into and out of the cells. The phosphate ion also helps in one of the blood's most important buffering systems.

Animal protein is the best source of phosphorus, because phosphorus is so abundant in the energetic cells of animals. The recommended intakes for phosphorus are the same as those for calcium: 700 to 800 milligrams per day for adults. Deficiencies are unknown.

**Chlorine**

The element chlorine occurs as a poisonous gas, but when it combines with sodium in salt, it is not poisonous but is part of a life-giving compound. It occurs in salt as the negative chloride ion.

The chloride ion is the major negative ion of the fluids outside the cells, where it is found mostly in association with sodium. Chloride can move freely across membranes and so is also found inside the cells in association with potassium. Its role in balancing the pH of the blood has already been described.

In the stomach, the chloride ion is part of hydrochloric acid, which maintains the strong acidity of the stomach. The cells that line the stomach continuously expend energy to push chloride into the stomach fluid. One of the most serious consequences of vomiting is the loss of acid from the stomach, which upsets the acid-base balance.

A chlorine compound is added to public water to reduce its bacterial count before it flows through pipes into people's homes. The compound turns to the deadly poisonous gas chlorine, kills dangerous microorganisms that might otherwise spread disease, and then evaporates, leaving the water safe for human consumption. The addition of chlorine to public water is one of the most important public health measures ever introduced in the developed countries and has eliminated such water-borne diseases as typhoid fever, which once ravaged vast areas, killing thousands of people.

The estimated safe and adequate daily dietary intake of chloride from the Committee on RDA is 1,700-5,100 mg.

**Potassium**

Potassium is critical to maintaining the heartbeat. The sudden deaths that occur in severe diarrhea and in children with kwashiorkor may often be due to heart failure caused by potassium loss. As the principal positively charged ion inside body cells, it plays a major role in maintaining water balance and cell integrity. When water loss from the body involves sodium loss, the ultimate damage comes when potassium is pulled out of the cells and excreted. Dehydration is especially scary, because potassium deficiency affects the brain cells early, making the victim unable to perceive that she needs water.

During nerve transmission the muscle contraction, potassium and sodium briefly exchange places across the cell membrane. Nerve and muscle cells, then, are especially rich in potassium, but all cells must contain some. Potassium is also known to play a catalytic role in carbohydrate and protein metabolism, but the exact nature of this role is not known.

A deficiency of potassium from getting too little in the diet is unlikely, but high-sodium diets low in fresh fruits and vegetables make it a possibility. Abnormal conditions such as diabetic acidosis or loss of large volumes of water can cause potassium deficiency. One of the earliest symptoms is muscle weakness.

Gradual potassium depletion can occur when a person sweats profusely day after day and fails to replenish his potassium stores. A study of this effect shows that up to about 3 grams of potassium can be lost in a day. The average diet in this country supplies about 1.5 to 2.5 grams. The authors of one study recommend that a person who sweats heavily and often should eat five to eight servings of potassium-rich foods each day.

**Caution:**

It has been pointed out several times previously that there are advantages to eating foods instead of taking supplements. Salt tablets contain sodium and chloride, but foods contain a multitude of minerals. The body evolved in dependence on foods, not supplements. Also, men who think fruit is only for dainty ladies might take note that because of the potassium it contains, fruit may do more for these muscles than meat.

Potassium supplements are not advisable except when prescribed, because too much potassium is as dangerous as too little. Even salt substitutes containing potassium should be avoided, especially by heart patients except as recommended by a physician.

Estimated safe and adequate daily dietary intake of potassium according to the Committee on RDA is 1,875 – 5,625 mg (1.9 – 5.6 grams).

Potassium-rich foods include bananas and many other whole, fresh fruits; orange juice and many other fruit juices; and potatoes, tomatoes, and many other vegetables.

**Sulfur**

Sulfur is present in all proteins and plays its most important role in determining the contour of protein molecules. Sulfur helps the strands of protein to assume a particular shape and hold it – and so to do their specific jobs, such as enzyme work. Some of the amino acids contain sulfur in their side chains; once built into a protein strand, one of these amino acids can link to each other by way of sulfur-sulfur bridges. The bridges stabilize the protein structure. Skin, hair, and nails contain some of the body's more rigid proteins, and these have a high sulfur content.

There is no recommended intake for sulfur, and no deficiencies are known. Only if a person lacks protein to the point of severe deficiency will he lack the sulfur-containing amino acids.

**Methionine and Cysteine**

Amino acids containing sulfur are methionine and cysteine. Cysteine in one part of a protein chain can bind to cysteine in another part of the chain by way of a sulfur-sulfur bridge. Two cysteine molecules linked this way are called cystine.

**Magnesium**

Magnesium barely qualifies as a major mineral. Only about 1-3/4 ounces of magnesium are present in the body of a 130-pound person, most of it in the bones. Bone magnesium seems to be a reservoir to ensure that some will be on hand for vital reactions regardless of recent dietary intake.

Magnesium also acts in all the cells of the soft tissues, where it forms part of the protein-making machinery and where it is necessary for the release of energy. Its major role seems to be as a catalyst in the reaction that adds the last high-energy phosphate bone to ATP. Magnesium also helps relax muscles after contraction and promotes resistance to tooth decay by holding calcium in tooth enamel.

A dietary deficiency of magnesium does not seem likely, but deficiency may occur as a result of vomiting, diarrhea, alcohol abuse, or protein malnutrition; in postsurgical patients who have been fed incomplete fluids into a vein for too long; or in people using diuretics. A severe deficiency causes tetany, an extreme and prolonged contraction of the muscles very much like the reaction of the muscles when calcium levels fall. Magnesium deficit is also thought to cause hallucinations experienced by alcoholics during withdrawal.

Recommended intakes of magnesium are 300 to 350 milligrams a day for adult males, 250 to 300 for females. Good food sources include nuts, legumes, cereal grains, dark-green vegetables, seafoods, chocolate, and cocoa. The kidney acts to conserve magnesium; the magnesium not absorbed is excreted in the feces.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 11:**

### **• The Trace Minerals**

If you could remove all of the trace minerals from your body, you would have only a bit of dust, hardly enough to fill a teaspoon. You would also die instantly. Although present in tiny quantities, each of the trace minerals performs some vital role for which no substitute will do. A deficiency of any of them may be fatal, and an excess of many is equally deadly. Remarkably, the way you eat and the way your body handles these minerals enables you to maintain a supply that is just sufficient for health and below the toxic level.

Laboratory techniques developed in the past few decades have enabled scientists to detect the minute quantities of trace minerals in living cells for the first time. Study of the “new” trace elements, using animals, is one of the most active areas of research in nutrition today. An obstacle to determining the precise role of a trace element lies in the nearly impossible task of providing an experimental diet devoid of that element. Even the dust in the air or the residue left on laboratory equipment by the rinsing water may contaminate the feed enough to prevent a deficiency. Thus research in this area is limited to the study of small laboratory animals, which can be fed highly refined, purified diets in an atmosphere free of all contamination.

The best-known trace elements – iron, iodine, and zinc – have been so thoroughly studied that we can describe many of their roles with certainty. Government authorities have established recommended daily intakes for these three. For six others, the Committee on RDA published tentative ranges for safe and adequate daily intakes for the first time in 1980. Five others are known to be essential nutrients, but the amounts needed are so tiny that they have not yet been measured. Many others are presently under study to determine whether they too perform indispensable roles in the body.

Whole books have been published just on the trace minerals. In selecting the information to present in this session we have chosen to give most attention to those that are likely to have the greatest impact on your health. Iron, for example, is often deficient in the diets of people the world over, and an iron deficiency profoundly hurts the quality of life. Iodine is easy to obtain in adequate amounts, but simple ignorance can precipitate a deficiency, with tragic and irreversible consequences. Until recently, zinc deficiencies were unheard of, but now we know they are present in many of the world's people. New knowledge of equal importance is coming to light about many of the other trace elements. An acquaintance with a few facts presented in this session should enable you to select a diet composed of protective foods that will ensure adequacy for all the essential nutrients.

### **Iron**

Iron is a problem nutrient for millions of people. If you want to plan and consume a diet adequate in iron, you must be well informed.

### **Iron in the Body**

Iron is found in every cell, not only of the human body but also of all-living things, both plant and animal. It occurs in many vital proteins, including those involved in cell respiration and DNA synthesis, and is part of many major enzymes.

Most of the iron in the body is a component of the protein hemoglobin and myoglobin. Both these proteins carry oxygen and release it. Hemoglobin is the oxygen carrier in the red blood cells, and myoglobin is the oxygen carrier in the muscle cells. Myoglobin has a greater holding capacity for oxygen and so serves as a reservoir; its presence in the muscle cells seems to draw oxygen into them. The muscle cells use this oxygen as the receiver for used-up carbon and hydrogen atoms flowing down the glucose-to-energy pathway. These atoms combine to make carbon dioxide and water, the final waste products of metabolism. Thus oxygen keeps the energy-yielding pathway open so that the muscles can remain active. As the muscles use up and excrete their oxygen (combined with carbons and hydrogens), the red blood cells shuttle between muscles and lungs to maintain fresh supplies.

The average red blood cell lives about four months. When it has aged and is no longer useful, it is removed from the body by the spleen and liver cells, which take it apart and prepare many of the degradation products for excretion. The liver saves its iron, however, and attaches it to a protein carrier, which returns it to the bone marrow. The bone marrow, in turn, constantly produces new red blood cells. Thus, although red blood cells are born, live, and die within a four-month cycle, the iron in the body is recycled through each new generation. Only tiny amounts of iron are lost, principally in urine, sweat, shed skin, and (if bleeding occurs), in blood.

About 80 percent of the iron in the body is in the blood, so iron losses are greatest whenever blood is lost. For this reason, “women need more iron,” as a well-known television commercial proclaims. Menstruation incurs losses that make a woman's iron needs nearly twice as great as a man's, but anyone who loses blood loses iron.

To help obtain iron, the body provides special proteins to absorb it from food and carry it to the liver, bone marrow, and other blood-manufacturing sites. Iron absorbed through the intestinal cells from food is captured by a blood protein, transferrin that carries it to tissues throughout the body. Each tissue takes up the amount of iron that it needs. The bone marrow and liver take large quantities, other tissues take less. In a pregnant woman, the placenta is avid for iron, delivering large quantities to the fetus even if this means depriving the mother's tissues of iron. Should there be a surplus, special storage proteins in the bone marrow and other organs store it.

Iron clearly is the body's gold, a precious mineral to be hoarded and closely guarded. The number of special provisions for its handling show how vital it is. At the receiving end, in the intestines, another provision shows this even more clearly. Normally only about 10 percent of dietary iron is absorbed. But if the body's supply is diminished or if the need increases for any reason, absorption increases. More transferrin (the carrier that picks up iron from the intestines) is produced so that more than the usual amount of iron can be absorbed.

If absorption cannot compensate for a reduced supply and stores are used up, the red cells become depleted. Then anemia sets in. The most common tests for iron deficiency are measures of the number and size of the red blood cells and of their hemoglobin contents. But before these levels fall, at the very beginning of an iron deficiency, the transferrin concentration rises. A sensitive test that will detect a developing iron deficiency before it is full-blown measures the amount of transferrin in the blood and the amount of iron it is carrying. Technically, this method is known as measuring the total iron-binding capacity (TIBC) and the transferrin saturation.

### **Hemoglobin**

The oxygen-carrying protein of the red blood cells.

Hemo = blood

Globin = globular protein

### **Myoglobin**

The oxygen-carrying protein of the muscle cells

Myo = muscle

### **Transferrin (trans-FURR-in)**

The body's iron-carrying protein.

### **Mucosal Block**

Iron can also lodge in the mucosal cells and end up being excreted from the body.

### **Storage Proteins**

The storage proteins are ferritin (FAIR-I-tin) and hemosiderin (heem-oh-SID-er-in).

### **Caution:**

For women only: you are often told that you need more iron, yet you may often have had your blood cell count or hemoglobin level pronounced normal. Does this mean that you don't need more iron? Not necessarily. The difference between you and the men you know is a difference in your body stores of iron, which doesn't show up in these tests. Most men eat more food than women do, because they are bigger, and so their iron intakes are higher. Besides, women menstruate, and so their iron losses are greater. These two factors – lower intakes and higher losses – may put you much closer to the borderline of deficiency. Even though you may never have been diagnosed as iron-deficient, you are likely to be deficiency-prone. Should you lose blood for any reason (even by giving a blood donation) or become pregnant (so that your blood volume would need to increase), you would need to pay special attention to your diet in an effort to maintain your iron stores. The information about iron in foods, which appears later in this session, is especially important to you.

### **Iron-Deficiency Anemia**

If iron stores are exhausted, the body cannot make enough hemoglobin to fill its new red blood cells. Without enough hemoglobin, the cells are small. Since hemoglobin is the bright red pigment of the blood, the skin of a fair person who is anemic may become noticeably pale. In a dark-skinned person, this symptom can be observed by looking in the corner of the eye. The eye lining, normally pink; will be very pale, even white. A sample of iron-deficient blood examined under the microscope shows smaller cells that are a lighter red than normal. The undersized cells can't carry enough oxygen from the lungs to the tissues, so energy release in the cells is hindered. Every cell of the body feels this effect; the result is fatigue, weakness, headaches, and apathy.

Long before the mass of the red blood cells is affected, however, a developing iron deficiency may affect other body tissues, including the brain. As researchers have become better acquainted with iron, they have learned that it plays roles in the brain not earlier appreciated. For example, iron works with an enzyme that

helps to make neurotransmitters, the substances that carry messages from one nerve cell to another. Children deprived of iron show some psychological disturbances, such as hyperactivity, decreased attentiveness, and even reduced IQ. These symptoms are among the first to appear when the body's iron level begins to fall and among the first to disappear when iron intake is increased again.

A curious symptom seen in some iron-deficient subjects is an appetite for ice, clay, paste, and other nonnutritious substances. Such people have been known to eat as many as eight trays of ice in a day, for example. This behavior has been observed for years, especially in women and children of low-income groups who are deficient in either iron or zinc, and has been given the name pica. Pica clears up dramatically within days after iron is given, long before the red blood cells respond.

Muscle tissue, too, is sensitive to depletion of iron stores. By the time the stores are exhausted, work capacity begins to be profoundly affected. One study has shown this especially clearly. As women's hemoglobin levels fell from normal to half of normal, their work capacity declined in proportion. At the lowest level they were unable to do much work at all.

### **Microcytic (my-cro-SIT-ic) Hypochromic (high-po-KROME-ic) Anemia**

This is iron-deficiency anemia.

Micro = small

Cytic = cells

Hypo = too little

Chrom = color

### **Pica (PIE-ka)**

A craving for nonfood substances. Also known as geophagia (gee-oh-FAY-gee-uh) when referring to clay eating.

Picus = woodpecker or magpie

Geo = earth

Phagein = to eat

### **Caution:**

Many of the symptoms described here are easily mistaken for "mental" symptoms. A restless child who fails to pay attention in class might be thought contrary. An apathetic homemaker who has let her housework pile up might be thought lazy. But the possibility is real that both these persons' problems are nutritional.

No responsible nutritionist would ever claim that all mental problems are caused by nutrient deficiencies. But poor nutrition is always a possible cause or contributor to problems like these. When you are seeking the solution to a behavioral problem it makes sense to check the adequacy of the diet and to have a routine physical examination before undertaking more expensive and involved diagnostic and treatment options.

It is conventional to measure the body's iron status by measuring the amount of hemoglobin (in grams per 100 milliliters of blood). The normal level is considered 14 to 15 grams per 100 milliliters for adult men, 13 to 14 for women. Yet many people who have values lower than this have no obvious symptoms. U.S. blacks have average values about half a gram lower than these; it is not known whether this is a genetically determined characteristic or is due to insufficient iron intakes. Some women have no symptoms of anemia – at least as measured by the performance of mental tasks – at levels as low as 10 or even 8 grams. Doubtless people vary; one many may feel miserable with a hemoglobin level of 12 grams; another may feel no effects at a drastically low level of, say, 6 grams: "Who, me? Anemic?" Still, such symptoms as fatigue, weakness, and the like are often seen at levels not much below the standards.

When hemoglobin begins to fall, it is a sign that a long period of depletion of body stores has already occurred. In view of this fact and in light of the behavioral effects of mild iron deficiency in children, it seems reasonable to try to achieve and maintain "normal" hemoglobin levels for the general population: 14 to 15 for men, 13 to 14 for women. Values much below these represent a real hazard to health and to the quality of life.

### **Norms for Children**

Ages 2-5: 11-g/100 ml

Ages 6-12: 11.5 g/100 ml

Note that hemoglobin is measured in grams per 100 milliliters, but we just use the number alone in speaking of it: "Hemoglobin, 14."

**Caution:**

A low hemoglobin level may represent a dietary iron deficiency, and if it does, the doctor may prescribe iron supplements. But the cause of an iron deficiency may be something else. For example, a vitamin B<sub>6</sub> deficiency can indirectly cause anemia, because vitamin B<sub>6</sub> is required to make the iron-containing portion of the hemoglobin molecule. A vitamin E deficiency can cause anemia by making the red blood cells membranes so fragile that the cells lose their hemoglobin. A folacin deficiency can cause it, because this vitamin is used in making new red blood cells to replace the old ones as they die. A vitamin B<sub>12</sub> deficiency can cause it, because folacin can't work without B<sub>12</sub>. A vitamin C deficiency can cause it by reducing the absorption of iron. Vitamin A, too, is involved in the making of red blood cells, and some people's low hemoglobin levels can be corrected only by administering vitamin A. Then there's the mineral copper, which we will discuss later in the session.

Feeling fatigued, weak, and apathetic is a sign that something is wrong but does not indicate that you should take iron supplements. It indicates that (you guessed it!) you should consult your doctor. The doctor herself must use all her knowledge to diagnose correctly the primary cause of a secondary anemia; you don't have a chance at making this kind of diagnosis. In fact, taking iron supplements may be the worst possible thing you could do, because they may mask a serious medical condition, such as hidden bleeding from cancer or an ulcer. Once again – the caution deserves repeating – don't self-diagnose.

However, the role of all these nutrients in making and maintaining red blood cells dictates a preventative measure – eat right! A study of over 200 older adults in Boston provides evidence to support this recommendation. These people all had moderately low hemoglobin levels (below 13) to begin with. Two-thirds were given iron-fortified foods; the other third received the same foods without added iron. At the end of the study, all had higher hemoglobin levels. Food made the difference with or without added iron.

**Secondary Nutrient Deficiency**

One caused indirectly – not by inadequate intake but by the deficiency of another nutrient, interference with absorption, disease, or other causes.

By these criteria, iron-deficiency anemia is a major health problem in both the United States and Canada and even more so in the rest of the world. It is especially common in older infants, children, women of childbearing age, and people in low-income and minority groups. The incidence of iron-deficiency anemia in these groups ranges from 10 to over 50 percent. It tends to cluster with indicators of low socioeconomic status, such as family instability, little money spent on food, little attention given to children. But no segment of society is free of iron-deficiency anemia, and these groups are not the only ones affected. For example, 1 out of every 20 Canadian men is at moderate risk (hemoglobin 12 to 14), and 1 out of every 100 is at high risk (hemoglobin below 12). Moreover, some subjects with normal hemoglobins are iron deficient by more sensitive tests.

**Iron Overload**

Iron toxicity is rare but not unknown. The body protects itself against absorbing too much iron by setting up a "block" in the intestinal cells. Proteins trap extra-absorbed iron and hold it until it can be shed from the body when the mucosal cells are shed. The average life of an intestinal cell is only three days; so this method promptly removes excess iron from the system. Still, the mucosal block can be overwhelmed, and iron overload is the result.

Two kinds of iron overload are known. One is caused by a hereditary defect, the other by ingesting too much iron. Tissue damage, especially to the liver, occurs in both, and infections are likely because bacteria thrive in iron-rich blood. Tissue damage is most severe in those who also drink large quantities of alcohol, because alcohol not only damages the liver but also increases the absorption of ferric iron. Certain wines (especially red wines) contain substantial amounts of iron; so the overconsumption of wine is particularly risky. Detection of iron overload is best accomplished by measuring the serum ferritin level, which reflects the body's total iron stores.

Iron overload is more common in men than in women. An argument against the fortification of foods with iron to protect women is that it might put more men at risk of overload. Indeed, there is some evidence from Sweden, where foods are generously fortified with iron, that this measure has increased the incidence of iron overload in men. It is too bad that a measure meant to promote the health of one sex might put the other at risk.

The ingestion of massive amounts of iron can cause sudden death. The second most common cause (after aspirin) of accidental poisoning in small children is ingestion of iron supplements or vitamins with iron. As few as 6 to 12 tablets have caused death in a child. A child suspected of iron poisoning should be rushed to the hospital to have his stomach pumped; 30 minutes may make a crucial difference.

## **Mucosal Block to Iron Absorption**

The provision of binding proteins (ferritin and a transferrin-like protein) in the mucosal cells to capture and hold unneeded iron to be shed with the cells.

## **Iron Overload**

Toxicity from iron overdose

## **Hemochromatosis (heem-oh-crome-a-TOCE-iss)**

Iron overload characterized by deposits of iron-containing pigment in many tissues, with tissue damage. Hemochromatosis is a hereditary defect in iron metabolism.

## **Hemosiderosis (heem-oh-sid-er-OH-sis)**

Iron overload characterized by excessive iron deposits in hemosiderin, the normal iron-storage protein.

## **Recommended Intakes of Iron:**

Men: 10 mg/day

Women (Canada): 14 mg/day

Women (U.S.): 18 mg/day

## **How recommended daily intake for iron is calculated (for example, for an adolescent girl):**

Losses from urine and shed skin: 0.5 to 1.0 mg

Losses through menstruation (about 15-mg total averaged over 30 days): 0.5 mg

Net for growth:

Average daily needs (total): 1.5 to 2.0 mg

Only 10 percent of ingested iron is absorbed, so this girl must ingest 15 to 20 mg per day.

## **Heme (HEEM)**

About 40 percent of the iron in meat, fish, and poultry is bound into molecules of heme, the iron-holding part of the hemoglobin and myoglobin proteins. Heme iron is much more absorbable (23 percent) than nonheme iron. Meat, fish, and poultry also contain a factor ("MFP factor") other than heme that promotes the absorption of iron, even of the iron from other foods eaten at the same time as the meat.

## **Milk Anemia**

Overconsumption of milk is a common cause of iron deficiency in children; the resulting anemia is known as milk anemia.

## **Iron in Foods**

The usual Western mixed diet provides only about 5 to 6 milligrams of iron in every 1,000 kcalories. The recommended daily intake for an adult man is 10 milligrams, and most men require more than 2,000 kcalories; so a man can easily meet his iron needs without special effort. The recommendation for a woman, however, is 14 to 18 milligrams per day. Because women typically consume fewer than 2,000 kcalories per day, they understandably have trouble achieving this intake. A woman who wants to meet her iron needs from foods must increase the iron-to-kcalorie ratio of her diet so that she will receive about double the average amount of iron – at least 10 milligrams per 1,000 kcalories. This means she must emphasize the most iron-rich foods in every food group.

Several factors influence the absorption of iron significantly enough so that they have to be considered by anyone who wants to know how much iron a person really gets from a meal.

The average amount of iron absorbed is 10 percent, but up to 40 percent of the iron in meat, fish, poultry, and soybeans may be absorbed. Less than 10 percent of the iron in eggs, whole grains, nuts, and dried beans is absorbed. At the bottom of the list is spinach; only 2 percent of its iron is absorbed. The iron from iron supplements, too, is absorbed at a rate of only about 2 percent. Vitamin C eaten with any iron source doubles or triples the amount of iron absorbed (except heme iron). Obviously, then, a woman who includes some meat in everyday meal planning will get a head start toward meeting her iron needs, especially if she makes periodic use of liver and other organ meats.

Foods in the milk group are notoriously poor iron sources, as poor in iron as they are rich in calcium. Although these foods are an indispensable part of the diet, they should not be overemphasized. In considering



the grain foods, remember that iron is one of the enrichment nutrients. Whole-grain or enriched breads and cereals – not refined, unenriched pastry products – are the best choices, and the more of them you eat, the more iron you receive. Finally, among other plant foods, the legume family, the dark greens, and dried fruits are the most iron rich. A set of guidelines, then for planning an iron-rich diet is as follows:

- **Milk and Cheese:** Don't overdo foods from the milk group (but don't omit them either; you need them for calcium). Drink skim milk to free kcalories to be invested in iron-rich foods.
- **Meat:** Use liver and other organ meats frequently, perhaps every week or two. Meat, fish, and poultry are excellent iron sources.
- **Meat Substitutes:** Don't forget legumes. A cup of peas or beans can supply up to 5 milligrams of iron.
- **Breads and Cereals:** Use only whole-grain, enriched, and fortified products.
- **Vegetables:** The dark-green leafy vegetables are rich in iron. Eat vitamin C-rich vegetables often to enhance absorption of the iron from foods eaten with them.
- **Fruits:** Dried fruits like raisins, apricots, peaches, and prunes are high in iron. Eat vitamin C-rich fruit often with iron-containing foods.

Knowledgeable cooking and menu planning can enhance the amount of iron delivered by your diet. The iron content of 100 grams of spaghetti sauce simmered in a glass dish is 3 milligrams, but it's 87 milligrams when the sauce is cooked in an iron skillet. Even in the short time it takes to scramble eggs, you can triple their iron content by cooking them in an iron pan. Admittedly, the absorption of this iron is poor, but every little bit helps. Therefore, an additional suggestion is:

- Cook with iron skillets whenever possible.

Even after taking all these precautions, a woman may not accumulate enough storage iron to prepare her for the increased demands of pregnancy and childbirth. In 1974 the Committee on RDA acknowledged for the first time that pregnant women might need supplemental iron. The Canadian Dietary Standard also includes this statement. However, since the iron from supplements is far less well absorbed than that from food, the doses have to be as high as 50 milligrams per day. Absorption of iron from supplements is improved when they are taken with meat or with vitamin C-rich foods or juices.

The use of fortified foods is another option. Some breakfast cereals boast that they contain 100 percent of the recommended daily intake of iron. These may indeed boost the day's iron intakes, even though absorption of their iron is poor. A number of proposals have been made for further fortification. Canada has considered adding iron to milk; other ideas are to add it to coffee, to junk foods, even to salt. At present, 25 percent of all the iron consumed in the United States derives from fortified foods. A proposal to increase the iron level in enriched bread above that now prescribed by FDA regulations has been defeated. Ultimately, it is up to the consumer herself to see that she gets enough iron.

## Enrichment

The addition of iron, thiamin, riboflavin, and niacin to refined grain products to restore approximately their original contents.

## Fortification

The addition of nutrients to a food – but not necessarily the nutrients that were originally found there.

## Zinc

Ten years ago, zinc was hardly known as a nutrient to the man on the street. In 1974, it appeared in the RDA tables for the first time, and today it is often added to vitamin-mineral supplements. Research on zinc has expanded to hundreds of articles.

## Zinc in the Body

Zinc appears in every body tissue but is distributed unevenly. The adult human body contains 2 to 3 grams of zinc. The highest concentrations are in the eye, liver, kidney, muscle, skin, bones, and male reproductive organs. Zinc is tightly tied up in tissues such as the skin, hair, and bones and so is unavailable to the rest of the body except when tissue or bone breaks down. Zinc must therefore be provided relatively regularly in the diet.

Zinc supports several physiological functions. Most importantly, there are now over 70 known enzymes, which require zinc as a cofactor. Zinc occurs at the active site, maintains the structural integrity of the protein, and may also facilitate the enzyme's catalytic activity by lowering the amount of energy necessary to get it started.

Zinc works with proteins in every corner of the body. It is necessary for normal metabolism of protein, carbohydrate, fat, and alcohol. It is associated with the hormone insulin in the pancreas. It is involved in the synthesis of DNA and RNA, cell replication, immune reactions, the cells' production and disposal of carbon dioxide, utilization of vitamin A, taste perception, wound healing, the making of sperm, and the development of the fetus.

Absorption of zinc is known to occur in the upper intestine, but a complete description of this process has not yet been derived from research. Zinc is evidently pulled (by active transport) into cells even when its concentration is higher inside them than outside. Absorption is aided by a small molecule, whose exact nature is disputed.

After zinc has entered a cell lining the intestine, it may become involved in the metabolic functions of the cell itself or pass through the far side of the cell into the portal blood. The absorbed zinc may also become trapped within the cell by a special binding protein similar to the one described earlier for iron.

As for iron, a homeostatic mechanism seems to be at work to regulate the amount of zinc entering the body. Extra zinc (or iron) is held within the intestinal cell and only the amount needed is released into the bloodstream. The zinc status of the individual influences the percentage of zinc absorbed from the diet; if more is needed, more is absorbed. Cells are shed daily from the intestinal lining and are excreted in the feces; they carry the zinc they have retained out of the body with them.

Zinc circulating within the body is taken up by liver cells and is bound to a protein inside them (liver metallothionein). The amount bound depends on the amount of circulating zinc. Zinc circulates in the body until the concentration in and around liver cells reaches a certain threshold. Then any additional zinc is packaged with liver metallothionein.

While traveling in the bloodstream, zinc is transported by proteins. Plasma proteins such as albumin, transferrin, and others may bind significant amounts of zinc. The significance of the involvement of either transferrin or albumin with zinc transport is complex. Anything that leads to a decrease in plasma albumin – for example, pregnancy or malnutrition – would lower plasma zinc levels as well. Anything that binds transferrin might also hinder zinc absorption. In normal individuals, transferrin is usually less than 50 percent saturated with iron, but in cases of iron overload, it is more saturated. Iron excess thus leaves too few binding sites available, thereby causing an impairment of zinc absorption.

An interesting phenomenon in zinc nutriture is the cycling of zinc in the body. The intestine actually receives two doses of zinc with each meal – one from ingested foods and the other from the zinc-rich pancreatic secretions. Thus even zinc that has already entered the body is rescreened periodically by the intestine and can be refused entry or tied up in intestinal cells on any of its times around.

Excretion of zinc occurs primarily by way of the feces, which contain both unabsorbed zinc and zinc from the pancreatic juices. Some zinc is also lost in the urine. Alcohol abuse increases urinary losses of zinc. An increase in muscle catabolism, as in fasting, injury, or surgery, also incurs urinary losses of zinc. Free dietary amino acids such as histidine or cysteine can bind zinc, and thus cause losses. People who take supplements of amino acids to help their health may therefore actually be harming it by interfering with their zinc absorption.

Other losses of zinc occur in sweat, hair, menstrual blood, seminal fluid, and human milk. Studies of all these losses added together have enabled researchers to estimate the human requirement for zinc.

### **Cofactor**

A mineral element that works with an enzyme, facilitating the enzyme's action.

### **Zinc-Binding Ligant (LYE-gand) (ZBL)**

The small molecule that assists in zinc absorption.

### **Metallothionein (meh-TAL-oh-THIGH-oh-neen)**

The binding protein for zinc is a sulfur-rich protein.

Metallo – containing a metal

Thio – containing sulfur

Ein – a protein

## **Zinc Deficiency and Toxicity**

A deficiency of zinc in humans was first reported in the 1960s from studies with growing children and adolescent males in Egypt, Iran, and Turkey. The native diets were typically low in animal protein and high in whole grains and beans; consequently they were high in fiber and phytates. The zinc deficiency was marked by dwarfism or severe growth retardation and arrested sexual maturation – symptoms that were responsive to zinc supplementation. Conditions other than diet which contribute to development of zinc deficiency, include loss of blood due to parasitic infections, climates that increase sweat losses, and clay eating.

Since the reports of the 1960s, cases of zinc deficiency have been discovered closer to home, in U.S. schoolchildren. A number of Denver children had low hair zinc levels, poor growth, poor appetite, and decreased taste sensitivity. The children were described as “picky eaters” and ate less than an ounce of meat per day. A recommendation from these observations might be that when poor growth is accompanied by poor appetite, the pediatrician should evaluate the child’s zinc status.

Reports of the role of zinc in wound healing are controversial. It appears that in individuals with normal zinc status, zinc has no effect on wound healing. Healing appears to be delayed, however, in persons with zinc deficiency. Zinc is known to be required in collagen synthesis, and the skin is rich in zinc.

An intriguing example of the many nutrient-nutrient interactions in human nutrition is the case of zinc and vitamin A. Zinc is required for the synthesis of retinol-binding protein, RBP. RBP, in turn, is necessary for mobilization of vitamin A from the liver. A zinc deficiency may therefore cause an apparent vitamin A deficiency, because plasma levels of vitamin A will remain low even though there is plenty of vitamin A stored in the liver.

Zinc deficiency in humans appears to be related to abnormal rod function and impaired visual adaptation to darkness. Zinc is necessary for the reaction that produces the active form of vitamin A (retinal) necessary to form rhodopsin, the rods’ visual pigment.

Zinc is a relatively nontoxic element. However, it can be toxic if consumed in large enough quantities. Accidental consumption of high levels of zinc may cause vomiting, diarrhea, fever, exhaustion, and a host of other symptoms. Large doses can even be fatal. See the table below for the areas affected and main effects of those areas.

Toxicity from ingestion of zinc could occur from misuse of supplements. Also, acidic foods or drinks which have been allowed to stand for long periods of time in galvanized containers may contain toxic levels of this trace mineral. Remember, too, that a large amount of one trace element may induce a deficiency of another. Such is the relationship between zinc and copper. Excess zinc intake may also interfere with the intestinal absorption of calcium, due to competition between the two elements for common intestinal binding sites.

By now, you can guess what populations might be at risk for developing inadequate zinc status. Primarily, they are people who are growing – infants, children, teenagers, and pregnant women. Pregnant teenagers are at particular risk, because they need zinc for their own ongoing growth as well as for the developing fetus. Persons on limited food intakes, such as those on weight control regimens, may also be at risk. A warning of those following very low kcalories or starvation diets – they cause not only a low zinc intake but also a loss of zinc from body tissues being broken down as a source of energy. The elderly may also have limited food intakes due to socioeconomic factors. Hospital patients with decreased appetite or receiving improperly formulated tube feedings are also at risk. Certain drug therapies may also interfere with zinc absorption.

The diets of vegetarians, especially pregnant vegetarians, who consume large amounts of fiber, phytate, and dairy foods or low levels of protein, need to be scrutinized for possible zinc deficiency. Populations dependent on food staples or cultural foods high in phytate and fiber content need to be evaluated as well for zinc status.

## **Recommended Intake of Zinc**

Adults (U.S.): 15 mg/day  
Men (Canada): 10 mg/day  
Women (Canada): 9 mg/day

## **Phytate or Phytic Acid**

Is a storage compound found in plant seeds. Phytic acid is concentrated in the husks of grains, legumes, and seeds, and is capable of binding zinc in an insoluble complex in the intestine. Phytate binds not only zinc but also other positive ions such as calcium, magnesium, copper, and iron.

## Zinc Toxicity

Area Affected	Main Effects
Blood	Anemia; reduced hemoglobin production
Bone	Growth depression
Digestive System	Diarrhea; vomiting; decreased calcium and copper absorption
Immune System	Fever; elevated white blood cell count
Kidney	Renal failure
Muscle	Muscular pain and uncoordination
Nervous System	Nausea; exhaustion; dizziness; drowsiness
Reproductive System	Reproductive failure

## Clay Eating (pica or geophagia)

Occurs among the poor in rural areas of the Middle East, and has also been noted in the rural South in the United States. The clay acts to bind zinc (as well as iron) by attracting these positively charged ions, making them unabsorbable in the intestine.

## Galvanized

Term referring to metal containers that have been treated with a zinc-containing coating to prevent rust.

## Zinc in Foods

The daily recommended intake of zinc is about 10 to 15 milligrams. This figure assumes that 40 percent of dietary zinc is available to the body, although, as we shall see later, this is not always the case. Requirements for infants and children are relatively high due to the role of zinc in normal growth and development.

An average 1,500-kcalorie diet provides about 6.3 milligrams of zinc per day, or about 40 percent of the RDA. Zinc is highest in foods of high protein content, such as shellfish (especially oysters), meats, and liver. As a rule of thumb, two ordinary servings a day of animal protein will provide most of the zinc a healthy person needs. Milk, eggs, and whole-grain products are good sources of zinc if large quantities are eaten. For the infant, breast milk is a good source of zinc, which is easier to absorb from human milk than from cow's milk. Vegetables, fresh or canned, vary in zinc content depending on the soil in which they are grown. The zinc content of cooking water varies from region to region as well.

Besides the zinc content of foods, many dietary factors affect the absorption of zinc. The refining of grains lowers their zinc content. Galvanized cooking pots, in earlier times, contributed zinc to foods, especially to acid foods, but with the increased use of stainless steel and plastic utensils to prepare and store food, this source of zinc is no longer significant.

Factors interfering with the availability of zinc for absorption include phytic acid, calcium, phosphorus, and fiber. Complexes with phytate become even more insoluble in the presence of calcium and phosphorus, as when people consume dairy foods. Calcium facilitates the binding of both zinc and copper to phytic acid. Zinc also forms insoluble complexes with some plant fibers. Therefore, a high-fiber diet may lead to a deficiency of zinc, especially if zinc is already in short supply.

Both phytic acid and fiber are prevalent in plant foods. As you might suspect, then, concern about the bioavailability of dietary zinc is increasing as more and more persons tend toward vegetarianism and higher fiber intakes. The plant foods highest in zinc, such as peanuts, cooked dried beans, and wheat germ, may not be able to nourish the body as effectively as animal foods because of their phytate and fiber content. Foods need to be selected carefully, not only for mineral content but also for mineral availability, so that vegetarian and high-fiber diets will supply the essential minerals in sufficient quantities to meet people's metabolic needs.

The process of baking bread usually includes the step of yeast fermentation. Enzymes produced by yeasts destroy phytate; thus helping make the zinc available for absorption. It is thought to be beneficial, when making whole-grain breads, to extend this period of fermentation.

In Middle Eastern countries where zinc deficiency has been reported, a common food staple is unleavened whole-grain bread. Without the fermentation process, the zinc availability from these breads is poor. The Whole Health Organization has suggested that intake recommendations for zinc be on a sliding scale based on the estimated biological availability of the mineral from various regional diets.

The presence of competing ions – cadmium, lead, mercury, arsenic, copper, and calcium – also influences zinc status. The reverse is also true; in fact, in the future, zinc may be used to compete with metals such as lead to reduce their toxicity. With regards to copper, a high zinc intake is known to produce symptoms of copper deficiency such as anemia.

**Caution:**

Whole-grain breads and cereal contain zinc, but they also contain phytate and fiber. Refined breads and cereals are stripped of their phytate and fiber, but they also contain less zinc. Which is a better zinc source – the whole grain or the refined product? The answer has to do with the numbers of molecules of zinc and zinc-binder present in the grain. If 100 molecules of zinc are present together with 50 zinc-binding molecules, then 50 of the zinc molecules may be bound but the other 50 will be available for absorption. Whole grains contain phytate and fiber, yes, but they contain relatively more zinc, enough so that the excess zinc is greater per serving of whole-grain bread than the amount available from a comparable serving of refined bread. Thus even though whole grains do contain some bound, unavailable zinc; they are still preferred to refined products as a zinc source. Food research in the future will ask, not how much zinc or how much zinc binder is present in the food but how much zinc relative to the amount of binder – or better still, how much available zinc.

This example illustrates a principle that may well have occurred to you many times as you read earlier sessions. Nutrition “facts” are often more complicated than they may seem at first. You might remember this the next time someone tries to sell you something on the basis of an oversimplified statement. Always ask, “Is he telling the whole story?”

**Iodine**

Iodine occurs in the body in an infinitesimally small quantity, but its principal role in human nutrition is well known and the amount needed is well established. Iodine is part of the thyroid hormones, which regulate body temperature, metabolic rate, reproduction, growth, the making of blood cells, nerve and muscle function, and more. The hormones enter every cell of the body to control the rate at which the cells use oxygen. This is the same as saying that thyroxine controls the rate at which energy is released.

Iodine must be available for thyroid hormones to be synthesized. The amount in the diet is variable and generally reflects the amount present in the soil in which plants are grown or on which animals graze. Iodine is plentiful in the ocean, so seafood is a dependable source. In the United States, in areas where the soil is iodine-poor (most notably the Plains states), the use of iodized salt has largely wiped out the iodine deficiency that once was widespread.

**Caution:**

People sometimes wonder whether sea salt, made by drying ocean water, is preferable to purified sodium chloride for use in the salt shaker. Sea salt does contain trace minerals, but it loses its iodine during the drying process. Thus, in a region where goiter is a risk, iodized sodium chloride is the salt to choose.

When the iodine level of the blood is low, the cells of the thyroid gland enlarge in an attempt to trap as many particles of iodine as possible. If the gland enlarges until it is visible, it is called a simple goiter.

Goiter is estimated to affect 200 million people the world over. In all but 4 percent of these cases the cause is iodine deficiency. As for the 4 percent (8 million), they have goiter because they overconsume plants of the cabbage family and others that contain an antithyroid substance whose effect is not counteracted by dietary iodine. The goitrogens present in plants serve as a reminder that food additives may not be such great offenders as some natural components of foods.

In addition to causing sluggishness and weight gain, an iodine deficiency may have serious effects on the development of an infant in the uterus. Severe thyroid undersecretion during pregnancy causes the extreme and irreversible mental and physical retardation known as cretinism. A cretin has an IQ as low as 20 and a face and body with many abnormalities. Much of the mental retardation associated with cretinism can be averted by early diagnosis and treatment.

The iodization of salt in the Plains states eliminated the widespread misery caused by goiter and cretinism in the local people during the 1930s. Once these scourges had disappeared, a new generation of children grew up who never saw the problem and so had no appreciation of its importance. Rejecting iodized salt out of ignorance, they allowed iodine deficiencies to creep back into their lives. Hopefully, now, education is keeping them informed of the need to continue using iodized salt.

The recommended intake of iodine for adults is 100 to 150 micrograms a day, a minuscule amount. Like chlorine, iodine is a deadly poison in large amounts, but the iodide ion, which occurs in foods, is far less toxic, and traces of it are indispensable to life. The need for iodine is easily met by consuming seafood, vegetables grown in iodine-rich soil, and (in iodine-poor areas) iodized salt. In the United States, you have to read the label to find out whether salt is iodized; in Canada all table salt is iodized.

Excessive intakes of iodine can also cause an enlargement of the thyroid gland resembling goiter, which in infants can be so severe as to block the airways and cause suffocation. A dramatic increase in iodine intakes in the United States concerns observers. Average consumption rose from 150 micrograms per day in 1960 to over 450 in 1970, and reached an all-time high of over 800 in 1974; since then it has declined somewhat but still is several times the RDA. The toxic level at which detectable harm results is thought to be over 2,000 micrograms per day for an adult, only a few times higher than current average consumption levels.

Most of the excess iodine seems to be coming from iodates – dough conditioners used in the baking industry – and from milk produced by cows exposed to iodine-containing medications and disinfectants. Now that the problem has been identified, both industries have reduced their use of these compounds, but the sudden emergence of this problem points to a need for continued surveillance of the food supply.

### **Goiter (GOY-ter)**

An iodine-deficiency disease. Goiter caused by iodine deficiency is a simple goiter.

### **Goitrogen**

A thyroid antagonist found in food; caused toxic goiter.

### **Cretinism (CREE-tin-ism)**

An iodine-deficiency disease characterized by mental and physical retardation.

### **The RDA for iodine**

150 ug

### **Canadian Dietary Standard**

140 – 150 ug for men

100 – 110 ug for women

### **Copper**

The body contains about 75 to 100 milligrams of copper, which performs several vital roles. It is part of several enzymes. As a catalyst in the formation of hemoglobin, it helps to make red blood cells. It is involved in the manufacture of collagen and the healing of wounds, and it helps to maintain the sheath around nerve fibers. Most of what is known about copper comes from animal research, which has provided clues about its possible roles in humans. Copper's critical roles seem to have to do with helping iron shift back and forth between its +2 and +3 states. This means that copper is needed in many of the reactions related to respiration and the release of energy.

Copper deficiency is rare but not unknown. It has been seen in children with kwashiorkor and with iron-deficiency anemia and can severely disturb growth and metabolism. Excess zinc interferes with copper absorption and can cause deficiency.

The best food sources of copper include grains, shellfish, organ meats, legumes, dried fruits, fresh fruits, and vegetables – a long list showing that copper is available from almost all foods. About a third of the copper taken in food is absorbed, and the rest is eliminated in the feces.

### **Estimated safe and adequate daily dietary intake of copper (adults)**

2-3 mg

### **Manganese**

The human body contains a tiny 20 milligrams of manganese, mostly in the bones and glands. Still, it represents billions on billions of molecules. Animal studies suggest that manganese cooperates with many enzymes, helping to facilitate dozens of different metabolic processes. Manganese deficiency in animals deranges many systems, including the bones, reproduction, the nervous system, and fat metabolism.

Deficiencies of manganese have not been seen in humans, but toxicity may be severe. Miners who inhale large quantities of manganese dust on the job over prolonged periods show many of the symptoms of a brain disease, with frightening abnormalities of appearance and behavior. "Facial expression is mask-like, the voice monotonous; and intention-tremor, muscle rigidity and spastic gait appear."

### **Estimated safe and adequate daily dietary intake of manganese (adults)**

2.5 – 5.0 mg

#### **Caution:**

The example of manganese underlines the fact that toxicity of the trace elements occurs at a level not far above the estimated requirement. Thus it is as important not to overdose as it is to have an adequate intake. The Committee on RDA underscores this point by adding the special warning to its trace-mineral table "not to exceed the upper end of the range of recommended intakes." The National Nutrition Consortium, too, worries that, now that more trace minerals are known, they will be added to vitamin-mineral pills, making toxic overdoses more likely. The FDA is not permitted to enforce limits on the amounts of trace minerals added to supplements; so this is an area in which the consumer himself has to be careful. Beware of supplements containing trace minerals. It is safer to consume a diet that provides foods from a variety of sources than to try to put together, without causing toxicity, a combination of pills that will meet all your needs.

### **Fluoride**

Only a trace of fluoride occurs in the human body, but studies have demonstrated that where diets are high in fluoride, the crystalline deposits in bones and teeth are larger and more perfectly formed. When bones and teeth become calcified, first a crystal called hydroxyapatite is formed from calcium and phosphorus. Then fluoride replaces the hydroxy (OH) portions of the crystal, rendering it insoluble in water and resistant to decay.

Drinking water is the usual source of fluoride, although fish and tea may supply substantial amounts. Where fluoride is lacking in the water supply, the incidence of dental decay is very high. Dental problems can cause a multitude of health problems, affecting the whole body. Fluoridation of community water where needed, to raise its fluoride concentration to one part per million (1 ppm), is thus an important public health measure. Fluoridation of community water is presently practiced in more than 5,000 communities across the United States, and about 100 million people are drinking it.

In some communities the natural fluoride concentration in water is high, 2 to 8 ppm, and children's teeth develop with mottled enamel. This condition, called fluorosis, may not be harmful (in fact, these children's teeth may be extraordinarily decay-resistant), but violates the prejudice that teeth "should" be white. Fluorosis does not occur in communities where fluoride is added to the water supply.

Not only does fluoride protect children's teeth from decay, but also it makes the bones of older people resistant to adult bone loss (osteoporosis). Fluoride is also required for growth in animals and is an essential nutrient for humans; in fact, the continuous presence of fluoride in body fluids is desirable. Luckily, all normal diets include fluoride. It is toxic in excess, but toxicity symptoms appear only after chronic intakes of 20 to 80 milligrams a day over many years. The amount consumed from fluoridated water is typically about 1 milligram a day. Despite its value, violent disagreement often surrounds the introduction of fluoride to a community.

People whose water supplies do not contain adequate fluoride need to find alternative means of protecting their children's teeth. The best temporary solution seems to be to use fluoride toothpastes and/or to have children obtain a fluoride treatment of the surface of their teeth every year. Fluoride tables are also available. For infants there are vitamin drops with fluoride in them, but their effectiveness is limited.

### **Enamel and Dentin**

The outer two layers of the teeth, enamel and dentin, are composed largely of calcium compounds, including hydroxyapatite and fluorapatite.

#### **Hydroxyapatite (high-droxy-APP-uh-tite)**

The major calcium-containing crystal of bones and teeth.

#### **Fluorapatite (floor-APP-uh-tite)**

The stabilized form of bone and tooth crystal, in which fluoride has replaced the hydroxy groups of hydroxyapatite.

### **Fluorosis (fleur-OH-sis)**

Mottling of the tooth enamel; due to ingestion of too much fluoride during tooth development.

Osis = too much

### **Estimated safe and adequate daily dietary intake of fluoride (adults)**

1.5 – 4.0 mg

### **Chromium**

Experiments on animals have shown that chromium works closely with the hormone insulin, facilitating the uptake of glucose into cells and the release of energy from it. When chromium is lacking, the effectiveness of insulin is severely impaired, and a diabetes-like condition results.

Like iron, chromium can have two different charges. The +3 ion seems to be the most effective in living systems. It also occurs in association with several different complexes in foods. The one that is best absorbed and most active is a small organic compound named the glucose tolerance factor (GTF). This compound has been purified from brewer's yeast and pork kidney and is believed to be present in many other foods. It may be that when more is known, the GTF, rather than chromium, will be dubbed an essential nutrient and classed among the vitamins.

Depleted tissue concentrations of chromium in human being have been linked to adult-onset diabetes and growth failure in children with protein-kcalorie malnutrition. Chromium has also been shown to remedy impaired carbohydrate metabolism in several groups of older people in the United States.

### **GTF (glucose tolerance factor)**

A small organic compound containing chromium.

### **Estimated safe and adequate daily dietary intake of chromium (adults)**

0.05 – 0.20 mg

### **Selenium**

Selenium is a trace element that functions as part of an enzyme. The enzyme acts as an antioxidant and can substitute for vitamin E in some of that vitamin's antioxidant activities.

Selenium deficiency affects the heart. A severe deficiency can cause heart failure; a chronic, mild deficiency enlarges the heart and impairs its function. In some parts of China, selenium deficiency affects hundreds of thousands of children; not until the 1970s, however, was the cause of their heart trouble confirmed and remedied with selenium supplements. The conclusive study of over 36,000 subjects was published in 1980.

The region of China in which Keshan disease is prevalent is a region where the soil and foods are selenium-poor. In other parts of the world, selenium-poor soil has been found to correlate with certain kinds of cancer. The question whether selenium protects against cancer has stimulated research with both animal and human subjects, and it seems possible that dietary selenium adequacy may be one of the many health factors that defend against cancer. Results of research to date have not been clear, however. For example, an attempt was made to show a relationship between blood selenium and breast cancer incidence in women in a selenium-poor area of Oregon, but no such relationship was found. The authors were forced to conclude that there was "no justification at this time for the use of selenium supplements by the people living in this low selenium area."

High doses of selenium are toxic, causing loss of hair and nails, lesions of the skin and nervous system, and possibly damage to the teeth. An outbreak of selenium poisoning arose in China in the 1960s when a local rice crop failed and inhabitants of five villages consumed vegetables from a region where selenium-rich coal contaminated the soil in which the vegetables were grown. Some 50 percent of the villagers became seriously ill before the cause was discovered.

### **Glutathione Peroxidase**

The enzyme of which selenium is a part is glutathione peroxidase, which destroys oxidative compounds that could otherwise oxidize other compounds in the cell.

### **Keshan Disease**

The heart disease caused by selenium deficiency is named Keshan disease, for one of the provinces of China where it was studied.

### **Estimated safe and adequate daily dietary intake of selenium (adults)**

0.05 – 0.20 mg

### **Molybdenum**

Finally, molybdenum has also been recognized as an important mineral in human and animal physiology. It functions as a working part of several metalloenzymes, some of which are giant proteins. One, for 120



example, contains two atoms of molybdenum and eight of iron. Deficiencies of molybdenum are unknown in animals and humans, because the amounts needed are minuscule – as little as 0.1 part per million parts of body tissue. Excess molybdenum causes toxicity in animals, but this effect has not been seen in humans.

### **Metalloenzyme**

An enzyme that contains one or more minerals as part of its structure.

### **Estimated safe and adequate daily dietary intake of molybdenum (adults)**

0.15 – 0.50 mg

### **Other Trace Minerals**

None of the trace minerals has been known for very long, and some are extremely recent newcomers.

- Nickel is now recognized as important for the health of many body tissues; deficiencies harm the liver and other organs.
- Silicon is known to be involved in bone calcification, at least in animals.
- Tin is necessary for growth in animals and probably in humans.
- Vanadium, too, is necessary for growth and bone development and also for normal reproduction; human intakes of vanadium may be close to the minimum needed for health.
- Cobalt is recognized as the mineral in the large vitamin B<sub>12</sub> molecule; the alternative name for vitamin B<sub>12</sub>, cobalamin, reflects the presence of cobalt.

In the future we may discover that many other trace minerals also play key roles: silver, mercury, lead, barium, and cadmium. Even arsenic – famous as the poisonous instrument of death in many murder mysteries and known to be a carcinogen – may turn out to be an essential nutrient in tiny quantities.

As research on the trace minerals continues, many interactions between them are also coming to light. An excess of one may cause a deficiency of another. (A slight manganese overload, for example, may aggravate an iron deficiency.) A deficiency of one may open the way for another to cause a toxic reaction. (Iron deficiency, for example, makes the body much more susceptible than normal to lead poisoning.) Good food sources of one are poor food sources of another; and factors that cooperate with some trace elements oppose others. (Vitamin C, for example, enhances the absorption of iron and depresses that of copper.) The continuous outpouring of new information about the trace minerals is a sign that we have much more to learn.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 12:**

### **• Nutrition Status, Food Choices, and Diet Planning**

All the nutrients have been presented and discussed, the food sources of each are known, and the human needs for them have been described. Now, how do you go about determining whether individuals or groups are receiving the nutrients they need? And if they are not, what food choices do they need to change? Then, how do you set about improving the diet while honoring their food preferences? This session addresses these questions.

#### **Nutrition Assessment**

To learn whether a person's nutrient needs are being met, the dietitian or other health professional performs a nutrition assessment. To give all the details of such a procedure would go far beyond the scope of this course (whole graduate courses are taught in this subject, and hundreds of pages of reading are required). However, any student of nutrition should know the basics of a proper nutrition assessment procedure, for two reasons.

For one thing, competent medical care includes attention to nutrition. The doctor should employ a person skilled in nutrition assessment techniques or refer all patients to such a person, to make sure their nutritional health is sound, while the health care organization (hospital or other) should make nutrition assessment a routine part of its workup on every patient so that nutrition handicaps will not hinder the response to medical treatment and the recovery from illness.

Second, because nutrition is such a popular subject today ("everybody's doing it"), fraudulent practices are even more abundant in this area than they have been in the past (and they have always been rampant). The knowledgeable consumer needs to know what procedures he or she can expect in a nutrition assessment, and what kinds of information they can yield.

For these reasons, this session begins with a brief summary of nutrition assessment techniques.

Nutrition assessment involves making an inventory of nutrition assets and liabilities as determined by four techniques:

- History taking.
- Anthropometric measures.
- Physical examination.
- Biochemical analysis (clinical or lab tests).

Each of these involves collecting data by a number of means and interpreting the findings in relation to the total picture.

#### **Historical Data**

A person's history reveals many clues about his present nutrition status. The person making a nutrition assessment explores the history of the subject from a number of different angles: medical, social, and drug history, as well as diet. Many circumstances of a person's life, including the environment he lives in, his cooking facilities, previous illnesses, persons he associates with, and others, have an impact on his nutrition status and provide the assessor with clues to likely problems.

Medical and social histories are often obtained in a nutrition assessment by reference to charts already filled out by the attending physician, nurse, or other worker. The drug history has seldom already been taken in a way that is useful to the nutrition assessor and therefore often requires special attention. Hundreds of drugs interact with nutrients, creating the possibility of imbalances or deficiencies, and they should not be overlooked in assessing a person's nutrition status.

As for the diet history, there are several means of obtaining food intake data, including the 24-hour recall, the usual intake record, the food frequency checklist, and the food diary. Great skill is necessary to obtain accurate food intake data. The dietitian trained in these techniques often uses food models and measuring devices to help clients identify serving sizes of food consumed.

The most commonly used method of obtaining food intake data is the 24-hour recall. To use this method one asks the person to recount everything eaten or drunk in the past 24 hours or for the previous day. Seldom does this method give enough accurate information about an individual's food intake to be valid, however. It is more often used in nutrition surveys to obtain estimates of the typical food intakes of large numbers of people in given populations.

## Food Frequency Checklist

The following information will help us to understand your regular eating habits so that we may offer you the best service possible. If you have any doubt about some items, be sure to underestimate the “goodness” of your habits rather than to overestimate.

1. How many times per week do you eat the following foods? Circle the appropriate number:

Per Week

- Poultry . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Fish . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Hot dogs . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Bacon . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Lunch meat . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Sausage . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Pork or ham . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Salt pork . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Liver . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Beef or veal . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Other meats (which?) \_\_\_\_\_ 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Eggs . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Fast Foods . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_

2. How many times per day do you eat the following foods? Circle the appropriate number:

Per Day

- Bread, toast, rolls, muffins . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Milk (including on cereal) . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Yogurt or tofu . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Cheese or cheese dishes . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Sugar, jam, jelly, syrup, honey . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Butter or margarine . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_

3. How many times per week do you eat the following foods? Circle the appropriate number:

Per Week

- Fruit or fruit juice . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Vegetables other than potato . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Potatoes and other starchy vegetables . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Salads or raw vegetables . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Cereal (which kind?) \_\_\_\_\_ 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Pancakes or waffles . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Rice or other cooked grains . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Noodles (macaroni, spaghetti) . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Crackers or pretzels . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Sweet rolls or doughnuts . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Cooked dry beans or peas . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Peanut butter or nuts . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Milk or milk products . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- T.V. dinners, pot pies, other prepared meals . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Sweet bakery goods (cake, cookies) . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Snack foods (potato or corn chips) . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Candy . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Soft drinks (which?) \_\_\_\_\_ 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Coffee or tea . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Frozen sweets (which?) \_\_\_\_\_ 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Instant meals, such as breakfast bars  
or diet meal beverages (which?) \_\_\_\_\_ 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Wine . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Beer . . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_
- Whiskey, vodka, rum, etc. . . . . 0 <1 1 2 3 4 5 6 7 8 9 >9 \_\_\_\_\_

## Food Frequency Checklist (continued)

4. What specific kinds of the following foods do you eat most often? Include the name of the food; whether it is fresh, canned, or frozen; and how it is prepared.
  - Fruits and fruit juices \_\_\_\_\_
  - Vegetables \_\_\_\_\_
  - Milk and milk products \_\_\_\_\_
  - Meats \_\_\_\_\_
  - Breads and cereals \_\_\_\_\_
  - Desserts \_\_\_\_\_
  - Snack foods \_\_\_\_\_
5. Please list the names of any liquid, powder, or pill form of vitamin or mineral product you take, and state how often you take it. Please list also any diet supplement you use (such as protein milkshakes or brewer's yeast), and how much you use, and how often you use it. \_\_\_\_\_
6. Is there anything else we should know about your food/nutrient intake? \_\_\_\_\_

An average of the 24-hour recall is that it is easy to obtain. It is also less frustrating to elicit information from the past 24 hours than to require a person to estimate his intake over a long period of time. However, the previous day's intake may not be the usual intake; the subject may be unable to estimate the amounts of food eaten; the subject may conceal facts about what she ate; and as a result, sometimes the information gathered in a 24-hour recall is totally meaningless as a reflection of a person's usual intake.

Another method is to obtain a "usual intake pattern." An inquiry on usual intake might begin with "What is the first thing you usually eat or drink during the day?" Similar questions follow until a typical intake pattern is obtained. This method is similar to the 24-hour recall and can be recorded on the same form. A skilled and patient interviewer can obtain much useful information from it. For a person whose intake varies widely from day to day, however, it may be hard to answer the questions, and in such a case the data obtained may be useless in estimating nutrient intake. However, the usual intake method is often useful to verify food intake when the past 24 hours have been atypical.

Another approach is to use a food frequency checklist. The purpose of this record is to ascertain how often an individual eats a specific type of food per day, week, month, or year. Subjects are asked to state how often they eat a certain food or food type, and a long list of foods is used to cover all possibilities. The information obtained can help pinpoint nutrients that may be excessive or deficiency in the diet. If used in conjunction with the usual intake or 24-hour recall, the food frequency record permits double-checking the accuracy of the information obtained.

Still another alternative is the food diary. Completion of a diary often helps to determine factors associated with food intake (time of day, place eaten, mood, and others present). The person keeping the diary is instructed to write down the required information immediately after eating. A food diary works well with cooperative people but requires considerable time and effort on their part.

The advantages of the food diary are several:

- The diary keeper must assume an active role.
- The person may for the first time begin to see and understand his own food habits.
- The assessor obtains an accurate picture of the diary keeper's lifestyle and factors that affect his food intake.

For these reasons food diaries are particularly useful in outpatient counseling for such nutrition problems as weight reduction or food allergy. The major disadvantages stem from poor compliance in recording the data and conscious or unconscious changes in eating habits that may occur while the diary is being kept.

After food intake data have been collected, they are used to determine nutrient intake, if appropriate. Comparison with standards such as the RDA or the Canadian Dietary Standard is the next step. The comparison is made either by estimating or by actually computing the amount of each nutrient obtained from each food on a typical day or in the recall.

This course provides two ways of estimating nutrient intakes from a diet history. One way is to use the information in sessions 8 through 11 to obtain rough estimates of the intakes of the vitamins thiamin, 124

riboflavin, folacin, vitamin B<sub>6</sub>, vitamin C, and vitamin A and the minerals calcium, iron, and zinc.

### Risk Factors for Poor Nutrition Status

	<b>Medical History</b>	
Recent major illness	Alcoholism	Hyperlipidemia
Recent major surgery	Cancer	Hypertension
Surgery of the GI tract	Circulatory problems	Mental retardation
Overweight	Liver disease	Multiple pregnancies
Underweight	Lung disease	Neurologic disorders
Recent weight loss or gain	Kidney disease	Pancreatic insufficiency
Anorexia	Diabetes	Paralysis
Nausea	Heart disease	Physical disability
Vomiting	Heavy smoking	Radiation therapy
Diarrhea	Hormonal imbalance	Teenage pregnancies
<b>Diet History</b>		<b>Social/Economic History</b>
Chewing or swallowing difficulties (including poorly fitted dentures, dental caries, and missing teeth)		Inadequate food budget
Inadequate food intake		Inadequate food preparation facilities
Restricted or fad diets		Elderly
Frequently eating out		Living (eating) alone
No intake for 10 or more days		Poor education
Intravenous fluids (other than total parenteral nutrition) for 10 or more days		
	<b>Drug History</b>	
Antibiotics		Catabolic steroids
Anticancer agents		Oral contraceptives
Anticonvulsants		Vitamin and other nutrient preparations
Antihypertensive agents		

### Food Intake Record (used to obtain either a 24-hour recall or the usual intake pattern)

Name and address \_\_\_\_\_ Date \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Did you take a vitamin/mineral supplement? \_\_\_\_\_  
 If yes, what kind? \_\_\_\_\_ Dose \_\_\_\_\_

Please record the amount and type of foods and beverages consumed today. [Or: Please record the amount and type of foods and beverages you typically consume each day.]

<b>Food</b>	<b>Amount (c, tbsp, or piece)</b>	<b>Description</b>
	(etc.)	

## History

Name \_\_\_\_\_ Today's date \_\_\_\_\_  
Address \_\_\_\_\_ Age \_\_\_\_\_  
\_\_\_\_\_ Sex \_\_\_\_\_  
\_\_\_\_\_ Phone \_\_\_\_\_  
Date of last medical checkup \_\_\_\_\_ Height \_\_\_\_\_  
Reason for coming in \_\_\_\_\_ Weight \_\_\_\_\_  
\_\_\_\_\_ Usual Weight \_\_\_\_\_

## Personal Data

1. Last grade of school completed \_\_\_\_\_ Still in school? \_\_\_\_\_
2. Are you employed? \_\_\_\_\_ Occupation \_\_\_\_\_
3. Does someone else live in your home? \_\_\_\_\_ Who? \_\_\_\_\_
4. Do you smoke in any way? \_\_\_\_\_ How much? \_\_\_\_\_
5. Have you recently lost or gained more than 10 lb? \_\_\_\_\_ If yes, please explain how \_\_\_\_\_
6. Are you pregnant? \_\_\_\_\_ How many months? \_\_\_\_\_
7. How many pregnancies have you carried to term? \_\_\_\_\_
8. Are your menstrual periods normal? \_\_\_\_\_ If not, please explain \_\_\_\_\_
9. Have you been told you have: (check any that apply)  
Diabetes \_\_\_\_\_ High blood pressure \_\_\_\_\_ Hardening of the arteries \_\_\_\_\_  
Lung disease \_\_\_\_\_ Kidney disease \_\_\_\_\_ Liver disease \_\_\_\_\_ Ulcers \_\_\_\_\_  
Cancer \_\_\_\_\_ Other \_\_\_\_\_
10. Do you eat at regular times each day? \_\_\_\_\_ How many times per day? \_\_\_\_\_
11. Do you usually eat snacks? \_\_\_\_\_ When? \_\_\_\_\_
12. Where do you usually eat your meal?  
Morning \_\_\_\_\_ Noon \_\_\_\_\_ Night \_\_\_\_\_  
With whom?  
Morning \_\_\_\_\_ Noon \_\_\_\_\_ Night \_\_\_\_\_
13. Would you say your appetite is good? \_\_\_\_\_ Fair? \_\_\_\_\_ Poor? \_\_\_\_\_  
If poor, please explain \_\_\_\_\_
14. What foods do you particularly dislike? \_\_\_\_\_
15. Are there foods you don't eat for other reasons? \_\_\_\_\_
16. Do you have any difficulty eating? \_\_\_\_\_
17. How would you describe your feelings about food? \_\_\_\_\_
18. Who prepares your meals? \_\_\_\_\_
19. Are you, or is any member of your family, on a special diet? \_\_\_\_\_  
If yes, who and what kind? \_\_\_\_\_
20. Do you drink alcohol? \_\_\_\_\_ How many drinks per day? \_\_\_\_\_  
Do you ever drink alcohol excessively? \_\_\_\_\_ How often? \_\_\_\_\_
21. Do you take any kind of medication, either prescribed by a doctor or over-the-counter, for any condition? \_\_\_\_\_
22. How would you describe your exercise habits? \_\_\_\_\_  
Kind of exercise \_\_\_\_\_ How intense? \_\_\_\_\_  
How long at a time? \_\_\_\_\_ How often? \_\_\_\_\_
23. Are there any other facts about your lifestyle that you think might be related to your nutritional health?  
\_\_\_\_\_ Explain \_\_\_\_\_

## Food Diary

Name \_\_\_\_\_  
Date \_\_\_\_\_

Time	Place	With Whom	Emotional State	Hungry or Not Hungry	Food Eaten (Amount)
		(etc.)			

The other way is to look up every food in the table of food composition and to add up manually the nutrients obtained; or to use a computer program that does the same thing automatically. This is an informative but time-consuming exercise, even when it is done with the help of a computer. It tends to imply an accuracy greater than can actually be obtained from data as uncertain as those that provide the starting information. Foods vary. Not all 200-gram tomatoes contain exactly 1.3 mg of niacin. Nutrient contents of foods are averages. Furthermore, the professionals who make up the tables assume that the foods are stored and prepared in a way that minimizes losses of vitamins.

Even more significantly, the person who reports eating “a serving” of greens may not know the difference between a quarter-cup and two whole cups; only trained individuals can accurately estimate serving sizes. Thus there are many possible sources of error in comparing nutrient intakes with nutrient needs in this way. Most history-takers learn to sue shortcut systems to obtain rough estimates of nutrient intakes and then use the calculation method to pin down any suspected nutrient deficiencies or imbalances.

Once an estimate of nutrient intakes has been obtained by means of a diet history, it has to be combined with other sources of information to confirm or eliminate the possibility of suspected nutrition problems. The assessor must constantly remember that a sufficient intake of a nutrient does not guarantee adequate nutrient status for an individual. The individual's needs may be high or his absorption, utilization, or excretion of the nutrient may be abnormal, so that even though he doesn't have a primary nutrient deficiency, he may have a secondary one.

### **Primary Deficiency**

A nutrient deficiency caused directly by lack of that nutrient in the diet.

### **Secondary Deficiency**

A deficiency caused by the body's inability to digest, absorb, or utilize a nutrient in the normal fashion, or by excess destruction or excretion of the nutrient.

### **Anthropometric Measures**

Anthropometrics are physical measurements that reflect growth and development. The measurements taken on an individual are compared with standards specific for sex and age. Those standards, in turn, are derived from measurements taken on large numbers of people of the same race and geographic location as those being measured.

Height and weight are well-recognized anthropometrics. Others include fatfold measurements and various measures of lean tissue. Some are used in specific situations. In infancy, a head circumference measurement may be useful. In liver disease, a measurement of abdominal girth may be informative. Anthropometrics are particularly useful when they are measured at intervals over time.

Anthropometric measures can be easy to take, and little equipment is required. However, their accuracy and value are limited by the skills of the measurer. Mastering the correct techniques takes time, and plenty of practice is needed before an assessor can use them reliably. Furthermore, significant changes in measurements are slow to occur in adults. When changes do occur in adults, they represent prolonged alterations in nutrient intake.

Among the standards used for anthropometric measures are several already presented. A table of average weights for height is often used as a standard for individual people's weight. To make the use of such a height-weight table meaningful, the assessor refers to a table of frame sizes such as the one based on elbow breadth or the one that compares wrist circumference to height. The table of average weights for height may not be useful in cases where a person has weighed much more or much less than the average all his life; to assess such a person's weight status it may be more informative to compare his weight, not with a supposed “ideal” body weight (IBW), but with his usual body weight (UBW); or to ask the person in a dietary interview, “Have you noticed a change in weight recently?”

The nutrition status of people suspected of being overnourished or undernourished with respect to protein and kcalories can be assessed anthropometrically. The triceps fatfold measurement, as used in assessing obesity, was mentioned in Session 7. To assess undernutrition, one uses not only weight for height and fatfold thickness but also measurements of the body's skeletal muscle and other lean tissue (visceral protein). The following table shows that different compartments are depleted, depending on whether the person has kwashiorkor (from protein deficiency), marasmus (from kcalorie deficiency), or a mixture of the two. The triceps fatfold measure provides an estimate of body fat. The midarm circumference (MAC) provides an index of the arm's total area; and an arithmetical calculation subtracts the fat from the total area, leaving an estimate of the lean tissue in the arm – the mid-arm muscle circumference (MAMC). The MAMC reflects the body's total skeletal muscle mass. The following table shows how these measures are used to help distinguish among different types of protein-kcalorie malnutrition (PCM) in malnourished hospital patients. In conjunction with these;

several lab tests are also used (see table below).

Anthropometric measures are also used to assess growth in children and weight gain in pregnant women.

### Anthropometric and Biochemical Measures Used to Assess PCM

	Body Compartment Measured	Body Compartment Measured	Body Compartment Measured
Measure	Body Fat	Skeletal Muscle	Visceral Protein
<b>Anthropometrics</b>			
Weight	X	X	
Triceps skinfold	X		
Midarm circumference	X	X	
Midarm muscle circumference		X	
<b>Lab Tests</b>			
Serum albumin			X
Serum transferrin			x
Total lymphocyte count			X
Creatine-height index		x	

The amount of creatinine excreted is thought to reflect total skeletal mass. It therefore should be proportional to height. If creatinine excreted (for a person of a given height) is low, this reflects depleted skeletal muscle.

### Physical Examination

Clues to a person's nutrition status can be identified by examining the person for physical signs of malnutrition. However, many of the signs are nonspecific: they can be associated with nutrient deficiencies but may be totally unrelated to nutrition. Physical findings can only be interpreted in light of other assessment findings.

Physical signs of malnutrition appear most rapidly in parts of the body where cells are being replaced at a high rate, such as in the hair, skin and gastrointestinal tract. Sessions 8 to 11 presented many tables of symptoms of vitamin and mineral deficiencies and toxicities indicating the many tissues and organs that would reflect signs of malnutrition. The following table summarizes the signs of vitamin/mineral malnutrition, organized nutrient by nutrient, as well as the biochemical tests used to confirm them.

#### Biochemical (Lab) Tests

Biochemical or clinical lab tests help to determine what is really happening inside the body. Blood and urine samples are most often used to directly measure nutrients or metabolites that are affected by poor nutrition. Biochemical measurements often can be used to detect subclinical malnutrition.

The lab tests most commonly used in hospitals today for nutrition assessment help uncover PCM. These include tests for serum albumin levels, serum transferrin levels, total lymphocyte count, and creatinine excretion. Used together with the anthropometric measures already mentioned, these lab tests help differentiate among different types of PCM:

- **Marasmus:** Somatic protein and fat severely depleted. Indicators: low %IBW or %UBW; fatfold thickness; MAC; MAMC; and creatinine-height index.
- **Kwashiorkor:** Visceral protein severely depleted. Indicators: low total lymphocyte count, serum albumin, and serum transferrin.
- **Kwashiorkor-Marasmus Mix:** Both body compartments depleted. Indicators: all.

Not only blood and urine tests but also skin tests may be used to assess nutrition status in the hospital. Various forms of PCM have been associated with depression of the immune system. The total number of lymphocytes (white blood cells that defend against infection) appears to decrease as protein depletion occurs; and this is why the total lymphocyte count is an index useful in nutrition assessment. Another test of the immune function is antigen skin testing. Organisms (usually three to four kinds) to which most people are immune are injected just under the skin. After 48 hours the sites of the injections are inspected for raised, hardened areas. These will be apparent in well-nourished persons; but in malnourished persons, they will not appear or will be very small, because the body is unable to resist the antigens.



## Selected Physical Findings and Laboratory Tests Useful for Assessing Some Vitamin and Mineral Deficiencies

Vitamins	Physical Findings Associated with Deficiency/Toxicity	Laboratory Tests Used for Assessment
Vitamin A	Triangular gray spots on eye; dryness of eye membranes and skin; night blindness; softening of the cornea; plugging of hair follicles with keratin; diarrhea; infections; bone pain; dental decay; nerve damage; anemia (Toxicity: bone abnormalities; joint pain; bleeding; slowed clotting time; stopping of menstruation; loss of appetite; headache; nausea; loss of hair; brittle nails; enlarged liver; jaundice)	Serum vitamin A Serum carotene
Thiamin	Loss of ankle and knee jerks; calf muscle pain; edema; wasting; mental confusion; weakness; peripheral paralysis; enlarged heart; cardiac failure.	Urinary thiamin Thiamin load test Erythrocyte (red blood cell) transketolase
Riboflavin	Dermatitis around lips and nostrils; cracking at corners of mouth; reddening of eyes; magenta-colored tongue; hypersensitivity to light.	Urinary riboflavin Erythrocyte glutathione reductase Riboflavin load test
Niacin	Bilateral symmetrical dermatitis; swollen, smooth, edematous tongue; mental confusion; irritability; diarrhea.	Urinary N-methylnicotinamide Urinary 2-pyridone
Vitamin B <sub>6</sub>	Dermatitis; cracking of corners of mouth; smooth, red tongue; irritation of sweat glands; abnormal brainwave pattern; confusions.	Tryptophan load test Urinary B <sub>6</sub> Blood transaminase Blood B <sub>6</sub>
Folacin	Smooth, swollen tongue with cracking; diarrhea; macrocytic anemia	Erythrocyte folate Urinary formiminoglutamic acid Serum folate
Vitamin B <sub>12</sub>	Smooth, swollen tongue; heightened sensitivity of skin; loss of sensation in fingers and toes; macrocytic anemia	Serum B <sub>12</sub> B <sub>12</sub> isotope methods Urinary methylmalonic acid Schilling test
Vitamin C	Swollen, spongy, bleeding gums; petechiae; poor wound healing; heart degeneration; rough skin; pain in joints; anemia; depression (Toxicity: nausea, cramps, diarrhea)	Serum vitamin C Urinary vitamin C Vitamin C load test
Vitamin D	Bowing of legs; beading of ribs; knock knees, wrist enlargement; retarded growth; poor tooth formation; protruding abdomen; muscle spasms (Toxicity: loss of appetite; headache; thirst; irritability; stones in soft tissues)	Serum 25-hydroxycholecalciferol Serum alkaline phosphatase Serum calcium and phosphorus
Vitamin E	Edema in infants; hemolysis (Toxicity: impaired blood clotting, GI distress)	Hydrogen peroxide hemolysis test Plasma tocopherol
Vitamin K	Bruising; slowed clotting time	Prothrombin time

Many factors other than nutrition can interfere with the immune response, and the value of skin testing as an index of nutrition status has been questioned. No studies to date have considered all the factors that might affect skin test results. Among known factors are age, certain allergies, and certain drug regimens.

Besides helping to assess PCM, laboratory testing can help assess nutrition status with respect to vitamins and minerals. The tests most often used are listed in the following table by each nutrient. As is true throughout the nutrition assessment procedure, the assessor must use caution in interpreting results of tests like these. Vitamin and mineral levels present in the blood may reflect disease processes, abnormal hormone levels, or other aberrations rather than dietary intake. Even if they reflect dietary intake, they may be affected by what the person has been eating recently, and may not give a true picture of the status of the person's nutrient stores; this sometimes makes it difficult to detect a subclinical deficiency. Furthermore, many nutrients interact. The assessor has to keep in mind that an abnormal lab value for one nutrient may reflect abnormal status with respect to other nutrients.

## Selected Physical Findings and Laboratory Tests Useful for Assessing Some Vitamin and Mineral Deficiencies - continued

Minerals	Physical Findings Associated with Deficiency/Toxicity	Laboratory Tests Used for Assessment
Calcium	Rickets; seizures; osteoporosis; osteomalacia	Serum calcium
Potassium	Muscle weakness (Toxicity: abnormal heart action)	Serum potassium
Magnesium	Tetany (extreme muscle contraction); muscle weakness; hallucinations	Serum magnesium
Iron	Pale nail beds, eye membranes, and palmar creases; fatigue; weakness; headaches; shortened attention span (Toxicity: infections; iron deposits in tissues)	Hemoglobin Hematocrit Iron binding capacity Serum ferritin
Iodine	Enlarged thyroid gland; sluggishness; weight gain	Serum protein-bound iodine Urinary iodine Radioiodine uptake
Zinc	Skin rash; hair loss; growth retardation; loss of taste and smell; weight loss; night blindness; infections; liver enlargement; apathy; irritability; slow wound healing (Toxicity: anemia; diarrhea; fever; pain; nausea; exhaustion)	Serum or plasma zinc Hair zinc concentration

### Nutrition Assessment Completed

Once the assessor has accumulated all the puzzle pieces available from the many types of data, she assembles them into a complete picture. All these pieces are needed to make sense of a person's nutrition status. The ultimate diagnosis is appropriately tentative and is confirmed only after careful remedial steps have been taken and have been shown to successfully alleviate the observed problems.

### Serum Albumin

The chief blood protein used to assess protein nutrition status.

### Serum Transferrin

An iron-carrying protein in the blood. The concentration of this protein increases if the person's iron stores are depleted; it decreases in protein malnutrition.

### Total Lymphocyte Count

A count of white blood cells, a measure of immune function, which may or may not reflect nutrition status.

### Creatinine Excretion

An indicator of lean body mass. Creatinine is a waste product produced by active muscle.

### Somatic Protein

The protein of voluntary muscles.  
Soma = body

### Visceral (VISS-er-ul) Protein

The protein of the internal organs.  
Viscera = internal organs

### Antigen Skin Testing

A test of the immune system's competence, in which an antigen is applied to the skin. A reaction means the immune system is working normally.

### How Well Do We Eat?

Interest in the nutrition status of our people dates from before World War II, when a food-consumption survey suggested that as many as a third of the population might be poorly fed. Programs to correct nutrition problems have been evolving ever since. Significant among the early ones were:

- **Enrichment of bread and cereal products.** In those states that have enrichment legislation, refined bread and grain products must have iron, thiamin, riboflavin, and niacin added to make them comparable to whole-grain products in their contents of those nutrients.

- **The National School Lunch Program.** The school lunch makes available to public school children (in those districts that have adopted it) lunches that supply at least one-third of the RDA for all of the nutrients.
- **Iodization of salt.** In areas where the soil is iodine-poor, this is an important public health measure.

During the 1940s, 1950s, and 1960s, many surveys of the U.S. population were conducted. Nutrients found lacking in subgroups of the population were the minerals calcium and iron; the B vitamins thiamin and riboflavin; vitamin A; and occasionally vitamin C. Most vulnerable to nutrient deficiencies were girls, women, and elderly men; but no group was without some cases of iron deficiency. Other nutrients now known to be important – vitamin B<sub>6</sub>, folacin, magnesium, and zinc, for example – were not studied in the early surveys.

During the 1970s, public awareness of the nutrition status of U.S. citizens reached a new high. The Senate's Poverty Subcommittee and the Select Committee on Nutrition and Human Needs held hearings, widely broadcast on national television that projected a picture of the poor family unable to feed its children. Hunger and malnutrition in the United States became a controversy and a political issue, disclaimed by some who said the findings were exaggerated, and singled out by others who considered them a scandal and a national disgrace. The findings that generated the controversy arose from the Ten-State Survey, conducted in the late 1960s (1968-1970).

### **The Ten-State (National Nutrition) Survey**

The ten states surveyed were California, Kentucky, Louisiana, Massachusetts, Michigan, South Carolina, Texas, Washington, New York, and West Virginia – chosen to represent geographic, ethnic, economic, and other features of the whole United States. Over 60,000 people were included.

Not only food intake but also other indicators of nutrition status were used: clinical tests using blood and urine samples, physical examinations, anthropometric measures, and medical histories. Interviews were conducted, to gain insight into conditions likely to precipitate nutrient deficiencies or to have been caused by them. The subjects' educational levels and financial status were determined, and information about foods available to them was collected. The results were reported in relation to age, sex, ethnic background, and location (whether the person resided in a low-income or high-income state). The findings from such a survey might be slightly different today, but the kinds of information collected would be the same.

The physical examinations revealed few severe deficiencies – a good sign, indicating that nutrition knowledge and food intakes had improved enough to eliminate most of the worst cases of undernutrition seen in earlier years. Deficiencies were present, however, and it was clear that low-income and uneducated people had poorer nutrition in every respect, although wealthy, well-educated people could also have poor nutrition. Iron nutrition was still a problem in all groups, especially among blacks; vitamin A nutrition status was a major concern especially among teenagers and Spanish Americans. Riboflavin deficiency appeared to be a potential problem, especially among blacks, Spanish Americans, and young people of all ethnic groups. Iodized salt clearly had remained an important part of the diet in the north-central states; iodine deficiencies were not seen. Protein deficiency was not widespread but was seen more often in the poor than in the well to do. Pregnant women and those who were breastfeeding their babies had lower protein intakes and lower blood levels of protein than most other groups.

Indicators of nutrient deficiencies tended to cluster together. A person deficient in iron was likely to lack vitamin A as well, for example. Generally, blacks and Spanish Americans had a higher prevalence of multiple deficiencies; a higher prevalence also occurred in the low-income status. An important finding was that in families where the homemaker had completed fewer years of school, there were more multiple low values in the family members. Importantly, too, trends seen among the children were also seen in adults in the same families.

Anthropometric measures revealed that people with higher incomes had greater height, weight, fatness, skeletal weight, and other indicators of earlier and greater physical development. Blacks were taller than whites and were more advanced in skeletal and dental development, reflecting their genetic endowment. Obesity was more prominent in adult women, especially in black women.

Sugar intakes were high in most groups, and high sugar intakes were often seen together with dental decay, especially in adolescents. Low income accompanied dental decay in all groups.

Overall, several groups were found in need of help regarding their nutrition: obese people, blacks, Spanish and Medical Americans, adolescents, and low-income families. The nutrients of greatest concern were iron, vitamin A, and riboflavin, with protein being a problem for pregnant and lactating women. Many nutrients were not studied, including vitamin B<sub>6</sub>, folacin, magnesium, and zinc.

The Ten-State Survey provided a disturbing answer to the question "How well do U.S. citizens eat?" 131

Clearly, not as well as might be expected in the most prosperous nation in the world. The identification of vulnerable groups confirmed the need for programs of many kinds to decrease the risk and incidence of nutrient deficiencies, and for continued surveillance of the U.S. population's nutrition status.

### **The HANES and the Nationwide Food Consumption Survey**

At about the same time (1971-1974), the U.S. National Center for Health Statistics conducted a study of over 20,000 people at 65 sampling sites in the United States. This study, known as the HANES (Health and Nutrition Examination Survey), avoided the bias of which the Ten-State Survey was accused by adjusting for the effects of oversampling among vulnerable groups. Careful efforts were also made to evaluate protein and kcalorie intakes in relation to height, sex, and age on an individual basis.

The investigators studied intakes of the same seven nutrients as previously, and niacin and kcalories in addition. Nutrient deficiencies were found only for protein, calcium, vitamin A, and iron. As expected, these were more extensive among people below the poverty line than among those above and generally more extensive in blacks than in whites. In particular:

- Protein intakes were low for low-income adolescents, women, and older men and for middle – and upper-income black women, older black men, and older white women.
- Calcium intakes were low for adult black women of all income groups.
- Vitamin A intakes were low for low-income white adolescents and young adult women and for adolescent black girls of all income groups.
- Iron intakes were low for all women and for infant boys regardless of income.

HANES II, undertaken in 1977 as a follow-up to HANES, was designed to collect biochemical and other data, with an emphasis on determining whether the physical condition of the subjects studied reflected the nutrient intakes found earlier. Particularly, the investigators wondered whether the test results would reflect the extensive low iron intakes known to exist in the population. As of 1981, with funding becoming increasingly limited for analysis of data, the results were just becoming available, and indeed, low blood and urine values were found:

- For protein and vitamin A, in less than 3 percent of subjects.
- For thiamin, in 14 percent of white and 29 percent of black subjects.
- For riboflavin, in 3 percent of white and 8 percent of black subjects.
- For iron, by three measures, in 5 to 15 percent of white and 18 to 27 percent of black subjects.

Not everyone with low intakes of a nutrient had low lab values, and the investigators suggested that those with low intakes were “at risk” for malnutrition.

In measuring the heights and weights of people, the HANES researchers observed that there is a continuing trend toward higher amounts of body fat among fatter Americans. It has long been known that improved nutrition, and especially adequate intakes of protein, could alter the average height of a population over several generations. (A well-known example is the case of the Japanese, whose children after World War II grew taller than their parents thanks to the availability of more meat). However, the trend toward higher weights in Americans reflects overnutrition, not “good” nutrition.

### **Persons with Nutrient Intakes at or below 70% of RDA**

<b>Nutrient</b>	<b>Income to \$6,000</b>	<b>Income \$6,000 to \$9,999</b>	<b>Income \$10,000 to \$15,999</b>	<b>Income \$16,000 and Over</b>
Vitamin A	36%	33%	32%	29%
Vitamin B <sub>6</sub>	59%	51%	49%	48%
Vitamin C	30%	29%	27%	23%
Calcium	49%	43%	39%	39%
Iron	29%	31%	33%	33%
Magnesium	48%	40%	36%	35%

## **Food Choices**

Among the reasons why you chose the foods you ate today may be any of the following:

- Personal preference (I like them).
- Habit or tradition (they are familiar; I always eat them).
- Social pressure (they were offered; I couldn't refuse).
- Availability (there were no others to choose from).
- Convenience (I was too rushed to prepare anything else).
- Economy (they were within my means).
- Nutritional value (I thought they were good for me).

Of these seven possible reasons, only one has to do with nutrition directly. Even people who pride themselves on obtaining good nutritional value in their meals will admit that the other six factors listed here also influence their food choices. Such being the case, it would be unrealistic to approach diet planning without taking all these factors into account. The only diet plan that will work is one that is in harmony with a person's preferences, social life, habits, environment, economic status, and lifestyle. No matter how nutritious a meal is, it cannot benefit a person's health until it is eaten.

### **Personal Preference, Habit, Tradition**

Why do we like certain foods? One reason, of course, is our preferences for certain tastes, and two of these preferences are widely shared: the tastes for sugar and salt. The taste sensors probably helped early humans to distinguish between edible and toxic substances, while their enjoyment encouraged them to eat large amounts to keep them alive until they found more food. Once, the tasty flavors of sugar and salt were available only from whole, natural foods; so they promoted behavior that benefited health. The sweet and salty tastes helped people identify life-giving fruits, vegetables, and grains; the liking for the salty taste also ensured that they would consume sufficient quantities of the two important minerals, sodium and chloride. Today, now that sugar and salt are available in pure form, our instinctive liking for them can lead us to overconsume foods to which they have been added —sometimes to the point of doing ourselves harm. Only nutrition education can counter this tendency.

Instinctive liking is one kind, but there are other kinds of liking — some of them almost as deep-seated and often as powerful. You like foods with which you have happy associations — those you eat in the midst of a warm family gathering at traditional holiday times, those someone who loved you gave you as a child, or those eaten by people you admire. By the same token, intense dislike — strong enough to be unalterable — can be attached to foods that you ate when you were sick, or that were forced on you when you weren't hungry, or that are eaten by people you don't respect. Your parents may have taught you to like and dislike certain foods for reasons of their own like these, without even being aware of the reasons. In fact, a parent may say to a child, "Eat that, it's good for you," without realizing that his great-grandparents told their children the same thing, and that what is being passed on is not necessarily wisdom, but generations of family custom.

### **Social Pressure**

Social Pressure is a powerful influence on food behavior. How can you refuse when your friends are going out for pizza and beer (or ice cream, or donuts)? Such pressure operates in all circles and across cultural lines. It is considered rude not to accept food or drink being shared by a group or offered by a host; you are not a member of the social gathering until you do. In today's world, where food is abundant, people are hard-pressed to find polite ways of refusing food that, in their self-interest, they must refuse. Many yield, if not to the temptation of the food itself, then to the pressure of social obligation.

### **Availability, Convenience, Economy**

We live in an era when we can choose our foods from among thousands of items on the supermarket shelf. They have come from all over the world, thanks to the efficiency of modern transportation systems. Modern techniques of processing and preserving foods permit long-term storage; many food items can sit on the shelf for years and still be safe to use. Fast-freezing methods now preserve the freshness of the harvest. Even after long trips in refrigerated trucks, extended time in the freezer section of the grocery store, and more time in your own freezer, spring and summer favorites like strawberries and corn on the cob can be enjoyed in the dead of winter. The cost of this luxury has been kept down by the increased productivity of our farmers. With effective pesticides and fertilizers, farmers have been able to increase their yields so that they not only feed the growing population at home but also keep the United States and Canada among the few remaining exporters of food in the world.

Not only is an abundance of foods available, but many have been made convenient in ways our grandparents never dreamed of — frozen meals, soup mixes, breakfast bars, total nutrition powders. Many foods have also been suited to our tastes by the addition of sugar and salt. These new foods have not been with us 133

long enough to have stood the test of time. As they replace traditional foods, we will need to know to what extent they offer the nutrients we need.

The abundant, low-cost, and constant food supply has not been an unmixed blessing. Artificial fertilizers, mechanization of the farm, and burgeoning transportation needs have put serious drains on our energy supply. Also, to support our growing population, more and more farmland is being covered with concrete highways and with cities that depend on those highways for their food. Pesticides and fertilizers run off into our streams and lakes, polluting the water supply and contaminating the food chain. Among the factors affecting our food choices in the future, two questions must become increasingly important: “How much energy was required to produce this food?” and “How did the production of this food affect the environment?” Up to today, these questions have had little or no bearing on people’s food choices.

## Nutritional Value

People are more nutrition-conscious today than ever before. While the many factors discussed above influence everyone’s food choices, the perceived nutritional value of food also has weight. But people often do not know how to choose among the many delicious, affordable foods available. The next section offers a summary that may be helpful.

## Diet Planning

There is no such thing as “the perfect diet.” And even if one person could devise “the perfect diet” for himself, it would not be suitable for the next person. Planners have to consider many factors in designing diets – all of those just mentioned, and many more. They also have many different foods to deal with, and there may be no overlap at all between the foods acceptable to a person of one nationality and those preferred by another. To complicate the task further, foods are not so simple as they once were. A hundred years ago, wherever you might have looked in the Western world, you would have found people eating the same basic types of foods – milk and dairy products, legumes, nuts, meats, vegetables, fruits, grains. But now we have to contend with TV dinners, veggieburgers, instant fruit drinks, and engineered foods of all descriptions. The guidelines once offered in the past don’t seem to apply to those foods. How does the Four Food Group Plan classify a veggieburger?

It can be done. It is still useful to think in terms of food groups for a start. Having reviewed the information about them from all the previous sessions, we can then add in the new foods with increased awareness and understanding of their place and value. The next few paragraphs review the suggestions offered so far and then put the new foods in their places. (Remember that in the sessions these suggestions were surrounded by discussion of pros and cons. They are only suggestions, not “rules.”)

- **Carbohydrate:** Select foods high in complex carbohydrate, both starch and fiber (grains, seeds, tubers, legumes, starchy vegetables), and in naturally occurring sugars (fruits, vegetables). Avoid the overuse of concentrated sweets (sugar, honey, cola beverages, cakes, candies, and the like).
- **Fat:** Be moderate in the use of fat-rich foods (meats, nuts) and pure fats (butter, margarine, oils), and balance your saturated fat intake with an approximately equal amount of polyunsaturated fat.
- **Protein:** Obtain adequate but not excessive amounts of protein, making sure to get high-quality protein from at least one source (meats, fish, poultry, eggs, cheese, milk). Or, combine protein-containing foods so as to get high-quality protein from the combination (grains and legumes).
- **KCalories:** Control kcalories so that the energy you take in from food equals the energy you expend for daily activities. If you are overweight, reduce calorie intake and increase activity in order to lose weight gradually.
- **Alcohol** (contributes kcalories, so is included here): Use in moderation, if at all.
- **Vitamins and minerals:** Choose foods that will supply ample amounts of all the essential vitamins and minerals, being careful to include a good vitamin A source (a serving of dark-green or deep-orange vegetable or fruit) at least every other day; a good vitamin C source (a serving of citrus fruit or the equivalent) every day; and a good calcium source (2 to 3 cups of milk or the equivalent) every day. Because vitamins and minerals – especially trace minerals – are lost when foods are refined or otherwise processed, emphasize unrefined, unprocessed foods in diet planning.
- **Salt (sodium):** Be moderate in its use, and if you have hypertension in your family, avoid sodium-rich foods and substitute potassium-rich foods (whole, fresh fruits and vegetables).
- **Iodine:** In areas where the soil is poor in iodine, be sure to use iodized salt.

- **Fluoride:** Be aware whether the water supply in your area is fluoridated or contains 1 ppm or more fluoride naturally. If it lacks fluoride, follow your dentist's advice regarding toothpaste or fluoride applications to protect your family's teeth from decay.

All these principles are familiar by now, as is the time-honored plan usually used as a guideline to abide by them: the Four Food Group Plan or its modified version that includes legumes. But the menu planner of today has to answer many questions:

- "Casseroles and soups don't fit in the Four Food Group Plan, but they are nutritious, aren't they?"
- I like to eat Italian-style; is pizza (or lasagna or spaghetti and meatballs) good for you?"
- "I eat in restaurants all the time, usually fast-food places. When I do cook at home its TV dinners or instant meals. Am I dying a slow death from malnutrition?"
- "I don't eat meat, fish, or poultry. How can I make my diet adequate?"

All these different kinds of people can assure themselves of good nutrition by learning a few facts about foods.

To answer the first two questions very briefly: Any combination of conventional foods can be fitted into the food groups with a little thought. A cup of vegetable soup, for example, could be considered to be roughly a serving of vegetables (ignore the broth as if it were mostly water). A cup of cream soup prepared with milk is nearly equal to a cup of milk. A slice of pizza could be counted roughly as a slice of bread and 1 fat (the dough) with the equivalent in calcium and protein of a cup of milk (if it's thickly coated with cheese) and a portion of vegetables (if it has, say, a half-cup or more of tomato and other vegetable topping on it). Basically, you simply use your common sense and your knowledge of what went into each dish.

No matter what country's cuisine you like, a little inspection will show that the custom of that country has evolved a balance of foods that meets people's nutrient needs. In Italy, the milk group is often represented by cheese; meats are included as such; the grains appear as pasta; and the vegetables are similar to those of North America. In China (to give one more example), the milk group is not apparent (Chinese adults don't use milk); rather, liberal uses of soybeans and soybean curd supply the needed calcium. Meats, again, appear as such; the grain is almost invariably rice; and this is an abundance of fruits and vegetables.

This short discussion should serve to answer the first two questions and illustrate the point that there is no one right diet, that many different ways of combining conventional foods can produce adequacy and balance. But the third question is more difficult to answer. What about the new foods?

### **Coping with the New Foods**

The understandings won from learning to read labels can help you to mix and match new and traditional foods to your advantage. Dr. Daniel Rosenfield, director of nutrition affairs at Miles Laboratories, points out that even an imitation food, while inferior to conventional foods by a legal definition, might have desirably lower levels of some components and might be nutritionally superior.

Many people fear that the new foods are inferior, however. Some are so put off by them that they try to avoid them altogether. Most use them with mixed feelings; the pleasure of the really delightful taste sensations sometimes offered is tainted with anxiety and guilt. (Some don't even think about it, of course.) Whatever your feelings on the subject, the chances are that you can't escape the new foods altogether. They are part of modern life, and in many ways a desirable part. They are easy to store and prepare, they save a tremendous amount of time and effort, and they are often tasty. Formulated foods used in school lunches are acceptable to children, who waste less of them, and they are lower in cost than conventional foods. They have won wide acceptance in institutional settings as well as by homemakers and individual consumers, and their use is on the rise. Rather than trying to avoid them altogether, it makes sense to learn to use them to your advantage.

Not all are of equal value. A substitute for hamburger made from textured soy protein, soy flour, wheat germ, and artificial flavors and colors may be lower in fat, higher in fiber, and equal in protein quality to a hamburger – that is, superior for some purposes. On the other hand, a TV dinner may cost twice as much as, and provide fewer nutrients than, the same meal prepared from the raw materials at home; and a fast-food meal may be three times as expensive as its homemade equivalent. The habitual use of a fortified breakfast cereal may prevent iron deficiency in a woman whose calorie intake is low; but the use of toasted, jam-filled, unenriched pastries for breakfast by her children may dilute the nutrients in their day's menus.

A strategy for dealing with the new foods is based on several principles. First, ask yourself how often you eat the food in question. The more often you use a food product, the more impact it will have on your diet, and the more important it is to be aware of the contributions it is, or isn't, making.

Second, consider a food's nutrient contributions in the context of the other foods in your diet. For example, the lack of vitamin C in the potato chips you eat is of no concern to you if you drink plenty of fruit juice, especially citrus juice, every day. But if you are relying on the food as a staple, to provide the nutrients usually contributed by a class of similar foods – for example, if you are regularly using a meat substitute in place of meat or soy milk instead of milk – then you owe it to yourself to be sure that the substitute provides the same nutrients the missing food would provide and is of high quality. (A cup of soymilk contributes only 20 milligrams of calcium whereas a cup of cow's milk contributes almost 300 milligrams.)

Third, keep the calories in mind. No matter how attractive, if a food you often use donates more calories than you can afford to consume, you have a hard fact to face up to.

Finally, put the spotlight on yourself. No matter how nutritious the food you eat, it cannot compensate for other flaws in your lifestyle. A balanced, health-oriented approach to life including adequate rest, some exercise, and adequate time for meals at appropriate intervals will pay off in dividends no selection of foods by itself can offer you. Within such a context, common sense should help you to avoid unnecessary extremes. It is probably true that you should try to include foods that contribute vitamin C in every day's meals. On the other hand, the idea that you should always eat farm-fresh foods, sitting down, with a placemat under your plate and a linen napkin in your lap, reflects a set of values that you may or may not wish to call your own. Drinking your breakfast or bringing home your family's dinner in a bucket can be part of a satisfactory nutrition picture and of a lifestyle that you find comfortable and acceptable. For ourselves, it seems appropriate to draw the line where adequate, balanced, and safe nutrition is achieved and to be open-minded about all other options.

We have come a long way from the introduction of the term nutrient in Session 1 to the conclusion of this section on diet planning. Students who have followed the path through all its turnings should consider themselves well grounded in the basics of nutrition.



## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 13:**

### **• Food Additives**

Food is a fantastically complex mixture of chemicals, probably numbering in the hundreds of thousands.

If you are curious to know what substances are in the foods you eat and what they do, you can't help wondering about additives. Reading labels is all very well, but it takes you only so far. The most a label tells you about additives is what they do to the foods they are in – but what do they do to you? This question may especially concern you if you have heard some of the stories that implicate additives in the causation of cancer, birth defects, and other frightening conditions.

For example, cyclamate, a widely used artificial sweetener, was banned from use in the United States in 1969 because of some tests suggesting that it could cause cancer. Since then, five other substances have been banned for similar reasons: red dye no. 2, violet no. 1, carbon black, diethylpyrocabonate, and salts of cobalt (used in beer). Two others, saccharin and nitrite, have also been banned, but the bans have been suspended – a situation some consumers find confusing and troubling. Some 20 other substances have been challenged as unsafe, including salt, sugar, xylitol, caffeine, MSG (monosodium glutamate), and all synthetic colors and flavors. People wonder what they might be consuming now that will be banned in the future, and what harm it may be doing.

A public paranoia has thus developed that has destroyed many consumers' confidence in the safety of the food supply. This is doubly ironic. The public's mistrust has stemmed from the presence in foods of substances that were put there to make the foods safer, more attractive, or in other ways beneficial to consumers. And the banning of some of these substances has resulted from the requirement that they be tested, that the tests be closely monitored, and that the whole process be open to public view.

Before getting into some of the down-to-earth facts about additives, it is important to make a distinction and to offer a perspective. Harmful substances do occur in foods. Sometimes they are even put there intentionally, by people who haven't realized the potential harm they may cause. But a greater danger by far comes from harmful substances that get into foods accidentally by way of contamination with disease-causing microorganisms or with unwanted substances from packaging, processing materials, or environmental pollution. In other words, the term additive is too loose. We should distinguish between intentional additives, put there on purpose after a rational decision-making process, and incidental or indirect additives, which find their way into foods by accident.

### **Paranoia (para-NOY-uh)**

Excessive or irrational suspiciousness and distrustfulness; unjustified fear.

Para = beyond

Nous = mind

### **Additive**

A substance not normally consumed as a food by itself but added to food either intentionally or by accident.

### **Intentional Food Additive**

An additive intentionally added to food, such as nutrients or colors.

### **Indirect (Incidental) Additive**

An additive unintentionally added to a food by an accident of contamination, such as packaging materials or chemicals used during processing.

### **Terminology**

To begin at the beginning, then, intentional food additives are substances put into foods to give them some desirable characteristic: color, flavor, texture, stability, or resistance to spoilage. Some additives are nutrients added to foods to increase their nutritional value, such as vitamin C added to fruit drinks or potassium iodide added to salt. The most common ones, roughly in order of the quantities used, are listed in the following Miniglossary. In addition, there are numerous additives used in still smaller quantities for miscellaneous other purposes.

## Miniglossary of Intentional Food Additives

Type of Food Additive	Purpose of Food Additive
Emulsifiers, stabilizers, thickeners	To give texture, smoothness, or other desired consistencies.
Nutrients	To improve nutritive value.
Flavoring agents	To add or enhance flavor.
Leavening (neutralizing) agents	To control acidity or alkalinity.
Preservatives, antioxidants, sequestrants, antimicrobial agents	To prevent spoilage, rancidity of fats, and microbial growth.
Coloring agents	To increase attractiveness.
Bleaches	To whiten foods such as flour and cheese and to speed up the maturing of cheese.
Humectants, anticaking agents	To retain moisture in some foods and to keep others (such as salts and powders) free flowing.

### Regulations Governing Additives

The agency charged with the responsibility of deciding what additives shall be in foods is the Food and Drug Administration (FDA). FDA's authority over additives hinges primarily on their safety. The procedure a manufacturer has to go through to get permission to put a new additive in food puts the burden on him to prove the additive is safe, and may take several years. First he has to test it chemically to satisfy the FDA that:

- It is effective (it does what it is supposed to do).
- It can be detected and measured in the final food product.

Then he has to feed it in large doses to animals and prove that:

- It is safe (it causes no cancer, birth defects, or other injury).

The manufacturer can't do just any animal tests. The doses are specified; two kinds of animals (usually rodents and dogs) must be used; and the time periods must be long. Finally, the manufacturer must submit all his test results to the FDA.

FDA responds to the manufacturer's petition by announcing a public hearing. Consumers are invited to participate at these hearings, where experts present testimony for and against the acceptance of the additive for the proposed uses. Thus the consumer's rights and responsibilities are written into the provisions for deeming additives safe.

If FDA approves the additive's use that doesn't mean the manufacturer can add it in any amount to any food. On the contrary: FDA writes a regulation stating in what amounts, and in what foods, the additive may be used. No additives are permanently approved; all are periodically reviewed.

Many substances were exempted from complying with this procedure at the time the law came into being, because there were no known hazards in their use. These substances, some 700 in all, were put on the GRAS list. However, any time substantial scientific evidence or public outcry has questioned the safety of any of the substances on the GRAS list, a special reevaluation has been made. Meanwhile, the entire GRAS list has been systematically and intensively reevaluated, and all substances about which any legitimate question was raised have been removed or reclassified. A set of 2,100 flavoring agents is similarly being reviewed, as well as some 200 coloring agents.

### GRAS (Generally Recognized as Safe) List

A list of food additives established by the Food and Drug Administration (FDA), that has long been in use and were believed safe. The list is subject to revision, as new facts become known.

### Carcinogen (car-SIN-oh-jen)

A cancer-causing agent.

Carcino = cancer

Gen = to produce.

## **Delaney Clause**

A clause in the Food Additive Amendment to the Food, Drug, and Cosmetic Act that states that no substance that is known to cause cancer in animals or humans at any dose level shall be added to foods in any amount.

## **Nitrite**

A salt added to food to prevent botulism.

## **Nitrosamines (nigh-TROHS-uh-meens)**

Derivatives of nitrites that may be formed in the stomach when nitrites combine with amines; and nitrosamines are carcinogenic.

## **Botulism (BOTT-you-lism)**

A form of food poisoning caused by botulinum toxin, a toxin produced by bacteria that grow in meat.

One of the criteria an additive must meet to be placed on the GRAS list is that it must not have been found to be a carcinogen in any test on animals or humans. The Delaney Clause (a part of the law on additives) is uncompromising in addressing carcinogens in food and drugs and has been under fire in recent years for being too strict. This brings us to the questions of what laws are appropriate in regulating food additives, and what changes should be made.

The Delaney Clause is criticized because it does not allow for the different effects on the body of varying dose levels of an additive. For example, when the artificial sweetener cyclamate was banned in 1969, it was estimated that a human would have to drink, each day, at least 138 12-ounce bottles of soft drinks containing cyclamates to ingest an amount of cyclamate comparable to the quantity given animals in the tests that caused the ban. The FDA was criticized for banning the use of cyclamates, but under the law it had no alternative. The Delaney Clause does not give FDA the right to make a judgment on dose levels of carcinogens or on the applicability of animal research to humans or even on the reproducibility of an experiment.

At present, a similar controversy centers on saccharin. Some animal tests have suggested that saccharin may be a weak carcinogen; thus it had to be automatically banned. But while consumers were grateful in 1969 when cyclamate was banned, they were upset and resentful in 1977 at the proposed banning of saccharin, the only familiar artificial sweetener remaining on the market. To satisfy both the law and the consumers, Congress passed the ban and then suspended it; as of 1983 saccharin was still being sold, but with a warning label: "Use of this product may be hazardous to your health. This product contains saccharin which has been determined to cause cancer in laboratory animals."

Nitrites, which are added to smoked meats such as hot dogs and cold cuts, have suffered a similar fate. A test on rats, published in 1978, suggested they caused cancer, and again an automatic ban had to be invoked. But the case of nitrites had a new twist. They are not added to meats just for flavor or eye appeal. They prevent bacterial spoilage, and in particular, the growth of the deadly bacterial species that produces botulinum toxin, the most potent biological poison known. An amount as tiny as a single crystal of salt can kill a person within an hour, and in survivors, troublesome after-effects linger for months. If nitrites were banned, the risk to users of these products would be intolerable; no other preservative was known that could do nitrite's job; and the only alternative seemed to be to take all smoked meats off the market.

The ban on nitrite was therefore suspended, pending further investigation. Not long after, the experiment connecting nitrites to cancer was heavily criticized, and its validity is doubtful. The risk to users of products containing nitrites is probably slight in comparison to other risks, but consumers have been shaken by the alarms raised and are more inclined to be mistrustful of all additives as a result.

## **The Public's Fears about Additives**

Another reason for the public's sometimes-unreasonable fear of additives is a generalized fear of anything "chemical" or "synthetic." Many deadly poisons are "natural" substances found in foods or produced by living organisms (consider mushrooms). Contrary to the public's suspicions, it is the processing of food and the introduction of additives that removes toxic substances, prevents the growth of dangerous microorganisms, and makes the food safe for our use. Foods are made of chemicals anyway, as the table below demonstrates. It has been argued that the food industry has not only the right but also the responsibility to educate the public about the safety of food additives. From this point of view, a food packager who advertises "no additives" is not doing the public a favor. By implying that there is something wrong with additives, he is exploiting the public's emotionalism rather than helping educate.

**These Chemicals are Found Naturally in Foods. No Additives are Present. Chemical Listings are not Necessarily Complete.**

Type of Food	Chemicals Found	Type of Food	Chemicals Found
Toast and Coffee Cake	Gluten, amino acids, amylose, starches, dextrins, sucrose, pentosans, hexosans, triglycerides, monoglycerides and diglycerides, sodium chloride, phosphorus, calcium, iron, thiamin (vitamin B <sub>1</sub> ), riboflavin, vitamin B <sub>2</sub> , niacin, pantothenic acid, vitamin D, methyl ethyl ketone, acetic acid, propionic acid, butyric acid, valeric acid, caproic acid, acetone, diacetyl, maltol, ethyl acetate, ethyl lactate.	Scrambled Eggs	Ovalbumin, conalbumin, ovomucoid, mucin, globulins, amino acids, lipovitellin, livetin, cholesterol, lecithin, choline, lipids (fats), fatty acids, lutein, zeaxanthine, vitamin A, biotin, pantothenic acid, riboflavin (vitamin B <sub>2</sub> ), thiamin (vitamin B <sub>1</sub> ), niacin, pyridoxine (vitamin B <sub>6</sub> ), folic acid (folacin), cyanocobalamin (vitamin B <sub>12</sub> ), sodium chloride, iron, calcium, phosphorus.

### **Caution:**

People who sell foods, like people who sell anything, may be inclined to take advantage of their customers in unfair ways, as we have often said before. A realistic (not necessarily cynical) view of this tendency helps protect you, the consumer, from being “taken.” Take a close look, sometime, at the foods that claim to contain “no additives, no preservatives.” Are they beneficial, nutritious foods? How do they resist spoilage – or do they? Do they contain large amounts of salt? (Salt is really an additive too, but not commonly thought of as one. In fact it is a very effective preservative – but is it preferable to other preservatives in terms of its effects on human health?) What is the motivation behind the claim on the label? Is the intention to reveal to you the unadorned truth about the contents of the package? Or is it trying to imply a health-promoting property that is really not unique to the food in the package --with or without additives? When a label says “no additives,” ask yourself: “So what?”

Another reason the public has become scared about what’s in foods is – ironically – because chemists are so much better at their jobs than they used to be, and the analytical techniques they use are so much more powerful than in the past. Where once they would say there were no detectable levels of a substance in food “down to one part per million,” now they have ways of detecting the same substance at one part per billion. This makes it seem as if new substances are appearing in our foods while in fact they may have been there all the time but are only now being seen. And the concentrations are so extremely low as to be insignificant. It is ironic, too, that the removal of substances from the GRAS list, which has improved the safety of those permitted, so alarmed the public that the effect seems to have been to make them mistrustful of the entire process. But the main reason for exaggerated alarm about additives is the public’s failure to understand the difference between toxicity and hazard.

### **Toxicity**

The ability of a substance to harm living organisms. All substances are toxic if high enough concentrations are used.

### **Hazard**

State of danger; used to refer to any circumstance in which toxicity is possible under normal conditions.

### **Toxicity versus Hazard**

Toxicity – the capacity of a chemical substance to harm living organisms – is a general property of matter; hazard is the capacity of a chemical to produce injury under conditions of use. All substances are potentially toxic, but are hazardous only if consumed in sufficiently large quantities.

This distinction is readily accepted in other area – such as air travel: “We fly in airplanes because they are ‘safe,’ but ‘safe’ is defined by the low number of deaths per million passenger miles, not the total absence of risk. When chemicals are involved, however, there seems to be an added scare factor.

## Margin of Safety

As used when speaking of food additives, a zone between the concentration normally used and that at which a hazard exists. For common table salt, for example, the margin of safety is 1/5 (five times the concentration normally used would be hazardous).

To see food additives in the correct perspective, it is necessary to understand the concept of margin of safety. Most additives that involve risk are allowed in foods only at levels 100 times below those at which the risk is still known to be zero; their margin of safety is 1/100. Experiments to determine the extent of risk involve feeding test animals the substance at different concentrations throughout their lifetimes. The additive is then permitted in foods at 1/100 the level that can be fed under these conditions without causing any harmful effect whatever. In many foods, naturally occurring substances appear at levels that bring their margin of safety closer to 1/10. Even nutrients, as you have seen, involve risks at high dosage levels. The margin of safety for vitamins A and D is 1/25 to 1/40; it may be less than 1/10 in infants. For some trace elements, it is about 1/5. People consume common table salt daily in amounts only three to five times less than those that cause serious toxicity.

The margin of safety concept also applies to nutrients when they are used as additives. Iodine has been added to salt to prevent iodine deficiency, but it has had to be added with care because it is a deadly poison in excess. Similarly, iron has been added to refined bread and other grains (enrichment), and has doubtless helped prevent many cases of iron-deficiency anemia in women and children who are prone to that disease. But the addition of too much iron could put men (who usually have enough) at risk for iron overload. The margin of safety for iron, too, is not so generous, and the upper limit has to be remembered.

All the additives just named are in foods for a reason. They offer benefits, in comparison with which the risks are deemed either small enough to ignore or worth taking. When the benefit to be gained from an additive is small, as in the case of color additives that only enhance the appearance of foods but do not improve their health value or safety, then the risks may be deemed not worth taking. Only 31 of a possible 200 color additives are now approved for use by the FDA.

It is also the manufacturers' responsibility not to use more of an additive than they have to, to get the needed effect. The case of nitrites, where higher dose levels could conceivably be associated with a risk, is an obvious example. Additives should also not be used:

- To disguise faulty or inferior products.
- To deceive the consumer.
- Where they significantly destroy nutrients.
- Where their effects can be achieved by economical, sound manufacturing processes.

## Additives in Perspective

All that has been said so far has been reassuring. The use of additives in the food supply seems to be justified, in many cases, by the benefits we gain from them; the risks associated with their use are small. All intentional additives are, and will doubtless continue to be, closely regulated and monitored. Furthermore, in many cases, combinations of intentional additives are no more harmful than these additives used singly, and may even be beneficial. Giving further reassurance, the FAO/WHO Expert Committee on Food Additives has concluded that "an increase in the number of food additives on a permitted list does not imply an over-all increase in the [total amount of] additives used; the different additives are largely used as alternatives – there is less likelihood of long exposure, or of high or cumulative dose levels being attained if a wide range of substances is available for use."

Finally, it should be noted that the safety of food additives is not first, or even third, on FDA's list of priority concerns; it is sixth. In order of concern, hazards within the FDA's areas of responsibility are:

- Food-borne infection, which is increasing because of large-scale operations and multiple transfers involving handling.
- Nutrition, which requires close attention as more and more artificially constituted foods appear on the market.
- Environmental contaminants, which are increasing yearly in number and concentration and whose consequences are difficult to foresee and forestall.
- Naturally occurring toxicants in foods, which occur randomly in arbitrary levels and constitute a hazard whenever people turn to consuming single foods either by choice (fad diets) or by necessity (famine).
- Pesticide residues.
- Intentional food additives listed last "because so much is known about them, and all are now, and surely will continue to be, well regulated."

The top item on this list is food poisoning, a real and frequent hazard to people who consume food that has been contaminated by toxic microorganisms during processing, packaging, transport, storage, or preparation in the home.

Deaths from food-borne infection can occur whenever batches of contaminated foods escape detection and are distributed. Close monitoring of processing, preparation, and distribution of food is extraordinarily effective, but individual consumers must be vigilant and knowledgeable in order to protect themselves against occasional hazards. Batch numbering makes it possible to recall all food items from a contaminated batch through public announcements on TV and radio. In the kitchen, the consumer must obey the rules of proper preparation and storage of foods to avoid the dangers of food poisoning.

Second on the above list is nutrition, the subject to which this entire course is addressed; third is contamination. Fourth is naturally occurring toxicants in foods, a much more serious and real hazard than most consumers realize.

Many commonly used plants and plant products contain naturally occurring toxicants. Mushrooms were mentioned earlier as a familiar example; but did you know a number of common foods have been observed to cause toxic effects?

- Cabbage, mustard, and other plants contain goitrogens, which can enlarge the thyroid gland.
- Potatoes contain solanine, a powerful inhibitor of nerve impulses; the margin of safety, assuming ordinary consumption of potatoes, is 1/10.
- Spinach and rhubarb contain oxalates, tolerable as usually consumed; but one normal serving of rhubarb contains 1/5 the toxic dose for humans.
- Honey can be a host to the botulinum organism and can accumulate enough toxin to kill an infant.

There are 700 other examples of plants that – as used – have caused serious illnesses or deaths in the Western hemisphere. At the same time, there has been no case of a death or illness caused by an additive as used at legally permitted levels in food. A well-known environmental scientist has said, “One can predict that if the standards used to test manmade chemicals were applied to ‘natural’ foods, fully half of the human food supply would have to be banned.

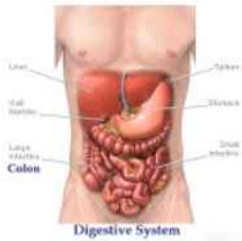
The fifth item on the list of FDA's hazards is pesticide residues, sometimes a serious problem.

People who are concerned about the levels of various additives and pollutants in the food supply would be well advised to eat as wide a variety of foods as possible so as to dilute the amount of any one substance. “The wider the variety of food intake, the greater the number of different chemical substances consumed, and the less is the chance that any one chemical will reach a hazardous level in the diet.”

## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 14:

### • Alternative Therapies

#### COLON THERAPIES: COLONICS, COLEMA, ENEMAS, COLON CLEANSSES



#### *COLON CLEANSING*

Retained debris in the colon leads to the absorption of toxins, resulting in systemic intoxication (poisoning). Symptoms of this condition can include mental confusion, depression, irritability, fatigue, gastrointestinal irregularities, and even allergic reactions such as hives, sneezing, and coughing. Many nutritionists and researchers believe that this toxicity can eventually lead to more serious disorders. Colon cleansing can rid the colon of debris, and help prevent and treat a variety of health

problems.

#### FASTING

The best means of removing toxins and wastes from the body is a fast. This should be the first step in any colon-cleansing program. In addition to following a fast, use a wheat grass, fresh lemon juice, garlic, or coffee enema. If bowel problems or related symptoms are chronic, repeat this program once monthly.

#### NUTRIENTS

The following supplements aid in cleansing the colon:

- Fiber - Ground flaxseeds, oat bran, and psyllium seed husks are good sources. Essential for a clean colon. Not habit forming.
- Acidophilus - Take on an empty stomach. Restores the normal “friendly” bacteria in the colon. If you are allergic to dairy products, use a nondairy formula.
- Apple pectin – Source of quality fiber. Helps to detoxify heavy metals.
- Wheat grass Juice or Capsules – To assist in keeping the colon clear of toxic debris and aid in healing of an inflamed colon.
- Aloe Vera Juice – Heals colon inflammation. Use a pure form.
- Vitamin C – Protects the body from pollutants. Use a buffered or esterified form.
- Herbal Laxative/Cascara Sagrada/Other – Helps remove debris from the colon and detoxifies the liver.

#### COLONICS

Colon lavage was first recorded 1500 BC, in the ancient Egyptian document, Ebers Papyrus which dealt with the practice of medicine. These enemas were described as the infusion of aqueous substances into the large intestine through the anus. Hippocrates (4<sup>th</sup> and 5<sup>th</sup> century BC) recorded using enemas for fever therapy. Galen (2<sup>nd</sup> century AD), also recognized and was a proponent of the use of enemas. Pare in 1600 AD, offered the first distinction between colon irrigation and the popular enema therapy of that age.

Colon therapy since the turn of the century has experienced periods of popularity alternating with periods of reaction. The factors that contributed mainly to this ambivalence primarily were due to the practice of colon hydrotherapy by the untrained and unskilled, which was very detrimental to its professional growth. When the therapy gained the attention of such physicians as James A. Wiltsie, MD and Joseph E. G. Waddington, MD, great value was placed on the therapeutic benefits of this modality. The philosophy attributed to colon therapy by certain physicians of this era was depicted by Dr. Waddington: “Abnormal functioning of the intestinal canal is the precursor of much ill health, especially of chronic disease conditions. Restoration of physiologic intestinal elimination is often the first, but too often ignored, important preliminary to eventual restoration of the health in general.” Dr. Wiltsie contends that “our knowledge of the normal and abnormal physiology of the colon, and of its pathology and management, has not kept pace with that of many organs and systems of the body. As long as we continue to assume that the colon will take care of itself, just that long will we remain in complete ignorance of perhaps the most important source of ill health in the whole body”.

In summary, through misconceptions, misunderstandings and preconceived emotionalism, controversy has prevailed, but accomplished nothing. Historically, we recognize two unequivocal conclusions. First, there is something of value to this modality or it would have been conclusively withdrawn; second, that through

lack of professional control and study, colon hydrotherapy never received the attention and recognition it justly deserves.

Today, with modern technological advancements in colon hydrotherapy instrumentation, particularly with regard to safety, along with educated and skilled therapists, colon hydrotherapy has become a valuable adjunctive modality to the physician in treating disease. At the time of this writing, colon hydrotherapy is still relatively unknown and misunderstood. Combined with sound nutrition, exercise and a positive mental and spiritual outlook, colon hydrotherapy can play an important role in achieving and maintaining vibrant health.

### **Definition:**

Colon hydrotherapy is an extended and more complete form of an enema. The concept involves the mechanical process of infusing warm filtered water into the rectum with the objective of cleansing and balancing the colon. This procedure removes fecal material from colon walls and dilutes the bacterial toxin concentration in the large intestine. The therapeutic effects of colon hydrotherapy are improved muscle tone which facilitates peristaltic action and enhances the absorption of nutrients from the cecum and ascending colon while minimizing the absorption of toxic waste material. The cleansing effects of colon hydrotherapy reduce stagnation and subsequent bacterial proliferation in the colon and maintain harmony of the intestinal flora in promoting optimal colon health.

Colon hydrotherapy is not a cure-all, but an important adjunctive therapy in the overall health care of the patient. The trained and skilled colon therapist alternately fills and empties the patient's colon with temperature and pressure regulated water. While on the empty cycle (only) the colon therapist gently manipulates the abdomen enhancing the removal of waste material.

The standard enema and colon hydrotherapy treatment both utilize the infusion of aqueous substances into the rectum. A standard enema involves the injection of water (one way) into the colon, which is retained and evacuated by the patient. Colon hydrotherapy is an instrument controlled continual bathing of the colon for cleansing and therapeutic purposes. The patient is not involved in the emptying of material from the rectum. There is no offensive odor or health risk to those in contact with sick patients as with enemas and bedpans and the dignity of the patient is maintained. The enema's cleansing ability is limited to the area of the rectosigmoid and shorter periods of time because of the body's natural wish to expel material from the rectum. Colon hydrotherapy extends beyond the natural expulsion area to offer greater cleansing and therapeutic benefits.

Variations in enema therapy include: The cleansing enema softens the feces and promotes evaluation of the bowel. The retention enema softens the feces and lubricates the lower bowel and rectum. The carminative enema is used primarily to relieve flatus (gas). The nutrient enema provides liquid nutrition for repaid absorption by the colon and rectum.

Colon hydrotherapy in itself encompasses all of these forms of enema therapy and the benefits of a closed system can be attained. Various prescribed supplemental solutions, i.e., saline, kayxellate, etc., or others may be implemented through the colon hydrotherapy (Model 1085) instrumentation (as prescribed by a Physician).

Colon hydrotherapy not only removes impactions, parasites, intestinal flatus and cellular debris, but is thought to cleanse and rejuvenate the portion of the immune system that resides in the intestinal tract (recent European studies indicate a greater portion located in the intestines than previously recognized). In summary, colon hydrotherapy provides tubular and cellular drainage outwardly from the rectum and inwardly via the portal and mesenteric lymphatic system.

### *Why Colon Hydrotherapy?*

Diseases and functional disturbances of the digestive organs are the most frequently complained about problems today. The health of most organs as well as our overall well being depends upon how well our bowel (intestine) functions. A change in diet after many years of wrong eating habits does not assure optimal colon health.

### **Consider these current Medical Facts:**

1. Over 400 million dollars are spent annually on laxatives in the U.S.
2. Over 70 million Americans suffer from bowel problems.
3. 100,000 people undergo colostomies each year in the U.S.
4. Worms outrank cancer as man's deadliest enemy on a worldwide basis.
5. Colon cancer is the second leading cancer killer in the U.S.
6. Over 100,000 Americans die annually due to this disease.



These facts demonstrate that the medical profession recognizes the important part, which the colon plays in health and disease. In all sickness, the status of the bowel is inquired into as a matter of routine and a laxative or enema prescribed when indicated.

Research has shown that regular use of refined carbohydrates and lack of fiber in the diet increases the transit time of bowel wastes and stimulate putrefaction in the colon. Both of these factors have been linked to constipation and certain bowel disease such as: Diverticulitis, colitis, and colon cancer which have a high success rate for cure with surgical management when detected early. The American Cancer Society has provided evidence in recent years which suggests that bowel cancer is caused by environmental agents such as: pesticides and herbicides sprayed on crops, hormones and antibiotics fed to animals and carcinogenic agents in the air we breathe. Periodic cleansing could minimize exposure of these potential carcinogens to the colon wall.

**Pros:**

1. Laxatives act as chemical irritants and stimulate the muscular walls of the colon to abnormally contract to expel the irritating substances. It is very easy to become dependent upon these drugs and permanently destroy the normal ability of the colon to eliminate naturally on its own accord. The oral route of administration is the least optimal method of evacuation of the large intestine. Very important digestive processes occurring higher up in the alimentary tract (stomach and small intestine) are interfered with. Most laxatives and other cathartics precipitate dehydration in the patient. Colon hydrotherapy alternately fills and empties the colon and would improve the hydration status of the patient.
2. Electrolytes, or minerals, are elements that are responsible for cell function throughout the body. When the body is properly nourished with good quality organic foods containing sodium, potassium and magnesium, the electrolyte level of the colon is replenished as part of the diet. The Colon Hydrotherapy (Model 1085) Instrumentation allows for supplementation via the rectum (saline, kayxellate, etc.) at the direction of the physician.
3. The intestinal flora are billions of microscopic organisms including: bacteria, yeast, fungi and viruses which inhabit the bowel and play a very important role in health and disease. Bacteria synthesize valuable nutrients and proper balance of these microorganisms is essential to the healthy colon. The large intestine is producing bacteria on a daily basis and adherence to proper nutrition will enhance the colon's ability to maintain balance following colon hydrotherapy. The physician may elect to prescribe lacto-acidophilus/bacillus culture to facilitate this process or incorporate low fat dairy products (yogurt, etc.) into the patient's dietary program.
4. Following a colon hydrotherapy treatment, the instrument is thoroughly cleansed and disinfected. A potent germicidal solution is used to properly disinfect the instrument and its contents are not harmful to the colon environment. When the disinfection procedure is completed, the instrument is generously cleansed with water clearing the germicidal solution completely from the instrument. The colon hydrotherapy instrumentation contains a check valve, which prevents wastewater from returning to the water supply. In addition, the application of a disposable unit consisting of: waste hose, water line, speculum and obturator which is discarded following each treatment, ensures against any possible contamination to the patient.

**Cons:**

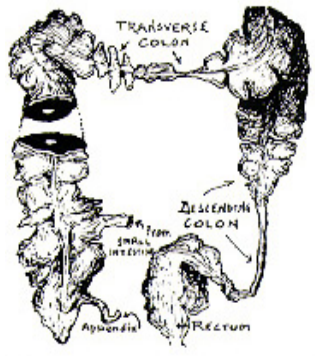
1. Possibility of weakening the colon from too many sessions.
2. Dependency.
3. Loss of minerals (leaching) from bones and teeth from too many sessions.
4. Uncomfortable both physical and emotional.

**Indications for Colon Hydrotherapy**

The history and physical examination of the patient (by the physician) would dictate the need for colon hydrotherapy in the overall treatment plan. Colon hydrotherapy has been shown to be beneficial for the following conditions:

1. Acute Fecal Impaction
2. Constipation
3. Colitis
4. Diarrhea
5. Parasitic Infections
6. Atonic Colon
7. Mucous Colitis
8. Fever Therapy

9. Hyper/Hypothermia
10. Paraplegics & Quadriplegics (Bowel Training)
11. Prevention
12. Abdominal Distention/Flatulence
13. Hemorrhoids (mild to severe)
14. Intestinal Toxemia
15. Nutrient Supplementation via Rectum
16. Diverticulosis
17. Balance Physiologic Flora of Large Intestine
18. Preparation for diagnostic study of the large intestine:
19. Barium Enema
20. Sigmoidoscopy & Colonoscopy
21. Surgery



## AN UNHEALTHY COLON

Through detoxification, proper diet and supplementation, vitality and health can be yours.



## ATONIC CONSTIPATION

Abnormally distended descending colon and sigmoid colon. Atonicity or distention of the lower descending sigmoid commonly caused by excessive use of enemas and laxatives. Such conditions of this section of the colon will cause pressure on the left ovary, bladder, uterus, and kidney.



## BOWEL ADHESIONS

Adhesions occur a great many times after surgery and will interfere mechanically with the peristaltic wave of the colon. They are common sights after surgeries: gall bladder, duodenum, appendectomy, hysterectomy, cesarean section, etc.



## PTOSIS

Ptosis of the first, second, third, and fourth degree are common mechanical conditions. Third and fourth degree ptosis cause such symptoms as lower back pain, frequent elimination of urine and pressures on uterus, ovaries, prostate, etc.



## SPASTIC CONSTIPATION

Pinching down of the descending colon. Spastic irritability: the descending colon is commonly the site of ulcerative colitis, mucous colitis, and irritable run colitis. This spastic colon also causes constipation, alternation constipation, or running off of mucous.

### Indications under Prescription and Direct Physician Supervision:

1. Diverticulitis
2. Ulcerative Colitis
3. Crohn's Disease
4. On Site Preparation Following Trauma
5. Early Pregnancy (up to 4 months)

### The Benefits of Body Cleansing:

1. Colon stimulation and rehabilitation
2. Cleanses the entire large intestine from the rectum to the cecum, providing relief and prevention of chronic constipation.
3. Facilitates the removal of stagnant fecal material and subsequent proliferation of bacteria and their toxins, along with gas, mucus, parasites and cellular debris, allowing the large intestine to perform its natural functions of absorption and assimilation optimally.
4. Is an effective therapy for acute fecal impactions.
5. An excellent screening device for early detection of colon cancer.
6. A valuable aid in promoting accuracy of their diagnostic colon procedures, i.e. barium enema, sigmoidoscopy and colonoscopy.
7. Would be an effective part of the preparation procedure prior to bowel surgery, promoting an optimal surgical field, and potentially decreasing the risk of post-operative complications due to the presence of bacteria at the suture line.
8. Would dramatically reduce problems associated with bowel function secondary to general anesthesia following surgery.
9. Would minimize defecation in the surgical suite while saving valuable surgical time.
10. Extremely useful to alcohol – drug detoxification as an aid in the internal cleansing process. Enhances the elimination of toxins from the large intestine and circulatory system.
11. A natural solution vs. chemical application.



## COLEMA

The Colema Board® is usually setup in the bathroom by placing the evacuation end (splashguard) over the toilet and the other end over a stool or chair. The bucket is placed on a counter near by, or on the tank of toilet. Another option is to place both ends of the board over five gallon buckets (metric conversion), so that the Colema® may be taken anywhere.

### Extra Items Needed:

1. Aside from the Board (and included tubing assembly and tips) and a 5 gallon bucket (or a similar container), you may want to obtain some extra items to make your Colema® experience more comfortable and relaxing.
2. Comfort Pad - placed on the Board and provides cushioning for your back while you take your Colema (which take about 45 minutes to 1 hour).
3. Lubricant - KY-Jelly® or a lubricant salve to apply to the rectal tip for easy insertion (do not use petroleum products as they will clog the holes of the tip).
4. Colander - to place in the toilet before taking the Colema® so that you can see what material comes out (a kitchen accessory).
5. Towel & Pillow - A towel may be placed on the board (where you will lie or over the comfort pad.) A pillow may be placed at the head end of the board to provide extra support and comfort.
6. Reading Materials - A book or magazine may be read while on the Board if you so choose. (Optional)
7. Candles & Music - To give a calm relaxing atmosphere to your Colema experience, you may add a few candles and soft, relaxing music in the background.

## Water Purification Suggestions:

We suggest using only purified water (as opposed to tap or municipal sources). Here are some suggestions for purifying your water for the Colema® procedure:

1. **BOIL:** Bring several gallons of water to a boil and let cool down before using.
2. **FILTER:** A home water filter or purifier may be used.
3. You may also purchase a 5-gallon container of purified water and heat half and mix with the other half. Cool to body temperature.
4. **FILLING YOUR BUCKET:** You can fill your bucket by using some of the following suggestions:
  - Shower Extension
  - Pitcher
  - Fill bucket in tub and lift to position. (Do not attempt if you are weak.)

### Solutions for the Water:

Here are some suggested ingredients you may use in your Colema water solution:

1. **Coffee:** 3 Tablespoons of ground coffee in 1 quart of water – Bring to a boil and simmer 15 minutes. Strain through strainer and cloth, put in bucket (5 gallon) and add water to make 5 gallons. Coffee - Stimulates the colon wall and helps to promote peristaltic action. However, a word of caution: If you have a toxic liver do NOT use coffee or if necessary, use a diluted solution.
2. **Epsom Salts:** 1 Tablespoon of Epsom Salts dissolved in 5 gallons of water.
3. **Lemon Juice:** ¼ cup strained Lemon Juice in 5 gallons of water.
4. **Garlic:** 4 cloves of garlic – put into blender with 1 cup of water. Strain and add ½ cup of Detoxificant #16 (put into bucket and fill with water).
5. **Catnip:** 2 cups of catnip in 2 cups of water – bring to a boil and boil 3 minutes. Strain and put in bucket and fill with water. This has a particularly calming effect on the system. (Recommended for children).

### Other Preparations:

1. Herbal tinctures (such as Black Walnut and Black Cohosh) may be used for parasite removal, Wheat Grass Juice helps to re-establish healthy intestinal flora, Hydrogen Peroxide (3%) (20 drops).
2. **Note:** Most water temperatures for colonics range from cold to very warm, but should be a comfortable temperature for the user.



### Cleaning Tips:

#### Tips & Tubing:

Plastic tips are disposable (designed for one use only). Stainless Steel Tips are reusable and may be cleaned with a bleach and water solution, germicidal solution and/or boiled to sterilize. The tubing may be cleaned with a bleach and water solution, then rinsed with fresh water. It is important to hang to dry for several hours before storing.

### Board:

Gently wipe the surface areas of the board with your choice of cleaning solution:

1. A bleach and water solution
2. Germicidal cleaner
3. A natural disinfectant cleaner
4. The comfort pad (included with the Deluxe Board only - available for purchase separately) may be cleaned with similar solutions as noted above.

### Cautions:

1. We do NOT recommend submersing the Boards in a tub filled with water.
2. We do NOT recommend abrasive cleaners.

## ENEMAS

Over time, toxic wastes can accumulate in the colon and liver, and then circulate throughout the body via the blood stream. A clean and healthy colon and liver, then, are essential for the health of all the organs and tissues of the body.

#### Definition:

There are two types of enemas – the retention enema and the cleansing enema. The primary action of the retention enema, which is held in the body for about fifteen minutes, is to help rid the liver of impurities. The cleansing enema, which is retained for only a few minutes, is used to flush out the colon.

#### Pros:

1. A coffee retention enema is quite helpful during a serious illness, after hospitalization, and after exposure to toxic chemicals. This enema can also be used during fasts to relieve the headaches sometimes caused by a fast-induced release of toxins.
2. Anything taken by mouth can be taken in an enema if there is severe vomiting. This will allow the individual to absorb the herb/mineral without the worry of nausea.

#### Cons:

1. When using any enema, keep in mind that they should never be used if there is rectal bleeding. In such a case, contact a physician immediately.
2. If you experience tension or spasms in the bowel while using an enema, try using warmer water – 99°F is a good temperature – to help relax the bowel. If the bowel is weak or flaccid, try using colder water – 75°F to 80°F – to help strengthen it.
3. Remember that excessive use of coffee enemas over six months or more may deplete the body's stores of iron, as well as other minerals and vitamins, causing anemia. Do not use coffee enemas for longer than four to six weeks at a time. If you develop anemia during treatment – or whenever you use this enema daily for a long period of time – be sure to take desiccated liver tablets as directed on the label.
4. Do not use hot water or very cold water.
5. Consult your physician before giving enemas to children, the elderly, the very ill, persons with hypertension, persons with bowel disease, or pregnant women.
6. If constipation persists after giving an enema, check with your physician.
7. Some people cannot tolerate coffee enemas as they spasm. Garlic enemas tend to be safer for first timers.

#### IDEAL SOLUTION FOR AN ENEMA

1. Take 3 buds of garlic; put in a blender with three cups of distilled water; blend until liquid. Use ½ cup of solution to 2 quarts of warmed water.
2. The addition of ½ teaspoon to one teaspoon of an organic soap, which is of a surfaction, can greatly help in softening. Sometimes the addition of an herb such as Lobelia or Chamomile is also very relaxing.
3. Do not worry if the water does not come out immediately or at all many times: the retaining of water is helping with dehydration, although you can use the last water entered into the body at a cooler temperature, which will cause rapid expulsion, if need be. Relieve yourself when there is discomfort.

#### COFFEE RETENTION ENEMA

When used as a retention enema – an enema that is held in the body for a specified period of time – coffee does not go through the digestive system, and does not affect the body as a coffee beverage does. Instead, the coffee solution stimulates both the liver and the gallbladder to release toxins, which are then flushed from the body.

#### Procedure:

1. To make the coffee enema solution, place 2 quarts of steam-distilled water in a pan, and add 6 heaping tablespoons of ground coffee (do not use instant or decaffeinated). Boil the mixture for fifteen minutes, cool to a comfortable temperature, and strain. Use only 1 pint of the strained coffee at a time, and refrigerate the remainder in a closed jar.
2. Place 1 pint of the enema solution in an enema bag. Do not use petroleum jelly to lubricate the tip of the enema bag. Instead, use vitamin E oil (buy it in oil form or pierce the end of a vitamin E capsule and squeeze the liquid onto the tip). The liquid will both ease insertion and have a healing effect on the anus and the lining of the colon, if these areas are inflamed. Aloe Vera may also be used for the purpose.
3. The best position to assume when receiving the enema is “head down and rear up”. After the liquid has been inserted, roll onto your right side and hold the solution in your body for fifteen minutes before allowing the fluid to be expelled. Do not roll from side to side.
4. Do not be concerned if the liquid is not expelled after fifteen minutes. Simply stand up and move around as usual until you feel the urge to expel the liquid.

#### Recommendations:

1. To maximize the benefits of this or any other retention enema, use a cleansing enema first.
2. Do not abuse coffee enemas by using them too often. Use them only once daily while following a program for a specific disorder, unless you are being treated for cancer. People with cancer may need up to three enemas a day. You may also use coffee enemas occasionally as needed.
3. If you have cancer, AIDS, or another serious illness, or if you have a malabsorption problem, add 1 cc of B-complex vitamins or 2 cc of injectable liver extract, plus a dropperful of liquid kelp or sea water concentrate to the enema solution. If you are unable to locate injectable forms of these supplements, open 2 capsules of a B complex supplement and add the contents to the enema solution, making sure it dissolves before use. Used daily, these supplements replace any lost B vitamins, help rebuild the liver, and provide an extra boost of energy.
4. To kill unwanted bacteria in the colon – or for any type of colon disorder, including diarrhea and constipation – add 5 drops of either Aerobic 07 from Aerobic Life Industries or Dioxychlor from American Biologics to the enema solution.

#### THE *L. BIFIDUS* RETENTION ENEMA

This retention enema, which should be used only three to six times a year, is helpful in cases of candidiasis and other yeast infections, and in cases of severe gas and bloating. When gas is the problem, the *L. bifidus* enema may provide relief within minutes. This remedy may also be beneficial when high colonics have been used or when antibiotics have been taken over long periods of time – practices that can kill the body's "friendly" bacteria. The *L. bifidus* enema replaces this flora, helping the body fight yeast infections and improving digestion. In fact, this enema can be useful during any severe illness.

#### Procedure:

1. To make the *L. bifidus* enema solution, place 6 ounces of Digesta-Lac from Natren in 1 quart of lukewarm steam-distilled water. (Be sure to avoid using very cold or very warm water.) Kyo-Dophilus from Wakunaga may also be used (empty the contents of 6 to 8 capsules into the water), although the Digesta-Lac works best. Mix until formula is dissolved. Use only 1 pint of the solution at a time, and refrigerate the remainder in a jar.
2. For best results, use a plain water enema before using the *L. bifidus* enema, as this makes it easier to retain the *L. bifidus* solution for the necessary period of time. After expelling the plain water enema, place 1 pint of the *L. bifidus* solution in an enema bag. Do not use petroleum jelly to lubricate the tip of the enema bag. Instead, use vitamin E oil (buy it in oil form or pierce the end of a vitamin E capsule and squeeze the liquid onto the tip). The liquid will both ease insertion and have a healing effect on the anus and the lining of the colon, if these areas are inflamed. Aloe Vera may also be used for this purpose.
3. The best position to assume when receiving the enema is "head down and rear up". After the liquid has been inserted, roll onto your right side and hold the solution in your body for fifteen minutes before allowing the fluid to be expelled. Do not roll from side to side.
4. Do not be concerned if the liquid is not expelled after fifteen minutes. Simply stand up and move around as usual until you feel the urge to expel the liquid.

#### THE LEMON JUICE CLEANSING ENEMA

The lemon juice enema is an excellent means of cleansing the colon of fecal matter and other impurities and of detoxifying the system. This enema also balances the pH of the colon, and is useful whenever cleansing of the colon is desired, as well as for colon disorders, such as constipation.

#### Procedure:

1. To make the solution for the lemon enema, add the juice of 3 lemons to 2 quarts of lukewarm steam-distilled water. (Be sure to avoid using either very cold or very warm water.) If desired, add 2 droppersful of liquid kelp to boost the mineral content of the solution.
2. Place all of the solution in an enema bag. Do not use petroleum jelly to lubricate the tip of the enema bag. Instead, use vitamin E oil (buy it in oil form or pierce the end of the vitamin E capsule and squeeze the liquid onto the tip). The liquid will both ease insertion and have a healing effect on the anus and the lining of the colon, if these areas are inflamed. Aloe Vera may also be used for this purpose.
3. The best position to assume when receiving the enema is "head down and rear up". After the liquid has been inserted, roll onto your back, and finally roll over and lie on your left side. As you are doing this, massage your colon to help loosen any fecal matter. Start on your right side and gradually move your fingers up toward the bottom of your rib cage, then across your abdomen and down the left side.
4. Note that 2 quarts is a lot of liquid. If you experience any pain during insertion, stop the flow of the enema bag and, remaining in the same position, take deep breaths until the pain subsides.

Then resume the enema flow. If you expel the liquid before all of it has been inserted, simply begin the process over again. If pain persists, discontinue the enema procedure.

5. Hold the solution in your body for three or four minutes before allowing it to be expelled. After two or three such sessions, you will find it easier to insert and hold the liquid.

### **Recommendations:**

1. If you have trouble with constipation, use the lemon juice enema once a week and the coffee retention enema once a week. The bowels will shortly move on their own, the colon will be clean, and the stool will not be foul smelling.
2. If you suffer from colitis, use the lemon juice enema once a week. Any time pain from colitis is experienced; this enema will quickly relieve the discomfort.
3. If allergic to lemons, prepare the enema solution with 1 to 2 ounces of wheat grass or garlic juice in place of the lemon juice, or fill the enema bag with plain steam-distilled water.

### ***THE CATNIP TEA ENEMA***

Catnip tea enemas are a good way to bring a high fever down quickly and keep it down. These also relieve constipation and congestion, which keep fever up. When body temperature goes above 102oF (102oF in children over two), take a cleansing catnip tea enema. Repeat the procedure every four to six hours, and continue taking the enemas twice daily as long as fever persists. Catnip tea enemas should not be used by children under two years of age.

### **Procedure:**

1. To make the solution for the catnip tea enema, place about 8 tablespoons of fresh or dried catnip leaves in a glass or enameled pot. (If you are using bagged catnip tea, use the amount recommended on the package to make 1 quart of tea.) In a separate pot, bring 1 quart of steam-distilled water to a boil. Remove the water from the heat and pour it over the herbs. Cover the pot and let the tea steep for five to ten minutes. Then strain out the catnip and allow the tea to cool to a comfortable, slightly warm temperature.
2. Place all of the solution in an enema bag. Do not use petroleum jelly to lubricate the tip of the enema bag. Instead, use vitamin E oil (buy it in oil form or pierce the end of the vitamin E capsule and squeeze the liquid onto the tip). The liquid will both ease insertion and have a healing effect on the anus and the lining of the colon, if these areas are inflamed. Aloe Vera may also be used for this purpose.
3. The best position to assume when receiving the enema is "head down and rear up". If you experience any pain during insertion, stop the flow of the enema bag and, remaining in the same position, take deep breaths until the pain subsides. Then resume the enema flow. If you expel the liquid before all of it has been inserted, simply begin the process over again. If pain persists, discontinue the enema procedure.
4. After the liquid has been inserted, roll onto your back, and finally roll over and lie on your left side. As you are doing this, massage your colon to help loosen any fecal matter. Start on your right side and gradually move your fingers up toward the bottom of your rib cage, then across your abdomen and down the left side. Hold the solution in your body for three or four minutes before expelling it.

## **COLON CLEANSSES**

### **Ivy Bridge**

"The key to good health is getting nutrients into the blood stream. This happens once the bowels have begun to be cleansed" – Ivy Bridge

### **Ingredients:**

1. ½ glass apple juice
2. 2 tablespoons Aloe Vera Juice
3. 2 tablespoons Liquid Chlorophyll
4. 1 heaping teaspoon Psyllium Hulls

### **Procedure:**

1. Combine in blender or stir with spoon. This mixture will thicken if allowed to sit, so drink it immediately. Follow with a full glass of pure, delicious-tasting water and two Cascara Sagrada capsules.
2. This drink should be taken first thing in the morning every day for 60 days. Thereafter, it can be taken every other day indefinitely.
3. NOTE: It is important to drink plenty of good, clear water, while on this regime.

## **Six Month Colon Rejuvenation Program To Restore Natural Peristaltic Action by Dr. Jack Ritchason**

This program is designed to restore the natural peristaltic action of the colon. It is done by alternating the two following programs for a period of six months. You change the program every thirty days. Hence, you would follow program one for thirty days and then do program two for thirty days and then go back to program one again. After six months you will have spent three months on program one and three months on program two.

### *Program Number One*

Take the following at night before retiring. Add the following to 4-6 oz. Of juice and drink:

1. 6 oz Aloe Vera Juice
2. 1 oz. Liquid Chlorophyll
3. 2-4 capsules of lower bowel (laxative) herb formula\*
4. 1 oz. Hydrated Bentonite Clay
5. 1 tablespoon of Psyllium Hulls

During the day, take the following:

1. 3 Acidophilus capsules three times each day between meals
2. ½ teaspoon of Plant Cell Salts twice each day in juice.

### *Program Number Two*

Take the following anytime day or night:

1. 1 oz. Aloe Vera Juice
2. 1 oz. Liquid Chlorophyll

At night before retiring, take the following:

1. 1 teaspoon of Psyllium Hulls in 4-6 oz. Of juice
2. 2-4 capsules of a lower bowel (laxative) herb formula\*

\*Persons may not wish to take this much of a lower bowel formula as they progress with the program. In fact, they may not need any of the lower bowel formula by the end of their thirty days.

### **Comments:**

1. With this program you are attempting to have loose bowel elimination for six months to rebuild and restore the natural muscular action of the colon. The colon is a muscle, but it cannot be exercised in the same manner that you would exercise an arm. You can take a weight and put it in your hand and lift it repeatedly to build up and tone your arm muscle, but you cannot take your colon out of the body to exercise it. Hence, you need to put fiber and other material into the colon that stimulates it to action so that it can be strengthened and toned. One other benefit of this program is that people can lose weight on it.
2. This program will slowly clean out the pockets and crevices in the colon and will restore the natural muscular action called peristalsis. We stress we want a loose bowel elimination, but we also want this bowel elimination to be controlled. If the bowel elimination becomes too loose (that is watery or excessively runny) you should back down on the lower bowel formula. If the elimination continues to be too loose, you should take a teaspoon of Psyllium in a glass of juice in the morning.
3. This does not replace other colon cleansing programs. This program is specifically designed to restore the natural peristaltic action (or to build it up in the person who has never had it). This program does not eliminate the need for other supplements a person might need to take. Some people have also used anti-parasitic herbs (like black walnut) or combinations. One does not need to have enemas or colonic irrigations with this program; however, a person could use a very high colonic irrigation with a garlic solution if they desired, as this would aid the process.



## **Seven Day Bentonite Colon Cleanse**

Eat nothing for seven days other than specified during the cleanse. Drink plenty of water (at least 5 glasses in addition to the instructions). You may have herbal teas or herbal beverages.

### **Items Needed:**

1. An empty quart jar with a screw top
2. An enema bag
3. 2 quarts water with ½ dropper garlic oil
4. Combination potassium 100
5. Acidophilus
6. Hydrated Bentonite (2 bottles)
7. Cascara Sagrada\*
8. Psyllium Hulls Combination
9. Liquid Chlorophyll
10. Fasting Plus
11. Vitamins & Minerals
12. Vitamins-Calcium w/Magnesium & Vitamin D
13. Bioflavinoids w/Vitamin C

### **Directions:**

5 times per day (every 3 hours) do the following:

1. Pour 4 oz. Juice into quart jar
2. Add 8 oz. Water
3. Add 1 teaspoon Chlorophyll
4. Add 2 tablespoons Bentonite
5. Last of all, add 1 tablespoon Psyllium Hulls Combination
6. Shake Violently for 10 to 15 seconds, or run through a blender.
7. Drink Immediately. Follow with an additional glass of water.

5 times per day (1-½ hours after drinking the above) take:

1. 2 Vitamins and Minerals
2. 2 Vitamin Calcium w/Magnesium and Vitamin D
3. 2 Fasting Plus
4. 2 Bioflavinoids w/Vitamin C
5. 2 Cascara Sagrada\*
6. 2 Potassium 100
7. 2 Acidophilus capsules
8. ½ teaspoon Cell Salts

\*Adjust the amount of Cascara Sagrada as required to have several bowel movements per day. Some individuals may need to take from 2 to 12 Cascara Sagrada per day. On rare occasions, some may need to take several enemas per day.

### **Enemas:**

There needs to be an enema done the day before you start this program, one done every night for the total of 7 days on the program, and one done the day after coming off the program for a minimum total of 9 for the total program. It is of the utmost importance to take a daily enema while on this cleanse. Coffee enemas or garlic enemas or an interchange of the two has been suggested. People who are extremely toxic and need this program the most sometimes will get sick a few days into the program. It is advised that they take high colon irrigation in the morning also. This will prevent them from becoming nauseated while on the program. This will enable them to complete the 7 days on the program.

### **Coffee Enema:**

Use 8 rounded tablespoons of regular grind coffee to 2 quarts of water. Boil thoroughly or perk. (You can make up to 1 gallon at a time).

### **Garlic Enema:**

Put ½ eyedropper full of garlic oil in 2-quart enema bag with water.

### **After Seven Days:**

1. After completing this program individuals should take 3 Acidophilus capsules twice a day – 3 upon arising and 3 before retiring each day for 2 months minimum to restore back the natural flora in the colon. Also one capsule of licorice root can be added each time the vitamin and minerals are taken if the person has low blood sugar.
2. Most individuals or families will want to stay on the cleanse for the full seven days and repeat twice a year. This is especially true of all those who are interested in prevention and in maintaining their good health. As for people with chronic health problems, the cleanse should be repeated 4 times a year, with a building program followed in the meantime.
3. Some nutritionists suggest a year-round use of the Bentonite; however, it has been suggested that the Bentonite Cleanse should be alternated with an individually designed building program. This program would use LBS, Psyllium, Cascara Sagrada, possibly Special Formula #1, and any other specific herbs and supplements for individual problems.

### **Nature's Sunshine Tiao He Cleanse**

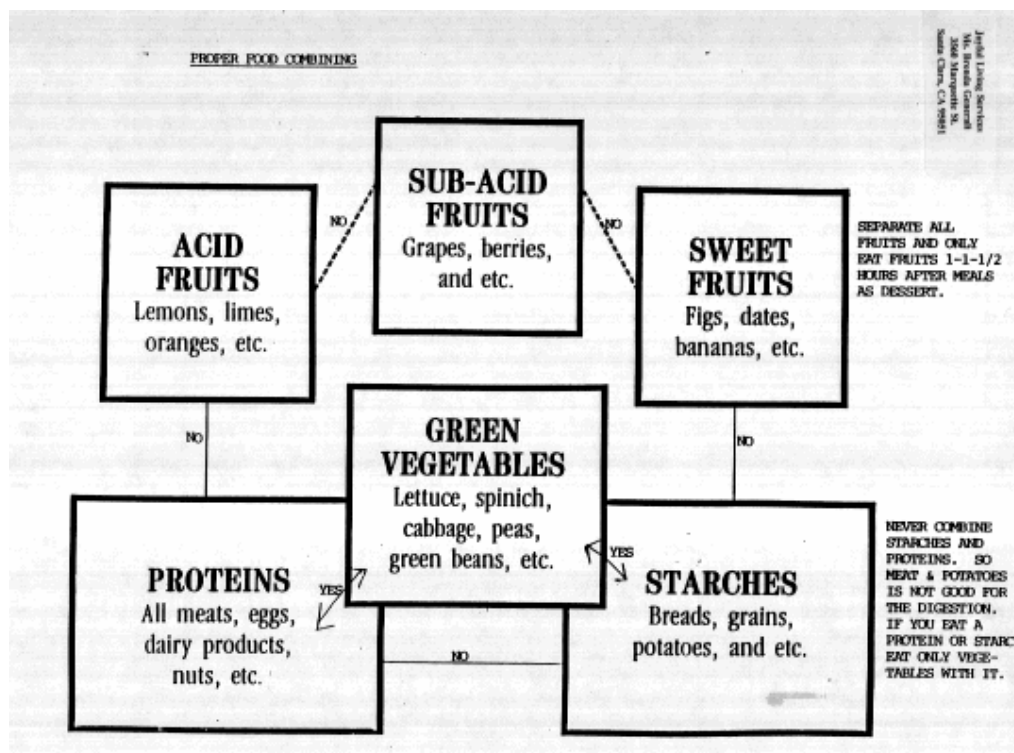
1. Balance and harmony – that's Tiao He. It's a path that leads to personal peace and happiness. Using the time-honored and popular Chinese system of herbal nutrition and adding respected Western herbal experience, Nature's Sunshine developed an important breakthrough: a cleansing system that blends both East and West for the best of both worlds – the Chinese Tiao He Cleanse.
2. Many years ago a Chinese herbalist from San Francisco designed a 10-day program to "balance" and "cleanse" the entire body.
3. The Tiao He Cleanse is perfect for those who are just getting acquainted with herbal supplements, or who have never experienced a cleansing program. The Chinese Tiao He Cleanse is prepackaged and simple to use. It's gentle, too.

### **Product Information**

1. LIV-C: Bupleurum root, peony root, pinellia rhizome, cinnamon twig, dong quai root, fushen plant, zhishi fruit, scute root, atractylodes rhizome, Panax ginseng root, ginger rhizome and licorice root.
2. Special Formula #1: Gentian root, Irish moss plant, cascara sagrada bark, golden seal root, slippery elm bark, fenugreek seeds, safflowers flower, myrrh gum, yellow dock root, parthenium root, black walnut hulls, barberry bark, dandelion root, uva ursi leaves, chickweed herb, catnip herb and cyani flowers.
3. LBS II: Cascara Sagrada bark, buckthorn bark, licorice root, capsicum fruit, ginger rhizome, barberry bark, Turkey rhubarb root, cough grass herb and red clover blossoms.
4. Psyllium Hulls
5. Burdock Root
6. Black Walnut Hulls

## FOOD COMBINING

Do you have digestive trouble? In other words, do you belch after a heavy meal or feel full? Does it seem like food

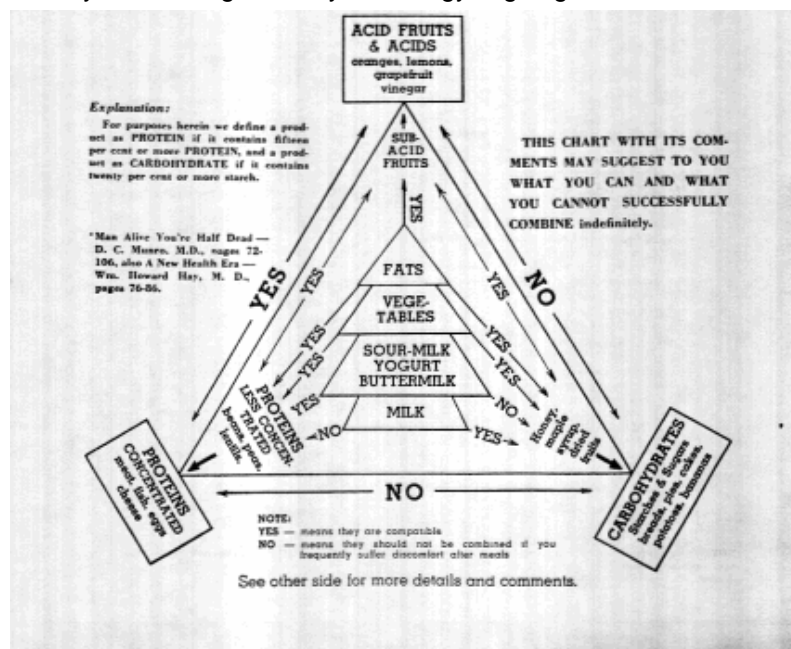


stays in your stomach for hours and hours? Do you still taste the food you ate 4 hours later? It typically takes 4 hours to break down fats and proteins (meat, eggs, dairy), 2 hours to break down starches (rice, potatoes, pasta), 1 hour to break down vegetables (salad, cooked or raw vegetables), and 1/2 hour to break down fruit.

### Think About This

If you eat all the above types of foods together at one meal like most people do, how long do you think it will take you to break them down? If we add up the amount of time it takes to break

each one of these food types down it would take approximately 7-1/2 hours for these foods to be broken down and leave your stomach to be absorbed in the small intestines. That's a very long time. Most people don't wait 7-1/2 hours between meals. Most people eat breakfast around 7 or 8 am, lunch around 12 or 1, and dinner around 5 or 6. That means that the last meal you ate is still in your stomach when you begin the next meal. And you're wondering why you're so tired and listless? Probably because your body is constantly trying to break down the food you're eating and all your energy is going to that task.



### How Can You Avoid This?

Simply by following proper food combining rules and by supplementing your digestion with a product that will help you break down your foods easily. Food Combining is a process that we suggest for eating each meal in which you only combine foods that can be broken down together. This allows a much quicker transit time. I've included a Food Combining Chart for you to follow. Let me know if you have any questions about it.

### Why Use Digestive Aids?

Even if you follow the food-combining chart that I've suggested above, you still might be low in your store of food enzymes and hydrochloric acid. These enzymes are created and stored by the liver and pancreas. If you constantly eat junk food and other foods that are devitalized of their nutrients your body will have to use its store of digestive aids. Once

they're depleted you have to depend on the foods you're eating to stimulate the production of these enzymes and HCL.

Most people by the time they reach 35 have approximately 1/2 the enzymes and HCL production they used to have. This is because the body begins to slow down. The metabolism decreases and the body doesn't need as much fuel (food) to keep it going. At the same time the body slows down the production of these

digestive aids. But, you keep eating at the same pace and the same types of foods not paying attention to the signals your body is giving you. These signals include belching, intestinal gas, bloating, nausea, over full stomach, pain in the stomach, and other symptoms related to the intestinal system such as diarrhea after a meal and formation of mucous after a meal relating to food allergies.

### **Take Responsibility for Your Health**

If you have these symptoms and are tired of them, then food combining will be useful to you. You will be amazed at how good you will feel in just a few days of following this program. It's not easy at first. The first week is difficult because we are so accustomed to sitting down and eating a salad, a protein, a starch, a fruit and maybe even a dessert at the same meal within the same hour. If you follow this program you will be limited to eating only a vegetable and a protein or only a starch and a protein at the meal and using the fruits and desserts as your desserts. If you need to lose weight this is the easiest way to do it. This is definitely NOT a diet BUT a lot of people have lost weight because they have begun to take responsibility for what goes into their mouth and how they feel afterwards. This is the beginning of "listening" to your body and learning what IT LIKES rather than what YOU LIKE. What your brain likes is not necessarily what's good for you. Everyone would love to eat whatever they want but there are consequences to doing this. Why don't you start today and feel better by following food combining rules and using digestive aids to help you along the way.

### **LOW FAT DIET/WEIGHT LOSS DIET: HIGH CHOLESTEROL & HIGH TRIGLYCERIDES**

This diet has been used by a number of Joyful Living Services' clients and the weight loss has been very positive. People who have had difficulty with high cholesterol and high triglycerides have also had positive results following these simple rules. It's more than just a diet - it's a lifestyle change. Remember that exercise is a MUST if you decide it's time to lose weight and lower your cholesterol. Without exercise it just won't work. It's not a fad diet either. Fad diets work great while you're on them but as soon as you go off the diet you gain the weight back plus more. The reason? Because the body went into what's called "starvation mode". A lot of people believe that if they starve themselves they will lose weight. Granted they probably will after a while depending on how long they starve. But the majority of the population will not lose weight and will either remain at the same body weight or even gain weight. The reason? In order to lose weight you must eat and you must eat foods that are low in fat so your body can burn the calories. If you're on a diet right now and are losing more than 4-5 pounds per month you're losing too fast. You may be losing muscle, which you don't want to do. If you are "stuck" at a body weight you are tired of, try incorporating the rules from this diet into your life. Remember - it's not a diet - it's a lifestyle change. That means you don't stop following it!

### **General Information**

The purpose of this diet is to lower your blood cholesterol, triglycerides, and for you to lose weight. There are three ways to reduce cholesterol:

1. Reduce dietary cholesterol
2. Reduce saturated fat intake
3. Increase polyunsaturated fat intake

### **Special instructions are as follows:**

Limit foods high in cholesterol: egg yolk, shrimp, prawns, dairy products containing butterfat, baked goods, desserts containing egg yolk and cream and organ meats (liver, heart, brain, kidney and sweetbreads). Cholesterol in the diet is limited to 300 mg per day. Limit foods high in saturated fats: animal fats and vegetable fats as palm oil, coconut oil, cocoa butter and vegetable shortening. Use polyunsaturated oils. Limit all meat to 9 oz. per day. Use fish and poultry as often as possible. Read labels carefully before using canned, packaged or frozen foods. Look for liquid vegetable oils as the first ingredient on the label.

### **Definition of terms:**

**SATURATED FAT** is usually a fat of animal origin. Some vegetable fats, however, are saturated. This may occur naturally (for example, palm oil and coconut oil), or as a result of food technology (for example, vegetable shortening, which is vegetable oil that has been "hydrogenated" causing the oil to solidify and become more saturated). **CHOLESTEROL** is a fatty substance manufactured by the body and normally present in the blood. It is present in foods of animal origin. **POLYUNSATURATED FAT** is a fat of plant origin. Most liquid vegetable fats are unsaturated. For example, safflower and corn oils are more unsaturated than olive and peanut oil.

Approximate composition of the diet is as follows: 1950 calories, 190 gms carbohydrate, 95 gms protein, 90 gms fat, and 300-mg cholesterol.

**FOODS**

Beverages

Protein Group  
Meat and Meat  
Substitutes 6 oz.  
cooked weight

**FOODS ALLOWED**

Coffee, tea, carbonated beverages, skim milk, nonfat buttermilk, evaporated skim milk, fruit juices, 2 cups low-fat milk daily.

Baked, broiled, boiled, roasted or sautéed in allowed oil: lean, well-trimmed pork, ham, beef, lamb, veal, poultry (white meat, cooked without skin), fish, shellfish (except shrimp, prawns, unless substituted for allowed egg yolks), oysters. Lean meat, fish or poultry canned in allowed oils.

Luncheon meats made from poultry, i.e., turkey salami, turkey bologna and turkey frankfurters.

Fish and poultry (white meat) are lower in saturated fats than red meats, and should be used more frequently.

Substitutions for 1 oz of meat:  
1 oz. cheese (pot, ricotta, mozzarella made with nonfat milk, special low fat cheeses (i.e., Farmers, Cheez-ola, Count-down, Sapsago; limit cheddar-type cheeses to 2 oz. per week).  
1/4-cup low fat or dry curd cottage cheese  
2 tablespoons old-fashioned peanut butter  
1/2 cup tofu  
1 oz. meat-flavored substitute made from soy protein

Low cholesterol egg substitutes, such as Eggbeaters or Second Nature.

Egg whites

Limit egg yolks to 3 per week, including those used in cooking or baking. You may substitute 4 oz. shrimp, prawns, crab or lobster or 2 oz. liver, sweetbreads, or heart for each allowed egg yolk.

**FOODS TO AVOID**

Whole milk and whole milk drinks, evaporated and condensed milk, yogurt, chocolate milk.

Regular ground beef or hamburger, heavily marbled or fatty meats, spareribs, duck, goose, poultry skin or dark meat, fish roe, brain, kidneys.

Meats canned or frozen in sauces or gravies, such as chili, hash, ravioli, pork and beans.

Crab or lobster, liver, sweetbreads, or heart, except as substituted for allowed egg yolks.

Luncheon meats and frankfurters (except those listed in "Foods to Use"), sausage, fried meats, ham hocks, bacon, salt pork.

Cheese spreads, cream cheese, regular cottage cheese, other cheeses not listed.

Peanut butter other than "old-fashioned", cashew butter.

Egg yolks in excess of 3 per week.

**FOODS**

Vegetables

**FOODS ALLOWED**

All without saturated fat added.

**FOODS TO AVOID**

Buttered, creamed or fried vegetables unless prepared with allowed fat.

Fruits

All, limit avocado to 1/8 per day.  
Avocado, more than specified amount.

Breads

Whole wheat, rye, raisin or white bread, matzoth, saltines, graham crackers, English muffins, tortillas, bagels, Boston brown bread. Baked goods with no whole milk, no egg yolk and with allowed fats.

Biscuits, commercial muffins, sweet rolls, cornbread, pancakes, waffles, french toast, hot rolls, cheese bread or crackers, party crackers.

Cereals

All except granolas.

Granolas.

Starches

Rice, macaroni, noodles, spaghetti, potatoes.

Any starch prepared with whole milk or cheese.

Fats

Safflower, corn oil, cottonseed oil, soybean oil, sunflower oil and sesame oil or margarine made from these oils, commercial mayonnaise.

Butter, lard, hydrogenated margarine and shortenings, coconut oil, palm oil, salt pork, suet, bacon drippings, gravies or cream sauce unless made with allowed fat and skim milk.

Soups

Bouillon, clear broth, vegetable soup, fat free cream soup made with skim milk, dehydrated soups.

Cream soups and soups made with animal fat.

Desserts &amp; Sweets

Jams, jellies, marmalades, honey, hard candies; sherbert, angel food cake, puddings made with skim milk, gelatin desserts, frostings made with allowed fat, meringues; cakes, cookies and pies made with allowed fats and milk; fruit whips. 1/2 cup ice milk once a week.

Desserts which contain whole milk, saturated or hydrogenated fat and egg yolks, commercial pies, cakes and cookies, cake mixes except angel food.

Miscellaneous

Pickles, salt, spices, herbs, nuts except those excluded, cocoa, carob powder, plain popcorn. Limit olives to 5 per day. Chips fried in polyunsaturated oil.

Coconut, Brazil, cashew and macadamia nuts, chocolate, corn chips, potato chips, buttered popcorn. Gravies made from pan drippings.

## Treating Triglycerides

Fat travels in the blood in two forms. One is cholesterol. This is a structural fat; it glues cells together, insulates nerves, and provides raw material for making hormones. But fat also travels as energy packages. These are called triglycerides - transformed butter and dietary oils circulating in the blood. Triglycerides have a cholesterol coating.

A "normal" triglyceride level is considered to be 40-180 mg/dL. A high blood fat level, also known as hypertriglyceridemia, is usually caused by an increase in stress hormone (cytokine) levels. The stressor is uncontrolled infection. While the upper limit of normal is 250 mg/dL, cytokines can kick triglyceride levels up to 750 or 1000. In this scenario, fat is circulating in the blood but not being burned up as fuel as it should. Even higher triglyceride numbers (1200-2000) are seen in people taking protease inhibitors, especially Norvir/Ritonavir.

A triglyceride count in the 250-750 range used to cause a bit of a stir in medicine, because levels this high over a number of years increase the risk of heart disease. Because of the close relationship between triglycerides and cholesterol, the higher risk is from elevated blood/serum cholesterol levels. AIDS patients usually have low cholesterol levels, so a sudden increase may be related to a triglyceride problem.

Triglyceride levels greater than 750 mg/dL take on a bigger significance due to their risk of causing inflammation of the pancreas (pancreatitis). In this condition, pancreatic enzymes begin to digest the pancreas itself; researchers are not sure what causes pancreatitis, but it may lead to kidney failure, ARDS (acute respiratory distress syndrome), coma, or multisystem organ failure. Many AIDS care physicians mention that they have patients with high triglycerides whom they are "watching". Are they watching daily, weekly, or monthly, and what good does watching do? At worst they may watch high triglycerides provoke pancreatitis. Stop watching (or being watched) and start treating.

Classic dietary treatment for high triglycerides is to reduce dietary fat to 20%-25% of total calories. A person living on 2500 calories may have to limit themselves to 53-67 fat grams per day. Olive oil is the best tolerated dietary fat for triglyceride watchers. Eating a high fiber diet, i.e., more beans, bran cereals, fruit, and vegetables, can be of some help. Two doses a day of psyllium can lower triglyceride levels. Simple white sugar in the diet, such as candy and sodas, might need a little trimming too, since sugar (and alcohol) calories can turn to fat when eaten in large quantities.

Aerobic exercise, something as simple as a 20-30 minute brisk walk (although 45 minutes would be better), can help lower triglyceride levels a few hundred points. The effect of weight training on triglycerides is less clear.

There are supplements and medicines that have a strong impact on high triglycerides. Lowering the high cytokine level is a good step. Cytokines rise because of the build-up of too many stray electrons - also known as oxidative stress. This can be affected by comprehensive antioxidant supplementation, including beta-carotene, Vitamins C and E, N-acetyl cysteine, and selenium. Interestingly, antioxidant supplements (especially selenium and sodium selenite) have a role in reducing recurrent pancreatitis and in stopping acute attacks.

Nature's Sunshine carries "Guggul Advantage" which supports the circulatory system and has been used to lower triglyceride levels. Soluble fiber dissolves completely in fluids and has the ability to lower cholesterol and triglyceride levels, lower blood pressure, help to normalize blood sugars, and help with the excretion of fats include psyllium hulls which are 80% soluble (oat bran is 15-30% soluble), LOCLO which is the most soluble fiber mixture available from Nature's Sunshine, and Fat Grabbers which contain psyllium hulls, guar gum, chickweed, and lecithin which help with the elimination and emulsification of fat.

Supplemental fish oils, providing 5-9 grams per day of omega-3 fatty acids, are helpful according to some studies and poster sessions. Nature's Sunshine carries flaxseed oil, which is high in the essential fatty acids. People with AIDS often have low platelet levels (a condition called thrombocytopenia), placing them at risk for poor blood clotting. Fish oils can also change blood-clotting rates, increasing the risk of undesirable, spontaneous bleeding. Therefore, people with AIDS must use fish oils with caution.

Another treatment, according to a few small studies and a lot of anecdotal reports, is L-carnitine. Its function is to help fats pass through certain parts of cells (the mitochondria) so that the fats can be used for fuel. Effective doses range from 2-6 grams per day: the higher dose was used in a two-week study that wanted to show rapid results. Two or three grams a day is a more normal dose. There are reports of diarrhea at 4 grams per day. Of note: in the study using 6 grams per day, several subjects who had high levels of the cytokine TNF-alpha saw them drop to normal.

Carnitine is an amino acid, found plentifully in beef, but not so much in chicken and fish. It is also produced in the body, from lysine, methionine, and vitamin C. But methionine is used up in cysteine

production, and cysteine levels are often low when fighting HIV infection. AZT is also known to inhibit carnitine synthesis. There is a prescription form of L-Carnitine, Carnitor, indicated for use in "failure to thrive".

Clinics using high doses of the B-vitamin niacin to lower triglyceride levels are also known. This was traditional cholesterol treatment for years. As niacin may affect the circulatory system, dosages can be ramped up from 500 mg per day to help the body adjust. But liver enzyme levels should be watched on high-dose niacin.

Gemfibrozil/Lopid is commonly used to treat high triglyceride levels in heart patients, and is equally effective under these circumstances. The "statin" drugs (such as Mevacor), which block cholesterol production in the liver, are not appropriate here. They may be contraindicated with some protease inhibitors.

You've made it through PCP, multiple rises and falls in CD4 counts, and are now doing great on a triple drug mix. Don't let a treatable condition land you in intensive care with pancreatitis. Treat hypertriglyceridemia.

## **SUGAR & SUGAR SUBSTITUTES**

### **HOW SUGAR WORKS**

Although natural sweeteners are more appealing and healthier than chemically refined sugars and syrups, the fact remains that all sweeteners are not nutritious and their use should be moderate. Sugar influences dietary imbalances by crowding out more nutritious foods and by using up valuable nutrients through sugar metabolism. Using sweeteners in conjunction with nutritionally sound foods can help reduce the rise in blood sugar levels and provide nutrients needed to metabolize sugar.

Unlike whole foods that are digested slowly and changed into forms of sugar that the body can use, concentrated sweeteners are absorbed quickly into the bloodstream causing a rapid rise in the body's blood sugar level. The pancreas usually responds by overproducing insulin. This causes the blood sugar to rapidly fall, creating a variety of symptoms including fatigue, irritability, lack of concentration and ... the desire for more sugar.

### **Natural Sweeteners**

By using natural sweeteners in a moderate way, we can have our cake and eat it too. When sweeteners are needed, choose among the least processed and most natural alternatives to white sugar.

### **Fruit Juice Sweeteners**

These offer good flavor, slower more uniform digestion and added nutrients. There are more and more delicious products such as breakfast cereals and cookies that use fruit juice (usually white grape) exclusively as a sweetener.

### **Malted Rice or Barley Syrups**

These are produced by using malt enzymes to convert the starch in barley and rice into a sweet syrup. Malt syrups are better tolerated by those who have blood sugar disorders because their principal sugar, maltose, does not stimulate insulin production. Malt syrups are about 25% less sweet than sugar, and can successfully replace sugar in many recipes. Reduce the liquid by half the amount of malted grain syrup used in the recipe.

### **Honey**

Raw and unfiltered, is a whole-unprocessed food. You only need to use half as much honey because it's twice as sweet as sugar. Of all the sweeteners, honey needs the least amount of refining and therefore is most deserving of the often-misused label "natural".

### **Molasses**

This is a thick dark liquid produced during the refining of white sugar. Blackstrap molasses is the remaining liquid after the sucrose crystals have been removed. It contains a significant amount of minerals, including iron. Barbados molasses is sweeter and milder than blackstrap but contains only a fraction of the minerals. It is made from the whole sugar cane. Look for molasses that does not use sulfur as a preservative.

### **Pure Maple Syrup**

This is a delicious whole food made by boiling maple sap. A traditional favorite drizzled on pancakes or waffles; maple syrup adds a superb flavor to baked goods.

### **Sucanat**

This is made from organically grown sugar cane juice. Nothing is added, only the water is removed. Sucanat contains the natural complex sugars, molasses, and up to 3% vitamins and minerals. It is comparable to white sugar in sweetness and use.



## REFINED SWEETENERS

### White Sugar

This is a processed crystalline by-product of the sugar cane. The cane is chemically stripped of its minerals and bleached. White sugar is quickly absorbed. Brown sugar is white sugar flavored with molasses.

### Turbinado Sugar

This is sometimes mislabeled "raw sugar". It is slightly less processed than white sugar. It is steam-cleaned rather than bleached. True raw sugar is not sold in the United States because it is unsanitary.

### Fructose

This is not actually made from fruit but from sugar by breaking down the sucrose molecule into fructose and glucose. Its claim to fame is that it reaches the bloodstream more slowly than other kinds of sweeteners and does not affect insulin secretions and blood sugar levels dramatically. Fructose is about 60% sweeter than sugar, but this is greatly reduced when cooked. Because it is only 55% fructose, high fructose corn syrup (commonly found in sodas) needs insulin to be metabolized.

## ARTIFICIAL SWEETENERS

Artificial sweeteners perpetuate cravings for sweets by keeping one's sweet tolerance level high. The current popular artificial sweetener, aspartame (NutraSweet) is 200 times sweeter than sugar. Some people are sensitive to aspartame and have reacted with headaches, depression, irritability or dizziness. Product advertising commonly claims that aspartame is a "natural" product. Its two ingredients, phenylalanine and aspartic acid are amino acids, but they are not found combined in nature as in the laboratory. The long-term effects of aspartame is not known.

## SUGAR ALCOHOLS

### Sorbitol, Mannitol, Xylitol

These are sugar alcohols. They act similarly to all sugars when broken down during digestion. Sorbitol and mannitol are derived from corn glucose and while half the calories of sugar, they are only half as sweet. Sorbitol is commonly found in diabetic food because it has a slow absorption rate and needs little if any insulin. Although xylitol has the same calories as sugar, it neutralizes acids in the mouth and may help reduce cavities.

### Sugar Content of Various Foods

<u>Food</u>	<u>Spoons of sugar per serving</u>
Pork and beans, 1 cup	5
Fruit yogurt, 8 oz.	8
Cola, 16 oz.	12
Chocolate cake, iced, 4 oz.	10
Ice cream, 1 cup	6
Glazed doughnut	6
Chocolate milk, 8 oz.	6
Peanut butter and jelly sandwich	7
Pecan pie, 5 oz.	12
Gelatin, 1 cup	8
Kool-Aid, sweetened, 8 oz.	6
Chewing gum, 7 sticks	4
Sweetened cereal, 2 oz.	7
Chocolate bar, 2 oz.	7
Thick shake, 11 oz.	9
Orange soda, 12 oz.	12
Jelly beans, a handful	8
Liqueurs/cordials, 2 oz.	4

## FAT IN THE DIET

On a percentage-of-calories basis, most vegetables contain less than 10 percent fat, and most grains contains from 16 to 20 percent fat. By comparison, whole milk and cheese contains 74 percent fat. A rib roast is 75 percent fat, and eggs are 64 percent fat. Low-fat milk or a skinned, baked chicken breast still has 38 percent fat. Not only do animal foods have more fat, but most of these fats are saturated fats, which research has shown to raise blood cholesterol levels. In addition, a lower fat, whole foods diet means fewer calories, since an ounce of fat contains twice as many calories as an ounce of complex carbohydrates. Studies have shown that a diet containing fewer calories can increase health and extend life. Labels can be very deceiving and

misleading. The fat content of some of the foods below may be surprising.

### **Fat Content of Various Foods**

<b><u>Food</u></b>	<b><u>Fat Content</u></b>
Cheeseburger	45%
Chocolate Bar	55%
Cheddar Cheese	74%
Potato Chips	60%
Beef Steak, Untrimmed	74%
Chicken (light) without Skin	24%
2% Milk	35%
Skim Milk	5%
Beef Frank	82%
Mayonnaise	99%

### **Controversial Foods**

While often touted by special interest groups, the safety of the following foods has been called into question.

#### **Milk**

Milk has traditionally been viewed as just about the most perfect food – especially for children. However, more recently experts have begun to question the safety of milk – especially for children. Dr. Benjamin Spock, the world-famous child care expert, shocked the nation by appearing at a press conference in 1992 warning parents about the dangers of milk.

According to the Physicians Committee for Responsible Medicine (PCRM), milk may cause diabetes, ovarian cancer, cataracts, iron deficiency, and allergies in both children and adults. Additional medical research associates milk consumption with greater frequency of cancer of the lymph system.

The statements of the PCRM may have some merit but much more research will be required for a final verdict. Until then, keep these safe eating guidelines in mind:

1. Breast milk is best for babies. Efficient breast pumps can be rented from hospitals to extract breast milk and make life easier for working mothers.
2. Mothers who are breast-feeding infants whose siblings or parents had childhood diabetes should avoid drinking large amounts of cow's milk as some proteins from the cow's milk that can trigger this condition can be absorbed into their breast milk.
3. Adults and children over the age of two should drink only skim or 1 percent low-fat milk.
4. Those who suffer from recurrent bouts of diarrhea, bronchitis, eczema, asthma, or runny nose, should be tested for a milk allergy.
5. People who get gas, diarrhea, or cramps after drinking milk, should drink it in smaller quantities with meals, switch to lactose-reduced milk, or try lactose pills (containing a key enzyme for digesting milk).

In addition, whole milk and whole dairy products like ice cream and cheese contain concentrated fat-soluble pesticides that have been shown to cause cancer in laboratory animals. They can also contain sulfa drugs and antibiotics as a result of mixing milk from healthy cows with the milk from ill or medicated cows. For protection against toxins in dairy products, rely on nonfat dairy products.

Another option is milk substitutes such as soy, almond, rice, or even goat's milk. Health food stores and many supermarkets sell these products, which are frequently made with organic (pesticide-free) ingredients.

#### **Butter and Margarine**

Many medical experts today are concerned about the safety of margarine because of its high content of hydrogenated oils. Hydrogenation is a process that turns liquid oils into semi-solid globules. This process artificially alters the chemical structure of the fatty acids in the product. Hydrogenated oils are also called trans-fatty acids. They are most often found in shortenings, cakes, crackers, cookies, french fries, and chips. They tend to act like saturated animal fats in the human body by raising cholesterol. Of margarine, the diet or whipped types have the fewest trans-fatty acids.

Butter, on the other hand, contains both saturated fat and, like other fatty dairy products, a whole host of carcinogenic pesticides and chemicals. Because neither butter nor margarine present a clear-cut option, it is best to use them in moderation, and find substitutes whenever possible.

## **The Whole Oil Story**

There are three types of fats, or lipids, which are differentiated by their chemical makeup: saturated, monounsaturated, and polyunsaturated. The human body needs a certain amount of each of these lipids for its proper function. Common fats and oils have components of all of these lipids. For example, canola oil is made up of 62 percent monounsaturated fat, 32 percent polyunsaturated fat, and 6 percent saturated fat.

### **Saturated Fats**

These are primarily found in animal foods and tropical oils such as coconut and palm oil. Due to their chemical structure, saturated fats tend to remain solid at room temperature. Though there is tremendous evidence that appears to support the relationship between high fat intake from animal sources and heart disease, some amount of saturated fat in the diet is necessary. Saturated fat is needed for the liver's production of cholesterol, an important component in the structure of cell membranes. In addition, stearic acid, one of the most common saturated animal fats, has been shown in some studies to be beneficial in fighting cardiovascular disease.

### **Monounsaturated Fats**

Monounsaturated fats are considered healthier than polyunsaturated fats because of their ability to lower LDL (commonly called bad) cholesterol while maintaining or raising HDL (or good) cholesterol. Canola oil and olive oil are naturally high in monounsaturated fats.

Although the evidence is not ironclad, a study published in the Journal of the American Medical Association surveyed 4,900 Italian men and women, whose ages ranged from twenty to fifty-nine, and found that those people who had a diet high in olive oil and low in butter and margarine also had lower overall levels of cholesterol and blood pressure than people whose diets included more butter and margarine.

### **Polyunsaturated Fats**

Plentiful in safflower, sunflower, and corn oil, polyunsaturated fats contain both omega-6 and omega-3 essential fatty acids (EFA's). Omega-6 is beneficial when a person is injured, causing blood to clot and blood vessels to constrict. In contrast, omega-3 inhibits harmful clotting, relaxes vascular smooth muscle, and has an anti-arrhythmic effect, reducing the risk of heart disease.

Humans evolved on a diet that contained small but roughly equal amounts of omega-6 and omega-3 fatty acids. Then, about one hundred years ago, the food supply began to change. The vegetable oil industry began to hydrogenate oil, which reduced the oil's omega-3 content. At the same time, the domestic livestock industry began to use feed grains, which happen to be rich in omega-6 fatty acids and low in omega-3's. As a result, the American diet now has an EFA ration of 20-25:1 omega-6 to omega-3, rather than the 1:1 ration with which humans evolved. The modern diet is too high in omega-6's, which may contribute to heart disease.

There are many foods that can boost the intake of omega-3 essential fatty acids. Fish is a good source, as well as beans – especially Great Northern, kidney, navy, and soybeans. In oils, omega-3 is most abundant in flaxseed, but there is also canola oil with a 10 percent omega-3 content, and soy, pumpkin seed, evening primrose, borage seed, walnut, and black currant oils.

Some of the symptoms of an omega-3 fatty acid deficiency include increased allergies, dry hair and skin, brittle nails, acne, eczema, rashes, or tiny lumps on the backs of your arms. To find out if any of these symptoms might be related to the lack of omega-3 in the diet, take a teaspoon or two daily of pure flaxseed (linseed) oil, the vegetable oil richest in omega-3 fatty acids, and see if symptoms diminish.

High temperature cooking, such as frying, destroys the EFA content of certain oils. Oils such as flaxseed and walnut should only be used for baking, and in soups and salads. When frying foods, use the more heat stable oils – canola, avocado, peanut, and olive.

### **Hydrogenated Oil**

Many processed foods contain "partially hydrogenated oil" as an ingredient. Hydrogenated oils contain man-made molecules called trans-fatty acids, which may interfere with normal metabolic functions due to their unusual molecular shape. The natural form of fatty acids, called the cis form, has a molecular shape that is biochemically suited for human health. According to John R. Lee, M.D., of Sebastopol, California, "Trans-fatty acids enter our metabolic processes but are defective for our bodily uses. Our cell membranes, our hormone synthesis, our immune system, our ability to deal with inflammation and to heal, and many, many other vital systems all become defective when trans-fatty acids substitute for the health-giving cis fatty acids. Unknowingly, we are poisoning ourselves."

Many processed food products contain these hydrogenated oils. However, in the United States, the exact amount of trans-fatty acids in a product is not required to be listed on the label of the product. As Dr. Lee points out, "Other countries, such as Canada, are more enlightened; food labeling there now requires that the included fats be measured and identified in terms of cis or trans forms." For better nutrition, he advises, "Choose butter over margarine; olive oil and flaxseed oils over the many processed oils on the supermarket shelves; fresh vegetables over canned or otherwise processed ones; and learn to read labels.

### **Oxidized Oils**

When oils are overheated and used for too long, as is the case with the cooking oils at fast food restaurants, they become oxidized. Oxidized oils are loaded with oxygen-damaging free radicals, according to Bernhard Hennig, Ph.D., R.D., of the Department of Nutrition and Food Science, College of Human Environmental Sciences, University of Kentucky. To counteract the dangers of free radicals, Dr. Lee advises taking vitamin and mineral supplements. "Protect your metabolic processes and cell membranes with antioxidants such as vitamins C, A (or beta-carotene), and E, plus the mineral antioxidant, selenium," he says.

### **ACID vs. ALKALINE**

We should eat only 20% acid foods. We should eat 80% alkaline foods.

The following table of foods is taken from Ragnar Berg of Germany. Foods preceded by the letters "AL" are alkaline forming. Foods preceded by the letters "AC" are acid forming.

<b>Column No. 1</b>		<b>Column No. 2</b>		<b>Column No. 3</b>	
<b><u>Non-starch foods</u></b>		<b><u>Proteins and Fruits</u></b>		<b><u>Starchy foods</u></b>	
AL Alfalfa		AC Beef		AL Bananas	
AL Artichokes		AC Buttermilk		AC Barley	
AL Asparagus		AC Chicken		AC Beans (Lima)	
AL Beans (String)		AC Clams		AC Beans (White)	
AL Beans (Wax)		AC Cottage Cheese		AC Bread	
AL Beets (Whole)		AC Crab		AC Cereals	
AL Beet Leaves		AC Duck		AC Chestnuts	
AL Broccoli		AC Eggs		AC Corn	
AL Cabbage (White)		AC Fish		AC Corn Meal	
AL Cabbage (Red)		AC Goose		AC Crackers	
AL Carrots		AL Honey (Pure)		AC Corn Starch	
AL Carrot Tops		AC Jello		AC Grapenuts	
AL Cauliflower		AC Lamb		AC Gluten Flour	
AL Celery Knobs		AC Lobster		AC Lentils	
AL Chicory		AC Mutton		AC Macaroni	
AL Coconut		AC Nuts		AC Maize	
AL Corn		AC Oyster		AC Millet Rye	
AL Cucumbers		AC Pork		AC Oatmeal	
AL Dandelion		AC Rabbit		AC Peanuts	
AL Eggplant		AC Raw Sugar		AC Peanut Butter	
AL Endive		AC Turkey		AC Peas (Dried)	
AL Garlic		AC Turtle		AC Potatoes (Sweet)	
AL Horseradish		AC Veal		AL Potatoes (White)	
AL Kale				AL Pumpkin	
AL Kohlrabi		AL All Berries		AC Rice (Brown)	
AL Leek		AL Apples		AC Rice (Polished)	
AL Lettuce		AL Apricots		AC Roman Meal	
AL Mushrooms		AL Avocados		AC Rye Flour	
AL Okra		AL Cantaloupes		AC Sauerkraut	
AL Olives (Ripe)				AL Squash (Hub'd.)	
AL Onions		AL Cranberries		AC Tapioca	
AL Oysterplant		AL Currants			
AL Parsley		AL Dates			
AL Parsnips		AL Figs			
AL Peas (Fresh)		AL Grapes			
AL Peppers (Sweet)		AL Grapefruit			
AL Radishes		AL Lemons			
AL Rutabagas		AL Limes			
AL Savory		AL Oranges			

AL	Sea Lettuce	AL	Peaches
AL	Sorrel	AL	Pears
AL	Soybean (Products)	AL	Persimmons
AL	Spinach	AL	Pineapple
AL	Sprouts	AL	Plums
AL	Summer Squash	AL	Prunes
AL	Swiss Chard	AL	Raisins
AL	Turnips	AL	Rhubarb
AL	Watercress	AL	Tomatoes

For people with weak digestion it is best to make food combinations as simple as possible. Follow the suggestions on how to combine foods. Combine foods found in columns one and two; also columns one and three. Never combine columns two and three. All foods in column one will combine with all foods in column two.

## Fruits

Citrus fruits cause alkalinity. Citrus fruits, when broken down, release an alkaline ash, which develops an alkaline condition in the body. Sometimes these acid fruits stir up the acids so rapidly that their effect is considered to be a bad one. This may be quite the reverse of the real truth. Should the eating of fruit cause you distress, you may be sure you are misinterpreting your symptoms. In any case like that, I would say you are very ill and require the aid or advice of a specialist in natural healing.

But in general, remember that fruit should be eaten in a natural harmony. This means, oranges and grapefruits and tangerines and lemons as the acid fruits mentioned go very nicely with other acid fruits like cranberries, pineapple and strawberries. They do not combine well with the sweet fruits or the dried ones we mentioned, like prunes, figs, raisins, dates or grapes. Berries and melons should always be eaten alone. There is no disagreeable surprise for your stomach, for example, than watermelon eaten in conjunction with another food.

The sub-acid fruits mentioned, such as apples, persimmons, pears, plums, peaches, apricots combine fairly well with the acid fruits, but we do not recommend the combinations. The safest procedure is the simplest one. You can use cream, if you must, but never sugar. White sugar is actually a poison to your system, no matter how much energy you seem to get from it, and brown sugar is like gilding the lily. The fruit itself is plentiful with sugar – you do not need to put sugar on your sugar.

In general, too, remember that sweet milk goes best with the acid fruits, while sour milk, like clabber, yogurt or even cottage cheese, goes best with the sub-acid fruits. In other words, a glass of milk at orange juice time is a permissible combination. Again, keep your diet simple. Fruits also can be classed in three columns:

### Column No. 1

#### Acid Fruits

Oranges  
Lemons  
Grapefruit  
Limes

### Column No. 2

#### Sub-Acid Fruits

Apples  
Pears  
Plums  
Peaches  
Grapes  
Apricots

### Column No. 3

#### Sweet or Dried Fruits

Dates  
Figs  
Raisins

Columns one and two will combine very nicely; also columns two and three. Columns one and three never mix. Do not combine acid fruits with sweet dried fruits. Berries and melons are best eaten alone.

## Acid/Alkaline Balance General Test

Use Nitrazine paper to determine the pH of the fluids of the body. A reading of 7.0 is neutral on a scale of 1.0 to 14.0. The normal pH of the body is slightly acid 6.3 to 6.8.

### Procedure for Testing

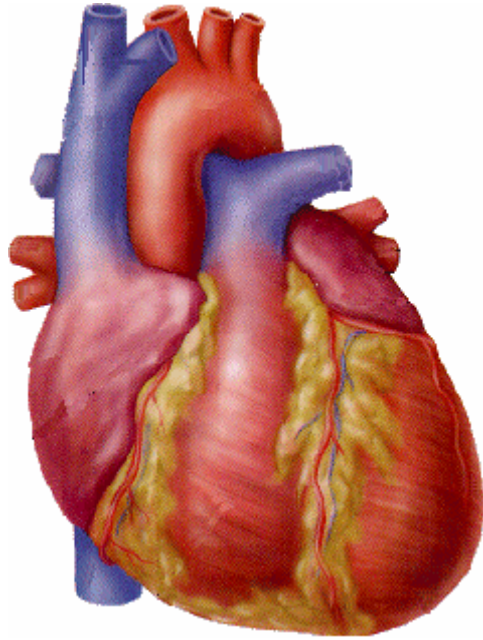
1. Take urine or saliva sample and test before meals or at least two hours after eating.
2. Check color of test strip with chart supplied with the Nitrazine paper and determine the pH.

### Interpretation of Test

1. If reading is above 6.8, the body is too alkaline and the person should be put on a diet of more acid-forming foods.
2. If reading is below 6.3, then the person is too acid and should be put on a diet including more alkaline foods.

## CHELATION: ORAL VS. INTRAVENOUS

One of the first uses of Chelation was in Russia in 1922, to remove the heavy metals from the blood stream of people who had blood poisoning from high amounts of various metals. Chelation was also used in Germany before World War II for the same reason and was brought into the United States in 1948. It was used to remove the heavy metals from the poisoned blood streams of men working on US ships who got too much lead from painting and chipping paint. As they were given Chelation to clear up the blood poisons, they began to realize that it was also removing the plaque from the arterial walls, improving overall circulation.



This was the beginning of Chelation therapy, as we know it today. There are approximately 10,000 Doctor's in the United States practicing Intravenous Chelation therapy, EDTA, meaning Ethylene Diamine Tetra Acetic. Dr. Albert J. Scarchill, an Osteopath from Farmington Hills, ID, has reported on a Chelation study of 19,000 people with vascular disease, 82.5% showed substantial improvement.

Chelation, (pronounced KEY-LAY-SHUN), comes from the Greek word "chele", which means "claw". The claw in Chelation Therapy is a synthetic amino acid, EDTA, which clamps onto certain minerals, calcium, tin, lead, mercury, and others that are impairing membrane function and contributing to free radical damage. Calcium in particular, is the substance that holds the plaque like glue to our arterial walls of our circulatory system. Plaque is made up of fat; collagen, cholesterol,

proteins and metals, all bonded together by calcium. When plaque build up to dangerous levels, it begins to cut off the circulation of the blood, forcing the heart to work harder. The fact is, many people do not know that they have clogged arteries or hardening of the arteries until it is too late.

Although EDTA intravenous chelation has been known to reverse hardening of the arteries, it is called non-consensus medicine; meaning that it is not FDA approved and is not covered by most insurance companies. Costs for this medical procedure can range from \$1,000-1,500 per treatment, which can be 1-2 times annually.

EDTA is not for everyone, because it is a one day out-patient procedure at a Doctors office, the release of these toxins in such a short time period can put a burden on the kidneys, which disposes of the heavy waste materials. A person must be in good overall health to handle the stress that the EDTA Chelation therapy procedure puts on the other systems of the body.

## WHAT IS CHELATION?

Chelating (pronounced key-laying) agents are substances which can chemically bond with, or chelate (from the Greek chele, claw), metals, minerals, or chemical toxins from the body. The chelating agent actually encircles a mineral or metal ion and carries it from the body via the urine and feces.

## HOW DOES IT WORK?

Chelation therapy involves injecting chelating agents into the blood-stream- for the purpose of eliminating from the body undesirable substances- such as heavy metals, chemical toxins, mineral deposits, and fatty plaques (as in the arteries; the agent binds to the calcium in the plaques). EDTA (ethylene diamine tetraacetic acid) is an effective and widely studied chelating agent. It cannot chelate mercury, however, DMSA and DMPS, the chemicals which work intravenously to chelate mercury, are not approved by the FDA.

EDTA is a synthetic amino acid; amino acids are the building blocks of protein. Chelation therapy with EDTA was first introduced into medicine in the United States in 1948 as a treatment for the lead poisoning- of workers in a battery factory. Shortly thereafter, the U.S. Navy advocated chelation for sailors who had absorbed lead while painting- government ships and facilities. The FDA approved IV EDTA chelation as a treatment for lead poisoning.

Physicians administering the chelation for lead toxicity observed that patients- who also had atherosclerosis (fatty-plaque buildup on arterial walls) or arteriosclerosis (hardening of the arteries) experienced reductions- in both conditions after chelation. Since 1952, IV EDTA chelation has been used to treat cardiovascular disease.

## ORAL CHELATION FOR HEAVY METAL TOXICITY AND CARDIOVASCULAR DISEASE

Human exposure to heavy metals has risen dramatically in the last 50 years, however, as a result of an exponential increase in the use of heavy metals in industrial processes and products. Today, chronic exposure comes from mercury-amalgam dental fillings, lead in paint and tap water, chemical residues

in processed foods, and "personal care" products (cosmetics, shampoo and other hair products, mouthwash, toothpaste, soap). In today's industrial society, there is no escaping exposure to toxic chemicals and metals.

In addition to the hazards at home and outdoors, many occupations involve daily heavy metal exposure. Over 50 professions entail exposure to mercury alone. These include physicians, pharmaceutical workers, any dental occupation, laboratory workers, hairdressers, painters, printers, welders, metalworkers, cosmetic workers, battery makers, engravers, photographers, visual artists, and potters.

### **THE HEAVY METAL HAZARD**

Some metals are naturally found in the body and are essential to human health. Iron, for example, prevents anemia, and zinc is a cofactor in over 100 enzyme reactions. They normally occur at low concentrations and are known as trace metals. In high doses, they may be toxic to the body or produce deficiencies in other trace metals; for example, high levels of zinc can result in a deficiency of copper, another metal required by the body.

Heavy or toxic metals are trace metals with a density at least five times that of water. As such, they are stable elements (meaning they cannot be metabolized by the body) and bio-accumulative (passed up the food chain to humans). These include mercury, nickel, lead, arsenic, cadmium, aluminum, platinum, and copper (the metallic form versus the ionic form required by the body). Heavy metals have no function in the body and can be highly toxic.

Once liberated into the environment through the air, drinking water, food, or countless human-made chemicals and products, heavy metals are taken into the body via inhalation, ingestion, and skin absorption.

If heavy metals enter and accumulate in body tissues faster than the body's detoxification pathways can dispose of them, a gradual buildup of these toxins will occur. High-concentration exposure is not necessary to produce a state of toxicity in the body, as heavy metals accumulate in body tissues and, over time, can reach toxic concentration levels.

Heavy metal exposure is not an entirely modern phenomenon: historians have cited the contamination of wine and grape drinks by lead-lined jugs and cooking pots as a contributing factor in the "decline and fall" of the Roman Empire; and the Mad Hatter character in Alice in Wonderland was likely modeled after nineteenth-century hat makers who used mercury to stiffen hat material and frequently became psychotic from mercury toxicity.

Human exposure to heavy metals has risen dramatically in the last 50 years, however, as a result of an exponential increase in the use of heavy metals in industrial processes and products. Today, chronic exposure comes from mercury-amalgam dental fillings, lead in paint and tap water, chemical residues in processed foods, and "personal care" products (cosmetics, shampoo and other hair products, mouthwash, toothpaste, soap). In today's industrial society, there is no escaping exposure to toxic chemicals and metals.

In addition to the hazards at home and outdoors, many occupations involve daily heavy metal exposure. Over 50 professions entail exposure to mercury alone. These include physicians, pharmaceutical workers, any dental occupation, laboratory workers, hairdressers, painters, printers, welders, metalworkers, cosmetic workers, battery makers, engravers, photographers, visual artists, and potters.

In my clinical nutrition practice, when I discuss with clients my concerns regarding heavy metal toxicity, I often get the response, "That isn't a problem for me." Most are astonished to learn that we are all being exposed to and absorbing these harmful substances to some degree in our daily lives. The astonishment turns to alarm when they hear what heavy metals do in the body.

The Effects of Heavy Metal Toxicity Studies confirm that heavy metals can directly influence behavior by impairing mental and neurological function, influencing neurotransmitter production and utilization, and altering numerous metabolic body processes. Systems in which toxic metal elements can induce impairment and dysfunction include the blood and cardiovascular, detoxification pathways (colon, liver, kidneys, skin), endocrine (hormonal), energy production pathways, enzymatic, gastrointestinal, immune, nervous (central and peripheral), reproductive, and urinary.

Breathing heavy metal particles, even at levels well below those considered nontoxic, can have serious health effects. Virtually all aspects of animal and human immune system function are compromised by the inhalation of heavy metal particulates. In addition, toxic metals can increase allergic reactions, cause genetic mutation, compete with "good" trace metals for biochemical bond sites, and act as antibiotics, killing both harmful and beneficial bacteria.

Much of the damage produced by toxic metals stems from the proliferation of oxidative free radicals they cause. A free radical is an energetically unbalanced molecule, composed of an unpaired electron, that "steals" an electron from another molecule to restore its balance. Free radicals result naturally when cell molecules react with oxygen (oxidation) but, with a heavy toxic load or existing antioxidant deficiencies, uncontrolled free-radical production occurs. Unchecked, free radicals can cause tissue damage throughout the body; free-radical damage underlies all degenerative diseases. Antioxidants such as vitamins A, C, and E curtail free-radical activity.

Heavy metals can also increase the acidity of the blood. The body draws calcium from the bones to help restore the proper blood pH. Further, toxic metals set up conditions that lead to inflammation in arteries and tissues, causing more calcium to be drawn to the area as a buffer. The calcium coats the inflamed areas in the blood vessels like a bandage, patching up one problem but creating another, namely the hardening of the artery walls and progressive blockage of the arteries. Without replenishment of calcium, the constant removal of this important mineral from the bones will result in osteoporosis (loss of bone density leading to brittle bones).

Current studies indicate that even minute levels of toxic elements have negative health consequences, however, these vary from person to person. Nutritional status, metabolic rate, the integrity of detoxification pathways (ability to detoxify toxic substances), and the mode and degree of heavy metal exposure all affect how an individual responds. Children and the elderly, whose immune systems are either underdeveloped or age-compromised, are more vulnerable to toxicity.

### Common Heavy Metals

Sources and Specific Effects Aluminum, arsenic, cadmium, lead, mercury, and nickel are the most prevalent heavy metals. The specific sources of exposure, body tissues in which the metal tends to be deposited, and health effects of each metal are identified below.

1. **Aluminum** - Sources of exposure: Aluminum cookware, aluminum foil, antacids, antiperspirants, baking powder (aluminum containing), buffered aspirin, canned acidic foods, food additives, lipstick, medications and drugs (anti-diarrheal agents, hemorrhoid medications, vaginal douches), processed cheese, "softened" water, and tap water. Target tissues: Bones, brain, kidneys and stomach. Signs and Symptoms: Colic, dementia, esophagitis, gastroenteritis, kidney damage, liver dysfunction, loss of appetite, loss of balance, muscle pain, psychosis, shortness of breath, and weakness. DR McLaughlin, MD, F.R.C.P. (C), professor of physiology and medicine and director of the Centre for Research in Neurodegenerative Diseases at the University of Toronto, states, "Concentrations of aluminum that are toxic to many biochemical processes are found in at least ten human neurological conditions." Recent studies suggest that aluminum contributes to neurological disorders such as Alzheimer's disease, Parkinson's disease, senile and presenile dementia, clumsiness of movements, staggering when walking, and inability to pronounce words properly. Behavioral difficulties among schoolchildren have also been correlated with elevated levels of aluminum and other neurotoxic heavy metals.
2. **Arsenic** - Sources of exposure: Air pollution, antibiotics given to commercial livestock, certain marine plants, chemical processing, coal-fired power plants, defoliants, drinking water, drying agents for cotton, fish, herbicides, insecticides, meats (from commercially raised poultry and cattle), metal ore smelting, pesticides, seafood (fish, mussels, oysters), specialty glass, and wood preservatives. Target tissues: Most organs of the body, especially the gastrointestinal system, lungs, and skin. Signs and Symptoms: Abdominal pain, burning of the mouth and throat, cancer (especially lung and skin), coma, diarrhea, nausea, neuritis, peripheral vascular problems, skin lesions, and vascular collapse. The greatest dangers from chronic arsenic exposure are lung and skin cancers and gradual poisoning, most frequently from living near metal smelting plants or arsenic factories.
3. **Cadmium** - Sources of exposure: Air pollution, art supplies, bone meal, cigarette smoke, food (coffee, fruits, grains, and vegetables grown in cadmium-laden soil, meats [kidneys, liver, poultry, or refined foods], freshwater fish, fungicides, highway dusts, incinerators, mining, nickel-cadmium batteries, oxide dusts, paints, phosphate fertilizers, power plants, seafood (crab, flounder, mussels, oysters, scallops), sewage sludge, "softened" water, smelting plants, tobacco and tobacco smoke, and welding fumes. Target tissues: Appetite and pain centers (in brain), brain, heart and blood vessels, kidneys, and lungs. Signs and Symptoms: Anemia, dry and scaly skin, emphysema, fatigue, hair loss, heart disease, depressed immune system response, hypertension, joint pain, kidney stones or damage, liver dysfunction or damage, loss of appetite, loss of sense of smell, lung cancer, pain in the back and legs, and yellow teeth. Current studies are attempting to determine if cadmium-induced bone and kidney damage can be prevented (or made less likely) by adequate calcium, protein (amino acids), vitamin D, and zinc in the diet.



4. **Lead** - Sources of exposure: Air pollution, ammunition (shot and bullets), bathtubs (cast iron, porcelain, steel), batteries, canned foods, ceramics, chemical fertilizers, cosmetics, dolomite, dust, foods grown around industrial areas, gasoline, hair dyes and rinses, leaded glass, newsprint and colored advertisements, paints, pesticides, pewter, pottery, rubber toys, soft coal, soil, solder, tap water, tobacco smoke, and vinyl 'mini-blinds'. Target tissues: Bones, brain, heart, kidneys, liver, nervous system, and pancreas. Signs and Symptoms: Abdominal pain, anemia, anorexia, anxiety, auto exhaust, bone pain, brain damage, confusion, constipation, convulsions, dizziness, drowsiness, fatigue, headaches, hypertension, inability to concentrate, indigestion, irritability, loss of appetite, loss of muscle coordination, memory difficulties, miscarriage, muscle pain, pallor, tremors, vomiting, and weakness. The toxicity of lead is widely acknowledged. The greatest risk for harm, even with only minute or short-term exposure, is to infants, young children, and pregnant women. A federal study conducted by the Centers for Disease Control and Prevention (CDCP) in 1984 estimated that three to four million American children have an unacceptably high level of lead in their blood. Dr. Suzanne Binder, a CDCP official, stated, "Many people believed that when lead paint was banned from housing [in 1978], and lead was cut from gasoline [in the late 1970s], lead-poisoning problems disappeared, but they're wrong. We know that throughout the country children of all races, and ethnicity's and income levels are being affected by lead [already in the environment]." In their book, 'Toxic Metal Syndrome', Dr.'s R. Casdorph and M. Walker report that over 4 million tons of lead is mined each year and existing environmental lead levels are at least 500 times greater than pre-historic levels. In 1989, the U.S. Environmental Protection Agency (EPA) reported that more than one million elementary schools, high schools, and colleges are still using lead-lined water storage tanks or lead-containing components in their drinking fountains. The EPA estimates that drinking water accounts for approximately 20% of young children's lead exposure. Other common sources are lead paint residue in older buildings (as in inner cities) and living in proximity to industrial areas or other sources of toxic chemical exposure, such as commercial agricultural land. All children born in the U.S. today have measurable traces of pesticides, a source of heavy metals and chlorine-based chemicals, in their tissues. Lead is a known neurotoxin (kills brain cells), and excessive blood lead levels in children have been linked to learning disabilities, attention deficit disorder (ADD), hyperactivity syndromes, and reduced intelligence and school achievement scores.
5. **Mercury** - Sources of exposure: Air pollution, batteries, cosmetics, dental amalgams, diuretics (mercurial), electrical devices and relays, explosives, foods (grains), fungicides, fluorescent lights, freshwater fish (especially large bass, pike, and trout), insecticides, mining, paints, pesticides, petroleum products, saltwater fish (especially large halibut, shrimp, snapper, and swordfish), shellfish, and tap water. Target tissues: Appetite and pain centers in the brain, cell membranes, kidneys, and nervous system (central and peripheral). Signs and Symptoms: Abnormal nervous and physical development (fetal and childhood), anemia, anorexia, anxiety, blood changes, blindness, blue line on gums, colitis, depression, dermatitis, difficulty chewing and swallowing, dizziness, drowsiness, emotional instability, fatigue, fever, hallucinations, headache, hearing loss, hypertension, inflamed gums, insomnia, kidney damage or failure, loss of appetite and sense of smell, loss of muscle coordination, memory loss, metallic taste in mouth, nerve damage, numbness, psychosis, salivation, stomatitis, tremors, vision impairment, vomiting, weakness, and weight loss. The primary source of exposure to mercury is "silver" dental fillings (approximately 50% mercury when placed); over 225 million Americans have these fillings in their teeth. Mercury fillings release microscopic particles and vapors of mercury every time a person chews. Vapors are inhaled while particles are absorbed by tooth roots, mucous membranes of the mouth and gums, and the stomach lining. In people with mercury amalgam fillings, measurements of the mercury level in the mouth ranges between 20 and 400 mcg/m<sup>3</sup>. Keep in mind that this is continuous exposure. The National Institute of Occupation Safety and Health places the safe limit of environmental exposure to mercury at 20 mcg/m<sup>3</sup>, but that is assuming a weekly exposure of 40 hours (the workweek) and the mercury involved is outside the body. The Environmental Protection Agency's allowable limit for continuous mercury exposure is 1 mcg/m<sup>3</sup> but, again, that is based on mercury sources outside the body. Neither figure addresses 24-hour-a-day exposure from mercury in one's mouth. Hal Huggins, DDS, a specialist in the effect of mercury amalgams on health, reports that 90% of the 7,000 patients he tested showed immune system reactivity from exposure to low levels of mercury. In 1984, the American Dental Association (ADA), without providing scientific evidence, claimed that only 5% of the U.S. population is reactive to mercury exposure, and that this figure is insignificant. Meanwhile, the ADA mandates that dentists alert all dental personnel to the potential hazards of inhaling mercury vapors. The Environmental Protection Agency (EPA) goes further, instructing dentists to treat mercury amalgam as a toxic material while handling before insertion, and as toxic waste after removal. Mark S. Hulet, DDS, who conducts research on amalgam fillings, wrote a pamphlet for his patients, in which he cites five categories of pathological reaction to mercury fillings, as identified by dentists, doctors, and toxicologists. The categories are:

- Neurological: emotional manifestations (depression, suicidal impulses, irritability, inability to cope) and motor symptoms (muscle spasms, facial tics, seizures, multiple sclerosis)
  - Cardiovascular problems: nonspecific chest pain, accelerated heart beat o Collagen diseases: arthritis, bursitis, scleroderma, systemic lupus erythematosus
  - Immune system diseases: compromised immunity
  - Allergies: Airborne allergies, food allergies, and "universal" reactors. One of the keys to mercury's effects on health may be its ability to block the functioning of manganese, a key mineral required for physiological reactions in all five categories, notes Dr. Hulet.
6. **Nickel** - Sources of exposure: Appliances, buttons, ceramics, cocoa, cold-wave hair permanent, cooking utensils, cosmetics, coins, dental materials, food (chocolate, hydrogenated oils, nuts, food grown near industrial areas), hair spray, industrial waste, jewelry, medical implants, metal refineries, metal tools, nickel-cadmium batteries, orthodontic appliances, shampoo, solid-waste incinerators, stainless steel kitchen utensils, tap water, tobacco and tobacco smoke, water faucets and pipes, and zippers. Target tissues: Areas of skin exposure, larynx (voice box), lungs, and nasal passages. Signs and Symptoms: Apathy, blue-colored lips, cancer (especially lung, nasal, and larynx), contact dermatitis, diarrhea, fever, headaches, dizziness, gingivitis, insomnia, nausea, rapid heart rate, skin rashes (redness, itching, blisters), shortness of breath, stomatitis, and vomiting. The greatest danger from chronic nickel exposure is lung, nasal, or larynx cancers, and gradual poisoning from accidental or chronic low-level exposure, the risk of which is greatest for those living near metal smelting plants, solid waste incinerators, or old nickel refineries.

### How Can We Protect Ourselves from Heavy Metals?

Logic dictates that, once the potential harm from heavy metals is understood, their production and use should be phased out and toxic storage heavily regulated. As is obvious from the list of exposure sources above, logic is not the guiding principle here, except in the case of lead, the use of which has been curtailed.

Even if all heavy metal production were to stop today, however, enough heavy metals have been released into our environment to cause chronic poisoning and numerous neurological diseases for generations to come. There are presently 600,000 toxic waste contamination sites in the United States alone, according to the U.S. Congressional Office of Technology Assessment. Of these, less than 900 have been proposed by the EPA for Superfund cleanup and approximately 19,000 others are under review. While some of these toxic messes were likely caused by accidents or ignorance, the majority came from illegal dumping by hazardous product or waste distributors, manufacturers, transportation companies, or waste management companies. Such practices have not ceased, as focus on profit continues to override concerns about health, the environment, and a more promising future for all of our children.

With the government doing little or moving very slowly to protect the public from the hazards of heavy metals, it is up to individuals to take measures to protect themselves. According to conventional medicine, there is nothing a person can do to address aluminum; arsenic, cadmium, lead, mercury, or nickel exposure, aside from avoiding known sources. Given the prevalence of these toxins in our lives, this is impossible.

Fortunately, there is a way to get these harmful substances out of the body. Intravenous and oral chelation, detoxification protocols, and specific nutritional therapies can remove heavy metals and chemical toxins and reduce the toxic load our bodies endure on a daily basis.

### THE CHELATION SOLUTION

Chelating (pronounced key-layting) agents are substances which can chemically bond with, or chelate (from the Greek chele, claw), metals, minerals, or chemical toxins from the body. The chelating agent actually encircles a mineral or metal ion and carries it from the body via the urine and feces. Many organic acids found in the body or in foods can act as chelating agents, including acetic acid, ascorbic acid (vitamin C), citric acid, and lactic acid. Natural chelation processes in the body are responsible for such things as the digestion, assimilation, and transport of food nutrients, the formation of enzymes and hormones, and detoxification of toxic chemicals and metals.

Intravenous chelation therapy involves injecting the chelating agent EDTA into the bloodstream for the purpose of eliminating from the body undesirable substances such as heavy metals, chemical toxins, mineral deposits, and fatty plaques (as in the arteries; the agent binds to the calcium in the plaques). EDTA (ethylene diamine tetraacetic acid) is an effective and widely studied chelating agent. It cannot chelate mercury, however, DMSA and DMPS, the chemicals which work intravenously to chelate mercury, are not approved by the FDA.

EDTA is a synthetic amino acid (amino acids are the building blocks of protein) and is approximately one third as toxic to the body as aspirin. Chelation therapy with EDTA was first introduced into medicine in the United States in 1948 as a treatment for the lead poisoning of workers in a battery factory. Shortly thereafter, the U.S. Navy advocated chelation for sailors who had absorbed lead while painting government ships and facilities. The FDA approved IV EDTA chelation as a treatment for lead poisoning.

Physicians administering the chelation for lead toxicity observed those patients who also had atherosclerosis (fatty-plaque buildup on arterial walls) or arteriosclerosis (hardening of the arteries) experienced reductions in both conditions after chelation. Since 1952, IV EDTA chelation has been used to treat cardiovascular disease.

Over 1,800 scientific journal articles have been published on the use of EDTA in intravenous (IV) chelation. In the past 30 years, hundreds of thousands of patients have received this therapy, as delivered by over 1,000 physicians in approximately 3,300,000 IV infusions. EDTA's success rate in increasing blood circulation is 82%, provided the patients received sufficient chelation.

### **How Chelation Aids Cardiovascular Health**

Chelation reduces calcium plaques on arterial walls. These atherosclerotic plaques are not limited to arteries nearest the heart. On the contrary, they are widespread and can affect blood flow (oxygen delivery) to every cell, tissue, gland, organ, and system being served by the over 75,000 miles of blood vessels in your body. Chelation reaches every blood vessel in the body, from the largest artery to the tiniest capillary and arteriole, most of which are far too small or too deep within the brain or other organ to be safely reached in surgery.

Other scientifically documented benefits of intravenous EDTA chelation therapy for the cardiovascular system include:

- Stabilization of arterial intracellular membranes o Maintenance of the electrical charge of platelets in the blood, reducing blood clumping (aggregation) and preventing blood clots.
- Marked improvement in nearly 100% of 2,870 studied patients with peripheral vascular disease
- Normalization of half of treated cardiac arrhythmias
- Reductions of cerebrovascular occlusion o Improved cognitive function in people with memory and concentration deficits and improved visual acuity (when problems are caused by arterial blockage)
- Improved myocarditis due to lead poisoning.
- Reduction of blood fat levels and improved capillary blood flow. O Increased peripheral blood flow to the extremities.
- Improved compliance of vascular tissues; decalcification of elastic tissues resulting in improved elasticity and resilience.
- Improved red blood cell membrane flexibility and permeability to potassium
- Decreased blood pressure levels, as a result of excretion of cadmium from renal tissues, diminished peripheral resistance, improved blood vessel resilience and pliability, decreased vascular spasm, and improved magnesium uptake.

In addition to the effectiveness of IV EDTA chelation therapy in treating cardiovascular disease and heavy metal toxicity, research has documented its benefits for aneurysm, Alzheimer's disease and senile dementia, arthritis, autoimmune conditions, cancer, cataracts, diabetes, emphysema, gallbladder stones, hypertension, kidney stones, Lou Gehrig's disease, osteoporosis, Parkinson's disease, scleroderma, stroke, varicose veins, venomous snake bite, and other conditions involving an interruption in blood flow and diminished oxygen delivery.

The ten top killers of Americans (in the order of frequency) include heart disease, cancer, stroke, accidents, pneumonia, diabetes, cirrhosis, arteriosclerosis, suicides, and infant death. All but accidents, pneumonia, suicides, and infant death have an underlying connection to reduced blood circulation. More than 90 percent of Americans live in jeopardy of having a serious illness relating to the circulatory system.

The human and financial cost of cardiovascular disease in the U.S. is astronomical. Every year, approximately 1.5 million Americans have a heart attack, 300,000 of who die before receiving medical attention. The treatment of cardiovascular disease rings up a total of \$100 billion dollars annually-\$200,000 spent every minute. Coronary artery bypass surgery (bypassing the blocked heart artery with grafted leg artery, average cost \$44,000) is the most frequently prescribed surgical procedure for heart disease, costing \$10 billion per year. Numerous leading medical doctors and authorities have stated that coronary bypass surgery is overprescribed and often unnecessary. Nearly 20,000 people die every year as a result of bypass surgery or angioplasty (ballooning of the occluded artery, average cost \$21,000).

Intravenous chelation is far safer, much less expensive, and less invasive. Proven effective in circulatory disorders, its benefits for cardiovascular patients is clear. IV chelation does pose some risks, however. 171

Although nontoxic, EDTA produces side effects in some people. These include burning, redness and swelling at the injection site, fever, hypotension (low blood pressure), joint pain, skin outbreaks or rashes, upset stomach, and, rarely, irritation of the kidneys and liver.

Some cardiologists who understand the benefits of intravenous EDTA chelation do not recommend its use with patients who are debilitated, emaciated, have weak or diseased kidneys, or advanced cardiovascular disease (end stage). They believe the sudden, massive infusion of EDTA puts too much stress on the kidneys, liver and detoxification pathways in these patients and could be harmful or even dangerous. Other doctors and medical researchers disagree, contending that "transient kidney malfunction" is a normal physiological adaptation occurring during the passage of toxic products (chelated metals and chemicals) through the kidneys, and that properly administered IV chelation will not cause kidney damage.

A common misconception about chelation is that it lowers the levels of calcium in the bones and teeth as the body draws calcium from them to replace the calcium drawn from the blood by the chelation process. On the contrary, the calcium to restore blood levels is drawn from places in the body where calcium has built up unnaturally, as in arterial plaques (which contribute to clogged arteries), calcified bursae (a source of bursitis), arthritic joints, and kidney stones.

Further, Garry Gordon, MD, D.O., co-founder of the American College of Advancement in Medicine (ACAM) and a pioneer in chelation therapy, states, "If calcium levels start to drop, the parathyroid glands kick in and start secreting parathormone which 'steals' back enough calcium from the EDTA (and other) chelates to keep the heart beating normally (serum calcium must stay at a constant level for normal heart function) and to activate cells called osteoblasts, which strengthen and rebuild bone. The more chelation we give people, the less osteoporosis they have and the less age-related calcium accumulation [arterial wall plaques] there is in the blood vessels."

There is no limit to the amount of IV EDTA chelation a person can be given and the peak beneficial effects last up to two months after treatment. IV chelation is safe for children as well as adults. People over 90 years old have enjoyed the benefits of chelation and more than 200,000 children in the U.S. have undergone IV chelation as treatment for lead poisoning.

Intravenous chelation has two drawbacks, however. Although much safer and less expensive than coronary bypass surgery or angioplasty, it is still relatively expensive (hundreds of dollars per visit) and not widely available, as there are comparatively few experienced medical doctors certified in IV chelation therapy. Fortunately, there is an even safer, inexpensive, and more easily obtained alternative: oral chelation.

### **Oral Chelation Ingredients for Arteriosclerosis and Arterial Plaque**

- Natural substances that can assist in breaking down the fatty deposits from the artery walls:
- Lipase- A plant enzyme that assists in the breakdown and digestion of fat. Lipotropic (has an affinity for lipids-fats). Lipotropics are fat metabolism assisting agents.
- Carrageenan- Lipotropic
- L-Lysine- Lipotropic
- Trimethylglycine- Lipotropic
- Choline- Lipotropic.
- Chondroitin sulfate- This nutrient is a constituent of the arterial wall and has anti-coagulant (prevents blood stickiness), anti-lipemic (anti-fat in the blood stream) and anti-thrombogenic (prevents clots) properties.
- L-Carnitine- Lowers blood fat levels and both triglycerides and total cholesterol levels.
- Garlic- Lowers LDL cholesterol, triglycerides, total cholesterol, and is used as a preventative for atherosclerosis (fatty deposits on the artery walls).
- Natural substances that can assist in the removal of mineral deposits from the artery walls:
- Magnesium- Displaces calcium within the cells of arterial walls. "Prescription for Nutritional Healing", James F. Balch, MD, Phyllis A. Balch, C.N.C., Avery Publishing Group, Garden City, New York, 1997. Pg. 541.
- Manganese- An important chelating agent. It is a major factor in blocking calcium from entering the cells of arterial lining. "Prescription for Nutritional Healing", James F. Balch, MD, Phyllis A. Balch, C.N.C., Avery Publishing Group, Garden City, New York, 1997. Pg. 541.
- Amino Acids- Because of their negative charge, amino acids have been found to be good chelators of positively charged minerals (especially calcium).

### **Natural substances that can assist in the removal of heavy metals:**

- Alginates and clays- Bind with unwanted toxic metals and remove them from the body through the intestinal tract.
- Coenzyme Q10- acts as a heavy metal chelator. "Prescription for Nutritional Healing", James F.

Balch, MD, Phyllis A. Balch, C.N.C., Avery Publishing Group, Garden City, New York, 1997. Pg. 541.

- L-Lysine and L-Glutathione- Detoxify heavy metals. "Prescription for Nutritional Healing", James F. Balch, MD, Phyllis A. Balch, C.N.C., Avery Publishing Group, Garden City, New York, 1997. Pg. 541.
- Vitamin C and Vitamin E- powerful chelating agents. "Prescription for Nutritional Healing", James F. Balch, MD, Phyllis A. Balch, C.N.C., Avery Publishing Group, Garden City, New York, 1997. Pg. 541.

## **Oral Chelation**

Chelation delivered orally involves ingesting nutritional food supplements which contain chelating agents (EDTA & numerous natural chelators) including; vitamins, minerals, amino acids, antioxidants, phytonutrients, and herbs.

Oral EDTA chelation has all the benefits of IV chelation, but is much slower acting because only 4% to 18% of an oral EDTA dose is absorbed (compared with 100% of an IV dose). Taken on a daily basis, oral chelation will gradually accomplish what its IV counterpart does in a few administrations. According to Dr. Garry Gordon, oral chelation is useful in reducing heavy metal toxicity and calcification, lowering blood cholesterol, lessening lipid peroxidation (free-radical oxidation of metabolized fats), thinning the blood, and preventing the formation of blood clots (a cause of heart attack).

In some areas, oral chelation may actually outperform IV EDTA (only) chelation. In addition, Extreme Health's oral chelation formula has the ability to chemically bond with and cause the elimination of mercury from the body (as evidenced by mercury levels in urine samples before and after chelation). As mentioned earlier, EDTA does not chelate mercury. In Extreme Health's formula, it is the other chelating agents-cilantro, chlorella, and lipoic acid-that effectively act on mercury.

The heightened benefits of oral chelation may result from the synergistic effect of combining EDTA with numerous natural chelating agents, such as activated clays, certain bioflavonoids, chlorella, cilantro, coenzyme Q10, garlic, L-cysteine, L-glutathione, lipoic acid, methionine, selenium, sodium alginate, and zinc gluconate. Each chelating agent has a predilection for different chemicals and mineral or metal ions.

The addition of nutrients known to support liver function and detoxification also increases oral chelation formula's effectiveness. A companion formula of antioxidants and other nutrients enhances the chelation process by replacing beneficial minerals removed during chelation, promoting the healing of tissues, and preventing free-radical oxidative damage. As with chelating agents, different antioxidants work on different free radicals. For this reason, the formulas contain a wide range-there are 30 different antioxidants in the Age-Less formula.

Antioxidant activity may play a particularly important role in amplifying the benefits of chelation. Elmer Cranton, MD, author of *Bypassing Bypass*, believes that the prevention of free-radical damage (which EDTA does) is the main action behind chelation's positive effects.

The effectiveness of oral chelation is a topic of debate, even amongst proponents of IV chelation. Our clinical research, however, demonstrates oral chelation's benefits for atherosclerosis and heavy metal poisoning. Many health professionals believe that oral chelation is not a replacement for IV chelation. I agree with this view when the patient's condition is too severe to wait for the slower-acting oral chelation to produce effects. When such patients have completed the recommended number of IV chelation treatments, however, oral chelation is of great benefit in maintaining their cardiovascular health.

In addition to heart patients, I particularly recommend oral chelation for anyone with a family history of heart disease, long-standing poor dietary practices, or a history of exposure to heavy metals or toxic chemicals. More generally, oral chelation is useful to anyone who wants to prevent cardiovascular disease and clear their body of the metals and toxins that we all accumulate and which can cause a variety of health problems.

As such, oral chelation can serve as a convenient, non-invasive, long-term health maintenance and preventative program. The gradual dosage delivery significantly reduces the risk of side effects; oral chelation is safe for children and adults.

## **Diet and Nutrition**

In keeping with a whole-body approach to health and medicine, we recommend that our clients implement healthy dietary and lifestyle practices along with the oral chelation formula program. Abuse of alcohol, drugs (recreational or prescription), and tobacco products, chronic stress, and lack of exercise are obviously detrimental lifestyle factors.

A poor diet is equally detrimental. We recommend that everyone, but particularly people concerned about cardiovascular disease, avoid the following foods and beverages or ingest them only in small amounts: alcohol (any form), baking soda, butter, caffeinated drinks (coffee, tea, others), canned vegetables,

chemical ingredients (mold inhibitors, preservatives, artificial sweeteners, meat tenderizers), chlorinated (tap) water, commercially prepared foods, fats and oils (especially fats from commercially raised animals, saturated fats, hydrogenated and partially hydrogenated oils), fried foods, heated polyunsaturated fats (fast foods oils, theater popcorn oil), lard, margarine, MSG (monosodium glutamate), processed and refined foods, red meat (or any products from commercially raised animals), salt (sodium chloride), soft drinks, softened tap water, spicy foods, sugar, commercial salad oils (many contain trans-fatty acids, refined by bleaching, chemicals, heat, and solvents), tallow, tropical oils (palm, cottonseed), and white-flour foods.

Nutritional deficiencies can contribute to cardiovascular disease. Certain vitamins, minerals, and other nutrients have been identified as vital for maintaining cardiovascular health. Degrees of deficiency of one or a combination of the following nutrients will result in corresponding symptoms of physical disease or inadequacy in the cardiovascular system:

- Vitamins: C, E, A (beta-carotene), D, B (1, 2, 3 [niacin and niacinamide], 5, 6, 12), folic acid, and biotin.
- Minerals: Calcium, chromium, copper, magnesium, manganese, molybdenum, potassium, selenium, and zinc.
- Amino acids: L-carnitine, L-lysine, L-proline
- Coenzyme Q10.

Nutritional deficiencies can contribute to the accumulation of heavy metals in the body. When sufficient levels of certain vitamins, minerals, and other nutrients are maintained in the body, the continued absorption of specific heavy metals is greatly reduced.

### **Nutrients Known to be Protective Against Heavy Metal Toxicity:**

- Heavy Metal Protective Nutritional Supplement
- Aluminum: magnesium
- Arsenic: Amino acids (containing sulfur), calcium, iodine, selenium, vitamin C, and zinc.
- Cadmium: Amino acids (containing sulfur), calcium, vitamin C, and zinc.
- Lead: Amino acids (containing sulfur), calcium, iron, vitamin C, vitamin E, and zinc.
- Mercury: Amino acids (containing sulfur), pectin (alginate), selenium, vitamin C. 67

### **Conclusion**

Research has proven the benefits of chelation for cardiovascular disease, heavy metal toxicity, and other conditions. The number of physicians who are available to diagnose and treat advanced health problems and administer intravenous chelation continues to grow. This development, along with the recent advent of oral chelation, reflects the rapid changes occurring in U.S. health care. The transformation of medical practice is due to both public dissatisfaction with the "cut or medicate," linear-delivery system of medicine and the demonstrated effectiveness of alternative and complementary therapies. Preventive health protocols (diet, exercise, and lifestyle modifications), chelation therapy, and nutritional sufficiency is the medicine of the future.

## **KNEIPP BATHS/OCEAN THERAPY**

### **Definition**

Kneipp wellness is a holistic system for overall health developed by Sebastian Kneipp, a nineteenth-century Bavarian priest. His approach includes aspects of hydrotherapy, herbalism, and aerobic exercise.

### **Origins**

Sebastian Kneipp was born to a poor family in Stephansreid, Bavaria, on May 17, 1821. He initially took up his father's trade of weaving, but longed to become a priest. With help from a sympathetic clergyman, he was admitted to high school as a mature student, but after five years of intensive studies, Kneipp became seriously ill with pulmonary tuberculosis. At that time, the disease was usually fatal, but Kneipp came across an eighteenth-century book about hydrotherapy that inspired him during the winter of 1849 to immerse himself several times a week in the icy Danube River. These brief exposures to cold water seemed to bolster his immune system, because Kneipp's tuberculosis went into remission and he was able to continue his theological studies in Munich. There, he convinced some of his fellow students to join his experiments with hydrotherapy.

Kneipp was ordained as a priest in 1852. In that capacity, he began using hydrotherapy to help some of his poorer parishioners. He broadened his approach to include herbalism, exercise, and other elements, and toned down his initial enthusiasm for shocking the body with cold water. "I warn all against too-frequent application of cold water," he later wrote. "Three times I concluded to remodel my system and relax the treatment from severity to mildness and thence to greater mildness still." Kneipp's reputation grew after a number of dying patients recovered when he was called to administer last rites and managed instead to restore them to health. In 1855 he was assigned to Worishofen, a village in the foothills of the Bavarian Alps that soon developed an international reputation as a place of healing. Kneipp summarized his teachings in two popular books,

My Water Cure in 1886 and So Sollt Ihr Leben (Thus Thou Shalt Live) in 1889. Supporters of his techniques formed Kneipp Societies in Germany and the United States.

Father Kneipp was later named a monsignor by Pope Leo XIII. After his death in Worishofen on June 17, 1897, his wellness techniques became less popular, but interest in hydrotherapy increased again during the latter part of the twentieth century.

### **Benefits**

Proponents of Kneipp therapy believe that it bolsters the immune system and results in improved overall wellness. In Germany, it is especially popular for treating varicose veins.

### **Description**

Today, Kneipp physiotherapy is essentially a form of classical naturopathy. It is founded on five "pillars":

- Hydrotherapy. Hydrotherapy involves the use of hot and cold water to stimulate the nerves, blood vessels and internal organs. It uses baths, compresses, packs, and water jets.
- Phytotherapy. Plant therapy takes the form of medicinal herbs added to bath water and also administered as juices, lozenges, teas, or ointments, etc.
- Exercise therapy. This aspect of treatment involves long hikes, gymnastics, tennis, cycling, and other vigorous activities to amplify the effects of the water and herb therapies.
- Nutrition therapy, which employs a low-protein, high fiber diet. Special Kneipp diets are also available for weight loss or such ailments as gout, diabetes, or metabolic problems.
- Health maintenance therapy. Patients in the Kneipp program are trained to adhere to their natural biorhythms.

### **Precautions**

All forms of hydrotherapy may pose some risk of water-borne infections, and patients should make sure that baths and similar facilities are properly maintained and disinfected. In addition, persons with serious health problems should consult their physician before undertaking an exercise program.

### **Side effects**

Side effects may vary, depending on the numerous herbs used in Kneipp therapy. When in doubt, it is best to consult a knowledgeable herbalist.

### **Research & general acceptance**

Initially, Kneipp was rejected as a charlatan by the medical establishment. At one point, he was taken to court for quackery, although the judge acquitted him after learning from Kneipp about the shortage of physicians in alpine villages. Kneipp is now recognized by naturopaths as a founding father of their discipline. The benefits of water are well known to physiotherapists, but there is so far little conclusive evidence that Kneipp or other methods of hydrotherapy can increase the body's immunity. One German study published in 1977 found that immunological reactions to protein and bacterial antigens were significantly more intense in patients who had undergone Kneipp hydrotherapy, compared to a group of healthy volunteers. There is little doubt among medical doctors that patients should benefit from the vigorous exercise and high-fiber diet included in the Kneipp prescription for wellness.

### **Key Terms**

- Hydrotherapy - A family of therapies that treat illness by using water either externally or internally.
- Phytotherapy - A form of treatment that uses plants or plant extracts either externally or internally.

## **LIGHT TREATMENT**

### **Why Full Spectrum Light?**

No life can exist without the presence of natural sunshine. Each spring we feel the joy and energy that longer sunfilled days bring. All of nature wakes up to the added benefit of more and more natural light. When daylight enters our eyes, it reaches the pineal gland (also known as the seat of the soul or the third eye) and activates our Endocrine system, which is connected to our immune and nervous systems. The pineal gland reduces the production of the light sensitive hormone, melatonin from 100% in the night to 10% during the day. The balance of melatonin has been proven to be a crucial element in many health related studies and has been linked to estrogen production, and many cancer related diseases. Stimulating proper production of melatonin from the pineal gland is paramount to good health.

The question is how do you do this? The answer to that has been addressed by many photobiologists as of late. "They state that exposure to Full-Spectrum light has an important influence on the endocrine

system and can reduce the risks of many diseases, including cancer. These studies have shown that the retina can, when stimulated by the proper wave lengths of light, synthesize melatonin directly to the pineal gland. Malillumination can prohibit proper secretion of melatonin. So light of a proper type and intensity can be considered a nutrient.

At the beginning of the 20th century over 70% of north Americans worked outdoors thus benefiting from exposure to essential natural outdoor light. The result of this change has been severe in many cases due to spending more and more time under the type of lights which are missing that portion of the sun's spectrum which is important in triggering proper melatonin secretion. It is estimated that over 38 million north Americans feel the effects of malillumination causing poor work conditions which can result in less energy and productiveness.

There is convincing research that poor lighting environments can produce increased depression and even result in more severe cases called S.A.D. or "Seasonal Affective Disorder." This problem increases more and more as the winter months bring shorter and shorter days. "Sunlight Starvation" also affects millions more in the form of a milder version called the "Winter Blues".

Since 1978 researchers and scientists worldwide have documented the successful use of bright light therapy as a significant antidepressant. According to the Dec 8th, 1993 issue of The Journal of the American Medical Association, for many patients with S.A.D., light therapy should be regarded as first-line treatment. Light therapy is endorsed by the American Psychiatric Assoc. and the National Institute of Mental Health. Your insurance carrier may reimburse the cost of this purchase if prescribed by your therapist.

### **FULL SPECTRUM SOLUTIONS HELPS RELIEVE STRESS IN THE WORKPLACE**

(Jackson, Michigan) It is no secret that since the majority of Americans spend over half their lives at work, the thought of the office does not evoke the most positive images for most of us. What most people do not realize, however, is that it may be the office building itself that is causing the feelings of stress and fatigue experienced by most working people. The good news is that Full Spectrum Solutions, a leading manufacturer of full spectrum lighting products, has the ability to transform any office into a healthier and more productive environment.

For at least eight hours a day each week, most of us work under lights we would never consider putting in our homes. Headaches, eyestrain, and foggy thinking - symptoms most commonly attributed to stress or fatigue are actually the result of the antiquated fluorescent lighting still being used in 99% of offices nearly 75 years after its invention, despite overwhelming scientific evidence that it is harmful to people's health. A recent Steelcase Workplace Survey illustrated the need for change with over half of the workers surveyed stating that poor lighting in the workplace triggers tired or watery eyes, and another third of office workers stating they suffer headaches from poor lighting.

Years of research has led to the realization that people depend on full spectrum light- the full range of rays from ultraviolet to infrared, with rainbow colors violet, indigo, blue, green, yellow, orange and red in between - for optimal health. While full spectrum light is available in abundance in the form of sunlight, the fact that the majority of the world's population now works indoors has created a need for a new source of healthy lighting. From this Full Spectrum Solutions was born.

As more employers implement full spectrum lighting in the workplace, more and more companies will experience the economic success that Control Data in Sunnyvale, California experienced when they made the switch. Following their \$15,000 investment in full spectrum lighting for their data processing center, Control Data's error reduction rate increased so dramatically after the first year that their profits increased by a significant \$225,000. Other companies report improved employee morale, greater productivity, better quality control, error reduction rate, and reduced absenteeism.

### **LIGHT: AN ELEMENT IN THE ERGONOMICS OF LEARNING**

#### **Malillumination vs. Posillumination**

**"Malillumination" is to "light" as "malnutrition" is to "food".**

There is a wealth of research indicating that the ergonomics of an environment significantly improve or retard individual and group learning performance. These elements include light, sound enhancement, color, room design, temperature, and instructional design and energy distribution. What follows is a discussion on the element of "light" as a contributor to the enhancement of learning performance and achievement.

(I draw heavily from the brilliant and sensitive work of Dr. Jacob Liberman and encourage you to read his book Light: Medicine of the Future (Bear and Co. 1991), for an in-depth discussion and analysis of the research referenced in the following overview.)



“Malillumination” is the term coined by pioneer light researcher, Dr. John Ott, to describe sunlight deficiency and the negative, harmful effects of artificial pink or cool-white fluorescent lighting on behavior, learning, health, hardiness and longevity.

On the other hand, “Posillumination” is the term I have chosen to refer to those simulated sunlight environments, about which an overwhelming body of research shows the positive impact of simulated sunlight (full spectrum lighting and color) on human behavior, learning, health, hardiness and longer life.

Schools, classrooms and other work environments where people spend time learning and working under simulated sunlight (full spectrum lighting and color) experience less stress and anxiety, improved behavior and attitudes, improved health and attendance, and increased performance and academic achievement.

Research in the use of light in schools has shown that cool-white fluorescent bulbs, (which are used in virtually all classrooms) cause: bodily stress, anxiety, hyper-activity, attention problems and other distress leading to poor learning performance.

Titoff, 1999, concluded in his research “There was a statistically significant difference between the students who worked under old-style fluorescent lights and those who worked under full-spectrum, visually-efficient lighting.” This controlled study verified that depression was lowered among those students who experienced learning under full-spectrum lighting. Also, depression actually increased under standard fluorescent lights among the fourth graders. As an elementary school principal, William Titoff conducted research for his Ph.D. dissertation and discovered that when the project was completed, “the teachers with the full-spectrum lighting refused to let me take it out and put back the old-style fluorescent bulbs.”

Harmon, 1938, found that over 4000 children developed observable deficiencies associated with Malillumination. In the late 1940's conditions of the learning environment (lighting, seating and decor) were instituted in schools, resulting in the following student improvements: 65% reduction in visual difficulties, 47.8% decline in nutritional problems, 43.3% reduction in chronic infections, 25.6% reduction in postural problems and, finally, 55.6% decline in chronic fatigue.

Ott, 1960, first discovered that mice lived an average of seven to eight months under pink and daylight-white fluorescent lights; whereas those mice living under natural, unfiltered daylight lived twice as long and were hardier.

In 1973, Ott studied four, first grade classes in Florida. Two classrooms were installed with full-spectrum, radiation-shielded fluorescent light fixtures, while the other two classrooms remained with the traditional cool-white fluorescent bulbs. In reporting the results of this study, Dr. Liberman stated that: “Concealed time-lapsed cameras took random sequences of students and teachers in the {four} classrooms. Although teachers were aware of the {research} program, neither they nor the students were aware of when they were being photographed.

With cool-white fluorescent lighting, some students demonstrated hyperactivity, fatigue, irritability, and attention deficits. In the classrooms with full-spectrum lighting, however, behavior and classroom performance, as well as overall academic achievement, improved markedly within one month after the new lights were installed. Furthermore, several learning-disabled children with extreme hyperactivity problems miraculously calmed down and seemed to overcome some of their learning and reading problems while in classrooms with full-spectrum lighting.

This study additionally demonstrated that children in rooms with full-spectrum lighting developed one-third of the number of cavities in their teeth as children in the classrooms with the standard cool-white fluorescent lights.” (Liberman, 1991) Hollwich, 1980, discovered that cool-white fluorescent lighting produced increased levels of stress producing hormones.

Wohlfarth and Sam, 1981, studied, according to Liberman, “the combined impact of selected colors and full-spectrum lighting on the behavior and physiology of both blind children with severe behavioral disorders and sighted children with severe handicaps.” Under full-spectrum lighting, blood pressure dropped significantly and aggressive behavior reduced significantly. However, when the lights were replaced with standard cool-white fluorescent bulbs, blood pressure increased and aggressive and disorderly conduct increased. And, the blind children were equally as affected as those with sight.

Liberman honestly laments that “For years we have been labeling and re-labeling children who appear to have difficulties we do not understand. We test and tutor them continually, only to find out that they are usually very bright but that for some reason outside of our understanding they do not achieve in the expected 177

manner within the traditional learning environment. Although the labels for these children have changed from dumb, stupid and lazy to dyslexic, minimally brain dysfunctioned, and learning disabled, the labels nonetheless scar them for life....”

How many must suffer before we realize that stupidity is a learned behavior; that the giftedness in each individual can be tapped and developed under optimal learning ergonomics, including the strategic use of “Posillumination” and the elimination of “Malillumination”?

Schools and classrooms, along with corporations and community organizations, across the country and abroad have gained award winning significant increases in student learning achievement as measured by a variety of standards. This has resulted because of an effective change in the ergonomics of learning, including changes in the elements of light, sound enhancement, room design, temperature, color, instructional design and energy distribution.

## **SKIN BRUSHING**

Dr. Jensen believed that skin brushing is one of the finest of all baths. No soap can wash the skin as clean as the new skin you have under the old. You make new skin every twenty-four hours on the body. The skin will be as clean as the blood is.

Skin brushing removes this top layer. This helps to eliminate uric acid crystals, catarrh and various other acids in the body. The skin should eliminate two pounds of waste acids daily. Keep the skin active. No one can be well wearing clothes unless they brush their skin. It is the greatest method to remove the scurf rim as found in the eye, which denotes an under active skin, a poorly elimination skin.

Use a dry vegetable bristle flesh massage brush with a long handle. It is not an expensive brush. Do not use nylon. Use this brush dry, first thing in the morning when you arise before putting clothes on and before any bathing. Use it in any direction all over the whole body except the face; use a special facial brush for this.

## **The Skin: An Essential Eliminative Organ**

The skin, the largest and most visible of all the body's organs, covers 3,000 square inches on the average adult and receives one-third of all the blood circulating through the body. To most people, the skin is undoubtedly important because of its relation to appearance. But the skin is much more than a beautiful outer covering. It is a protective organ, shielding the internal organs from a host of potentially harmful factors including bacteria, sun's rays and injury. (Though the skin is elastic and tough, it is very subject to being abused, damaged and diseased, especially since it is itself visible and unprotected.) It also helps to regulate body temperature and to prevent body dehydration and is an organ of perception. In addition, perhaps the least understood function of the skin is its role as an eliminative organ.

The body excretes unusable substances in many ways. The eliminative channels of the body include the bowel, kidneys, skin and lungs. Dr. Bernard Jensen, a world-renowned nutritionist, has stated that more toxins and poisons are moved daily through the skin than all the other eliminative organs combined. The skin is the largest and, some say, the most important path of elimination. If it should fail to function for even a few hours, a tremendous strain would be placed on the internal organs, causing a break down in their function with death resulting.

The skin can reduce the workload of the bowel and kidneys. The kidneys are especially aided by the skin, emphasized by the comparable chemical make-up of sweat and urine. For this reason, the skin is sometimes referred to as the third kidney. Since the skin has the greatest surface area of any body organ, it is ideally suited for fluid excretion. It is equipped with about two million tiny glands distributed all over the skin that bring water and wastes to the surface.

Wastes are excreted through the skin in the form of visible perspiration, insensible perspiration and invisible gases. Perspiration is from Latin words meaning, “breathe through”, and perspiration is sometimes referred to as skin breathing.

Working up a sweat through exercise or exertion is an obvious sign of perspiring. Such exercise can provide a break for the kidneys by quickly removing a large quantity of wastes through the skin. Whatever moves the skin-massage, exercise, skin brushing-stimulates the perspiration process. Also, saunas and exposure to sunshine can prompt visible perspiration.

Most of the body's perspiring, however, is known as “insensible”. The skin is constantly perspiring but it is generally dry to the touch and we are not aware that we are sweating. That's why this type of perspiration is called insensible. It has been estimated that a liter of fluids a day can be lost this way.

Without proper cleansing, toxins and poisons can accumulate on the skin's surface, obstructing to some degree further elimination through the pores. After the skin is cleansed, it should then be nourished. Ideally, a skin condition can be enhanced with a natural, herbal moisturizer. This skin will readily absorb nutrients applied externally, especially after being cleaned.

## **SLANT BOARDS**

**(For prolapsus and regenerating the vital nerve centers of the brain.)**



When there is lack of tone in the muscles we can expect prolapsus of the abdominal organs. The heart, lacking tone, cannot circulate blood properly throughout the body. Likewise, arteries and veins cannot contract to help the blood against gravity into the brain tissues.

There are some people who apparently have tried everything to get well, who still find all organs working under par. Many people do not realize that all the quickening force for every organ of the body comes from the brain. People whose occupations require them to sit or stand continually are unable to get the blood into the brain tissues because the tired organs cannot force the blood uphill. If we deny the brain tissues good

blood in the proper amount, in time, every organ in our body will suffer.

The heart gets its start from the brain and continues its everlasting pumping because of it. No organ can do without the brain. Dr. Jensen attributes the success of his healing work to the very fact that he definitely recognizes that the brain must be fed properly. Slanting board exercises are absolutely necessary to regaining perfect health.

The reports are phenomenal as to what can be done in cases of prolapsus and lack of tone in the abdominal walls. A Mr. C.M. Pierce, who became interested in this form of exercise, has done wonders in rejuvenating his body. Dr. Jensen quotes from Health News of September 26, 1941: "One night three years ago, I saw Dr. Jensen demonstrate the slanting board and instantly saw how to make my system much easier, and on the way home I told my neighbor, "I am going to make a board like that". Since then he has made many, selling them throughout the country. In fact, Mr. Pierce, who was born October 11, 1966, is still active in his business.

There are many cases where the board is contraindicated. It is best in most cases to get professional advice, for some people have had unhappy experiences due to the very fact they started too strenuous a program to begin with. If you haven't done much exercising of the abdominal muscles, it is well to take these exercises slowly and gradually increase them as you get stronger.

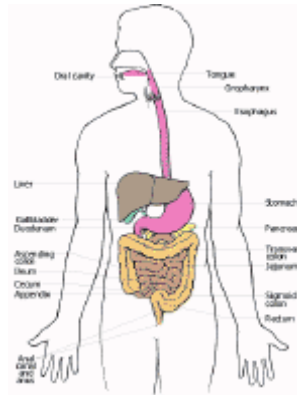
Do not use the board in cases of high blood pressure, hemorrhages, some tubercular conditions, cancer in the pelvic cavity, appendicitis, ulcers of the stomach or intestines, and pregnancy, unless under the care of a physician.

The slanting board exercises are practically the same as any other lying-down exercises. The most important exercise is to hold on to the sides of the board bringing the knees up to the chest. This forces all the abdominal organs up towards the shoulders. While in this position, twist the head from side to side and in all directions, thus utilizing the extra force to circulate blood to congested areas of the head, especially bringing the stomach and abdominal organs up towards the chest while holding the breath.

Slanting board exercises are especially good in cases of inflammation and congestion above shoulders, such as sinus trouble, bad eyes, falling hair, head eczema, ear conditions, and similar troubles. Slanting board exercise is needed and has helped more than any other treatment in cases of heart trouble, fatigue, dizziness, poor memory and paralysis. The average person should maintain the foot end of the board at chair height for all exercises, but if dizzy at first, the foot end of the board should not be raised quite so high to begin with. Exercise only five minutes a day. More time than that is too much. Gradually increase time spent on the board. The average patient should lie on the board ten minutes at 3:00 p.m. in the afternoon and again just before going to bed. After retiring, lift the buttocks up to allow the organs to return to a normal position.

## LIVER & GALLBLADDER FLUSHES

Nobody seems to know for sure how many functions it performs, or how it accomplishes over 500 tasks in such a small space. But the liver is one of your most important and largest vital organs.



Weighing 3-4 pounds and lying behind the lower ribs on the right side, the liver is capable of regenerating its own tissue faster than any other organ of the body. It can also function with only 20% of its original mass before you begin to notice any specific health problems.

The liver not only aids digestion (being able to make over a thousand different enzymes), but it also serves the body by filtering impurities from the blood, storing various nutrients and is the main participant in the defensive wars of the immune system. In it chemical compounds are burned, altered, broken down, synthesized, or excreted.

Associated with the liver is the gall bladder, a kind of storage bag that holds bile exuding from the liver. When oils and fats are eaten, bile is squeezed into the small intestine to "melt down" these huge molecules so they can be digested further.

Looking at the liver's surface, you would never guess the complexity of the inner tissue. Both arteries and veins feed it. This means that it can process blood both before and after the lungs oxygenate it. The hepatic artery carries the oxygenated blood into the liver, and the portal vein carries newly digested nutrients directly into it from the small intestine. Before the nutrients are allowed to circulate in the blood, the liver inspects them, and where needed, detoxified before they flow into the arteries for general distribution.

An example of the liver's protective ability is the processing of alcohol into harmless carbon dioxide and water. Another relates to lactic acid produced when glucose is burned by muscular contractions. Since too much of this acid can be fatal, the liver not only renders it harmless, but also turns it into glycogen for future energy needs. The liver lets nothing go to waste.

The functions of this triangular-shaped organ can be generally listed as follows:

- Metabolizes (reorganizes according to the body's need at the time) proteins, fats, and carbohydrates, which provide energy and nutrients.
- Stores vitamins, minerals, and sugars (energy reserves).
- Filters harmful chemicals and pathogens from the blood.
- Creates bile, which breaks down fats and excretes waste.
- Helps the body assimilate and store fat-soluble vitamins (A, D, & K).
- Stores extra blood for emergencies.
- Creates blood proteins as chelators and it aid blood-fluid balance.
- Helps maintain electrolyte and water balance in the body.
- Breaks down and eliminates hormones that are no longer needed.

### Signs of an Ailing Liver

As impurities are allowed into the bloodstream by an overworked liver, headaches are common. Constipation is also a symptom and as a result, allows poisons to be reabsorbed into the blood. Eventually, a "red nose" (ala alcoholics) may follow as a result of obstructed bile flow, and dark spots can appear on the face or back of the hands. Bad breath or a bitter taste might be evident and the tongue is sometimes coated. Gas often proceeds a meal, and more frequent urination gets a person up during the night. This may be because during the day the overworked liver under-stimulates the kidneys to function.

There may be sleeping difficulties, chills because the body's temperature cannot be properly controlled, heartburn, overweight or underweight, appendicitis, and anal itching. Parasites may grow uninhibited and abnormal bacteria will tend to be out of control in the bowel. The skin can turn yellow along with the whites of the eyes, and the mind is often plagued with depression.

These are matters to be promptly attended to, and the following suggestions have been found to be most helpful:

### Liver Therapy

- Regular Physical Exercise - Keeps the blood flowing and is a natural massage for the liver and gall bladder. Wastes produced by the body are released more easily through the lungs and skin rather than being trapped in the blood for the kidneys and liver to dispose of.

- Natural, High Quality Foods - These are obviously required, but eating simply and avoiding rich and complicated mixtures is best. Too much salt, fat, concentrated proteins (meat) and just plain overeating are stressful to the liver.
- Lemons, oranges, grapes, black olives, fresh berries, and tomatoes are therapeutic. Vegetables like artichokes, asparagus, beets, carrots, celery, leeks, dandelions, radishes, onions, garlic, and cabbage are also beneficial.
- Massage Therapy, Sweat Baths, Hot & Cold Showers, Breathing Exercises - These all benefit the liver. Hot and cold showers are stimulating. Breathing deep and low into the abdomen will reduce stress, toxins, and the tightness that retards circulation.
- Healing Clay - This is also used internally, and externally and a warm poultice. Redmond Clay greatly enhances mineral absorption and helps solve constipation problems at the same time if you drink plenty of water with it. Clay has never been properly appreciated even though its effectiveness is easily proven.

There are a number of excellent herbs to clean and heal the liver. Dandelion root is one of the best. Barberry and Oregon grape roots are similar and help to clean out congestion. Various mints have always been beneficial, including fennel, peppermint, and spearmint, thyme, and rosemary. Chamomile is excellent for several body systems at once.

We are giving you several options to help rejuvenate the liver. All need not be used, but are meant to help the reader in his investigation of various herbal and other preparations that are easily available.

A gradual liver flush is advisable. Like dieting to lose weight, the body needs to have enough time to take care of the toxins that the flush will release so that the eliminative organs are not overwhelmed, drowning the person in his own wastes!

Eating light foods, getting more rest, putting excessive stress out of your life by meditation, prayer, and being alone with Mother Nature (and that doesn't mean locking yourself in the bathroom!), drinking plenty of pure water and mild exercise are a wonderful beginning. Come to think of it, why should you ever stop doing these things? A cup of fresh lemon juice once or twice a day before meals will help cleanse the gall bladder, as will Cascara Sagrada and Barberry Root. LBS II is recommended even if the bowels are not sluggish.

### **For A Stressed Liver**

If the liver is merely under stress and hasn't degenerated into a cirrhosis or hepatitis condition, Oregon grape liquid, LIV-A with Milk Thistle, LIV-J, the Chinese formula, LIV-C, and Special Formula #1 are excellent. Food Enzyme Digestive Aid would help relieve stress on the liver while it restores itself with proper nutrition.

### **For A Weakened Liver**

- For a weakened liver, BP-C, AD-C, BP-X, Gentian liquid, Garlic, and Papaya Mint are good, along with the digestive aids mentioned above. Ginger is another marvelous liver herb, even as a poultice. Each of these herbs will have different effects on the system, and you are advised to seek wise counsel before trying them. The strongest formulas for rebuilding a weakened liver are the Chinese formulas BP-C and AD-C.
- Vitamin C, B, E, Mineral Maintenance, zinc, and formula P-14 would be part of a support program to increase the speed of healing. Some protein is necessary, but in moderate amounts. As the body improves, the "tongue" will clear up as well.

With continuous attacks upon the liver from chemicals, pathogens, parasites, and unpleasant emotional situations, learning about the liver and how to take care of it has to be one of the greatest topics in the field of health. Your liver is where you live!

### **Liver & Gallbladder Flushes & Detoxification**

The liver and gallbladder flush is an important detoxifying agent which can help restore the normal functional capacity of these organs. For more information regarding the function of the liver, [click here](#). Listed below are the steps that should be followed:

- Monday through Saturday noon, drink as much unfiltered, unsweetened apple juice or apple cider as your appetite will permit in addition to regular meals and any supplements that may have been suggested. The apple juice should preferably be purchased from a health food store to assure there are no additives.
- At noon on Saturday, eat a normal lunch.
- Three hours later take 2 Tablespoons Epsom Salts dissolved in about one ounce of hot water. The taste may be objectionable and may be followed by a little citrus juice (freshly squeezed if possible).
- Two hours later repeat step 3.
- Grapefruit juice, grapefruit or other citrus fruits or juices may be eaten for the evening meal.
- At bedtime have 1/2 cup of warm, virgin olive oil blended with 1/2 cup of lemon juice. (Virgin olive

oil can be purchased from any health food store. It is best to use fresh citrus juice, but canned or bottled are permissible.)

- Following Step 6, go immediately to bed and lie on the right side with the right knee pulled up close to the chest for 30 minutes before going to sleep.
- The next morning, one hour before breakfast, take 2 Tablespoons Epsom Salts dissolved in two ounces of hot water.
- Be sure to continue with a normal diet and any nutritional program that has been suggested to you.

### **Recommendations**

Some clients have occasionally reported slight to moderate nausea when taking the olive oil/citrus juice; this nausea will slowly disappear by the time you go to sleep. If the olive oil induces vomiting, you need not repeat the procedure at this time. This occurs only in rare instances. This flushing of the liver and gallbladder stimulates and cleans these organs as no other method. The most common side effect of this flush is diarrhea the day and/or the day after the Epsom salts are taken.

Clients who have chronically suffered from gallstones, biliousness, backaches, nausea, etc. generally find small gallstone-type objects in the stool the following day. These objects are light green to dark green in color. They are very irregular in shape, gelatinous in texture and vary in size from grape seeds to the size of a nickel. If there seems to be a large number of these objects in the stool, the liver flush should be repeated in two weeks. To be sure the gallbladder has been thoroughly flushed, it is recommended to have a follow-up Kinesiology visit.

It is not recommended for clients under 25 years of age or clients with known large stones unless under a professional's guidance. Before doing this flush it is recommended that the body be tested through Kinesiology to find out if there are gallbladder stones and if the body is strong enough to tolerate such a flush.

For those people who cannot do the flush on Saturday and Sunday, the days can be changed to fit into your schedule.

### **You can also do an herbal gallbladder cleanse as follows:**

- For two days take 8 ounces of apple juice every two hours until 1/2 gallon has been taken.
- Take 2 or more Fasting Plus every two hours and do not eat. Every 4 hours take 1 Cascara Sagrada to stimulate bile flow.
- At bedtime on the 2nd day, take 2-4 ounces of virgin olive oil mixed with 2 ounces of fresh lemon or grapefruit juice.
- Repeat in 1/2 hour.
- Sleep on your right side.
- Within 24 hours you should expel stones, mucous, or sludge through the bowel.

### **Testimonial by Shelley Charlesworth**

I did a 'liver cleanse' or gallbladder flush about 6 nights ago! I'm a 50 year old female in good health. I'm not overweight and have no health problems. I'm active and have been a schoolteacher for 25 years. I did not have any symptoms of gallstones nor did I have an ultrasound. I just had always been curious to try a gallbladder flush and see if anything came out- as they say most everyone has these gallstones and it's good to get them OUT. I did the flush at about 9:30 p.m. And I vomited about 12:30! I thought oh hell what an un-pleasant waste of time. BUT the next morning I DID pass some (25?) gelatinous looking things that were greenish - none larger than a small pea. I felt lousy - bloated and not hungry the next day. But since then I've felt great! I think I vomited because I ate some plain white rice and drank some carrot juice about 5pm. I have been researching various liver/gallbladder cleanses and most say NOT to eat all day and to drink organic apple juice and only that for at least 2 days prior. I took only 4oz of fresh squeezed lemon juice followed by 4 oz of olive oil at about 10 PM. I nearly gagged \*\*YUK\*\* as I was taking it! I will do it again but will follow your directions. I wish I had come across this web site BEFORE I did my flush!

### **Testimonial By: Gene Saunders**

I am a sixty-two year old male, six foot three inches, and one hundred and eighty pounds. I went back to my logbook and found out I have done sixteen liver flushes and my wife (Bobbi) has done twenty. The tenth flush resulted in the largest number of stones (fifty Lima bean size stones in a grand total of four hundred (the rest were pea to rice size)). My sixth flush resulted in the largest stone (as large as the end of my thumb). Bobbi no longer gets stones and will probably only do one flush a year as a safeguard in the future. Bobbi and I read up on liver flushes for several months before doing our first. I found it hard to get around for fear of the unknown, but then we did it, found out that it worked, and that we felt and looked better. All stones were black in color on the last flush. Prior flushes have resulted in light to dark green stones. I no longer use apple juice since I can not see that it has any effect. The first flushes I did followed John Thomas's book "Young Again"; latter flushes

followed Hulda Regehr Clark's book "the Cure for all Diseases". On my last flush I went my own way and did a three day water fast before the flush, did the Epsom salt routine, and used olive oil and fresh grapefruit juice (tastes better and works as well as lemon juice). This gave the best results for me. Prior flushes have been varied on the number of stones, (three small pea size minimum to fifty or so maximum) and how I feel during the flush (the sicker I feel the more stones I get. Hope this information is of some use.

### **Testimonial By: Carla Houchen**

My son and I completed your liver flush this weekend. He reported that he had at least 5000. I didn't have that many but mine were extremely large. Both of us have been tired but feel good if that makes any sense. We will be trying this again in two weeks because of the size and amount.

## **KIDNEY FLUSHES**

### **Healthy Kidneys**

Just under your shoulder blades are the tops of your two kidneys, two bean-shaped organs that regulate the fluid in your body. They also excrete too much acid or alkaline elements and clear the blood of toxins. About 2.5 pints of water are excreted as urine every day. Urine is about 96% water. The kidneys cannot do their job without a sufficient amount of water, so remember to drink enough water.

About 2.4 million nephrons inside the kidneys filter the blood. They help to regulate the sodium/potassium ratio, vital for energy production, etc. All in all, about 300 pints of water are filtered each day.

With such a big job to do, certain nutritional elements are important to keep them healthy so you don't experience the various kinds of pain produced by discontented kidneys such as bladder infections, kidney stones, or pain in the lower back.

The kidneys can be poisoned, clogged, malnourished, ruptured by blows, and overworked until they begin to break down. Blood in the urine is a sign, or could be an infection of the filtering tubules. To help you maintain strong kidneys, here are some guidelines to follow:

- Eat enough fruits and vegetables. Green drinks, Aloe Vera juice, cranberry juice, or cranberry apple juice, lemon juice, or watermelon juice along with the seeds are all good choices. By taking 2 tablespoons of apple cider vinegar in a glass of water, much strength can be gleaned. Too much meat is hard on kidneys (ham and pork being the worst), and causes potassium and calcium to be lost while causing a build-up of uric acid, which is hard on the urinary system.
- Cornsilk is a great diuretic that is mild and effective. Parsley is also important and helps clear the kidneys/bladder of gravel and stones. Other herbs perform this same service like Hydrangea, and Uva Ursi.
- Herbal combinations may perform several functions. Urinary System combinations feed the whole system and are great for maintaining healthy organs. Potassium combinations may be needed in times of stress, diarrhea and long fasts.
- Vitamins to help the kidneys would of course include Vitamin C, a natural diuretic and detoxifier, Vitamin A for tissue health and immunity, and the mineral Magnesium to help manage calcium levels and prevent kidney stones. The kidneys are vital, so treat them with special care.

### **Following are several kidney flushes that have been successful for our clients:**

1. Drink lemon juice every hour. Drink ½ glass warm water with 1 lemon. Excellent for dissolving kidney stones.
2. Drink ¼ cup lemon juice (fresh squeezed is best) every 2 hours for 3 days. On the odd hours you can have water or "one kind" of juice. No food. At the end of the third day be ready for bed and do the following: Take 1/3 cup of castor oil or cod liver oil and 2 ounces of lemon juice. Drink it and get into bed and stay in bed. Make sure you do not get up for a least 20 – 30 minutes.

## Herbs that should not be used with Medications

### Quick Reference -Medications/Herbs

#### Please Note

**This is not a complete list. Other herbs not listed are not necessarily safe. You should always be informed concerning herbs and other medications you are taking.**

If you are on these Medications	Be cautious about possible interactions with these Herbs
<b>Anticoagulants</b> <ul style="list-style-type: none"><li>• Warfarin (Coumadin)</li></ul>	Alfalfa Chinchona Bark Clove Oil Ginkgo Garlic Ginger Ginseng Feverfew
<b>Antiplatelet Drugs</b> <ul style="list-style-type: none"><li>• Aspirin</li><li>• NSAIDs</li><li>• Ticlopidine (Ticlid)</li><li>• Clopidogrel (Plavix)</li></ul>	Alfalfa Chinchona Bark Clove Oil Ginkgo Garlic Ginger Ginseng Feverfew
<b>CNS Stimulants</b> <ul style="list-style-type: none"><li>• Decongestants</li><li>• Methylphenidate (Ritalin)</li><li>• Dextroamphetamine (Dexedrine)</li><li>• Beta2 Agonists</li><li>• Caffeine/Theophylline</li></ul>	Guarana Kola Ma Huang St. John's Wort Yohimbe
<b>CNS Depressants</b> <ul style="list-style-type: none"><li>• Alcohol</li><li>• Benzodiazepines</li><li>• Opioids</li><li>• Antihistamines</li></ul>	Hawthorn Kava-Kava Skullcap Valerian
<b>Antidepressants</b> <ul style="list-style-type: none"><li>• Tricyclics</li><li>• MAO Inhibitors</li><li>• SSRIs</li></ul>	Ginseng Ma Huang Passion Flower St. John's Wort Yohimbe



## Quick Reference-Conditions/Herbs

### Please Note

This is not a complete list. Other herbs not listed are not necessarily safe. You should always be informed concerning herbs and a specific condition.

#### **If you have these Conditions**

#### **Be cautious about possible interactions with these Herbs**

Diabetes

These may affect glycemic control:

- Garlic
- Ginger
- Ginseng
- Hawthorn
- Ma Huang
- Nettle

Hypertension

- Devil's Claw
- Ginseng
- Goldenseal
- Hawthorn
- Licorice
- Ma Huang
- Squill
- Yohimbe

Depression

- Valerian
- Kava-Kava

Allergies to Asteraceae Composite Family (ragweed, daisy, aster, chrysanthemum)

- Chamomile
- Echinacea
- Feverfew
- Yarrow

Allergies to other pollens

- Goldenrod
- St John's Wort
- Slippery Elm

Pregnancy of Nursing Special caution is always indicated for a woman who is pregnant or nursing. At least the herbs listed are contraindicated or not recommend, but this is not a complete list. Contraindicated or not recommended:

- Aloe (internal)
- Black Cohosh
- Dong Quai
- Feverfew
- Ginseng
- Kava-Kava
- Saw Palmetto

Safety not fully established

- Garlic
- Ginger
- St. John's Wort
- Valerian

## **Herbs and Surgery - The Combination Could be Dangerous**

**Many people who suffer from sleep disorders take herbal medication, not only to promote sleep, but for other health problems. Many people who suffer from sleep disorders have to undergo surgical procedures, not only for conditions relevant to sleep, but also for other medical reasons.**

In the July 11 issue of JAMA (the Journal of the American Medical Association) an article reports that physicians from the University of Chicago have researched several common herbal remedies and investigated the danger of their use in conjunction with surgical procedures. Some of the most common remedies can cause dangerous complications for people during or shortly after surgery.

JAMA lists eight such herbal remedies, preparations commonly used by many people. Two herbs often used by people with insomnia or other sleep problems are kava and valerian. Both these herbs promote sleep, reduce stress and anxiety and calm the body. They are, in fact, mild sedatives and this is where the danger of taking them in conjunction with surgery comes in. They may well increase the sedative effects of the anesthetic or other sedatives prescribed by your doctor. They should not be taken for a week or more before surgery and for several days after surgery is over.

**People take herbal remedies for many conditions besides using them to promote sleep.**

- **Garlic - Reduces blood pressure and helps to ward off infection.**
- **Ginkgo biloba - Not only increases circulation, it also helps with concentration and memory problems. There is a danger in using these in conjunction with surgery because both of these herbs interfere with the clotting properties of the blood and could cause severe bleeding problems. It would be wise to discontinue them a week before the date of your operation.**
- **Echinacea** - Promotes healing and fights infection. Sounds like this would be desirable when you have surgery, but beware. Echinacea can cause a problem because it boosts your immune system and impairs immune suppressive drugs. Echinacea is especially dangerous if your surgery involves a transplant. Use of this herbal product should be discontinued as far in advance of surgery as possible.
- **Ephedra** - Often taken for its decongestant properties. However, this herb also increases your heart rate and raises the blood pressure. Stop using it at least 24 hours before surgery or heart attack or stroke could occur.
- **Ginseng** - Taken to improve the general health and well being and to reduce stress, also interferes with the clotting of the blood. Stop using it at least a week before surgery.
- **St. John's Wort** - Used for anxiety and depression, has already been under fire for it's dangerous interactions with prescription medications. It alters the rate of metabolism of other drugs and may either increase or decrease the desired effect. Don't use St. John's Wort for at least 5 days before surgery.

**The JAMA article goes on to state that herbal remedies and dietary supplements don't undergo the rigorous testing and controls of prescription medications. To add to the difficulty, many people don't report adverse effects of using herbal or dietary supplements. Also, many times labels on herbal supplements may be wrong as to content or strength.**

If you are taking any herbal medication or dietary supplements, be sure to let your physician know. This is important at any time, as these supplements may have an adverse reaction when combined with your prescription medicines. It's doubly important to inform your doctor of everything you are taking if you're slated for surgery.

## **Herbal Weight Loss: No "Magic Formula" - by Melanie McLean**

**I don't have to tell you that there isn't such thing as a pill or remedy out there that will magically make the pounds melt away, but herbs can promote weight loss in a variety of ways. The action of certain herbs "trick" the brain into thinking the stomach is full, while others function thermogenically (speed up the body's metabolism).**

### **How They Work**

**Thermogenic herbs (most classified as stimulants) contain substances like caffeine that speed up body functions like heart rate, digestion, and respiration. Their effects may get you up off the couch and keep you moving. Some thermogenic herbs like green tea, nettle, and dandelion are safe as, or safer, than prescription and over the counter weight loss drugs. Other herbs act as diuretics (water reducers) by causing water weight loss. Buchu and uva-ursi rid your body of excess fluid, but weight returns**

quickly when the herb is halted. Even though some can be very beneficial, others can be potentially dangerous and even toxic.

### **Beware of These Herbs**

**It should be noted that the FDA (Food and Drug Commission) has linked the following to cause serious side effects and even death -- so AVOID THEM**

- **Herbal Laxatives** - Usually sold as a diet tea, cascara, senna, buckthorn, aloe and rhubarb root. These herbs can cause cramping, diarrhea, and if overused, could cause your bowels to no longer function without laxative stimulation.
- **Ephedra** - Also known as ma huang, in high doses can raise blood pressure, increase heart rate, and over stimulate the central nervous system. The FDA reports more than 800 reports of side effects linked with the use of ephedra, including heart palpitations, seizures, stroke, chest pain, and heart attack. This herb has caused at least two deaths.
- **Herbal fen-phen** - Ephedra is the main ingredient in the version of the dangerous diet drug known as fen fen. Herbal fen-phen has not been shown to even work in clinical trials, but we know its misuse is associated with severe side effects, from heartbeat irregularities to death from heart attack and stroke.

### **What is Safe?**

- **Cayenne** - If you aren't plagued by spicy food, try sprinkling a dash of cayenne on your food. It contains an ingredient called capsaicin that stimulates saliva, stimulates digestion and accelerates your metabolism at a safer level.
- **Green Tea** - This tea is a natural stimulant that behaves much like coffee but with the added benefit of vitamin C and flavonoids (compounds that are antioxidants). You can regulate the strength of the stimulant by steeping the tea quickly or for a long time. It can be purchased in a tea bag, or loose. It also is available in capsules, but is said to be better assimilated as a liquid.
- **Seaweed** - A good source of trace minerals such as chromium and iodine, seaweed is a natural thyroid stimulant. It is usually contained in kelp capsules or tablets. If you suspect your weight problem is due to a thyroid problem, or if you currently take any thyroid medication, you should check with a doctor before taking kelp or seaweed.

**Good luck in exploring all your herbal options. Remember your health is very important and herbal remedies should be viewed with the same precaution as taking any medication. If you want to make herbs a part of your health regime, you should research and thoroughly investigate all our earth has to offer!**

### **Removing Clients from Medications**

Unless you are a MD, it is illegal in the United States to prescribe, diagnose, or change your client's medications. You can be fined or even put in jail if you are found guilty of any of the above. This is why it is vital that you have all of your clients complete a waiver before you see them. Be sure to have your client sign 2 copies of the waiver. You give one copy to your client and you keep the other copy. This waiver will basically state that you are not a doctor, you will not diagnose them, you will not prescribe to them, and you will only speak to them from the knowledge that you have gained through training. A waiver for Iridology is attached. Edit it for your own business and use it when you consult with your clients.

If you have a client who comes to you and is taking medications there are several steps that you can take with your client to help them "remove themselves" from their medications. The steps are:

1. Look up the medications they are on in a PDR (Physician's Desk Reference) to find out what it is for, how it works, and possibly what can be used instead. A lot of clients don't even know why they are on a particular drug and they don't even know how it works.
2. Once you have found out about the medication they are on, find out what "alternative" product can do the same thing for them. Find out what herbs, vitamins, lifestyle changes, and diet are necessary to help your client need less of the medication.
3. Once your client decides they want to be removed from their medication you need to work very closely with them. Be sure to have them take the herbs and vitamins each day but at a different time than their medication. Start at a low dose and move up. Once that particular herb or vitamin is built up in the body it should help your client so they can begin to reduce the amount of medication they are taking.

4. Remember that a lot of medications deplete essential vitamins, minerals, amino acids, and essential oils. Once you know which ones are depleted, put your client on a rebuilding program to replace those important nutrients.
5. It may take a year or more for your client to remove themselves from their medication. Be sure to work with them weekly or monthly depending on how much support they need.

## Useful Web Sites

### Natural Medicine & Herbs

#### American Botanical Council- (<http://www.herbalgram.org>)

- Learn about the use of Herbs and Phytomedicines
- Order Herbalgram, the Journal of the ABC
- Find out about Commission E Monographs
- Order books, Tapes
- Find about ethnobotanical trips to Belize, Costa Rica, the Peruvian Amazon, and Africa.

#### PhytoPharmica ([www.phytopharmica.com](http://www.phytopharmica.com))

- Check out their product line of over 180 nutritional supplements, natural medicines, and herbal extracts.
- Browse through numerous medical abstracts of popular natural health products and related health issues.
- Subscribe to their Email newsletter.
- Purchase their products from us.

### Columbines and Wizardry Herbs (Howie Bernstein)(a wildcrafter)

#### <http://www.teleport.com/~howieb/howie.html>

- Find out about wildcrafting
- See the Columbines and Wizardry Herbs Catalog
- The 1998 Herbal Apprenticeship Program

### Ethnobotany, Herbal Resources

#### Henriettes Herbal Homepage (<http://sunsite.unc.edu/herbmed/>)

- Henriette's Herbal Homepage is one of the most complete general resources. Use the culinary Herb FAQ when you need information on gardening, harvesting, using and preserving herbs. This site also welcomes contributions from its reader's experience. You'll find many practical ideas. This is certainly a site worth exploring

### Kathie's Herb Page

(<http://www.muscanet.com/~kschmitt/>)

**Grow your own; Summary" I first started out growing herbs just because they are pretty, then I started with a simple tea garden of herbs, then continued with edible flowers, and now my main studies are medicinal herbs. ! Cooking Recipes Making Cooking Oils"**

### Other useful websites

- The National Council against Health Fraud ([www.quackwatch.com/](http://www.quackwatch.com/))
- Your Guide to Health Fraud, Quackery, and Intelligent Decisions
- Healthfinder (<http://www.healthfinder.gov/>) Federally sponsored program with patient health info Healthfinder? can lead you to selected online publications, clearinghouses, databases, web sites, and support and self-help groups, as well as the government agencies and not-for-profit organizations that produce reliable information for the public. The information you find can help you make better choices for yourself and your family about your health and human services needs.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 15:**

### **• Parasites, Candida Albicans & Hiatal Hernias**

#### **Parasites**

They eat off our tissues then release their toxic waste back into our systems. While most of us are familiar with some of these common culprits - ringworm, tapeworm, mites, and heartworm - few of us want to accept the possibility that our own bodies often host over a dozen different parasites that feed and live off our internal organs.

While parasites are most prevalent in areas with hot, humid climates, they are finding their way into a large number of American homes. Although they usually live in the gastrointestinal tracts of their hosts, they can travel to the joints and tissues causing aches and pain. Keeping your body healthy and clean decreases their chance of survival.

After my brother, a doctor, tested my middle son and me for parasites, I began a simple parasite cleanse and repeated it at least once a year. Years later our family started traveling to Mexico once a year, and after reading the book, "Guess What Came To Dinner" by Ann Louise Gittleman, I decided to do a more intense cleanse. While the health of our family seemed good as far as not having colds and flu, we struggled with food allergies, gas, sore joints and skin problems. Through my research, I learned the importance of treating the entire family at the same time, pets included.

I noticed that my youngest son, at the age of four, was grinding his teeth consistently at night. While this could be due to a lack of certain minerals, or even an emotional disturbance, it can also be due to parasites. Another symptom he has had for almost three years is an appetite swing between not wanting to eat anything at all, to not being able to eat enough. I took him to my chiropractor to have him muscle tested with a bottle of Parasites homeopathic medicine. That was exactly what he needed. Because of the dark circles under his eyes, another sign of parasites, my chiropractor recommended also using liquid black walnut.

Hulda Regehr Clark, Ph.D., N.D., in her book, "The Cure of all Cancers", claims ridding the body of parasites can cure cancer. She states, "In 1990 I discovered the true cause of cancer. The cause is a certain parasite, for which I have found evidence in every cancer case regardless of the type of cancer". I've never been diagnosed with cancer, so I can't prove or disprove her bold statement. But, I strongly believe that a person's health will improve after eliminating parasites, changing the environment where they thrive, and rebuilding the body to a healthy state causing new arrivals to perish before settling down to live.

**Dr. Clark names the parasite responsible for cancer is the "intestinal fluke", a member of the flatworm family, which typically causes colitis, Crohn's disease and irritable bowel syndrome. It is when the organism moves out of the intestine and into other areas of the body that several problems result. After reading Dr. Clark's book and seeing pictures of a fluke, I realized that when I did my first major cleanse over ten years ago, I had passed these parasites. Dr. Clark believes that the fluke moves out of the intestine and into other organs such as the liver and survives in our bodies at different times. It may have started in the shoulder, moved to the chest, then back and so on throughout the body.**

**The common symptomatic complaints are digestive pain, nausea, headaches, or diarrhea (my two older sons experienced these after beginning their cleanses.) Acute symptoms range from ulcers, acne, foul breath, coated tongue, menstrual irregularities, skin problems, sleep disturbances, itching of the skin and the anus, and constant picking of the nose. Since these also relate to other diseases, they are often misdiagnosed for the flu, Epstein Barr/chronic fatigue syndrome, candida, colitis, or other immune related diseases. Allergies, types of cancer, irritable bowel syndrome and malabsorption syndrome can also be caused by parasites.**

#### **Treatment**

"The most important element in diagnosing a parasitic infection is often the physician's suspicion that a parasite may be involved - a possibility that is too often overlooked." Consult a doctor if you suspect parasites. The basic test for determining parasites is through a purged stool sample. If this test shows up negative and you still suspect parasites, a doctor may recommend a blood test, sputum test, urine test, radiology test, a biopsy or a culture test. It is recommended that you maintain the following steps of treatment -preferably under the guidance of a health care practitioner. Various degrees of detoxification may take place throughout your body during treatment.

- Clean the intestinal tract:** Parasites can't survive in a healthy environment. Remove mucus and encrusted waste through colonics and home enemas along with the use of herbal fibers such as: 189

agar-agar, bentonite clay, beet root, comfrey root, flax seeds, papaya and psyllium husks. A tablespoon of unprocessed oil a day helps keep the intestinal system lubricated decreasing the parasite's ability to cling to the walls of the intestine.

- **Modify your diet:** Avoid white flour and sugar. Eating a nutritional diet will build the intestinal tract while starving the parasite. A diet of 25% fat, 25% protein, and 50% complex carbohydrates is recommended.
- **Limit Your Intake of: Raw fruits and vegetables avoid cold or iced foods and drinks.** They cause the intestine to contract and hold in toxins. Avoid red meats. Add garlic, onions, carrot tops, radish roots, kelp, raw cabbage, ground almonds, pumpkin and sauerkraut to your diet. Enzymes such as bromelain, papain, pepsin, and hydrochloric acid help aid in digestion of food and parasites.
- **Eliminate parasites with** effective substances such as Nature's Sunshine herbal supplements, medication, homeopathic remedies, and supplements. Taking large doses of powdered vitamin C helps keep the colon clean and the bowel moving. Again, Type A blood is a predisposition in which the body doesn't produce enough hydrochloric acid, therefore, supplementing is often necessary.
- **Rebuild the intestinal tract:** With friendly bacteria. An overgrowth of Candida Albicans prevents production of hydrochloric acid and provides a toxic environment in which parasites can live. Add Lactobacillus acidophilus, Lactobacillus bifidus, Bifidophilus, and other flora supplements after eliminating the parasites. This restores the good flora that keeps the parasites from surviving.
- **Avoid re-infection:** Through a change in lifestyle and environment. Drink safe water, not stream or even city-treated water. Invest in a reverse osmosis water treatment, which blocks even the tiniest microorganism. Again, the most frequent ways parasites enter our bodies are through:
  - **Contaminated water and food.**
  - **Saliva (kissing).**
  - **The pores of the skin (walking barefoot).**
  - **Petting and handling animals and their feces.**
  - **Fleas and other insect bites.**
  - **Through the nose on windy days.**
  - **Sexual intercourse.**

**It is important to remember to wash hands after petting pets, handling dirt or preparing raw meat. Thoroughly rinse your vegetables in water with 1-2 tablespoons of Clorox bleach, change bedding daily during treatment, and practice other common safeguarding tips. Be aware that parasites can also be transmitted through blood transfusions and breast milk.**

## **Cleansing**

Parasites are believed to be most active during a full moon. Therefore if you choose to do a cleanse, start two days before the moon is full. Drinking lots of water, eating figs and sesame seeds on an empty stomach will assist your cleanse during treatment. You may experience flu-like symptoms as the parasites die off. Hydrated bentonite and charcoal help to quickly rid the body of the die off.

**A cleansing fast** recommended by Jack Ritchason, for the intestinal tract consists in eating raw fruits and drinking fresh fruit juices diluted with equal parts of water for three days. During the fast Ritchason recommends taking the following:

- **Herbal Pumpkin, 3, 3x a day**
- **Black Walnut, 4, 3x a day**
- **Chaparral, 1, 3x a day**
- **Special Formula #1, 1, 3x a day**
- **Normal dosage of Vitamin C**

## **Herbs**

There are a number of suggested remedies to use including: Homeopathic Remedy para-remedy; black walnut, cranberry powder, butt nut root, herbal pumpkin and thyme and sage which can be used every day on foods for seasoning.

**Horsetail is known to kill the eggs of parasites, and wormwood helps expel worms and**

parasites. Garlic when eaten raw or used as an extract, helps kill roundworm and hookworm. Plants containing alkaloid, or berberine, such as golden seal, help prevent the growth of parasites in the intestine and vaginal area. Some people have benefited from taking two capsules of Red clover, Pau D'Arco, and Echinacea three times a day. Nature's Sunshine recommends starting with their Tiao He cleanse, then using the Para cleanse.

**We need to replace the myth that it's normal to have parasites living in our bodies with the fact that it is un-healthy to have an organism feeding off our nutrients, blood, and waste material. Our bodies don't need the extra hungry hitchhikers.**

**Sources:** "Do You Have Parasites?" In Sunshine Sharing, Vol. 4 #10, 1993; "Parasites" in Today's Herbs, Vol. 15 #9, 1995; "The Neglected Tonics!" In Sunshine Sharing, Vol. 3 #6, 1992.

## **CANDIDA DIET**

### **What Is Candida Albicans?**

Candida Albicans is a yeast growth present in all of us and is normally controlled by bacteria in the intestines. But when something destroys helpful bacteria, the yeast begins to invade and colonize the body tissues. These yeast colonies release powerful chemicals into the bloodstream, causing such varying symptoms as lethargy, chronic diarrhea, yeast vaginitis, bladder infections, muscle and joint pain, menstrual problems, constipation and severe depression. The medical term for this yeast overgrowth is candidiasis (can di di' a sis).

Candida overgrowth is not a new problem, but is usually thought of as a minor infection of the mucous membranes, skin and nails. But the increased and sometimes excessive use of antibiotics, birth control pills and steroids will allow candidiasis to become a chronic, systemic infection that causes tissue damage throughout the body. Chemicals produced by the candida attack the immune system and if the immune system weakens, the candida will spread out into various body tissues and colonize.

### **Causes of Candida**

What causes this normally harmless yeast to grow out of control? Several factors can lead to an overgrowth of candida. One is the use of antibiotics for extended periods. Broad-spectrum antibiotics taken for respiratory, urinary or ear infections are especially harmful because they destroy the Candida-controlling bacteria, as well as disease-causing bacteria. Steroids such as Cortisone (Decadron or other cortisone-type drugs) suppress the immune system's ability to fight Candida growth. Any hormone imbalance caused by birth control pills or frequent pregnancies also favor Candida overgrowth. There are usually parasites as well somewhere in the body when there is high Candida. Another cause of Candida overgrowth can be from a low Acidophilus and Bifidus culture in the colon. It is imperative that there are enough of these two friendly bacteria in the system in order to control Candida overgrowth. Without these friendly bacteria Candida can and probably will become out of control.

### **Symptoms of Candida**

Both men and women can have candidiasis. However it does occur more frequently in women (especially young women) with more severe effects. Candida symptoms fall into the following four main areas:

#### **Gastrointestinal and Genitourinary Symptoms**

These include constipation, diarrhea, gas, bloating, indigestion, heartburn, PMS, recurrent yeast vaginitis, vaginal burning and itching, vaginal discharge, loss of sexual feelings and proctitis.

#### **Allergic Symptoms**

(These symptoms occur with the passing of toxins into the bloodstream.) These symptoms include hayfever, earaches, bronchitis (recurrent), hives, headaches, sore throats, coughing, acne, nasal congestion, and chemical sensitivities to tobacco smoke, perfume and foods. The person just feels "sick all over".

#### **Disfunctioning Glandular and Organ Symptoms**

These include infertility, menstrual problems, ovarian failure and ACTH deficiency, hypothyroidism, chronic lymphocystic thyroiditis, diabetes mellitus, impotence and endometriosis.

#### **Emotional and Mental Symptoms**

These occur because of central nervous system involvement. These include poor memory, fatigue, drowsiness, feelings of unreality, uncoordination, tingling and numbness, joint pain, muscle weakness, muscle pain, irritability, inability to concentrate, confusion and severe depression.

## Diagnosis of Candida

Candida Albicans is present everywhere, subsisting on the surface of all living things. Since candida germs live in every person's body, especially on the mucous membranes, vaginal and other smears and cultures for the presence of candida are useless. Therefore the diagnosis for candidiasis is made from a person's medical history, score on a candida questionnaire or their response to a kinesiology/muscle test for candidiasis. Finally the diagnosis is confirmed by the person's response to treatment for candida overgrowth.

## Treatment of Candida

Treatment for candidiasis is simple and effective. The goal is to get the yeast out of the tissues and to build up the body's ability to keep it out. There are several elements used in the treatment of yeast overgrowth. They are based on each patient's history and response to treatment.

1. Use of an anti-fungal herb called Pau d'Arco or Taheebo tea. Pau d'Arco is highly effective against Candida because it can penetrate into body tissues and work on a cellular level. Many doctors prescribe the anti-fungal drug Nystatin, which is only effective in the digestive tract.
2. Use of an anti-parasitic herbal combination called Herbal Pumpkin. This combination contains pumpkin seeds, culvers root, cascara sagrada bark, violet leaves, chamomile flowers, mullein leaves, marshmallow root and slippery elm bark, which have been proven to help support the immune system, stimulate the elimination system and therefore allow the body to eliminate the parasites.
3. Replace the microflora in the intestinal tract by taking capsules of Lactobacillus Acidophilus. These bacteria have been found to be extremely successful in reducing candida in the intestinal tract. Are you a coffee drinker? Do you drink decaffeinated or caffeinated? The rumors of decaffeinated coffee being less harmful for the body than caffeinated has been disproven by the medical establishment. Caffeine can kill up to 75% of the friendly acidophilus flora in the colon per cup of coffee. The same goes for decaffeinated. It takes the body approximately five hours to replace that flora depending on the diet and balance of the body at the time.
4. Take a combination of nutrient supplements that build-up the body's immunity and kill off the yeast or make it difficult for it to reproduce. An overgrowth of candida will interfere with the body's metabolism in ways that make normal amounts of nutrients ineffective, so there is an increased need for nutrition.
5. Eat a low carbohydrate diet with no more than 60-80 grams of carbohydrate per day. Because yeast feeds on sugar, wheat and dairy products they should be avoided. Yeasts, molds and fungi cross-react so yeast products should be avoided such as vinegar, mushrooms, cheeses, commercial breads and alcohol.
6. Avoid using antibiotics and steroids unless absolutely necessary since antibiotics promote the growth of the yeast germ in the body.
7. Stop using birth control pills and especially if there is discharge or headaches with periods. The progesterone of these pills causes changes in the vaginal mucus membrane, which makes it easier for candida to multiply.
8. Follow the Candida Control Diet. Fill out the Candida Albicans Questionnaire to find out if you need to do something about the amount of Candida present in your body.
9. Have yourself tested through Kinesiology to find out how much Candida is present in your body and what areas are affected by it.

Many clients notice a great improvement in as much as a few days and many within three weeks. Still it takes an average of six to twelve months to eradicate a candida overgrowth. The candida probably became well established before it was identified which is why treatment must be persistent. The major symptoms to improve are headaches, diarrhea, emotional and behavior problems, vaginitis and chemical sensitivities.

When fighting a Candida infection a person must be systematic and disciplined because the miseries of the problem do not cease immediately with treatment. Candida "die-off" can cause some very uncomfortable symptoms temporarily. These symptoms disappear soon after beginning the diet.

## Summary

An overgrowth of Candida Albicans is a chronic, dangerous infection. If left unchecked it will continue to spread and break down the body's ability to fight off disease. Everyone including infants and children are susceptible to candidiasis. The goal when treating a candida infection is to remove yeast from the infected tissue and rebuild the immune system.



## Candida Albicans Questionnaire

Candida Albicans symptoms are listed by category. As Candida is accumulative, this applies to the present and your entire past life. Score 1 if occasional, 2 if frequent, or 3 if severe.

### DIGESTIVE SYSTEM

- \_\_\_\_\_ Gas w/most foods, not just one food
- \_\_\_\_\_ Intestine pain, colitis
- \_\_\_\_\_ Bloating with or w/o gas
- \_\_\_\_\_ Belching w/most foods
- \_\_\_\_\_ Constipation, stool hard-difficult to move
- \_\_\_\_\_ Diarrhea, stool watery over long period
- \_\_\_\_\_ Heartburn, chronic
- \_\_\_\_\_ Hiatal Hernia conditions

Total Score \_\_\_\_\_

- \_\_\_\_\_ Indigestion
- \_\_\_\_\_ Mucus in stools
- \_\_\_\_\_ Hemorrhoids
- \_\_\_\_\_ Dry mouth
- \_\_\_\_\_ Bad Breath
- \_\_\_\_\_ Crave sugars
- \_\_\_\_\_ Crave breads
- \_\_\_\_\_ Crave alcoholic beverages

### NERVES AND STRESS

- \_\_\_\_\_ Headaches, occasional but constant
- \_\_\_\_\_ Migraine headaches
- \_\_\_\_\_ Depression
- \_\_\_\_\_ Lethargic
- \_\_\_\_\_ Laziness, consistent
- \_\_\_\_\_ Hyper-agitation
- \_\_\_\_\_ Memory, loss or poor
- \_\_\_\_\_ Concentration, noticeable less/loss
- \_\_\_\_\_ Energy loss

Total Score \_\_\_\_\_

- \_\_\_\_\_ Schizophrenia
- \_\_\_\_\_ Psychiatric drugs
- \_\_\_\_\_ Shock treatment
- \_\_\_\_\_ Dizziness, vertigo
- \_\_\_\_\_ Insomnia
- \_\_\_\_\_ Hyper-activity
- \_\_\_\_\_ Fatigue
- \_\_\_\_\_ Drained
- \_\_\_\_\_ Spacy feeling

### GENITOURINARY

- \_\_\_\_\_ Vaginal, yeast outbreak, discharge, burning
- \_\_\_\_\_ Penis, Scrotum, yeast outbreak, fungi
- \_\_\_\_\_ Jock itch
- \_\_\_\_\_ Menses, irregularities, cramping
- \_\_\_\_\_ Premenstrual, anxiety, depression problems
- \_\_\_\_\_ Impotence
- \_\_\_\_\_ Urethritis
- \_\_\_\_\_ Cystitis

Total Score \_\_\_\_\_

- \_\_\_\_\_ Urinary infection reoccurring low grade
- \_\_\_\_\_ Bladder infection reoccurring low grade
- \_\_\_\_\_ Endometriosis
- \_\_\_\_\_ Prostatitis
- \_\_\_\_\_ Loss of sexual desire
- \_\_\_\_\_ Premenstrual tension
- \_\_\_\_\_ Urinary frequency/urgency
- \_\_\_\_\_ Urinary Burning

### ALLERGY-MUCUS SYMPTOMS

- \_\_\_\_\_ Hayfever
- \_\_\_\_\_ Ear, draining, aches, infections
- \_\_\_\_\_ Hives
- \_\_\_\_\_ Asthma
- \_\_\_\_\_ Chemicals, sensitivity
- \_\_\_\_\_ Food, sensitivity
- \_\_\_\_\_ Odors, fragrances, sensitivity
- \_\_\_\_\_ Heat/cool sensitivity
- \_\_\_\_\_ Mucus, chronic body, nose, throat, etc.
- \_\_\_\_\_ Five sense disturbances
- \_\_\_\_\_ Tobacco smoke sensitivity
- \_\_\_\_\_ Eyes burning/tearing

Total Score \_\_\_\_\_

- \_\_\_\_\_ Ear Pain
- \_\_\_\_\_ Chest congestion
- \_\_\_\_\_ Wheezing
- \_\_\_\_\_ Headaches
- \_\_\_\_\_ Head fullness, pressure above ears
- \_\_\_\_\_ Itching, ears, nose, and body
- \_\_\_\_\_ Rashes, allergic
- \_\_\_\_\_ Blister, rash in mouth
- \_\_\_\_\_ Mucus congestion or nasal discharge
- \_\_\_\_\_ Dry throat
- \_\_\_\_\_ Cough

### GENERAL, POTENTIAL CONTRIBUTING CAUSES FOR

- \_\_\_\_\_ Crohn's disease
- \_\_\_\_\_ Anorexia Nervosa
- \_\_\_\_\_ Systemic Lupus Erythematosus
- \_\_\_\_\_ Sarcoidosis
- \_\_\_\_\_ Myasthenia Gravis
- \_\_\_\_\_ Alcoholism, especially wine & beer
- \_\_\_\_\_ Drug addiction

Total Score \_\_\_\_\_

- \_\_\_\_\_ Multiple Sclerosis
- \_\_\_\_\_ Hypoglycemia
- \_\_\_\_\_ Hyperactivity
- \_\_\_\_\_ Psychosomatic disorders
- \_\_\_\_\_ Asthma
- \_\_\_\_\_ Allergies

## GENERAL SYMPTOMS - ENVIRONMENTAL

_____ Fatigue	_____ Muscle aches
_____ Molds, exposure to, moldy house, close to ground	_____ Numbness, tingling, burning
_____ Fungus conditions, between toes/fingers, under finger nails or in skin folds	_____ Muscle weakness, paralysis
_____ Infection, chronic reoccurring	_____ Joints, pain or swelling
_____ Eye matting, infection, mucus discharge	_____ Spots in front of eyes
_____ Mouth infection/thrush	_____ Vision is erratic/failing
_____ Rashes, body/diaper	_____ Drowsiness
Total Score _____	_____ Lack of coordination when needed
	_____ Arthritis/joint swelling

Antibiotics kill both good and bad bacteria in the body creating a bacterial imbalance and the increase of Candida. Birth control pills historically add to Candida emergency. Consequently, these drug uses are weighed heavily.

<b>DRUG</b>	<b>Used less than 1 month - Score 25</b>	<b>1 month or continued use - Score 50</b>
Tetracyclines	_____	_____
Antibiotics	_____	_____
Prednisone or other cortisone type	_____	_____
Birth control pills	_____	_____
Drug Total	_____	_____
Combined Drug Total	_____	
Combined Category Total	_____	
Your Total	_____	

Candida can run from mildly irritating to severe, even life threatening. Even a low score then would require treatment if bothersome. A three in headache, yeast infection, etc., would invite corrective measures.

## SCORES

1-30 would indicate Candida is in balance.

31-40 would indicate normal; however, Candida needs to be watched. Use mild Candida diet and treat irritating symptoms.

41-55 would indicate moderate Candida diet and treatment of Candida symptoms.

56+ would indicate severe Candida diet and full Candida treatment.

## Candida Control Diet

### DIET DO's

\* \* \* FOODS YOU CAN EAT \* \* \*

#### MEAT

Beef	Squirrel
Salmon	Rabbit
Chicken	Quail
Turkey	Duck
Lamb	Goose
Veal	Cornish Hen
Egg	Pheasant
Tuna	All game bird

#### BEVERAGES

Nature's Sunshine Vita-Lemon  
Nature's Sunshine Herbal Beverage  
Nature's Sunshine GlanDiet Shake  
Water

#### FISH

All fresh fish  
Clam  
Lobster  
Shrimp  
Crab  
Oysters

All meats & Eggs  
No BACON, SAUSAGE, HAM  
HOT DOGS, LUNCH MEATS

#### NUTS, SEEDS & OILS (UNPROCESSED)

Almonds  
Brazil  
Cashews  
Filberts  
Pecans  
Pumpkin Seeds

#### ALL FRESH VEGETABLES

Asparagus	Lettuce
Beets	Onions
Broccoli	Parsley
Brussel Sprouts	Peas, Beans
Cabbage	Legumes
Carrots	Tomatoes (fresh)
Cauliflower	Summer Squash
Celery	Winter Squash
Cucumbers	Zucchini, Acorn
Eggplant	Red Potatoes
Green Peppers	Butter Squash
Greens	Radishes
Turnip	Okra
Spinach	Parsnip
Mustard	Corn
Beets	Collards
	Kale

#### AVOID ALL FRUIT FOR 2 WEEKS

Apple	Grapefruit
Avocado	Mango
Banana	Nectarine
Peach	Orange
Pear	Papaya
Apricot	Pineapple

#### EAT ALL FRUIT ALONE!!

#### (OILS - COLD PRESSED)

Almonds	Apricot
Avocado	Corn
Linseed	Olive
Safflowers	Sesame
Butter	

#### WHOLE GRAINS

Barley	Corn
Millet	Oats
Rice	Wheat
Cereal grains	Break & Muffins

Containing no yeast, honey, or sugar

Avoid All Grains for 2 Weeks. Reintroduce 1 at a Time.

**DIET DONT's**  
**\* \* \* FOODS YOU MUST AVOID \* \* \***

1. Fruit Juices: Either canned, bottled, or frozen. Exception: Freshly prepared juice.
2. Coffee & Tea: Regular coffee, instant coffee, decaffeinated coffee, and teas of all sorts including herb tea. Exception: Traditional medicinal herb teas.
3. Melons: Watermelon, honeydew melon, and especially cantaloupe.
4. Edible Fungi: All types of mushrooms, morels, and truffles.
5. Cheeses: All types including cottage cheese and cream cheese. Prepared foods, Velveeta, macaroni and cheese, any other cheeses containing snacks. NO buttermilk, sour cream, any other sour milk products.
6. Yeast: Brewer's yeast, baker's yeast, vitamins, minerals, unless labeled "yeast free" and "sugar free".
7. Antibiotics: Specifically penicillin, streptomycin, ampicillin, amoxicillin, keflex, ceclor, septrin, and bactrim.
8. Processed Foods: Packaged and processed foods containing yeast and refined sugar. Also avoid enriched flour products.
9. Nuts: Peanuts and pistachios usually contain mold, which in turn will feed yeast.
10. Sugar: All sugar containing foods and sweeteners.
11. Alcohol: Fermented liquors and liqueurs, and beverages such as cider and root beer.
12. Malt Products: Milk drinks, cereals, and candy.
13. Condiments, Sauces, and Vinegar-Containing Foods: Mustard, ketchup, Worcestershire, Accent (monosodium glutamate), steak, barbecue, chili, shrimp and soy sauces, pickles, pickled vegetables, relishes, green olives, sauerkraut, horseradish, mince meat, and tamari. Also avoid sprouts. Vinegar of all kinds and vinegar containing foods such as mayonnaise, and salad dressing. (Freshly squeezed lemon juice may be used as a substitute for vinegar in salad dressings prepared with unprocessed vegetable oil.)
14. Processed & Smoked Meats: Pickled and smoked meats, fish including sausages, hot dogs, corned beef, pastrami, and pickled tongue.
15. Dried & Candied Fruits: Raisins, apricots, dates, prunes, figs, and pineapple.
16. Leftovers: Molds grow in leftover food unless it's properly refrigerated. Freezing is better.

# **Hiatal Hernia: An Overlooked Cause of Disease**

**By: Steven H. Horne**

About three years ago Jack Ritchason, a naturopathic physician, corrected a health problem I must have carried since childhood--a hiatal hernia. The impact this simple maneuver has had on my health has amazed me. I immediately noticed a difference in my lung capacity and my digestion and in the months that followed I began to put some muscle on my skin and bones frame and gain newfound strength and stamina.

Dr. Ritchason tells me that this is a common health problem and my own observations as well as those of others confirm this fact. But this is more than a personal observation as the American Digestive Disease Society has estimated that nearly half of all adults--some 60 million people--have a hiatal hernia. It occurs more often in women than in men. It affects people of all ages; but is most prevalent in people over 50 and highly likely in people over 65.

## **The Great Mimic**

Hiatal Hernia has been called the "great mimic" because it mimics many disorders. A person with this problem can get such severe pains in their chest that they think they are having a heart attack. They may think they have an over acid stomach because they will regurgitate stomach acid after they eat, or their stomach may hurt so badly they will think they have an ulcer. This is just a sampling of the symptoms that may occur from this disorder.

## **What is a Hiatal Hernia?**

When you swallow, your food passes down a long tube known as the esophagus into the stomach. This tube must pass through a muscle known as the diaphragm, which is located near the bottom of your rib cage. This opening in the diaphragm, which permits the esophagus to pass through, is regulated by a sphincter muscle (or "valve"), which relaxes and opens when we swallow to permit the food to pass through the diaphragm and into the stomach. This sphincter then closes to prevent stomach acid from coming back up into the throat. A hiatal hernia occurs when the top of the stomach rolls or slides up into this opening and becomes stuck there.

## **Symptoms**

Naturally, when part of the stomach is forced into this opening, the sphincter cannot close properly. Thus, stomach acid may travel back up into the esophagus causing burning sensations (heartburn), esophageal spasms, inflammations and ulcers.

The cramped position of the stomach can also stress the Vagus nerve, which stimulates the release of hydrochloric acid. This can cause both over and under secretion of hydrochloric acid and stomach enzymes. It may also affect the sphincter or valve at the bottom of the stomach so that digestive secretions "leak" out of the stomach and are lost before they have completed their job.

The hiatal hernia will also interfere with the movement of the diaphragm muscle. This muscle normally pulls downward to expand the chest capacity and inflate the lungs. Since the hiatal hernia interferes with this movement, the person may be restricted to shallow breathing, or will resort to using the chest and shoulders to expand the lung capacity and take a deep breath.

The esophagus may also "kink" in the throat, which will irritate the thyroid gland and may cause some difficulty in swallowing. Often persons with hiatal hernias will have difficulty in swallowing capsules or tablets as they get the sensation that they are "sticking" in their throat.

The irritation on the vagus nerve can cause reflex irritations throughout the body. The vagus nerve comes from the medulla and goes to the heart, esophagus, lungs, stomach, small intestines, liver, gall bladder, pancreas and colon. It also has links to the kidney, bladder, and external genitalia. Thus, a hiatal hernia may start imbalances in the system such as decreased stomach acid and pH imbalance in the intestines and elsewhere.

If a person develops poor stomach digestion due to a lack of hydrochloric acid; they will have difficulty digesting and assimilating protein and most minerals. It will also contribute to food putrefaction in the intestines, causing greater toxicity in the body. This lack of nutrition and toxic condition may contribute towards food allergies, constipation, anemia and immune and glandular system weaknesses.

Two other problems that a hiatal hernia may contribute to are asthma and heart disease. Since the hernia reduces the lung capacity by interfering with natural breathing, it could be a factor in asthma. The hernia may also put pressure on the heart. Gas in the intestines may put pressure on the hernia and push it against the bottom of the heart, which may be one way, in which a heart attack can be triggered. None of this spells immediate fatality, but it does point to a major contributing factor in degenerative illness.

## Causes

The causes of a hiatal hernia are speculative and unique to each individual. However, there are a number causes. First of all there may be a mechanical cause. Improper lifting, hard coughing bouts heavy lifting, sharp blows to the abdomen (the kind that "knock the wind out of you"), tight clothing and poor posture may contribute to the development of this problem. Improper lifting may be the biggest mechanical cause of this disorder. If the air is not expelled out of a person's lungs while lifting, it will force the stomach into the esophagus.

Secondly, there are dietary causes. Hiatal hernia just about always accompanies a swollen ileocecal valve. The ileocecal valve is the valve between the small and large intestines which permits material to enter the colon from the large intestine, but prevents material in the colon from moving back into the small intestine. When this valve becomes swollen and irritated it cannot close properly. This allows material from the colon to leak back into the small intestine. This is analogous your sewer backing up into your kitchen. This creates gas and indigestion, which puts pressure on the stomach and presses it tighter against the diaphragm.

The relationship between the ileocecal valve and the hiatal hernia is a chicken/egg situation ... it is hard to know which comes first. However, it is clear that the ileocecal problem aggravates the hernia. Hence, the things that irritate that valve may be causal factors. These are the basic causes of digestive problems: poor food combining, overeating, drinking with meals, overeating and eating when upset.

Lastly, there are emotional causes. According to one applied kinesiologist text a hiatal hernia comes from repressed anger. A person "swallows their anger" and "can't stomach it." When you get angry, you suck your breath upward. If you fail to release this anger, your stomach stays up. I have observed that most of the people with severe hiatal hernias have a great deal of emotional stress and hold a lot of it inside.

## Identification

The easiest way to tell if you or someone you know has a hiatal hernia is to place your fingers on the solar Plexus, just below the breastbone. Then take a deep breath. You should feel the solar plexus expand and move outward. If there is no movement at the solar plexus and you have to lift your chest and shoulders to take a deep breath, then you probably have a hiatal hernia. You should be able to take a deep abdominal breath without lifting your shoulders. There are other, more complicated, methods of determining if you have a hiatal hernia, such as muscle testing, but this is a fairly simple and reliable method.

## Correction

Since a hiatal hernia is primarily a mechanical problem, the easiest and best way to correct it is mechanically. Medical doctors have attempted surgery to correct this disorder, but the results tend to be poor. Cutting into this area can further weaken it so that the hernia will return in short order. A better method is to manipulate the stomach and bring down the hernia by hand. Unfortunately, you can't do this to yourself. You will need to find a good chiropractor, applied kinesiologist or massage therapist who understands this problem and knows how to correct it. If you want to learn how to do this adjustment to others, you will have to find someone who does it and have them show you how since it is impossible to adequately describe the technique(s) in writing. They have to be learned through demonstration and practice.

## Self-Adjustment

There are some self-help adjustment techniques. They aren't as effective as having someone else perform the adjustment, but they may help. The best one I've tried is to drink a pint of warm water first thing in the morning, then stand on your toes and drop suddenly to your heels several times. The warm water helps to relax the stomach and diaphragm and puts some weight in the stomach. By dropping down suddenly, the weight of the water helps to pull the stomach down. In a mild case, this might be enough to bring the hernia down. In a more severe case it may loosen the stomach and make it easier for someone else to bring it down. It will also help you to keep the stomach down once mechanical corrections have been made.

## Nutritional Aids

Until the problem is corrected mechanically; there are some nutritional therapies, which may be of help. Immediate, but temporary, relief of pain and discomfort can often be achieved by the use of a mucilaginous herb like slippery elm or comfrey. These herbs absorb the digestive secretions and help to prevent their traveling back up the esophagus and burning it. They also help to prevent irritation of the ileocecal valve. Comfrey can also speed the healing of this problem once mechanical adjustments have been made. Comfrey/pepsin is a good combination for this problem as well. A digestive aid will help the person obtain the nutrients they need when the hernia is interfering with digestion. This may take the form of a hydrochloric acid supplement or a food enzyme tablet, or perhaps an herbal digestive aid such as papaya and peppermint, chamomile tea, safflowers, ginger root and so forth.

Other food or herb products that have been used to help people with hiatal hernias include: raw cabbage juice (where ulcerations have occurred), balm, barley water, brown rice, celery, coriander, gentian, hops, licorice, marshmallow and passion flower. Dietary modifications may be necessary to relieve the problem and to keep it from reoccurring once it has been corrected. Since the pressure of abdominal gas can push the stomach upward, it would be advisable to avoid gas-forming foods like beans. It would also be wise to watch food combinations carefully and to avoid overeating. Dr. Jack Ritchason recommends that people with hiatal hernias avoid eating any heavy meals after 3 pm.

Below you will find a checklist of symptoms, which will help you in identifying people who have this problem so they can take steps to correct it.

### Symptoms of a Hiatal Hernia

What is a Hiatal Hernia? A hiatal hernia occurs when the top of the stomach rolls or slides up into the opening in the diaphragm which the esophagus passes through and becomes stuck there. This condition may create difficulty with digestion (and hence general nutrition and well being) as well as breathing difficulties, nervous problems, circulatory problems and glandular imbalances. All of the following symptoms have been connected with a hiatal hernia. If you have some of these symptoms especially those marked with an asterisk (\*) you may wish to consider being checked for this condition.

- **DIGESTIVE DIFFICULTIES** \*Belching, \*Bloating, \*Heartburn, \*Difficulty digesting meat/high protein foods, Tension or pressure at the solar plexus, Sensitivity at the waist, Intestinal gas, Regurgitation, Hiccups, Lack or limitation of appetite, Nausea, Vomiting, Diarrhea, Constipation, Colic in children, Difficulty in gaining weight or overweight, Ulcers.
- **BREATHING AND CIRCULATION PROBLEMS** \*Difficulty with deep abdominal breathing, \*Difficulty in swallowing capsules, \*Asthma, \*Inability to take a deep breath from diaphragm, Overall fatigue, Tendency to swallow air, Allergies, Dry tickling cough, Full feeling at base of throat, Pain or burning in upper chest, Pressure in the chest, Pain in the left side of chest, Pressure below breastbone, Lung pain, Rapid heartbeat, Rapid rise in blood pressure, Pain in left shoulder, arm or side of neck.
- **STRUCTURAL COMPLAINTS** TMJ (Temporo-Mandibular Joint Pain), Bruxism (Grinding teeth in sleep), Joint pain, Localized or overall spinal pain, Headaches.
- **STRESS** \*Suppression of anger or other emotions, \*Living with or having lived with a quick-tempered person, Dizziness, Shakiness, Mental Confusion, Anxiety attacks, Insomnia, Hyperactivity in children.
- **OTHER AILMENTS** \*Open ileocecal valve, \*General weakness, \*Difficulty in getting and/or staying healthy, Overactive thyroid, Cravings for sugar or alcohol, Candida Albicans, Menstrual or prostate problems, Urinary difficulties, Hoarseness

### Sources

For more information about the problem of hiatal hernias, read the book "Hiatal Hernia Syndrome: Insidious Link to Major Illness" by Theodore A. Barody, Jr., M.A., D.C., "Hiatus Hernia" by Penny Hemphill from an Australian Magazine, Nature & Health, and "Chiropractic Handout".

## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 16:

### • Water Purification, The Ideal Diet & Home Health Tests

#### FLUORIDATION

For over five decades, the American Dental Association has continuously endorsed the fluoridation of community water supplies and the use of fluoride-containing products as safe and effective measures for preventing tooth decay. Fluorides and Fluoridation contains resources that provide important facts and answer a myriad of questions. New information and resources will be added to this area, as they become available. In the following sections, you will find the latest information about fluoride and fluoridation.



#### **Fluoride: Nature's Cavity Fighter**

Fluoride is a mineral that occurs naturally in all water sources, even the oceans. The fluoride ion comes from the element fluorine. Fluorine, the 17th most abundant element in the earth's crust, is never encountered in its free state in nature. It exists only in combination with other elements as a fluoride compound.

Fluoride is effective in preventing and reversing the early signs of dental caries (tooth decay). Researchers have shown that there are several ways through which fluoride achieves its decay-preventive effects. It makes the tooth structure stronger, so teeth are more resistant to acid attacks. Acid is formed when the bacteria in plaque break down sugars and carbohydrates from the diet. Repeated acid attacks break down the tooth, which causes cavities. Fluoride also acts to repair, or remineralize, areas in which acid attacks have already begun. The remineralization effect of fluoride is important because it reverses the early decay process as well as creating a tooth surface that is more resistant to decay. (See also Fluoridation Facts: Question 1. What is fluoride and how does it reduce tooth decay?)

Fluoride is obtained in two forms: topical and systemic. Topical fluorides strengthen teeth already present in the mouth making them more decay-resistant. Topical fluorides include toothpastes, mouthrinses and professionally applied fluoride therapies.

Systemic fluorides are those that are ingested into the body and become incorporated into forming tooth structures. Systemic fluorides can also give topical protection because fluoride is present in saliva, which continually bathes the teeth. Systemic fluorides include water fluoridation or dietary fluoride supplements in the form of tablets, drops or lozenges.

As a result of the widespread availability of these various sources of fluoride, the decay rates in both the U.S. and other countries have greatly diminished.

#### **The proper mix is key**

It is important to note that the effective prevention of dental decay requires that the proper mix of both forms of fluoride (topical and systemic) be made available to individuals. Your dentist can help you assess whether you are receiving adequate levels of fluoride for all family members from the two forms (topical and systemic).

#### **Topical Fluorides Self-Applied**

One method of self-applied topical fluoride that is responsible for a significant drop in the level of cavities since 1960 is use of a fluoride-containing toothpaste. The American Dental Association recommends that children (over two years of age) and adults use fluoride toothpaste displaying the ADA Seal of Acceptance or consult with a child's dentist if considering the use of toothpaste before age 2. Other sources of self-applied fluoride are mouthrinses designed to be rinsed and spit out, either prescribed by your dentist or an over-the-counter variety. The ADA recommends the use of fluoride mouthrinses, but not for children under six years of age because they may swallow the rinse.

#### **Professionally-Applied**

Professionally applied fluorides are in the form of a gel, foam or rinse, and are applied by a dentist or dental hygienist during dental visits. These fluorides are more concentrated than the self-applied fluorides, and therefore are not needed as frequently. The ADA recommends that dental professionals use any of the professional strength, tray-applied gels or foam products carrying the ADA Seal of Acceptance. There are no ADA-accepted fluoride professional rinses for use in dental offices.



## **Systemic Fluorides**

Systemic fluorides such as community water fluoridation and dietary fluoride supplements are effective in reducing tooth decay. These fluorides provide topical as well as systemic protection because fluoride is present in the saliva.

## **Community Water Fluoridation**

Fluoride is present naturally in all water sources. Community water fluoridation, which has been around for over 50 years, is simply the process of adjusting the fluoride content of fluoride-deficient water to the recommended level for optimal dental health. That recommended level is 0.7 - 1.2 parts fluoride per million parts water. Water fluoridation has been proven to reduce decay in both children and adults. While water fluoridation is an extremely effective and inexpensive means of obtaining the fluoride necessary for optimal tooth decay prevention, not everyone lives in a community with a centralized, public or private water source that can be fluoridated. For those individuals, fluoride is available in other forms.

## **Dietary Fluoride Supplements**

Dietary fluoride supplements (tablets, drops or lozenges) are available only by prescription and are intended for use by children ages six months to 16 years living in nonfluoridated areas. Your dentist or physician can prescribe the correct dosage. It is based on the natural fluoride concentration of the child's drinking water and the age of the child (see chart). For optimum benefits, use of dietary fluoride supplements should begin when a child is six months old and be continued daily until the child is 16 years old. The need for taking dietary fluoride supplements over an extended period of time makes dietary fluoride supplements less cost-effective than water fluoridation; therefore, dietary fluoride supplements are considerably less practical as a wide-spread alternative to water fluoridation as a public health measure. Fluoride supplements are recommended only for children living in non-fluoridated areas.

It is important to note that fluoridated water may be consumed from sources other than the home water supply, such as the workplace, school and/or day care, bottled water, filtered water and from processed beverages and foods prepared with fluoridated water. For this reason, dietary fluoride supplements should be prescribed by carefully following the recommended dosage schedule (see chart). Dietary fluoride supplements are not recommended for children residing in a fluoridated community.

## **Conclusion**

No matter how you get the fluoride you need -- whether it be through your drinking water, supplements, toothpaste, mouthrinse or professionally applied fluoride -- you can be confident that fluoride is silently at work fighting decay. Safe, convenient, effective...however you describe it, fluoride fits naturally into any dental care program. For more information about the oral health benefits of fluoride, just ask your dentist.

## **New York State Coalition Opposed to Fluoridation - Fluoridation 101**

Impure, untested and unrequired fluoride chemicals are legislated into most U.S. water supplies, not to kill nasty microbes, but to medicate tap water drinkers who are assured water fluoridation is a safe and effective way to prevent tooth decay. But it is neither.

A 1940's concept, water fluoridation and dentistry's continued goal, for every American's faucet to dispense 1 milligram fluoride via approximately one quart of water, is, shockingly, not supported by valid science.

Dentists mistakenly believed swallowed fluoride created decay resistant teeth by becoming part of children's developing enamel; but they were wrong. Fluoride's beneficial effects, if any, are topical according to the U.S. Centers for Disease Control and the American Dental Association.

Public health officials predicted fluoride would eradicate tooth decay like vaccines prevented some diseases but they were wrong about that, too. They said fluoride was a necessary nutrient and, like vitamin C prevents scurvy, fluoride would prevent tooth decay - wrong again. The U.S. Surgeon General reports tooth decay is at epidemic proportions among the nation's poor and minority populations, many of whom live in fluoridated communities.

Fluoride tablets are prescribed to children from communities that won't or can't fluoridate their water supply. With no or very poor research support, dentists say swallowing 1 milligram fluoride daily reduces tooth decay without fluoride's adverse effects such as dental fluorosis but they are even wrong about that.

Fluoride supplements, never safety tested by the US Food and Drug Administration (FDA), were "grandfathered" in before the FDA drug testing laws were enacted. New research shows that children who consume fluoride tablets are more at risk for dental fluorosis. That's why the Canadian Dental Association, the Western Australian Health Authority's Dental Section and the German Scientific Dental Association no longer recommend

routine fluoride supplementation.

Astonishingly, research now shows swallowing fluoride is virtually useless and has unnecessarily exposed millions of Americans to fluoride's adverse side effects such as bone disease and dental fluorosis - white spotted, yellow or brown stained and sometimes pitted and crumbly teeth - which has, not so surprisingly, increased dramatically in North American children. Ironically, studies show tooth decay rates are virtually the same in fluoridated and non-fluoridated communities, alike. But babies who shun tap water and drink bottled water are protected against dental fluorosis.

Some studies even show that cavity levels decline after water fluoridation stops. And that those children most at risk for fluorosis are also the ones most at risk for cavities. And at levels 3 or 4 times "optimal," fluoride can actually cause tooth decay.

In fact, dental fluorosis has gotten so bad that some dental experts say that it costs more to repair teeth damaged by fluoride than would have been saved had water fluoridation actually reduced tooth decay.

## **HOW WE GOT INTO THIS MESS?**

At the turn of the last century, many residents of the Southwest US had unusually ugly teeth. They called it "Colorado Brown Stain." Dental researchers sought to discover the source of this disfiguring tooth malformation. The culprit was high levels of fluoride in the water. Since these ugly teeth resisted decay, well-meaning but misguided dentists assumed the fluoride also caused the teeth to resist decay. However, what they overlooked is significant. The water supply was also very high in calcium and magnesium, essential nutrients we now know makes teeth strong.

In another highly unbelievable move, the dentists convinced public health people to experiment with this new fluoride discovery. They hypothesized that, if natural fluoride (calcium fluoride) in drinking water makes teeth resist decay, let's see if artificially fluoridating a town's water makes any difference.

So they used all the people in a few cities like Grand Rapids Michigan and Newburgh New York as their guinea pigs. In Newburgh, NY, they added sodium fluoride into the water supply in 1945 and left Kingston, NY, unfluoridated to act as the control.

Of course they declared fluoridation a success after only five years even though the teeth of the children who were born into the experiment hadn't even erupted yet. They said fluoride was safe because they examined school children who weren't sick two weeks before the examination date - virtually eliminating the very children who may have been made ill by the fluoride. And they never even checked out the adults.

Ten years later, the State University of New York found that children in fluoridated Newburgh had more cortical bone defects and higher rates of hemoglobin anemia. Kingston never fluoridated and recent studies show that tooth decay rates are higher in fluoridated Newburgh and their rates of dental fluorosis has skyrocketed.

And what's even more perverse is that the chemical used to fluoridate your drinking water is an industrial waste product that, along with fluoride, carries lead, arsenic, and other contaminants to a faucet near you.

The silicofluorides haven't even been safety tested in animals. With the map of the USA as a laboratory, researchers are finding that silicofluorides increase children's lead absorption, increases women's risk of hip fractures, increases dental fluorosis, can lower IQ and contribute to cancer risk and DNA damage. Fluoridation has provided a lucrative sector for researchers to apply for federal grants to study the after effects of the crazy decision to put fluoride into humans' water supply and then see what happens.

Over 62% of US communities fluoridate and most foods and beverages sold in the US are made with that water. US children are overdosed with fluoride whether rich or poor, healthy or malnourished from various sources. So it's not a surprise that after fifty years of pushing fluoride as a panacea to tooth decay, the US Surgeon General recently reported an oral health epidemic among the poor and certain minority groups, who most often already live in fluoridated communities. If their bodies were nourished, their teeth would prosper. But instead dentists are lobbying legislators all over the US to fluoridate water supplies - even when the people have voted against it and even when the studies say fluoride is hurting our children. Meanwhile, the American Dental Association reported to the press on June 16, 2000 that they have a new cavity-fighting tool - calcium.

## **WHAT YOU CAN DO**

Join the nationwide call for congressional hearings on fluoridation. URL: (Cut and paste in your browser) [http://www.citizens.org/Food\\_Water\\_Safety/Fluoridation/fluoride.htm](http://www.citizens.org/Food_Water_Safety/Fluoridation/fluoride.htm)

## **Who the New York State Coalition Opposed to Fluoridation?**

The New York State Coalition Opposed to Fluoridation consists of physicians, dentists, legislators, lawyers, scientists, environmentalists and other professionals as well as mothers, fathers and others who contribute their efforts in a volunteer capacity to inform the public about fluoride's/fluoridation's harmful dental, systemic and cumulative effects. Our primary objective, ultimately, is to end the fluoridation of public water supplies. We are part of a national and international network of organizations that oppose water fluoridation.

## **TAP WATER FOR DRINKING AND SHOWERING**

### **How Clean Is Your Water & Should You Use Your Tap Water?**

"120 million may get unsafe drinking water" was the headline of a front-page article that appeared in the USA Today paper. The article covered a comprehensive drinking water study completed by the consumer group Natural Resources Defense Council (NRDC) that analyzed EPA records on compliance with the Safe Drinking Water Act. According to the article, the study found:

- 43 percent of all water supplies violated health standards
- There were a total of 250,000 violations affecting 120 million people
- More than 900,000 people became ill each year, and as many as 900 die each year due to waterborne illness.

Although the article cited biological-related incidents in Milwaukee and New York, according to NRDC representatives, many of the violations also involved other SDWA contaminants. The POU/POE industry has equipment, which is tested or certified to reduce many of these contaminants such as lead.

It should also be noted that 57 percent of all water supplies were not cited as violators and that the municipal water supply in the United States is considered to be one of the safest in the world. These are important facts to keep in mind to prevent any unjustified "scare tactic" marketing.

WQA will provide a more in-depth follow-up on this as soon as the actual report is studied. Copies of the 44-page report are available by sending \$8.94 for the report and \$14 for the appendices to the National Resources Defense Council, 1350 New York Avenue, Suite 300, Washington, DC 20005.

### **How safe is Your Shower?**

A recent series of scientific studies have confirmed that your morning shower is not the most innocuous pleasure of the day. Scientists have learned that we absorb as much or more synthetic volatile chemicals from the water we shower in daily than we receive by ingestion of the same type of water daily from food and drinking water. Two studies are of particular significance here.

1. Professor Julian B. Andelman, Center for Environmental Epidemiology, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, PA reported in the scientific journal: The Science for the Total Environment, 47, Pgs 443-460, that roughly 60% more chloroform and trichlorethylene can be absorbed by the body in the shower than is absorbed from ingesting drinking water for that day. To prove this, he constructed a model shower in his lab, and introduced these two volatile chemicals into the showerheads set at different heights and at different temperatures. When the hot water mixes in the shower with the cold water, the volatile chemicals are driven off into the air and, of course, breathed into the lungs. In the lungs, the blood barrier is only one cell thick so the chemicals gain immediate access to the blood stream.
2. The role of skin absorption of volatile organic contaminants (VOCs) was reported by Halina S. Brown, Ph.D. et al in the American Journal of Public Health, Vol. 74, Pg. 479-484. They found a direct line relationship between the concentration of volatile chemicals in water that were in contact with the skin, and the concentration of those same chemicals in the blood stream immediately after exposure. This is quite understandable when we realize that the skin is the largest organ of the body and is composed of lipid membranes that are indeed permeable to volatile chemicals. What does all this mean to you and me?

Chemical companies constantly affirm that a little chemical poison does not hurt us, but why expose ourselves unnecessarily?

Clinical ecologists have learned that the more you are exposed to chemicals in your environment, the more quickly you become sensitive to those same chemicals. After a time of continuous exposure, persons can reach their threshold level for that contaminant and thereafter evidence certain characteristic symptoms, which will appear more and more often. Again, prevention is the safest route to follow. Don't allow yourself to

become sensitive to chlorine or any of the chlorinated by-products from municipal water.

To those who rather doubt that this is a truth at all, let us recount an experiment that is conducted in laboratories occasionally. Anyone can do this for himself or herself:

*"Take a glass of water from the faucet after it has been running a few minutes. Test the water in the glass for free chlorine residue. Our value that we received for water in this city was 1.11 parts per million free chlorine. Then hold your fingers in the glass of water for 15 seconds, and test the water again for chlorine. You will be amazed to see the difference. Our value was 0.19-PPM chlorine. That calculates to a decrease of 82.9% chlorine for just 15 seconds contact. The few fingers have about 1 one-hundredth the surface area of the whole body that is exposed in a shower situation, so you can readily understand why Dr. Brown and her colleagues reported these findings in the Journal of the American Public Health Association. Something to think about the next time you swim in a chlorinated pool or take a chlorinated shower."*

What can you do about this for yourself? You can get a shower filter from Ozark Water Lab by contacting them at 800-835-8908.

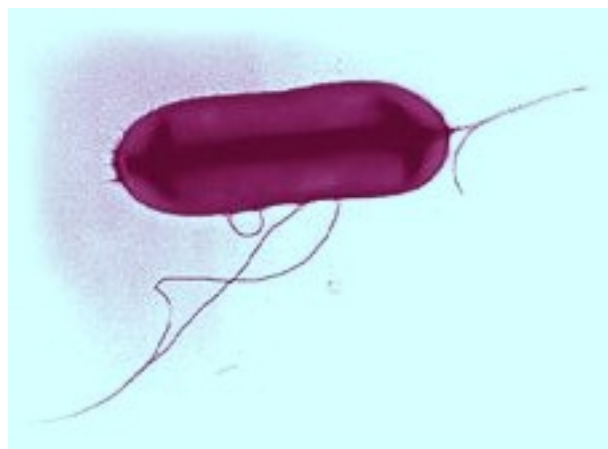
### **Do You Drink Water From A Well?**

At one time natural underground water sources were almost always drinkable without treatment. No longer is this true in many parts of our nation; therefore, we need R/O purifiers now more than ever since they do remove bacteria and viruses. Without doubt, they do work best where the water is chlorinated. If your water source is not chlorinated, then a few precautions are helpful. Whenever you finish using the R/O unit for more than a day, put 2-3 drops of Clorox in the diverter cup and attach to the faucet. Run the water through the unit for 1-2 minutes until you can smell the chlorine coming out of the white tube. This diminishes bacterial growth on the outside of the membrane.

Notice at this point that the EPA does not recommend the use of only carbon filters on unchlorinated water sources since bacteria can build up even faster. The R/O unit contains a membrane before the carbon filter to prevent bacteria from even reaching the carbon filter, but the pressure must be high enough.

Most springs and wells (and some city water systems) require a 10-inch sediment pre-filter to protect and extend the life of the small pre-filter in the R/O unit. All wells and springs give up copious quantities of dirt, mud, sand, and algae at times of intense rainfall, so it is good economy to protect the filter with a large one.

Thus you can discern that even the best operating R/O purifier in the world may not work as efficiently as it could if the water quality is unusual in some respect. The good news is that all of these abnormalities can be corrected for by slight alterations.



### **SWIMMING POOLS, JACUZZI'S AND SAUNAS**

#### **Deadly E. coli outbreak at Atlanta waterpark hospitalizes eight children.**

An E. coli outbreak occurred hospitalizing at least eight children who played in the Captain Kid's Cove pool at the popular White Water park near Atlanta June 11 and 12. Georgia Health officials believe that fecal contamination in the pool was the source of the infection.

The children were infected with a dangerous strain of E. coli known as 0157:H7 which often causes hemolytic uremic syndrome in children under five. HUS is a serious complication of E. coli infection which attacks the red blood

cells, kidneys, and potentially the heart and brain. Six of the infected children are suffering from HUS and require treatment by kidney dialysis, blood transfusions and respirators.

Among those hospitalized is three year old Brody Weiss, son of Atlanta Braves shortstop Walt Weiss. As of June 24, Brody was listed in serious condition at Scottish Rite Medical Center.

"Still unclear is how a potentially fatal strain of bacteria managed survive two days in water treated with chlorine..."

## Conventional Swimming Pool Water Testing & Treatment Provides Inadequate Defense Against E. coli Bacterium Transmission

Contaminated beef is the most common method of transmitting E. coli bacteria, which causes approximately 20,000 infections and 200 deaths in the United States each year. What is particularly alarming about the 0157:H7 strain is the apparent ability to survive in a swimming pool environment.



While many swimming pool operators and health officials believe that a free chlorine residual of 1.5 to 3.0 parts-per-million provides sufficient sanitation, there are several factors, which have a significant impact on the bactericidal effectiveness of the sanitizer. For example, correcting the pH of a swimming pool or spa from 7.8 to 7.4 at a fixed free chlorine residual will cause a dramatic reduction in the kill time for E. coli.

Most regulatory agencies set water quality requirements based on the measurement of free chlorine residuals with DPD test kits. However, free chlorine is composed of two distinct parts or species known as Hypochlorous acid (HOCl) and Hypochlorite ion (OCI<sup>-</sup>), which are not equal in their ability to sanitize. The ionic form of chlorine (OCI<sup>-</sup>) is slow acting, while the Hypochlorous acid (HOCl) is 80 to 300 times more effective.

Unfortunately, bather loading and chemical dosing constantly influence the dissociation between the two chlorine species, rendering mandated sanitizer residual levels and the DPD measurement thereof a weak tool in maintaining bacteriological efficacy.

The maintenance of a chlorine residual in conformance with Health Department requirements provides little assurance of healthy water quality.

## Oxidation Reduction Potential (ORP) Provides Qualitative Measurement and Control of Sanitizer Effectiveness



The CAT 2000 Automated Controller ensures inactivation of E. coli and waterborne pathogens through the Oxidation-Reduction Potential method of chemical control.

### OVERVIEW

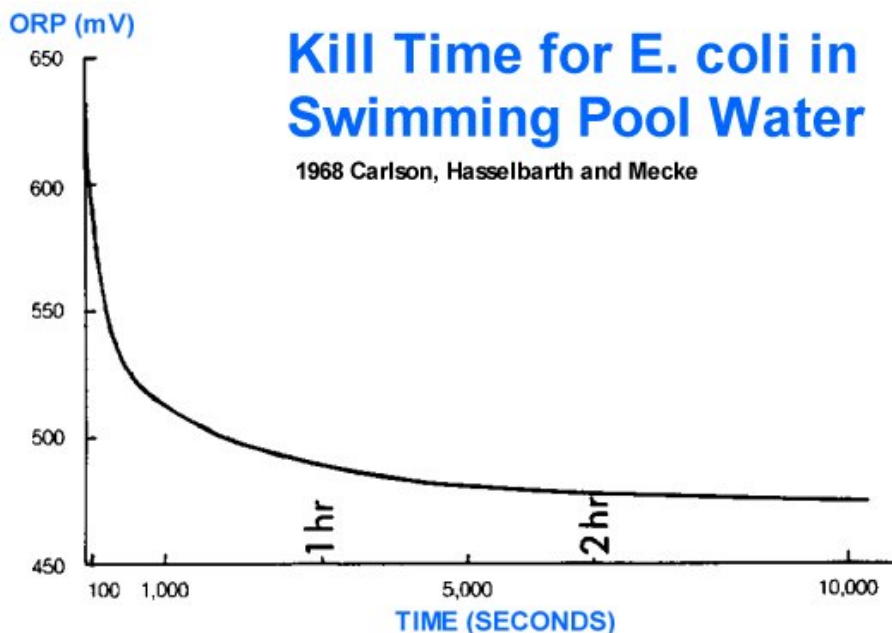
CAT Controllers monitor and maintain water quality using the Oxidation-Reduction Potential method of water analysis. Conclusive research demonstrates the Oxidation-Reduction Potential (ORP) method of water analysis is the only reliable measure of kill time for waterborne pathogens in swimming pools. The CAT Controller monitors water quality by use of pH and ORP sensors to continually compare sensed values to safe set point levels and automatically dose chemicals to insure proper disinfection.

ORP and E. Coli 1968 - Carlson, Hasselbarth and Mecke. Studies at the Water Hygiene Institute of the German Federal Health Office demonstrated that the rate of killing for E. Coli organisms in swimming pool water is dependent on ORP and not on the free residual chlorine level. The kill time is just a fraction of a second at an ORP level of 650 mV, but increases rapidly to several hours at lower ORP values.

For further information on CAT Controllers: Chemical Automation Technologies, Inc.

## Maintaining an Oxidation Reduction Potential (ORP) of 650 mV Provides Nearly Instant Kill of E. coli Bacteria

Non-electric copper/silver cartridges will work well with pools - not true. Non-electric cartridge or catalytic type units can work well with spas where there is a constant re-circulation of water and the flow through type purifier "sees" the water several times per hour, constantly purifying it. However, in a swimming pool, the water may turn



over only once per day and therefore, when using a catalytic type unit, a residual of chlorine is required to keep the water sanitized. Pool storeowners want you to come back to replace expensive cartridges and buy chlorine. Electronic ionizers work much better in a pool since they leave a purifying residual of minerals in the water.

### The Mineralizer

- The Mineralizer Copper/Silver ionizer may cause staining. Anything can potentially cause staining given improper conditions - chlorine, leaves, chemical imbalances, minerals, act. Vinyl and new
- quartz/pebble finishes are extremely hard to stain. Also today, there are very effective stain removal additives available that, if needed, will quickly and inexpensively remove any type of surface stains.
- Copper and/or silver may be dangerous to humans. The normal amount of copper with the Mineralizer in your pool water is 0.3 PPM, well below the EPA maximum of 1.3 for drinking water. Fish can easily live in ionized waters - try that with chlorine.
- Bacquacil type products give good water quality; but at a very high cost. Most users of non-chlorine type products can pay for a Mineralizer in one season. Besides, what could be better than swimming in mineral water?
- The electric Mineralizer requires a residual of chlorine remain in the water - not true. Only occasional low doses of chlorine are required to "polish" the water. This low dosage should burn off quickly not requiring a chlorine residual and not exposing yourself to a toxic chemical?
- The Mineralizer still requires some chlorine - true. However, your chlorine cost will drop by approximately 90% hurting the pool stores chemical sales. Lifeguard has been in business since 1988 and has sold thousands. Why do you think you haven't heard of the

### Mineralizer until now?

- Chlorine is more forgiving than copper/silver ions - not true. Copper/silver ions are not affected by heat or sunlight. Chlorine requires cyanuric acid additive or it will burn off in hours. Copper/silver take weeks to come out of solution.
- The Mineralizer requires more testing than chemical systems - not true. Since ions are added automatically and dissipate slowly, the homeowner simply test pH and copper every 1-2 weeks. A very low dosage of oxidizer (preferably bleach) needs to be added when the weather has lost its crystal clarity, usually once per week in the summer and 3-4 weeks in cooler weather.
- Chlorine will keep you water clear - true. But copper/silver ionized water will give you unmatched water clarity and fresh water quality!
- Wouldn't you really rather swim in natural minerals than chemicals?

### WHY AREN'T YOU USING A MINERALIZER?

- Why are you using caustic chlorine or expensive Bacquacil where there are affordable alternative sanitizers for you pool?
- Why are you exposing yourself and your family to potentially dangerous long-term effects of poisonous chlorine and Bromine when there are very affordable alternatives for your pool or spa?
- Why would you swim in water that dries your skin, sinuses, hair and eyes, bleaches your clothes



and hair, and smells like chemicals; when there is a natural mineral alternative that is like swimming in pure, fresh lake water?

- Why are you buying and handling large quantities of chlorine every year when a natural chlorine reducer will pay for itself in most pools in 1-2 years?
- Why are you baby sitting your pool and testing it constantly when there is a natural mineral, ion generator that automatically produces the sanitizer and requires much less monitoring and testing and is more forgiving?

### **COMPARISON: MINERALIZER VS OZONE**

- The MINERALIZER can give residential users a "chemical free water" because there is a purifying residual of copper and silver ions present in the water at all times. The small dosage of oxidizer required after every spa usage will react and dissipate out before the next usage.
- The copper/silver ions present (.3-.4PPM copper and .03PPM silver) is t easily sufficient to kill algae, bacteria and virus present in the water
- The entire vessel has a purifying residual, not just a few feet away from the injector point. Copper/silver ions are filtered out of the water after they flocculate and kill contaminants.
- Cu/Ag ions are not effected by heat, sunlight or bather load and stay in solution until reacting with a contaminant.
- A chlorine/sanitizer residual is not required with the MINERALIZER (in residential applications) because of the continuous presence of a purifying Cu/Ag residual. A tiny dosage of an oxidizer is required after each usage to burn off bather sweat, oil, etc.
- Since ozone provides no residual, many users run their circulating pumps overtime to provide ozone exposure. The MINERALIZER only requires circulation time sufficient to maintain water temperature, saving considerable energy.
- Cu/Ag ions are pH neutral and will not effect other additives. Other than pH control and slight oxidation, no other algaecides or additives are never required.
- Since Cu/Ag ions are not oxidizers, they are not effected by bather load. Any oxidizer reacts with organic matter including skin, hair and eyes.

It's simply the BEST system for purifying your pool or spa! There really is a better, healthier, easier way!

### **CATALYTIC--Nature 2---Vision--cartridge systems**

These products are really bacteriostatic filters and they kill contaminants only in the cartridge itself, requiring long circulation times since they only work when the pump is running.

#### **Advantages:**

- Reduces chlorine/oxidizer usage 50-80%
- Higher quality water since chlorine residual (.4 PPM) is lower

#### **Disadvantages:**

Still swimming in chlorine

- Must purchase cartridge enclosure system and install
- Must return to store every 4-6 months to replace expensive cartridge
- Negligible Cu/Ag residual purifying the water, thereby requiring long circulation times and chlorine residual.

#### **Changing to another system:**

Simply turn it off and revert to any purification system you want.

#### **Compared to a MINERALIZER**

The long-term cost will be --much--much higher than MINERALIZER since cartridge must be replaced. This is the reason pool supply stores push this product. Add up the cost of the system and the replacement cartridges and there's no comparison with the MINERALIZER and you're still swimming in chlorine! Since the cartridge is "purifying" the water ONLY when it passes through, a chlorine residual is required since there is NO purifying residual in the pool. These systems work better in spas where there is more circulation time and the device treats the water many times per day in a pool the water may only turn over 1 to 1 1/2 times per day, limiting it's effectiveness. The MINERALIZER generates and leaves a purifying residual of Cu/Ag ions throughout the pool so only normal circulation time is required. MINERALIZER systems do require low-level chlorine "shock" about once per week (typically 1-gallon household bleach). That low level chlorine shock reacts almost immediately with the water and oxidizes out quickly leaving chlorine free swimming and very high water quality.

## **BAQUACIL---SOFT SWIM--CHLORINE ALTERNATIVE**

Also called biaguanide. This product is a synthetic chemical purification product that is considered a chlorine alternative. Unlike chlorine, biaguanide is not an oxidizer, so it does not attack your body to react or “burn up” organic contaminants.

### **Advantages**

- Higher quality water, non-chlorine softer “feel” to the water
- No “device” to purchase

### **Disadvantages**

- COST--- Very, Very expensive Users report 300-500% more expensive than a conventionally chlorinated system
- Special test kit required
- Manually added into the pool
- Frequent clarifier/shock treatments similar to shock treatments common to chlorinated pools.

### **Changing to another system**

Water must have the Bacquacil removed before starting any other system. The water is heavily oxidized and Bacquacil “burned out” over several days with no swimming. The pool’s pump is turned off and the chlorine reacts to the Bacquacil and drops it into a gel form to the pool’s bottom where it is vacuumed out on “waste” so that it doesn’t go through the filter. Most users change the cartridge sand or DE and start again. Water can now be treated with another system.

### **Compared to a MINERALIZER**

Many users complain that the water eventually gets a “plastic” taste to it and that the chemical seems to lose some of its effectiveness over a long period of use. The big difference is cost, most Bacquacil users can pay for a MINERALIZER system in less than a year with what they’ll save. About 33% of MINERALIZER customers are switched from Bacquacil and report water quality easily on par with their former system.

## **OZONE GENERATORS**

Ozone generators like the OZONIZER manufactured by our company are available for pools and spas in ultra-violet light and corona discharge technology. UV units are lower in ozone output and more suitable for spas and CD units with higher output are for larger pools. Larger surface area + and - plates and/or more plates will increase the output of a CD unit. The output of any ozone generator is related to airflow (volume), air temperature, and in particular humidity. Humid air will significantly reduce ozone production and frequently air dryers are recommended. Its primary advantage (time in water--water quality), is also its primary disadvantage (time in water--no residual).

### **Advantages**

- Reduces chlorine usage 50-90%
- Higher quality water since chlorine residual is very low
- “Oxygenates” the water

### **Disadvantages**

- Very expensive “device” to purchase
- High amp (electricity) draw, energy cost increases to run it
- Generates “oxidizer-ozone” like chlorine in that it “burns up” contaminants
- Corrosive “oxidizer-ozone” production reduces life of the device. The more humid the air, the faster the device deteriorates.
- Still swimming in chlorine (although much lower residual)
- Requires injector installation to “vaporize” the ozone into water
- Leaves NO ozone residual, ozone only stays in water about 30 sec to 1 minute
- Water is purified only at injection point, thereby requiring chlorine residual
- Water must be circulated much longer (18-24 hours)

### **Changing to another system**

Turn it off and start your new purifier immediately



### **Compared to a MINERALIZER**

The MINERALIZER leaves a purifying residual of Cu/Ag ions in the water and only normal water circulation is required (8-12 hours). Cu/Ag ions are unaffected by humidity and NO chlorine residual is required leaving higher water quality. MINERALIZER draws significantly less current (200-1000 ma depending upon setting) using only about \$5 per year in energy in most backyard pools. Ozone devices are more complicated and more expensive to manufacture and, therefore, much more expensive to purchase. Ozone's best application, we feel, is in drinking water and aquariums where no residual is required, sunlight is minimal, and organic load is high and the ozone will oxidize it.

### **Salt or brine chlorine generators**

There are two types of chlorine generators available today. Both systems generate chlorine from its most basic form--salt. The salt generator has a low level of salt (saline) in the pool and as this salt moves past the high voltage chamber, the salt is changed into free active chlorine (sodium hypochlorite-or-bleach) where it is free to oxidize (burn up) contaminants--just like a conventional chlorinated system. The brine generator is different in that the salt is converted into chlorine in the brine tank and then introduced into un-saline water as a chlorine purifier.

#### **Advantages**

- Automatically generates chlorine
- Only salt required, no more chlorine purchases

#### **Disadvantages**

- Still swimming in chlorine
- Expensive device
- Uses high amp draw--high energy usage
- Generating very corrosive chemical--limited life of the generator chamber
- Generator chamber typically titanium for longer life---very expensive to replace
- Swimming in saline water (ever been to the ocean?) or brine model requires frequent handling and disposal of very caustic brine by-product

#### **Changing to another system**

Unless you go back to a chlorinated system, saline systems must have the pool drained and salt removed; there is no other way to get it out.

### **Compared to a MINERALIZER**

Like the MINERALIZER, chlorine generators produce and inject the sanitizer automatically. However, the method of purification is totally different. The MINERALIZER ions are toxins to contaminants, not oxidizers. Chlorine--irregardless how it is introduced is an oxidizer--"burns up" contaminants and, of course attacks your body. Water quality with the brine generator is the same as a chlorinated pool. Saline pools, however, also have that "brackish" water feel and taste and leave you with that uncomfortable "sticky" feeling you have when you leave the ocean water. Probably the single biggest advantage of the MINERALIZER is the unparalleled water quality.

### **SOLAR FLOATING IONIZER**

Available for years through many home shopping catalogs. About the size of a floating Frisbee, this plastic product floats in your pool and has a small solar cell on the top which generates a low DC current into ONE center self sacrificing copper (+) electrode and one outer (-) stainless spring electrode.

#### **Advantages**

- Mineral purifier produces high quality water
- Just "throw" it in your pool and let it work

#### **Disadvantages**

- Easily susceptible to accidental breakage by swimmers--not under warranty
- Only ONE self sacrificing electrode
- Requires direct strong sunlight to generate electric current--will not work in shade or cloudy days--results in inconsistent ion output.
- Does NOT change polarity---not self cleaning
- Small single electrode --frequently replaced, easily scaled and insulated since polarity does NOT change
- Requires new test kit--copper test
- Must lightly chlorinate weekly

## Changing to another system

No adjustments necessary, can start new system immediately

## Compared to a MINERALIZER

Both are ion generators, that is where the similarity ends. The solar unit depends upon the sun for energy, whereas the MINERALIZER maintains a constant output from the setting it has. Copper/silver ions MUST be maintained at .3-.4 PPM to sanitize the water. Ion output is dependent on many factors:

- Voltage and amperage: Consistent with an electronic MINERALIZER. Voltage can be changed as necessary as electrodes wear. Different pool sizes (gallons) require different voltage settings on the electronic MINERALIZER; all pool sizes use the same Floatron unit with inconsistent output. Inconsistent output means more testing and inconsistent chlorine and algicide usage.
- Electrodes--solar unit DOES NOT change polarity which will clean electrodes, ion output will cease if not constantly manually cleaned. MINERALIZERS change polarity about every 2 minutes and will automatically "self clean". The small single electrode on the Floatron will wear out about 4 times faster than a top line MINERALIZER and twice as fast as our economy model--check your long term costs!!! Price wise, the Floatron is about the same as the new economy model electronic MINERALIZER.

## Conventional chlorine OR bromine chemicals

Chlorine has been enormously beneficial to mankind improving the quality of drinking water and virtually eliminating waterborne diseases. However, chlorine is a very caustic, corrosive chemical and it attacks anything organic. Waterborne "organic" pathogens, algae, bacteria, and virus. Unfortunately, it also attacks the skin, hair, and eyes of the humans swimming in it. Ever notice the higher level of chlorine in the water, the more that your skin is dried out and your eyes burn?

## Advantages

- Conventional "familiar" system to its users
- Always effective in high enough quantities
- Easy to purchase from a variety of sources
- Can be "automatically" added with in line chlorinator device

## Disadvantages

- Dangerous to store
- Caustic and hazardous handle, ingest and to breath
- Reacts to your body and "dries" it out and is absorbed
- Uncertain long term exposure health effects
- Chloramines (by product of chlorine and organic waste) are PROVEN carcinogens. Varying levels of chloramines are found in chlorinated pools.

## Changing to another system

Simply let the chlorine naturally burn off/dissipate and start the new system immediately.

## Compared to a MINERALIZER

Chlorine, it is well known, has unwanted side effects. Studies show that more chlorine is absorbed through the skin, than by drinking it. So the longer one is in the water swimming, it follows that more chlorine is absorbed. Try this at home: Take a glass of tap or chlorinated swimming pool water. Take your pool chlorine test kit and test the water for chlorine (usually about 1-3 PPM). Now swirl two fingers in the glass for about 30 seconds to 1 minute and re-test for chlorine. SURPRISED??? Gone isn't it?? Where did the chlorine go? It reacted with and/or was absorbed by your skin. This is one reason why commercial pools go through much more chlorine when they have high bather loads. So why expose you and your family to it when there are affordable alternatives?

## Average chlorine skin absorption versus oral ingestion

	Skin absorption	Time	Oral absorption	Consumed
Adult bathing	63 %	15 min	27%	1 liter
Infant bathing	40%	15 min	60%	1 liter
Child bathing	88%	1 hour	12%	1 liter

Skin absorption rates are tremendous. People with pools and hot tubs especially take note! These calculations are based on hand skin absorption rates. The hand is a much better barrier against harmful substances compared to other areas of the body, so true absorption rates are significantly higher. American Journal of Public Health 1984 74, pg. 479-484

## Why Mineralizer?

### What chlorine/Bacquacil /Nature 2 salesman won't tell you

- Copper and silver may be toxic to humans. Any metals in high enough concentrations can be toxic. The recommended copper level for a MINERALIZER system is only .3 PPM, well below the EPA maximum of 1.3 for drinking water. Fish can easily live in ionized water, try that with chlorine!
- Chlorine is more forgiving and easier to use than a MINERALIZER! NOT TRUE! Ions are added automatically and, unlike chlorine are unaffected by sunlight and have no effect on your pools pH. Chlorine requires a cyanuric acid additive (in all pool chlorine) to keep it in solution or it will burn off in only hours. Copper and silver ions take weeks to come out of solution.
- Using a MINERALIZER still requires chlorine! True! But no residual of chlorine. It will kill his chemical sales! Unfortunate for him but fortunate for you, your chlorine cost will drop 90+% LIFEGUARD has been in business since 1988 and sold thousands, why do you think you never heard about this product until now?
- Copper/silver ionizers may cause staining! Minerals present in all pool water under the right conditions can cause staining--even in chlorinated pools. Stains develop over months and years and if they do occur are removable with over the counter stain removal agents and brushing. Most vinyl, fiberglass, and new quartz/pebble surfaces are impervious to staining anyway.
- You'll need lots of other chemical additives with a MINERALIZER! The opposite is true, typically chlorinated pools require additional heavy "shocking" and occasional usage of clarifiers and algaecide. With a MINERALIZER you need to keep your pH, alkalinity and hardness balanced (same as chlorinated pool) and weekly use low doses of chlorine to "polish" or oxidize the water. That's it. (Some owners of porous masonry pools use stain preventive additives but this is not required).
- Catalytic units (cartridge purifiers) will reduce your chlorine usage 50-80%! True, but you must replace the cartridge every 4-6 months. Add up this cost over the life of your pool and see how much more this will cost you than a MINERALIZER. The cartridge salesman has got you; you have to come back! Also, the water MUST be circulating for a cartridge purifier to work, that means longer more expensive pump running time than a MINERALIZER which leaves a purifying residual of Cu/Ag ions in the pool.
- MINERALIZER systems require more testing than chemical systems. Not true! Since ions are added automatically and burn off slowly, the homeowner simply tests pH and copper (test kit included) every 1-2 weeks. A very low dosage of an oxidizer (preferably chlorine bleach) needs to be added whenever the water has lost its crystal clarity. This is usually once per week in the summer and every 2-3 weeks in the cooler weather.
- Chlorine will keep your water crystal clear! True, but ionized water has unmatched water clarity and quality! Wouldn't you really rather swim in minerals than chemicals?
- Getting your pool chlorinated by a pool service company is the easiest! True, but for only a little effort (testing every 1-2 weeks and adding low level of chlorine) and using an automatic pool vacuum cleaner you can have unmatched water quality. Pool service companies typically treat your pool once per week with very high doses of chlorine gas. Just after he comes you have 6-10 PPM chlorine and the water is very uncomfortable. On week later before he comes again, the chlorine has dropped to a trace and will shortly become algae-infested if it is not treated again.

## PURIFICATION PROCESSES

### What's The Best Water Purification System Available?

Is distillation the best method of water purification available today? The answer is no. It used to be before water became contaminated with modern volatile pollutants. When water purification had to remove only mud, sand, algae and bacteria, distillation was a highly effective purification system. Today, however, both surface and ground waters contain increasing amounts of chemical pollutants. These include the trihalomethanes, which come from chlorine degradation and industrial effluents. These chemicals are proven carcinogens.

Why is distillation ineffective against these pollutants? It is because they are volatile - meaning they evaporate in the presence of heat. Many of these chemicals have a lower boiling point than water. Thus some of these chemicals will vaporize before the water even begins to boil in a distiller.

In former years this was no problem, but today it is a real problem with distilled water. The EPA (Environmental Protection Agency) tells us that they have identified some 700 chemicals now in our water supply nationwide. New chemicals are being formulated each year. We have only to look around us to see some of the places these chemicals are being used. For example, the formulation of plastic requires the use of a certain amount of these volatile solvents. The more sophisticated the manufacturing, the more these chemicals are needed for cleaning the components. Disposing of these chemicals is one of industry's major problems. At present most of them are being dumped out back of the plant, slipped into the sewer or injected into the ground.

There is good reason to believe that it is no longer safe to drink water out of a faucet anywhere unless it has been purified at the faucet level. Even large city plants cannot keep up with the volume or type of pollutants in their source water. Realizing this, large numbers of Americans have turned to bottled water - over one billion dollars worth this year. In addition to this, water treatment gadgets of all kinds are turning up in the marketplace.

Each citizen must decide for him/herself how to obtain a pure source of water to drink and cook with. Distilled water is less than the best option. It is expensive to operate, produces a mixture of chemicals and needs constant cleaning and attention. If our children and we are to survive in this polluted age we need a new solution. It is our opinion that the new solution lies in a combination of a reverse-osmosis membrane and a carbon filter system. We suggest you settle for no less.

### **How About Softened Water?**

Always use your water softener if you have one. There are at least two good reasons. The softener, if working properly, will reduce the calcium and magnesium compounds in the ion exchange process making less work for your reverse-osmosis membrane to do. Actually, reverse-osmosis is a softener too, but much more than a softener. The second reason is that a properly attended to water softener will remove some of the iron that is often found in natural waters. If there is considerable iron, a special iron-cleaning additive will have to be added to the resin tank to prevent the iron from fouling the resin. This pretreatment will greatly increase the life of the R/O membrane. You have known that it is wise not to drink the soft water due to the high sodium content. With a R/O unit to remove the sodium, you can feel comfortable in connecting up both hot and cold water to the softener since the sodium will be removed by the R/O.

### **How Can You Test Your Water?**

We recommend a R.O.P.E. test for all water whether it be from a Reverse Osmosis Unit, from an underground well, or from your tap.

The Reverse Osmosis Proficiency Evaluation (R.O.P.E.) test is a very helpful device to determine just how clean your water is. It can be used to good advantage to pin point any qualities of the source water supply that would interfere with any health program. For all people today, it is comforting to know that there is a readily available method by which their one-time purchase of a water purifier can be checked at any time. Most people prefer to have this test done every 6 months or at least once a year. Many scientists are coming to believe that the water we drink today is more vital to our health than even the food we consume.

What do all the figures really mean? Let's discuss them one at a time:

1. Total Iron: Suggested level is set at .3 parts per million. This is because some people can discern a slight bitterness of the water if it is higher than 0.3. Some natural waters contain much more - 2-PPM, even 25 PPM. It is not harmful - just unpleasant and difficult to keep the bathroom appliances clean. Any amount of iron in water over 0.1 PM is considered deleterious to water filters. City water systems usually do an excellent job of removing iron, but well water is always subject to checking. If your value is above 0.1 PPM, there are ways of controlling it or removing it.
2. Hardness: The hardness values on your ROPE test are very carefully measured since it affords an excellent way of determining how much calcium and magnesium are in the water. Again, neither of these are in any way harmful to the body, but can be deleterious to water filters if too high.
3. Total Dissolved Solids: Includes the calcium and magnesium compounds measured by the hardness determination, but it also includes all other dissolved minerals - toxic and harmless.
4. PH is of course a measure of the water's acidity or alkalinity and should be between 6.5 and 8.5. A pH of 9.0 or more is not good for cellulose water filter membranes.
5. Additional Tests: Depending upon the values received above, and the type of water being evaluated, other tests are occasionally recommended. These are alkalinity, chlorides, etc.

# THE IDEAL DIET

## IDEAL DIET

1. Whole
2. Natural
3. Pure
4. Varied

## EXCLUSIONS

1. White Flour
2. White Sugar
3. Processed Foods
4. Additives and Preservatives
5. Fried Foods
6. Fast Foods

TO INSURE THAT YOU ARE GETTING A PROPER BALANCE OF NUTRIENTS, YOU MUST EAT A WIDE VARIETY OF WHOLESOME, FRESH FOODS ALONG WITH YOUR NUTRITIONAL PROGRAM - EAT AT HOME TO STAY WELL!

## BASIC DAILY MENU

(Always follow the Food Combining Chart and Remember, this is an example of a recommended menu only!)

Breakfast - Have 1 egg either soft or hard boiled or 1 cup of cooked or cold cereal or 1 slice of toast. (Never Skip This Meal!)

Lunch - Always have a salad with raw beets, carrots, tomatoes, parsley, lettuce, sprouts and celery. This meal should include a slice of bread and another starch such as a potato or rice. Otherwise have a protein such as tuna fish or chicken.

Dinner - Always have a salad with raw beets, carrots, tomatoes, parsley, lettuce, sprouts and celery. This meal should include a slice of bread and another starch such as a potato dinner or rice or other starch. Otherwise have a protein such as tuna, chicken, tofu or other protein. (A good example would be a dinner salad, steamed vegetables and a protein or a starch.)

## PRIMARY FOOD GROUPINGS OF A HEALTHY DIET

### Vegetable

Rule of Thumb: The darker the color the more nutritious. Some exceptions would be cauliflower. Always preserve the nutrients in your vegetables by:

1. Eat them raw as much as possible by grating, slicing and dicing them.
2. Steam them.
3. Bake them.
4. If you're not hungry but just want something, you can substitute a vegetable drink made by juicing your own vegetables at lunch or dinner as long as there is variety in the drink. (Example would be V8)

### Fruit

Rule of Thumb: When possible, buy organic, unwaxed and undyed fruits. Do the best and:

1. Buy fresh fruits while they're in season only. Don't buy green fruit. Fruit does not ripen once it's picked off the vine, it only softens.
2. Buy unsulfured, unsweetened dried fruits such as prunes, apricots, apples, dates, etc. and soak them overnight in luke warm water before eating them to stimulate the enzymes so they are easier to digest. (Avoid eating them straight out of the bag!)
3. Buy vine ripened citrus fruit. Green citrus fruit is unhealthy.

### Milk and Dairy Products

Rule of Thumb: If dairy products are tolerated, purchase:

1. Raw unsalted goat's milk and unsalted rennetless goat cheese.
2. Raw cow milk, buttermilk and cream.
3. Yogurt and kifer with active cultures.
4. Raw cottage cheese.
5. Raw, unsalted butter.
6. Raw, rennetless milk cheeses.
7. Soy milk, soy cheeses.

## **Meat, Poultry, Fish, Eggs and Other Proteins**

Rule of Thumb: Purchase only those raised on the free range without antibiotics and hormones. If you prefer to consume these products, do the following:

1. Eat red meat sparingly (beef, lamb, venison).
2. Avoid pork and pork sausages.
3. Avoid raw sushi.
4. When possible, purchase organically raised meats, poultry and eggs.
5. Purchase the freshest fish possible.
6. Use tofu, eggplant and beans as meat substitutes.

## **Seeds, Nuts, Whole Grains and Legumes**

Rule of Thumb: Use pasta sparingly. Avoid eating seeds or nuts out of the bag. Use whole wheat only if tolerated by those individuals without respiratory or Candida difficulties.

1. Eat sunflower, unhulled sesame, pumpkin seeds, etc. Sprouted mung, alfalfa, chia, etc. Soak them overnight in water and blend in blender to make a nut butter to stimulate the enzymes so they are easier to digest. (Avoid eating them straight out of the bag!)
2. Eat almonds, walnuts, peanuts, pine nuts, cashews, pecans, etc. Soak them overnight in water and blend in blender to make a nut butter to stimulate the enzymes so they are easier to digest. (Avoid eating them straight out of the bag!)
3. Purchase whole wheat, oats, millet, buckwheat, brown rice, whole cornmeal, rye and quinoa grains.
4. Purchase whole grain products such as whole grain pastas, crackers, breads and desserts. The healthiest store bought pasta would contain beet, spinach and durum wheat flours.
5. Purchase soy, kidney, black, pinto, navy, lima, lentil and split pea beans. Soak them overnight in water before cooking to stimulate the enzymes so they are easier to digest.

## **Cold-Pressed Vegetable Oil**

The only oil that is recommended is Virgin Olive Oil. This is because it is the only cold or heat processed oil that is not processed with the chemical Hexane.

## **Sweetening**

Rule of Thumb: Most average people cannot tolerate any sweetening on foods as this can cause intestinal gas as well as slow down the digestion process. It is also contrary to proper food combining. If your body can tolerate some sweetening, purchase:

1. Raw Honey.
2. Barley Malt.
3. Date Sugar.
4. Real Maple Syrup.
5. Sweet herbs such as Stevia, Cinnamon, Nutmeg and Ginger.

## **Seasoning**

Rule of Thumb: Stay away from Black Pepper as much as possible as this can irritate the stomach lining. White table salt contains both sodium chloride (chlorinated salt crystals) as well as sugar and is not advised. If your body can tolerate some seasoning, purchase:

1. Garlic (fresh or powdered).
2. Herbs such as onion, basil, oregano, dill, parsley, cayenne/capsicum (red pepper), kelp (has a salty taste), rosemary, etc.

## **Beverages, Desserts**

Rule of Thumb: Use only if it is tolerated.

1. Nut Milk/Protein Shakes using milk, seeds, cashews or almonds. Soak the seeds and/or nuts overnight to stimulate the enzymes and soften them. Blend them in a blender and add spices and flavorings.
2. Fruit Shakes and Natural Ice Cream using cut up and frozen fruit. Use water or milk in blender and blend to the desired consistency.
3. Purchase only unsulfured organic wines. You can tell if they have been treated with sulfites because the label will read "contains sulfites" and the bottle won't usually have a wooden cork. Do not purchase bottles with plastic corks.

## Home Health Tests

The following are tests you can have your clients take themselves at home or you can help them with when they see you for consultations. Begin practicing these tests on yourself to be sure you know how to use them. Find out where you stand with your health and begin working towards better health. Once you feel comfortable with the tests yourself, have your friends and family take them and see how they do. Then move on to clients and help them with their daily health regime.

### Acid/Alkaline Balance

General Test:

Use Nitrazine paper to determine the pH of the fluids of the body. A reading of 7.0 is neutral on a scale of 1.0 to 14.0. The normal pH of the body is slightly acid 6.3 to 6.8.

#### Procedure for Testing:

1. Take urine or saliva sample and test before meals or at least two hours after eating.
2. Check color of test strip with chart supplies with Nitrazine paper and determine the pH.

#### Interpretation of Test:

1. If reading is above 6.8, the body is too alkaline and the person should be put on a diet of more acid-forming foods.
2. If reading is below 6.3, then the person is too acid and should be put on a diet including more alkaline foods.

### Adrenal Gland Function Test

The systolic blood pressure is about 10 mm higher when a person is standing than when he is lying down.

#### Procedure of Testing:

1. Lie down and take the blood pressure.
2. Stand and take the blood pressure.
3. Rest for 6 minutes lying down.
4. Stand up and immediately take the blood pressure.

#### Interpretation of Test:

1. If the blood pressure is lower after standing, suspect adrenal gland weakness.
2. The greater the drop in blood pressure the greater the degree of adrenal dysfunction.

### Allergy Test (food)

Food allergies or reactions occur when a person consumes foods to which the person has an intolerance.

#### Procedure for Test:

1. Take pulse reading after resting for five minutes in order to determine the base number of beats per minutes (normally 70 beats per minute).
2. Consume food to be tested and wait for twenty minutes, and then retake the pulse.

#### Interpretation of Test:

If there is an increase of 12 beats or more per minute over base reading, the person is considered to have an allergic reaction to the food consumed or tested.

### Bladder/Urinary Tract Infections

Simply purchase a "Dipstick" test kit from your local pharmacy and use the test strip to test a urine sample. If the strip changes color, then it is an indication of an infection. Be sure that the urine collection procedure is clean and not contaminated with germs from some other source.

## **Blood Flow Test**

There are three test points on the legs used to check circulation. These points may be a good indication that there is either sufficient or insufficient circulation.

### Procedure for Test:

1. Check top of foot by applying light pressure to the skin.
2. Check the point on the inside of the ankle.
3. Check the point behind the knee.

### Interpretation of Test:

Normally the test points mentioned are points where the pulse in the artery can be felt. If the pulse is not evident, then it is an indication that the artery supplying blood to the leg is narrowed and appropriate steps should be taken.

## **Breast Self Test**

See literature provided by American Cancer Society – men can get breast cancer the same as women and should take the self-test also. Note: Lumps that are stationary, asymmetrical and hard should be given special attention.

## **Cancer**

The type of cell produced in cancer and the type of cell produced in pregnancy has been known for almost a century. Therefore, a home pregnancy test kit can test for the presence of cancer cells in an individual. Naturally, due to the relationship of pregnancy and cancer, you cannot test pregnancy women. Others that you cannot test are women on estrogen replacement therapy, women at time of ovulation, women on birth control pills, individuals using chemotherapy or radiation therapy, individuals showing albumen or blood in the urine, those bedridden or who have lost 15% of his or her weight as well as those with a badly depleted liver. A test on these individuals is invalid and misleading.

### Procedure for testing:

1. Use a clean, one-gallon glass jug. Do not clean with soap or detergent.
2. Get a home pregnancy test kit from the drugstore that will detect the HCG hormone (E.P.T. by Warner Lambert). Do not use a kit that tests for LH hormone.
3. Collect all urine voided in a 24-hour period in the gallon jug, and keep in a cool, non-refrigerated place. Mix well by shaking. During the waking hours of the collection period (if the person does not have glaucoma or is subject to bleeding) take orally one-100 mg. Niacin tablet every two hours so your skin will flush, indicating that the blood vessels have been dilated.
4. Pour a sample of urine in the cap provided in the test kit.
5. Place 20 drops of urine in the test tube with a dropper being careful not to touch the glass tube with the end of the dropper. Shake for 20 seconds.
6. Add the reagent from the plastic vial or bottle to the test tube. Place the plug in the vial and shake for 20 seconds or more.
7. Place the test tube in the support and let stand undisturbed for 24 hours. Watch for dark brown sediment to appear in the mirror, which is placed under the test tube. Check tube every two hours with a flashlight and magnifying glass. This is helpful since the longer it takes for the dark brown sediment to appear the less involvement there is with cancer.

### Interpretation of Test:

1. Negative: a translucent, tan fluid with no dark brown sediment after 24 hours is considered negative. No HCG showing in the urine is the same as a negative pregnancy test.
2. Early Detection: A thin, dark brown deposit appearing at any time, and taking many forms such as a hair-thin circle, a thin star or straight line.
3. Advanced Stage: A thick, dark brown ring appearing during the 24-hour period as pictured in the test instructions or any other dark brown formation such as a double ring, broad spot, etc.



## Diabetes Self Test

There are two types of diabetes: juvenile or insulin dependent diabetes commonly known as Type I; and adult-onset diabetes commonly known as Type II. Type I diabetes should be determined with a blood test kit which can generally be purchased from a local pharmacy. Type II diabetes can be simply checked by testing a person's ability to determine sweetness.

### Type II Testing Procedure:

1. Fill five glasses with 8 oz. of water. To one glass of water add  $\frac{1}{2}$  teaspoon of sugar. To the second, add 1 teaspoon of sugar; to another, add 1-1/2 teaspoons of sugar; to another, add 2 teaspoons of sugar; and, to the last, add 2-1/2 teaspoons of sugar.
2. Mark the glasses with a random code and rearrange the glasses in a random order.
3. Ask the person being tested to taste each glass with a straw and rinse the mouth between testing. Place the glasses in order of their sweetness.

### Interpretation of Test:

Individuals with type II diabetes will generally not be able to taste less than 1-1/2 to 2 teaspoons of sugar. Those who are normal should be able to distinguish between  $\frac{1}{2}$  to 1-1/2 teaspoons of sugar in a glass of water.

## Digestion

Most natural health practitioners will agree that most chronic health problems begin with a digestive problem. Lack of hydrochloric acid produces a deficiency that affects the vital assimilation of nutrients necessary for life.

### Procedure for Test:

1. Purchase Nitrazine paper used for testing.
2. Test the first urine in the morning.

### Interpretation of Test:

1. Compare the color on the test strip with the chart supplies by the manufacturer.
2. A reading of 7 is neutral; a reading above 7 indicates alkalinity and a reading below 7 would indicate acidity. If the reading is 6 or above the person can be subject to many illnesses from improper digestion. For optimum health the reading should be between 5.00 to 6.0. Should the reason be too high, the person should supplement with HCL and enzyme tablets.
3. Note: Do not pay any attention to the test taken at any other time of day in determining digestive activity.

## Heart Function Test

Check pulse beat the first thing in the morning before arising. This pulse should be under 60 after a night's rest. If the pulse is over 80 the client should be advised to make changes in diet and lifestyle.

### Stomach Acid Test (for those experiencing heartburn)

Take a spoonful of apple cider vinegar or lemon when a person is experiencing heartburn. If this makes the heartburn go away, then you need HCL. If the heartburn gets worse, then the person has too much HCL and should not take any HCL.

## Thyroid Test

The following test can be used to detect a deficient thyroid. Take the oral daytime temperature with a regular fever thermometer. It should read 98.6. If below 98.6, it could indicate a hypothyroid. Shake down the thermometer before going to bed and place on nightstand. Upon awakening in the morning, and while still in bed, check oral temperature. If 97.6 or below there is a deficient thyroid. Normally, iodine supplementation will normalize the thyroid condition.

## Ulcers

See Stomach Acid Test.

## **CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE:**

- **References**

1. "Understanding Nutrition", Third Edition, Whitney Hamilton
2. "Prescription for Nutritional Healing", Second Edition, James F. Blach, M.D., Phyllis A. Balch, C.N.C.
3. "Alternative Medicine, The Definitive Guide", The Burton Goldberg Group
4. "Certified Natural Health Professional", Institute of the National Association of Certified Natural Health Professionals, Practicum
5. Miscellaneous Articles by the following Authors: Dr. Bernard Jensen, Lois and Jennifer Lively of Nature's Sunshine, Steven Horne of Nature's Sunshine, Jon Cotton of Total Health Secrets, Various Nature's Sunshine lectures, Dr. Jim Jenks of Nature's Sunshine, Various Health Food Stores.

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 16 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

1. **What type of water purification do you use at your home and place of employment? After studying this session, do you believe you are using the best water purification process available?**
  
  
  
  
  
  
  
  
  
  
2. **Keep track of your diet for 1 week. Compare it to the Ideal Diet. How does it compare? Do you need to change your diet? If so, how?**
  
  
  
  
  
  
  
  
  
  
3. **Have you ever heard of the Home Health Tests we included in this session? Perform 3 Home Health Tests of your choosing. Write down the results.**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 15 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

4. **Do some research on the web. List as many types of parasites as you can find.**
  
  
  
  
  
  
  
  
  
  
5. **Which parasite causes TB?**
  
  
  
  
  
  
  
  
  
  
6. **Which parasite is most common in the mountains and is found in streams?**
  
  
  
  
  
  
  
  
  
  
7. **Take the candida test. How did you score? This is private so if you want to share it will be kept confidential. If you don't want to share we understand completely.**
  
  
  
  
  
  
  
  
  
  
8. **What is your favorite food? Is it on the candida diet?**
  
  
  
  
  
  
  
  
  
  
9. **What is the main cause of a hiatal hernia?**
  
  
  
  
  
  
  
  
  
  
10. **Can you adjust a hiatal hernia yourself?**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 14 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

11. **What is the difference between oral and intravenous chelation therapy?**
12. **Why would anyone want to have chelation therapy rather than orthodox therapy?**
13. **What is slanting used for?**
14. **What causes a stressed liver?**
15. **What can you do for a weakened liver?**
16. **What type of sugar is the most unhealthiest for the human body?**
17. **Why should anyone do skin brushing?**
18. **What herb reduces blood pressure?**
19. **What is the best enema to bring down a high fever?**
20. **What is a triglyceride? When is it too high or too low?**
21. **What is cholesterol? When is it too high or too low?**

**CERTIFIED HEALTH & NUTRITION COUNSELOR ONLINE COURSE - SESSION 13 – QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

- 22. All foods are composed of chemicals, even if they have no additives in them. T/F**
- 23. Additives that might be toxic constitute a hazard at the concentrations used. T/F**
- 24. Additives are allowed in foods only because they confer a benefit in comparison to which the risk, if any, is insignificant. T/F**
- 25. The presence of several additives in foods is more hazardous than the presence of only one of them. T/F**
- 26. If rank-ordered among the problems related to the food supply, the risk from additives falls second. T/F**
- 27. Take a look at the foods you bought the last time you shopped at the supermarket. Ask yourself these questions:**
- **Are they beneficial, nutritious foods?**
  - **How do they resist spoilage – or do they?**
  - **Do they contain large amounts of salt?**
  - **What is the motivation behind the claim on the label?**
  - **Is the intention to reveal to you the unadorned truth about the contents of the package?**
  - **Or is it trying to imply a health-promoting property that is really not unique to the food in the package —with or without additives?**
  - **When a label says “no additives,” ask yourself: “So what?”**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 12 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

28.     **What do anthropometric measurements provide?**
  
29.     **What is the purpose for a physical examination?**
  
30.     **What is subclinical malnutrition?**
  
31.     **What is the purpose of iodized salt?**
  
32.     **What is the role of vitamin B<sub>6</sub>?**
  
33.     **Keep a food diary for 7 days using the form included in this session. Evaluate your diet and tell us what you've learned about it from this session.**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 11 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-119. We will grade your question & answer session and will let you know if we have any questions or concerns.

34. **Where is iron principally found?**
35. **Where are new red blood cells synthesized?**
36. **Iron-deficiency anemia is most common in \_\_\_\_\_ and \_\_\_\_\_.**
37. **Name 11 sources of iron-rich foods:**
38. **Zinc supports which physiological functions in the body?**
39. **What are the richest food sources of zinc?**
40. **A deficiency of iodine may cause a \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.**
41. **Copper is important for which 3 bodily functions?**
42. **An overdose of Manganese may cause which severe brain-disease syndrome in humans?**
43. **Chromium deficiency is believed to be responsible for what disease?**
44. **A severe deficiency of selenium can cause what?**



CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 10 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

45. What percentage of the body's weight is water?
46. Which water is rich in calcium and magnesium?
47. Name three toxic heavy metals that industrial waste may add to the water supply.
48. What controls microbial contamination in the water supply?
49. What are the principal electrolytes in the body fluids?
50. What is a normal pH of the body fluids?
51. What is atherosclerosis?
52. Ten percent of hypertension cases are attributed to \_\_\_\_\_.
53. The 1- percent of calcium found in body fluids helps maintain what?
54. Calcium deficiency may be caused directly by what?
55. Calcium deficiency diseases are which 3 diseases?
56. What is a negative chloride ion?
57. Which mineral is primarily involved in the working of nerve and muscle cells?
58. A deficiency in magnesium causes \_\_\_\_\_.

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 9 – QUESTION & ANSWERS

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

59. Fill in the following equation: \_\_\_\_ RE is roughly equivalent to \_\_\_\_\_ IU of vitamin A from animal tissues or \_\_\_\_ IU from plant tissues.
60. Deficiency of vitamin A causes the following:
61. The recommended intake for vitamin A is \_\_\_\_\_ for women, \_\_\_\_\_ for men.
62. Vitamin D promotes:
63. Deficiency of vitamin D causes:
64. Vitamin E protects the \_\_\_\_\_.
65. The recommended intake of vitamin E is \_\_\_\_\_ to \_\_\_\_\_ per day for adults.
66. Vitamin K promotes:
67. Keep track of your diet for 7 days. Calculate the amount of vitamin A, D, E and K in your diet. Are you getting enough? Vitamin A \_\_\_\_\_ Vitamin D \_\_\_\_\_ Vitamin E \_\_\_\_\_ Vitamin K \_\_\_\_\_.

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 8 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

68.     **The B vitamins serve as coenzymes assisting many enzymes in the body. T/F**
69.     **Deficiency of vitamin C causes scurvy, but scurvy is prevented by the daily intake of only 5 milligrams of vitamin C and can be cured by a few days of 50-milligram doses. T/F**
70.     **What are the best food sources of vitamin C?**
- 
- 
- 
- 
- 
- 
- 
- 
- 
- 
71.     **B-vitamin deficiencies seldom occur in isolation. T/F**
72.     **Riboflavin is concentrated in beans and rice. T/F**
73.     **Niacin is found wherever fat is found. T/F**
74.     **Vitamin C acts as an antioxidant. T/F**
75.     **What is connective tissue?**
- 
- 
- 
- 
- 
- 
- 
- 
- 
- 
76.     **What is scurvy and when was it first discovered?**
- 
- 
- 
- 
- 
- 
- 
- 
- 
- 
77.     **What is collagen and how is it used in the body?**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 7 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

**78.** Make a simple approximation of your frame size. What did you learn? Are you surprised at the answer you received or was it expected?

**79.** Score your diet based on the 7 questions on page 11. What is your diet's total score?

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 6 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

- 80. Why should people who consume a high-protein diet drink more water?**
- 81. Why does the person with liver disease have high blood ammonia while the person with kidney disease has high blood urea?**
- 82. What is ketosis?**
- 83. What is a kcalorie?**
- 84. How many kcalories are in a meal consisting of 1 baked potato, 1 pat of butter, 1 glass of whole milk, 1 fish fillet, 1 portion of green beans, and 1 slice of lemon?**
- 85. Keep an individualized estimate of your energy needs; the best means would be to monitor your food intake and body weight over a period of time in which your activities are typical of your lifestyle. If you keep a strictly accurate record of all the food and beverages you consume for a week or two, and if your weight does not change during that time, you can assume that your energy budget is balanced. Share with us what you found out about your energy needs. Everything is held strictly confidential.**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 5 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

**86. What is the purpose of bile?**

**87. What is chyme?**

**88. Describe the process of eating from the time you chew your food to the time you eliminate.**

**89. Do you use antacids? If so, when do you use them?**

**90. What pH is the natural pH of the urine?**

CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 4 – **QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

1. \_\_\_\_\_ is the protein that relays calcium's messages.
2. Acidosis is too much acid in the blood and body fluids. T/F
3. The human body contains an estimated 20,000 to 60,000 different kinds of proteins. T/F
4. A buffer is a compound that can reversibly combine with  $H^+$  ions to help maintain a constant pH. T/F
5. Interstice = \_\_\_\_\_
6. Renal = \_\_\_\_\_

## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 3 – QUESTION & ANSWERS

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

**1. What 4 vitamins are soluble in fat?**

**2. Based on the table on page 8, determine your fat intake each day for the next week. Write down the total fat intake for the entire day. Is your fat intake too high? Do you need to modify your diet?**

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

**3. As for cholesterol, the foods that contain the highest amounts are such organ meats as liver and kidneys and such shellfish as lobster, oysters, and shrimp. T/F**

**4. What are lipoproteins and where can you find them?**

**5. What is Linoleic acid?**



6. **What are** prostaglandins?
7. Death from loss of lean body tissue will never occur in a fat person. T/F
8. An ounce of lean meat supplies \_\_\_\_ kcalories from its protein and \_\_\_\_ kcalories from its fat.
9. **What are** aldehydes?
10. Eggs contain about 240 milligrams of cholesterol each, in the yolk and the white. T/F

## CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 2 – QUESTION & ANSWERS

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

11. Define **Homeostasis**:

12. List the 6 types of sugars:

13. Which **sugar** is the principal energy-nutrient ingredient of carbonated beverages, candy, cakes, frostings, cookies, and other concentrated sweets?

14. Sucrose is a disaccharide. T/F

15. The person who is limiting kcalories must limit sugar alcohols just as carefully as sugars. T/F

16. A milligram (mg) is 1/10,000 of a gram. T/F

17. A homeostatic system is static. T/F

18. What is the difference between Type I diabetes and Type II diabetes?

**CERTIFIED HEALTH & NUTRITION COUNSELOR COURSE - SESSION 1 – QUESTION & ANSWERS**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

Please be sure to fill out the information above, complete the test and e-mail or fax it back to us at [iridology@netzero.net](mailto:iridology@netzero.net) or 530-878-1119. We will grade your question & answer session and will let you know if we have any questions or concerns.

1. List the fat-soluble vitamins:
  
  
  
  
  
  
  
  
  
  
2. List the water-soluble vitamins:
  
  
  
  
  
  
  
  
  
  
3. List the major minerals:
  
  
  
  
  
  
  
  
  
  
4. List the trace minerals:
  
  
  
  
  
  
  
  
  
  
5. What is a kcalorie?
  
  
  
  
  
  
  
  
  
  
6. How much water should you drink daily?