CERTIFIED HEALTH & NUTRITION COUNSELOR ONLINE 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 complex-ion; 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 with 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 fore 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.

Food Examples	
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

<u>Caution</u>:
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_1, E_2, 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 kcalories.

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 recycles – 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 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 1/2 g fat
	1 oz high-fat meat contains	8 g fat
	2 tbsp peanut butter contains	15 1/2 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		
	1 c milk	2 fat	10 g
Dinner			
	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		
	Total		**109 g fat (rounded off)**

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 bath 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 organ meats 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 kcalories 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 kcalorie intakes to compensate for the kcalories 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 ONLINE 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 joyful@best.com or 425-955-4639. 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