Section 3

Calories

The calorie is the unit for measuring the energy value of foods. A calorie is a measure of heat. One small calorie represents the amount of heat needed to raise the temperature of 1 gram of water 1 degree Celsius (called the gram calorie). A large calorie, or kilocalorie, is equal to 1000 small calories. It is the amount of heat needed to raise 1 kg of water (1 liter) 1 degree Celsius.

Fat has approximately 9 calories per gram while carbohydrates and proteins contain about 4 calories per gram. Therefore, to calculate the total caloric content of a food, multiply the number of grams of fat by 9, and each of the grams of carbohydrates and proteins by 4 and add the totals together. For example, if a food has 10 grams of fat, 10 grams of carbohydrate and 10 grams of protein, the total caloric content is 10x9 (fat) + 10x4 (carbohydrate) + 10x4 (protein) = 170 calories. It is necessary to consume 3500 calories to add 1 pound of body weight.

The Food and Nutrition Board of the National Research Council opined that the average caloric needs for a 19--50 year old male is 2900 calories per day or 17 calories per pound of body weight;2200 calories per day or 16 calories per pound of body fat for a 19--50 year old female.

Active people, such as athletes, require more calories than sedentary people. For example, a baseball pitcher expends 1440 calories per a typical nine inning game. A 200 lb athlete will require approximately 3000 calories to keep from losing or gaining weight in the off season. The same 200 lb athlete will require 3600 calories to fuel training.

An Athlete's Caloric Needs by Body Weight and Activity Level

Weight	Postseason (cal)	Off-season (cal)	Non starter	Starter
150	2,100	2,550	3,000	3,450
160	2,240	2,720	3,200	3,680
170	2,380	2,890	3,400	3,910
180	2,520	3,060	3,600	4,140
190	2,660	3,230	3,800	4,370
200	2,800	3,400	4,000	4,600
210	2,949	3,570	4,200	4,830
220	3,080	3,740	4,400	5,060
230	3,220	3,910	4,600	5,290

240	3,360	4,080	4,800	5,520

How Many Calories Are Needed To Gain One Pound Of Muscle?

It is necessary to consume 3500 Calories to add one pound of body weight, provided that all other variables remain the same. A muscle fiber is composed of approximately 70% water, 7% lipids and 22% tissue. Therefore, one pound of muscle tissue (454 grams) would contain about 100 grams of protein (454g x .22 = 100 g of protein). In theory, 450 protein calories would produce the desired one pound of muscle weight 100 g protein x 4.5 cals = 450 kcals protein). You would need 14 grams of protein daily to gain one pound of muscle in one week (14g protein x 7 days/wk = 100g protein).

To Gain Weight and Build Muscle

Emphasize large muscle group exercises and progressive resistance training methodologies.

Allow your weight gain to occur over a long period of time… One to two pounds per month.

Maintain a quality diet that is low in fat.

Exercise regularly so that the extra calories in your diet are not "wasted" and stored as fat.

Perform aerobic exercise for total fitness.

Carbohydrates

Carbohydrates are basic foodstuffs formed when energy from the sun is harnessed in plants. They are organic compounds consisting of carbon, hydrogen and oxygen in various combinations. Carbohydrates are the body's preferred energy source, containing many vitamins and minerals. They are generally high in fiber and low in fat.

Carbohydrates come in two basic forms:

Simple carbohydrates, known as sugars, are found naturally in foods such as fruits. Fruits are a monosaccharide (one molecule sugar) commonly referred to as fructose. Disaccharides are combinations of two simple sugars to form a new compound (glucose + fructose = sucrose). Sucrose is table sugar.

Complex carbohydrates, commonly known as starches, are multiple combinations of simple sugars (polysaccharides). Starches have more nutritional value than simple sugars because of their high vitamin and mineral content. Wheat, rice, corn, legumes (beans and peas), and vegetables are common starches. Carbohydrates should comprise approximately 60 percent of one's dietary intake.

Carbohydrates are digested and converted to glucose, a simple carbohydrate absorbed into the blood from the intestines. Blood glucose may be utilized directly by some tissues, such as the brain, for energy, or it can be stored in the liver or muscles as glycogen (a complex carbohydrate). Excess blood glucose may be excreted in the urine or converted into fat and stored in the body's adipose tissue.

Dietary fiber is the carbohydrate in plants that is resistant to digestive enzymes which leaves residue in the digestive tract enhancing the peristalsis process. Dietary fiber adds bulk to the contents of the large intestine thereby diluting any possible cancer causing agents that might attack cell walls. Fiber may bind with carcinogens so that they are excreted by the bowel. Fiber also may bind with and lead to the excretion of bile salts which contain cholesterol. Additionally, fiber slows down gastric emptying and glucose absorption which helps to regulate blood sugar thereby lengthening the sensation of fullness or satiety, which is important to people on weight loss diets. Increasing the intake of complex carbohydrates will lead to an increase in dietary fiber. Dietary fibers can be either water--soluble (gums and pectins) or water--insoluble (cellulose, hemicellulose). Bran cereal is high in fiber, containing 5--13 grams of fiber per ounce.

Sports performance, to a large extent, depends upon the amount of glycogen which is stored in the muscles before and during exercise or the athletic event. Consequently, the athlete should make sure that 60 to 70% of their total calories comes from carbohydrates.

Fat

Fat is the most concentrated form of food energy, containing approximately twice as many calories as carbohydrates or proteins. 20 to 30% of an athlete's total calories should come from fat. Fat allows the baseball player to last for nine innings; the basketball player to play 60 minutes; and the boxer to box for 12 rounds. Fat calorie intake should be equally distributed among saturated, monounsaturated and polyunsaturated fats.

Dietary fats are also known as lipids. The two major dietary lipids are triglycerides and cholesterol.

Triglycerides--are composed of two different compounds--glycerol and fatty acids.

Glycerol--is an alcohol (clear, colorless syrupy liquid).

Fatty acids--are chains of carbon and hydrogen atoms that vary in the degree of hydrogen saturation. A **saturated fatty acid** has a full quota of hydrogen atoms. **Monounsaturated fatty acids** are capable of absorbing two or more hydrogen ions. **Polyunsaturated fatty acids** are capable of absorbing four or more hydrogen ions. Most saturated fats come from animal sources and tend to be solid at room temperature. Conversely, unsaturated fats come from plant sources and are liquid at room temperature. Sources of saturated fat include beef, pork, eggs and dairy products. Monounsaturated fats include chicken, olive oil, canola oil peanuts. Polyunsaturated fats include fish, safflower, soybean and sunflower oil.

Hydrogenated fats or oils are treated by a process that adds hydrogen to some of the unfulfilled bonds which hardens the fat or oil. These fats are called trans fatty acids.

Essential Fatty Acids--are fats or oils which are polyunsaturated. Essential fatty acids are grouped into two families; **omega--6** and **omega--3 fatty acids.** Although both types of essential fatty acids are needed, an excess of omega--6s can promote inflammation, tumor growth and blood clotting. The main sources of omega--6 fatty acids are vegetable oils, such as corn oil and soy oil, which contain a large amount of linoleic acid. Omega--3 fatty acids are found in flaxseed oil, walnut oil and fatty fish. The main component of flaxseed and walnut oils is alpha--linolenic acid while the predominant fatty acids found in fatty fish (salmon, mackerel and sardines) are eicosapentaenoic acid (E P A) and docosahexaenoic acid (D H A). In the early 1970's scientists observed that Greenland Eskimos had an exceptionally low incidence of heart disease and arthritis even though they consumed a high fat diet. Research discovered the Eskimos consumed large quantities of EPA and DHA omega--3 fatty acids. Fish oils, EPA and DHA, help to prevent atherosclerosis, heart attack, depression, cancer, rheumatoid arthritis, diabetes and ulcerative colitis. The recommended daily intake of EPA and DHA is 650mg.

Medical literature suggests that fish oils prevent and may help to reverse atherosclerosis, angina, heart attack, congestive heart failure, arrhythmias, stroke and peripheral vascular disease. Fish oils help to prevent blood clotting, reduce blood pressure, stabilize heart rhythm and maintain artery wall elasticity.

International Health News Findings

Researchers at the University of Cincinnati have found that supplementing with as little as 2 grams/day of fish oil (410 mg of EPA plus 285 mg of DHA) can lower diastolic pressure by 4.4 mm Hg and systolic pressure by 6.5 mm Hg in people with elevated blood pressure.

Daily supplementation with as little as 2.7 grams of EPA and 1.8 grams of DHA can markedly reduce the number of tender joints and increase the time before fatigue sets in.

The human brain is one of the largest "consumers" of DHA. A normal adult human brain contains more than 20 grams of DHA. Low DHA levels have been linked to low brain serotonin levels which are connected to an increased tendency for depression, suicide, and violence. A high intake of fish has been linked to a significant decrease in age-related memory loss and cognitive function impairment, and a lower risk of developing Alzheimer's disease.

There is considerable evidence that fish oil consumption can delay or reduce tumor development in breast cancer. Studies have also shown that a high blood level of omega-3 fatty acids combined with a low level of omega-6 fatty acids reduces the risk of developing breast cancer. Daily supplementation with as little as 2.5 grams of fish oils has been found effective in preventing the progression from benign polyps to colon cancer and researchers in Korea recently reported that prostate cancer patients have low blood levels of omega-3 fatty acids.

Danish researchers have concluded that fish oil supplementation may help prevent arrhythmias and sudden cardiac death in healthy men. An Italian study of 11,000 heart attack survivors found that patients supplementing with fish oils markedly reduced their risk of another heart attack, a stroke or death. A group of German researchers found that fish oil supplementation for 2 years caused regression of atherosclerotic deposits and American medical researchers report that men who consume fish once or more every week have a 50% lower risk of dying from a sudden cardiac event than do men who eat fish less than once a month.

Recommended Intake of Fatty Acids

Fatty Acid	Type of Fat	Recommended Intake	
		Grams	% of Calories
DHA plus EPA combined. Oil from cold water fish such as salmon, trout, mackerel and sardines.	Omega-3	0.65 g	0.3%
DHA (docosahexaenoic acid) To be at least…… Pregnant and lactating women……	Omega-3 ……	0.22 g 0.30 g	0.1%
EPA (eicosapentaenoic acid) To be at least……	Omega-3 ……..	0.22 g	0.1%
Alpha linolenic acid (LNA) Oil from flax seeds (50%), walnuts and green leafy vegetables. LNA can be converted to EPA and DHA in the body; however, the enzyme responsible for this conversion becomes less active with age as well as in a number of disease conditions such as hypertension and diabetes.	Omega-3	2.22 g	1.0%
Linoleic acid (LA) Not to exceed…….	Omega-6 ……	4.44 g 6.67 g	< 3.0%

Oil from corn, safflower, sunflower and soybeans.			
Trans fatty acids Not to exceed…….. Hydrogenated or partially hydrogenated vegetable oils found in many margarines and baked goods. It is recommended to keep intake at a minimum.	NA …….	2 g	< 1.0%
Saturated fatty acids Not to exceed…… Fats that are solid a room temperature such as beef, pork and butter.	NA ……	…….	< 8.0%
Monounsaturated fatty acids It is recommended that a majority of fatty acids should come from monounsaturates found abundantly in olive oil and canola oil.	Omega-9		

Cholesterol

Cholesterol is a fat--like, pearly substance that is an essential component in the formation of cell membranes and several hormones. Cholesterol can be obtained from one's diet. It is found only in animal food products and not in fruits, vegetables, nuts, grains or other plant sources. Cholesterol, is also naturally found in the body, manufactured primarily by the liver and to a lesser extent by the kidneys. Cholesterol is most common in the blood, brain tissue, liver, kidneys and fatty covers around nerve fibers. It helps to absorb and move fatty acids, and is necessary in the production of vitamin D on the surface of the skin.

Metabolic Breakdown and Use of Dietary Fat

Dietary fat is digested into fatty acids, glycerol and cholesterol and ultimately used for energy, utilized to form cell structures or stored as fat. Since lipids are insoluble in water, the liver constantly makes compounds called lipoproteins (lipids covered by a protein coat). The protein portion of the compound is called an apoprotein which allows the lipid to be transported in the blood.

Lipoproteins contain a core of triglycerides and cholesterol esters surrounded by a coat of apoproteins, cholesterol and phospholipids.

Four Types of Lipoprotein

Chylomicron (85% triglcerides; 9% phospholipids; 4% cholesterol; 2% protein). After digestion, fats are carried in the blood as chylomicrons.

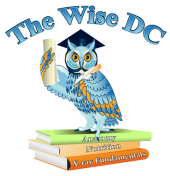
Very low-density lipoproteins (VLDL) consist of 50% triglycerids; 20% cholesterol. 20% phospholipids + 10% protein. This lipoprotein delivers fatty acids and glycerol to the tissues.

Low-density lipoproteins. **LDL** contain 45% cholesterol. Increased levels of LDL, particularly if oxidized or modified, are associated with increased risk for coronary heart disease. LDL are often referred to as the bad cholesterol, for high levels are believed to contribute to the development of heart disease.

HDL high density lipoproteins. HDL contain 55 percent protein and moderate amounts of cholesterol. Several subclasses of HDL have been identified, such as HDL_2 and HDL_3. Higher levels of HDL, particularly the HDL_2 component, have been associated with a lessened risk of coronary heart disease. HDL are often referred to as the good cholesterol, for it is believed that they reduce the risk of heart disease.

Health Implications of Dietary Fat and Cholesterol

The average American consumes about 40 percent of their dietary Calories from fat (16 percent from saturated fat) and more cholesterol than is needed (between 400-600 milligrams per



day). High levels of LDL and low levels of HDL increase the risk of disease. To promote health reduce the total amount of fat in the diet to less than 30 percent of caloric intake, strike a balance in the ratio of saturated, monounsaturated, and polyunsaturated fats to approximately 10 percent of the Calories from each, and reduce cholesterol intake to less than 300 milligrams per day, or possibly less than 100 milligrams per 1,000 Calories consumed. Polyunsaturated fats may help decrease total cholesterol, but they also appear to decrease the HDL component. Monounsaturated fats help lower total cholesterol, but, unlike polyunsaturated fats, they have little effect on HDL levels.