

Basic Nutrition Concepts: Macronutrients, Micronutrients, and Water

Unit: Culinary Science

Problem Area: Nutrition

Lesson: Basic Nutrition Concepts: Macronutrients, Micronutrients, and Water

■ **Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

- 1 Explain the role of macronutrients and micronutrients in a healthy diet.
- 2 Explain the nutritional benefits and food sources of vitamins and minerals.
- 3 Explain the importance of water in a healthy diet.
- 4 Explain the properties and sources of fats, proteins, and carbohydrates.

■ **Resources.** The following resources may be useful in teaching:

“Carbohydrates, Proteins, and Fats,” *The Merck Manuals Online Medical Library*. Accessed Dec. 6, 2010. <<http://www.merck.com/mmhe/sec12/ch152/ch152b.html>>.

“Fiber-O-Meter: Dietary Fiber Calculator,” *WebMD*. Accessed Dec. 6, 2010. <http://www.webmd.com/diet/healthtool-fiber-meter?ecd=wnl_hlc_111110>.

“Food & Fitness,” *TeensHealth*. Accessed Dec. 6, 2010. <http://kidshealth.org/teen/food_fitness/>.

Insel, Paul, et al. *Nutrition*, 4th ed. Jones-Bartlett, 2011.



Thompson, Janice, and Melinda Manore. *Nutrition: An Applied Approach*, 2nd ed. Benjamin Cummings, 2008.

USDA: ChooseMyPlate.gov. Accessed July 20, 2011.

<<http://www.choosemyplate.gov/>>.

Wardlaw, Gordon M., and Anne M. Smith. *Contemporary Nutrition*, 7th ed. McGraw-Hill, 2010.

■ **Equipment, Tools, Supplies, and Facilities**

- ✓ Overhead or PowerPoint projector
- ✓ Visuals from accompanying masters
- ✓ Copies of sample test, lab sheets, and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

■ **Key Terms.** The following terms are presented in this lesson (shown in bold italics):

- amino acids
- antioxidants
- beta-carotene
- calories
- carbohydrates
- cholesterol
- complete proteins
- complex carbohydrates
- denatured proteins
- essential amino acids
- essential fatty acids (EFAs)
- fats
- fat-soluble vitamins
- fiber
- fortified
- free radicals
- fructose
- glucose
- incomplete proteins
- lactose
- lipids
- macronutrients
- micronutrients
- minerals

- monounsaturated fats
- polyunsaturated fats
- proteins
- saturated fats
- simple carbohydrates
- starch
- sucrose
- trans fats
- vegans
- vitamins
- water-soluble vitamins

■ **Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Share the following with your class: Sodium is an essential mineral (micronutrient) for good health and is normally part of all diets. Yet how much is too much sodium? Most teens need only 1,500 milligrams (mg) of sodium per day—less than 1 teaspoon of table salt. However, the average American ingests between 2,300 and 4,700 mg per day. Sodium intake is one of the factors in the development of high blood pressure (hypertension) in older adults. Use VM–A to review the sodium levels of various forms of apples, potatoes, and peanuts. How do the raw foods compare to the processed foods in sodium levels?

To reduce sodium intake: Cover up some holes in the salt shaker; use more fresh foods versus processed foods; make your own condiments (e.g., salad dressings and sauces); and taste food before adding salt.

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Explain the role of macronutrients and micronutrients in a healthy diet.

Anticipated Problem: What is the role of macronutrients and micronutrients in a healthy diet?

I. Macronutrients and micronutrients

A. **Macronutrients** are the dietary fats, proteins, and carbohydrates required by the body in large amounts each day.

1. **Lipids** are dietary fats that include fatty acids (with linoleic and alpha-linolenic acids being the essential fatty acids), triglycerides, and cholesterol. Fat intake is the key to maintaining a caloric balance and body weight. Dietary fat intake amounts may be a precursor to inflammation, coagulation, and gene expression. **Fats** are substances that provide stored energy for the body, carry and store other nutrients until needed, and—depending on the type of fat—provide essential chemicals for cell structure and replenishment. Food sources include animal and vegetable types. Fat is necessary to a balanced diet. Although some fats are particularly healthy, many can have long-term detrimental effects on the cardiovascular system. Fats also have the potential to add unneeded pounds to the body.
 2. **Proteins** are the building blocks of all cells in the body and are an important source of **calories**, which are units used for measuring the energy produced by food when oxidized in the body. Proteins help repair cells and make new ones; they are especially important for growth and development during childhood, adolescence, and pregnancy. Protein food sources generally contain other important nutrients as well. All animal and some vegetable sources contain proteins constructed from amino acid chains that facilitate muscle, blood, bone, and all other cell growth and maintenance. Foods that contain proteins are grouped as complete or incomplete proteins.
 3. **Carbohydrates** are sugars, starches, and fibers. They are primary energy sources and, for many people, are often the major food type consumed. The Institute of Medicine recommends that 45 to 65 percent of a person's total caloric intake be from carbohydrates. Sugar and starch supply glucose that is used as energy for brain, central nervous system, and red blood cell activities. Fiber is non-digestible and helps people feel “satisfied” after a meal and promotes healthy bowel movements. Carbohydrate-rich foods include fruits, vegetables, grains, nuts, seeds, and milk products. Derivative products include various types of sugars, flours, and syrups.
- B. **Micronutrients** are vitamins and minerals required by the body in very small amounts. Micronutrients help the body produce enzymes and hormones. As small as the amounts are, compared to macronutrients, their absence can cause severe health issues. According to the World Health Organization, *“Iodine, vitamin A, and iron are most important in global public health terms. Their lack represents a major threat to the health and development of populations the world over, particularly children and pregnant women in low-income countries.”*
1. **Vitamins** are organic (from living matter) substances essential to good nutrition and regulation of metabolic (energy) processes. The body requires vitamins in minute amounts. They help carry out normal functions (e.g., growth, cell repair, fighting diseases, and digestion). Vitamins are found in a wide variety of foodstuffs or are provided as supplements. They are essential for overall health and nutrition. A diet that includes lots of fruits and vegetables and whole grains usually delivers most of the vitamins required. Vitamins are often identified by letters or, in some cases, by the scientific name, such as vitamin B₁ (thiamine) and vitamin B₂ (riboflavin). Vitamins are broken into two groups

based on the material in which they dissolve: fat-soluble and water-soluble vitamins.

- a. **Fat-soluble vitamins** (A, D, E, and K) and carotenoids dissolve and are transported in fats to be absorbed in the bloodstream. Any excess fat-soluble vitamins are stored in the liver until needed. Because these vitamins are stored in the body, they are not needed each day. High doses of vitamin supplements have the potential to be **toxic** (poisonous).
 - b. **Water-soluble vitamins** (vitamin C and the B complex vitamins) dissolve in water and are not stored by the body; they are eliminated in urine. Therefore, water-soluble vitamins must be supplied daily. They are also easily destroyed during food preparation and storage. To reduce vitamin loss, it is necessary to refrigerate fruits and vegetables, reuse the water from cooked vegetables, and keep milk and grains out of direct light.
2. **Minerals** are inorganic (from matter other than plant or animal) substances—usually obtained from the earth in salts, coal, sulfur, and water—required by the body in minute amounts to ensure a healthy nutritional balance. Mineral consumption helps ensure bone and muscle health. Minerals also provide antioxidant properties and help remove toxins from the body. Common minerals key to good nutrition and their chemical symbols are:
- a. Calcium (Ca)
 - b. Iron (Fe)
 - c. Magnesium (Mg)
 - d. Phosphorus (P)
 - e. Potassium (K)
 - f. Sodium (Na)
 - g. Zinc (Zn)

Teaching Strategy: Use VM-B to review the macronutrients and the micronutrients.

Objective 2: Explain the nutritional benefits and food sources of vitamins and minerals.

Anticipated Problem: What are the nutritional benefits and food sources of vitamins and minerals?

II. Food sources and nutritional benefits of vitamins and minerals

A. Fat-soluble vitamins

1. Vitamin A (also known as retinol, retinal, and carotene)
 - a. Food sources of vitamin A are whole eggs, milk products, beef liver, non-fat and low-fat dairy items, and dark green and bright orange vegetables (e.g., broccoli, carrots, cantaloupe, pumpkin, tomatoes, peaches, collards, sweet potatoes, and other squashes). Non-fat and low-fat dairy products are

often **fortified** (replaced and strengthened, with vitamin A in this case) because of what was lost during fat removal.

- b. Nutritionally, vitamin A is vital for vision, especially night vision, tissue and bone repair, and reproduction. It also helps the immune system fight off infections from bacteria and viruses. **Beta-carotene** is a carotenoid and one of the pigments (dyes) found in green and deep orange vegetables. It is converted to vitamin A in the body if the body needs it. When the body doesn't need it, beta-carotene acts as an antioxidant that helps prevent arthritis, acts to prevent premature aging, and fights some forms of cancer.

2. Vitamin D

- a. Food sources of vitamin D are beef liver, egg yolks, and fatty fishes (e.g., salmon).
- b. Nutritionally, vitamin D is generally produced in the body during exposure to the sun. Approximately 10 to 20 minutes of exposure to full sun per day provides the body with its requirement. Many people do not receive enough sunlight each day, so vitamin D is typically added to common foods (e.g., milk and other dairy products). It is essential for bone growth and strength.

3. Vitamin E

- a. Food sources of vitamin E are green leafy vegetables, vegetable oils, nuts, seeds, and whole grains. Smaller amounts are found in yams and sweet potatoes.
- b. Nutritionally, vitamin E is a powerful antioxidant (Alpha-tocopherol) that protects from free radical damage and has been associated with lower death rates from heart disease when taken in small doses (200 IU). Vitamin E is also associated with healthy hair and skin.

4. Vitamin K

- a. Food sources of vitamin K are dark green leafy vegetables (e.g., spinach), cabbage, broccoli, Brussels sprouts, and cauliflower. It is also added to fortify many cereal products.
- b. Nutritionally, the greatest benefit of vitamin K to good nutrition is its role in blood clotting. It also helps strengthen bones. Recent synthetic vitamin K studies report that supplements resulted in a 77 percent reduction in hip fractures and all non-vertebral fractures among the elderly.

B. Water-soluble vitamins

1. Vitamin C (ascorbic acid)

- a. Food sources of vitamin C are citrus fruits (e.g., oranges, limes, lemons, and grapefruit), red bell peppers, broccoli, kiwi, tomato juice, strawberries, potatoes, melons, and other dark green vegetables.
- b. Antioxidants help fight colds, strengthen the immune system, fight cancers, and prevent cataracts. **Antioxidants** are substances or nutrients in food that prevent or slow oxidative damage to human bodies, such as heart disease, cancer, diabetes, and macular degeneration. As body cells use oxygen, they give off **free radicals** (byproducts) that can cause damage. Antioxidants prevent or repair damage from pollutants to which people are

exposed and from pollutants consumed. Antioxidants assist the immune system's defense mechanisms and reduce the risk of infections and cancers. Common antioxidant-rich vitamin and mineral sources are vitamins A, C, and E as well as selenium. Vitamin C also assists in collagen formation (healthy blood vessels), bone and teeth development, and wound healing. It helps the body resist infection and has been associated with a decreased risk of cancer, heart disease, and cataracts.

2. Vitamin B complex

- a. Vitamin B complex is an essential element of optimal growth and development. It helps the body extract energy from food. According to the Colorado State nutrition Web site, B vitamins are important for "*normal appetite, good vision, healthy skin, a healthy nervous system, and red blood cell formation.*" These vitamins are found in numerous food sources and are best ingested in food form rather than as supplements. B-vitamin deficiencies include beriberi, pellagra, and forms of anemia. For example, alcoholics are prone to thiamine (B₁) deficiency when alcohol replaces food, and vegans often require a B₁₂ supplement. Other symptoms of B-vitamin deficiency are:
 - (1) Bleeding gums
 - (2) Bruising easily
 - (3) Diarrhea
 - (4) Wounds that heal slowly
 - (5) Dry and/or rough skin
 - (6) Anemia
- b. Thiamin or B₁ helps the body produce energy from food (especially carbohydrates), positively affects nervous system function, and helps promote a normal appetite. B₁ dissolves in cooking liquids. Food sources are cereals and whole grains, **enriched** (a state in which nutrients removed during food processing are replaced in the final product) grain products, pork, liver, peas, and legumes. Deficiency symptoms are mental confusion and muscle weakness.
- c. Riboflavin or B₂ helps the body produce energy from food, aids in digestion, and promotes healthy skin and nerves. Riboflavin is sensitive to light. Food sources are whole and enriched or fortified grains (breads and cereals), lean meats, milk, liver, eggs, nuts, and green leafy vegetables. Deficiency symptoms are dermatitis and sensitivity to light.
- d. Niacin or B₃ helps the body produce energy from food, aids in digestion, and promotes healthy skin and nerves. Food sources are lean meats, liver, chicken, tuna, peanut butter, and whole and enriched grains. Deficiency symptoms are skin disorders, diarrhea, and irritability.
- e. Pantothenic acid or B₅ helps the body produce energy from food, breaks down the macronutrients (fats, proteins, and carbohydrates), and aids in hormone formation. Food sources are organ meats (e.g., liver and kidney, meats, egg yolk, dairy foods, whole grains, mushrooms, avocados, and

- legumes). Deficiency symptoms are rare due to its easy availability in numerous foods but may include fatigue, nausea, and difficulty sleeping.
- f. Pyridoxine or B₆ aids in protein and glucose metabolism, helps the body use fats, aids in red blood cell formation of **hemoglobin** (a component of the red blood cells that carries oxygen to all parts of the body), and is essential for normal immune system function. Food sources are pork, whole grains and cereals, green leafy vegetables, legumes, and meats. Deficiency symptoms are anemia, skin disorders (e.g., cracks at the corners of the mouth), and a smooth tongue.
 - g. Vitamin B₁₂ or cobalamin helps the body build genetic material (DNA) and a healthy nervous system. It also helps develop an adequate number of red blood cells and aids in maintaining the nervous system. B₁₂ is found in animal food sources (e.g., beef, pork, kidney, eggs, fish, oysters, shellfish, and dairy products). Deficiency symptoms are anemia, nerve damage that may cause tingling in fingers and toes, and neurological disorders.
 - h. Folic acid (folate) aids in all body metabolism functions, including protein metabolism and red blood cell formation. It helps prevent certain birth defects and reduces coronary heart disease risks. Folic acid is also necessary to produce new cells and to make DNA and RNA blueprints for cells. Food sources are liver, kidney, oranges, strawberries, green leafy vegetables, beans, legumes, fish, and whole grains and cereals. Deficiency symptoms are folate anemia, diarrhea, and smooth tongue.
- C. Minerals—Various minerals are used in the body. All of them support the viability of vitamins to do their jobs. In many cases, the vitamins would wash away and be useless without the presence of required minerals. Common minerals and their food sources include calcium, iron, magnesium, potassium, and sodium.
- 1. Calcium (also available as calcium carbonate, calcium citrate, and calcium malate) is the most abundant mineral in the human body. Most calcium is stored in bones and teeth. The body requires adequate vitamin D to absorb and use calcium efficiently. Calcium is a necessary mineral that helps ensure strong bones and teeth. It also assists with metabolic functions (e.g., blood clotting). Food sources are fresh produce, whole sardines, dark green vegetables, and most dairy products. Many food products are “calcium fortified” to ensure an adequate daily intake of calcium. Calcium supplements are prescribed to prevent osteoporosis.
 - 2. Iron (ferrous fumarate, ferrous sulfate, and ferrous gluconate) is considered a trace mineral that the body requires for transferring oxygen to the cells. Most iron is found in the red blood cells. Food sources of dietary iron are organ meats (e.g., liver, kidney, and heart) and other red meats, fish, poultry, green leafy vegetables, eggs, nuts, and legumes. Iron deficiency symptoms are fatigue, anemia, and potential immune system disorders. Dietary iron can be toxic in large amounts.
 - 3. Magnesium (magnesium oxide, magnesium sulfate, and magnesium carbonate) is an abundant mineral in the human body and is needed for healthy bones and normal enzyme and nervous system function. It helps maintain a

healthy immune system and ensures a regular heartbeat. Dietary food sources are green leafy vegetables, nuts, seeds, legumes, and whole grains.

4. Potassium is essential to control liquid transfer in and out of cells. It helps maintain the body's pH balance and its nervous system and brain function. Food sources are bananas, raisins, greens, citrus, melons, turkey, fish, peas, beans, and soy products.
5. Sodium (NaCl) is an essential mineral that regulates fluid balance inside and outside of cells. It helps maintain proper acidic levels and the normal function of nerve cells and muscles. Sodium is a component of table salt—40 percent sodium (Na) and 60 percent chloride (Cl). Salt is found in virtually all foods and is in greater amounts in processed foods and beverages.
 - a. Most sodium in processed foods is added as a preservative or as a flavoring. The word “sodium” is part of many other words on a nutrition label. Regardless of the form in which it is listed on a label (e.g., monosodium glutamate or MSG), it is still a salt.
 - b. An excessive intake of most any mineral can have negative affects on the body, but none more than salt. Overindulgence can lead to bloating (edema—water retention), hypertension, weight gain, and damage to arteries and the heart.
 - c. It is one of the most controllable minerals consumed as part of a diet, and it is also the most overconsumed.
 - d. High-sodium condiments are onion salt, garlic salt, catsup, barbecue sauce, bouillon, baking soda, mustard, pickles, MSG, and soy sauce.

Teaching Strategy: Use VM-B to review the macronutrients and the micronutrients. You may want to bring in items and have students examine the sodium content on the labels to aid in awareness.

Objective 3: Explain the importance of water in a healthy diet.

Anticipated Problem: What is the importance of water in the diet?

III. Water and diet

- A. Water (H₂O) is an essential nutrient and one of the four macronutrients needed in large amounts daily. More than 70 percent of the body is made up of water; it is part of every cell. Although it has no nutritional value or calories of its own, the body cannot live or function without it. People can survive for weeks or months without food, but they can only survive for about four days without water. The body uses water for the following:
 1. Digestion—Water helps maintain proper body weight.
 2. Circulation—The surface tension allows capillary action, which allows water movement through the blood vessels to carry oxygen and nutrients.
 3. Waste removal—Water washes waste out of the cells.

4. Absorption—Water moves nutrients and transports the water-soluble vitamins to the cells.
 5. Transport of nutrients—Water is the medium that carries water-soluble vitamins.
 6. Tissue building—Water helps keep skin toned and pliable.
 7. Body temperature maintenance—Water absorbs or releases more heat than many other substances. It acts as the body's natural cooling system in the form of perspiration.
- B. Consumption
1. People can survive for weeks or months without food and only a few days without water.
 2. Adults should drink 6 to 8 cups of water per day. Adults consume and excrete about 10 cups of water per day, most of which come from beverages. However, some water is produced as a byproduct of breaking down fats, sugars, and proteins.
 3. While most soft drinks and other processed beverages are basically flavored water, the body has to remove elements from those flavored liquids to access the water for its basic functions. Therefore, pure water is the best beverage for the body.
- C. Hard water versus soft water
1. More minerals—calcium, magnesium, lead, and iron—equal harder water.
 2. Hard water is linked to lower incidences of heart disease due to less sodium.
 3. Soft water contains more mineral salts and, as such, is a source of dietary sodium and must be calculated into a person's intake.
 4. Soft water helps soaps and detergents lather.

Teaching Strategy: Assign LS–A.

Objective 4: Explain the properties and sources of fats, proteins, and carbohydrates.

Anticipated Problem: What are the properties and sources of fats, proteins, and carbohydrates?

IV. Properties and sources of macronutrients

A. Properties and sources of fats

1. Fats are a component of most foods and are an important part of the daily diet. Regardless of media's negative portrayal of "fat" and "cholesterol," everyone's body needs them. Fats provide 9 calories per gram, regardless of the type—saturated, monounsaturated, polyunsaturated, and trans fats.
 - a. Fats hold and transport vitamins in the body.
 - b. Fats lubricate cells.
 - c. Fats provide energy to the body in the form of stored calories.

- d. Fats are important to normal central nervous system functions.
 - e. Fats assist in hormone production and regulation.
 - f. Fats cushion the organs and body tissues.
 - g. Fats help regulate body temperature.
2. **Essential fatty acids (EFAs)** are those necessary lipids that humans cannot synthesize, and they must be obtained through diet. EFAs are long-chained polyunsaturated fatty acids. The two types are Omega-3 (from linolenic acid) and Omega-6 (from linoleic and oleic acids). EFA deficiency is common in the United States and has been linked to serious health conditions (e.g., heart attack, cancer, asthma, schizophrenia, depression, stroke, obesity, diabetes, arthritis, ADHD, and Alzheimer's disease).
- a. EFAs support the cardiovascular, reproductive, immune, and nervous systems.
 - b. EFAs manufacture and repair cell membranes for optimum nutrition and eject waste products.
 - c. EFAs produce prostaglandins that regulate heart rate, blood pressure, blood clotting, fertility, conception, and inflammation. In addition, they help fight infections.
 - d. EFAs are necessary to children's proper growth, especially neural development and maturation of the sensory system.
3. Omega-rich food sources
- a. Omega-3 food sources include flaxseed oil, canola oil, walnuts, sesame seeds, avocados, mustard greens, sardines, salmon, and albacore tuna.
 - b. Omega-6 food sources include flaxseed oil, flaxseed, pumpkin seeds, pine nuts, pistachio nuts, raw sunflower seeds, olives, and olive oil.
4. The four main types of fats are divided into those that are liquid at room temperature—monounsaturated and polyunsaturated—and those that are solid or semi-solid at room temperature—saturated and trans fats.
- a. **Monounsaturated fats** are the healthiest of the fatty acids and are liquid at room temperature. They have properties that help clear clogged arteries and appear to inhibit some cancers. Major food sources are olives, olive oil, canola oil, avocados, all nuts and seeds, and peanut butter.
 - b. **Polyunsaturated fats** are healthy fatty acids and are liquid at room temperature. Omega-3 and Omega-6 fatty acids are polyunsaturated varieties. Food sources include fruits and vegetables, grains, and many plant sources, including legumes (e.g., nuts, seeds, beans, corn, vegetables, olives, and canola oils). Breads and cereals as well as oily fish (e.g., salmon and sardines) are good sources of polyunsaturated fats.
 - c. **Saturated fats** are the least healthy essential fatty acids and should represent a limited portion of the diet. Food sources of saturated fats are red meats, dairy foods, and some vegetable oils (e.g., palm and coconut). Saturated fat intake has been linked to heart and artery diseases.
- Cholesterol** is a whitish waxy substance essential for good health; it is naturally manufactured by the body (in the liver) and is often associated

with foods rich in saturated fats. The saturated fats in butter, full-fat dairy products, and red meats increase levels of LDL (bad cholesterol). Cholesterol can be good and bad for a person's health.

- (1) Cholesterol makes cell membranes and the bile acids needed to digest food.
 - (2) Cholesterol is the raw material necessary to the manufacture of vitamin D and estrogen and testosterone (hormones).
 - (3) Cholesterol is dangerous in high amounts and is particularly responsible for clogging arteries. It is associated with heart attacks and strokes.
 - (4) Cholesterol is sometimes produced in excessive amounts in the liver.
- d. **Trans fats** are human-made lipids that are not classic fatty acids and are the unhealthiest fat type. Trans fats are unhealthy because of the way in which they are created. Liquid fats (oils) are turned into solid fats (e.g., margarine) through the process of hydrogenation, which changes the natural state of oil. In the process, the fat does not harden completely; it stays in a transient form somewhere between liquid and solid. Trans fats raise LDL and simultaneously lower HDL (good cholesterol) and cause other changes in arteries that can be the precursor platform for heart disease. Trans fat food sources include all "hard stick margarine," most fast foods, and most commercially processed baked goods. They may taste good, but they have no nutritional benefits.

B. Properties and food sources of protein

1. As an essential building block for life and health, protein produces 4 calories per gram. **Calories** are units used for measuring the energy produced by food when oxidized in the body. Roughly, a food calorie is the amount of energy a 150-pound person burns each minute while sleeping.
 - a. Proteins build muscles, organs, and all body tissue.
 - b. Proteins help clot blood.
 - c. Proteins assist with hormone and enzyme action in the body.
 - d. Proteins assist the normal functioning of the immune system.
 - e. Proteins help regulate fluid movement in cells.
2. Protein molecules are made up of many strands or chains of **amino acids** (chief components of proteins that are synthesized by cells or obtained as essential components of diet). A protein is a large, extremely complex substance consisting of amino-acid residues. Amino acids combine in various groupings to form different types of protein molecules. There are 22 amino acids, and all 22 are necessary to form a complete protein. Of the 22 amino acids, 13 are made in the body. The other nine are called **essential amino acids** and must be provided in the diet.
3. Protein food sources
 - a. **Complete proteins** are proteins that contain all nine essential amino acids, including lysine and tryptophan. This type of dietary protein contains all the amino acids necessary to make new protein. The body does not

produce essential amino acids; they must be supplied by foods. Proteins derived from animal (including fish, seafood, and poultry), dairy (including yogurt and cheese), and egg sources are considered complete proteins. Food sources of the essential amino acids are most meats, milks, cheeses, eggs, vegetables, grains, and nuts. Soybeans are the only plant protein considered to be complete. Eggs are considered the most easily digestible source of protein, and all other food sources of protein are compared to an egg standard.

- b. **Incomplete proteins** are proteins missing one or more essential amino acid. Food sources of incomplete proteins are nuts, seeds, beans, legumes, tofu, peas, and grains. Some incomplete proteins are found in vegetables. One can combine individual foods that are incomplete proteins to form a complete protein. **Vegans** (people who do not eat most animal products) are able to formulate complete proteins by eating combinations of incomplete protein sources. For example, rice and beans or corn and beans, when eaten together, create a complete protein.
- 4. **Denatured proteins** are proteins cooked to the point of charring or burning, such as the charring of the outside of grilled meat (crisp and chewy). Such denatured proteins are no longer digestible and are no longer viable for absorption by the body.

C. Properties and carbohydrate food sources

- 1. Carbohydrates are the main source of energy for the body. Their molecules are readily digested and turned into energy in the body, though they can also be easily converted to fat if unused. At one point, people were consumed with the idea that all carbohydrates were bad, including bread, pasta, and some fruits and vegetables. The idea that all carbohydrates are bad is an oversimplification. However, too much of the wrong carbohydrates can be unhealthy. The source for all carbohydrates is plants. Sugar and starch are the primary digestible carbohydrates, and the body converts them to glucose (blood sugar) to feed all the body's cells. Carbohydrates provide 4 calories per gram.
 - a. Bad carbohydrates send blood sugar levels quickly higher and include the following food sources: white bread, baked goods from refined white flour, white rice, soda, some sugary juices, and potatoes—especially French fries. Diets heavy in these food sources are linked to diabetes, heart disease, and obesity.
 - b. Good carbohydrate food sources release their glucose at a much more relaxed level so blood sugar levels do not spike. Food sources of good carbohydrates are fruits and vegetables as well as whole wheat and grain products.
 - c. **Fiber** (the indigestible part of plant materials) may or may not be able to absorb water. When a carbohydrate includes fiber, it takes the body longer to break it down and access the calories and nutrients in that food. The fiber passes through the body largely unchanged and undigested. Fiber keeps bowels moving and is known to lower cholesterol levels. Fiber is found in most fruits and vegetables, legumes, and whole grains.

2. Carbohydrates are classified as simple or complex.
- Simple carbohydrates** are one or two sugar molecules linked together—monosaccharides and disaccharides. They are found in sugar, juice, milk, honey, corn, fruit, candy, soda, etc. Simple carbohydrates are **fructose** (fruit and honey sugar), **glucose** (simple sugar), **lactose** (milk sugar), and **sucrose** (table sugar). These simple carbohydrates digest quickly and break down into sugar to provide a fast energy source. A drop in blood sugar may be caused by ingestion of simple rather than complex carbohydrates. The need for a snack may result from a drop in a person's blood sugar level. Glucose is the only food the brain can use for nourishment, and it is the primary source of energy in the bloodstream.
 - Complex carbohydrates**—beans, lentils, whole grains, and vegetables—are carbohydrates processed more slowly by the body due in part to the amount of fiber inherent in the food. The slower digestion releases sugars over a period of time and creates a more constant level of energy. Polysaccharides (sugars) bind with starch molecules (e.g., potatoes, starchy vegetables, dry beans, grains, nuts, seeds, and pasta) or bind with fiber molecules (e.g., vegetables, whole grains, whole fruits, brown rice, and oatmeal). Either way, the body breaks down complex carbohydrates over a long period to access sugar needed for energy. **Starch** is a complex carbohydrate composed of long strands of sugar compressed by the body into small, tight compartments for storage and use as energy at a later time. When starch is eaten, these compartments must be broken open to release the usable sugars inside. The result of breaking these compartments is that the sugars are absorbed more slowly into the bloodstream. Food sources for starches are potatoes, beans, and grains, among others.

Teaching Strategy: Use VM–C and VM–D to review the properties and food sources of fats. Use VM–E and VM–F to review the properties and food sources of proteins. Use VM–G, VM–H, and VM–I to review the properties and food sources of carbohydrates. Assign LS–B, LS–C, and LS–D.

- **Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used.
- **Application.** Use the included visual masters and lab sheets to apply the information presented in the lesson.
- **Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

■ Answers to Sample Test:

Part One: Multiple Choice

1. b
2. c
3. a
4. b
5. d
6. a
7. b
8. d
9. c
10. d

Part Two: True/False

1. F
2. T
3. T
4. F
5. F
6. F
7. T
8. T
9. T
10. F

Part Three: Completion

1. amino acids
2. water
3. 90
4. denatured
5. complex
6. monounsaturated
7. minerals
8. antioxidants
9. trans fats
10. water

Basic Nutrition Concepts: Macronutrients, Micronutrients, and Water

► Part One: Multiple Choice

Instructions: Circle the letter of the correct answer.

- _____ 1. Macronutrients include all of the following except _____.
- a. fats
 - b. vitamins
 - c. carbohydrates
 - d. proteins
- _____ 2. The “healthiest fatty acid” listed is _____.
- a. polyunsaturated fat
 - b. cholesterol
 - c. monounsaturated fat
 - d. saturated fat
- _____ 3. All of the following foods are sources of complete proteins except _____.
- a. walnuts
 - b. eggs
 - c. steak
 - d. salmon



- ____ 4. The best description of micronutrients is that ____.
- a. they are tiny and hard to see
 - b. they are needed in small quantities in the diet
 - c. they are all found in chicken
 - d. None of the above
- ____ 5. Complex carbohydrates are found in ____.
- a. tuna
 - b. apple juice
 - c. chocolate
 - d. kidney beans
- ____ 6. All of the following are fat-soluble vitamins except ____.
- a. vitamin C
 - b. vitamin D
 - c. vitamin K
 - d. vitamin E
- ____ 7. Fiber is ____.
- a. part of protein
 - b. found in plants
 - c. monounsaturated
 - d. a simple carbohydrate
- ____ 8. Essential fatty acids must be obtained from food sources and are found in ____ foods.
- a. cholesterol-rich
 - b. saturated fat
 - c. vitamin B-rich
 - d. Omega-3 and Omega-6
- ____ 9. Calcium is the most abundant mineral in the human body, and most is stored in ____.
- a. hair and nails
 - b. complete proteins
 - c. bones and teeth
 - d. the bloodstream
- ____ 10. Symptoms of B-vitamin deficiency are ____.
- a. bleeding gums
 - b. diarrhea
 - c. anemia
 - d. All of the above

► Part Two: True/False

Instructions: Write *T* for true or *F* for false.

- ____ 1. There are eight essential amino acids.
- ____ 2. Saturated fat is linked to heart disease.
- ____ 3. Water carries nutrients throughout the body.
- ____ 4. Glucose is the sugar found in fruits.
- ____ 5. Beef is considered the highest standard in protein; all other proteins are compared to it.
- ____ 6. A calorie is a nutrient.
- ____ 7. Complete proteins can be created from groups of incomplete proteins.
- ____ 8. Pork chops have saturated fat.
- ____ 9. Carbohydrates include sugars, starches, and fibers.
- ____ 10. Simple carbohydrates digest slowly and break down into sugar to provide a sustained energy source.

► Part Three: Completion

Instructions: Provide the word or words to complete the following statements.

1. The building blocks of protein are _____.
2. More than 70 percent of the body is made up of _____.
3. Ten grams of fat are equal to _____ calories.
4. When the outside of a steak is charred black on the grill, the protein is considered _____.
5. The type of carbohydrate that generally has the most nutrition is a _____ carbohydrate.
6. Avocados and olives are rich in _____ fat.
7. Iodine, salt, and phosphorus are examples of _____.
8. Substances or nutrients in food that prevent or slow oxidative damage to our bodies are called _____.
9. The unhealthiest types of fat are created through a process called hydrogenation and are called _____.
10. People can survive for weeks or months without food, but they can only survive about four days without _____.

SODIUM COMPARISONS

Think about sodium intake as the amount present in raw food and the amounts added during cooking and as a condiment.

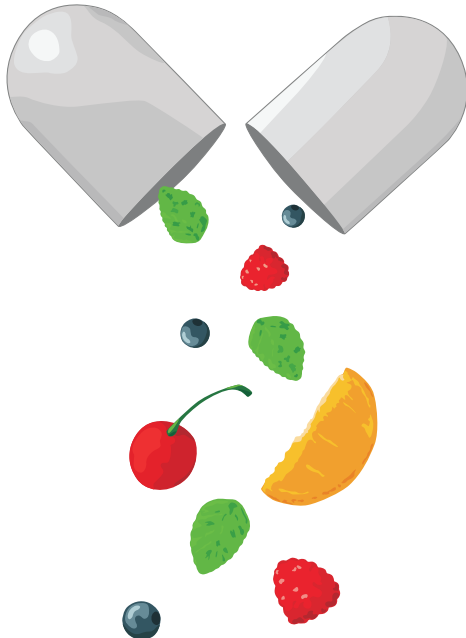
- ◆ $\frac{1}{4}$ t. salt = 500 mg sodium
- $\frac{1}{2}$ t. salt = 1,000 mg sodium
- $\frac{3}{4}$ t. salt = 1,500 mg sodium
- 1 t. salt = 2,000 mg sodium

- ◆ Apple, fresh, 1 to 2 mg
- Applesauce, 1 c., 6 mg
- Apple pie, $\frac{1}{8}$, frozen, 208 mg
- Apple pie, fast food, 400 mg

- ◆ Potato, fresh, 1 to 5 mg
- Potato chips, 10 chips, 200 mg
- Mashed potatoes, instant, 1 c., 485 mg
- Potato salad, $\frac{1}{2}$ c., 625 mg

- ◆ Peanuts, unsalted, 1 c., 8 mg
- Peanut butter, 1 T., 81 mg
- Peanut brittle, 1 oz., 145 mg
- Dry roasted peanuts, salted, 1 c., 986 mg

NUTRIENTS

MACRO Needed in Large Amounts	MICRO Needed in Tiny Amounts
Lipids All fats	Minerals Calcium, iron, and sodium
Proteins Meats, fish, dairy, and eggs	Fat-Soluble Vitamins A, D, E, and K
Carbohydrates Plants	Water-Soluble Vitamins C and B complex
Water Moves nutrients and waste between cells Cools the body Lubricates joints	



PROPERTIES OF FATS

- ◆ Monounsaturated and polyunsaturated fatty acids are liquid at room temperature.
- ◆ Saturated fats, such as sticks of butter and margarine, are solid at room temperature. Many cake and cupcake icings are prepared with hydrogenated (trans fat) shortenings.



FOOD SOURCES OF FATS: MONOUNSATURATED AND POLYUNSATURATED

- ◆ Monounsaturated fatty acids, such as extra virgin olive oil and avocados, are the healthiest type of fat.



- ◆ Polyunsaturated fatty acids, such as whole grain wheat bread and fresh salmon, are sources of the Omega-3 and Omega-6 fats.



FOOD SOURCES OF FATS: SATURATED AND TRANS FAT

- ◆ Consumption of saturated fats, such as fried chicken and egg products, should be limited.

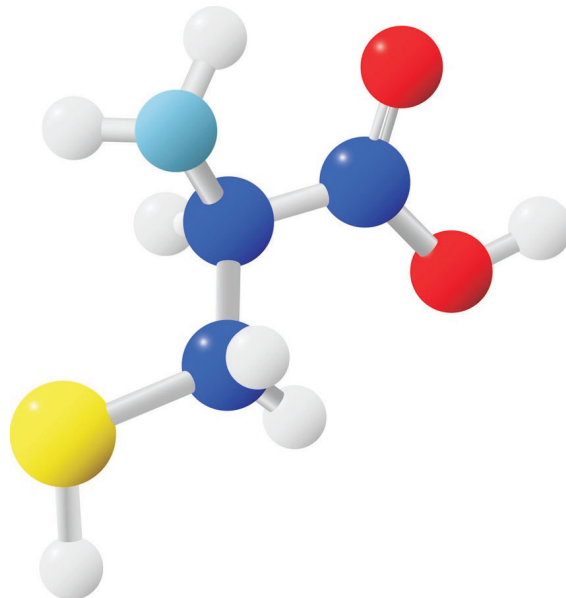


- ◆ Trans fats are a source of LDL (bad cholesterol) and should be avoided in a person's diet. Food sources include fast foods (fries and cheese sauce), soda, and commercially prepared baked goods.



PROPERTIES OF PROTEINS

- ◆ Chains of amino acids make up proteins. It takes 22 amino acids to make one complete protein. This image represents the amino acid cysteine.
- ◆ Proteins are the building blocks of all muscles, blood cells, internal organs, skin, nails, and hair.



FOOD SOURCES OF PROTEINS

- ◆ Nuts are sources of incomplete proteins.
- ◆ Red meats, poultry, dairy products, and eggs are sources of complete proteins.



PROPERTIES OF CARBOHYDRATES

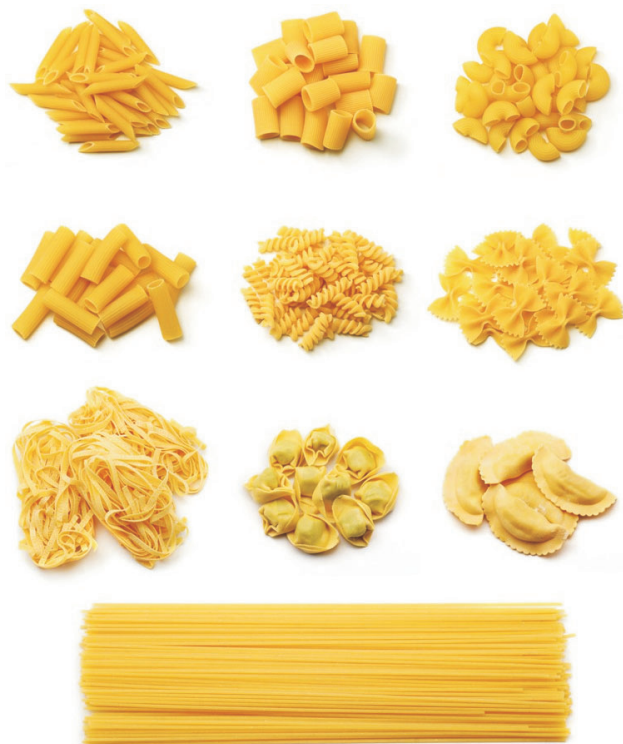
Carbohydrates are sugars, starches, and fibers.



- ◆ Plants are the only source of carbohydrates.
- ◆ They are a major source of dietary energy.
- ◆ Glucose, fructose, and lactose are simple carbohydrates.
- ◆ Whole grains, pasta, and cereal are complex carbohydrates.
- ◆ Glucose is food for the brain.
- ◆ Starches are long strands of compressed sugar.
- ◆ Fiber is indigestible, keeps bowels regular, and helps control cholesterol levels.

FOOD SOURCES OF SIMPLE CARBOHYDRATES

- ◆ Simple carbohydrates (e.g., honey, fruits, and juices) get energy into the bloodstream fast!
- ◆ Complex carbohydrates (e.g., whole grain breads and pasta) enter the bloodstream more slowly.



Macronutrients and Micronutrients

Purpose

The purpose of this activity is increase knowledge and awareness of macronutrients and micronutrients.

Objectives

1. Define “selected nutrients” in your own words.
2. Record food sources of selected macronutrients and micronutrients.
3. List ways in which the body utilizes selected macronutrients and micronutrients.

Materials

- ◆ lab sheet
- ◆ computer with Internet access
- ◆ related texts and reference books
- ◆ writing utensil

Procedure

1. Complete this lab sheet individually. Use your class notes, textbooks, reference books, and Web sites to research and answer each of the following questions.
2. Write your answers in complete sentences.
 - a. List the macronutrients. Define each in your own words.



- b. List two ways in which the body uses water to promote good nutrition.

- c. List the four fat-soluble vitamins and a minimum of three food sources for each.

- d. List the water-soluble vitamins. How are water-soluble vitamins stored in your body?

- e. List four common minerals required by the body. List one nutritional use of each mineral listed.

Macronutrients and Micronutrients

2. Answers will vary but should include responses similar to those shown below.
- a. The macronutrients are fats (lipids), proteins, and carbohydrates.
- (1) **Fats** are stored energy, and they carry and store nutrients until needed. Fats are necessary to maintain cell structure and to replenish cells. Fats come from animal (butter and lard) and plant (oil) sources.
 - (2) Proteins are the building blocks of all cells in the body and are an important source of calories. Proteins repair cells and make new ones and are especially important for growth and development during childhood, adolescence, and pregnancy. Protein is found in all animal and in some vegetable food sources. In general, animal proteins (meats, fish, dairy, and eggs) are complete protein sources and plant proteins (beans, grains, and legumes) are incomplete protein sources.
 - (3) Carbohydrates are sugars, starches, and fibers. They are primary energy sources. For many people, they are the major foods consumed. Sugar and starch supply glucose used as energy for brain, central nervous system, and red blood cell activities. Fiber is non-digestible and helps people feel “satisfied” after a meal. In addition, fiber promotes healthy bowel movements. Carbohydrate-rich foods are fruits, vegetables, grains, nuts, seeds, and milk products. Other products include various types of sugars, flours, and syrups.
- b. Any two of the following ways water promotes good nutrition is acceptable. Others responses may be acceptable depending on the context of the answer.
- (1) Water moves nourishment and waste in and out of cells.
 - (2) Water lubricates joints.
 - (3) Water is essential to maintain blood volume and blood pressure.
 - (4) Water keeps skin pliable and healthy.
- c. The four fat-soluble vitamins and food sources for each are:
- (1) Vitamin A is found in several food sources, including whole eggs, milk products, beef liver, non-fat and low-fat dairy, and dark green and bright orange vegetables (e.g., broccoli, carrots, cantaloupe, pumpkin, tomatoes, peaches, collards, sweet potatoes, and other squashes).
 - (2) The primary source of Vitamin D is sunlight, although vitamin D is also added to milks, cereals, and other food items.
 - (3) Vitamin E is commonly found in green leafy vegetables, vegetable oils, nuts, seeds, and whole grains as well as (smaller amounts) in yams and sweet potatoes.

- (4) Vitamin K is found in all dark green leafy vegetables (spinach), cabbage, broccoli, Brussels sprouts, and cauliflower. It is added to fortify many cereal products.
- d. The water-soluble vitamins are the B vitamins and vitamin C. Water-soluble vitamins are not stored in the body and must be replaced daily.
- e. Four common minerals required by the body and one nutritional use of each include:
 - (1) Iron helps the red blood cells carry oxygen (in the hemoglobin), helps prevent anemia, and helps other vitamins work.
 - (2) Calcium strengthens bones, allows vitamin D to work, prevents heart disease, and reduces the risk of colon cancer.
 - (3) Magnesium allows vitamin C to work, converts blood sugar to energy, and assists in normal heart rhythms.
 - (4) Zinc assists in protein formation, is essential for proper enzymatic action, helps form insulin, and helps muscles work.
 - (5) Potassium is essential for normal heart rhythm, aids in normal blood pressure, and aids in central nervous system function.

Dietary Fats Research

Purpose

The purpose of this activity is to connect specific types of foods to specific types of fats and fatty acids.

Objective

Identify the types of dietary fat found in common foods and ingredients.

Materials

- ◆ lab sheet
- ◆ related references and textbooks
- ◆ computer with Internet access
- ◆ writing utensil

Procedure

1. In the small Word Bank below are terms that represent dietary types of fat. Below the Word Bank, 20 common foods and ingredients are listed.
2. In the space provided, write the matching terms from the Word Bank that describe the composition of each food or ingredient. Use as many terms as needed to best describe each food's composition. You may use each word as many times as needed.
3. You may use your class notes, reference books, textbooks, and Web sites to research the fats and/or fatty acids associated with common foods.



WORD BANK

Cholesterol
Monounsaturated fat
Polyunsaturated fat
Saturated fat
Trans fat

- a. Chicken _____
 - b. Margarine _____
 - c. Salmon _____
 - d. Walnuts _____
 - e. Canola oil _____
 - f. Avocado _____
 - g. Hamburger, fried _____
 - h. White chocolate _____
 - i. Pumpkin seeds _____
 - j. Butter _____
 - k. Pork _____
 - l. Whole wheat bread _____
 - m. Bacon _____
 - n. Eggs, poached _____
 - o. Soy beans _____
 - p. Cottage cheese _____
 - q. Turkey breast _____
 - r. Olives _____
 - s. Peanut butter _____
 - t. Hydrogenated shortening _____
4. Which foods surprised you regarding their fat type?
5. Participate in a class discussion of the answers you researched.
6. Turn in your completed lab sheet to your instructor.

Dietary Fats Research

- a. Chicken = Cholesterol and saturated fat
- b. Margarine = Trans fat is the preferred choice. (However, students may find a reference, depending on the type of margarine, to logically list cholesterol, monounsaturated fat, polyunsaturated fat, and saturated fat.)
- c. Salmon = Cholesterol, polyunsaturated fat, and saturated fat
- d. Walnuts = Monounsaturated fat and polyunsaturated fat
- e. Canola Oil = Monounsaturated fat and polyunsaturated fat
- f. Avocado = Monounsaturated fat and polyunsaturated fat
- g. Hamburger, fried = Cholesterol and saturated fat
- h. White chocolate = Cholesterol and saturated fat
- i. Pumpkin seeds = Monounsaturated fat and polyunsaturated fat
- j. Butter, salted = Cholesterol and saturated fat
- k. Pork = Cholesterol and saturated fat
- l. Whole wheat bread = Polyunsaturated fat (NOTE: Some wheat breads may contain other fats based on recipe composition.)
- m. Bacon = Cholesterol and saturated fat
- n. Eggs, poached = Cholesterol and saturated fat
- o. Soy beans = Monounsaturated fat and polyunsaturated fat
- p. Cottage cheese = Cholesterol and saturated fat
- q. Turkey, breast = Cholesterol and saturated fat
- r. Olives = Monounsaturated fat and polyunsaturated fat
- s. Peanut butter = Monounsaturated fat and polyunsaturated fat
- t. Hydrogenated shortening = Trans fat (NOTE: Some may contain other types of fat as well.)

Protein Research

Purpose

The purpose of this activity is to research complete and incomplete proteins.

Objectives

1. Identify food sources of complete proteins.
2. Identify food sources of incomplete proteins.
3. Research how the body uses proteins.

Materials

- ◆ lab sheet
- ◆ related references and textbooks
- ◆ computer with Internet access
- ◆ writing utensil

Procedure

1. Use your class notes, reference books, textbooks, and Web sites to answer the following questions about proteins.
2. Answer each question using complete sentences, and confine your answers to the space provided.
 - a. What is the total number of amino acids? How many amino acids are needed to make a complete protein?



- b. How many amino acids are termed “essential amino acids?” Why are these amino acids “essential?”
- c. How does the body use proteins?
- d. List five foods that contain incomplete proteins.
- e. List five foods that contain complete proteins.
- f. List two foods that are incomplete proteins that, when eaten together, make a complete protein.

Protein Research

- a. There are 22 amino acids, and all 22 are necessary to form a complete protein.
- b. Nine amino acids are considered essential because they must be consumed in the diet. Of the 22 amino acids, 13 are made in the body, and the others are called essential amino acids, which must be provided in the diet.
- c. Protein builds and repairs cells, tissue, and organs in the body. Hair and nails are nearly pure protein, and protein is an essential element in blood, bones, and skin.
- d. Answers will vary, but common responses include the following incomplete protein foods: nuts, seeds, beans, legumes, tofu, peas, and grains. Some incomplete proteins are found in vegetables.
- e. Answers will vary, but common responses will include the following complete protein foods. Animal (including red meats, fish, seafood, and poultry), dairy (including yogurt and cheese), and egg sources are considered complete proteins.
- f. Answers will vary, but common responses will include the following incomplete protein food combinations. Grains and legumes (e.g., whole wheat bread and peanut butter, rice and beans, and bean soup with whole grain crackers), grains and dairy (e.g., milk and cereal or cheese and whole grain crackers), or legumes and dairy (e.g., tofu in a cream sauce or nuts in ice cream) are incomplete proteins.

Carbohydrates Research and Written Report

Purpose

The purpose of this activity is to research dietary carbohydrates and vegetarian diets.

Objectives

1. Identify forms of carbohydrates in common foods.
2. Research a lacto-ovo vegetarian diet and a vegan diet.
3. Write a persuasive essay.
4. Follow the persuasive essay rubric.

Materials

- ◆ lab sheet
- ◆ related references and textbooks
- ◆ computer with Internet access and printer
- ◆ writing utensil

Procedure

1. Use your class notes, reference books, textbooks, and Web sites to research dietary carbohydrates.
2. Write a persuasive essay that will convince the reader a diet rich in carbohydrates is proper and healthy. Focus your paper on the following points:
 - a. Carbohydrate variety and numerous food choices
 - b. Overall benefits of carbohydrates versus fats and proteins



- c. Three “forms” carbohydrates can take
 - c. Benefits of each carbohydrate form
 - d. Benefits most important to good nutrition
 - e. Meeting protein needs with a lacto-ovo and a vegan diet
3. Persuasive Essay Rubric:
- a. Typed and printed
 - b. One to two pages in length
 - c. 1.5 line spacing
 - d. Convincing argument—A high-carbohydrate diet is a healthy diet.
 - e. Format:
 - (1) The opening paragraph presents your argument.
 - (2) The body of the paper focuses on your major persuasive points.
 - (3) The closing paragraph summarizes your argument.
 - f. Structure:
 - (1) Complete sentences
 - (2) Correct spelling
 - (3) Correct punctuation
 - (4) Correct grammar
4. Share your report findings with a small group. Take a few minutes to tell each other the most surprising facts you learned about carbohydrates.
5. Then share the small group findings with the entire class.
6. Turn in your completed persuasive essay to your instructor.