

MedLab: NUTRITION

AT A GLANCE

Students will calculate and visualize the amount of carbohydrates, proteins, and fats that are in their food, and learn how to interpret a nutrition label.

OBJECTIVES

Students will:

- Describe the characteristics of animal nutrition
- Calculate and visualize the amount of carbohydrates, proteins, and fats in their food
- Interpret a nutrition facts label

KEY VOCABULARY

metabolism, ingestion, digestion, absorption, elimination, nutrition, essential nutrients, non-essential nutrient, calories, proteins, amino acids, fats, fatty acids, vitamins, minerals, carbohydrates, United States Department of Agriculture (USDA), MyPlate, grains, vegetables, fruits, dairy, oils, nutrition facts label, serving size, cholesterol, percent daily value

SUGGESTED GRADE

LEVELS: 9—12

IL LEARNING GOALS

6.C, D; 7.A, C; 11.A; 12.A; 22.B; 23.A, B

NGSS

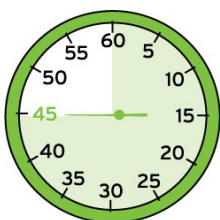
MS-LS1; HS-LS1

PACE YOURSELF

THREE 45 MINUTE PERIODS



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ADVANCE PREPARATION

1. Ensure that students know how to use an electric scale.
2. Determine a convenient location in your classroom for students to collect and measure sugar, protein powder, shortening and salt for *Part 1: What's in Your Food?*
3. Assign students to bring in a nutrition label before starting *Part 2: What's in a Nutrition Label?*
4. Determine how you will divide students into groups of 3-4.
5. Make copies of the student worksheet for every student.
6. Make copies of the *Fast Food Nutrition Guide* for each group.
7. Make copies of the *Part 2: What's in a Nutrition Label?* template on card stock for every student.



MATERIALS

Per Class:

5 Post-It® posters
Sugar
Shortening
Protein powder
Salt
4 Electric scales
Paper towels

Per Student:

Paper plate
Student worksheet
Part 2: What's in a Nutrition Label?
Nutrition labels (student supplied)
Calculator
Assorted markers

Per Group:

Set of markers
3"x3" Post-It® pad
Fast Food Nutrition Guide
4 Plastic cups
4 Spoons
Tape or glue stick



WHAT YOU NEED TO KNOW

Have you ever heard of the saying, "You are what you eat"? It is the modern form of Anthelme Brillat-Savarin's, a French lawyer and politician, saying, "Dis-moi ce que tu manges, je te dirai ce que tu es", which translates to "Tell me what you eat and I will tell you what you are".

Why do you think such a saying exists? Is there a direct connection

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between the food that we eat and what we are composed of? The scientific answer is yes—and no. Of the food that we ingest and digest, we can either absorb or eliminate the food components. The food components that we absorb can be used as fuel for our **metabolism**, which includes chemical reactions that convert energy from food to energy for life processes, or as building blocks for our bodies. The food components that cannot be used by our bodies for energy or as building materials will be eliminated from the body into the environment.

Refer to Figure 1 to see the four stages of food processing. The first step is **ingestion**, or the physical act of eating or feeding. The second step is **digestion**, where food is broken down into smaller components. Afterwards, the food components can either undergo **absorption** where they are taken up by cells and used for metabolism or as building blocks. Other food components that cannot be used by the body undergo **elimination** where they are excreted into the environment. The first three steps of this process is considered animal **nutrition**.

Of the food molecules that we can absorb and use, we will focus on essential nutrients: proteins, fats, vitamins and minerals, and one non-essential nutrient: carbohydrates. **Essential**

nutrients are materials that our bodies require to ensure normal and efficient functioning, but cannot produce on their own. **Non-essential nutrients** are materials that our bodies can assemble from other food components. Proteins, fats and carbohydrates provide us **Calories** (also known as a “food calorie” or kilocalorie), or the amount of energy required to raise one kilogram of water by one degree Celsius. Additionally, proteins serve as building blocks for our bodies. Vitamins and minerals do not provide us Calories, but they are considered vital to our diet because they assist with enzyme functioning and homeostasis, or internal balance.

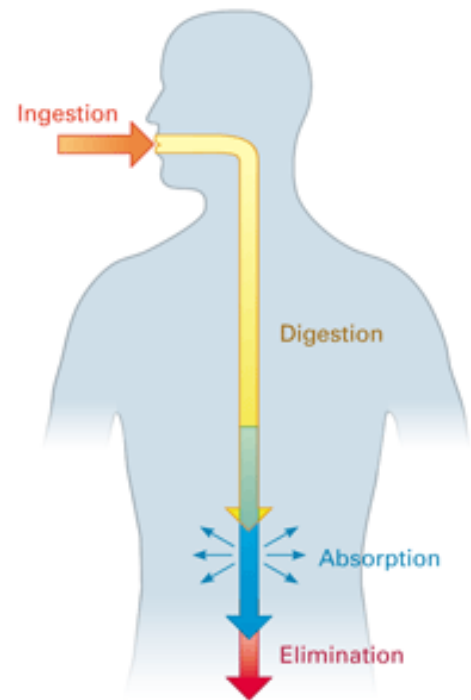
Figure 2: Complete sources of protein



healthandwellnesssource.org

The following paragraphs will detail the essential nutrients: proteins, fats, vitamins and minerals. **Proteins** are large organic molecules that are made up of components called **amino acids**. There are many different amino acids. They can be used as fuel for metabolism, but are mostly used as building blocks for the body. When used as fuel for metabolism, one gram of proteins provides us four Calories. When used as building blocks, proteins make up our cells, tissues, and organs. In terms of nutrition, we classify proteins, specifically amino acids, into three categories: essential amino acids, non-essential amino acids, and conditional amino acids. *Essential amino acids* cannot be produced by the human body, therefore must be a part of our diet. Nine of the 22 amino acids are considered essential amino acids: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Foods from animal sources, such as meat, eggs, and cheese, are complete sources of essential amino acids because they contain all nine essential amino acids (Figure 2). Foods from plant sources, such as corn and beans, are incomplete sources of essential amino acids because they contain less than the nine essential amino acids. *Non-essential amino acids* are amino acids that our bodies can produce. Four of the 22 amino acids are con-

Figure 1: Four stages of food processing



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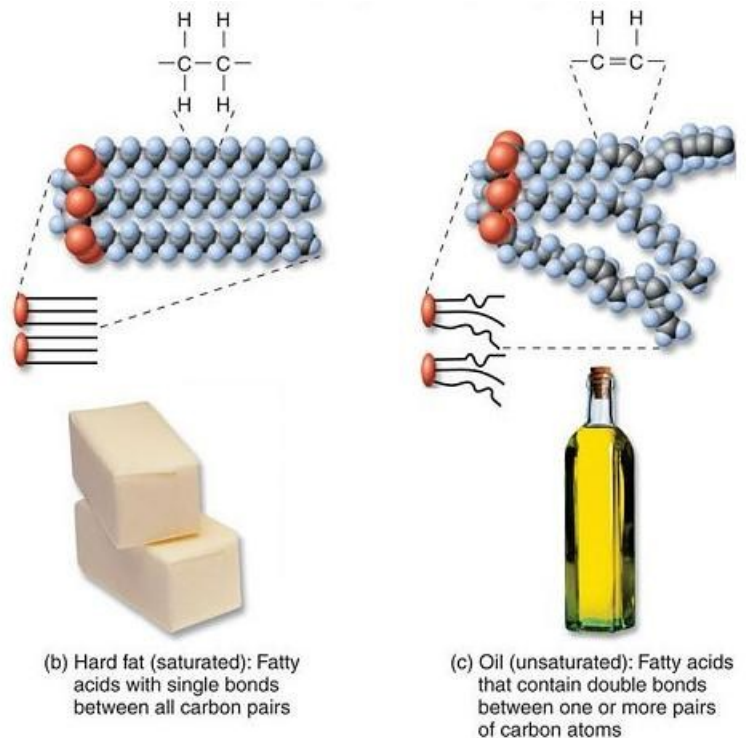
sidered non-essential amino acids: alanine, asparagine, aspartic acid, and glutamic acid. *Conditional amino acids* are amino acids that are needed in times of illness and stress. Seven of the 22 amino acids are considered conditional amino acids: arginine, cysteine, glutamine, tyrosine, glycine, ornithine, proline, and serine.

Fats are large organic molecules that are made up of components called glycerol and fatty acids. When used as fuel for metabolism, one gram of fat provides us nine Calories. When used as structural material, fats make up our cell membranes and also provide our bodies with insulation from cold temperatures. We will focus on fatty acids in this lesson. **Fatty acids** are molecules composed of long chains of carbon and hydrogen atoms. These chains are non-polar and do not mix well with water. In *saturated fatty acids*, there are only single bonds between the carbon and hydrogen atoms. These molecules are “flat” and can be easily compressed into solids at room temperature. An example of a saturated fatty acid is butter. In *unsaturated fatty acids*,

we can find both single and double bonds between the carbon and hydrogen atoms. These molecules have a “kink” in their structure and cannot be easily compressed into solids at room temperature, thus are liquids at room temperature. An example of an unsaturated fatty acid is olive oil. Sometimes we see the terms “hydrogenated fat” or “trans fat” on nutrition labels. This means that hydrogen atoms have been added to an unsaturated fatty acid to turn the double bonds into single bonds, thus “flattening” the molecule. The molecule can now become a solid at room temperature and will have a longer shelf life. Examples of these types of fats are found in some peanut butters and margarine. A diet high in saturated fatty acids, “hydrogenated fats”, or “trans fats” can lead to arteriosclerosis—the clogging of blood vessels.

Vitamins are organic molecules that are only needed in small quantities in our diets, but have diversified functions in our bodies. For example, vitamin C is necessary in the production of connective tissue while vitamin K is important for the proper blood clotting. The Nobel Prize winning physiologist Albert Szent-Györgyi famously stated, “A vitamin is a substance that makes you ill if you don’t eat it.” Humans need 13 different types of vitamins in varying daily amounts from 0.01-100 mg. Vitamins do not provide us Calories. Nine of the 13 are *water-soluble vitamins*: B₁ (thiamine), B₂ (riboflavin), B₃ (niacin), B₅ (pantothenic acid), B₆ (pyridoxine), B₇ (biotin), B₉ (folic acid), B₁₂ (cobalamin), and C (ascorbic acid). Four of the 13 are *fat-soluble vitamins*: A (retinol), D, E (tocopherol), and K (phyloquinone). For the most part, overconsumption of water-soluble vitamins is harmless because they can be flushed out with our urinary system. *Fat-soluble vitamins* are not as easily removed from our bodies because they are deposited into our body fat, therefore overconsumption can be toxic. Figures 4 and 5 on the next page details water-soluble and fat-soluble vitamins, where they can be found, major functions in the body, and symptoms of deficiency and excess.

Figure 3: Saturated and unsaturated fatty acids



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Figure 4: Water soluble vitamins requirements in humans summary

Table 41.1 Vitamin Requirements of Humans: Water-Soluble Vitamins

Vitamin	Major Dietary Sources	Some Major Functions in the Body	Possible Symptoms of Deficiency or Extreme Excess
Water-Soluble Vitamins			
Vitamin B ₁ (thiamine)	Pork, legumes, peanuts, whole grains	Coenzyme used in removing CO ₂ from organic compounds	Beriberi (nerve disorders, emaciation, anemia)
Vitamin B ₂ (riboflavin)	Dairy products, meats, enriched grains, vegetables	Component of coenzymes FAD and FMN	Skin lesions such as cracks at corners of mouth
Niacin	Nuts, meats, grains	Component of coenzymes NAD ⁺ and NADP ⁺	Skin and gastrointestinal lesions, nervous disorders Flushing of face and hands, liver damage
Vitamin B ₆ (pyridoxine)	Meats, vegetables, whole grains	Coenzyme used in amino acid metabolism	Irritability, convulsions, muscular twitching, anemia Unstable gait, numb feet, poor coordination
Pantothenic acid	Most foods: meats, dairy products, whole grains, etc.	Component of coenzyme A	Fatigue, numbness, tingling of hands and feet
Folic acid (folacin)	Green vegetables, oranges, nuts, legumes, whole grains (also made by colon bacteria)	Coenzyme in nucleic acid and amino acid metabolism	Anemia, gastrointestinal problems May mask deficiency of vitamin B₁₂
Vitamin B ₁₂	Meats, eggs, dairy products	Coenzyme in nucleic acid metabolism; needed for maturation of red blood cells	Anemia, nervous system disorders
Biotin	Legumes, other vegetables, meats	Coenzyme in synthesis of fat, glycogen, and amino acids	Scaly skin inflammation, neuro-muscular disorders
Vitamin C (ascorbic acid)	Fruits and vegetables, especially citrus fruits, broccoli, cabbage, tomatoes, green peppers	Used in collagen synthesis (e.g., for bone, cartilage, gums); antioxidant; aids in detoxification; improves iron absorption	Scurvy (degeneration of skin, teeth, blood vessels), weakness, delayed wound healing, impaired immunity Gastrointestinal upset

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Figure 5: Water soluble vitamins requirements in humans summary

Table 41.1 Vitamin Requirements of Humans: Fat-Soluble Vitamins

Vitamin	Major Dietary Sources	Some Major Functions in the Body	Possible Symptoms of Deficiency or Extreme Excess
Fat-Soluble Vitamins			
Vitamin A (retinol)	Provitamin A (beta-carotene) in deep green and orange vegetables and fruits; retinol in dairy products	Component of visual pigments; needed for maintenance of epithelial tissues; antioxidant; helps prevent damage to lipids of cell membranes	Vision problems; dry, scaling skin Headache, irritability, vomiting, hair loss, blurred vision, liver and bone damage
Vitamin D	Dairy products, egg yolk (also made in human skin in presence of sunlight)	Aids in absorption and use of calcium and phosphorus; promotes bone growth	Rickets (bone deformities) in children, bone softening in adults Brain, cardiovascular, and kidney damage
Vitamin E (tocopherol)	Vegetable oils, nuts, seeds	Antioxidant; helps prevent damage to lipids of cell membranes	None well documented in humans; possibly anemia
Vitamin K (phyloquinone)	Green vegetables, tea (also made by colon bacteria)	Important in blood clotting	Defective blood clotting Liver damage and anemia

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Minerals are inorganic nutrients that are similar to vitamins in that they are only needed in small amounts but have diversified functions in the human body. For example, potassium is important in proper nerve functioning and calcium is essential in bone health and maintenance. Minerals are also similar to vitamins in that they do not provide us Calories. Overconsumption of minerals can lead to health issues. A diet high in salty foods, thus high in sodium, can lead to high blood pressure. Additionally, a diet high in ex-

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cess iron can lead to nausea and even liver damage. Figure 6 details several minerals, where they can be found, major functions in the body, and symptoms of deficiency.

Figure 6: Mineral requirements of humans summary

Mineral	Major Dietary Sources	Some Major Functions in the Body	Possible Symptoms of Deficiency*
Calcium (Ca)	Dairy products, dark green vegetables, legumes	Bone and tooth formation, blood clotting, nerve and muscle function	Retarded growth, possibly loss of bone mass
Phosphorus (P)	Dairy products, meats, grains	Bone and tooth formation, acid-base balance, nucleotide synthesis	Weakness, loss of minerals from bone, calcium loss
Sulfur (S)	Proteins from many sources	Component of certain amino acids	Symptoms of protein deficiency
Potassium (K)	Meats, dairy products, many fruits and vegetables, grains	Acid-base balance, water balance, nerve function	Muscular weakness, paralysis, nausea, heart failure
Chlorine (Cl)	Table salt	Acid-base balance, formation of gastric juice, nerve function, osmotic balance	Muscle cramps, reduced appetite
Sodium (Na)	Table salt	Acid-base balance, water balance, nerve function	Muscle cramps, reduced appetite
Magnesium (Mg)	Whole grains, green leafy vegetables	Cofactor; ATP bioenergetics	Nervous system disturbances
Iron (Fe)	Meats, eggs, legumes, whole grains, green leafy vegetables	Component of hemoglobin and of electron-carriers in energy metabolism; enzyme cofactor	Iron-deficiency anemia, weakness, impaired immunity
Fluorine (F)	Drinking water, tea, seafood	Maintenance of tooth (and probably bone) structure	Higher frequency of tooth decay
Zinc (Zn)	Meats, seafood, grains	Component of certain digestive enzymes and other proteins	Growth failure, scaly skin inflammation, reproductive failure, impaired immunity
Copper (Cu)	Seafood, nuts, legumes, organ meats	Enzyme cofactor in iron metabolism, melanin synthesis, electron transport	Anemia, bone and cardiovascular changes
Manganese (Mn)	Nuts, grains, vegetables, fruits, tea	Enzyme cofactor	Abnormal bone and cartilage
Iodine (I)	Seafood, dairy products, iodized salt	Component of thyroid hormones	Goiter (enlarged thyroid)
Cobalt (Co)	Meats and dairy products	Component of vitamin B ₁₂	None, except as B ₁₂ deficiency
Selenium (Se)	Seafood, meats, whole grains	Enzyme cofactor; antioxidant functioning in close association with vitamin E	Muscle pain, possibly heart muscle deterioration
Chromium (Cr)	Brewer's yeast, liver, seafood, meats, some vegetables	Involved in glucose and energy metabolism	Impaired glucose metabolism
Molybdenum (Mo)	Legumes, grains, some vegetables	Enzyme cofactor	Disorder in excretion of nitrogen-containing compounds

*All of these minerals are also harmful when consumed in excess.

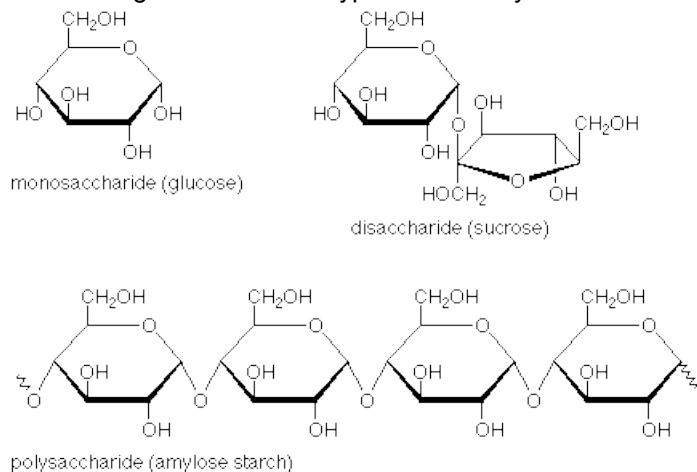
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Non-essential nutrients include **Carbohydrates**—organic molecules made up of sugars or chains of sugars. (External sources of carbohydrates are “non-essential” because humans can metabolize other materials to perform the same nutritional functions.) *Monosaccharides*, like glucose and fructose, are single sugar units. *Disaccharides*, like sucrose and lactose, are made up of two sugar units linked together. *Polysaccharides*, like glycogen (in animals) and starch (in plants), are made up of many sugar units linked together. See Figure 7 on the next page for molecular representations of these different types of carbohydrates. When used as fuel for metabolism, one gram of carbohydrates provides us four Calories.

Carbohydrates can serve as a structural molecule in plants, but not in animals where it is usually stored in long chains as future fuel for metabolism. Plants have special organelles called cell walls, which are made of structural carbohydrates called cellulose. This is what gives plant cells the necessary rigidity to stand upright without the presence of a skeleton. Humans can ingest cellulose, or more popularly known as dietary fiber, but cannot digest or absorb it. Although dietary fiber is eliminated, it is an important part

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Figure 7: Different types of carbohydrates



chemistry2.csudh.edu

carbohydrates in the human body difficult. Often, the body will convert excess carbohydrates into another chemical called acetyl-CoA that is a precursor of fatty acids. Fatty acids do not dissolve in water and therefore are more compact in the human body. The overconsumption of carbohydrates will lead to the conversion of carbohydrates to fats, and fats are more difficult for the body to use as fuel.

Now that we've learned about the different types of nutrients, how can we apply this knowledge to real life? Also, how can we use this knowledge to help us make healthy eating decisions? The **United States Department of Agriculture (USDA)** is the federal department responsible for developing and carrying out policies on farming, agriculture, forestry and food. In 2011, the USDA published a tool called **MyPlate**, which is an updated version of food pyramids that we may be accustomed to seeing in educational and medical settings. The USDA states that "MyPlate illustrates the five food groups that are the building blocks for a healthy diet using a familiar image—a place setting for a meal." MyPlate recommends a daily diet composed of 30% grains, 20% proteins, 30% vegetables, and 20% fruits. A smaller serving of dairy is recommended. Take note that these amounts vary with several factors including gender, age, level of physical activity, pregnancy, and state of health.

Grains are any food product made from wheat, rice, oats, cornmeal, barley or another cereal grain and are usually high in carbohydrates. Bread, pasta, and breakfast cereals are examples of grain products. Grains can be divided into two categories: whole grains and refined grains. *Whole grain* food products contain the entire grain kernel. Examples are whole-wheat flour, oatmeal, and brown rice. Refined grain food products contain part of the grain kernel. This process elongates the shelf life of the food, but it removes important nutrients such as many forms of vitamin B, the mineral iron, and dietary fiber. Examples are white flour, white

of a healthy diet. It scrapes the walls of our digestive system and stimulates the secretion of mucus. The mucus assists in the efficient transport of food components that need to be eliminated. Without sufficient amounts of dietary fiber, humans can experience constipation, which if left unchecked can lead to the toxic build up of feces inside our bodies. Although our bodies metabolize carbohydrates over proteins and fats because it is easier to do so, the overconsumption of carbohydrates can lead to health issues such as diabetes and weight gain. Carbohydrates are polar molecules have an affinity to water, thus easily dissolve in it. This makes long-term storage of

Figure 8: MyPlate

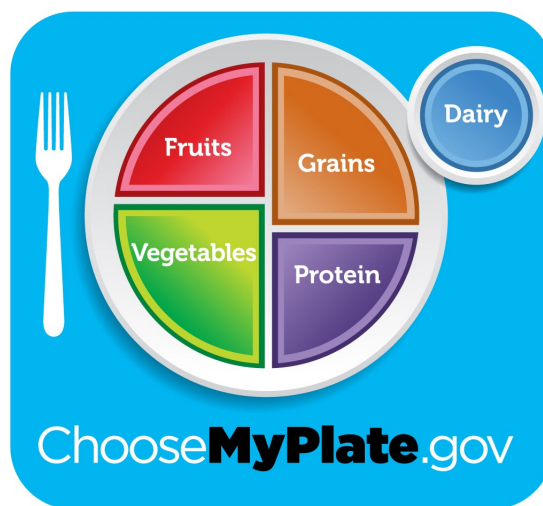


Figure 9: Examples of grain food products



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bread, and white rice. It is recommended that at least half of our intake of grains includes whole grains. Having a balanced serving of grains in our diets may decrease the chances of heart disease and prevent constipation. And whole grains that are rich in vitamin B9 (folic acid or folate) may prevent neural tube defects in developing fetuses.

Recall that proteins are large organic molecules that are made up of components called amino acids. *Essential amino acids* cannot be produced by the human body, therefore must be a part of our diet. Nine of the 22 amino acids are considered essential amino acids: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Foods such as meat, eggs, quinoa, soy and cheese, are complete sources of essential amino acids because they contain all nine essential amino acids. The USDA recommends that eating proteins from animal sources should be lean or low fat. Most foods from plant sources, such as corn and beans, are incomplete sources of essential amino acids because they contain less than the nine essential amino acids. Proteins are important because amino acids are the building blocks of our bodies. Furthermore, foods high in proteins are rich in B vitamins, vitamin E, and the minerals iron, magnesium and zinc. Seafood is particularly high in omega-3 fatty acids, which reduce inflammation in the human body, help lower blood pressure, and may also assist with health issues such as rheumatoid arthritis and depression.

A **vegetable** is the edible part of a plant. Vegetables can be separated into five categories: dark green vegetables (e.g. broccoli and spinach), starchy vegetables (e.g. corn and potatoes), red and orange vegetables (e.g. carrots and tomatoes), beans and peas (e.g. lentils and soy beans), and other vegetables (e.g. garlic and onions). Vegetables can be good sources of carbohydrates and proteins, but they tend to be lower in fats. Vegetables are rich in vitamins B9 (folic acid or folate), vitamins A and C; the mineral potassium and dietary fiber. The benefits of having vegetables as a part of a balanced diet include reducing the risk of heart disease, high blood pressure, many types of cancers, obesity, and type 2 diabetes. Also, vegetable-rich diets can prevent the formation of kidney stones and prevent bone density loss.

Figure 10: Examples of vegetables and fruits



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Fruits are the flowering part of a plant and are the way that a plant spreads its seeds. Fruit food products can come in many forms such as fresh, canned, frozen, dried, and juiced. Examples include apples, strawberries, bananas, avocados, cucumbers, and squashes. Fruits are rich in carbohydrates, but tend to be lower in proteins and fats. Fruits are a good source of the vitamin C, vitamin B9 (folic acid or folate), the mineral potassium, and dietary fiber. The benefits of a balanced diet with fruits is very similar to the benefits described for vegetables. It is important to note that the USDA recommends that half of our diet is composed of vegetables and fruits.

Dairy food products include milk and anything produced from milk. Examples are cow milk, goat milk, cheese, yogurt, and milk-based desserts such as ice cream and frozen yogurt. The USDA recommends that we should choose dairy products that are low-fat or fat-free. These dairy products are usually high in the mineral calcium. Some dairy products that are high in fats, such as butter, cream, and cream cheese are usually not a good source of calcium. Sometimes, overindulgence of these products may lead to arteriosclerosis. The mineral calcium is integral in bone health, especially in children, and may reduce the risk of osteoporosis. In order to

Figure 11: Examples of dairy products



news.brown.edu

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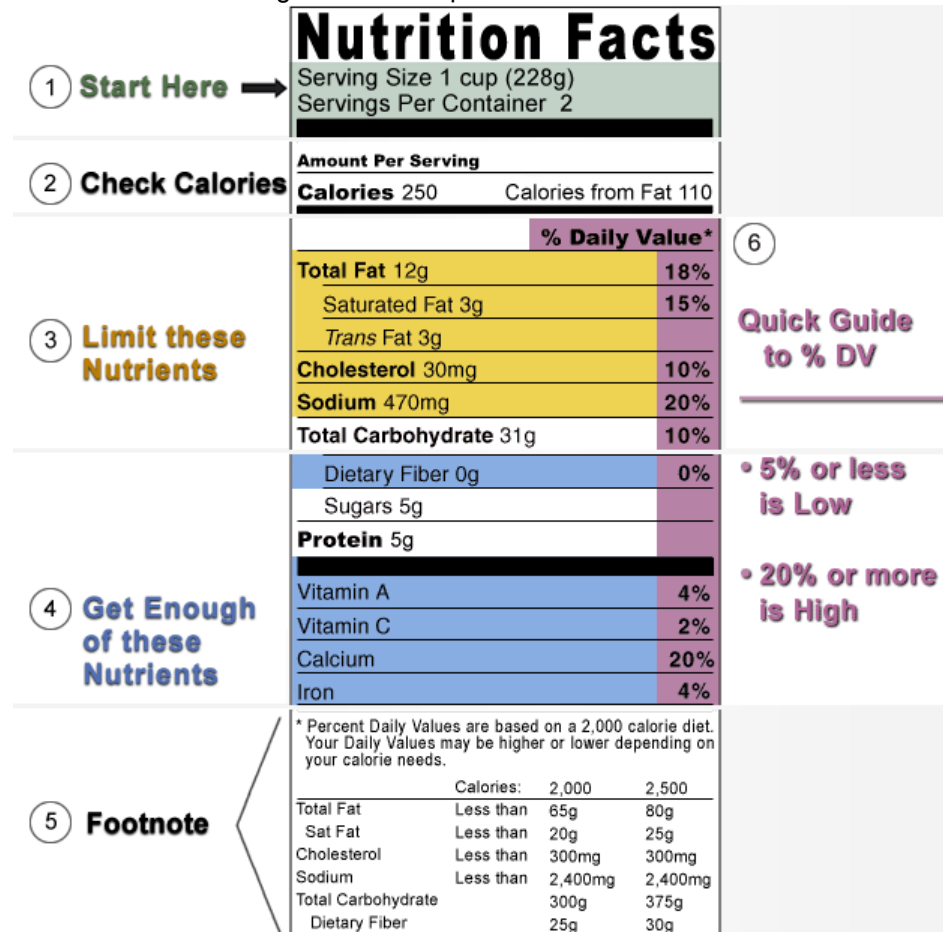
absorb calcium, vitamin D must be present. Thankfully, dairy products also serve as a rich source of vitamin D. Dairy is a good source of carbohydrates, mostly because it contains the “milk sugar” lactose. It also contains a good amount of protein because it is an animal product. A balanced diet with dairy food products may reduce the risk of heart disease, high blood pressure, and type 2 diabetes.

Vegetarians and vegans avoid some or all animal products. They can still eat a healthy diet while getting their nutrients from a different balance of foods. Their proteins may come from dairy, beans, nuts and grains. Their vitamin D can come from sun exposure and mushrooms. They may also take supplements. Variety and healthy choices are essential for everyone no matter what their lifestyle.

Now that we are aware of the different types of nutrients and the different amounts of nutrients that our bodies need on a daily basis, how do we make informed choices about having a healthy diet? The best place to start is by looking at nutrition facts labels. **Nutrition facts labels** are packaging labels that make it easier for consumers to determine the amount of nutrients in the food product, and to compare one food product to another. The nutrition facts label shown below is from a package of macaroni and cheese. It is essential to

know how to read a nutrition facts label to achieve a healthy diet.

Figure 12: Example nutrition facts label



fda.gov

We can analyze a nutrition facts label by first looking at the serving size section at the top of the label. The **serving size** is the amount of food that is used as reference on a nutrition facts label. It is important

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to note that some food products contain more than one serving size. This nutrition facts label uses one cup as a reference, but the entire package of macaroni and cheese contains two servings, or two cups:

$$\frac{1 \text{ cup}}{\text{serving}} \times 2 \text{ servings} = 2 \text{ cups}$$

The next item down the label is the amount of Calories. For each cup of macaroni and cheese, the consumer will consume 250 Calories. If the consumer eats the entire package of macaroni and cheese, the consumer will consume 500 Calories:

$$2 \text{ servings} \times \frac{250 \text{ calories}}{\text{serving}} = 500 \text{ calories}$$

Below the Calories section, we see the nutrients that we should limit and are highlighted in yellow: fats (saturated and trans), cholesterol, and sodium. Fats (saturated and trans), sodium, and total carbohydrates were covered earlier in this section. **Cholesterol** is a large lipid molecule that is mainly produced in our liver, and also comes from the food that we eat. Cholesterol only comes from animal sources and is an important component in our cell membranes and cell signaling. There are two types of cholesterol: high-density lipoprotein (HDL) and low-density lipoprotein. *High-density lipoprotein (HDL)* is considered “good cholesterol” because it can reduce risk of heart disease. *Low-density lipoprotein (LDL)* is considered “bad cholesterol” because it can cause arteriosclerosis, or the clogging of arteries.

Refer to the blue highlighted portion of the nutrition facts label. These nutrients are dietary fiber, vitamins and minerals. Recall that these nutrients do not provide us Calories, but are still an essential part of a healthy diet. The non-highlighted items include carbohydrates and proteins.

The bottom section of the nutrition facts label states that the values we see on the label are based on a 2,000 Calorie diet. The amount of Calories that someone consumes depends on many factors such as gender, age, level of physical activity, pregnancy, and state of health. Take these factors into consideration when analyzing a nutrition facts label and making dietary choices.

The right side of the nutrition facts label outlines the percent daily value of some nutrients. **Percent daily values** tell us how much of the nutrient found in one serving of a food product provides us our daily needs of the nutrient. For example, one serving of the macaroni and cheese will provide the consumer 31 grams of carbohydrates, or 10% of our daily need of carbohydrates. We can calculate the total daily value of carbohydrates we need:

$$\begin{aligned} \frac{31 \text{ grams}}{x \text{ grams}} &= \frac{10\%}{100\%} \\ 10x &= 3100 \\ x &= 310 \text{ grams} \end{aligned}$$

It is important to note that food manufacturers do not have to report substances that are lower than 0.5 grams (g). Therefore if there is 0.4 g of trans fat in a food product, the manufacturer can report it as 0 g. Additionally, any values between 0.5 g—5.0 g should be rounded to the nearest half gram. Any values above 5.0 g should be rounded to the nearest whole gram. Although this simplifies a nutrition facts label, it makes it more challenging to get precise calculations.

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WARM UP

1. Before your class comes in, have a paper plate for each student and coloring utensils set up at their tables. Label the board into 6 different sections with headings that read: Fruit, Vegetable, Grain, Protein, Dairy, and Other.
2. Explain to the class that today we will be talking about nutrition, food groups, and how to make healthy choices at fast food restaurants.
3. Have each student take a paper plate and give them about five minutes to draw and label a picture of their favorite meal, side dishes, desserts, and drinks included.
4. Have students perform a think, pair, share with the person sitting next to them to discuss their drawings.
5. Briefly go over the food groups/portion plate and the importance of having a well balanced diet. Ask students to try and identify the foods they have drawn on their plates. Have students write down each item on a separate post it note and then have them stick their post its under the appropriate heading on the board. (Fruit, vegetable, grain, protein, dairy, other)
6. Discuss the foods that were posted up on the board. Ask students if all of the sections are filled equally. Are there a lot of items in the "other" column? Is the other column good for our bodies? Why is it important to have an equal amount of all food groups in our everyday diets?



ACTIVITY

Part 1: What's in Your Food?

1. Divide the classroom into groups of three to four students. Give each group a McDonald's Nutrition Guide. Give each student the student worksheets.
2. Have students look at the McDonald's Nutrition Guide with their group and choose one meal (a main entrée, side dish, beverage, and dessert) that their group would order if they could have anything they wanted. Students should write down their menu choices from the McDonald's Nutrition Guide and list each item in the "Food Item" column in the chart on their student worksheet.
3. First, have the students total the number of Calories they will be consuming in their meal. Record the number of Calories and compare it to a 2,000 Calorie diet.
4. Have students find the columns marked "Protein" in their McDonald's Nutrition Guide. They should record the amount of protein for each item in the chart on their student worksheet.
5. Have students find the columns marked "Total Fat" in their McDonald's Nutrition Guide. They should record the amount of fat for each item in the chart on their student worksheet.
6. Have students find the column marked "Total Carbs" for each menu item they chose. Have them record the amount of carbs for their meal in the chart.
7. Have students find the column marked "Sodium" for each menu item they chose. Have them record the amount of sodium for their meal in the chart.
8. Have students add up the total amounts of Calories, protein, fats, carbs, and sodium that their meal contains and write it in their chart.
9. Next, ask students to convert the grams of protein, fat, and carbs in their meal to teaspoons by multiplying the total grams of each by $\frac{1}{4}$ (or 0.25): _____ grams X 0.25 = _____ tsp.

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10. In order to calculate the amount of salt in their meals, students use the fact that there are 2,300 mg of sodium in each teaspoon of salt. Therefore:
$$\frac{\text{mg of sodium}}{2,300 \text{ mg of sodium}} = \text{teaspoons of salt}$$
11. Once they have figured out the amount of salt in teaspoons, students should use a teaspoon to measure out that amount of salt and put it in an empty plastic cup. This represents the amount of salt they would be eating in the meal they have selected.
12. Have students do the same thing for the sugar in their meal. After they figure out how many teaspoons of sugar their meal has, have them measure out that amount in teaspoons and put it into a second empty cup.
13. Lastly, have students do the same thing for the fat in their meals. Use a teaspoon to measure out the amount of shortening and put that shortening into the third empty cup. The shortening represents the amount of fat they would be eating in the meal they chose. Students can use the craft stick to help get the shortening off of their spoons.
14. Have students turn over their paper plates they started with in the warm up. Give students 5-10 minutes to create a new plate that is nutritious based upon what they learned from the lesson as well as a short quick write explaining why the changes they made were necessary and why.

Part 2: Analyzing Food Labels

1. Ask students to collect nutrition labels before you begin this part of the lesson. Ask them to locate a nutrition label that is high in carbohydrates, fats, or proteins. The Food and Drug Administration identifies a food high in a nutrient when it is around 20% of your daily value.
2. Once students locate an appropriate nutrition label, they should carefully cut it from the rest of the food packaging, clean it (if necessary), and note the name of the food product.
3. First, instruct students to turn to the Part 2: Analyzing Food Labels section of their student worksheets. They will either tape or glue their nutrition label to the appropriate box.
4. Next, they will answer the questions that follow. Some of the questions will require them to show their calculations.
5. As they answer the questions, they will also have to circle the appropriate items on their nutrition labels using different colors.



CHECK FOR UNDERSTANDING

1. What is metabolism? *The chemical reactions that convert energy from food to energy for life processes, or as building blocks for our bodies.*
2. What are the four stages of food processing? *Ingestion, digestion, absorption, and elimination.*
3. Which of the four stages of food processing is considered nutrition? *The first three stages: ingestion, digestion, and absorption.*
4. What is the difference between essential and non-essential nutrients? *Essential nutrients are materials that our bodies require to ensure normal and efficient functioning, but cannot produce on their own. Non-essential nutrients are materials that our bodies can assemble from other food components.*
5. What are some examples of essential nutrients? *Proteins, fats, vitamins and minerals.*

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6. What are an example of a non-essential nutrient? *Carbohydrates.*
7. Which food materials provide us Calories and how many calories do they provide per gram? *Fats: 9 Calories/gram, proteins; 4 calories/gram, and carbohydrates: 4 Calories per gram.*
8. List some characteristics of proteins. *Answers will vary. They are large organic molecules that are made up of components called amino acids. There are 20 different amino acids. They can be used as fuel for metabolism, but are mostly used as building blocks for the body.*
9. List some characteristics of fats. *Answers will vary. They are large organic molecules that are made up of components called glycerol and fatty acids. They can be used as fuel for metabolism or as structural material. When used as structural materials, fats make up our cell membranes and also provide our bodies with insulation from cold temperatures.*
10. List some characteristics of vitamins. *Answers will vary. They are organic molecules that are only needed in small quantities in our diets, but have diversified functions in our bodies.*
11. List some characteristics of minerals. *Answers will vary. They are inorganic nutrients that are similar to vitamins in that they are only needed in small amounts but have diversified functions in the human body.*
12. List some characteristics of carbohydrates. *Answers will vary. They are organic molecules made up of sugars or chains of sugars. Monosaccharides, like glucose and fructose, are single sugar units. Disaccharides, like sucrose and lactose, are made up of two sugar units linked together. Polysaccharides, like glycogen (in animals) and starch (in plants), are made up of many sugar units linked together.*
13. Which five food groups, and what quantities, are recommended by MyPlate? *MyPlate recommends a daily diet composed of 30% grains, 20% proteins, 30% vegetables, and 20% fruits. A smaller serving of dairy is recommended.*
14. List some factors that affect MyPlate. *Gender, age, level of physical activity, pregnancy, and state of health.*
15. What are some examples of grains? *Bread, pasta, and breakfast cereals.*
16. What are some examples of proteins? *Meat, eggs, cheese, corn and beans.*
17. What are some examples of vegetables? *Dark green vegetables (e.g. broccoli and spinach), starchy vegetables (e.g. corn and potatoes), red and orange vegetables (e.g. carrots and tomatoes), beans and peas (e.g. lentils and soy beans), and other vegetables (e.g. cucumbers and onions).*
18. What are some examples of fruits? *Apples, strawberries, bananas, raisins, prunes, and orange juice.*
19. What are some examples of dairy? *Cow milk, goat milk, cheese, yogurt, ice cream, pudding, and frozen yogurt.*
20. Describe a nutrition facts label. *Packaging labels that make it easier for consumers to determine the amount of nutrients in the food product, and to compare one food product to another.*



WHAT'S HAPPENING?

Through the Warm Up and two Activities, students will be able to evaluate their meal selection by visualizing the amount of proteins, fats, carbohydrates, and sodium. After visualizing the content of these nutrients in their meal choices, they can make more informed and healthier choices in the future. Additionally, students will learn about the five food groups and their recommended daily quantities from MyPlate. They

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will analyze nutrition facts labels, which will also help them make more informed and healthier choices in the future.



DIFFERENTIATED INSTRUCTION

- Provide students with calculators to assist in the math calculations.
- Provide groups with menus from different restaurants. Have them look up the ingredients for each food item and complete estimated nutrition facts labels of their own.
- To illustrate the difference between the consumption of proteins, fats, carbohydrates, and sodium in the chosen meals and the recommended daily allowances (RDA), measure out the RDA's for sugar, salt, and fat and show them to the class after they have completed the activity.
- Instead of giving the students the full nutrition guide, you can preselect four menu items for each group and their food labels along with a food picture and allow students to make calculations based upon your choices.
- You can distribute one nutrition facts label to the entire class and walk them through the identification and calculations.
- You can ask students to bring in three different nutrition facts labels: one high in proteins, one high in fats, and one high in carbohydrates.



EXTENSIONS

LANGUAGE ARTS

- Create a classroom *blog* for students to take pictures of a healthy lunch or snack and have them include a caption of why the picture is a healthy meal choice. This can give students a chance to teach each other about proper nutrition and why it is important.
- Have students create a healthy menu for a meal or a whole day and describe their foods. What words can they use to make their dishes sound extra delicious (tantalizing, savory, creamy)?

MATH

Health agencies and nutrition experts recommended that no more than 20% of the total fat intake in a day be from saturated fat. That is, if you consume 60 grams of fat in a day, only 12 of those grams should be from saturated fat. Look at the fat and saturated fat values for the items you selected during the activity and calculate what percentage of the total fat of each item is from saturated fat. Do the items follow the recommendations of health agencies and nutrition experts? Have students explain their answers.



DIGITAL RESOURCES

- Log onto www.msichicago.org and have students explore the *Would you Eat That?* application by trying to figure out what ingredients make up certain food and drinks. Also, experience the *Chew or Die App* for your phone which challenges students to make healthy food choices!
<http://www.msichicago.org/online-science/games-and-apps/>
- Show your students the movie *Supersize Me* and discuss long term effects of consuming fast food regularly.

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- Show your students the movie *Food, Inc.* and discuss how modern Americans grow and get their food.
- Illinois Central College's Stages of Digestion interactive:
<http://faculty.icc.edu/instructionaldesign/digestion/digestive3.html>
- McGraw Hill's "Biochemical Pathways—Cellular Respiration" textbook excerpt:
https://highered.mcgraw-hill.com/sites/dl/free/0072986573/343029/Eng12e_ch06.pdf
- Several fast food restaurants have posted important nutrition information on their websites:
<http://www.tacobell.com/nutrition>
<http://www.mcdonalds.com/usa/eat.html>
<http://www.kfc.com/nutrition/>
- This website allows you to search a database of fast food choices and sort them by restaurant name, nutritional content, Calories, fat, etc:
<http://www.fastfoodfacts.info/>



RELATED EXHIBITS

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