



# YOUNG VOICES:

Life With Diabetes

## Lesson 1: Sources of Energy in the Diet

**Inquiry Focus:** Where is the energy in food?

**Student Learning Objectives:** By the end of the lesson, students will be able to do the following

- Give examples of how energy is used by the body
- List the 3 sources of energy in the diet and several foods that are good sources of each
- Describe how each of the 3 sources differ
- Recognize the amount of fats, proteins, and carbohydrates in a food from the nutrition information label on food packaging

**Time Frame:** 1 class period (extended if students do additional research)

### Materials:

- Packaged foods with nutrition labels (clean empty boxes and cans are o.k.)
- Access to a computer or a printout from How Stuff Works web page on 45 Common Foods and the Number of Calories They Contain: <http://recipes.howstuffworks.com/45-common-foods-and-the-number-of-calories-they-contain.htm> (The website has a printer-friendly version available.)
- Access to a computer or a printout from the Nutrition Facts Label Overview from the USFDA web site: <http://www.cfsan.fda.gov/~dms/foodlab.html> (The website has a printer-friendly version available.)
- Access to a computer and the spreadsheet file provided with this lesson's resources

### Teacher Background Information:

- The body uses energy every moment of every day for important life functions that we usually don't think about, such as breathing and repairing bones. Energy is also used for thinking, seeing, standing up from a desk, running a marathon, and playing a game of basketball.
- The food we eat provides energy, but the body can use only certain components of food as energy. The three main sources of energy in food are fats, proteins, and carbohydrates. Much like a fireplace burns different fuels, the body can use any of these as energy, although they do burn differently.
  - The word “**fats**” may bring up associations with the specialized tissue that stores them,

called “adipose” tissue. Fats are a group of substances often used by animals to store energy, and for this reason they are dense in energy. Chemically, fats generally consist of a backbone of “glycerol” and three long chains made of carbon and hydrogen called “fatty acids.” Whether a fat is solid or liquid at room temperature depends on its chemical structure, such as the length and shape of the fatty acid; the word “oil” is often used to refer to fats that are liquid at room temperature. Foods with high fat content include butter, cooking oils (including vegetable and olive oil), and lard.

- **Proteins** are often talked about as the main thing that muscles and meat are made of. In addition to making up structural and functional parts in animals and plants, proteins can also be used as energy. Proteins are made up by stringing together smaller building blocks called “amino acids,” and there are 20 standard amino acids. Differences in the amino acid sequence allows for an incredibly diverse range of functions in different proteins, from sensing light in the eye to contracting a muscle. Foods with a lot of protein include meat, beans, eggs, and milk.
- **Carbohydrates** in the diet ultimately come from the photosynthesis of plants, which stores energy from the sun in the chemical bonds of sugars. The word “carbohydrate” is a bit confusing, since “hydrates” are compounds with water associated with them; water is not separate from the carbon in a carbohydrate, though the general chemical makeup has one carbon atom for every oxygen and two hydrogens, which might sound familiar since water is made of one oxygen and two hydrogens. Sugars are simple carbohydrates that give the sweet taste to table sugar, candy and fruit, and they can be strung together to form more complex carbohydrates known as starches, such as those found in potatoes, rice, bread, and pasta. Though technically a carbohydrate, dietary fiber can not be digested by humans and so is not a source of energy in food.
- The amount of energy in food is measured with a unit called the Calorie; because science likes to use the metric system, a Calorie is defined as the amount of energy needed to raise the temperature of 1 liter of water by 1 degree Celsius. This definition of “Calorie” can sometimes be confused with how the term is used in other areas of science, where it is usually spelled with a lower-case “c” and refers to the energy needed to raise the temperature of one milliliter of water by 1 degree Celsius. The total number of Calories in a food is listed on the packaging.
- Fats have about twice the calories per gram as carbohydrates or proteins (9 Calories per gram for fats versus 4 Calories per gram for carbohydrates and proteins). Food labels include the total number of calories and the number of grams per serving from fats, proteins, and carbohydrates. In the US, fiber is included in nutrition labels under “carbohydrates,” though humans can not use it for energy – specialized digestion is needed like that in termites and cows. (Note: a list of 45 common foods and the number of Calories they have can be found at <http://recipes.howstuffworks.com/45-common-foods-and-the-number-of-calories-they-contain.htm> )

## Instructional Activities:

In this first lesson, provide an overview of the five lessons in which students will learn:

- Sources of energy for the body
- How the body unlocks the energy through digestion
- How blood glucose is the primary way in which this energy is delivered to the rest of the body
- How sometimes the body has trouble producing blood glucose: this condition is known as diabetes.
- Some of the things we can do when the blood glucose isn't produced properly

Have students work in small groups. They should list simple examples of how the body uses energy. This can be as simple as kicking a ball or just breathing. Ask for volunteers to share examples.

Discuss where this energy comes from. How does the body get the energy? (Although they've been taught otherwise, it's not uncommon for some students to intuitively believe that the energy originates from within the body.) Since humans don't photosynthesize and can't plug into a wall socket, most students will be able to state that the energy comes from food, although exactly how may not be understood.

In the same groups, ask students to name different types of nutrients that are found in food. Then record their ideas. Included should be sugars, proteins, and carbohydrates. Other food ingredients are important, but we will be focusing on these three because they are sources of energy for the human body.

Explain to students that the amount of energy in food is measured with a unit called the Calorie. Write this out for students to see and emphasize the capital C. Science uses the metric system, and a Calorie is defined as the amount of energy needed to raise the temperature of 1 liter of water by 1 degree Celsius. This definition of "Calorie" can sometimes be confused with how the term is used in other areas of science, where it is usually spelled with a lower-case "c" and refers to the energy needed to raise the temperature of one milliliter of water by 1 degree Celsius. A food Calorie therefore is sometimes referred to as a kilocalorie or Kcal.

The task today is to find out where the Calories in food come from, based on the kind of food. The Food and Drug Administration now requires all food manufacturers to list nutritional information on food packaging, including the total number of Calories. So, in a way, the package tells you how much energy you will get from a particular kind of food.

Have students open the web page or printout of "45 Common Foods and the Number of Calories They Contain" and compare the number of Calories in each one. Note that these amounts are based on a typical serving of the food or beverage. Which are the top 10 foods with the most energy stored in them? Which are 10 the lowest in energy? If time allows, you may wish to have them jump to the link on this web page (or use the printout) to the web page: "Calories and Fat in 36 Fast Foods" and conduct a similar comparison.

Explain to students that this list does not explain which of the nutrients in each of these foods gives them more energy or less energy. This missing information is important because of the three types of nutrients, fats, proteins, and carbohydrates some are easier for the body to get the energy out of than

others. Have students open the web page or printout of “Nutrition Facts Label Overview.”

Have student groups send one person up to select five of the food packages. They should use the worksheet to record information off of the nutrition labels and compare them. (As an option, use the spreadsheet template and have students record the information on the spreadsheet. The spreadsheet allows them to enter and share information on many foods. It will also allow them to sort the foods by the type of nutrient and Calorie level.)

Have students record what they found on a master sheet or on the chalkboard. If you can have them add the data to a class spreadsheet, this will allow you to sort all of the foods by the type of nutrient.

### **Lesson Assessment:**

Using their data, have students list the top 5 foods that provide the most energy from each of the three types of nutrients: fats, carbohydrates, and proteins. They should be able to use data to support their choices.

### **Reflection:**

Ask students to reflect on which foods have the most Calories coming from fats, which types have mostly carbohydrates and which ones proteins. Ask them to discuss what they have heard about eating foods that are rich in each nutrient type.

Ask students to note the other nutritional information found on the label and discuss what those other elements in food are and what they might do.

### **Vocabulary:**

- Calorie - the unit by which energy in food is measured; in nutrition this term is equal to the amount of energy needed to heat 1 liter of water by 1°C
- Fat - a dense source of energy in the diet made up of glycerol and fatty acids; contains 9 Calories per gram
- Oil - a fat that is liquid at room temperature
- Protein - a source of energy in the diet made up of amino acids; contains 4 Calories per gram
- Carbohydrate - a source of energy in the diet made up of sugars that can be strung together to make more complex carbohydrates; contains 4 Calories per gram

### **NSES Standards Addressed:**

Scientific Inquiry: Formulate and revise scientific explanations and models using logic and evidence.

Life Science: The Cell: Most cell functions involve chemical reactions. Food molecules taken into cells react to provide the chemical constituents needed to synthesize other molecules. Both breakdown and synthesis are made possible by a large set of protein catalysts called enzymes.

Life Science: Matter, Energy, and organization in living systems: The chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed.

Personal and Community Health: Personal choice concerning fitness and health involves multiple factors; selection of foods and eating patterns determine nutritional balance; many diseases can be prevented, controlled, or cured; some diseases . . . result from specific body dysfunctions and cannot be transmitted.

Historical perspectives: Usually, changes in science occur as small modifications in extant knowledge; scientific knowledge evolves by changing over time, almost always building on earlier knowledge.





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## Bibliography

1. American Dietetic Association. [www.eatright.org](http://www.eatright.org). 2008.
2. American Diabetes Association. [www.diabetes.org](http://www.diabetes.org). 2008.
3. Centers for Disease Control and Prevention. [www.cdc.gov](http://www.cdc.gov). 2008.
4. Dietary Guidelines for Americans. [www.health.gov/dietaryguidelines](http://www.health.gov/dietaryguidelines). 2006.
5. How Stuff Works. <http://recipes.howstuffworks.com/45-common-foods-and-the-number-of-calories-they-contain.htm>. 2008.
6. Juvenile Diabetes Research Foundation International. [www.jdrf.org](http://www.jdrf.org). 2008.
7. Kids Health. [www.kidshealth.org](http://www.kidshealth.org). 2008.
8. Medline Plus. [www.medlineplus.gov](http://www.medlineplus.gov). 2008.
9. Miller, Kenneth. R. and Levine, Joseph. Prentice Hall Biology: Teachers Edition. Upper Saddle River. Pearson Education. 2002.
10. My Pyramid. [www.mypyramid.gov](http://www.mypyramid.gov). 2008.
11. National Diabetes Education Program. <http://ndep.nih.gov>. 2008.
12. National Digestive Diseases Information Clearinghouse. <http://digestive.niddk.nih.gov>. 2008.
13. The National Academies Press. [www.nap.edu/html/nses](http://www.nap.edu/html/nses). 1996.
14. Nutrition.gov. [www.nutrition.gov](http://www.nutrition.gov). 2008.
15. US Food and Drug Administration: Center for Food Safety and Applied Nutrition. <http://www.cfsan.fda.gov/~dms/foodlab.html>. 2004.
16. USDA National Nutrient Database. [www.nal.usda.gov/fnic/foodcomp/search](http://www.nal.usda.gov/fnic/foodcomp/search). 2008.

Authored By:

Mark Brady and John Whyte, MD, MPH, Chief Medical Expert, Discovery Health Channel  
William McDonald, Curriculum Director, Discovery Education

