Digestion

Activity from *The Science of Food Teacher's Guide: From Ecosystems to Nutrition* and for *The Mysterious Marching Vegetables*

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BioEd℠
Teacher Resources from the
Center for Educational Outreach at
Baylor College of Medicine

Fourth edition. First edition published 1997.
Printed in the United States of America

ISBN: 978-1-888997-76-7

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The activities described in this book are intended for school-age children under direct supervision of adults. The authors and Baylor College of Medicine cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

This publication and educational unit were made possible by grant number R25 RR13454 from the National Center for Research Resources (NCRR) and by grant number R25 ES10698 from the National Institute of Environmental Health Sciences, (NIEHS). NCRR and NIEHS are components of the National Institutes of Health (NIH). The opinions, findings and conclusions expressed in this publication are solely those of the authors and do not necessarily reflect the official views of Baylor College of Medicine, NCRR, NIEHS or NIH.

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Acknowledgments
The Science of Food educational materials, first developed as part of the My Health My World® project at Baylor College of Medicine, have benefited from the vision and expertise of scientists and educators from a wide range of specialties. Our heartfelt appreciation goes to Michael Lieberman, M.D., Ph.D., William A. Thomson, Ph.D., and Carlos Vallbona, M.D., who have lent their support and expertise to the project.

Special acknowledgment is due to our partners in this project, American Physiological Society (APS) and the Texas Medical Association. We especially thank Marsha Lakes Matyas, Ph.D., and Katie Frampton of APS for their invaluable direction of field testing and dissemination activities in the Washington, D.C. area.

We are indebted to the Science Education Partnership Award Program of the NCRR and to L. Tony Beck, Ph.D., for supporting the development and field testing of this unit. We also thank the National Institute of Environmental Health Sciences, Allen Dearry, Ph.D., Frederick Tyson, Ph.D., and Liam O'Fallon for their support of the My Health My World project and the related Environment as a Context for Opportunities in Schools (ECOS) project.

Many dedicated professionals helped assure the educational and scientific integrity of this publication. In particular, we are grateful to the following individuals who provided guidance: Joan Carter, R.D., Kimberly Chang, Ph.D., Marta Fiorotto, Ph.D., Katie Frampton, Michael Grusack, Ph.D., Kyle Roberts, Ph.D., Saundra Saunders, M.A., and Faye Sinnott.

We are especially grateful to the many classroom teachers in Washington, D.C., and Houston, Texas, who field tested these materials and provided invaluable feedback.

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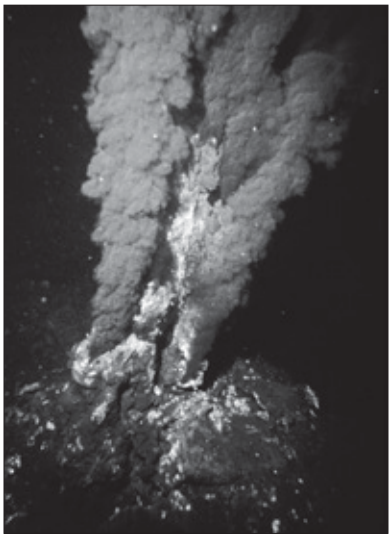
Food and Energy in Living Things

Life Science Basics



Some specialized bacteria make the molecules they need without sunlight. Bacteria that live in hot deep-sea vents obtain energy through the chemical breakdown of hydrogen sulfide in a process known as chemosynthesis. The bacteria are the primary producers in this environment.

In soil, some bacteria combine nitrogen- or iron-containing compounds with oxygen and capture the energy produced by these reactions.

Photo courtesy of NOAA.

Living things often are classified as producers or consumers, depending on how they obtain energy and nutrients. Producers typically are able to use solar energy to make the molecules they need from relatively few substances present in the air, water and soil. On land, green plants are the primary producers. In water, some plants and many varieties of algae, bacteria and other one- to many-celled organisms (Protists) are producers. All other organisms are consumers, which live directly or indirectly on food provided by producers.

Almost all producers make the molecules they need through photosynthesis. During photosynthesis, producers absorb energy from the sun and use it to combine carbon from carbon dioxide with water to make sugars and other carbohydrates. Thanks to this amazing process, light energy from the sun is converted into chemical energy stored in the bonds between atoms that hold molecules together. Plants use the energy stored in these molecules to build other compounds necessary for life. Likewise, consumers, who cannot trap energy directly from sun, must rely on molecules manufactured by plants for food.

The general sequence of who eats whom in an ecosystem is known as a food chain. Energy is passed from one organism to another at each step in the chain. Along the way, much energy is given off as heat. In fact, about 85–90% of the total usable energy is released as heat at every step in a food chain. Most organisms have more than one source of food. The relationship among all the energy flow interactions that happen in an ecosystem usually are described as a food web.

PRODUCERS AND CONSUMERS

- **HERBIVORES**, such as giraffes and caterpillars, are primary consumers. They feed on plants and other producers.
- **CARNIVORES**, such as anteaters and spiders, are secondary consumers. They feed on primary consumers. Most secondary consumers are animals, but a few are plants, like the pitcher plant.
- **OMNIVORES** eat plants and animals. Humans, pigs, dogs and cockroaches all are omnivores.
- **DECOMPOSERS** live off waste products and dead organisms. Many kinds of bacteria and fungi (molds and mushrooms) are decomposers. The decomposers themselves are important food sources for other organisms in soil, such as worms and insects. Litterfeeders, such as termites and earthworms, feed on partially broken down bits of plant and animal matter.
- **SCAVENGERS** feed on dead organisms that have been killed by another animal or that have died naturally. Vultures, flies and crows are examples of scavengers.

Digestion

Life Science

Food must be broken down, both physically and chemically, before it can be used by the cells within an organism. The process of breaking food down into usable components is known as digestion. Within the human body, digestion begins in the mouth, where pieces of food are mechanically broken, by chewing, into smaller pieces. In addition saliva mixes with the food and begins to break it down. After food is swallowed, other components of the digestive system—stomach, small intestine, large intestine, liver and pancreas—continue the process of making food available for use by cells in the body.

Unit Links

The Mysterious Marching Vegetables
Story, p. 21–25

Explorations
Chew On This, p. 8;
Neat Teeth, p. 8

The stomach serves as a powerful mixing machine in which food is combined with special chemicals (enzymes) that begin to break large food molecules into smaller ones. Food usually stays in the stomach for two to three hours, after which it passes into the small intestine, where it is combined with secretions from the liver and pancreas. These very important organs produces substances (bile from the liver and pancreatic fluid from the pancreas) that help break down fats, proteins and carbohydrates into smaller molecules. The small intestine is responsible for absorbing the nutrients released during digestion. The walls of the small intestine are covered with millions of tiny, finger-like projections called villi. These structures increase the surface area of the small intestine to facilitate the absorption of nutrients into the bloodstream.

Proteins and their building blocks (amino acids) are vital to every cell in the body. Humans are not able to make their own amino acids, so they must include protein (equivalent to 4 ounces of chicken white meat) in their daily diet. During digestion, proteins are broken down into the different amino acids of which they are made. Then the body builds new proteins from the amino acids. You might say that the amino acids are recycled!

This activity will allow students to observe how chemicals in the body begin to break down proteins.

SETUP

You will need meat tenderizer, located in the spice section at the grocery store, and a piece of sliced turkey luncheon meat for each group. Have students conduct this activity in groups of four.

SAFETY

Have students wash hands before and after the activity. Clean work areas with disinfectant.

CONCEPTS

- Food must be broken down into smaller units before it can be used by the body.
- Digestion is the process of breaking food down.
- Special chemicals in the body break food molecules into smaller units.
- Proteins—found in all meats, dairy products and vegetables (especially peas and beans)—are important for muscles and cell growth and repair.

OVERVIEW

Students learn about digestion and proteins by observing the action of meat tenderizer on luncheon meat.

SCIENCE, HEALTH & MATH SKILLS

- Predicting
- Making qualitative observations
- Drawing conclusions

TIME

Preparation: 10 minutes
Class: 30 minutes

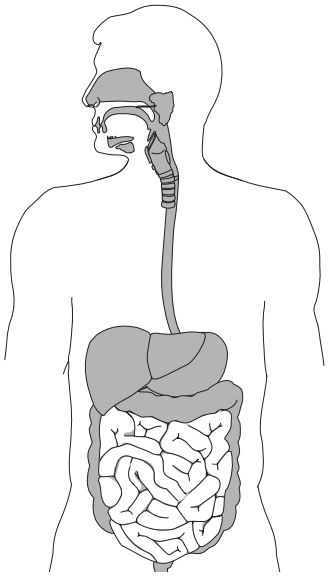
MATERIALS

Each group will need:

- 2 clear, resealable plastic bags, sandwich size
- 1/2 slice of turkey luncheon meat
- 1/2 tsp of meat tenderizer, or papaya enzymes (available at health food stores)
- Plastic, serrated knife

ENZYMES

Meat tenderizer contains an enzyme called papain, which is extracted from the papaya plant. Enzymes break proteins apart into amino acids—smaller molecules that are the building blocks of new proteins that the body needs. Amazingly, enzymes themselves also are a kind of protein molecule!



The total surface area of the inside of the small intestine is about 250 m^2, about the same area as a tennis court!

SOURCES OF PROTEINS

Foods that are rich in protein include meats, poultry, fish, dairy products, eggs, peas, dried beans, lentils and chick peas.

PROCEDURE

Session 1: Setting up

1. Let Materials Managers collect 1/2 slice of turkey luncheon meat, a plastic knife and two resealable plastic bags. Have the groups label their bags "1" and "2." Ask students, *What happens to food when you eat it? Do you think that food stays the same inside your body?* Discuss students' ideas about digestion. Mention that they will be able to explore what happens to one kind of food—turkey meat (protein)—when digestion begins.
2. Have the students in each group cut the piece of turkey in half and place one section in the bag labeled "1." Direct them to place the other section in bag "2" and to add 1/2 teaspoon of meat tenderizer to that bag. Have them seal the bag and shake the turkey slice within the bag so that it is well coated with the tenderizer.
3. Have the students place the bags to one side of the classroom for about an hour. (If students will be making observations the following day, refrigerate the bags to prevent spoilage.) Have students write, in their journals or on a sheet of paper, what they predict will happen to the slices of turkey.

Session 2: Making observations

1. Have students observe the texture and color of the meat samples without removing them from the plastic bags. Ask, *Is there anything different about the turkey that was combined with the meat tenderizer? What do you think happened?*
2. Ask students to think about the changes they observed in the meat with tenderizer. Mention that the substance they added was a chemical that helps soften the muscle fibers in meat by beginning to break them down into smaller pieces.
3. Help students understand that similar substances work within their stomachs and small intestines to break down the food they eat. Have students draw or write about their observations.
4. Mention that turkey meat is a muscle. Help students understand that protein is the building block for muscles and that it is used inside each muscle cell. Protein that we eat must be broken into smaller components before it can be used by our bodies. You may want to mention that the chemical meat tenderizer also is a kind of protein. It provides another example of the variety of roles that proteins play inside plants and animals.

VARIATIONS

- Students can investigate the importance of chewing by repeating the experiment using a finely chopped piece of luncheon meat and comparing the outcomes.