Nutrition and Food Science
Teacher's Guide

Grade Level: 9–12 | **Curriculum Focus:** Life Science/Health | **Lesson Duration:** 3 class periods

Program Description

The food you eat can be more than just a tasty treat; it can be science! From the creation of the U.S. Food and Drug Administration to the secret bacteria lurking in your common kitchen, this episode will uncover the history and mystery of food science.

The food science video segments were created in partnership with the Institute of Food Technologists and the IFT Foundation.

Lesson Summary

Students review the definition, causes, and common symptoms of food-borne illnesses, as well as basic ways to prevent them at home. They work in teams to investigate one type of food-borne illness and present a scenario about a person with the illness. The class must identify the food-borne illness based on information presented.

Onscreen Questions

Part 1, "Food Science, Overview and History" and "Food Safety"

- How has technology helped improve our food supply?
- What are effective ways to reduce food-borne illness?

Part 2, "Chemistry of Food" and "Fun Food Factories"

- How is thermodynamics used to calculate the calorie content of foods?
- Which well-known American snack was first baked by European monks?

Lesson Plan

Student Objectives

- Define a food-borne illness and its causes.
- Describe the symptoms and possible causes of a food-borne illness.
- Explore how food-borne illnesses can be prevented.

Materials

- *Nutrition and Food Science* video
- Computer with Internet access

Procedures

1. After watching the video, ask students to name some assurances that most of the food we buy at stores or restaurants is safe to eat. *Examples include the following: Food is packaged to prevent the growth of microorganisms and to maintain its freshness. Preservatives may be added to prevent spoilage and the growth of molds, yeasts, and bacteria. The FDA (Food and Drug Administration) oversees the development, trade, and safety of the nation's food and drug supply. Inspectors are placed in every meat plant in the country. Local health departments regularly inspect restaurants.*
2. Talk about what happens if food is not safe to eat. What is a food-borne illness and what causes it? (*An illness caused by a pathogen, or harmful microorganism, that enters the body through food.*) Explain that the pathogen is usually a bacterium or virus that can come in many forms. For example, more than 2,000 types of the bacteria salmonella are responsible for food-borne illnesses.
3. Talk about how these microbes cause illness. What happens to the microbes inside the body? (*They reach the intestines, attach to their walls, and begin to multiply. Some produce toxins there; others invade deeper body tissues.)* How long does it take to feel symptoms? (*It ranges from hours or days, depending on how long it takes for the microbe to enter intestines and multiply.*) What are some common symptoms? (*diarrhea, abdominal cramps, nausea*)
4. Explain that harmful microbes can be found in many foods, including fruits, vegetables, and dairy products, particularly raw chicken, eggs, meat, and seafood. The danger zone, or temperature range in which microorganisms thrive, is 40 to 140° Fahrenheit. Below that range, most don't multiply or they multiply slowly. Above that range, they begin to die. Ask students: How can we use this information to avoid food-borne illness? (*Foods that may carry microbes, such as raw chicken, should be refrigerated at 40° Fahrenheit. Then they should be cooked to at least 140° Fahrenheit*.)
5. Share these four basic steps for preventing food-borne illness at home. (From the Partnership for Food Safety Education's FightBAC campaign. See the Web site below for more details.)
    - CLEAN: When preparing food, always keep hands, preparation surfaces, and serving containers and utensils clean.
    - COOK: Food should be cooked thoroughly and kept hot until it is ready to serve, and leftovers should be reheated before serving.
    - CHILL: Perishable foods should be refrigerated below 40°Fahrenheit or frozen as until served, and leftovers must be refrigerated or frozen within two hours of purchase or cooking.

- SEPARATE: Avoid cross-contamination. Do not let raw meat or poultry or their juices come into contact with other foods.

6. Divide the class into five to seven teams. Give each team a slip of paper with one of the following diseases on it. Ask them not to reveal their disease to any other team.
    - botulism (*Clostridium botulinum*)
    - campylobacteriosis (*Campylobacter jejuni*)
    - E. coli (*Escherichia coli*, commonly called *E. coli*)
    - perfringens (*Clostridium perfringens*)
    - salmonellosis (*Salmonella*)
    - shigellosis (*Shigella*)
    - staphylococcal infection (*Staphylococcus aureus*)
7. Explain that the first part of the assignment is to work in groups to research the disease, including the following factors:
    - specific microorganisms that cause sickness
    - how the microorganism is transmitted
    - symptoms of illness
    - onset (how long it takes for symptoms to appear)
    - any other important details
8. The next part of the assignment is to create and present a skit about someone who has just come down with this "mystery illness." The skit could be a conversation between a patient and doctor or a discussion between two friends or coworkers. The skit should take no longer than five minutes, but it should include enough details to help the audience figure out the patient's illness. Each skit should reveal the following:
    - any unusual or potentially dangerous food the person ate that day or the preceding three days before getting sick
    - where the food was eaten (home, a friend's house, a restaurant)
    - how the food was packaged, stored, handled, or prepared
    - other foods that were prepared or bought at the same time
    - the person's symptoms
9. The following Web sites provide information about how food-borne illnesses spread, as well as details about the microbes, foods, and symptoms of specific illnesses. Students should begin by finding details about their assigned disease at the first four sites below:

- Fight BAC: Keep Food Safe from Bacteria (Four Steps; see "Illnesses" for chart of causes, sources, and symptoms)
  http://www.fightbac.org/main.cfm
- Food-Borne Illness and Disease (see chart for specific diseases)
  http://www.fsis.usda.gov/Fact_Sheets/Food-borne_Illness_What_Consumers_Need_to_Know/index.asp
- Food-Borne Diseases (transmission, symptoms, diagnosis, treatment for specific diseases)
  http://www.niaid.nih.gov/factsheets/food-bornedis.htm
- Food Poisoning Table
  http://www.webmd.com/hw/health_guide_atoz/ug1995.asp
- Produce Handling Education Campaign (details about fruits and vegetables)
  http://portal.fightbac.org/pfse/toolsyoucanuse/phec/
- CDC: Food-Borne Illnesses (common diseases, general diagnosis and treatment)
  http://www.cdc.gov/ncidod/dbmd/diseaseinfo/food-borneinfections_g.htm

10. Give students time to complete their research and work on their skits. Then ask each team to present their skit. Assign each one a letter, number, or color to help students keep track of teams as they take notes during each skit.
11. Disclose the names of the diseases you assigned to the teams and challenge students to identify the disease described in each skit.
12. To conclude the lesson, talk about what students learned. Which foods or actions were they surprised to learn might increase the risks of food-borne illnesses? Has this activity changed how they'll handle, prepare, or order food? If so, how? What specific actions can they can take to avoid food-borne diseases in the future?

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Students provided several details about food-borne illnesses and their causes; presented a clear and accurate skit describing the causes, transmission, onset, and symptoms of a specific food-borne illness; identified several of the diseases presented by the class; cited several ways that food-borne illnesses can be prevented.
- 2 points: Students provided some details about food-borne illnesses and their causes; presented a satisfactory skit describing the causes, transmission, onset, and symptoms of a specific food-borne illness; identified some of the diseases presented by the class; cited one or two ways that food-borne illnesses can be prevented.
- 1 point: Students provided few or no details about food-borne illnesses and their causes; presented a vague or inaccurate skit, which did not describe the causes, transmission, onset, or symptoms of a specific food-borne illness; identified few or no of the diseases presented by the class; cited few or no ways that food-borne illnesses can be prevented.

Vocabulary

contaminated

Definition: Dirty, polluted, or infected through contact

Context: The bacteria spread through contaminated ice cream purchased across the United States, causing thousands of consumers to fall ill.

epidemiologist

Definition: A scientist who studies the causes, transmission, and control of disease in a population

Context: After 200,000 people across the United States fell ill, doctors, epidemiologists, and pathologists worked to find the culprit.

food-borne illness

Definition: A sickness resulting from a virus, bacteria, parasite, or other microbe that enters the body through food

Context: An estimated 76 million cases of food-borne illnesses occur yearly in the United States.

irradiation

Definition: The treatment of food with radiation to kill microorganisms and reduce food losses due to spoilage

Context: Food irradiation is a food-safety technology that can eliminate disease as well as spoilage-causing bacteria from foods.

microbe

Definition: A microscopic organism, such as a bacterium, virus, mold, fungus, or yeast

Context: Microbes begin to die in environments above 140° Fahrenheit.

microorganism

Definition: Microscopic living things, such as bacteria

Context: Microorganisms are everywhere: in our air, in the shower, and inside our bodies.

nutrients

Definition: Substances, including proteins, carbohydrates, vitamins, and minerals, found in foods that people require stay healthy

Context: While we have an abundant food supply in the U.S., other parts of the world have fewer food choices, which can limit their intake of important nutrients and create serious health consequences.

pathogen

Definition: A microorganism such as a bacterium or virus that can cause disease

Context: It took several days before the pathogen, the illness-causing microorganism, could be identified.

preserve

Definition: To keep or protect from decay

Context: Scientists are working on new types of packaging to help preserve food.

Academic Standards

Mid-continent Research for Education and Learning (McREL)
McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education addresses 14 content areas. To view the standards and benchmarks, visit http://www.mcrel.org/compendium/browse.asp.

This lesson plan addresses the following national standards:

- Science—Life Sciences: Understands the structure and function of cells and organisms
- Health: Knows essential concepts about the prevention and control of disease; Knows environmental and external factors that affect individual and community health; Understands essential concepts about nutrition and diet; Knows how to maintain and promote personal health

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K–12 to promote scientific literacy. To view the standards, visit this Web site:
http://books.nap.edu/html/nses/html/overview.html#content.

This lesson plan addresses the following science standards:

- Science in Personal and Social Perspectives
- Life Science
- Science and Technology

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- http://school.discovery.com/teachingtools/teachingtools.html

DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into sections indicated by video thumbnail icons; brief descriptions are noted for each one. Watching all parts in sequence is similar to watching the video from start to finish. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units—These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link—Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources—This screen gives the technical support number and Web site address.

Video Index

I. Food Science, Overview and History (6 min.)
See how early food-safety regulations came to be and learn about the scientific development of TV dinners, nutrient-rich packaged foods, and other food-related items.

II. Food Safety (7 min.)
Explore food irradiation and other methods that enhance food safety and prevent spoilage and the growth of molds, yeasts, and bacteria.

III. Chemistry of Food (9 min.)

Discover how to use a bomb calorimeter to determine the energy value of certain foods and see how thermodynamics can calculate calorie content.

IV. Fun Food Factories (24 min.)
Tour fun food factories around the country and learn how Twinkies, Jelly Belly jellybeans, Hershey's chocolate bars, and some other favorite U.S. snack foods and candies are produced.

Curriculum Units

1. Establishing Regulations
Pre-viewing question
Q: What food-safety laws do you know about?
A: Answers will vary.

Post-viewing question
Q: What does the U.S. Food and Drug Administration do?
A: The U.S. Food and Drug Administration, known as the FDA, is responsible for protecting the public health by assuring the safety of the nation's human and animal food supply, as well as human and veterinary drugs.

2. Food Technology
Pre-viewing question
Q: What might be the most difficult challenge of eating in space?
A: Answers will vary.

Post-viewing question
Q: How did TV dinners come about?
A: TV dinners were developed after the food processing company CA Swanson and Sons encountered a storage problem following Thanksgiving one year in the 1950s. With too much turkey and not enough storage space, the company packed the meat in small portions and transported it in refrigerated trains across the United States. They packaged the food in compartmentalized aluminum trays and marketed the dinners to tie in to the latest craze—television. Families could conveniently eat their dinners in front of the television.

3. Food-Borne Illnesses and Bacteria
Pre-viewing question
Q: What might cause food poisoning?
A: Answers will vary.

Post-viewing question
Q: How common are food-borne illnesses in the United States?

A: An estimated 76 million cases of food-borne illnesses occur each year in the United States. This includes sickness resulting from viruses, parasites, and toxins, as well as bacteria and a large number of unknown sources. The Centers for Disease Control and Prevention estimates that at least 300,000 people are hospitalized and 5,000 people die from food-borne illnesses each year.

4. Reducing the Risks
Pre-viewing question
Q: What can you do to prevent food-borne illnesses?
A: Answers will vary.

Post-viewing question
Q: What factors affect the rate at which food-borne microbes reproduce?
A: Factors that affect the rate at which food-borne bacterial microbes reproduce include the nutrients in foods, which bacteria use to reproduce; the ph, or level of acidity or alkalinity of food; moisture; and the temperature of food. Bacteria thrive in warm conditions and multiply slowly in colder temperatures, so refrigeration at 40° F or below is effective in reducing food-borne illness.

5. Energy Content in Foods
Pre-viewing question
Q: What kinds of foods do you eat when you need energy?
A: Answers will vary.

Post-viewing question
Q: How does a bomb calorimeter work?
A: A bomb calorimeter can determine the energy content in food. A sample is placed inside a crucible, and a fuse wire is attached to ignite the sample. Then the crucible is placed inside of a bomb, which is charged with oxygen. The bomb is placed inside a metal bucket that contains a certain amount of water and then ignited. The energy released from the bomb is measured through a sensor and a thermometer. The bomb calorimeter can be used manually or with a controller, which can electronically determine the energy in the sample when the bomb is ignited.

6. Energy Content in Peanuts
Pre-viewing question
Q: What kinds of chemistry experiments have you conducted?
A: Answers will vary.

Post-viewing question
Q: What was the difference in the energy value found during the experiment and the true energy value of peanuts?
A: The energy released by the peanut was found to be about 15.6 kilojoules per gram. The actual energy value of a gram of peanuts is 23.6 kilojoules per gram. The difference was 8 kilojoules per gram.

7. Inside Some Sweet Factories
Pre-viewing question
Q: Describe your favorite soft drink.
A: Answers will vary.

Post-viewing question
Q: What gives the jellybeans their flavors?
A: Jellybeans are infused with natural flavorings to get the essence of specific flavor. And factory workers prepare a slurry, or a syrup that contains natural flavorings.

8. Two Candy Factories
Pre-viewing question
Q: What factors make candy especially good?
A: Answers will vary.

Post-viewing question
Q: Describe an interesting part of the candy cane-making process.
A: Workers add water, corn syrup, and sugar to copper pots and heat the mixture to more than 300°F, before pouring the candy on to a table to cool. The candy is then hand-kneaded to keep it supple. To make candy canes, workers make an 80-pound log of candy, which is put into a batch roller; there it is rotated and kept warm so that the candy makers can bend it by hand before it cools.

9. Cereal and Pretzel Production
Pre-viewing question
Q: What kinds of cereals are nutritious?
A: Answers will vary.

Post-viewing question
Q: What does the shape of the traditional twist pretzel represent?
A: The twist of the pretzel shows crossed arms, representing the way European monks trained children to pray.

10. Ice Cream Factory
Pre-viewing question
Q: What do you think makes one type of ice cream different from another?
A: Answers will vary.

Post-viewing question
Q: How long does it take to launch a new flavor?
A: It takes anywhere from two months to a year to design and launch a new flavor; Ben & Jerry's comes out with about a dozen new flavors each year.

11. The Giant Sugar Factory
Pre-viewing question
Q: Why are the ingredients in Tootsie Rolls kept secret?
A: Answers will vary.

Post-viewing question
Q: Why were Tootsie Roll Pops created?
A: Tootsie Roll Industries wanted to create a product to make the candies last longer, so they squeezed the secret chocolate recipe inside a fruit-flavored hard candy, which resulted in the world's first soft-centered lollipop.

12. A Cream-Filled Snack
Pre-viewing question
Q: Why do you think Twinkies are a popular treat?
A: Answers will vary.

Post-viewing question
Q: Why were Twinkies invented?
A: Jimmy Dewar, a Chicago bakery manager, wanted to make an inexpensive treat during the Depression. The original Twinkies sold for two for a nickel.