Food Preservation

Crocked Cabbage, Jerked Beef, and Pickled Pigs' Feet

Introduction

In this project, young people learn about storing and preserving food. When they first hear about food preservation, they might think, "I live near a grocery store. I don't have a garden. I don't hunt. Why should I care about food preservation?" The activities can help answer this question.

They can also help young people appreciate the knowledge and skills their ancestors had. And they will see that technology is sometimes invented before people really understand what makes the technology work. For example, our ancestors probably didn't know all the scientific reasons that dried foods didn't spoil rapidly. But they found out that it worked and developed methods for drying foods. If people who lived before our time had not developed ways to store food, we would still be spending most of our time searching for food. We would not have much time to study science. We would be too busy finding our next meal!

In fact, humans' ability to produce and store food was one of the most important advances in the history of civilization. Before people started growing their own food, they gathered fruits, nuts, berries, and plants, and hunted wild animals. They feasted when they found plenty of food. But they starved if the weather or some other problem kept them from finding food. These hunter-gatherers often moved from place to place in search of food.

When humans learned to grow their own food, they could often stay in one place during the growing season. But they still had to find food after the growing season was over. After people found ways to preserve food, even for short periods, their lifestyles changed. People who could produce more food than they needed in a day had extra time and energy. They were able to use this free time for other things, like science and art.

Young people will also realize that the industrial age brought with it many changes in the way people produce and distribute food. Worldwide transportation allows people to eat foods that do not grow nearby. These changes have affected what people eat and how much time they spend preparing food. They also affect the safety of our food supply. In the process of growing large amounts of food and shipping it all over the world, illnesses are sometimes spread to many people.

Many learners will find that their families have recipes for preserving foods. Grandparents and great-grandparents might have passed them down from one generation to the next. These traditions can help learners understand the history and roots of their families. It can also help them see how local conditions have influenced cultures and history around the world.

Humans have been preserving foods since 15,000 to 10,000 B.C. Some ways of doing this are freezing, freeze-drying, fermentation, and using herbs and spices.

Of course, people who lived thousands of years ago didn't have freezers and refrigerators. But scientists have found mammoths and other large mammals stored deep underwater. The cold water temperatures preserved meat for years. Archeologists have also found meat frozen in pits or in the colder parts of caves.

Today, companies use a process called *freeze-drying* to make products like "astronaut ice cream" and instant coffee. But people in South America were freeze-drying potatoes thousands of years ago. Natives carried potatoes high up into the Andes Mountains. They sliced and crushed the potatoes to a pulp. Then they spread the pulp on rock and left it overnight. The next morning, they returned to gather the freeze-dried potatoes. This method worked high in the mountains, where the atmospheric pressure is low, the air is very dry, and nighttime temperatures are below freezing.[1]

Another method, fermentation, has been used since 6000 B.C. It is used to produce breads, vinegar, cheese, and yogurt.[2]

People have also used spices and herbs as preservatives for thousands of years.

Here are just a few of the topics learners will explore during this project: What makes different methods of food preservation work? What is the role of pH, osmosis, air pressure, bacteria, mold, fungi, and irradiation? How is food preservation changing? Why can't people always trust food safety instructions that were written as recently as five years ago?

Cautions

The purpose of this project is not to teach home food preservation. It is not a recipe book. Instead, this project introduces learners to the techniques used to preserve food. It also helps them understand the science and technology behind the techniques. Many books and other sources give step-by-step directions for canning, freezing, dehydrating, or salting different foods.

Learners should check up-to-date resources on food safety. Knowledge about foods, food preservation, and disease-causing substances found in foods is changing quickly. But keep in mind that the goal of this project is not to conduct an in-depth course in microbiology.

The information included here is not meant to unduly alarm learners about our food supply. But they should learn how to look at data and make informed choices about what they eat. They should be aware of the risks and benefits of various preservation techniques, additives, and food-growing processes. They should also realize that most bacteria are beneficial. Usually, food safety issues focus on harmful bacteria, but some bacteria help people stay healthy. Learners should also realize that all

foods are composed of chemicals. Chemicals that are added to foods carry with them some costs and some benefits.

Activities: Brief Descriptions

This project has 10 activities:

Activity 1: A Survey in My Kitchen. This activity introduces learners to food preservation. They survey a kitchen to find examples of preservation techniques.

Activity 2: pH, Pickling, and Osmosis. Measure the pH of foods and saliva. Pickle your own finger. Find out why a pickle is not just a cucumber in water. See osmosis in action.

Activity 3: Mold, Fungus, and Bacteria. How many different ways can you make an egg grow fuzz?

Activity 4: Dehydration. How much weight can an apple lose when the water is removed? Build a homemade food dehydrator.

Activity 5: Canning, Pressure Cooking, and Air Pressure. The pressure is on! Why do we sometimes cook food in a pressure cooker? Learn some properties of air pressure.

Activity 6: Refrigerating and Freezing Foods. What's the burn? Wrapping and storing foods properly.

Activity 7: Can You Find the Food Additives? Search for chemicals added to common foods.

Activity 8: Fermentation—What a Cheesy Idea! Capture a yeast strain. Make your own yogurt.

Activity 9: Controversial Questions on Food Safety and Preservation. A fishbowl activity helps learners discuss different ideas and opinions with respect.

Activity 10: Food Jeopardy! A game to keep you out of jeopardy.

Materials. A list of materials is included with each activity. The Materials Summary (page 3-52) lists everything needed for all activities.

Why Study Uses of Herbs?

Benefits for Learners

Today, most Americans do not spend much time thinking about food preservation. But having a year-round supply of good food is vital. If we save food when it is plentiful, we will not starve in times when food is less plentiful. There are several reasons young people should be interested in this issue:

- Many young people wonder how people might solve the problem of world hunger. They may be surprised to learn that simply growing more food is not the answer. Food shortages in some areas of the world are often caused by poor food preservation and distribution. Up to a third of the harvest in some countries is lost before it ever gets to the people who need it.

- Reports of contaminated food are common. News reports often talk about people getting sick because of *E. coli*, salmonella, and listeria in their food. The way food is produced and distributed will continue to affect young people in the future.
- The science of food preservation involves microbiology, chemistry, and physics. Practical concerns include taste, texture, storage space, available technology (freezers, pressure cookers, etc.), and planned uses. Both scientific and practical knowledge can help young people explore a variety of careers. Some food-related careers require years of formal education, and some do not.
- In rural areas, many people still can, freeze, dry, or pickle their own food. By doing activities related to food preservation, learners see that family members, especially women, use science at home. Science is essential to daily life. Studying food preservation can also connect learners to family traditions and history. They might even conduct research and oral histories.

Skills. This project helps learners develop skills they can use throughout life:

- collecting and analyzing data
- developing arguments that use research and data
- making observations
- making inferences
- designing and evaluating experiments
- decoding food labels
- doing estimations

Topics and concepts. This project addresses many scientific topics and concepts:

- pH, acids, bases
- osmosis
- air pressure
- microbiology
- pressure cooking
- heat and temperature
- food additives
- freezing and refrigeration
- safe food preparation and storage
- molds, bacteria, fungi
- food irradiation
- dehydration
- fermentation

Career links. As young people learn about food preservation, they will discover new career possibilities. Some examples are food science,

anthropology, history, agricultural extension, microbiology, health care, food and agriculture policy, pest management, economics, food preparation, and hygiene or public health. There are several things you might do to help learners explore these career possibilities. Take them on a trip to a local farm or food processing plant. Go to a local grocery store to find out how food is preserved there. Find out what stores do with food that is spoiled or out of date. Arrange a visit to your local public health service. Invite an extension agent to demonstrate food preservation techniques to your group. Find out how archeologists use the remains of foods to learn about ancient culture, geographic range, climate, and diet. Ask local fast food restaurants to explain how they prevent food poisoning.

Compliance with national science standards. This project addresses the following National Science Education Content Standards for grades 5–8:

Content Standard A: Abilities Necessary to do Scientific Inquiry

- Use appropriate tools and techniques to gather, analyze and interpret data
- Develop descriptions, explanations, predictions and models using evidence

Content Standard B: Physical Science

- Properties and changes of properties in matter
- Transfer of energy

Content Standard E: Science and Technology

- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Personal health
- Risks and benefits
- Science and technology in society

Safety Note:

Activities involving food should not be done in a laboratory where chemicals are used or stored for nonfood purposes. If your group or class usually meets in a laboratory, arrange to hold the meeting in another room instead. A cafeteria or kitchen is a good place to meet whenever you have food that will be eaten.

Benefits to the Community

Contaminated food or water can make thousands of people sick at one time. When food poisoning is reduced, communities are healthier. Fewer people miss work. Fewer people spend time and money in doctors' offices. Young people who do this project will have some ideas about how to make the local food supply safer. The whole community can benefit when learners share this knowledge.

Learners can find out a lot about local culture, history, and technology as they interview people in their community. They begin to see the adults they know as sources of important knowledge. Learners can also help community members appreciate one another's wisdom and knowledge.

They can present their knowledge in fairs, community centers, grocery stores, or other places.

Ideas for Additional Projects

Young people might enjoy finding out what technologies for food preservation were used 200 years ago. If possible, bring in old equipment and ask learners to identify it. Or you might visit an Amish hardware store. Identify which tools require electricity and which ones don't. Discuss how our lives might be different if we didn't have refrigerators.

Visit a farm that has a smokehouse. Find out how foods are smoked and how foods are cured. Learn why most smokehouses have dirt floors. Discover why hogs are usually slaughtered in late autumn in the southeastern United States. Explore a root cellar. Find out what types of foods do well in cellars.

Learn about the process of potting meat. Find out why potting is not usually seen as a good idea now. Explore other techniques that are not addressed in this guide: smoking, curing, root cellaring, carbonation, and pasteurization.

Make a list of all the ingredients in one lunch. Then try to find out where in the world this meal came from. See if you can trace the ingredients back to the farms that produced them. On a map, mark the areas of the world that contributed to your lunch.

This project guide does not discuss oxidation or rancidity. These chemical processes can change the quality of foods. Encourage learners to find out more about these processes and how to slow them.

Readings for Young People

The Canning Season by Margaret Carlson (Kimanne Smith, illustrator). Ages 4-8. Minneapolis: Carolrhoda Books, 1999.

Angels in the Dust by Margot Theis Raven (Roger Essley, illustrator). Ages 4-8. Mahwah, NJ: Bridgewater Books, 1999.

Back Home by Gloria Jean Pinkney (Jerry Pinkney, illustrator). Ages 4-8. New York: Dial Books for Young Readers, 1992.

The Barn by Avi. Ages 9-12. New York: Orchard Books, 1994.

More Science Experiments You Can Eat by Vicki Cobb (David Cain, illustrator). Ages 9-12. New York: HarperCollins, 1994.

Milk: From Cow to Carton by Aliki. Ages 4-8. New York: HarperCollins Juvenile Books, 1992.

Bread Bread Bread (Around the World Series) by Ann Morris (Ken Heyman, illustrator). Ages 4-8. New York: Mulberry Books, 1993.

The Popcorn Book by Tomie De Paola. Ages 4-8. New York: Holiday House, 1989.

Corn Is Maize: The Gift of the Indians by Aliki (illustrator). Ages 4-8. New York: Cromwell, 1976.

Eat Your Words: A Fascinating Look at the Language of Food by Charlotte Foltz Jones (John O'Brien, illustrator). Ages 9-12. New York: Delacorte Press, 1999.

Eating the Plates: A Pilgrim Book of Food and Manners by Lucille Recht Penner. Ages 4-8. New York: Macmillan, 1991.

Food: Its Evolution Through the Ages by Piero Ventura. Ages 9-12. Boston: Houghton Mifflin, 1994.

Food: How We Hunt and Gather It, How We Grow and Eat It, How We Buy and Sell It, How We Preserve and Waste It and How Some Have Too Much and Others Have None by Milton Meltzer, (Sharon Lane Holm, illustrator). Ages 9-12. Brookfield, Ct: Millbrook Press, 1998.

Food Safety (True Book) by Joan Kalbacken. Ages 4-8. San Francisco: Children's Press, 1998.

It's Disgusting—And We Ate It! True Food Facts from Around the World—And Throughout History! by James Solheim (Eric Brace, illustrator). Ages 4-8. New York: Simon & Schuster Books, 1997.

The Science Chef Travels Around the World: Fun Food Experiments and Recipes for Kids by Joan D'Amico (Karen Eich Drummond, contributor; Tina Cash-Walsh, illustrator). Ages 9-12. New York: John Wiley & Sons, 1996.

The Science Chef: 100 Fun Food Experiments and Recipes for Kids by Joan D'Amico (Karen Eich Drummond, contributor; Tina Cash-Walsh, illustrator). Ages 9-12. New York: John Wiley & Sons, 1994.

Leader Background Information

Food Preservation, History, and Culture

People around the world preserve various foods in different ways. We learn a lot about history and cultures when we study why and how people preserve certain foods.

Maize, or corn, has been very important to the native people of North America. It made up about 80 percent of the traditional diet of many Native Americans. Native women developed corn by crossbreeding grasses and weedy seed plants. They have been doing this for thousands of years.[3] Maize shows up in Mayan creation stories, worship, and myth. For example, Mayan legends say that humans came from sacred ears of maize. They describe humans as a cornfield ready to serve the creator. Native peoples thrived on a diet made up mainly of corn and beans. They created many ways to preserve and cook food. Native peoples sun-dried corn to make hominy. They ground it into meal to make tortillas and other foods.

Sausage making is another ancient way to preserve food. People have been making sausage for centuries in the Chinese, Greek, Roman, and Babylonian cultures. Roman butchers formed guilds to keep their people from finding out how they salted, spiced, and dried their sausages.[4] People in different parts of the world made sausage in various ways. For example, in cold climates, people often smoked sausage. In warm climates, spices were added to preserve the meat. People also used local

ingredients to flavor their sausages. Sometimes, towns became known for the flavor or type of sausage they made.

Salt has been used as a chemical preservative since ancient times. It was used to preserve meat in Europe during the Middle Ages. Food for farm animals was often so scarce during the winter that many of them were butchered and salted. Only a few animals were kept alive so that they could breed. Meat preserved this way is very high in salt. It is probably a good thing that many people in Europe did not eat meat during the season of Lent in the spring. It might have kept many people from having high blood pressure and other problems caused by eating too much salt.

Kim chee, or kimchi, is so important in Korean life that the food has been named a national treasure. Kim chee is made up of vegetables (often Chinese cabbage) pickled in salt, red peppers, and garlic. It is similar to sauerkraut, which is made with green cabbage. Kim chee is high in vitamins C and B.[5] It is also very spicy.

All of these ways of preserving food affected people's lives in several ways. Some of the effects are surprising.

For example, some scientists think that witch hunts might have been triggered by food poisoning from ergotism.[6] Ergotism is a disease caused by a fungus that affects grain. It can cause people or animals to have seizures, "see things" that aren't really there, fear others, or even die. Sometimes, people thought things like this were caused by witchcraft. Witch hunt crazes almost always started after cool, rainy, growing seasons. This kind of weather helped produce the ergot poison in food supplies.

People don't usually connect food preservation to building cities or fighting wars. But a steady food supply is vital to both efforts. Napoleon offered a prize to anyone who could come up with a way to provide a steady supply of safe food to his troops. The winner was Nicholas Appert, who developed canning. He experimented with canning in the 1790s and tested it widely. In 1809 he claimed the prize. Appert believed that air and fermentation caused food to spoil. He did not realize that the canning process worked because of the process he used, which killed microorganisms. It was not until the 1860s that Louis Pasteur used the microscope to prove that microorganisms existed. He was finally able to explain what made food spoil. So the technology of canning existed for almost 70 years before science could explain why it worked.[7]

According to the Centers for Disease Control, more than 250 types of bacteria, viruses, and parasites can cause food-borne illnesses.[8] In 1994 there were between 6.5 and 33 million cases of food-borne illness and about 9,000 deaths from food poisoning in the United States.[9] These illnesses cost $1 billion to $10 billion each year.[10] Some food-borne illnesses are declining. But others are becoming more common. Two examples are salmonella and a fatal strain of *E. coli*.[11]

These increases are caused partly by changes in the ways animals are raised. The way foods are processed and shipped also makes a difference.

Back when most food came from small farms, outbreaks of disease were limited to a small area. Now, meat from a single diseased cow can be distributed throughout the world. Thousands of people can suffer. Vegetables grown in a single field irrigated with contaminated sewage can cause illnesses in many countries. One hamburger from a fast food restaurant may contain meat from dozens of states and more than one country. There is often no way to know which foods come from contaminated places.

New strains of harmful microorganisms make it hard to keep food safe. For example, the *E. coli* bacteria that live in human and animal intestines are normally helpful. They produce vitamins. They can keep harmful bacteria from growing.[12] But human and animal waste products that contain these bacteria can contaminate meat. The result can be deadly. In 1982 a new strain of *E. coli* was recognized. It was labeled *E. coli 0157:H7*. The most famous *E. coli 0157:H7* outbreak caused three deaths and hundreds of illnesses among people who ate hamburgers at a fast food chain. Millions of pounds of ground beef have been recalled due to *E. coli* contamination. The bacteria can also live in swimming pools. As few as 10 to 100 *E. coli* bacteria are enough to cause a fatal illness in swimmers who ingest them.[13] Illness or death can also be caused by an invisible amount of fecal material in meat or on vegetables and fruits. So the impact of just one type of harmful microorganism can be enormous. The global food distribution system can spread their impacts across the world.

An Introduction to Microscopic Life Important to Food Safety

The human population increased greatly after the microscope was invented. Why? The microscope allowed us to look at tiny organisms that are sometimes found in foods. For the first time, we could study these microorganisms. We learned about which ones could make us sick. We discovered ways to keep them from contaminating our food. As a result, fewer people died of food poisoning.

Most food poisoning is caused by organisms that are found naturally in food, air, or water. Bacteria cause most contamination problems. Molds and viruses also cause food-borne diseases. There are many new antibacterial products on the market. Learners may wonder why people can't use them to kill all the nasty germs and eliminate the problems. To know why this isn't possible, it is important to know a little about the organisms that cause food poisoning. Here is a brief introduction.

Fungi are organisms that get food by directly absorbing nutrients. They do not undergo photosynthesis.[14] Fungi were once considered plants, but now they are seen as a completely separate group. Fungi can consist of one cell or many. You can see some with the naked eye. You must use a microscope to see others. More than 100,000 species of fungi have been identified. More than a million species may exist.[15] Mushrooms and puffballs are examples of fungi. They are some of the largest living

organisms on earth. For example, one fungus has been found that covers 1.6 million square feet and weighs about 200,000 pounds. Yeasts are microscopic fungi. In breads, yeast turns starch into sugar. When the yeast then digests the sugar, it produces gases and water. This is what causes bread to rise. Other small fungi are useful in fermentation. They are used to produce cheeses and to make many medicines.

Mold is a fuzzy growth on organic matter. It is produced by several types of fungi. Mold begins as microscopic spores that spread through the air. People used to believe that it was safe to eat moldy food if they cut off the moldy part. Now we know that in many cases this is *not* true. Some molds even contain cancer-causing agents.[16]

Heating or cooking moldy foods does not make them safe. The furry or fuzzy fibers grow down into the food in tangled masses. The fibers can be so small that you can't see them without a magnifying glass. All soft foods with mold should be thrown away. These include breads, lunch meats, dairy products, leftovers, peanut butter, grains, leafy greens, nuts, seeds, and juices. You may be able to salvage some harder foods by trimming off the moldy areas plus an additional 1-1/2 inches. Foods you may try to salvage include apples, pears, carrots, potatoes, turnips, broccoli, cauliflower, cabbage, smoked meats, and country ham.

Bacteria are single-celled microscopic organisms. They are very small and are less complex than fungi. Bacteria use fermentation or respiration to make energy from organic compounds such as sugars. They can also use inorganic compounds such as ammonia or hydrogen sulfide. Bacteria are among the oldest forms of life on earth. They have existed for more than 3.5 billion years.[17] There are thousands of species of bacteria. Most are harmless. A few cause diseases in humans or animals. Together with fungi, bacteria are responsible for the decay of all organic matter.

If conditions were just right, one bacterium could reproduce to make two bacteria in 20 minutes and four in 40 minutes. Doubling can make the numbers add up quickly. If the right food and space were available, one millionth of a gram of bacteria (less than 0.000000002 ounces) could produce 1,000 tons of bacteria in 14 hours! Fortunately, the perfect conditions for growing bacteria do not exist in real life. But in poor growing conditions, some bacteria can form hardened "shells" called spores. Spores are very difficult to kill. They can survive boiling in water, the vacuum of space, and going without nutrients for decades.[18]

Bacteria That Play a Role in Food-Borne Diseases

Salmonella is widespread in animals, especially poultry, swine, dairy products, and seafood. Salmonella bacteria are also found in water, soil, insects, factory surfaces, and kitchen surfaces. There are 2 to 4 million cases of salmonella poisoning in the United States each year. Most of these cases are caused by contaminated eggs. Salmonella poisoning has increased sixfold in the past decade in some parts of the country.[19] Older recipes for ice cream and eggnog often use uncooked eggs. Such recipes used to be fairly safe, but now they are unsafe because salmonella has

become a poultry epidemic. Eggs should always be cooked until the yolk is firm. Raw cookie dough, cake batter, Caesar salad dressing, and homemade mayonnaise can transmit salmonella if they contain raw eggs. The USDA reports that before special procedures began to be used in 1998, salmonella was in about 20 percent of broiler poultry and 50 percent of ground turkey. By 1999 salmonella contamination had dropped to 11 and 36 percent respectively, because of the new procedures.[20]

E. coli 0157:H7 can be a deadly strain of the *E. coli* bacteria. *E. coli* live in the intestines of all animals, including humans. *E. coli* bacteria are beneficial. They make vitamins and crowd out more harmful bacteria. Illnesses related to harmful strains of *E. coli* come from fecal contamination. Meats, vegetables, fruits, or raw milk can be contaminated when they contact animal waste products. The bacteria can also be spread through person-to-person contact. Most cases of *E. coli O157:H7* come from consuming ground beef, milk, or unpasteurized fruit juices that were contaminated during processing. When meat is further processed, the bacteria can spread through a large volume of meat. A similar problem can occur with venison. Several deaths from *E. coli 0157:H7* occur each year in the United States.[21]

Botulism is caused by a bacteria that is widely distributed in nature. It can be found in poultry, cattle, horses, fish, improperly canned foods, luncheon meats, canned vegetables and meats, soils, waters, and sediments.[22] Botulism bacteria produce a neurotoxin that can lead to severe or fatal food poisoning. Botulism bacteria can be killed by heat. Cases of botulism poisoning are most often associated with home-canned foods that were not processed the right way. Botulism should be of concern with almost any food that is not very acidic, such as mushrooms or some tomatoes.

Clostridium perfringes belongs to the same genus as the botulism organism, but it produces a less severe disease. The bacteria are found in soil, water, and unprocessed foods. They are also in the intestinal tracts of both animals and humans.[23] Clostridium spores can survive boiling for hours. They can even thrive in cooked foods. Many cases of clostridium poisoning happen on holidays, when food is often left on the table for hours. It also happens in institutions where food is prepared hours before it is served. Illness can occur when meats spend several hours at room temperature or when large pots of meat, gravy, stews, or casseroles are cooled too slowly in the refrigerator. Clostridium perfringes is one of the most commonly reported types of food poisoning. According to estimates from the Centers for Disease Control, there are about 10,000 cases each year in the United States.

Listeria bacteria have caused several massive food recalls of products such as hot dogs and cheese. Listeria is hardy. It resists freezing, drying, refrigeration, salt, nitrates, and acidity. Fortunately, most healthy people only get flu-like symptoms when poisoned by Listeria. However, Listeria can kill the young, elderly, or ill people. It can also cause miscarriages.

Listeria bacteria thrive in cold temperatures. Outbreaks of Listeria-related illness can often be traced back to prepared salads, cheese, unpasteurized milk, or some seafoods.[24] Listeria bacteria are carried by many birds and mammals, including 1 to 10 percent of humans.

Staphylococcus bacteria exist just about everywhere. In humans and animals, they are found on the skin, hair, and mucous membranes of the nose and throat. Boils, abscesses, pimples, and other skin inflammations and infections may be caused by (or contain) the staphylococcus bacteria.[25] Staphylococcus, or staph, bacteria are widespread in untreated water, raw milk, and sewage. Staph is one of the first types of bacteria to have developed strains that are immune to our strongest antibiotics.[26] Staph bacteria pose particular problems in meat, poultry, eggs, tuna/egg/chicken/potato/macaroni salads, and cream-filled foods.[27] Foods that are handled a lot during preparation are more likely to be contaminated. The staph bacteria themselves can be killed by heat. But illness is actually caused by a toxin or poison produced by the bacteria. This toxin is not killed by heat. So it is important to control the growth of staph rather than attempt to kill it off afterward.

Shigellosis bacteria are found in the intestines and stools of infected people.[28] Infected people can contaminate food when they do not wash their hands after using the toilet, then handle liquid or moist food or water. The bacteria are spread by direct contact with an infected person, by eating or drinking contaminated food or water, or by contact with a contaminated object.

Campylobacter bacteria contaminate 20 to 100 percent of ground chicken and 90 percent of turkeys. For years scientists thought campylobacteriosis was mainly a problem for nonhuman animals. Recently, researchers have realized that illness from campylobacteria affects 2 to 4 million Americans each year.[29] The bacteria are found in the intestinal tracts of poultry, cattle, and sheep. They are also in unpasteurized milk and raw shellfish. “Campy” is easily killed by heat. Its growth is slowed or stopped by salt, acid, and drying.

Parasites and Viruses

Parasites are “freeloaders.” These organisms depend on another organism for survival usually without contributing anything to that organism. Parasites are much larger than bacteria and viruses, but they may still be microscopic in size. Three parasites found in water can affect food safety—cyclosporae, cryptosporidia, and giardia.[30] These protozoa can contaminate food that is washed with infected water. Contamination can also occur when the food is growing or when it comes in contact with unwashed hands. Cryptosporidia sickened more than 400,000 people in Wisconsin in one outbreak. Another outbreak killed at least 20 people in Las Vegas.[31]

Viruses are the smallest and simplest forms of life. Viruses are genetic material surrounded by a coat of protein. They cannot move or reproduce

on their own. Instead, they invade a host cell and turn that cell into a virus factory by injecting genetic material into the host. There is no effective treatment or cure for diseases caused by viruses. Two types of viruses are often mentioned in connection with food safety, the Hepatitis A virus and the Norwalk virus. The Hepatitis A virus may be found in raw shellfish and mollusks contaminated by untreated sewage. Sandwiches, salads, juices, and drinks can also carry the virus. Cooking doesn't always kill it. The Norwalk virus thrives in human feces. Like Hepatitis A, it can be present in raw shellfish taken from polluted waters. Foods such as salads and sandwiches prepared by infected people can also transmit the Norwalk virus.[32]

Killing Harmful Microorganisms

Getting rid of or controlling food-borne harmful microorganisms is not always easy. But there are many steps you can take to protect yourself. Remember that thorough cooking kills most food-borne bacteria, viruses, and parasites. You can cut down on eating processed foods by eating locally grown foods in season and grinding your own hamburger. This will reduce exposure to harmful bacteria. You can also use disinfectants. But disinfectants and antibacterials do not provide an answer to all food-borne illnesses.

Products labeled "antibacterial" do not kill all the bacteria present on an object. Most of these products advertise that they kill 99.99 percent of the bacteria present. This is indeed a high percentage. But bacteria are so small and can exist in such high numbers that these products may still leave thousands of bacteria present. For example, if a hand has 10 million bacteria on it to begin with, 1000 bacteria would remain after it has been washed with an antibacterial product. Even more would be left if the hand was not washed thoroughly. Even the process of sterilization may not remove all bacteria. The official definition of sterilization allows one bacteria to survive from a starting count of 100 million. In general, it is easier for disinfectants to kill bacteria than to kill viruses, fungi, and spores.

There is another safety issue to consider. Disinfectants act by poisoning biochemical activities in the cells of microorganisms. However, humans share many of the same basic biochemical activities and pathways. The better a disinfectant is at killing microorganisms, the more likely it is to have side effects in humans and other animals.

Overuse of antibacterial products poses other problems as well. Overuse could lead to the development of new strains of resistant bacteria. This has already happened with many antibiotic drugs. So, if not used wisely, the products we use to fight harmful bacteria could lead to the development of even more harmful bacteria.