**Food Safety: Hazards to Food Safety and Factors that Affect Foodborne Illness**

**Lesson 1: Keeping Our Food Safe**

**Grade Level(s)**

9 - 12

**Estimated Time**

1 hour (50 minutes, plus 10 options minutes)

**Purpose:**

Each year thousands of Americans experience foodborne illnesses caused by pathogens or biological toxins. Agricultural chemicals and additives in our food supply contribute to risks of chronic illnesses such as cancer. Students will explore how food becomes contaminated, the consequences for public health, and how to prevent and respond to food safety issues.

**Objectives:**

* Where, when and how is our food system vulnerable to contamination?
* How can we determine the origin of a foodborne illness outbreak?
* What should be done to improve food safety?

**Standards:**

**Agriculture and the Environment:**

**Science, Technology, Engineering & Math:**

**Materials**

* Student handouts
* Presentation slides (link)
* Answer Key
* FoodSpan Infographic

**Background Agricultural Connections**

Crops used to feed and clothe people are grown a number of different ways, conventionally, industrially, organically, naturally, even in your own backyard. During this process, it might come in contact with diseases, contaminates, insects, or agricultural chemicals used to prevent these things. Once the food leaves the farm, it is carried by truck, train, even in airplanes, where it can come in contact with even more contaminates. Before it reaches your home or plate at a restaurant, food needs to go through a number of processing steps to ensure that food is safe.

For more background information on this topic, you can look at the Food Safety Primer (<http://www.foodsystemprimer.org/food-safety/>)

**Vocabulary:**

Pesticides:

**Interest Approach – Engagement**

*Food Contamination: Where are we most vulnerable? (5 Minutes)*

Have students pair up and make their best guess about where food safety is threatened by chemicals or pathogens (e.g., disease-causing bacteria and viruses). Ask each pair to choose any food item and list at least three situations, from production through consumption, in which it could be contaminated.

If needed, provide students with the following example: an apple could be contaminated during production by the spraying of **pesticides**, during transportation by coming into contact with contaminated containers, or during preparation if it is sliced on a contaminated cutting board. Students can refer to the **FoodSpan Infographic** for the steps in the supply chain. Ask for volunteers to share and generate a list on the board.

**Procedures:**

*How Does Food Become Contaminated? (15 Minutes)*

Students will learn about the different way’s food can become contaminated as it moves along the supply chain. Display the **Presentation slides** as an introduction to microbial and chemical contamination.

Have students read the **Food Contamination handout** for a summary of ways that food can become contaminated. Ask students to compare the list from the warm-up with what they learned from the handouts. Discuss similarities and differences.

*Food Safety in Action: Outbreak Investigation (25 Minutes)*

In a hypothetical scenario about a foodborne illness outbreak, students will act as a local health department official. An outbreak is defined as two or more cases caused by the same contaminated food and resulting in the same illness. Using data collected from a survey of event attendees, they will determine the food and the pathogen most likely responsible for the outbreak.

Provide pairs of students with copies of the **Outbreak Investigation** handout and explain their task. Use the **Answer key** to verify students’ responses. Once students have completed the investigation, ask:

* Which pathogen in which food caused the outbreak?
* What was challenging about this activity? What was surprising?
* What did you learn about how public health officials respond to outbreaks?
* How could an outbreak like this have been prevented?

*How Do We Prevent Food Contamination? (10 Minutes)*

Once students have completed the investigation outbreak, divide students into groups of four and assign each person a reading. Once students complete their reading, have them share with the group what they found. This will prime students for tomorrow’s lesson. If you do not have class-time for readings, assign all four sections for students as homework.

**1. Microorganisms and foodborne illness**

As was discussed in lesson two, microorganisms are very small life forms. Bacteria, viruses, parasites, yeasts and molds are all types of microorganisms. Some microorganisms are helpful and are even used in food production. For example, yeasts are used to make wine, beer, and bread. One type of mold is used in the manufacturing of blue cheese. However, there are other microorganisms that can be harmful and can cause foodborne illness.

Viruses are very small organisms that can cause foodborne illness. Viruses do not increase in numbers while they are in food. They are just catching a ride to the next human where they will start to multiply and increase in numbers. Some viruses that cause foodborne illness are Hepatitis A and Norwalk-like viruses. Most viruses that cause foodborne illness are spread through poor handwashing or poor hygienic practices. Viruses can be spread through almost any ready-to-eat food, including ice.

Bacteria are small single celled organisms and are responsible for causing most cases of foodborne illnesses. Unlike viruses, bacteria will multiply in certain foods if given the right conditions. In order to make our food safe from bacterial growth, we need to understand what bacteria need to grow. Basically, bacteria are a lot like us. They need food, water, a nice environment, and time to grow.

**2. Conditions necessary for bacterial growth**

*Food* – Bacteria need food to grow and multiply. They prefer high protein foods such as meats, poultry, seafood, eggs, dairy products, cooked vegetables such as beans, and cooked cereal grains such as rice.

*Water* – Bacteria need available water in order to grow and multiply. We can control bacterial growth by limiting the water that is available for bacteria. Some foods are dehydrated to remove the water and prevent bacterial growth. Examples of these foods are cereals, dried fruits and uncooked macaroni shells. Other foods have a large amount of salt or sugar added to combine with the water and make it unavailable to bacteria. Some examples of these foods are jams, honey, and marmalade.

*Temperature* – Bacteria need a nice environment in which to live and part of the environment is the temperature. The temperature range in which bacteria grow best is 40°F to 140°F. This is referred to as the temperature danger zone. We can control bacterial growth in our foods by keeping our foods out of this temperature danger zone. We either want to keep our foods below 40°F or above 140°F to prevent bacteria from growing.

Freezing or refrigerating foods will slow or stop the growth of bacteria in our foods. It is importan*t* to remember however, that neither refrigeration nor freezing kills bacteria. Some bacteria will continue to grow very slowly at refrigerated temperatures. Because of this, leftovers should not be kept any longer than three or four days. Other bacteria will start to multiply again if the temperature of the food rises into the temperature danger zone.

Thoroughly cooking foods at high temperatures will kill most bacteria. Once food is cooked, we can control regrowth of bacteria by maintaining our foods at 140F or above.

*Time* – Bacteria need time to grow and multiply while in the temperature danger zone. If conditions are favorable, bacteria can double in numbers every 20 minutes. Foods should not be allowed to stay in the temperature danger zone for very long. Foods need to be kept hot or cold. When foods are cooled from hot to cold, they need to be cooled as fast as possible. The same is true for reheating. Always reheat foods as quickly as possible, so that foods do not remain in the temperature danger zone for very long. If foods have been left out at room temperature for more than two hours, they should be considered unsafe and should be discarded.

*Acidic Foods* – Another part of the bacteria’s environment is the acidity of the food. Bacteria don’t grow very well in acidic foods. Some examples of acidic foods include soda pop, orange juice, ketchup, sauerkraut, and most fruits. Some food manufacturers control bacterial growth in their foods by making them more acidic.

**3. Which foods must be kept out of the temperature danger zone to prevent bacterial growth?**

Although bacteria doesn’t grow in all foods, there are many foods in which they will readily grow. We will call these foods risky foods. Risky foods must be kept either hot or cold to prevent bacteria from growing in them. Risky foods include:

1. *Foods from an animal source* (both raw and cooked). Examples include eggs, meat, fish, and poultry.
2. *Foods from a plant source that have been heat-treated or cooked.* Examples include baked potatoes, mashed potatoes, cooked beans, cooked macaroni, and cooked rice.
3. *Raw seed sprouts*. Examples include alfalfa sprouts and bean sprouts.
4. *Cut melons.* Examples include watermelon, cantaloupe and honeydew.

Foods will not be risky if they are too acidic (such as ketchup or sauerkraut) or if they do not have enough water available (such as cereal) for bacteria to grow.

In addition to risky foods, there are other foods that we keep in the refrigerator such as soda, bottled water, raw fruits and vegetables, and jelly. The reason that we keep foods such as soda or bottled water refrigerated is because they taste better when cold. The reason we keep foods such as raw fruits and vegetables refrigerated is because refrigeration slows the growth of spoilage organisms, and the quality of food will stay better longer. Spoilage organisms are not usually the organisms that cause foodborne illness. The exception to this is cut melons and raw seed sprouts which must always be refrigerated to prevent bacterial growth. When you’re not sure whether a certain food has to be refrigerated or not, always refrigerate the food. It is better to be safe than sorry!

Sometimes bacteria can cause problems even in foods considered non-risky. These foods may become contaminated through improper food handling practices or through other environmental sources. Even though non-risky foods don’t support the growth of bacteria, some bacteria can survive in these foods and when eaten, can make us sick. There have been foodborne illness outbreaks involving foods such as orange juice, apple juice, and dry cereal, which are usually considered non-risky. Refrigeration of these foods would not have prevented the outbreak, because remember, refrigeration does not kill bacteria. The way to prevent future outbreaks is to prevent contamination of the food in the first place by following proper growing and food handling practices. One step that food processors are taking to prevent these outbreaks is to pasteurize (heat treat) juices or to use other processes to kill any harmful bacteria that are present. Some ground beef is currently being irradiated (electronically treated) which is similar to the pasteurization of milk and eggs. Some fruits and vegetables may soon also be irradiated to prevent outbreaks.

1. **Irradiation of Food**

You may have heard about people eating undercooked hamburgers and becoming very sick. They have a sudden onset of abdominal pain, severe cramps and even bloody diarrhea that lasts for days and days. One type of bacteria that can show up in ground hamburger is called E. coli. It can damage the kidneys and can even kill people. There is a scientific procedure that can fix this problem.

Many years ago, people got sick from drinking milk that had dangerous bacteria. Eventually, milk was heated slightly to kill the germs – called pasteurization. Milk is now safe to drink.

Today, foods like hamburger can be treated to kill all germs and the process is called irradiation. It kills 99.999 percent of the E. coli in hamburger.

1. How does it work? Food is sent through a shielded room on a conveyor belt. High-energy radiation goes through the package and product. The beam destroys the bacteria’s DNA making it impossible for the bacteria to continue living. It takes from one to three seconds. The Radura symbol is placed on all product packages which are irradiated and the words “irradiated for food safety.”
2. History of irradiation: Scientists received a patent on the process in 1905; NASA began using for all astronaut food in 1972; spices irradiated beginning in 1983; approved for poultry, beef, veal and other red meat in1990 and irradiation of refrigerated and frozen raw meat and shell eggs in 2000. Common items, such as cotton balls, adhesive bandages, baby bottles and medical supplies are irradiated for safety.

Where can it be purchased? Dairy Queen hamburgers, Schwan’s meats, many grocery stores including SuperValu, HyVee and Cashwise and others.

1. Does irradiation make the food radioactive? No, the energy passes through the food, but does not remain in it. It works like a dental X-ray. Teeth are not radioactive after an X-ray.
2. Does irradiation change the food? The amount of energy is controlled, and food changes are minimal, preserving the foods’ safety, nutritive value and quality.
3. Is the US the only country using irradiation? Almost 40 countries permit irradiation of over 50 different foods.

**Wrap-Up: (**5 Minutes)

Have students share in their jigsaw reading groups and take notes about each of the other three readings. If time allows, have students share aloud what they learned/important things to remember from each reading.