Chapter 2: Food Safety

SAFE PRACTICES

Did you know good food safety habits are important in our every day lives?

From farmer to consumer, it is important to ensure food is safe. Foodborne microbes are one of the leading causes of illness in the United States. It has been estimated that 15% of US citizens each year are affected by **foodborne illness**.

The key is to prevent foodborne illness, not to treat. The United States government promotes food safety to its citizens. The Federal Drug Administration (FDA) and the United States Department of Agriculture (USDA) regulate and inspect foodservice facilities to ensure safety. Along with the FDA and USDA, the Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC) require safe handling of raw and partially cooked meats. Raw and partially cooked meats are the most common causes of foodborne illness.

One of the top causes of foodborne illness is meat that has not been cooked to the proper temperature. Higher temperatures kill the microorganisms that can cause foodborne illness. When preparing meat, we should use thermometers to make sure the center of the

meat has been cooked to its proper temperature. Each type of meat requires a different cooking temperature. To properly determine the temperature, the thermometer must first be calibrated.

Calibration ensures the thermometer reads the correct temperatures. This can be done by placing it in ice-cold water (32° Fahrenheit) or

boiling water (212° Fahrenheit). Water molecules increase in motion as they move through these states (solid, liquid, gas). When energy changes state, it undergoes a phase change such as ***melting***, ***freezing***, ***evaporation***, or ***vaporization***. You will observe these types of state changes in *Food Explorations Lab I* of this chapter.

Melting occurs when a solid becomes a liquid by absorbing heat. In this phase change, molecular bonds are broken to allow melting to occur. Freezing is the opposite of melting. It is when a liquid becomes a solid. During freezing, heat leaves the liquid to allow tight molecular bonds to form. Evaporation and vaporization are when a liquid becomes a gas because heat moves into the liquid and allows the molecules to move more freely.

There are also other reasons foodborne illness may occur. For example, food can be contaminated with harmful bacteria during food preparation. Washing your hands for 20 seconds, or as long as it takes to sing Happy Birthday to yourself twice, at the proper temperature and using cleansing agents are essential in preventing illness. Washing our hands before eating can help keep us safe. The bacteria on our hands can easily transfer to the food we're eating. You will observe why hand washing is an important practice in *Food Explorations Lab II* of this chapter.

Preventing microbial growth in food can be a little harder. Many factors affect microbial growth on food (e.g. pH, moisture). It is important to keep foods at the right temperature to prevent growth (less than 40°F or greater than 140°F). Food can't be kept for too long at room temperature before it is considered unsafe for consumption. Storing raw foods (meat and dairy products) properly and washing foods like, fruits and vegetables, are also methods that keep food safe.

Given enough time, mold can grow in cold or hot temperatures.

Even when proper prevention techniques are in place, age effects occur. When foods age, they produce certain microorganisms like mold, yeast, and bacteria.

Molds are multicellular organisms with a cotton-like appearance. They grow on the surface of dry foods, like bread, at room temperature. If given enough time, they can grow in cold or hot temperatures. You will learn more about mold growth on food in *Food Explorations Lab III* of this chapter.

Yeast is a single celled microorganism. It can grow on foods like citrus fruits because they provide the best environment for yeast to reproduce. The conditions for this environment include sugar, acidity (pH 4.0 to 4.5), and oxygen.

Bacteria are tiny single cellular microorganisms smaller than molds and yeasts. They reproduce in high moisture and neutral pH conditions (pH 7), where sugar and salt are not present. Depending on the bacteria, different environmental conditions are needed. Some bacteria love the cold, some love the heat, and some love room temperature. It is important to remember, however, that not all bacteria are bad for your health!

From the farm to the kitchen, everyone should be aware of the methods to prevent foodborne illness. Let's find out what we can do to keep our food safe!

Think About It

Food Explorations Lab I

1. Thermometers should be calibrated to ensure that food is cooked to the correct _____.

2. The state change from a liquid to a gas is called _____.

3. The water molecules in the _____ state of matter move the slowest.

Food Explorations Lab II

1. Which part of our body is most likely to contaminate food during preparation? _____

2. The correct storage _____ can prevent microbial growth on food.

3. Washing hands before _____ can help keep you safe.

Food Explorations Lab III

1. Multi-cellular organisms that grow on dry food are called _____.

2. A single cellular microorganism that grows on citrus fruit is called _____.

3. The smallest microorganisms that grow on food are _____.

Food Explorations Lab I:

Changing States

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this lesson, you will learn how to calibrate a bimetallic stemmed thermometer. Your teacher will first demonstrate using the boiling water method. Then, you will calibrate a bimetallic stemmed thermometer using the ice water method. During both parts of the lab, you will record temperatures and then construct graphs using this data.

Lab Objectives

In this lab, you will learn how to…

1. Observe and graph the temperature changes that occur during the changes of state for water.

2. Calibrate a bimetallic stemmed thermometer.

Lab Safety: Before beginning ANY investigation you should put on your safety goggles and apron. It is important to avoid getting chemicals on your hands. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation.

Lab Question

How can changes of state be used to calibrate a bimetallic stemmed thermometer?

Observation of State Changes

MATERIALS

Safety goggles
Aprons (optional)
1 thermometer
1 cup filled with ice chips
1 cup filled halfway with water
1 kitchen timer or stopwatch

PROCEDURE

Before you begin your part of the lab investigation, your teacher will heat a pot of water to demonstrate:

a. How to calibrate a thermometer with the Boiling Water Method.

b. Temperature and state changes that occur when heat is applied to water.

1. Record the temperature of the water as it warms every 2 minutes for 10-minutes in Table B.

2. Record any observed state changes in Table A.

3. Create a line graph in Line Graph B on page 37 with your data from Table B. First, label the y-axis in Line Graph B with the appropriate unit of measure. If your thermometer measures °F, create a y-axis ranging from 20° to 250°F. If your thermometer measures °C, create a y-axis ranging from -6° to 126°C. Be sure to use 10° increments.

4. Record each data point on the graph by matching degree of temperature with the minutes the temperature was measured. Connect the temperatures on your graph with a line (left to right) once all five points have been recorded.

5. If the final temperature reached for the boiling water was 212°F or 100°C, the thermometer is calibrated correctly and ready for use. If the final temperature is not correct, you will need to calibrate the thermometer. To calibrate, you should twist the nut below the thermometer head until the dial reaches 212 °F or 100 °C.

6. Next, your group will calibrate a thermometer using the Ice Water Method.

7. Combine the water with the ice chips. Place the thermometer into a cup of ice water. Measure and record the temperature of the water every 20 seconds for 180 seconds in Table C.

   NOTE: Do NOT let the thermometer stem touch the sides or bottom of the cup. When measuring the ice water, the thermometer should stay in the mixture for at least 30 seconds or until the dial stops moving.

8. Record any observed state changes in Table A.

9. Create a line graph in Line Graph C on page 37 with your data from Table C. First, label the y-axis in Line Graph C with the appropriate unit of measure. If your thermometer measures °F, create a y-axis ranging from 20° to 250°F. If your thermometer measures °C, create a y-axis ranging from -6° to 126°C. Be sure to use 10° increments.

10. Record each data point on the graph by matching degree of temperature with the seconds the temperature was measured. Connect the temperatures on your graph with a line (left to right) once all 9 points have been recorded.

11. If the final temperature reached for the ice water was 32°F or 0°C, the thermometer is calibrated correctly and ready for use. If the final temperature is not correct, you will need to calibrate the thermometer. To calibrate, you should twist the nut below the thermometer head until the dial reaches 32 °F or 0 °C.

Table A. Observed State Changes

State	Observed State Changes
Ice Water	
Boiling Water	

Table B. Boiling Water Time Table

State	MINUTES				
	2	4	6	8	10
Boiling Water					

Line Graph B. Boiling Water

	Boiling Water				
(°)					
	2	4	6	8	10
	Minutes				

Table C. Ice Water Time Table

State	SECONDS								
	20	40	60	80	100	120	140	160	180
Ice Water									

Line Graph C. Ice Water

	Ice Water								
(°)									
	20	40	60	80	100	120	140	160	180
	Minutes								

Conclusion:

1. Based on the reading and lab observations, were the thermometers used to measure the boiling water and the ice water calibrated? Support the answer using evidence from the investigation.

2. Using the graphs, determine the boiling point and melting point of water. Describe the appearance of the graphs that allowed you to make this determination.

3. Describe how the water molecules' speed will change as the temperature increases and water changes from a solid to a liquid and from a liquid to a gas?

4. Explain why it is important that thermometers be calibrated before being used for cooking.

5. Describe how the changes of state were used to calibrate the thermometer.

Food Explorations Lab II:

Invisible Creatures

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this investigation, you will work in groups to determine where bacteria can be located on your hands and the effect of hand washing on cleanliness.

Lab Objectives

In this lab, you will learn how to…

1. Identify the areas of the hand where bacteria are the most concentrated.

2. Properly wash your hands for general health and disease prevention.

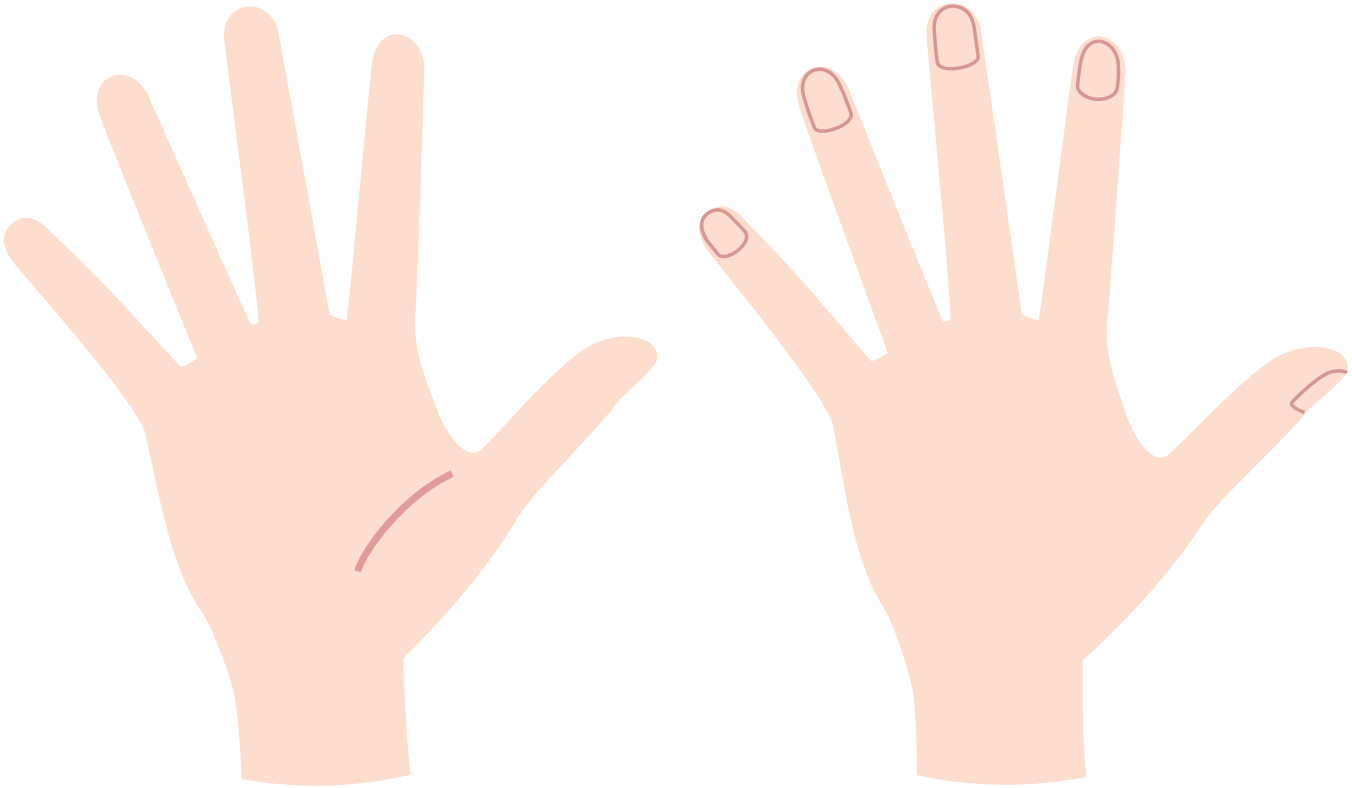
Lab Safety: Before beginning ANY investigation you should put on your safety goggles and apron. It is important to avoid getting chemicals on your hands. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation.

Lab Question

Which of the following areas on the hand contain the most bacteria?

Palm Finger Nails Wrist Fingers Thumb Back of Hand

Prediction: Using the drawing below, shade in locations on each hand where you predict bacteria are the most concentrated.



Provide an explanation for your prediction:

Observation of Bacteria

MATERIALS

Safety goggles
Glo Germ™
Warm water
Colored pencils or markers
Aprons (optional)
UV light
Soap

PROCEDURE

You will use Glo Germ™ and a UV light to determine where bacteria concentrate on your hands. **Do not point the UV light in the direction of anyone's eyes and only turn it on when it is time to use.**

1. Gently shake the bottle of Glo Germ™. Place a small amount (about the size of a quarter) into your palm and spread over both of your hands. Make sure to cover the area under and around your nails, between your fingers and a small portion of your wrists.

2. Place your hands under the UV light to view the bacteria present. This part of the procedure works best in a darkened room.

3. Draw your *visual* observations of where the bacteria are located on your hands on the next page using a light colored pencil or marker.

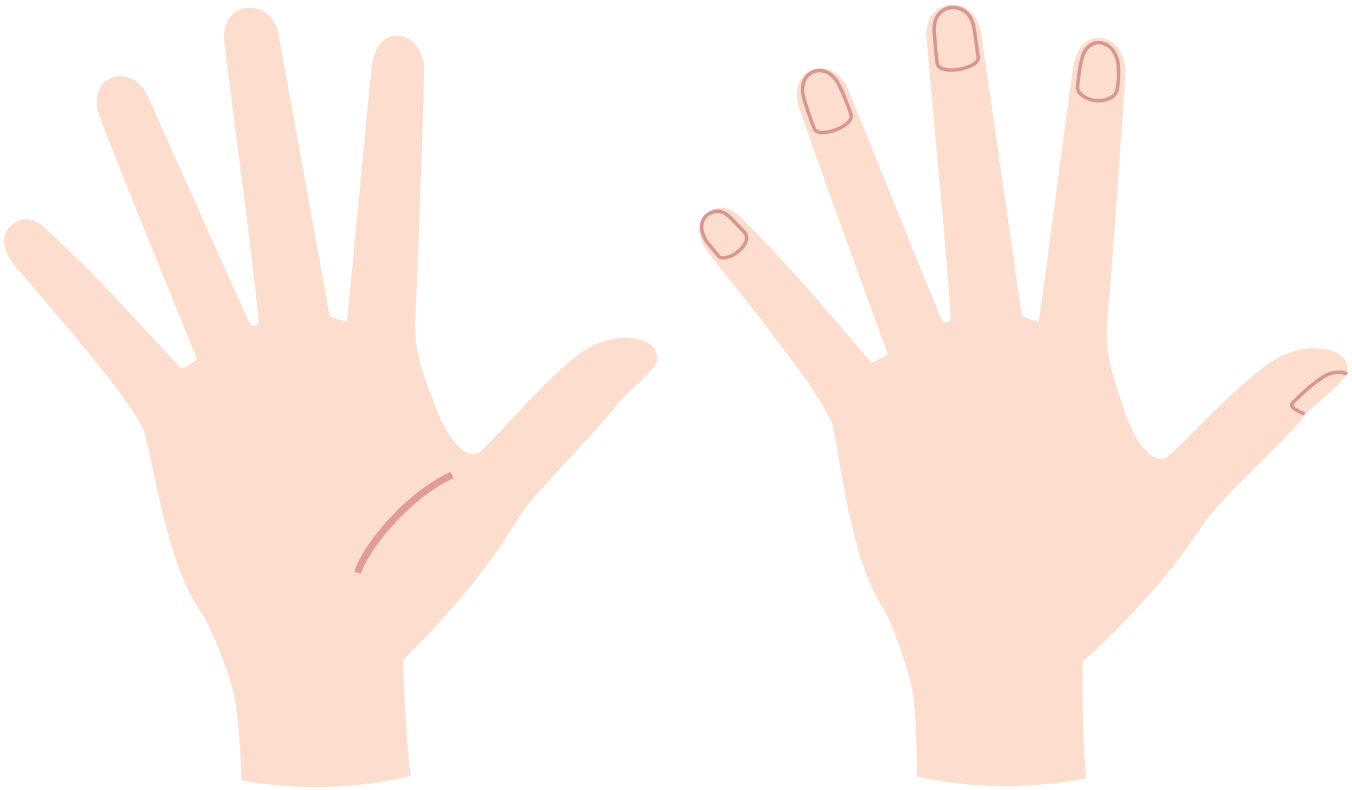
4. Wash your hands with warm water and soap for at least 20 seconds.

5. Place your hands under the UV light to view the bacteria present again. Draw your *visual* observations of where the bacteria are located on your hands on the next page (same hand drawing as before), but this time use a dark colored pencil or marker. The contrasting colors will highlight any areas that still had bacteria on them.

6. Wash your hands with warm water and soap for at least 20 seconds. Pay special attention to the areas that you were not able to clean properly the first time.

7. Draw your *visual* observations of where the bacteria are located on your hands on the next page (same hand drawing as before), but this time circle the areas that still have bacteria on them.

DATA



Conclusion:

1. Explain how the amount and location of bacteria on your hand changed from no hand washing to the first and second hand washings?

2. Use supporting evidence from the investigation to explain if your original response to the lab question was correct or incorrect.

3. List the areas of your hands that had the most bacteria and explain why bacteria are often concentrated in these areas.

4. Infer and describe how bracelets, jewelry, or watches may interfere with hand washing.

5. Referring to the "Safe Practices" reading and your observations during the investigation, describe the most effective way to wash your hands to prevent foodborne illness.

6. Explain three (3) ways people can spread the bacteria that is on their hands.

7. Identify 2 situations throughout your day in which hand washing is very important.

Food Explorations Lab III:

Multiplying Organisms

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this investigation, three types of food will each be placed in two different environments to determine which food and environment is best for the growth of mold.

Lab Objectives

In this lab, you will learn how to…

1. Identify factors that increase the growth of mold.

2. Identify ways to reduce the growth of mold on food.

Lab Safety: Before beginning ANY investigation you should put on your safety goggles and apron. It is important to avoid getting chemicals on your hands. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation.

Lab Questions

1. Which of the following food items will produce the MOST mold growth? (Circle your answer.)

Apple Slices Cheese Bread

Prediction: I predict _____ will produce the most mold because…

2. Which environment will produce the most mold growth? (Circle your answer.)

Aerobic (air present) Anaerobic (air not present)

Prediction: I predict the _____ environment will produce the most mold because…

Observation of Mold Growth

MATERIALS

Safety goggles
Aprons (optional)
1 slice of white bread
2 slices of apple
2 pieces of cheese
1 paper plate
1 plastic sandwich bag
1 plastic knife
1 black permanent marker
1 microscope (optional)
2-3 microscope slides (optional)

PROCEDURE

1. Obtain your food samples. Draw your *visual* observations of each food in the Food Sample Drawings table under Day 1.

2. Prepare your food samples. Place one piece of each food type (half a slice of bread, 1 slice of apple, and 1 piece of cheese) in the plastic sandwich bag. The foods in the plastic bag should be considered an anaerobic environment (no air). Be sure to squeeze out any air from the plastic bag prior to closing it to ensure you are creating an anaerobic environment. Be sure to label your plastic bags with your group name.

3. Using the black marker, divide the paper plate into thirds. Place the remaining food samples (half a slice of bread, 1 slice of apple, and 1 piece of cheese) on the divided paper plate (aerobic environment, which has air). Be sure to label your paper plate with your group name.

4. Place all six food items to the side for later observation.

5. One to two times a week for up to 3 weeks, observe the food samples for visible mold growth. When mold is visible on at least 2 samples of the available food types, use a plastic knife to remove a small sample from each and proceed with the remainder of the lab investigation.

6. Record your *visual* observations after 3 weeks in the Food Sample Drawings table under Final Day. Be sure to identify if your sample was stored in an anaerobic or aerobic environment.

   NOTE: Not all foods will produce mold.

7. (Optional) Observe each mold type under a microscope.

Table A. Food Sample Drawings

Apple		Cheese		Bread	
Day 1					
Final Day					
AEROBIC	**ANAEROBIC**	**AEROBIC**	**ANAEROBIC**	**AEROBIC**	**ANAEROBIC**

Conclusion:

1. Which food type had the most mold growth? Why?

2. Describe how the mold types differ for each food sample? Consider appearance, color, and odor.

3. For each type of food, which environment produced the most mold? Is oxygen necessary for the mold to grow?

4. Brainstorm or research a few examples in which mold growth (fermentation) is used to produce food products. Describe your findings below.

5. Based on the reading and your observations, what conditions are ideal for microbial growth? Describe how food can be kept safe from molds.

Investigating Your Health:

Fearless Food Safety

Name: _____

Objective: Investigate food safety by describing ways to prevent foodborne illness, describing the correct hand washing procedure, and tracking how many times you wash your hands in one day.

Food safety is handling, storing, and preparing food in ways to keep food safe. ***Cross-contamination*** is the spreading of bacteria to clean surfaces that can cause foodborne illness. To prevent cross-contamination, keep raw meat, fish, and poultry away from ready-to-eat foods, like fresh fruits and vegetables. Don't use a plate or knife that touched raw meat. Always wash your hands after you touch raw meat. Washing countertops and using clean dishes and silverware can also prevent cross-contamination. Washing your hands correctly, and before touching food, may also prevent bacteria from spreading to food. Cooking foods to their proper temperatures will prevent foodborne illness from occurring. Salmonella is the most common foodborne causing pathogen. It can be found in raw meat, fish, poultry, and eggs. E. coli is another pathogen that can be found in raw or undercooked meat, fish, and poultry. Both salmonella and E. coli are bacteria that can cause foodborne illness. ***Foodborne illness*** happens when you get sick from eating a food contaminated with a harmful substance. If food safety measures are not followed, you or the people you're cooking for could get sick. For more interesting food safety tips, see the *Try This at Home* recipe!

Hand Washing Practices

1. During the course of one day, track how many times you washed your hands. Describe the circumstances for why you washed your hands each time in the table below.

	Why did you wash your hands?
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

2. Investigate and describe the correct way to wash your hands as recommended by the Food and Drug Administration (FDA). Be sure to explain the importance of soap/water, how long to wash your hands for, and how to turn off the faucet.)

3. List 3 instances when you should wash your hands.

4. Investigate and describe below 2 other ways can you prevent foodborne illness.

5. Complete the table below to identify 3 ways foodborne illness can occur and what bacteria caused the illness.

Situation	Cause	Bacteria
Example: **Improper Storing**	**Raw meat was stored next to fresh vegetables in the refrigerator**	**E. Coli Salmonella**
Cross-Contamination		
Improper Handling		
Improper Storing		

6. Ask a family member if they have had any bad experiences with mold, bacteria, or foodborne illness. Describe their experience below.

TRY THIS AT HOME:
Wash Away Germs

You will need:

2-3 teaspoons of cooking oil
1 teaspoon cinnamon

How clean are your hands?

1. With your hands over the sink, pour 2-3 teaspoons of cooking oil into your hands.
2. Then sprinkle the cinnamon onto your hands. Pretend that the cinnamon is bacteria.
3. Rub your hands together.
4. Wash your hands without using soap. Sing "Happy Birthday to You," while you wash your hands.
5. Look at your hands. Can you still see bacteria (cinnamon)?
6. Wash your hands again using the directions below.

Proper Hand Washing Instructions

1. Wet your hands with warm running water.
2. Add soap.
3. Rub hands together while singing "Happy Birthday to You" twice.
4. Scrub under your fingernails and between every finger.
5. Rinse soap off with running water.
6. Use a clean paper towel to turn off the water.
7. Dry your hands with a clean paper towel.