U.S. FOOD & DRUG ADMINISTRATION

FOOD SAFETY

LifeSmarts
Learn it. Live it.

RETAIL AND HOME

The "Retail and Home" module brings food safety closer to home, focusing on the crucial steps needed to keep food safe in grocery stores and kitchens. This module highlights the importance of proper food handling, storage, and preparation to prevent foodborne illnesses. One significant focus is the discussion on cross-contamination and how everyday actions, like using a cutting board or storing food in the refrigerator, can have significant impacts on health. Developed by educators and FDA experts, this lesson ties into LifeSmarts topics such as consumer awareness, health, and safety. Students will explore real-world scenarios that demonstrate the importance of food safety practices in their daily lives. With engaging videos, practical lab instructions, and interactive discussions, teachers will find this lesson a valuable tool for reinforcing key food safety principles and preparing students for LifeSmarts competitions.

DISCUSSION QUESTIONS

- How does the FDA Food Code help ensure food safety in retail establishments? Discuss its significance and how it is implemented in restaurants and grocery stores.
- What are the "Four Steps to Food Safety" in the home, and why are they important for preventing foodborne illness?

CHALLENGE QUESTION

- Research a real-world example where the breakdown of food safety practices in a retail setting led to a significant foodborne illness outbreak. What were the key factors that contributed to the outbreak, and how could it have been prevented?

See this lesson and more at LifeSmarts U.

This lesson was developed by educators and experts in conjunction with the U.S. Food & Drug Administration

VOCABULARY

- Sanitizer
- Cross-contamination
- FDA Food Code
- Cold Chain
- Shelf-stable
- Foodborne Illness
- Consumer Advisory
- Handwashing
- Food Inspection
- Expiration Date

ACTIVITIES

- Fast-Food Footwork
- Supermarket Smarts
- Crossed Up!
- The Science of Cooking a Hamburger
- Coliform Counts

VIDEOS

* See reverse side for list

VIDEO LINKS

Salmonella Linked to Chicken: AJ's Story (2:19)
https://youtu.be/IPOLIpcW8Fg

Food and Kitchen Safety (3:03)
https://www.youtube.com/watch?v=iAJviCO5VuA

Grocery Store Food Safety (29:27)
https://www.youtube.com/watch?v=wkPMN1oBFFw

Crossed Up! Lab Instruction (8:10)
https://youtu.be/t0okeNUzKKI

Cooking Burgers (0:34)
http://www.youtube.com/watch?app=desktop&v=PcHEW4giNkU

Cooking Right: The Science of Cooking a Hamburger Lab Instruction (11:35)
https://youtu.be/3dgI1aIMLG0

A Chilling Investigation Lab Instruction (7:46)
https://youtu.be/PdUnXiLUBjE

Don't Cross Me Lab Instruction (8:43)
https://youtu.be/lEXiP8oxYVo

OTHER WEB LINKS

FDA Food Code
https://www.fda.gov/food/retail-food-protection/fda-food-code

Food Business Safety
https://www.health.state.mn.us/communities/environment/food/index.html

Food Marketing Institute (FMI)
http://www.fmi.org

Food Safety is Everyone's Business - USDA
http://www.usda.gov/media/blog/2023/06/07/food-safety-everyones-business

CDC Food Safety
http://www.cdc.gov/foodsafety

Food Safety for Your Family/Kids Health
http://www.kidshealth.org/en/parents/food-safety.html

Your Gateway to Government Food Safety Information
http://www.foodsafety.gov

Partnership for Food Safety Education
http://www.fightbac.org

DISCUSSION QUESTIONS (SAMPLE ANSWERS)

- A: The FDA Food Code provides a set of guidelines and recommendations that retail food establishments, such as restaurants and grocery stores, must follow to ensure food safety. It covers various aspects, including proper cooking temperatures, employee hygiene, and the prevention of cross-contamination. The code is adopted by nearly 3,000 state, local, and tribal jurisdictions as the legal basis for their food inspection programs. By adhering to the FDA Food Code, establishments can reduce the risk of foodborne illnesses, protect public health, and maintain consumer trust. Implementation of the code involves regular training for food handlers, routine inspections by health authorities, and the adoption of Hazard Analysis and Critical Control Point (HACCP) procedures to manage food safety risks.

- A: The "Four Steps to Food Safety" in the home are Clean, Separate, Cook, and Chill. These steps are crucial for preventing foodborne illness by controlling the conditions in which bacteria can grow and spread. Cleaning involves washing hands and surfaces regularly to remove bacteria. Separating involves keeping raw meats, poultry, and seafood away from other foods to prevent cross-contamination. Cooking ensures that food reaches a safe internal temperature to kill harmful bacteria. Chilling involves refrigerating or freezing foods promptly to slow bacterial growth. Following these steps helps to minimize the risk of contamination and ensures that food is safe to eat, protecting the health of everyone in the household.

CHALLENGE QUESTION (SAMPLE ANSWER)

- **A well-known example is the 1993 E. coli outbreak linked to undercooked hamburgers served at Jack-in-the-Box restaurants.**
  https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6951920/

  Key Points:
  Breakdown in Food Safety: The outbreak was caused by undercooked ground beef patties that did not reach the required internal temperature to kill E. coli bacteria. The FDA Food Code at the time recommended cooking ground beef to an internal temperature of 155°F, but some patties were cooked to only 140°F.

  Consequences: The outbreak resulted in over 700 reported cases of illness and four deaths, leading to significant legal and financial repercussions for the company.

  Prevention: The outbreak could have been prevented by strictly adhering to the FDA Food Code's temperature guidelines and ensuring that all food handlers were properly trained in safe cooking practices. Following the outbreak, Jack in the Box implemented more rigorous food safety protocols, including better temperature monitoring and more stringent cooking practices.

SCIENCE AND OUR FOOD SUPPLY

Food Safety - Retail & Home

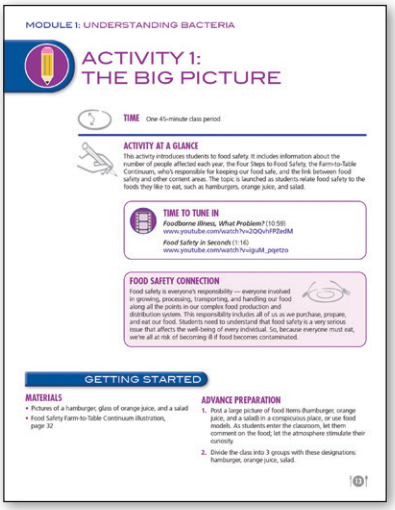
Teacher's Guide for Middle and High School Classrooms

DEPARTMENT OF HEALTH & HUMAN SERVICES · USA

FDA

OVERVIEW OF ACTIVITIES

The activities are written in this easy-to-understand format.


MODULE 1: UNDERSTANDING BACTERIA

ACTIVITY 1:
THE BIG PICTURE

TIME One 45-minute class period

ACTIVITY AT A GLANCE

TIME TO TUNE IN

FOOD SAFETY CONNECTION

GETTING STARTED

MATERIALS

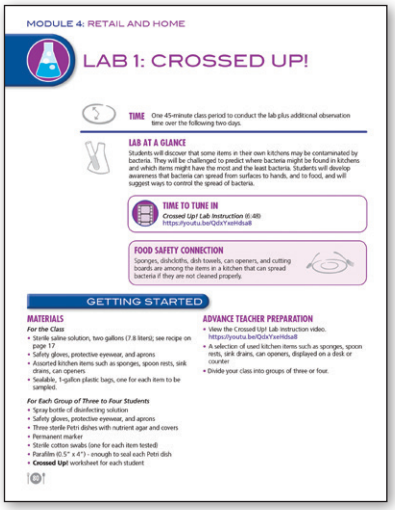
ADVANCE PREPARATION

TIME: The approximate amount of time needed to perform the activity.

ACTIVITY AT A GLANCE: Briefly summarizes the activity.

TIME TO TUNE IN: Shows the URL for online video or digital content (for youth) related to that module. Video URLs and web links are shown in purple.

FOOD SAFETY CONNECTION: Relates background information to relevant public health impact.


MODULE 4: RETAIL AND HOME

LAB 1: CROSSED UP!

TIME One 45-minute class period to conduct the lab plus additional observation time over the following two days.

LAB AT A GLANCE

TIME TO TUNE IN

FOOD SAFETY CONNECTION

GETTING STARTED

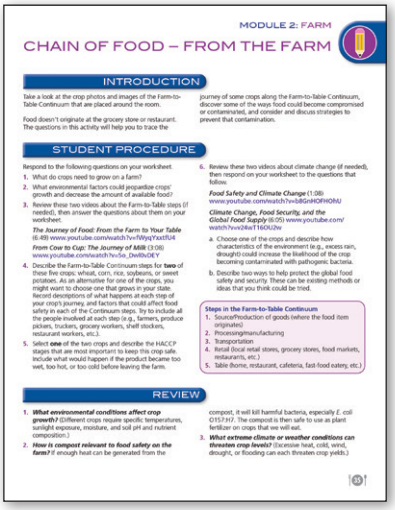
MATERIALS

ADVANCE TEACHER PREPARATION

LAB AT A GLANCE: Briefly summarizes the lab.

MATERIALS: Lists the items needed to perform the activity.

ADVANCE TEACHER PREPARATION: Indicates what you need to do *before* conducting the activity.


MODULE 2: FARM

CHAIN OF FOOD – FROM THE FARM

INTRODUCTION

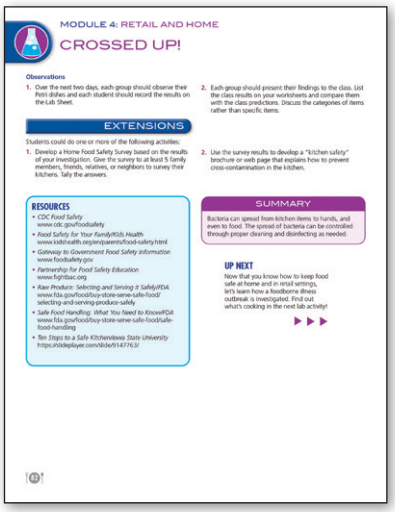
STUDENT PROCEDURE

REVIEW

INTRODUCTION: Provides fun, innovative suggestions for introducing the activity. Where provided, suggested teacher dialogue is indicated by ***boldface italics***.

STUDENT PROCEDURE: Provides the step-by-step process for the activity. Where provided, suggested teacher dialogue is indicated by ***boldface italics***.

REVIEW: Uses interesting questions to guide students through a review of what they learned in the activity.


MODULE 4: RETAIL AND HOME

CROSSED UP!

Observations

EXTENSIONS

RESOURCES

SUMMARY

UP NEXT

EXTENSIONS: Suggests activities to help students learn more about the topic.

SUMMARY: Summarizes key concepts learned in the activity.

RESOURCES: Provides references to online resources that enhance the activity or lab for further study.

UP NEXT: Provides a preview of the next activity.

SAFETY FIRST IN THE LAB

Preparing for the Lab

- NEVER EAT OR DRINK ANY FOOD OR LIQUID IN THE LAB.
- Pull back and secure long hair.
- Wash your hands thoroughly with warm water and soap before and after the lab.
- Disinfect all surfaces with a disinfecting bleach solution before beginning a lab. (see TIP box).
- Wear appropriate safety equipment (gloves, protective eyewear, and lab aprons).
- NEVER EAT, DRINK, OR CHEW GUM IN THE LAB. Keep your hands, pencils, etc., out of your mouth.
- INAPPROPRIATE BEHAVIOR WILL NOT BE TOLERATED AT ANY TIME IN THE LAB!

TIP **Disinfecting Bleach Solution:** 20 mL of liquid household bleach (chlorine bleach) in 1 L of tap water.

Safety Gloves

- Wear safety gloves when inoculating Petri dishes and when working with raw meat.

  Safety gloves are made from many types of materials, including vinyl and polyethylene. They can be purchased at a local pharmacy, grocery store, or through science supply catalogs. Comply with your school's instructions for limitations for glove materials.
- When removing safety gloves, be careful not to contaminate your hands, items, or surfaces with any residue that may be on the gloves. As you remove the gloves, insert the first glove you remove inside the second glove you remove, with the side that touched your skin pulled off inside out.
- Throw away used gloves immediately after removing them.
- Wash your hands with warm water and soap after removing the gloves.

Hot Surfaces

- Use thermal gloves or hot-pad holders when working with hot plates, burners, autoclaves, or any other heat source.

Petri Dishes

- Use Parafilm to seal Petri dishes after inoculating them.
- Never open a Petri dish with organisms growing in it. It could contain/release dangerous pathogens!

Pipettes

- ***Never pipette by mouth.*** Always use a pipette bulb or pipette aid.
- Be careful when attaching a pipette bulb. Hold your hand close to the end of the pipette where the bulb will be attached. Push the bulb onto the pipette carefully and gently. If you push too hard, the pipette could break and you could cut yourself.

Food in the Lab

- NEVER EAT OR DRINK ANY FOOD OR LIQUID IN A LAB.
- Thoroughly wash hands before and after handling and cooking raw meat.
- Wear safety gloves and lab aprons when handling raw meat, as well as protective eyewear when cooking raw meat.

Proper Clean-Up

- Wear safety gloves and take appropriate defensive measures when cleaning up cultures and used equipment.
- Wash all glassware and other instruments in hot, soapy water, then sterilize them (see page 6).
- Properly dispose of used Petri dishes and other used equipment (see below).
- Thoroughly disinfect all surfaces, especially those that were in contact with raw meat.
- Before leaving the lab, wash your hands with warm water and soap or use a gel hand sanitizer.

Disposal of Used Materials and Equipment

- Check your school, local, or state safety regulations for specific information on how to properly dispose of potentially hazardous materials. If there are no guidelines, follow these precautions:

For Raw Meat

- Unless contaminated with a virulent pathogen in the lab, raw meat and other foods can usually be disposed of as regular solid waste. Place the meat in a sturdy, plastic bag, seal, and dispose.

For Used Swabs, Pipettes and Other Disposable Equipment

- Materials used by each group of students should be placed into a sturdy, plastic trash (garbage) bag that won't leak. If your lab contains glass, place it in a cardboard box, and seal it before disposal. Dispose the closed bag in the trash.

For Used Petri Dishes

- Place them into a plastic bag and add the disinfecting bleach solution; tightly close the bag and place it into another bag (double-bag), then dispose.

Note: Equipment that will be reused should be cleaned using hot, soapy water and then placed in boiling water for 10 minutes or sterilized in an autoclave.

LAB PROCEDURES

Washing Hands

- Use warm water and soap.
- Wet hands and add soap.
- Scrub hands for 20 seconds away from the running water. Thoroughly scrub wrists, under fingernails, around nail beds, and between fingers.
- Rinse hands under running water.
- Dry hands thoroughly with clean paper towels.
- Use the paper towels to turn off the faucet.
- Dispose of used paper towels in the trash.

Note: If necessary, disposable alcohol wipes or gel hand sanitizers can be substituted for soap and water.

Disinfecting

Disinfecting Bleach Solution: 20 mL of liquid household bleach (chlorine bleach) in 1 L of tap water.

To Disinfect Countertops

- Put solution in a spray bottle and label the bottle "Disinfecting Solution."
- Wipe off counters to remove any visible soil.
- Spray the disinfecting solution on counters and leave it on for 2 minutes.

Note: Use the solution within 24 hours, then dispose of remaining solution by pouring it down the drain. Solution will lose its effectiveness in 24 hours.

Sterilizing Equipment

(test tubes, pipettes, etc.)

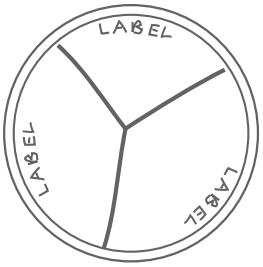
Options

- Use an autoclave.
- Use dry heat — 160°F to 180°F (71°C to 82°C) for three to four hours.
- Use chemical agents, such as 5% bleach, ethyl or isopropyl alcohol, commercial disinfectants, or iodine solutions.

Inoculating a Petri Dish

1. Label

- Divide the Petri dish into sections (if applicable) and label the bottom (agar side) of the dish using a permanent marker.
- Label along the outer edges of the dish or the sections, so the labels don't interfere with viewing the colonies. Include date and initials.



2. Inoculate

- Use a sterile cotton swab* to wipe the surface or liquid being tested. Hold the cotton swab at one end; if using a divided Petri dish, do not touch the end that will be used to inoculate the agar.

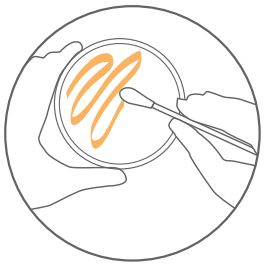
  ** For a control dish, use a new, untouched cotton swab to streak the control dish to check for any microbial contamination.*

For a Dry Surface

- Wet the swab by dipping it in boiled or sterile water. Then, squeeze out the swab by pressing it against the inside of the container. (If the swab is too wet, the liquid will flow into other sections and the microbial colonies will run into each other.)
- Swab the dry surface.

For a Liquid

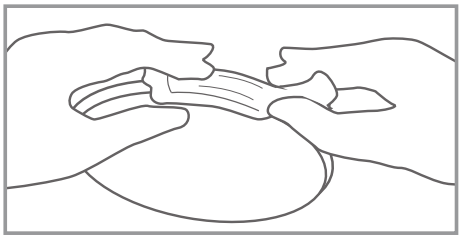
- Dip the sterile cotton swab in the liquid. Then squeeze the swab by pressing it against the inside of the container.
- Inoculate the nutrient agar using a back-and-forth motion, covering the entire area of the dish or section. Do not swab too close to the dividing lines for the next section.



3. Parafilm

Place the cover on the Petri dish and seal it closed using Parafilm.

- Cut a narrow strip of Parafilm (0.5" x 4") and stretch it around the outside edge (along the full circle perimeter) of the covered dish.



4. Incubate

- Place dishes upside down (label side up) in an incubator set at 95°F (35°C) or let the dishes sit at room temperature in a dark place for the appropriate amount of time.

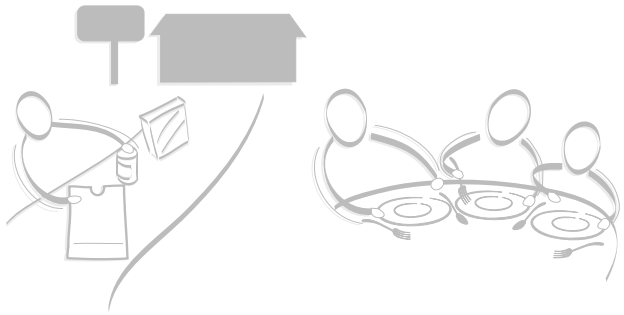
TIPS **For Viewing Inoculated Petri Dishes**

- View the dishes on a light-colored surface.
- Use a dissecting microscope or hand lens to observe the microbial colonies.

Lab Videos Teacher Note: Most of the labs in this curriculum include an instruction video by Dr. Janie Dubois, the curriculum's lead lab instructor. Each video includes set up instructions as well as some discussion about possible experimental results. You could show students the first set up segment and pause the video before the results discussion, which you can show to your students later, once they review their own results.

MODULE 4 RETAIL AND HOME

This module examines the preparation of food in retail foodservice establishments and in the home.



BACKGROUND INFORMATION

Module 4 discusses the retail section of the Farm-to-Table Continuum as well as how to handle food at home.

ACTIVITIES

ACTIVITY 1: Fast-Food Footwork explores how retail foodservice establishments ensure that food is safely stored, prepared, and served.

Time to Tune In
Salmonella Linked to Chicken: AJ's Story (2:19)
youtu.be/lPOLIpcW8Fg

Food and Kitchen Safety (3:03)
www.youtube.com/watch?v=iAJviCO5VuA

ACTIVITY 2: Supermarket Smarts explores many aspects of safe food handling in a supermarket or grocery store.

Time to Tune In
Grocery Store Food Safety (29:27)
Teacher Note: You might choose to show only a subset of this video.
www.youtube.com/watch?v=wkPMN1oBFFw

LABS

LAB 1: Crossed Up! examines how bacteria can be spread among the items in a kitchen if they are not properly cleaned.

Time to Tune In
Crossed Up! Lab Instruction (8:10)
https://youtu.be/t0okeNUzKKI

LABS 2 - 4: The Science of Cooking a Hamburger is taught in a series of three labs that explore the Four Steps to Food Safety: clean, separate, cook and chill.

Time to Tune In
Cooking Burgers (0:34)
www.youtube.com/watch?app=desktop&v=PcHEW4giNkU

Lab 2: Cooking Right

Time to Tune In
Cooking Right: The Science of Cooking a Hamburger Lab Instruction (11:35)
https://youtu.be/3dgI1aIMLG0

Lab 3: A Chilling Investigation

Time to Tune In
A Chilling Investigation Lab Instruction (7:46)
https://youtu.be/PdUnXiLUBjE

Lab 4: Don't Cross Me

Time to Tune In
Don't Cross Me Lab Instruction (8:43)
https://youtu.be/lEXiP8oxYVo

LAB 5: (advanced level or honors) Coliform Counts uses a coliform analysis of raw ground beef and applies the results to food safety.

BACKGROUND INFORMATION

RETAIL

The Four Steps to Food Safety Connection: In any restaurant or place that serves food, the Four Steps are critical.

Hi-Tech Hamburgers – Fast-Food Technology

To eliminate human error, an engineer developed a two-sided "clam shell" type grill that has a temperature sensor. It cooks burgers on both sides simultaneously, using a sensor to ensure that all of the burgers reach a safe internal temperature.

Two-sided grill.

Important Note: The "clam shell grill" is one way to ensure safer food. Other methods, such as cooking on a grill and flipping burgers, are also effective. The point is to ensure that foods are cooked to a high enough temperature to kill any pathogens.

Handwashing

Humans are one of the biggest sources of food contamination in restaurants: for example, contamination can occur when someone doesn't wash their hands and then prepares or serves food. Proper handwashing is critical to keep food safe.

Supermarkets

There are several ways in which supermarkets/grocery stores follow the Four Steps to Food Safety:

- Receiving areas are maintained at cold temperatures of 41°F (5°C) or below to maintain the cold chain that started way back in the field.
- Storage areas and display cases are kept clean and temperature controlled. Products are stored within the cold zone of the display cabinet.

The milk is stored in clean, temperature-controlled display cases.

- Food preparation areas are kept clean and are set up to avoid cross-contamination.
- Foods are always separated to avoid cross-contamination. Raw meats, fish, and poultry are never mixed together or mixed with fruits and vegetables.

FDA Food Code

FDA publishes the FDA Food Code, which is a reference guide that instructs retail food establishments, such as restaurants, grocery stores, and institutions, such as nursing homes and schools, about how to prevent foodborne illness. It consists of a model code which is adopted by nearly 3,000 state, local, and tribal jurisdictions as the legal basis for their food inspection programs for safeguarding public health. It ensures that food is safe and unadulterated (free from impurities) and honestly presented to the consumer. It also provides references, public health reasons, and explanations for code provisions, guidelines, and sample forms. The FDA first published the Food Code in 1993 and revises it every four years.

DID YOU KNOW?

The Food Code has a provision for restaurants and food stores to display Consumer Advisories, which are advisory messages to consumers, usually at the point of sale or service, to help them make a more informed decision about consumption of food that may affect their health. Often found in menus, on placards, or on posters, these messages concern foods such as raw or under-cooked meats, poultry, seafood, shellfish, eggs, or unpasteurized juice.

BACKGROUND INFORMATION

Know The Code

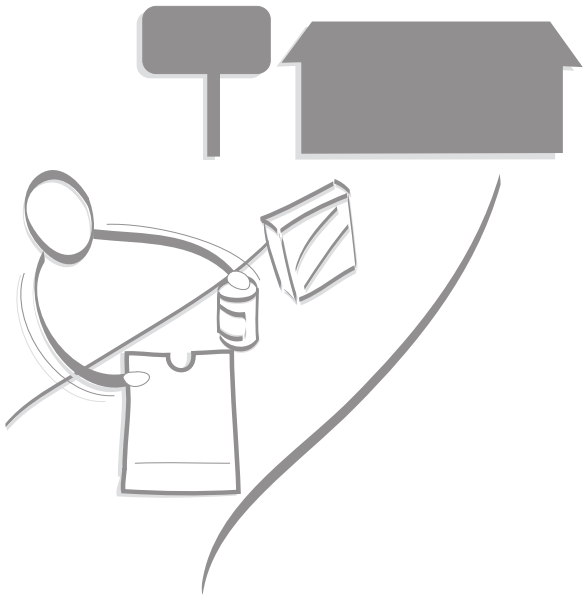
The Food Code

Foodservice employees must take extra care when working with food because harmful bacteria can spread to food and make people sick when the food is eaten. Remember: One person working in a foodservice establishment can infect multiple people if he or she doesn't follow safe food-handling practices, especially proper handwashing. Everyone plays a role in keeping our food safe.

Here are TIPS from the FDA's Food Code for people working in foodservice and food stores:

- Don't go to work if you're not feeling well. Sick food workers can transmit diseases to food — and other people. Those experiencing diarrhea, vomiting, jaundice, or sore throat with fever should be kept away from food preparation and clean items that touch food.
- Wash your hands frequently — when entering the kitchen, after using the toilet, after handling raw meat and poultry, after handling dirty dishes, before putting on gloves, after handling anything dirty, etc.
- Know the correct cooking temperatures for foodservice for meats and poultry
  - Intact meat (e.g., beef, pork), fish, and single order eggs should be cooked to 145°F for 15 seconds. Intact means that it has not undergone any manipulation, such as pounding or cubing.
  - Non-intact and ground meat should be cooked to 155°F for 17 seconds.
  - Poultry and stuffed foods should be cooked to 165°F (instantaneous).

  The correct temperature for refrigerated foods is 41°F or less. Use a calibrated thermometer to check temperatures.
- Prepare food with clean equipment, dishes, and utensils. Store food in clean containers and use clean utensils.
- Use deli tissue, spatulas, tongs, dispensing equipment, or single-use gloves to help keep potentially contaminated bare hands from touching ready-to-eat foods.



- Provide a proper barrier to cover any skin lesions, open wounds, boils, or infected wounds on your hands and arms.
- Don't wear artificial fingernails or jewelry when preparing food.
- Don't sneeze or cough into foods. If you sneeze or cough, wash your hands again with warm water and soap right away.
- To prevent the growth of bacteria, clean and sanitize receiving, storage, cutting, checkout, and display areas regularly.

Three Supermarket Facts

- During the 1940s, the establishment of supermarkets was on the rise across the United States.
- A clean, neat store was one of the top three features that customers deemed important when choosing a primary supermarket.
- On April 25, 1882, William B. Purvis, an African American inventor from Philadelphia, Pennsylvania, patented an improved paper bag machine. His improved machine manufactured satchel bottom shopping bags at an improved volume with greater automation than any previous machinery.

BACKGROUND INFORMATION

Sanitation

Sanitizers are chemical or physical agents that reduce microorganism contamination levels present on inanimate environmental surfaces. Using hot, soapy water is sufficient for cleaning food-contact surfaces, cutting boards, utensils, etc. Periodically, kitchen sanitizers can be used for added protection against bacteria. Sanitizers help kill bacteria so that bacteria don't spread to food. There are two classes of sanitizers:

1. Sanitizers of Non-Food Contact Surfaces: Traditionally, the performance standard used by the U.S. Environmental Protection Agency (EPA) for these sanitizers has required a reduction of the target microorganism by 99.9% or 3 logs (1000, 1/1000, or 10^3) after 5 minutes of contact time.
2. Sanitizing Rinses for Previously Cleaned Food Contact Surfaces: Traditionally, the EPA performance standard for these sanitizers has required a 99.999% or 5-log (10^5) reduction of the target microorganism in 30 seconds.

In comparison, disinfectants come in a variety of categories and are also agents that help eliminate undesirable microorganisms from inanimate (non-living) environmental surfaces. Because these surfaces are inanimate, they are considered contaminated, not infected. Measurement of disinfectant performance varies by product type (spray, dilution product, impregnated wipe, etc.). Disinfectant performance is typically not defined in terms of a specific percentage or log-reduction target. Unlike the sanitizers for food-contact surfaces, products that are termed disinfectants are usually not intended for use in association with food-contact surfaces.

Note: Read and follow label directions to determine the specific microorganism a product kills and how to use the product effectively. Sanitizers and disinfectants must remain in contact with a surface for a specified period of time in order to kill organisms. Be sure to check the label.

Food Inspection

FDA, USDA, and state and local regulatory agencies are responsible for protecting the safety and wholesomeness of food. These agencies conduct food inspections to check and assure that the nation's food supply is safe to eat and that proper sanitary conditions are enforced. Agency scientists test samples to see if any substances are present in unacceptable amounts. If contaminants are identified, the agencies take corrective action. The agencies also inspect foods that are imported to the United States from other countries to make sure they are in compliance with government standards, and set labeling standards to help consumers know what is in the foods they buy.

DID YOU KNOW?

Mary Mallon, also known as Typhoid Mary, was a famous typhoid carrier who allegedly contributed to the most famous outbreaks of carrier-borne disease in medical history. Mary was first recognized as a carrier of the typhoid bacteria during an epidemic of typhoid fever in 1904 that spread through Oyster Bay, New York, where she worked from household-to-household as a cook. She was a healthy carrier of the disease, which meant she had at some point had a mild case of typhoid and still carried the disease, although she was not affected. This also meant she could spread the disease. Fifty-one original cases of typhoid and three deaths were directly attributed to her (countless more were indirectly attributed), although she was immune to the typhoid bacillus, *Salmonella* Typhi. *The New York American, June 20, 1909 Typhoid Mary (1870 est.–1938)*

Food Package Dates

The "Sell By" date on food packages is a calendar date on the packaging of a food product that indicates the last day the product can be sold. The "Sell By" date tells the retailer how long to display a product. It guides the rotation of shelf stock and allows time for the product to be stored and used at home. The date is quality driven, not a food safety concern.

The "Best if Used By" date on packages is a calendar date on the packaging of a food product, which represents the recommended time limit a food should be used for best flavor or quality. It is not a purchase or safety date.

The "Use By" date is the last date a consumer is recommended to use a product while it is at peak quality. This date is recommended for best flavor or quality. It is not a "Sell By" or food safety date.

BACKGROUND INFORMATION

The "Expiration" date on food packages is a calendar date that indicates the last date a food should be eaten or used. Foods that are purchased or used after the expiration date could contain spoilage bacteria or pathogens and may not be safe to eat. Don't buy foods after the expiration date has passed. At home, throw out foods after the expiration date has passed.

HOME

Even with all the food safety precautions involved in getting food from the farm to the table, food can still become contaminated, so it's important for YOU to always practice the Four Steps to Food Safety. Once you purchase food and take it home, the responsibility for food safety is literally in your hands.

Overview of the Four Steps to Food Safety in the Home

Clean: Wash hands and surfaces often. Wash hands with warm water and soap, and cutting boards, dishes, utensils, and surfaces with hot, soapy water before and after food preparation.

Separate: Keep raw meats, poultry, and seafood, and the juices from raw foods, away from other foods in your shopping cart, on kitchen counters, and in your refrigerator.

Cook: Cook foods to proper temperatures. Using a food thermometer is the only reliable way to ensure that hamburgers, meat, and poultry reach a safe internal temperature.

Chill: Refrigerate promptly. Refrigerate or freeze foods quickly because cold temperatures keep harmful bacteria from growing and multiplying. Follow the 2-Hour Rule: Refrigerate or freeze perishables, prepared foods, and leftovers within 2 hours or less of being out of the refrigerator.

DID YOU KNOW?

You can use one teaspoon of liquid chlorine bleach per quart of clean water to sanitize surfaces. The bleach solution needs to be made daily and must sit on the surface to be sanitized for about 10 minutes to be effective. (This solution has a 24-hour shelf-life.) Note: Don't wash raw produce with soap, detergents, or bleach solutions. Rinse raw produce under running water.

DANGER ZONE

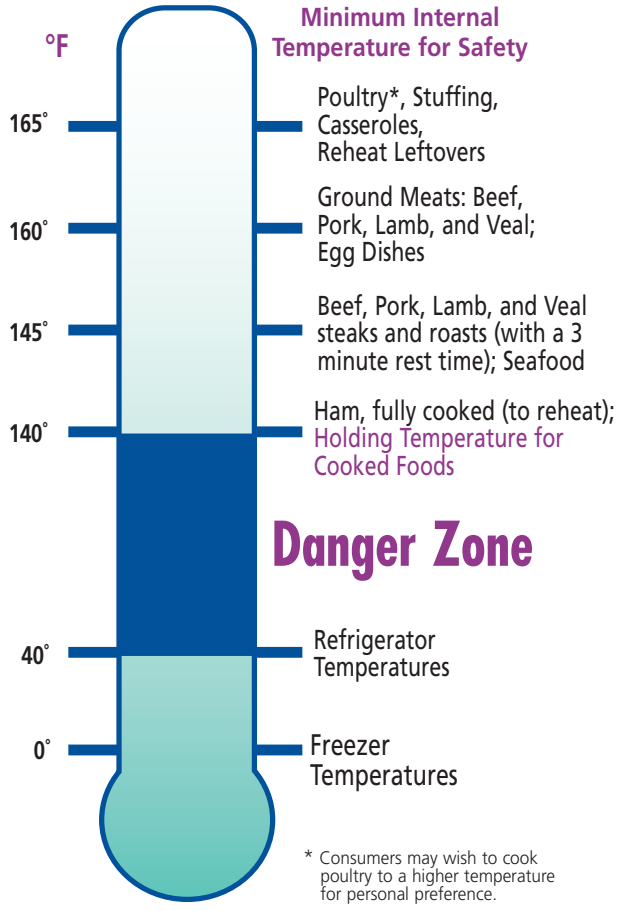
The Danger Zone is the temperature range in which most bacteria can grow. Some bacteria can double their numbers within minutes and form toxins that cause illness within hours. That's why it's important to keep food below or above the temperatures at which bacteria can grow. Usually this is below 40°F (4°C) (some pathogenic bacteria can grow at 32°F [0°C] or above 140°F [60°C]).

BACKGROUND INFORMATION

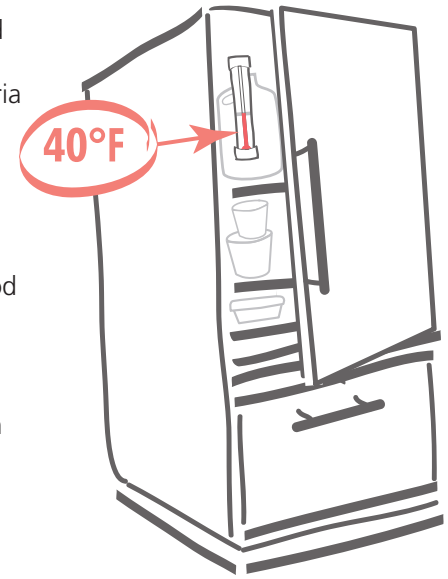
Food Safety Precautions

- Cook food to safe internal temperatures (see Recommended Safe Cooking Temperatures on the Apply the Heat Chart). Use a food thermometer to check.
- Keep hot foods hot. Maintain hot cooked food at 140°F (60°C) or above.
- Reheat cooked food to 165°F (74°C). Never let the temperature fall below 140°F (60°C).
- Keep cold foods cold. Store food in the refrigerator (40°F [4°C] or below) or freezer (0°F [-18°C] or below).
- Don't leave food out at room temperature for more than 2 hours.

Apply the Heat Chart



Follow these COOL rules



- Refrigerate food quickly because cold temperatures keep most harmful bacteria from multiplying. Some people think it will harm their refrigerator to put hot food inside, but it's not true. Hot food won't harm your refrigerator.

  More importantly, prompt refrigeration of foods will keep your food and you safer.
- Set your home refrigerator no higher than 40°F (4°C) and the freezer unit at 0°F (-18°C). Check the temperature occasionally with an appliance thermometer.
- Refrigerate or freeze perishables, prepared food, and leftovers within 2 hours.
- Divide large amounts of leftovers into shallow containers for quick cooling in the refrigerator.
- Marinate foods in the refrigerator.
- Don't pack the refrigerator too full. Cold air must circulate to keep food safe.
- At family outings or barbecues, use a cooler to keep perishable foods cold. Always use ice or cold packs and fill your cooler with food. A full cooler will maintain its cold temperatures longer than one that is partially filled.

Shelf Stable

"Shelf Stable" is defined as a food that can be stored unrefrigerated on the shelf for a period of time and remain suitable for consumption.

Food Safety Implication: Many foods are processed and packaged for food safety and preservation purposes. For food to be considered shelf stable, the techniques used should inhibit microorganisms from growing in the product

BACKGROUND INFORMATION

at non-refrigerated storage temperatures (extended periods over 40°F [4°C]). Some Shelf-Stable foods include:

- Canned vegetables, fruits, and juices
- Canned meat
- Cereals
- Cookies
- Crackers
- Nuts
- Raisins

Why can shelf-stable foods be stored on the shelf at room temperature?

There are numerous techniques that make some foods shelf-stable. The primary technique is to lower the water content of the food (some foods, like flour, are naturally low in water). Bacteria need water to grow and if there isn't enough water present, then the bacteria will not grow. Foods can also be acidified, which is a technique used by processors to preserve foods by adding acids and rendering food safe from harmful bacteria. Food also can be heated to ultra-high temperatures so that it becomes sterile. Some irradiation treatments work in this manner. Once the food is made sterile, however, it has to be hermetically sealed (airtight). If not, the food can become recontaminated and pathogens and other bacteria can grow quickly.

How long can shelf-stable foods be safely stored on the shelf?

According to FDA, food can be safe forever from a foodborne-illness standpoint, but if shelf-stable food has been on the shelf for an extended period of time, you might not want to eat it because the quality may not be good. In this case, the "best if used by" date on the label of the product is an indication whether or not the quality of the food is good. Food quality deals with the taste, texture, and nutritional value of food. For example, freezer burn, rancidity, and food spoilage are all quality-related issues. The FDA does not require an expiration date for shelf-stable foods, since the storage time for these foods is a quality issue, not a food safety concern.

Are food additives necessary and are they safe?

Yes, food additives are necessary. Without them, food spoilage, food costs, and the loss of food to pests would be higher. FDA evaluates all food additives for safety before they are allowed in foods and has found them to be safe and effective in the quantities in which they are consumed in foods.

FOODBORNE ILLNESS

Foodborne illness (also known as foodborne disease or food poisoning) is an infection or intoxication caused by the transfer of microbial or chemical contaminants (substances that spoil or infect) from food or drinking water to a human. In most cases, the contaminants are bacteria, parasites, or viruses. Microorganisms in food may cause illness when they are eaten and get established in the body.

Common Symptoms: Most cases of foodborne illness in healthy adults are self-limiting and of a short duration. An important warning sign of foodborne illness is bloody diarrhea. Other common acute symptoms, which can range from mild to severe, are diarrhea, cramps, nausea, fever, vomiting, and body aches.

When to Notify a Doctor: Some foodborne illnesses, such as *E. coli* O157:H7, can be life-threatening, particularly for young children, older adults, and those with weakened immune systems. Symptoms that are severe or prolonged may need to be treated. People who believe they may have contracted a foodborne illness should call their physician.

It's important to note that botulism poisoning can be fatal. Botulism is mostly linked with inadequately processed, home-canned, or home-bottled food. Botulism symptoms include dry mouth, double vision followed by nausea, vomiting, and diarrhea. Later, constipation, weakness, muscle paralysis, and breathing problems may develop. It's important to **get immediate medical help**. With proper treatment, most victims survive.

BACKGROUND INFORMATION

What to do if you think you have a contaminated product?

The first rule is: Don't use the product.

To Report a Problem with Food

- For all questions or problems related to meat and poultry, please contact USDA.
- If you are a consumer, health professional, or member of the food industry who wants to voluntarily report a complaint or adverse event (illness or serious allergic reaction) related to a food product, you have three choices:
  - Call an FDA Consumer Complaint Coordinator if you wish to speak directly to a person about your problem.
  - Complete the MedWatch Online Voluntary Reporting Form and submit electronically or in paper format that can be mailed to FDA.
- If you are a member of the food industry who needs to submit a Reportable Food Registry report when there is a reasonable probability that an article of food will cause serious adverse health consequences or death to humans or animals, please visit the Reportable Food Registry page.

At-Risk Populations

Some people are more susceptible to more serious symptoms or side effects from illnesses than the general population. At-risk groups for foodborne illness include very young children, pregnant women, older adults, and people with weakened immune systems. The Food Safety Implication is that extra care should be taken to ensure that at-risk people do not contract foodborne illness.

Why some people are "At Risk" for Foodborne Illness: Our immune systems help fight diseases, but some people's immune systems may be weakened, or in the case of children, not yet fully developed. As a result, their bodies cannot effectively fight illness.

- Infants and Children: Their immune systems are not fully developed and they produce less acid in their stomachs, which makes it easier for harmful microorganisms to get through their digestive system and invade their bodies.
- Pregnant Women: Pregnancy, by itself, is a period when a woman's immune system is suppressed. The fetus is at risk because harmful microorganisms can cross the placental membranes and infect the developing child, who does not have a fully developed immune system.
- Older Adults: Poor nutrition, lack of protein in diet, and poor blood circulation may result in a weakened immune system.
- People with Certain Diseases: The immune systems of people with certain illnesses, such as HIV/AIDS and those undergoing cancer chemotherapy, can be weakened. Thus, their bodies are not able to effectively fight illnesses.

FIGHT BAC! CAMPAIGN

The Fight BAC! Campaign began as a national public education project of The Partnership for Food Safety Education, which bought together industry, government, and consumer groups to educate Americans about the importance of using safe food-handling practices.

The campaign focuses on the Core Four Food Safety messages, four simple steps people can take to fight foodborne bacteria and reduce the risk of foodborne illness. The Core Four Food Safety messages are: Clean, Separate (Combat Cross-Contamination), Cook, and Chill. www.fightbac.org/food-safety-basics/the-core-four-practices/ (If you scroll down, there are some good, colorful fact sheets.)

BAC! is the campaign's yucky green bacteria character who tries his best to spread contamination wherever he goes!

BACKGROUND INFORMATION

FAQs

Are some foods more likely to cause foodborne illness than others?

Just about any food can become contaminated if handled improperly. However, foods rich in protein, such as meat, poultry, fish, and seafood, are frequently involved in foodborne illness outbreaks for two reasons:

1. Protein-rich foods tend to be of animal origin. Therefore, microorganisms of animal origin are frequently found in animal foods.
2. Animal foods are rich in protein that bacteria break down into amino acids, which are an important nutrient source to some bacteria.

Bacteria also need moisture in order to survive and reproduce; they thrive in foods with high moisture content. These include starchy, egg-rich foods and cream-based foods, such as potato or pasta salads, cream-based soups, and custard or cream pies.

How sick can I get from eating contaminated food?

There are many variables. Your age, general health, and how much contaminated food you ate are all factors. The most common symptoms are diarrhea, nausea, vomiting, and abdominal pain, but you don't necessarily get all the symptoms. At-risk people can become very ill and can even die from foodborne illness because their immune systems are less able to fight off the bacteria.

Can the symptoms of foodborne illness be mistaken for the flu?

Yes. Foodborne illness often shows itself as flu-like symptoms such as nausea, vomiting, diarrhea, or fever, so many people may not recognize that the illness is caused by bacteria or other pathogens in food.

Experts from the Centers for Disease Control and Prevention (CDC) report that many of the intestinal illnesses commonly referred to as stomach flu are actually caused by foodborne pathogens. People do not associate these illnesses with food because the onset of symptoms often occurs 2 or more days after the contaminated food was eaten.

If I forget to follow some of the basic food safety rules, won't heating or reheating foods kill foodborne bacteria?

To be safe, always follow the Four Steps to Food Safety rules when preparing, serving, and cooking foods. Proper heating and reheating will kill foodborne bacteria. However, some foodborne bacteria produce poisons or toxins if the food is left out at room temperature for an extended period of time; these toxins are not destroyed by high cooking temperatures. An example is the foodborne bacterium *Staphylococcus,* which produces a toxin that can develop in cooked foods that sit out at room temperature for more than 2 hours.

For more food safety information about specific food groups, check out FDA's **Food Facts for Consumers** www.fda.gov/food/buy-store-serve-safe-food/food-facts-consumers.

ACTIVITY 1: FAST-FOOD FOOTWORK

TIME Two 45-minute class periods - one for an introduction to the activity and one for the presentations

ACTIVITY AT A GLANCE

Students will explore how retail foodservice establishments ensure that food is safely stored, prepared, and served. Through research they will also learn about local health regulations and how the Four Steps to Food Safety apply to all aspects of foodservice.

TIME TO TUNE IN

Salmonella Linked to Chicken: AJ's Story (2:19)
youtu.be/IPOLIpcW8Fg

Food and Kitchen Safety (3:03)
www.youtube.com/watch?v=iAJviCO5VuA

FOOD SAFETY CONNECTION

Students eat and often work in all types of foodservice establishments. Exploring all the aspects of safe food handling in a retail situation helps make them better consumers and employees.

GETTING STARTED

MATERIALS

- Assorted materials for students to prepare class presentations
- **Food Safety Checklist for Students Working in Foodservice Establishments** (page 76), one for each student
- Internet access
- **Credible Source Guide** for each student (page 123)
- **Fast-Food Footwork** worksheet for each student

ADVANCE TEACHER PREPARATION

Divide the class into groups.

FAST-FOOD FOOTWORK

INTRODUCTION

Today you're going to become FBI (FoodBorne Illness) Investigators. You will research how workers keep our food safe in the places we eat. Let's start by thinking about the different kinds of places that we eat food. Where have you eaten in the past two days? *(List the suggestions.)*

- ***Where else is food served? Think of as many places as possible*** (school cafeteria, fast-food restaurants, street vendors, state fairs, sports events, rodeos, salad bars, delis, home, friend's house, relative's house, vending machine, etc.).
- ***How do you think these places make sure our food is safe to eat?***

STUDENT PROCEDURE

1. You are going to prepare a creative presentation about an ideal eatery that ensures the safety of the food being served. Your presentation must include the Four Steps to Food Safety. For each area of the eatery that deals with a Step (ex: food preparation, dishwashing, food service, food storage), there should be a science-based explanation of how that Step helps keep the food safe. Also included should be a food safety training session for your employees. Finally, adapt the **Food Safety Checklist** to reflect the needs of your eatery. Your presentation could be a PowerPoint, webpage, skit, 3-D Model, etc. Respond to the questions below to help you prepare your creative presentation.

   Select a food establishment for your group to research.

2. Develop a food safety plan to ensure that the food in your eatery is safe. Complete your worksheet with responses to the following questions, which should help you build a description and profile for your eatery.

   About the eatery:

   - What types of foods are prepared and served?
   - Who are the typical customers?
   - How is the safety of the food ensured
     – During storage?
     – During preparation?
     – After preparation and before serving?
     – While serving?
   - What happens to food that's not used?
   - How are employees trained in food safety procedures?
   - How are cleanliness and handwashing standards maintained?
   - Are there any unique machines or procedures the establishment uses to ensure food safety?
   - Who are the key people involved in monitoring food safety at your eatery (managers, health department authorities, health inspectors, etc.)?
   - What role does food safety play in their daily jobs?
   - Do customers have any responsibility for food safety?

   About the regulations and the inspectors:

   - What do food inspectors look for when they visit a food establishment?
   - What are the local, county, and state health regulations governing the food establishment?
   - How do these health regulations relate to bacterial growth and its spread?
   - How does the manager implement Hazard Analysis and Critical Control Point (HACCP) procedures? Refer to the HACCP steps on page 31.
   - How does the manager implement the FDA Food Code?

REVIEW

- There are many systems and regulations in place that guide retail establishments in preventing foodborne illness.
- Food safety is a major part of a retail food establishment's operations. Retail establishments play an integral part in keeping our food safe because they might also be the final link in the Farm-to-Table Continuum.
- Handwashing is one of the most important things an employee can do to prevent foodborne illness.
- Health department professionals are scientists and food safety detectives.
- Every employee in a foodservice operation has responsibility for food safety.
- Customers have a responsibility for food safety after they purchase the food.
- Everyone who works in a food service job needs to follow safe food handling and cleanliness practices.

FAST-FOOD FOOTWORK

Examples of how restaurants and supermarkets practice the Four Steps to Food Safety

- **Clean:** Employees in restaurants and food stores must wash their hands. Storage areas and display cases are kept clean.
- **Separate:** Food preparation areas are kept clean to avoid cross-contamination. There are also separate departments created for foods such as raw meat, fish, and poultry to avoid cross-contamination.
- **Cook:** Temperature probes are used to make sure the food is cooked to the right temperature.
- **Chill:** Foods are chilled or frozen to stay fresh.

EXTENSIONS

Students could do one or more of the following activities:

1. If you work in a local foodservice job, share how you were trained in food safety. Explain how food safety guidelines are enforced where you work.
2. Create an FBI case scenario with takeout food and include at least three food safety violations. Have other students read or listen and try to identify the violations and propose a plan to minimize the risk of foodborne illness.
3. Trace a food through a fast-food restaurant. How is it kept safe until you purchase it? How is it touched and by whom? Is there a way to ensure that everyone who touches the food has clean hands?
4. Interview local health department officials and health inspectors. Ask them about their careers and how they use their science backgrounds in their daily jobs.
5. Design an innovative "Be Sure to Wash Your Hands" sign to post in the rest rooms in your school.
6. Research your school's food safety guidelines. How do those guidelines relate to the Four Steps to Food Safety?
7. Explain what is implied by this statement: "The responsibility for food safety is literally in your hands."

RESOURCES

- *Food Business Safety*
  www.health.state.mn.us/communities/environment/food/index.html
- *FDA Food Code*
  www.fda.gov/food/retail-food-protection/fda-food-code
- *Food Marketing Institute (FMI)*
  www.fmi.org
- *Food Safety is Everyone's Business*
  www.usda.gov/media/blog/2023/06/07/food-safety-everyones-business
- *National Restaurant Association*
  www.restaurant.org

SUMMARY

Food safety is an important aspect of retail food establishments. There are strict science-based regulations governing foodservice. Managers and all employees working in food establishments have responsibility for food safety. Customers are responsible for the safety of their food once they purchase it and take it home.

UP NEXT

Hope you were successful in conducting your FBI investigation. Now let's keep food safe at the grocery store!

STUDENT WORKSHEET

ACTIVITY 1: FAST-FOOD FOOTWORK

Name _____ Date _____ Class/Hour _____

1. Select a food establishment for your group to research. _____

2. Develop a food safety plan to ensure that the food in your eatery is safe as you respond to the following questions that will help you build a description and profile for your eatery.

About the eatery:

a) What types of foods are prepared and served? _____

b) Who are the typical customers? _____

c) How is the safety of the food ensured

– During storage? _____

– During preparation? _____

– After preparation and before serving? _____

– While serving? _____

d) What happens to food that's not used? _____

e) How are employees trained in food safety procedures? _____

f) How are cleanliness and handwashing standards maintained? _____

g) Are there any unique machines or procedures that the establishment uses to ensure food safety?

_____

h) Who are the key people involved in monitoring food safety at your eatery (managers, health department authorities, health inspectors, etc.)?

_____

i) What role does food safety play in employees' daily jobs? _____

j) Do customers have any responsibility for food safety? _____

About the regulations and the inspectors:

a) What do food inspectors look for when they visit a food establishment?

_____

b) What are the local, county, and state health regulations governing the food establishment?

_____

c) How do these health regulations relate to bacterial growth and its spread?

_____

d) How does the manager implement Hazard Analysis and Critical Control Point (HACCP) procedures?

_____

FOOD SAFETY CHECKLIST

for Students Working in Foodservice Establishments

Check	Food Safety Action	Additional Advice
☐	Protect food from sick people.	• Sick food workers can transmit diseases to food. • People experiencing diarrhea, vomiting, jaundice, or sore throat with fever should be kept away from food preparation and any items that come in contact with food. • People with skin lesions, open wounds, boils, or infected wounds on their hands and arms must be provided with a proper barrier to cover those areas of the body. • Protect food from sneezes and coughs.
☐	Wash hands and do not use your bare hands to touch ready-to-eat foods.	• Handwashing is critical in fighting disease transmission and must be done: **a)** after touching bare human body parts (other than clean hands and clean, exposed portions of arms); **b)** after using the toilet room; **c)** after caring for or handling service animals or aquatic animals; **d)** after coughing, sneezing, using a handkerchief or disposable tissue, using tobacco products, eating, or drinking (except as specified in Food Code, section 2-401.11(B)); **e)** after handling soiled equipment and utensils; **f)** during food preparation, as often as necessary to remove soil and contamination and to prevent cross contamination when changing tasks; **g)** when switching between working with raw food and working with ready-to-eat food; **h)** before donning gloves to initiate a task that involves working with food; and **i)** after engaging in other activities that contaminate hands. • Do not wear fingernail polish or artificial fingernails when working with exposed food unless wearing intact gloves in good repair. • Organisms that cause foodborne illness can be anywhere. Think about everything you touch and if you should wash your hands again before preparing food. • Use of deli tissue sheets, spatulas, tongs, dispensing equipment, or single-use gloves can prevent bare hands from touching ready-to-eat foods. • Except for a plain ring such as a wedding band, DO NOT wear jewelry when you prepare food.
☐	Thaw food properly.	• Care must be taken to keep food within a certain temperature range in order to retard bacterial growth. The Food Code, section 3-501.13, lists acceptable thawing parameters.
☐	Cook foods of animal origin thoroughly (eggs, poultry, meat, fish, shellfish, and dairy products).	• Different foods require specific cook times and temperatures to be effective in eliminating pathogens that cause foodborne illness. Consult the FDA Food Code for more information.
☐	After cooking, keep food hot or quickly cool and refrigerate.	• Use the Food Code as a guide; for buffet service, provide hot holding equipment, such as hot plates or chafing dishes. For cold items, rest containers on a bed of ice, drain off water, and add more ice as ice melts.
☐	Clean and sanitize food-preparation utensils, serving implements, dishes, equipment, and surfaces.	• Prepare food with clean and sanitized equipment, dishes, and utensils. Store food in clean dishes and use clean utensils.
☐	Wash fruits and vegetables.	• Wash raw fruits and vegetables thoroughly, including watermelons and cantaloupes, to remove soil and other contaminants before being cut, combined with other ingredients, cooked, served, or offered for human consumption in ready-to-eat form.
☐	Examine cans and packages of food.	• Do NOT accept swollen and dented cans or damaged packages.
☐	Protect food from cross-contamination hazards.	• Clean and sanitize cutting boards and work surfaces according to the Food Code, section 4-602.11. Use clean wiping cloths according to the Food Code, section 3-304.14.
☐	Protect foods from poisonous or toxic materials contamination (from cleaning products, pesticides, foreign objects, etc.)	• Careless use of chemicals can also make people sick. Chemicals need to be kept in an area that is not above food, equipment, utensils, linens, and single-service or single-use articles (see Food Code section 7-301.11).

ACTIVITY 2: SUPERMARKET SMARTS

TIME Two 45-minute class periods — one for an introduction to the activity and one for the presentations

ACTIVITY AT A GLANCE

Students will develop an awareness of the importance of food safety in retail food establishments. They will be challenged to design and manage their own food-safe supermarket or grocery store departments using the Four Steps to Food Safety. At the end of this activity, each group will present its findings in an innovative presentation.

TIME TO TUNE IN

Grocery Store Food Safety (29:27)
Teacher Note: You might choose to show only a subset of this video.
www.youtube.com/watch?v=wkPMN1oBFFw

FOOD SAFETY CONNECTION

Because students purchase food from retail establishments, exploring all the aspects of safe food handling in a supermarket, grocery store, or fast-food restaurant will help make them better consumers *and* employees.

GETTING STARTED

MATERIALS

- Assorted materials for students to prepare class presentations
- Grocery bag
- Internet access
- **Credible Source Guide** (page 123) for each student

ADVANCE TEACHER PREPARATION

- Write the names of each of the following supermarket departments on separate pieces of paper. (These departments offer a good variety of food safety principles.)
  - Meat/Poultry/Seafood
  - Deli
  - Produce
  - Dairy/Eggs
  - Grocery
  - Frozen Food
  - Checkout
  - Employee Break Area
  - Home Delivery
- Put the department name slips in a grocery bag and place the bag on your desk.
- Divide the class into several groups; each group will draw one department slip and research food safety aspects of that department in a supermarket/grocery store. You may use an electronic name generator to generate departments.

SUPERMARKET SMARTS

INTRODUCTION

I have a challenge for you! Today we're going to take on the management roles for specific departments in a supermarket/grocery store.

How do these stores practice the Four Steps to Food Safety?

How are these stores a link in the Cold Chain?

STUDENT PROCEDURE

1. One member from your group should select a department slip from the grocery bag. Your challenge is to reduce the opportunity for foodborne pathogens to grow or spread by creating a detailed food safety program for your department.
2. You will prepare an innovative presentation to share your department's food safety plan with the class. Consider the following as you prepare your plan:
   - Research the food safety needs of the department by using the Internet and/or interviewing a store manager or the department manager.
   - Research local, state, and federal regulations to find out what procedures the store personnel must follow.
3. Design the department so that it follows the Four Steps to Food Safety.
   - Analyze the role of the Four Steps to Food Safety within the department.
   - How does the Cold Chain come into play in the department?
   - Include handwashing recommendations for employees.
5. Present your department's plan to the class and show how food safety was incorporated into the department. Make a PowerPoint® presentation, blog post, webpage, poster, advertisement, poem, song, play, 3-D model, or come up with an original idea.
6. Compare the food safety needs found in each of the departments chosen by the groups. *What are the similarities and differences?*

REVIEW

1. ***Supermarkets are "major Four Steps territory." What is meant by that?***
   - **Clean:** Employees in restaurants and food stores must clean their hands. Storage areas and display cases must be kept clean as well.
   - **Separate:** Food-preparation areas must be kept clean to avoid cross-contamination. There are separate departments for raw meat, fish, poultry, and produce to avoid cross-contamination.
   - **Cook:** Temperature probes should be used to make sure that food is cooked to the right temperature.
   - **Chill:** Foods need to be chilled or frozen to stay fresh.
2. ***What is the "Cold Chain?"*** (The Cold Chain is a series of actions that maintain the temperature of food as it travels from the farm to the table.) *How does the Cold Chain come into play in the supermarket?* (Supermarkets are a link in the Cold Chain. Storage areas and display cases are kept at safe temperatures to keep food frozen or chilled.)
3. ***What are some things you discovered about supermarket food safety that you didn't know?***
4. ***What do you think science has to do with supermarket food safety?***
5. ***What's one of the most important things an employee can do to prevent foodborne illness?*** (Wash his/her hands.)
6. ***Whose responsibility is it to keep food safe once the food is purchased?*** (The customers.)

SUPERMARKET SMARTS

EXTENSIONS

Students could do one or more of the following activities:

Supermarkets/Grocery Stores

- Interview a local supermarket manager and find out how he or she ensures food safety.
- Create an FBI (Foodborne Illness) scenario about what happens to the food between the time you take it out of the store and get it home. Build in at least three violations of the Four Steps to Food Safety. You can also try to identify the violations and then propose a plan to minimize the risk.
- Trace a food through the supermarket/grocery store. How is it kept safe until you purchase it? How many times is it touched, and by whom? Is there a way to ensure that all those who touch the food have clean hands? Report your findings.

Other Foodservice Establishments

- Ask your school's foodservice manager to speak to your class about the food safety guidelines they follow. How do those guidelines relate to the Four Steps to Food Safety?
- Do a follow-up lesson that applies what you've learned in this activity to restaurants, picnics, cookouts, banquets, and your own kitchen at home.
- Plan a food safety training session for employees in your supermarket department. Make a list of guidelines that each employee must follow. Present this to the class.

RESOURCES

- *Food Code/Food and Drug Administration*
  www.fda.gov/food/retail-food-protection/fda-food-code
- *Food Marketing Institute (FMI)*
  www.fmi.org
- *International Food Information Council*
  https://ific.org/
- *National Restaurant Association (NRA)*
  https://restaurant.org
- *The National Sanitation Foundation*
  www.nsf.org

SUMMARY

Food safety is an important aspect of designing and managing a supermarket or grocery store. There are strict regulations governing foodservice, and the regulations are science-based. Everyone has responsibility for food safety: managers, employees, and customers.

UP NEXT

Now that you have managed your own supermarket or grocery store department, let's see how well you do in the kitchen. Now we'll go on a scavenger hunt in the kitchen…looking for BACTERIA!

LAB 1: CROSSED UP!

TIME One 45-minute class period to conduct the lab plus additional observation time over the following two days.

LAB AT A GLANCE

Students will discover that some items in their own kitchens may be contaminated by bacteria. They will be challenged to predict where bacteria might be found in kitchens and which items might have the most and the least bacteria. Students will develop awareness that bacteria can spread from surfaces to hands, and to food, and will suggest ways to control the spread of bacteria.

TIME TO TUNE IN

Crossed Up! Lab Instruction (8:10)
https://youtu.be/t0okeNUzKKI

FOOD SAFETY CONNECTION

Sponges, dishcloths, dish towels, can openers, and cutting boards are among the items in a kitchen that can spread bacteria if they are not cleaned properly.

GETTING STARTED

MATERIALS

For the Class

- Sterile saline solution, two gallons (7.8 liters); see recipe on page 17
- Safety gloves, protective eyewear, and aprons
- Assorted kitchen items such as sponges, spoon rests, sink drains, can openers
- Sealable, 1-gallon plastic bags, one for each item to be sampled.

For Each Group of Three to Four Students

- Spray bottle of disinfecting solution
- Safety gloves, protective eyewear, and aprons
- Three sterile Petri dishes with nutrient agar and covers
- Permanent marker
- Sterile cotton swabs (one for each item tested)
- Parafilm (0.5" x 4") - enough to seal each Petri dish
- **Crossed Up!** worksheet for each student

ADVANCE TEACHER PREPARATION

- View the Crossed Up! Lab Instruction video. https://youtu.be/t0okeNUzKKI
- A selection of used kitchen items such as sponges, spoon rests, sink drains, can openers, displayed on a desk or counter
- Divide your class into groups of three or four.

CROSSED UP!

INTRODUCTION

Bacteria are everywhere, including in our own kitchens! In this lab, you're going to become kitchen inspectors and look in my kitchen for things that may contain bacteria.

Where in our kitchens could bacteria be growing?

Could bacteria be on the kitchen items that we use when preparing food? Make a list of students' responses.

Some Probable Answers:

- Can-opener blades
- Cutting boards
- Dishcloths (used & new)
- Dishes
- Dish towels
- Paper towels
- Pot scrubbers
- Sink stoppers or disposal covers
- Sponges (used & new)
- Utensils
- Vegetable brushes

STUDENT PROCEDURE

1. With your group, predict which kitchen items among the samples provided contain the most bacteria and which contain the least bacteria. Record this information on your Lab Sheet, and respond to the question " *Why would/wouldn't bacteria be found on these items?"*
2. As a class, vote on the items **most** and **least** likely to harbor bacteria. List the top five items in each category on the board and keep the lists there throughout the lab. Record your predictions on your lab sheet.
3. Wash your hands in warm water and soap.
4. Choose at least three or four kitchen items your group wants to sample.
   - Include items you think will have lots of bacteria as well as those you think will have fewer bacteria. For example: compare new sponges or just-washed dishcloths with dirty or just-used sponges or dishcloths.
   - Try for as many different items as possible, but at least two groups should choose the important ones, such as sponges, dishcloths, and dish towels.
5. Place each item in a storage bag and label the bag with the name of the item.
6. Disinfect your work area with the disinfecting solution.
7. Prepare the Petri dishes:
   - Keep the Petri dishes closed and turn the dishes so the agar side is up.
   - Use your permanent marker to label the bottom of your Petri dishes. Write with small lettering, close to the edge of the dish, so your writing does not hide potential colony growth.
   - Divide one of the Petri dishes into thirds and label them "Control", "Saline", and "Swab". This is your control dish. Swab the "Saline" side with a swab dipped in the saline solution; swab the "Swab" side with a dry swab; and leave the "Control" side alone. (The purpose of this control dish is to determine whether or not the agar, the saline solution or the swab are contaminated. If, at the end of the lab, colonies are growing on the control dish, then the dish, agar, saline, and/or swab were contaminated.)

   - Divide the other Petri dishes in half and label each half with the name of the item you will swab.
   - Label the dishes with the date, your group name, class, and hour to avoid mix-ups.
8. Add enough saline to the plastic bag containing each item you want to sample so the item can be thoroughly wet. Seal the bag completely and shake the item in the saline so all surfaces of the item become wet. Open the bag and dip a swab into the saline. As you pull the swab out of the bag, roll the swab along the side of the bag to remove excess saline. Swab the section of your Petri dish that corresponds to the item you are sampling. Repeat this procedure with the other items you wish to sample.
9. Carefully seal all of the Petri dishes with Parafilm.
10. Incubate the dishes upside down (agar side on top) in a dark place at room temperature for two days.
11. Properly dispose of all lab materials and disinfect your work areas.
12. Wash your hands in warm water and soap.

CROSSED UP!

Observations

1. Over the next two days, each group will observe their Petri dishes and each student will record the results on the Lab Sheet.
2. Each group will present their findings to the class. List the class results on your worksheets and compare them with the class predictions.

EXTENSIONS

Students could do one or more of the following activities:

1. Develop a Home Food Safety Survey based on the results of their investigation. Give the survey to at least five family members, friends, relatives, or neighbors to survey their kitchens. Tally the answers.
2. Use the survey results to develop a "kitchen safety" brochure or webpage that explains how to prevent cross-contamination in the kitchen.

RESOURCES

- *CDC Food Safety*
  www.cdc.gov/foodsafety
- *Food Safety for Your Family/Kids Health*
  www.kidshealth.org/en/parents/food-safety.html
- *Your Gateway to Government Food Safety Information*
  www.foodsafety.gov
- *Partnership for Food Safety Education*
  www.fightbac.org
- *Selecting and Serving Produce Safely/FDA*
  www.fda.gov/food/buy-store-serve-safe-food/selecting-and-serving-produce-safely
- *Safe Food Handling: What You Need to Know/FDA*
  www.fda.gov/food/buy-store-serve-safe-food/safe-food-handling
- *Ten Steps to a Safe Kitchen/Iowa State University*
  https://slideplayer.com/slide/9147763/

SUMMARY

Bacteria can spread from kitchen items to hands, and even to food. The spread of bacteria can be controlled through proper cleaning and disinfecting as needed.

UP NEXT

Find out what's cooking in the next lab activity! ▶ ▶ ▶

STUDENT WORKSHEET

LAB 1: CROSSED UP!

Name _____ Date _____ Class/Hour _____

1. Review the kitchen items on display. In the chart below, predict which have the most and the least bacteria. Why would/wouldn't bacteria be found on these items?

_____

_____

Class Predictions About All Items to Be Sampled

Kitchen Items with the Most Bacteria	Kitchen Items with the Least Bacteria

2. Select and list the items that your group will sample:

_____

_____

List your items in the corresponding Group Results column below.

Group Results

Kitchen Items with the Most Bacteria	Kitchen Items with the Least Bacteria

3. When you compare your predictions with the results, what are some surprises?

_____

_____

4. List the class results in the chart below:

Class Results

Kitchen Items with the Most Bacteria	Kitchen Items with the Least Bacteria

STUDENT WORKSHEET

LAB 1: CROSSED UP! (CONTINUED)

5. When you compare the class predictions with the class results, are there any surprises?

6. Could bacteria transfer from kitchen items to your food? Your hands? What might happen in these cases?

7 Why do certain kitchen items have more bacterial growth than others?

8. How do the data you collected relate to the Four Steps to Food Safety?

9. How could you reduce the bacteria on the items you tested?

10. What are your suggestions to avoid cross-contamination in the kitchen?

11. What advice would you give to family members to help them prevent the spread of foodborne bacteria?

THE SCIENCE OF COOKING A HAMBURGER LABS OVERVIEW

TIME Four 45-minute class periods to conduct Labs 2, 3, and 4 and to observe all results.

LAB AT A GLANCE

In the next three labs, grouped under the overall header, The Science of Cooking a Hamburger, students will explore the Four Steps to Food Safety: clean, separate, cook, and chill. Ground beef is used for the labs, since it is a food that students are familiar with and may be cooking at home. Lab 2 explores the relationship between cooking temperature and the presence of bacteria in ground beef. Lab 3 includes a review and summary of what the students have learned about the Four Steps and encourages them to apply these principles to their everyday lives. Lab 4 investigates how bacteria can be transferred from one food to another and if cleaning a surface prevents cross-contamination.

TEACHER NOTE: These labs can be conducted as a teacher demonstration or by student groups, depending on what better suits your class. You could also prepare materials (such as labeling test tubes and sealed, pre-prepared Petri dishes) prior to the day of the lab to save time. Please be sensitive that some students can be turned off from eating ground beef if we overstate the case and alarm them unnecessarily. Most of us have eaten (some people have not, are vegetarian, or have beef-related allergies) well-done hamburgers and enjoyed them and we are all okay! You might remind students that hamburgers purchased at most fast food franchises are carefully cooked and safe to eat.

FOOD SAFETY CONNECTION

Hamburgers are a staple in the diet of many teens. Knowing how to cook them to a safe internal temperature is important to prevent foodborne illness. Cross-contamination is a common problem when preparing food at home. These labs highlight the importance of cleaning surfaces and hands before cooking, separating foods, cooking to the right temperature, and chilling the foods within 2 hours of being out of the refrigerator.

THE SCIENCE OF COOKING A HAMBURGER

SAFETY FIRST

- NEVER EAT OR DRINK ANY FOOD OR LIQUID IN THE LAB.
- Pull back and secure long hair.
- Wash your hands thoroughly with warm water and soap before and after the lab as well as before and after handling raw meat.
- Disinfect all lab surfaces with disinfecting solution before and after working in the lab (page 5).
- Wear appropriate safety equipment (gloves, protective eyewear, and lab aprons).
- Beware of hot surfaces. Use a thermal hot pad when handling frying pans, hot plates, etc.
- Thoroughly clean all thermometers between uses with alcohol wipes.
- Seal inoculated Petri dishes with Parafilm.
- Never open a dish with organisms growing in it. Some organisms could be dangerous pathogens.
- After the lab is completed, discard all disposable dishes and materials using safe techniques (page 5).

BACKGROUND

- It's particularly important to thoroughly cook ground meats, such as beef, because there's a greater chance for bacterial contamination with ground meat than with whole cuts. The bacteria start to grow on the outside of the meat. When the meat is ground, any bacteria on the outside will be distributed throughout the meat. In addition, when making patties, harmful bacteria from hands, utensils, and surfaces can be transferred inside the hamburger patty. It's important, therefore, to make sure that the center of the hamburger has reached a temperature high enough (160°F [71°C]) to kill any foodborne pathogens.
- An "instant read" food thermometer with a probe in the tip is best to check the proper temperature of hamburgers. The probe should be inserted in the side of the burger (horizontally) so the entire sensing area (usually 2 to 3 inches [5 cm to 8 cm]) is positioned into the center of the burger.
- It may not always be possible to check the hamburger with a thermometer, especially when you're eating in a restaurant. In this case, the safest thing is to ask that the hamburger be cooked to a temperature of 160°F which is considered well-done. Send it back if it is not cooked thoroughly.

LAB 2: COOKING RIGHT – THE SCIENCE OF COOKING A HAMBURGER

TIME One 45-minute class period to conduct the lab plus additional observation time over the next several days

LAB AT A GLANCE

This lab explores the relationship between cooking temperature and the abundance of bacteria in ground beef.

TIME TO TUNE IN

Cooking Right: The Science of Cooking a Hamburger Lab Instruction (11:35)
https://youtu.be/3dgI1aIMLG0

GETTING STARTED

MATERIALS

For Each Group

- Dishwashing detergent to clean utensils
- Spray bottle of disinfecting solution
- 0.5-pound inexpensive, raw, ground beef (do not use pre-molded burgers or burger in a tube)
- Wear safety gloves and lab aprons when handling raw meat, as well as protective eyewear when cooking raw meat.
- 12 alcohol wipes
- Paper towels
- Ruler
- Scale to weigh the hamburgers
- Non-stick spray to keep the hamburgers from sticking to the pan during cooking
- One digital, instant-read food thermometer (rapid read, thin-probe type is best)
- Stove with overhead fan, or hot plate
- Frying pan 8" in diameter works well
- Thermal gloves or hot pads for handling the hot frying pan
- Spatula for removing hamburgers from frying pan
- Four paper plates
- Five sterile Petri dishes with nutrient agar and covers
- Five pieces Parafilm (0.5" x 4") to seal dishes
- Three packages sterile cotton swabs (6 total)
- Permanent marker
- **Cooking Right** worksheet for each student

ADVANCE TEACHER PREPARATION

- Review the Cooking Right: The Science of Cooking a Hamburger Lab Instruction video.
  https://youtu.be/3dgI1aIMLG0
- Divide the class into groups of three or four.
- Purchase enough ground beef for each group to have a half pound.
- Take the ground beef out of the refrigerator about a half hour before class, just long enough to warm it up a bit. This will speed-up the cooking process.
- Use an alcohol wipe to disinfect the outside of the plastic wrap around the ground beef package.
- Use an alcohol wipe to disinfect a sharp knife.
- Remove the plastic wrap from the ground beef package by slitting the wrap on three sides; be careful not to touch the beef with the knife. Peel the wrap away from the meat.
- Review Background on page 86.

COOKING RIGHT

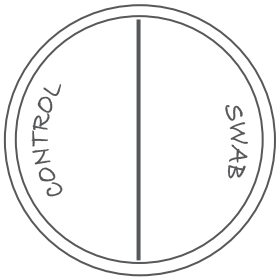
INTRODUCTION

- ***When you order a hamburger, do you specify how you want it cooked? Well done, medium, or rare?*** Take a tally of the class. ***Why? Discuss your reasons for about 5 minutes.***
- If no one has mentioned cooking thoroughly so that "it's safe to eat," or "so you won't get sick," ask: ***How can you be sure that this hamburger will be safe to eat?*** List the students' answers on the board. Then explain: ***Today you're going to use science to help answer that question. What do you think science has to do with cooking a hamburger? Let's find out!***
- Most ground beef from the supermarket is safe; however, there is a remote possibility that a bad bacterium, such as *E. coli* O157:H7, can find its way into some foods like ground beef. Because there's a possibility that *E. coli* O157:H7 can be in the hamburger, it's important to cook all ground meat to a safe internal temperature.

STUDENT PROCEDURE

1. Consider the following questions before you do your lab, and complete the answers on your **Cooking Right** Lab Sheet:
   - *What variables should be considered?*
   - *How can you ensure that all burgers are the same size? Why do they need to be the same size?*
   - *Does thickness matter? Why or why not?*
   - *How should you take the temperature?*

2. Wash your hands with warm water and soap.
3. Disinfect your work area with the disinfecting solution.
4. Petri Dish Preparation:
   - Keep the Petri dishes closed and turn the dishes so the agar side is up.
   - Use your permanent marker to label on the bottom of your Petri dishes. Write with small lettering, close to the edge of the dish, so your writing does not hide potential colony growth.
   - One of your dishes should be labeled "Control." Divide this dish in half by drawing a line down the center of the dish; label one side "Swab."
   - Label the other Petri dishes "Raw", 120°F (49°C), 140°F (60°C), 160°F (71°C).
   - Label the dishes with the date, your group name, class, and hour to avoid mix-ups.



5. Wearing safety gloves, lab aprons, and protective eyewear, make four 50 gram hamburgers (weigh them on the scale), each approximately 0.5 inches thick and two inches in diameter; place them on a paper plate.
6. Make four 50 gram hamburger patties (weigh them on the scale), each approximately 0.5 inches thick and two inches in diameter; place them on a paper plate.
7. Take one sterile swab out of a package and streak the side of the Control dish labeled "Swab."
8. Use another sterile swab to sample the inside of one of the patties and inoculate the dish labeled "Raw."
9. Spray the pan with non-stick spray and put a patty in the center of the frying pan.
10. You will cook the patty to 120°F (49°C). Do not press down on the patty while cooking because you will need the juices for inoculation. Once the patty is cooking, keep track of its temperature. Remove the patty with your spatula to a clean plate and insert the thermometer into the side of the patty. **It is critical to take the reading within 15 seconds of taking the patty from the pan** because the meat continues to cook.

11. After each use, disinfect the thermometer with a clean alcohol wipe.
12. Continue cooking the patty until it reaches 120°F (49°C). (Use a new alcohol wipe each time you take the temperature.) When the patty has reached 120°F (49°C) on the paper plate, use the spatula to break it in half.
13. Use a sterile swab and collect juice from the center of the patty.
14. Inoculate the Petri dish labeled "120°F" (49°C).
15. Cook the two remaining patties in the same way, to 140°F (60°C) and 160°F (71°C), respectively, and repeat the inoculating procedure using the corresponding Petri dish.
16. Seal all five Petri dishes with Parafilm.
17. Properly discard all used lab materials and disinfect the work area.
18. Wash your hands with warm water and soap.
19. Incubate the dishes upside down (agar side up) at room temperature for two days in a dark place.

Observe, Record, and Summarize Results

Observe your dishes over the next two days. Each group should record the number of colonies in each of the four sample dishes. In the space provided on your worksheet, graph your results for the four samples. Answer these questions on your worksheet.

- *Which temperature produced the most effective reduction in colony numbers?*
- *How did the numbers of colonies from the raw hamburger patty compare to the cooked burgers?*
- *What did the control dish show?*

SAFETY AND LAB TECHNIQUES REVIEW

1. Review safety procedures for handling and cooking raw meat.
2. While these are normal practices for laboratory work, it is particularly essential to wear safety gloves and lab aprons when handling raw meat, as well as protective eyewear when cooking raw meat.
3. Wash your hands before and after doing the lab.
4. For added consistency, especially for more advanced students, weigh the raw hamburger patty to make sure that all patties are the same weight.
5. Measure diameter and thickness to ensure that size isn't a variable that could invalidate the results.

STUDENT WORKSHEET

LAB 2: COOKING RIGHT

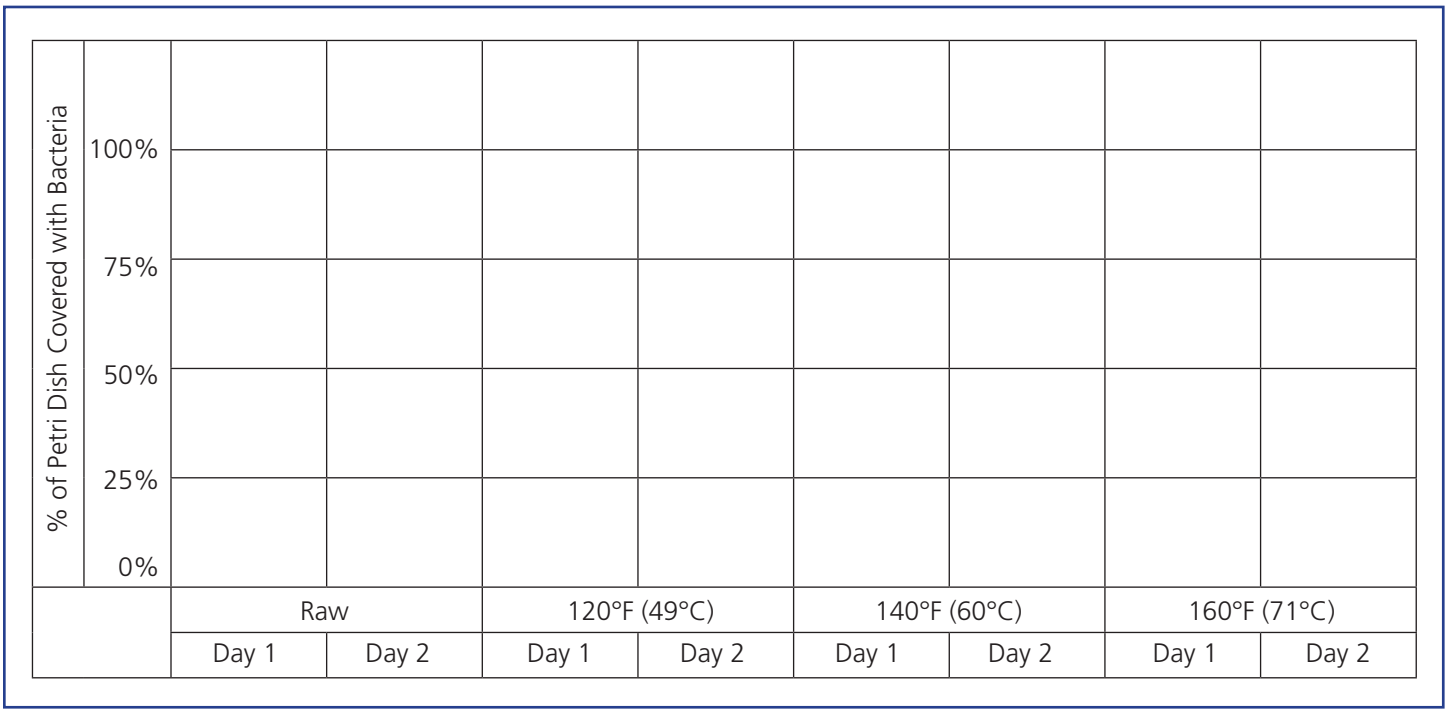
Name _____ Date _____ Class/Hour _____

Record your observations for each day; include the number of colonies you see on the agar as a percentage.

Cooking Right/The Science of Cooking a Hamburger Data Table

	Petri Dish Control	Raw Hamburger	120°F (49°C)	140°F (60°C)	160°F (71°C)
Day 1					
Day 2					

Graph Results



STUDENT WORKSHEET
LAB 2: COOKING RIGHT (CONTINUED)

1. Which temperature produced the most effective reduction in bacterial numbers?

2. How did the number of bacteria in the raw hamburger compare with the cooked burgers?

3. What is the purpose of the control dish?

LAB 3: A CHILLING INVESTIGATION

TIME One 45-minute class period to conduct the lab plus additional observation time over the next several days

LAB AT A GLANCE

This lab investigates differences in bacterial counts between ground beef left at room temperature overnight and ground beef that has remained refrigerated.

TEACHER NOTE: This lab can be conducted as a teacher demonstration or by student groups, depending on what better suits your class. You could also prepare materials (such as labeling test tubes and sealed, pre-prepared Petri dishes) prior to the day of the lab to save time. Please be sensitive that some students can be turned off from eating ground beef if we overstate the case and alarm them unnecessarily. Most of us have eaten (some people have not, are vegetarian, or have beef-related allergies) well-done hamburgers and enjoyed them and we are all okay! You might remind students that hamburgers purchased at most fast food franchises are carefully cooked and safe to eat.

TIME TO TUNE IN

A Chilling Investigation Lab Instruction (7:46)
https://youtu.be/PdUnXiLUBjE

FOOD SAFETY CONNECTION

Chilling is a critical method for controlling microbial growth. It does not kill microorganisms; therefore, it's important to handle meat properly when defrosting and cooking.

SAFETY FIRST

- NEVER EAT OR DRINK ANY FOOD OR LIQUID IN THE LAB.
- Pull back and secure long hair.
- Wash your hands thoroughly with warm water and soap before and after the lab as well as before and after handling raw meat.
- Disinfect all lab surfaces with disinfecting solution before and after working in the lab (page 5).
- Wear appropriate safety equipment (gloves, protective eyewear, and lab aprons).
- Seal inoculated Petri dishes with Parafilm.
- Never open a dish with organisms growing in it. Some organisms could be dangerous pathogens.
- After the lab is completed, discard all disposable dishes and materials using safe techniques (page 5).

A CHILLING INVESTIGATION

GETTING STARTED

MATERIALS

For Each Group

- Dishwashing detergent to clean the utensils
- Spray bottle of disinfecting solution
- Three sterile Petri dishes with nutrient agar and covers
- Three pieces of Parafilm (0.5" x 4") to seal Petri dishes
- Sharp knife and alcohol wipes
- Safety gloves and lab aprons when handling raw meat.
- Two packages sterile swabs (for individuals) or 3 swabs for each group.
- Two sealable (one gallon) plastic bags
- 0.5 pounds (226.8 grams) of ground beef
- Permanent marker
- **A Chilling Investigation** worksheet for each student

ADVANCE TEACHER PREPARATION

ON THE DAY BEFORE THE LAB

- Review A Chilling Investigation Lab Instruction video. https://youtu.be/PdUnXiLUBjE
- Purchase 0.5 pound (226.8 grams) of ground beef.
- Use an alcohol wipe to disinfect a sharp knife and a second alcohol wipe to clean the meat package.
- Divide the ground beef package in half by cutting through the package, including the meat and the bottom of the Styrofoam™ tray.
- Put each half into a self-sealing bag and seal.
- Label one bag "Chilled" and refrigerate immediately.
- Label the other bag "Room Temperature" and leave it out at room temperature at least overnight.
- Be sure to put the sealed bags on plates or in a bowl to prevent the possibility of raw meat juices leaking onto other food items in the refrigerator or onto the counter.
- Do not touch the outside of the bags with your dirty gloves.
- On the day of the lab, each group will take turns swabbing each bag of meat (they do not need individual bags).

INTRODUCTION

You can use the following scenario as an introduction to **A Chilling Investigation**, or ask students to come up with a scenario about when meat might be unintentionally left out of the refrigerator for too long.

Suggested Scenario:

Last night, Ms. Smith bought two packages of hamburger that she planned to cook for dinner the next evening. She put one package in the refrigerator. But then the phone rang, and other things occurred that distracted her. She forgot to put the other package of hamburger in the refrigerator. It sat out on the kitchen counter all night long. She woke up the next morning and placed the hamburger in the refrigerator, but wondered if the unrefrigerated hamburger was safe to eat.

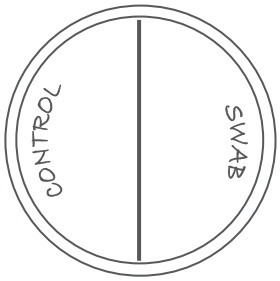
Would you eat the unrefrigerated hamburger? Why or why not? Let's test both packages of hamburger and see if there's any difference between them.

A CHILLING INVESTIGATION

STUDENT PROCEDURE

1. Each group should make a prediction about the properly refrigerated ground beef versus the ground beef that was left out at room temperature.
2. Wash your hands in warm water and soap.
3. Disinfect your work area with disinfecting solution.

   Wear safety gloves, eyewear, and lab aprons when handling the meat.
4. Prepare the Petri dishes:
   - Keep the Petri dishes closed and turn the dishes so the agar side is up.
   - Use your permanent marker to label the bottom of your Petri dishes. Write with small lettering, close to the edge of the dish, so your writing does not hide potential colony growth.



   - Label the bottom of one Petri dish "Control" and draw a line down the center of the dish; label one side "Swab."
   - Use a sterile swab to streak the "Swab" side of the Control dish.
   - Label the other Petri dish "Chilled" and a third dish "Room Temp."
   - Label the dishes with the date, your group name, class, and hour to avoid mix-ups.
5. Use a sterile swab to gather juice from the center area of the chilled ground beef and streak the "Chilled" Petri dish.
6. Use a sterile swab to gather juice from the center of the Room Temperature ground beef and inoculate the "Room Temp" Petri dish.
7. Use Parafilm (0.5" x 4") to seal the Petri dishes.
8. Incubate the three dishes upside down in a dark place at room temperature for up to 2 days.
9. Properly dispose of all lab materials and disinfect your work area.
10. Wash your hands thoroughly in warm water and soap.

Over the next day or two, observe the dishes and record your observations (for each day) on the **Chilling Investigation** worksheet. Include the number of colonies you see on the agar. **Do not open the Petri dishes**.

STUDENT WORKSHEET

LAB 3: A CHILLING INVESTIGATION

Name _____ Date _____ Class/Hour _____

Record your observations for each day; include the number of colonies you see on the agar as a percentage.

A Chilling Investigation Data Table

	Control	Chilled	Room Temperature
Day 1			
Day 2			

1. Why did your teacher cut the package of ground beef in half, rather than just buying two individual packages?

2. Did the cold temperature kill the bacteria in the refrigerated sample? Why or why not?

3. What did you observe about the unrefrigerated sample?

4. Where in the Farm-to-Table Continuum was the safety of the meat compromised? How could this have been prevented?

5. Who had the final responsibility for the safety of this meat?

6. Would cooking the unrefrigerated meat thoroughly make it safe for human consumption? Provide a rationale for your response and support your answer with evidence.

LAB 4: DON'T CROSS ME

TIME One 45-minute class period to conduct the lab plus additional observation time over the next several days.

LAB AT A GLANCE

The purpose of this lab is to investigate how bacteria can be transferred from one food to another and to determine if cleaning a surface prevents cross-contamination.

TEACHER NOTE: This lab can be conducted as a teacher demonstration or by student groups, depending on what better suits your class. You could also prepare materials (such as labeling cutting boards and sealed, pre-prepared Petri dishes) prior to the day of the lab to save time. Please be sensitive that some students can be turned off from eating ground beef if we overstate the case and alarm them unnecessarily. Most of us have eaten (some people have not, are vegetarian, or have beef-related allergies) well-done hamburgers and enjoyed them and we are all okay! You might remind students that hamburgers purchased at most fast food franchises are carefully cooked and safe to eat.

TIME TO TUNE IN

Don't Cross Me Lab Instruction (8:43)
https://youtu.be/lEXiP8oxYVo

The following link has several short videos about food safety; you might want to include one or two for your class introduction to the lab.
www.cdc.gov/foodsafety/communication/food-safety-videos.html#kitchen-food-safety

SAFETY FIRST

- NEVER EAT OR DRINK ANY FOOD OR LIQUID IN THE LAB.
- Pull back and secure long hair.
- Wash your hands thoroughly with warm water and soap before and after the lab as well as before and after handling raw meat.
- Disinfect all lab surfaces with disinfecting solution before and after working in the lab (page 5).
- Wear appropriate safety equipment (gloves, protective eyewear, and lab aprons).
- Seal inoculated Petri dishes with Parafilm.
- Never open a dish with organisms growing in it. Some organisms could be dangerous pathogens.
- After the lab is completed, discard all disposable dishes and materials using safe techniques (page 5).

DON'T CROSS ME

GETTING STARTED

MATERIALS

For the Group

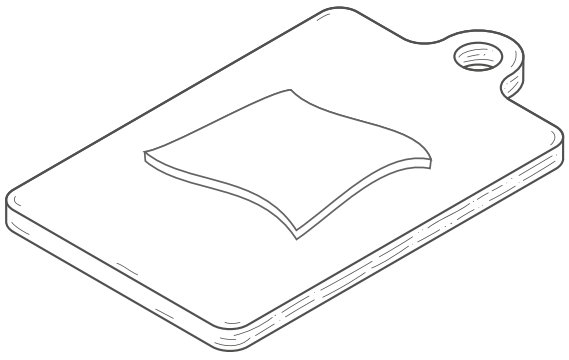
- Dishwashing detergent to clean the utensils
- Spray bottle of disinfecting solution
- Safety gloves, protective eyewear, and lab aprons for anyone handling cheese and raw meat
- One pound (454 grams) of inexpensive, ground beef (this will yield 16 small hamburger patties, if working in groups)
- Alcohol wipes
- Three individually packaged slices of cheese or cheese product
- Four sterile Petri dishes with nutrient agar and covers
- Four pieces Parafilm (0.5" x 4")
- Three packages sterile swabs (six total)
- Two cutting boards
- Sterile saline solution (contact lens or wound wash solution) to moisten swabs
- **Don't Cross Me** worksheet for each student.

ADVANCE TEACHER PREPARATION

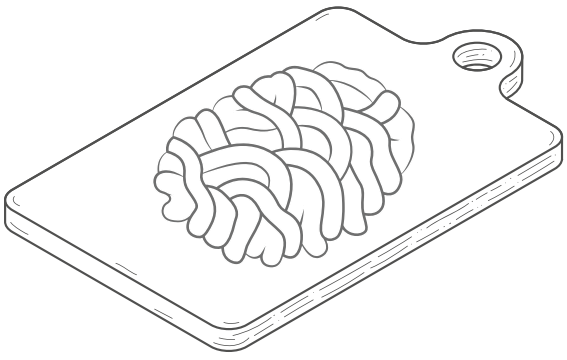
- Review Don't Cross Me video. https://youtu.be/lEXiP8oxYVo
- Divide the class into groups of three or four.
- Sufficient ground meat should be available for each group to make two 2-inch patties. A quarter pound (113 grams) should yield four patties.
- Each group will need three pieces of cheese/cheese product.
- Use an alcohol wipe to clean the outside of the ground beef package.
- Then use another alcohol wipe to disinfect a sharp knife.
- Use the knife to slit around three sides of the meat package and carefully remove the wrap from the ground beef, taking care to not touch the ground beef with the knife.

INTRODUCTION

Today we'll investigate the important role that two of the Four Steps to Food Safety, clean and separate, play in keeping our food safe.



Cheese



Raw Ground Beef

DON'T CROSS ME

STUDENT PROCEDURE

1. Wash your hands thoroughly with warm water and soap.
2. Put on safety gloves, eyewear, and a lab apron.
3. Disinfect your work area using the disinfecting solution.
4. Wash the two cutting boards with hot, soapy water and air dry if possible. Dry with a lint-free paper towel otherwise.
5. Petri Dish Preparation:
   - Keep the Petri dishes closed and turn the dishes so the agar side is up.
   - Use your permanent marker to label the bottom of your Petri dishes.
   - Divide the bottom of one of the Petri dishes into thirds and label them "Control," "Swab," and "Saline."
   - Label the bottom of another dish by drawing a line down the center. Label one side "Control Board A" and the other side "Control Board B."
   - Label the bottom of a third Petri dish "Control Cheese."
   - Label the bottom of the remaining dish by dividing it in half and labeling one side "Board A" and the other side "Board B."
6. Label the cutting boards "A" and "B."
7. Moisten a sterile swab with sterile saline solution and swab cutting board A; streak the cutting board "Control Board A" side of the respective Petri dish.
8. Repeat step 6 for cutting board B.
9. Partially unwrap, then swab, one slice of cheese. Inoculate the "Control Cheese" dish. Be careful not to touch the cheese with your fingers. You can discard the cheese.
10. Make a 2-inch ground beef patty on cutting board A. Make another 2-inch patty on cutting board B. Press the patties into the boards as you are making them. Let the patties sit on the cutting boards for several minutes.
11. Remove the patty from cutting board "A" and properly dispose of the meat.
12. Remove your gloves and discard them.
13. Thoroughly wash cutting board A in hot, soapy water; air dry to ensure the board is not contaminated. If you don't have enough time to air-dry. use a lint-free paper towel to dry the board.
14. Put on new gloves.
15. Unwrap a slice of cheese and put it on cutting board A in the same place where the ground beef was. Let the cheese sit on the board for several minutes.
16. Lift the cheese from the cutting board and use a sterile swab to swab the side of the cheese that was touching the cutting board.
17. Use this swab to streak the Petri dish "Board A." Discard the cheese.
18. Remove your gloves and discard them.
19. Put on new gloves.
20. Remove the patty from cutting board "B" and properly dispose of the meat.
21. Remove your gloves and discard them.
22. Put on new gloves.
23. Unwrap the remaining slice of cheese and place it on cutting board "B" in the same place that the patty was. Let the cheese sit on the board for several minutes.
24. Use a sterile swab to swab the side of the cheese that was touching the cutting board.
25. Inoculate Petri dish "Board B." Discard the cheese.
26. Seal the Petri dishes with Parafilm and incubate upside down at room temperature in a dark place for 2 days.
27. Put used materials, including your gloves, in the trash. Wash the cutting boards and knife with hot, soapy water, and disinfect your work area.
28. Wash your hands thoroughly in warm water and soap.

Observe, Record, and Summarize Results

Observe your dishes over the next 2 days and record your observations in the Data Table on your worksheet. **Do not open your Petri dish.**

STUDENT WORKSHEET

LAB 4: DON'T CROSS ME

Name _____ Date _____ Class/Hour _____

Record your observations for each day; include the number of colonies you see on the agar as a percentage.

Don't Cross Me Data Table

	Control	Control Board A	Control Board B	Cheese Control	Board A	Board B
Day 1						
Day 2						

Conclusions:

1. What does the Cold Chain have to do with the things you have learned in the last three labs?

2. What are some ways our food can become contaminated after we purchase it?

3. Does what you learned about ground beef/hamburger apply to other foods as well? What about poultry? Fish? Seafood? Eggs?

4. What are some other things you have learned in these three labs?

DON'T CROSS ME

REVIEW

What will happen to the bacteria in the hamburger? (The burger can be cooked to 160°F [71°C] and the harmful bacteria will be killed.) **What will happen to the bacteria on the contaminated cheese?** (The cheese will not be cooked, which means that the bacteria will be eaten. The person eating the "contaminated" cheese might get sick.)

EXTENSIONS

Students could do one or more of the following activities:

Promoting Food Safety

- Write a brochure about the importance of food safety precautions to distribute to school administrators and groups that may be cooking at sports events, school events, fundraisers, etc.
- Talk with local TV channels in your area about working with them to produce a segment on food safety and using food thermometers. This could be broadcast through your school's broadcast studios and posted on social media.
- Prepare a food safety campaign about using a thermometer when cooking meat and share it with your local PTSA or other parent organization.

Learning More

- Visit a local fast-food restaurant and interview the manager to find out how he/she makes sure their hamburgers are cooked to a safe internal temperature.
- Visit the USDA website and learn more about cooking meat safely: **www.fsis.usda.gov/**
- Use the graphics and information from the USDA website to design a brochure or PowerPoint® presentation about how to cook meat safely.
- Test how variations in the thickness of hamburgers can affect the time it takes to reach a safe internal temperature. Cook hamburgers made from the same batch of ground beef for the same amount of time. Take the internal temperature. The temperature may vary from hamburger to hamburger. Many people cook hamburgers on a time basis, believing that if one is done, they will all be done; this is not a safe practice.
- Test how to measure the temperature of a hamburger accurately at three different areas on the burger. Take the temperature on the edge versus the center of the burger, and at the thinnest versus the thickest part of the hamburger.

RESOURCES

- *North American Meat Institute (NAMI)*
  www.meatinstitute.org/
- *Everyday Food Safety for Young Adults*
  www.fda.gov/food/buy-store-serve-safe-food/everyday-food-safety-young-adults
- *Four Steps to Food Safety*
  www.foodsafety.gov/keep-food-safe/4-steps-to-food-safety
- Iowa State Extension Service
  www.extension.iastate.edu
- *National Cattlemen's Beef Association*
  www.beef.org
- *Partnership for Food Safety Education*
  www.fightbac.org
- *Top 10 Kitchen Safety Do's and Don'ts*
  www.tasteofhome.com/article/kitchen-safety-tips/
- *Your Gateway to Government Food Safety Information*
  www.foodsafety.gov

SUMMARY

Bacteria can spread from kitchen items to hands, and even to food. The spread of bacteria can be controlled through proper cleaning and disinfecting as needed.

LAB 5: COLIFORM COUNTS

TIME One 45-minute class period plus additional observation time for 1 to 2 days

LAB AT A GLANCE

This is an **advanced level or honors lab**. During this investigation, students will perform a coliform analysis of raw ground beef. They will collect, organize, and interpret data while practicing safe lab techniques. In the end, they will apply the results of a coliform analysis to food safety.

TEACHER NOTE: This lab can be conducted as a teacher demonstration or by student groups, depending on what better suits your class. You could also prepare materials (such as labeling test tubes and sealed, pre-prepared Petri dishes) prior to the day of the lab to save time. Please be sensitive that some students can be turned off from eating ground beef if we overstate the case and alarm them unnecessarily. Most of us have eaten (some people have not, are vegetarian, or have beef-related allergies) hamburgers and enjoyed them and we are all okay! You might remind students that hamburgers purchased at most fast food franchises are carefully cooked and safe to eat.

FOOD SAFETY CONNECTION

The presence of coliforms in food does not mean that the food is not consumable; it means that proper precautions must be taken to reduce their presence in the food before it is eaten.

COLIFORM COUNTS

SAFETY FIRST

- NEVER EAT OR DRINK ANY FOOD OR LIQUID IN THE LAB.
- Pull back and secure long hair.
- Wash your hands thoroughly with warm water and soap before and after the lab as well as before and after handling raw meat.
- Disinfect all lab surfaces with disinfecting solution before and after working in the lab (page 5).
- Wear appropriate safety equipment (gloves, protective eyewear, and lab aprons).
- Never pipette by mouth; always use a pipette bulb or aid.
- Beware of hot surfaces. Use a thermal hot pad when handling frying pans, hot plates, etc.
- Seal inoculated Petri dishes with Parafilm.
- Never open a dish with organisms growing in it. Some organisms could be dangerous pathogens.
- After the lab is completed, discard all disposable dishes and materials using safe techniques (page 5).

BACKGROUND

- **Coliforms** are bacteria of great concern because they indicate the potential presence of pathogenic microorganisms such as *Cryptosporidium*, *Salmonella*, or *Giardia*. They can be found in untreated water and find their way into food from fecal contamination resulting from unsanitary processing conditions or human food handlers. Coliforms are not disease producers themselves, but they indicate that food may have been contaminated with fecal contamination, which may contain pathogens. They are also normal constituents of plant products.

  Sometimes there are as many as 104 to 106 coliforms in 1 gram of ground beef.
- **Bile salts** inhibit the growth of gram-positive bacteria. This reduces competition and allows the gram-negative bacteria, which are the coliforms, to grow more readily.
- **Neutral Red** is a dye, which acts as a pH indicator. (Coliforms give off CO_2, which combines with water to form carbonic acid which causes a color change in the agar. So, the color change indicates their presence.)
- **Crystal Violet** allows coliforms to grow by inhibiting gram-positive bacteria.

  If the students see a halo around a colony, it's likely to be bile precipitate.

COLIFORM COUNTS

GETTING STARTED

MATERIALS

For the Class

- Spray bottle with disinfecting solution
- 0.25 pound (113 grams) of ground beef (ground chuck or other inexpensive cut of beef is best)
- Safety gloves, eyewear and lab aprons
- 1.5 or 2 L flask
- Violet red bile agar (VRBA)
- Sterile spatula or tongue depressor
- Sterile aluminum foil for weighing the samples
- Burner to heat agar
- Scale
- 90 mL of sterile saline solution (contact lens solution)
- Blender (sterilize bowl, if possible)
- **Coliform Counts** worksheet for each student

For Each Group

- Five sterile Petri dishes with covers — four for the ground beef and one for the control dish.
- Five pieces of Parafilm (0.5" x 4")
- Three sterile test tubes
- 27 mL of sterile saline solution
- Test tube rack
- Permanent marker
- Four sterile, disposable 1 mL pipettes with pipette bulbs
- Thermal gloves or hot pads to handle hot flasks

ADVANCE TEACHER PREPARATION

- Obtain the violet red bile agar in powder form.
- Make sure that all the materials and equipment are available for the lab.

INTRODUCTION

Has anyone ever heard about coliforms and how they might relate to food safety? This advanced-level lab will lead us down a new and intriguing path that scientists take to analyze a food, such as ground beef, to determine if it might be contaminated with pathogens. Let's get started and see what coliforms are and if they really count!

- Review good lab techniques and procedures (pages 5-6).
- Most hamburgers are safe to eat. However, occasionally some bad bacteria show up in hamburgers. (If you haven't already done so, discuss why ground beef is so special in terms of bacterial content (see *Cooking Right* on pages 87-91).
- There could be harmful organisms growing in the Petri dishes.
- Detection of coliform bacteria is important because although coliforms are not disease producers themselves, they indicate that food may have been contaminated with fecal contamination, which may contain pathogens. They are also normal constituents of plant products.

PROCEDURE

Teacher Demonstration (optional approach)

- Divide the class into groups of four students each.
- Distribute a copy of the **Coliform Counts** worksheet to each student.
- Wash your hands in warm water and soap.
- Disinfect the work area.
- Have students assist with the preparation of the VRBA and ground beef solution.

Preparation of the Violet Red Bile Agar (VRBA)

1. Prepare the VRBA according to the instructions on the label:
   - In a flask, add 41.5 grams of agar to 1 L of water (use the best water available, e.g., distilled, etc.).
     - A general rule is that it takes about 20 mL per Petri dish. This will tell you about how many mL of agar to prepare.

COLIFORM COUNTS

- Once you have the VRBA agar in the flask, bring it to a slow boil. Make sure the agar is at a rolling boil. Be very careful, as it can flash boil over the top very quickly.
  - The agar should be translucent with no undissolved granules of agar on the sides of the flask.

2. Cool the agar slightly. **Caution:** It will harden if cooled too long. Monitor the agar temperature as it cools. The best temperature for pouring is 111°F–115°F (44°C–46°C). A water bath set at this temperature would be ideal.

Preparation of the Ground Beef Solution

1. Add 90 mL of sterile saline solution to the blender.
2. Weigh out 10 grams of ground beef on sterile aluminum foil; wear safety gloves.
3. Add the ground beef to the sterile saline solution in the blender. Blend for about one minute on high. The concentration of the ground beef solution is 1:10.

Student Procedure

Each group of students should prepare test tubes and Petri dishes following these instructions:

1. Wash your hands in warm water and soap.
2. Wear safety gloves, eyewear, and lab aprons.
3. Label five Petri dishes on the bottom: "10," "100," "1,000," "10,000," and "control."
4. Set up three test tubes and label them: "100," "1,000," and "10,000."
5. Add 9 mL of sterile saline solution to each of the three test tubes.

Inoculate Petri Dishes

(see **Coliform Counts** Lab Sheet for diagram)

1:10

- Pipette 1 mL of the 1:10 ground beef solution directly into the Petri dish marked "10."
- Carefully swirl the dish to cover the surface. Cover the Petri dish.

1:100

- Pipette 1 mL of the 1:10 ground beef solution into the test tube marked "100." Now the concentration of the ground beef solution is 1:100.
- Thoroughly mix the solution by holding the test tube by the top and gently striking the bottom with the finger on the other hand for about five strikes.
- Pipette 1 mL of this solution into the Petri dish marked "100."
- Repeat this procedure for the 1:1,000 and 1:10,000 dilutions.

Add the agar to the Petri Dishes Containing the Ground Beef Solutions

1. Watch your teacher demonstrate how to pour the agar out of the flask into the Petri dishes and how to flame the mouth of the flask before you do this step.
2. Pour about 10 mL of agar into each Petri dish containing the ground beef solution and then swirl the dish to mix and evenly cover the bottom of the dish.
3. As soon as the agar is solidified, pour in another 4 to 6 mL of agar and swirl again to spread evenly.
4. Pour a control dish to make sure the agar is not contaminated.
5. Seal all dishes with Parafilm.
6. Store the dishes upright until the agar is solid. Then invert the dishes and let the dishes sit at room temperature (away from the sun) overnight.
7. After the lab is completed, discard all disposable dishes and materials using safe techniques (page 5).
8. Wash your hands in warm water and soap.

Record Data

1. Examine the sealed Petri dishes for the presence of colonies over the next two days. Be sure that when you count the colonies, you multiply by the dilution factor. This should give relative numbers of coliforms in the ground beef.
2. Report your group's findings to the class for analysis and discussion.

RESOURCES

- *American Society for Microbiology*
  www.asm.org
- *Cells Alive!*
  www.cellsalive.net

SUMMARY

Testing for the presence of coliforms is one way food scientists can check for possible food contamination. The presence of coliforms in food indicates the potential presence of pathogenic microorganisms, and means that proper precautions must be taken to reduce their presence in the food before it is eaten.

UP NEXT

Now that you know how to keep food safe at home and in retail settings, let's learn how a foodborne illness outbreak is investigated.

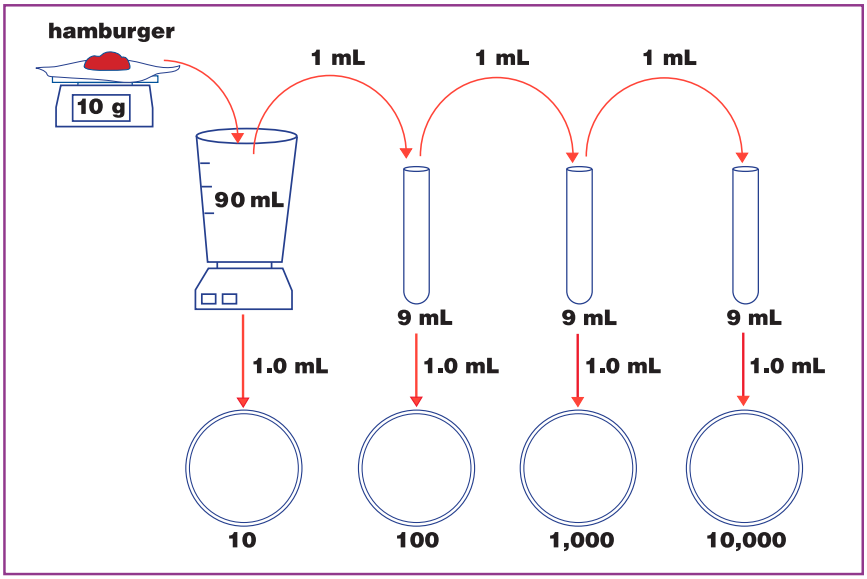
STUDENT WORKSHEET

LAB 5: COLIFORM COUNTS

Name _____ Date _____ Class/Hour _____

This advanced lab is a combination of teacher demonstration and student activity. Please follow the directions carefully and refer to the diagrams in the "Inoculate Petri Dishes" section.

NOTE: Dilutions are made in case the bacterial colonies on the agar dishes from the 1:10 and 1:100 dilutions are too numerous to count.



Respond to the following questions once you have completed the lab:

1. What is the purpose of the control dish?

2. Which concentration of the ground beef solution was the easiest to count? Why?

3. What was the purpose of this lab? Explain how the lab relates to reducing foodborne illness.

4. What should be done to ensure that the hamburger is safe to eat?

5. What do you think is the source of coliform bacteria in the meat?

6. Do you think that pathogens make you sick every time you eat them? Why? Why not?

7. List three other foods that you would like to test for coliform bacteria. Explain why you chose each food.

8. What do you think the coliform count would be for raw oysters and sushi?

9. Do you think fresh strawberries would be high or low in coliforms? Explain.

STUDENT WORKSHEET SAMPLE ANSWERS
ACTIVITY 1: FAST-FOOD FOOTWORK

Name _____ Date _____ Class/Hour _____

1. Select a food establishment for your group to research. Sample response: McDonald's
2. Develop a food safety plan to ensure that the food in your eatery is safe as you respond to the following questions that will help you build a description and profile for your eatery.

About the eatery:

a) What types of foods are prepared and served?
Hamburgers, French fries, sodas, salads, and chicken nuggets are some of the foods prepared and served.

b) Who are the typical customers? Young adults (25 – 34 years old) are the most frequent customers of McDonald's

c) How is the safety of the food ensured

– During storage? Temperature checks and "use by date" checks are used to keep food safe during storage.

– During preparation? Daily food checklist and color-coded utensils and gloves are used to keep food safe during preparation.

– After preparation and before serving? The machines are cleaned every 2 hours; temperature checks on food holding equipment are used to keep food safe after preparation and before serving.

– While serving? All employees must wash their hands hourly and wear color-coded gloves to keep food safe while serving.

d) What happens to food that's not used? Composting, rendering, or anaerobic digestion are used to treat food not used.

e) How are employees trained in food safety procedures?
Demonstrations, simulations, and hands-on experiences are used to train employees in food safety procedures.

f) How are cleanliness and handwashing standards maintained?
Food handlers wash their hands every half hour, and the daily checklist is used to maintain cleanliness and handwashing standards.

g) Are there any unique machines or procedures that the establishment uses to ensure food safety?
Color-coded utensils for different food items and color-coded gloves for different employee roles are some of the unique procedures used to keep food safe.

h) Who are the key people involved in monitoring food safety at your eatery (managers, health department authorities, health inspectors, etc.)?
Answers will vary. The manager is the key person involved in monitoring food safety by completing the daily food safety checklist; third party auditors are also used to verify key food safety standards and procedures. For example, in Florida, the state conducts food safety inspections of restaurants.

i) What role does food safety play in employees' daily jobs? Answers will vary. Employees complete the daily food safety checklist.

j) Do customers have any responsibility for food safety? Customers must eat prepared food within two hours or, if not eaten, make sure food is stored properly. Customers should also wash their hands before eating.

About the regulations and the inspectors:

a) What do food inspectors look for when they visit a food establishment?
Food inspectors look for proper handwashing, time and temperature controls, cross-contamination issues, and dishwasher sanitation.

b) What are the local, county, and state health regulations governing the food establishment?
Example: In Florida, the state is the sole regulator of food establishments. The inspectors look for foodborne illness factors.

c) How do these health regulations relate to bacterial growth and its spread?
Inspectors look for hazardous foods, i.e., those requiring precise time and temperature maintenance as a means of controlling bacteria growth and its spread.

d) How does the manager implement Hazard Analysis and Critical Control Point (HACCP) procedures?
Restaurant food safety and quality management procedures are integrated into the McDonald's Operations and Training Program. They are based on the Hazard Analysis and Critical Control Point principles and are followed in every McDonald's restaurant.

STUDENT WORKSHEET SAMPLE ANSWERS

LAB 1: CROSSED UP!

Name _____ Date _____ Class/Hour _____

1. Review the kitchen items on display. In the chart below, predict which have the most and the least bacteria. Why would/wouldn't bacteria be found on these items?

   The following responses are for an in-class lab using these kitchen items: wet sponge, spoon rest, sink drain, can opener, kitchen shears, food thermometer, bottle opener, and pot scraper. The sponge will have the most bacteria because it is moist most of the time. The food thermometer will have the least bacteria because it is cleaned after each use.

Class Predictions About All Items to Be Sampled

Kitchen Items with the Most Bacteria	Kitchen Items with the Least Bacteria
Sponge	Food thermometer

2. Select and list the items that your group will sample:

   Kitchen shears, spoon rest, can opener

List your items in the corresponding Group Results column below.

Group Results

Kitchen Items with the Most Bacteria	Kitchen Items with the Least Bacteria
Can opener	Spoon rest

3. When you compare your predictions with the results, what are some surprises?

   We thought the can opener would have the most bacteria but the kitchen shears had the most.

4. List the class results in the chart below:

Class Results

Kitchen Items with the Most Bacteria	Kitchen Items with the Least Bacteria
Sponge	Pot scraper

STUDENT WORKSHEET SAMPLE ANSWERS
LAB 1: CROSSED UP! (CONTINUED)

5. When you compare the class predictions with the class results, are there any surprises?

We thought the food thermometer would have the least bacteria but the pot scraper had the least bacteria.

6. Could bacteria transfer from kitchen items to your food? Your hands? What might happen in these cases?

Bacteria could transfer from the kitchen items to our food or our hands. If this happened, our food could be contaminated with foodborne pathogenic bacteria.

7 Why do certain kitchen items have more bacterial growth than others?

Answers will vary. Certain kitchen items may have more bacteria than others because they are not cleaned on a regular basis.

8. How do the data you collected relate to the Four Steps to Food Safety?

Answers will vary. The relationship of our data to the Four Steps to Food Safety is that kitchen utensils need to be cleaned on a regular basis to prevent cross-contamination.

9. How could you reduce the bacteria on the items you tested?

Answers will vary. The bacteria could be reduced by washing the utensils in warm water and soap or in the dishwasher.

10. What are your suggestions to avoid cross-contamination in the kitchen?

Answers will vary. To help prevent cross-contamination in the kitchen, I would suggest that each utensil used be washed and dried before it is used a second time.

11. What advice would you give to family members to help them prevent the spread of foodborne bacteria?

Answers will vary. To help prevent the spread of foodborne bacteria, I would suggest that all kitchen utensils be washed thoroughly in warm water and soap or in the dishwasher.

STUDENT WORKSHEET SAMPLE ANSWERS
LAB 2: COOKING RIGHT

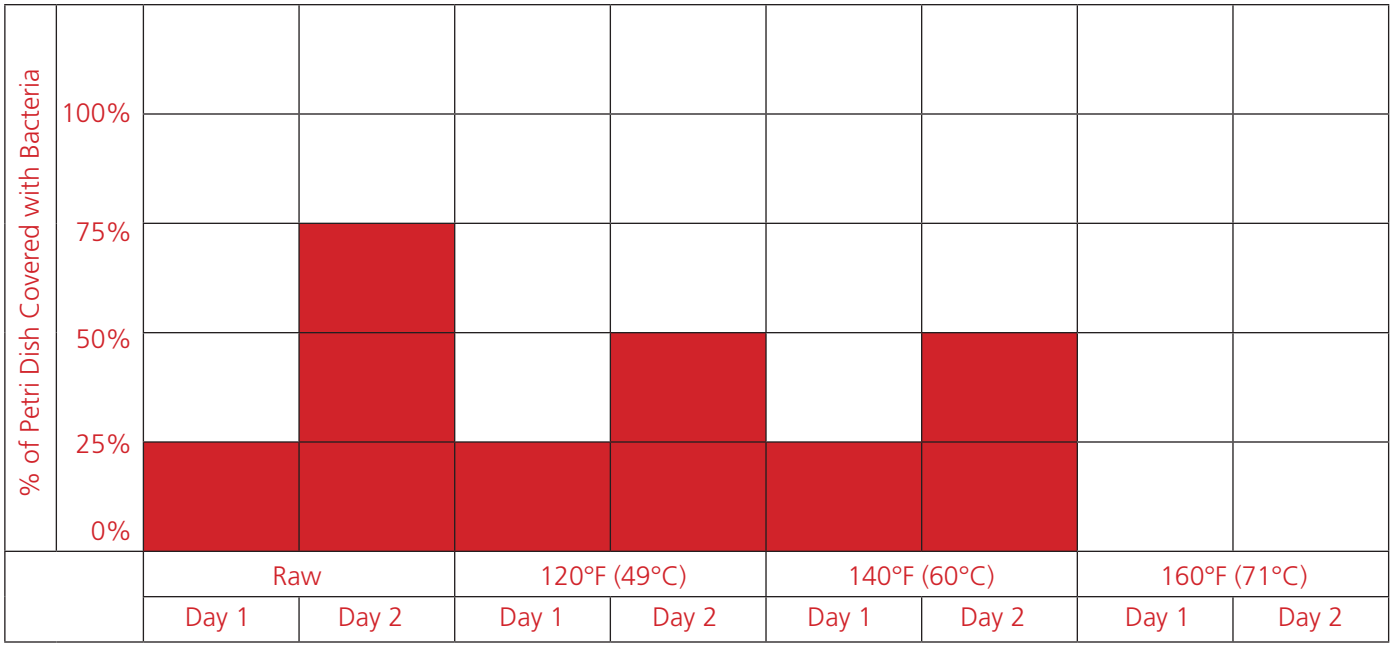
Name _____ Date _____ Class/Hour _____

Record your observations for each day; include the number of colonies you see on the agar as a percentage.

Cooking Right/The Science of Cooking a Hamburger Data Table (Sample Data Based on Actual Lab Results)

	Petri Dish Control	Raw Hamburger	120°F (49°C)	140°F (60°C)	160°F (71°C)
Day 1					
	No colonies	Individual colonies cover 25% of the agar	Individual colonies cover 25% of the agar	Individual colonies cover 25% of the agar	No colonies
Day 2					
	No Colonies	Individual colonies cover 75% of the agar	Individual colonies cover 50% of the agar	Individual colonies cover 50% of the agar	No colonies

Graph Results



STUDENT WORKSHEET SAMPLE ANSWERS
LAB 2: COOKING RIGHT (CONTINUED)

1. Which temperature produced the most effective reduction in bacterial numbers?

The hamburger cooked to 160°F (71°C) was the most effective in reducing the bacterial numbers.

2. How did the number of bacteria in the raw hamburger compare with the cooked burgers?

There were many more colonies in the Petri dish inoculated with the raw hamburger juices than there were in the Petri dishes inoculated with the juices from the cooked hamburgers.

3. What is the purpose of the control dish?

A negative control dish helps us to verify the source of the bacteria. If the control dish has growth, that may indicate contamination of the swabs or the nutrient agar.

STUDENT WORKSHEET SAMPLE ANSWERS
LAB 3: A CHILLING INVESTIGATION

Name _____ Date _____ Class/Hour _____

Record your observations for each day; include the number of colonies you see on the agar as a percentage.

A Chilling Investigation Data Table (Sample Data Based on Actual Lab Results)

	Control	Chilled	Room Temperature
Day 1			
	No colonies present	25% of the agar is covered with individual colonies	50% of the agar is covered with overlapping colonies
Day 2			
	No colonies present	50% of the agar is covered with individual colonies	Almost 100% of the agar is covered with overlapping colonies.

1. Why did your teacher cut the package of ground beef in half, rather than just buying two individual packages?
   One package of meat was used so that the meat samples would be from the same source. If they were from different sources, then another variable would be added to the lab.

2. Did the cold temperature kill the bacteria in the refrigerated sample? Why or why not?
   No, the cold temperature did not kill the bacteria in the refrigerated sample because bacteria colonies grew on the agar that was inoculated with the juice from the refrigerated meat.

3. What did you observe about the unrefrigerated sample?
   Answers will vary. The unrefrigerated sample of meat smelled rotten and looked gray. On day two, the bacterial colonies were all overlapping and covered all of the agar inoculated with the juices from the ground beef left at room temperature. The agar inoculated with the juices from the refrigerated ground beef was only 50% covered with individual colonies.

4. Where in the Farm-to-Table Continuum was the safety of the meat compromised? How could this have been prevented?
   The meat was compromised at the Table, i.e., once it was purchased by the consumer. This could have been prevented by keeping the meat refrigerated until ready to use.

5. Who had the final responsibility for the safety of this meat?
   The consumer has final responsibility for the safety of the meat.

6. Would cooking the unrefrigerated meat thoroughly make it safe for human consumption? Provide a rationale for your response and support your answer with evidence.
   Cooking unrefrigerated meat thoroughly would not make it safe to eat because as the bacteria grow in the meat, they could produce harmful toxins which are not destroyed by cooking.

STUDENT WORKSHEET SAMPLE ANSWERS
LAB 4: DON'T CROSS ME

Name _____ Date _____ Class/Hour _____

Record your observations for each day; include the number of colonies you see on the agar as a percentage.

Don't Cross Me Data Table (Sample Data Based on Actual Lab Results)

	Control	Control Board A	Control Board B	Cheese Control	Board A	Board B
Day 1						
	No Bacteria	No Bacteria	No Bacteria	No Bacteria	No Bacteria	25% of the Petri dish covered with individual colonies
Day 2						
	No Bacteria	No Bacteria	No Bacteria	No Bacteria	No Bacteria	50% of the Petri dish covered with individual colonies

Conclusions:

Answers will vary. The cheese slice placed on the unwashed cutting board became contaminated from the hamburger because there were bacteria growing in the Petri dish inoculated with that cheese slice.

1. What does the Cold Chain have to do with the things you have learned in the last three labs?
   Answers will vary. The ground beef must be kept cold to prevent it from becoming contaminated with too many bacteria and toxins from those bacteria.

2. What are some ways our food can become contaminated after we purchase it?
   Answers will vary. Some ways food can become contaminated after we purchase it are by not refrigerating the food within the proper amount of time, or by not washing cutting boards properly between uses with different kinds of food.

3. Does what you learned about ground beef/hamburger apply to other foods as well? What about poultry? Fish? Seafood? Eggs?
   Answers will vary. Ground beef must be kept at the proper temperature as would poultry, fish, seafood, and eggs.

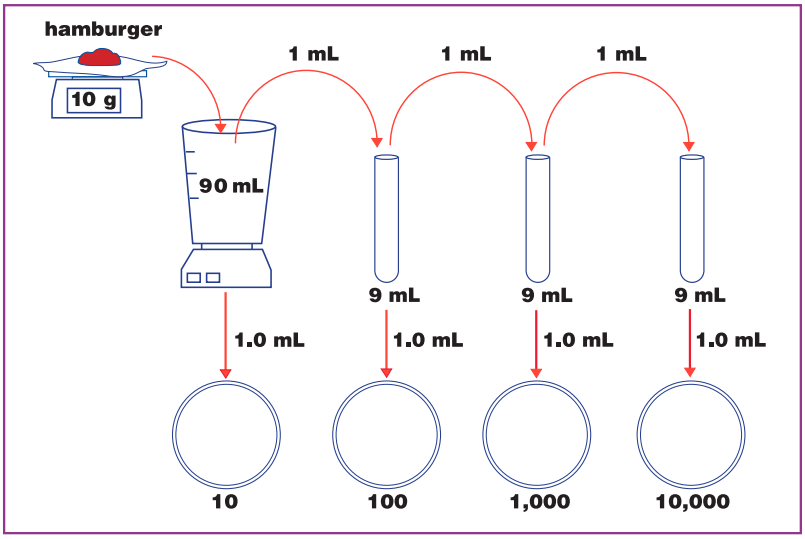
4. What are some other things you have learned in these three labs?
   Answers will vary. Hamburgers must be cooked to 160° F to destroy all of the bacteria. When ordering a hamburger, you should ask for it to be cooked to 160° F, not medium or rare.

STUDENT WORKSHEET SAMPLE ANSWERS
LAB 5: COLIFORM COUNTS

Name _____ Date _____ Class/Hour _____

This advanced lab is a combination of teacher demonstration and student activity. Please follow the directions carefully and refer to the diagrams in the "Inoculate Petri Dishes" section.

NOTE: Dilutions are made in case the bacterial colonies on the agar dishes from the 1:10 and 1:100 dilutions are too numerous to count.



Respond to the following questions once you have completed the lab:

1. What is the purpose of the control dish?
   The purpose of the control dish is to be a benchmark or a point of comparison against which other test results are measured and to make sure that none of the materials used in the lab are contaminated.

2. Which concentration of the ground beef solution was the easiest to count? Why?
   The 1:10,000 dilution was easiest to count because the concentration had the least amount of ground beef.

3. What was the purpose of this lab? Explain how the lab relates to reducing foodborne illness.
   Answers will vary. This lab shows that if a sample containing bacteria is diluted, then the number of bacteria in the sample are reduced. By reducing the number of bacteria, the chances of being infected by those bacteria is reduced. Detection of coliform bacteria is important because they indicate that food may have been contaminated with fecal contamination, which may contain pathogens.

4. What should be done to ensure that the hamburger is safe to eat?
   To ensure that the hamburger is safe to eat, the ground beef should be cooked to 160° F.

5. What do you think is the source of coliform bacteria in the meat?
   Answers will vary. A possible source of the coliform bacteria in the meat could be the animal from which the meat came.

6. Do you think that pathogens make you sick every time you eat them? Why? Why not?
   Answers will vary. Pathogens don't make you sick every time you eat them because sometimes there are not enough of the pathogens in the food to make you sick.

7. List three other foods that you would like to test for coliform bacteria. Explain why you chose each food.
   Answers will vary. I would like to test: bagged lettuce because it has so many cut surfaces; raw milk because it can be so harmful to certain populations who eat the soft cheese that is made from the milk; and orange juice because I am not sure it would be contaminated with coliforms.

8. What do you think the coliform count would be for raw oysters and sushi?
   Answers will vary. I think the coliform count would be high for oysters because the waters they grow in are often contaminated with waste. In sushi, it would depend on what the sushi is made from. If it is made from raw fish, the coliform count could be high because the fish could be contaminated with coliforms.

9. Do you think fresh strawberries would be high or low in coliforms? Explain.
   Answers will vary. If the strawberries are irrigated with contaminated water, they could be contaminated with coliforms.

Science and Our Food Supply:
Investigating Food Safety from Farm to Table
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Center for Food Safety and Applied Nutrition
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FDA Subject Matter Experts

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- ***Coordinated Outbreak Response and Evaluation Network***
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- ***Office of Regulatory Science***

Curriculum Development Experts

Mimi Cooper, M.Ed.
Lead SOFS Advisor
Educational Consultant
St. Augustine, FL

Janie Dubois, Ph.D.
SOFS Laboratory Instructor
International Food Safety Capacity Building Expert
Olney, MD

Susan Hartley, B.S.
Biomedical Sciences Teacher
Hinkley High School
Aurora, CO

Laurie Hayes, B.A.
SOFS Advisor
Educational Consultant
Clovis, CA

Isabelle Howes, M.L.S.
National Training Coordinator for FDA School-Based Food Safety & Nutrition Education Programs
Graduate School USA
Washington, D.C.

Tiffany M. Hoy, M.E.
Agricultural Education Teacher; FFA Advisor
Tyrone Area High School
Tyrone, PA

Henie Parillon, Ed.S.
Supervisor of Science, K-12
Orange Public Schools
Orange, NJ

Mercedes Parker, B.S.
Family Consumer Sciences Educator; Teaching & Training Program; TAFE Sponsor
V.R. Eaton High School
Haslet, TX

Tiska Rodgers, MNatSci
Science Teacher, Grades 7-12
Clarkton Jr-Sr High School
Clarkton, MO

Elena Stowell, M.S. NBCT AYA Biology
Biology & Earth Systems; College in the High School Biology Teacher
High School SOFS Advisor
Kentwood High School
Kent, WA

Peter Sykora, B.S.
Science Instructor, K-12
Watford City Middle School
Watford City, ND

Keshia D. Williams, Ed.S. NBCT
Secondary Science Teacher
George Washington Carver High School
Montgomery, AL