

# Hot Off the Grill

## Objective

Students will observe the amounts of bacteria in Petri dishes inoculated with hamburger meat that has been cooked to different temperatures. They will also learn that cooking hamburgers to the recommended temperature of 160° F (71° C) will kill pathogenic bacteria.

## Background

About 6 million people get sick every year from eating food that is contaminated. Most food contamination can be prevented by proper food handling. One common way food is contaminated is by cross-contamination. If you pet the dog, then open the refrigerator and pull out a slice of bologna for a sandwich, you may transmit germs from the dog to the food you are about to put in your mouth. If you prepare the sandwich on a bare counter that has not been washed, you are exposing your sandwich to germs from anything that has been on the counter since the last time it was washed thoroughly. If the plate you use to hold your cooked hamburger is the same one you used to carry the raw patty to the grill, you may contaminate your burger with the same kind of bacteria you just killed by cooking it.

It's easy to avoid cross-contamination simply by washing your hands thoroughly before preparing or eating food, by washing counters often with hot, soapy water and clean wiping cloths, by keeping dishes and cooking implements clean and by storing meats and other foods that require cooking separate from fruits, vegetables and other foods that you can eat raw.

Meat, poultry and fish are not safe to eat until they have been cooked. That's because they are particularly attractive to the kind of bacteria that can make us sick. Bacteria growth slows down at temperatures below 40 degrees, so meats can be stored for short periods of time at that temperature, in the refrigerator, until we are ready to use them. Cooking meat at high temperatures kills bacteria, but the meat must be cooked all the way through. The only way to make sure it is done all the way through is to use a meat thermometer. Meat and poultry are not considered safe to eat until they have reached a temperature of 160 degrees or higher, no matter what the meat looks like. Research done by the U.S. Department of Agriculture shows that one out of every four hamburgers turns brown in the middle before it is safely cooked. Some ground beef patties look done at internal temperatures as low as 135° F (57° C). Most people are suspicious of meat that is pink, but some turkey, pork, ground beef or veal remains pink even after it has been cooked thoroughly. Meat and poultry grilled or smoked outdoors can also look pink, even when well done.

Hamburgers got their name from a village in Hamburg, Germany. They were named for a style of preparing meat which originally involved slicing the meat very, very thin and eating it raw. That practice may have been safe when the meat was prepared and eaten almost immediately after slaughtering the

Oklahoma Academic  
Standards

GRADE 6

Life Science: 2-1,4

## Vocabulary

**bacteria**—a widely-distributed group of typically one-celled microorganisms, many of which produce diseases. Many are active in processes of fermentation, the conversion of dead organic matter into soluble food for plants and the fixing of atmospheric nitrogen.

**contaminate**—to make impure by contact or mixture with harmful bacteria, fungi, or dangerous chemicals.

**cross-contamination**—transmitting bacteria from one thing to another.

**ground beef**—beef that has been ground

**hamburger**—a sandwich made with a patty of ground meat usually in a roll or bun.

**transmit**—to send from one person, thing, and or plant to another

beef animal, but most of us eat meat that has been transported over many miles and stored in several places before it makes it to our tables, so there are many more opportunities for bacterial growth.

The hamburger meat we buy in the store is usually made from the less tender and less popular cuts of beef. Trimmings from more tender cuts may also be used. Grinding tenderizes the meat, and the fat reduces its dryness and improves flavor. Grinding also exposes more of the meat surface to the bacteria normally occurring in the air, on the meat, on the butcher's hands and on the cutting equipment. For that reason ground beef is more likely to be contaminated than larger cuts of meat.

Most ground beef is ground and packaged in local stores. All meat transported and sold in interstate commerce must be federally inspected. The larger cuts are usually shipped to local stores, where some of it is ground.

All meat will shrink in size and weight during cooking. The amount of shrinkage will depend on its fat and moisture content, the temperature at which the meat is cooked and how long it is cooked. The higher the cooking temperature, the greater the shrinkage.

## Materials

- Dishwashing detergent
- Disinfecting bleach solution (20 ml of liquid household bleach in 1 L of tap water)
- Alcohol wipes or cotton balls and isopropyl alcohol
- Paper towels
  
- .5 pound (227 grams) of inexpensive, raw hamburger, such as chuck (enough to make 4 patties, approximately 50 grams each. DO NOT USE PRE-MOLDED HAMBURGERS.)
- Metric ruler
- Scale for weighing the hamburgers
- Hot plate and a regular skillet
- Non-stick spray to keep the hamburgers from sticking to the pan during cooking
- 1 digital, instant-read food thermometer (rapid-read, thin-probe type is best)
- Sharp knife
- Spatula for removing hamburgers from skillet
- Clean paper plates for cooked hamburgers
  
- 5 sterile Petri dishes with nutrient agar and covers
- Parafilm to seal dishes
- Sterile cotton swabs
- Permanent marker
  
- Thermal gloves or hot pads for handling the hot skillet

- Safety gloves, safety goggles, lab aprons for anyone handling and/or cooking meat

## Procedures

1. Prepare 5 sterile Petri dishes containing nutrient agar and familiarize yourself with the proper use of a food thermometer.
2. Prepare 1 hamburger patty (approximately 50 grams) to cook as students enter the classroom.
3. As students walk into the room ask them how they like their hamburgers cooked—well done, medium, or rare?”
4. Ask for a volunteer to take a tally of the class. Ask students to explain and discuss their choices. 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?”
5. Read and discuss background and vocabulary about food safety. Explain that most hamburger from the supermarket is safe; however, there is a remote possibility that bad bacteria, such as *E. coli* O157:H7, can find its way into some foods, like hamburger. Because of that possibility it is important to cook all ground meat to a safe internal temperature.
6. Explain that you will be exploring the amount of bacteria present in raw hamburger and in hamburgers cooked to different temperatures.
7. Ask volunteers to assist you in labeling 5 Petri dishes: control, raw, 120° F (49° C), 140° F (60° C), 160° F (71° C)
8. Demonstrate how to set up a control dish.
9. Show students how to swab the raw hamburger, inoculate the “raw” dish, and seal the dish with Parafilm.
10. Discuss:
  - “What factors should be considered?” (Weight, size, thickness of hamburgers, temperature, consistency, etc.)
  - “How can we assure that all the hamburgers are the same size?” (They should be weighed.) “Why?” (If the hamburgers vary in size, another variable is introduced.)
  - “Does thickness of the hamburgers matter?” (Burgers should be about .5 inches [1.3 cm] thick. It’s easier to accurately insert the thermometer in a burger of this thickness.)
11. Demonstrate how to prepare three hamburgers—weigh and measure them to assure that they are all the same weight and thickness. Cook one hamburger to 120° F (49° C).
12. Discuss:
  - “Why is it important to take the hamburger out of the pan to measure the temperature?” (The heat from the pan will interfere with getting an accurate temperature reading of the inside of the hamburger.)
  - “How should you take the temperature?” (Take the temperature through the side and into the center, making sure the temperature probe reaches the center of the burger, not just the outer edge. Follow the instructions on the thermometer package.)
13. Clean the thermometer with alcohol after every temperature reading. Discuss:
  - “Why is this necessary? (If there are bacteria in the meat, they might get onto the thermometer and be transferred to the next hamburger you’re cooking.) This is called ‘cross-contamination’.”
14. When the hamburger has reached 120° F (49° C), break it in half and demonstrate how to swab the inside. Ask, “Why do you break it rather than cut it in this scientific test?” (The knife might have bacteria on it and you might transfer that bacteria into the hamburger.)
15. Have a volunteer swab inside the broken edge of the hamburger and inoculate the “120° F” dish. Seal the dish with Parafilm.
16. Cook the two remaining hamburgers: one to 140° F (60° C) and the other to 160° F (71° C).
17. Volunteers will inoculate the dishes after each hamburger has reached the desired temperature. Seal the

dishes with Parafilm.

18. Place the inoculated Petri dishes in the incubator at 95° F (35° C) for 1 to 2 days, or let them sit at room temperature for the appropriate amount of time.
19. After the Petri dishes have sat for a day or two, students will observe, record, and report bacterial numbers in the four samples. Discuss:
  - “Which temperature produced the most effective results in reducing bacterial numbers?” (The temperature of 160° F [71° C] should show the best results. This is the recommended temperature for safely cooking ground meat.)
  - “How did the amount of bacteria in the raw hamburger compare to the cooked burgers?” (The raw hamburger will have much more bacteria than any of the cooked hamburgers.)
  - “What did your control show?”

Activity adapted from *The Science and Our Food Supply Curriculum*, US Food and Drug Administration Center for Food Safety and Applied Nutrition and the National Science Teachers Association.

# Safe Food Handling

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## AT THE STORE

- Don't let juice from raw meat, poultry or fish drip on to your hands or any fresh foods in your grocery cart. Raw juices may contain bacteria.
- Shop for cold and frozen products last. Use a cooler for the ride home, especially during the summer if you are running other errands.
- Avoid unpasteurized milk and juice and eggnog or other foods made with raw eggs.

## IN THE KITCHEN

- Always wash your hands in hot, soapy water before preparing and after handling raw meat, poultry, seafood or eggs.
- Cook all meat and poultry—or casseroles that contain meat or poultry—at a minimum oven temperature of 325 degrees F.
- Cook meats thoroughly, but don't overcook them.
- Keep your refrigerator at no more than 40 degrees F. and your freezer at 0 degrees F.
- Don't store raw fish in your refrigerator for more than 24 hours. Raw poultry or ground beef will keep for one to two days and raw red meat for three to five.
- Thaw frozen food in the fridge or in a microwave, not at room temperature.
- Never put cooked food on the plate used when it was raw.
- To keep bacteria from growing, put your sponge or scouring pad in the dishwasher every time you run it.