What's Lurking in Lunch?
Player Guide

The Story

Outbreak!

Dozens of high school juniors and seniors stay home sick or show up at the emergency room and doctors' offices with similar symptoms. School and medical personnel call the Department of Public Health to report their suspicion that a foodborne outbreak might be happening!

There are several lunch options close to the high school. Juniors and seniors are allowed to leave campus at lunch time. Most of the local eateries offer daily specials that are priced well and that students prefer to buy. The specials that were available on the day that the foodborne outbreak occurred are described in the Appendix.

Hunt for the Contaminating Microbe!

You are assigned to a team of trained professionals who must search for clues throughout the community. What microbe is causing the outbreak? Where were the students infected? What did they eat that caused them to become sick? Who allowed the food to become contaminated? Your team must work quickly because this information is essential to cure the sick students and prevent others from being infected. Use the light rail, the local bike-sharing program, your feet, and the Internet to move around the board and collect the information you need to answer these questions. Record information you find on your Outbreak Notepad.

Object

Your goal is to discover the cause of a foodborne illness outbreak. You need to discover the following:

- **Culprit:** Who caused the illness by not following proper food-handling procedures?
- **Pathogen:** What toxic microorganism caused the food poisoning outbreak?
- **Location:** Where did infection occur? Was it in a neighborhood restaurant or the school cafeteria?
- **Food:** What did the pathogen contaminate to cause the outbreak?

In order to confirm your suspicions, you will visit the hospital to collect symptom data, eateries to interview employees about their food-handling practices, a microbiology lab to obtain test results, and the Department of Public Health to gather data about food choices and to calculate attack rates.

Set-Up

Starting with the youngest player, each player chooses one of the four roles described on Page 2. Each role can only go to one player!
Place your game piece on the corresponding space on the game board.
Make sure each player has an Outbreak Notepad, a pencil, a calculator, and a Player Guide.
Deal the Culprit cards, face down, to each player.
Deal the Location cards, face down, to each player.
Deal the Lab Test cards, face down, to each player.
Deal the Food-Attack Rate cards, face down, to each player.

Professional Role Descriptions

Bioinformaticist: Bioinformaticists use tools from many fields, including computer programming, mathematics, and biology to store, retrieve, organize and analyze biological information for patterns related to disease.

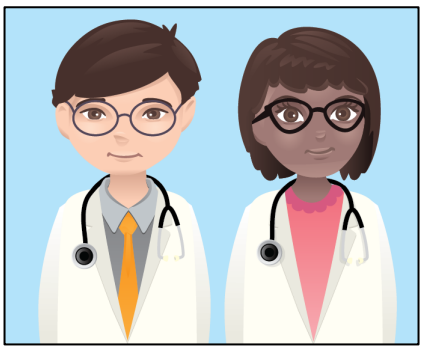
Perks: You get to use the calculator. To use the Internet repeatedly, you don't have to leave the building each turn.

Epidemiologist: Epidemiologists study the distribution and patterns of health events, health characteristics and their causes or influences in populations.

Perk: You get to look at one Food-Attack Rate card held by another player after all the cards have been dealt.

Medical Technologist: Medical technologists analyze the chemical and biological characteristic of patient samples in a laboratory. They work to diagnose disease at the molecular, cellular, and tissue levels.

Perk: You get to look at one Lab Test card held by another player after all the cards have been dealt.



Physician: Physicians, along with other healthcare professionals, such as nurses and physician assistants, are usually the first to encounter people when they get sick. They observe the patients and order the proper tests to understand disease.

Perk: You get the Medical Chart after all the cards have been dealt.

Game Play

Analyze the Clues!

The Physician may look at the Medical File and record symptom and onset data on the Epidemiology Notepad at the beginning of the game. The Medical File is then placed face down in the hospital.
The Epidemiologist gets to look at one Food-Attack Rate card held by any player at the beginning of the game.
The Medical Technologist gets to look at one Lab Test card held by any player at the beginning of the game.

Order of Play: Physician -> Epidemiologist -> Medical Technician -> Bioinformaticist

Your Turn!

Your turn starts by rolling the dice and moving. After moving, you may do one of the following depending on where you land:

- Make a Conjecture
- Ask for Collaboration
- Use the Internet
- Make a **Final Guess**

Movement

Roll both dice and move a number of squares up to the result of the roll.

Move only up, down, left and right (no diagonals).
You may not enter the same square twice in a turn.
Board the Light Rail from 'Enter' squares and leave the Light Rail on 'Exit' squares.
Enter and exit the Greenbike path at any point.
Enter buildings only through the doorways (doors are not counted as a square).
Using the light rail or Internet Express ends your movement.
A player's turn ends when they enter a location, no matter what number was rolled.
You may not re-enter a building you exited from on the same turn
You may not end your movement in the same square as another player. You may 'jump' over their game piece if you have enough movement, otherwise you must end one square behind them.

Shortcuts:

Players may use the Light Rail as a short-cut to cross the board. Rail tracks are indicated by the purple lines that connect them. Players can move in any one direction per turn.
Players may use a Greenbike and travel on the path around the school, which is equivalent to one square. The path is indicated by the green line around the school.

Special:

If you're the Bioinformaticist, you may choose to stay in any of the Internet Express locations instead of rolling the dice and moving.

Making a Conjecture

You can make a conjecture during a turn only if you are in the suspected eating location. For example, if you want to say, "I suspect that the foodborne illness was caused by Dirty Dan in the school Cafeteria," you must be in the school cafeteria.

Once you have made a Conjecture, the player to your left checks their cards to see if they have either of the guessed components (e.g., the Cafeteria card or the Dirty Dan card). If she holds any of the three cards, she

shows only ONE to you. It is important that she only show the card to you, so the other players may not see which card is being used to disprove the Conjecture. You should then check off the card you saw on your Notepad. If the first player to your left does not hold any of the cards used in the Conjecture, the next player to the left checks his or her cards and this continues around the table until either the Conjecture is proved wrong or there are no remaining players. Once a Conjecture has been disproved, your turn ends and the next player rolls the dice. The player's Conjecture only gets disproved once, so even if two players hold cards disproving the Conjecture, only the first one will show the suggesting player his or her card.
When you've gathered enough information and ruled out several causes, carefully analyze the clues that you've collected to guess which **pathogen**, **food**, **location**, and **culprit** is responsible for the outbreak.

Asking for Collaboration

If you are in the Department of Health, Microbiology Lab, or Hospital, you may look at information from another player. The type of information depends on the location:

- Department of Health: Food-Attack-Rate Card
- Microbiology lab: Lab-Test Card
- Hospital: Medical Chart

Using the Internet

If you are in the Department of Health, Microbiology Lab, or Hospital, you may look at information from another player. You may have the player of your choice show you a Food-Attack-Rate Card OR Lab-Test Card at the beginning of your NEXT turn (before you roll the Conjecture).

Share your Findings!

Now that you're feeling confident about the cause of the outbreak, it's time to share your suspicions and evidence. You can make your **Final Report** from anywhere on the board.

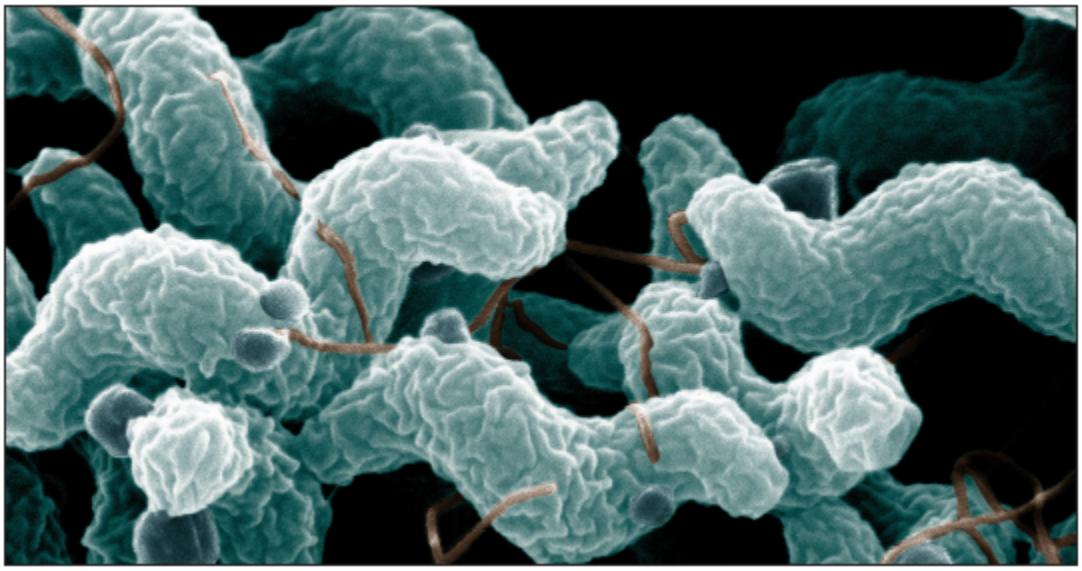
Announce which **pathogen**, **food**, **location**, and **culprit** you suspect are responsible for the outbreak and describe the evidence that supports your conclusion. Open up the Confirmation envelope and, if you are correct, lay the cards on the table face up. Then present the Microbe Test Results to the group. If you are wrong, however, you return the cards to the Confirmation Envelope without revealing them to the other players. If you make an incorrect final report, you are out of the game, though you must still disprove others' Conjectures with the cards in your hand.

Save the Day!

A player wins the game if their **Final Report** is proven correct.

Now that you have identified the offending microbe, you can treat patients with the proper medicines, you can inform the eatery to dispose of the contaminated food, and you can educate the eatery workers to store and prepare foods in ways that prevent contamination. Good work!

Microbe Reference Manual



Name of organism: Campylobacter jejuni (Cam-pillow-**back**-ter Je-**joon**-eye)

Types of food where this organism can be found:

a. Meats
b. Poultry
c. Gravy
d. Dried or precooked foods
e. Time and/or temperature-abused foods

How soon a person gets sick after ingesting: 8 – 16 hours

How soon a person feels better after getting sick: Usually 24 hours

Symptoms present during illness:

a. Intense abdominal cramps
b. Watery diarrhea

Type of laboratory tests performed to identify this organism:

Antibody Test

- Antibodies detect flagella and CadF adhesion proteins.

Molecular Test

- PCR and sequencing detect the alpha toxin gene which is 324 base pairs in length.

Selective Culture Media

- Bacterial colonies grow on sheep blood agar surrounded by a zone of blood cell destruction (hemolysis) caused by the toxin they release.
- Bacterial colonies grow on egg yolk agar surrounded by characteristic toxin precipitation.

Gram Staining

- Gram staining reveals purple/blue colonies that form heat-tolerant endospores.

Microscopy

- Bacteria appear spiral-shaped when viewed using a microscope.

Name of organism: Listeria monocytogenes (Liss-**tear**-e-uh mawn-o-site-**o**-jennies**)**

Types of food where this organism can be found:

a. Unpasteurized milk
b. Cheeses made with unpasteurized milk
c. Ready-to-eat deli meats

How soon a person gets sick after ingesting: **9-46 hours for gastro-intestinal symptoms; 2 – 6 weeks for invasive disease**

How soon a person feels better after getting sick: **Variable**

Symptoms present during illness:

a. Fever
b. Muscle aches
c. Nausea
d. Diarrhea
e. Premature delivery or stillbirth
f. Bacteremia or meningitis in the elderly/immunocompromised

Type of laboratory tests performed to identify this organism:

Antibody Test

- Antibodies detect protein P60 which helps it invade and survive in host cells

Molecular Test

- PCR and sequencing detect a virulence gene which is 1,590 base pairs in length

Selective Culture Media

- Blue-green, round colonies surrounded by opaque halos grow on chromogenic agar.
- An arrow-shaped zone of hemolysis points toward the tested bacteria grown on blood agar; known as a positive reverse CAMP test.

Fluorescence Staining

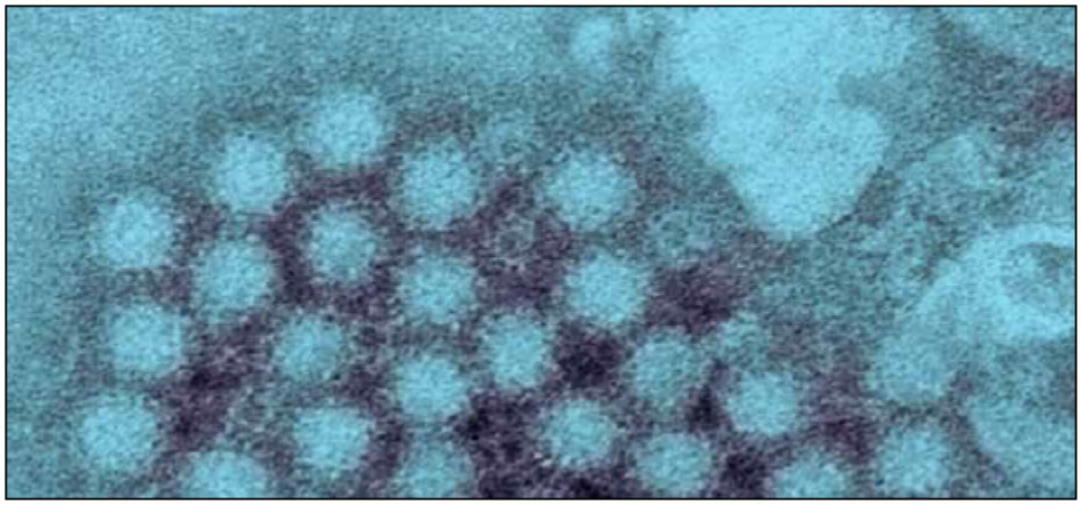
- Bacteria are stained using a species-specific fluorescent ribosomal RNA antibody.

Gram Staining

- Gram staining reveals purple/blue colonies

Microscopy Test

- Bacteria appear rod-shaped when viewed using a microscope.



Name of organism: Norovirus (Nor-o-vi-rus)

Types of food where this organism can be found:

a. Raw produce
b. Uncooked foods
c. Cooked foods not reheated after contact with an infected food handler
d. Contaminated drinking water
e. Shellfish from contaminated waters

How soon a person gets sick after ingesting: 12 – 48 hours

How soon a person feels better after getting sick: 12 – 60 hours

Symptoms present during illness:

a. Nausea
b. Vomiting
c. Abdominal cramping
d. Diarrhea
e. Fever
f. Headache

Type of laboratory tests performed to identify this organism:

Antibody Test

- Rapid enzyme immunoassay (EIA) detects a viral capsid protein.

Molecular Test

- PCR and sequencing detect a viral capsid gene that is 213 base pairs in length.

Fluorescence Staining

- Viruses are stained using a species-specific fluorescent capsid antibody.

Microscopy

- Transmission electron micrograph shows icosahedral viral capsid particles in body fluid, fecal, or food samples.

Name of organism: Salmonella (Sal-mo-**nel**-la)

Types of food where this organism can be found:

a. Eggs
b. Poultry
c. Meat
d. Unpasteurized milk or juice
e. Cheese
f. Raw fruits and vegetables

How soon a person gets sick after ingesting: 6 – 48 hours

How soon a person feels better after getting sick: 4 – 7 days

Symptoms present during illness:

a. Diarrhea
b. Fever
c. Abdominal Cramps
d. Vomiting

Type of laboratory tests performed to identify this organism:

Antibody Test

- Antibodies on a strip detect species-specific lipopolysaccharides in food and body fluid samples through color change.

Molecular Test

- PCR and sequencing detect a species-specific flagella protein that is 204 base pairs in length.

Selective Culture Media

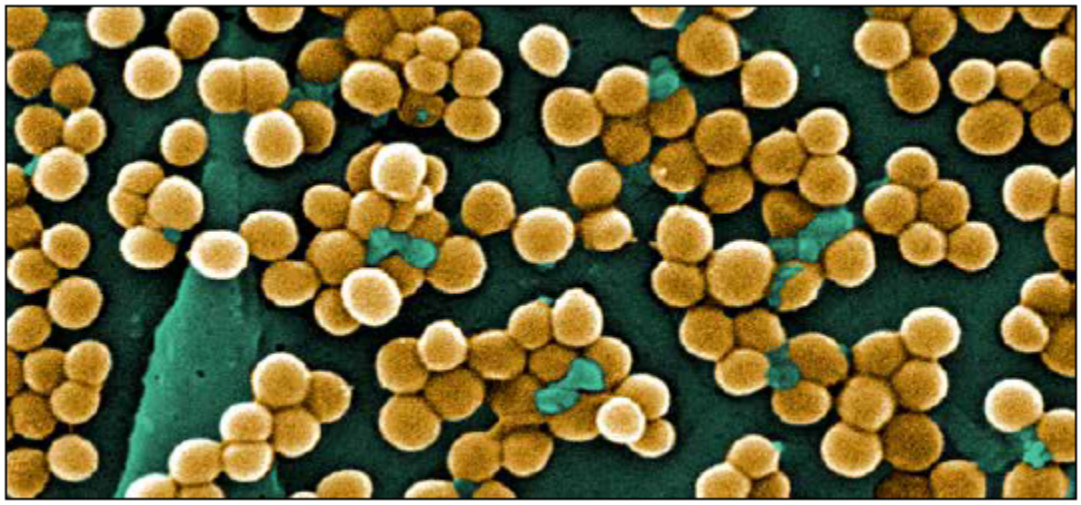
- Colonies grow on xylose lysine deoxycholate (XLD) agar when food samples are swabbed.

Gram Staining

- Gram staining reveals pink/red colonies.

Microscopy

- Bacteria appear rod-shaped when viewed using a microscope.



Name of organism: Staphylococcus aureus (Staff-low-**cock**-us **are**-e-us)

Types of food where this organism can be found:

a. Unrefrigerated/improperly refrigerated meats, potato and egg salads, and cream pastries

How soon a person gets sick after ingesting: 1 - 6 hours

How soon a person feels better after getting sick: 24 - 48 hours

Symptoms present during illness:

a. Sudden severe nausea and vomiting
b. Abdominal cramps
c. Diarrhea
d. Fever

Type of laboratory tests performed to identify this organism:

Antibody Test

- Antibodies detect protein P60 which helps it invade and survive in host cells.

Molecular Test

- PCR and sequencing detect an oxacillin resistance gene (mecA) which alters penicillin binding. This bacteria is antibiotic resistant!

Selective Culture Media

- Bacteria grown on antibiotic agar shows resistance since a zone of inhibition is absent.
- Bacteria grow and ferment mannitol on mannitol salt agar (MSA) and pH indicator, causing the red agar to turn yellow.
- Bacterial colonies appear pink when grown on chromogenic agar.
- Halos of hemolysis appear around colonies grown on blood agar.

Staining

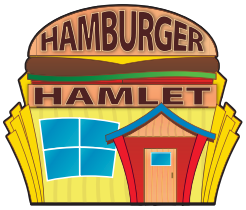
- Gram staining reveals purple/blue colonies.

Microscopy

- Scanning electron microscopy shows numerous grape-like clumps of round bacteria.

Specials Menu

There are several lunch options close to the high school and juniors and seniors are allowed to leave campus at lunch time. Most of the local eateries offer daily specials that are priced well and that students prefer to buy. Here are the specials that were available on the day that the foodborne outbreak occurred.

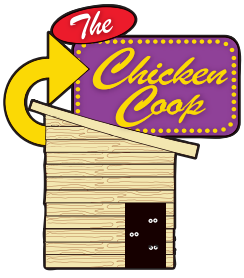


Hamburger Hamlet
$4.95 (includes a milkshake and French fries)
Classic Bacon Cheeseburger – beef patty, topped with bacon, lettuce, tomato, cheddar cheese, ketchup, and pickles served on a bun

Burrito Barn
$4.95 (includes a cola beverage, tortilla chips, guacamole, fresh tomato salsa, and a cup of vanilla ice cream)
Tasty Burrito – shredded chicken, chorizo, grated cheddar cheese, lettuce, hot sauce served on a flour tortilla

Ice Cream Igloo
$4.95 (includes a cola beverage, French fries, and a vanilla hot-fudge sundae with whipped cream and a cherry)
Chile Cheese Dog with cheddar cheese, onions, and diced tomato served on a bun

Sub Shack
$4.95 (includes a cola beverage, potato chips, and a vanilla ice cream cone)
Meatball Sub – meatballs, pepperoni slices, marinara sauce, lettuce, and mozzarella cheese on a 6” roll



Chicken Coop
$4.95 (includes a lemonade beverage, potato chips, and a milkshake)
Chicken Club Sandwich – grilled chicken breast, bacon strips, cheddar cheese, lettuce, and mayonnaise served on a bun

Cafeteria
Meal - $3.95 (includes 2% milk or orange juice, tater tots, and soft serve vanilla or chocolate ice cream)
Fish Sticks – 5 fish sticks served with tartar sauce
Salad Bar - lettuce, tomato, cucumbers, cheddar cheese cubes, ham cubes, and ranch dressing

Glossary

Agar: A gelatinous material that comes from algae, specifically used to grow (culture) bacteria and other cells for diagnostic or laboratory experiments purposes.

Amplify: To make more copies of something.

Antibiotic: Medications that destroy or slow down the growth of bacteria.

Antibody: Large Y-shaped proteins recruited by the immune system to identify and neutralize foreign objects like bacteria and viruses.

Antibody Test: Antibodies can identify specific microbes in samples by attaching to molecules on their surfaces.

Assay: A method to analyze the presence of a substance and the amount of that substance in sample.

Attack Rate: The cumulative incidence rate of infection or disease in a group over a period of an epidemic; often expressed as a percentage. For example, "There was an attack rate of 95% for those who ate the sausage sandwich." OR "There was a 5% attack rate for those who did not eat the sausage sandwich."

Bacteremia: The presence of bacteria in the blood.

Base Pair Fragment: A piece of DNA measured by how many chemicals, called "bases," are linked together.

Blood Plasma: The liquid component of blood which is a mixture of water, sugar, fat, protein, and salts.

Blood Serum: Blood plasma with the clotting elements removed.

Chromogenic Agar: Agar that changes color.

Chromatography: A set of laboratory techniques used to separate and analyze mixtures of chemicals.

Colony: A visible cluster of (many) bacteria that all grow from a single bacteria.

Colony Forming Unit: Individual colonies of bacteria, yeast or mold.

Culture: The growing of microorganisms, tissue cells, or other living matter in a specially prepared nutrient medium (like agar).

DNA: A molecule found inside of cells that contains the genetic instructions that guide the processes of life.

Epidemic: The occurrence of more cases of a disease than would be expected in a community or region during a given time period. From the Greek "epi-", "upon" + "demos", "people or population" = "epidemos" = "upon the population." This is sometimes called an outbreak.

Endospore: Tough, dormant (not growing, developing or reproducing) structures that some bacteria are able to form when stressed.

Epidemiologist: A medical scientist who studies the transmission and control of epidemic diseases.

Epidemiology: The branch of medicine that deals with the study of the causes, distribution, and control of disease in populations.

Fermentation: A chemical phenomenon in which an organic molecule splits into simpler substances.

Fluorescent: Brilliantly colored and giving off light; "fluorescent colors."

Gram Stain: A method of staining bacteria using a dye called crystal (gentian) violet to help distinguish between different types. The gram-staining characteristics of bacteria are denoted as gram-positive or gram-negative, depending upon whether the bacteria take up and retain the crystal violet stain or not.

Hemolysis: The bursting/destruction of red blood cells (hemo = blood; lysis = to separate).

Immunocompromised: People who have weakened immune systems and get infections more often.

Meningitis: Inflammation of the coverings that surround the brain and spinal cord.

Microscope: An instrument that gives an enlarged image of an object or substance that is very small or not visible with the unaided eye.

Microbiology: The study of the characteristic shapes, colors, and structures of microbes. This field is aided by an instrument known as a microscope.

Molecule (MOLL-uh-cyool)**:** A molecule is a group of two or more atoms that stick together. Molecules are so small that nobody can see them, except with a special type of microscope called an electron microscope. Pretty much everything on Earth and other planets is made of molecules, and so is space dust.

Molecular Test: DNA fragments are amplified using the Polymerase Chain Reaction and then sequenced.

Organic: Anything that contains carbon (except carbon dioxide).

Foodborne Illness: Diseases, usually either infectious or toxic in nature, caused by agents that enter the body through the ingestion of food. A disease caused by consuming contaminated food or drink.

Onset (disease onset): The beginning of the disease or condition under study.

Pathogen: A disease-causing organism (such as a bacterium or virus).

Polymerase Chain Reaction: Sometimes called "molecular photocopying," the polymerase chain reaction (PCR) is a fast and inexpensive technique used to amplify, or make many copies of, small segments of DNA.

Precipitation: When solids settle out of a solution.

Reverse CAMP Test: CAMP is an acronym for Christie, Atkins, Munch, Petersen, the discoverers of this phenomenon. This procedure is used to confirm that a bacterial strain is a Group B streptococci by production of a characteristic zone of hemolysis when grown in proximity to *S. aureus* on blood agar.

Rod-Shaped Bacteria: Bacteria that look like sticks or ovals (bacillus).

Selective Culture Media: A type of media that selects for the growth of one type of organism, while inhibiting (preventing) the growth of others.

Spiral-Shaped Bacteria: Bacteria that are shaped like spirals or corkscrews (spirilla).

Stool: Fecal matter, feces, poop.

Toxin: A poisonous substance produced during the metabolism and growth of certain microorganisms and some higher plant and animal species.

Viral Capsid: A protein shell that surrounds the genetic material of a virus.

Zone of Inhibition: The area on an agar plate where growth of a control organism is prevented by an antibiotic placed on the agar surface. If the test organism is susceptible to the antibiotic, it will not grow where the antibiotic is.

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