It was winter break, and Alex was sick in bed. It was the middle of the second week, and he could not stop coughing. It was sometimes hard to breathe. His mom took him to visit the doctor.

The doctor used a stethoscope to listen carefully to Alex's breathing. "It looks like you have pneumonia, Alex," she said. "We'll swab your throat to see what's going on."

"What do you mean? Won't you just give me some antibiotics to get better?"

"Not yet," said Dr. Ali. "Pneumonia is a disease that affects your lungs. It has different causes. Most often, it's caused by a virus or bacteria."

"If you know what I have, why can't I have the medicine now?"

"Antibiotics only kill bacteria. They won't work if you have viral pneumonia. So we'll swab your throat and see what grows."

"That sounds gross. Is there something living in my throat that can grow?" asked Alex.

"Well, bacteria are alive and are made of cells. Antibiotics kill cells by damaging them," replied Dr. Ali. "Unlike bacteria, viruses aren't cells. Antibiotics aren't effective in treating diseases caused by viruses, like the cold, the flu, and some types of pneumonia."

"So why can't I have the antibiotics anyway, just in case I have the kind caused by bacteria? Why do I have to wait?"

"That's a great question, Alex. Over time, people have sometimes overused or incorrectly used antibiotics. Now there are bacteria that cannot easily be killed by antibiotics. To make sure that the medicines we have keep working, we have to use them more carefully. Don't worry—I'll have an answer for you tomorrow. Then we can see if you need antibiotics or not."

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In this unit, you will investigate how scientists first learned about cells and how this led to new understandings on how infectious diseases are spread. You will gather evidence about the structures and functions of cells, including microbial, animal, and plant cells. You will develop models of cells and explain how cells in animals and plants get the matter and energy they need to survive and grow.

1 Disease Outbreak

INVESTIGATION

Different diseases are caused by different factors, such as germs, heredity, or even the environment. **Infectious** (in-FEK-shuss) diseases are caused by other organisms. Some of these diseases are passed directly from one person to another. Sometimes more people in an area get an infectious disease than expected. Doctors call this type of event an outbreak. How quickly can an infectious disease spread among a group of people? What can be done to stop more people from getting sick? In this activity, you will begin to look for a **pattern**—something that happens in a repeated and predictable way—in the spread of a disease.

GUIDING QUESTION

How do scientists figure out the source of an infectious disease outbreak?

MATERIALS

For each group of four students

- 1 graduated cylinder (50-mL)
- 1 set of colored pencils

For each student

- 1 plastic cup (9-ounce)
- paper towels
- graph paper
- 1 Student Sheet 1.1, "Tracking the Disease: Collecting Data"
- 1 Student Sheet 1.2, "Tracking the Disease: Analyzing Data"
- 1 pair of chemical splash goggles

SAFETY

Wear chemical splash goggles while working with the liquids in this activity. Do not touch the liquids or bring them into contact with your nose or mouth. Wash your hands thoroughly if any of the liquids touch your skin and after completing the activity.

PROCEDURE

Part A: Planning Your Day

1. In your group of four, discuss in what ways an infectious disease is spread around a community. Record your ideas in your science notebook.
2. In the table on Student Sheet 1.1, "Tracking the Disease: Collecting Data," fill in the "Place" column by listing the place you will go to on Day 1. Your teacher may assign your first place or let you choose.

Part B: Going Out

Your teacher will guide you through Steps 3–7.

3. Using the graduated cylinder, add 10 mL of water to a clear plastic cup. This liquid will represent the blood and fluids in your healthy body.
4. On Day 1, go to the place you recorded in the table on Student Sheet 1.1.
   a. Roll the number cube, and follow the Action Key below, which tells you which action you will take. Squeeze 2 drops from the bottle labeled for that action into your cup. This represents an action that might expose you to an infectious agent.

Action Key

NUMBER CUBE ROLLS	ACTION
1 or 4	Action 1
2 or 5	Action 2
3 or 6	Action 3

   b. Record the title of the Action in the table on Student Sheet 1.1.
   c. Repeat Steps 4a and 4b two more times.

5. On Day 2, go to your second place, and record the location in the table on Student Sheet 1.1. Repeat Steps 4a–c.
6. On Day 3, go to your third place, and record the location in the table on Student Sheet 1.1. Repeat Steps 4a–c.
7. Did you get sick?
   a. Find out by having your teacher add 2 drops of Disease Indicator to the cup that represents your body. If you have become sick, the solution will change color. If the solution does not change color, you have not become sick.
   b. Record your results.
8. Dispose of your liquid as directed by your teacher.

Part C: Analyzing the Results

9. Where did the disease come from? Look for a pattern by following these steps:
   a. As a class, fill out the totals for each location in the table titled "Analyzing the Locations" on Student Sheet 1.2, "Tracking the Disease: Analyzing Data."
   b. From the data in your table, create a bar graph of the number of infected people at each place. If you need help with graphing, use the Bar Graphing Checklist in Appendix C to help you.
      - Be sure to label your bars and axes, and title your graph.
      - If you like, use different colors or shadings in your graph.
   c. On Student Sheet 1.2, record your ideas about the place where you think infection started.
   d. As a class, fill out the totals for each activity in the tables for "Analyzing the Action" on Student Sheet 1.2.
   e. From the data in the "Analyzing the Action" tables, create a bar graph of infected people who took each action at the place you have hypothesized the infection started.
   f. **Evidence** is factual information or data that support or refute a claim. With your group of four, discuss your ideas about the source of the disease and the evidence that supports your claim. Then discuss your explanation with the class.

ANALYSIS

1. Based on your graph of the class results,
   a. from where did people get the infectious disease? Describe the evidence that supports this claim.
   b. from what action did people get the infectious disease? Describe the evidence that supports this claim.
   c. how certain are you of your answers to a and b? Explain.
2. Imagine that you are the director of the health department in the town where this disease is spreading. It is your job to help prevent people from getting sick with this disease.
   a. Explain what actions you would recommend to try to end the outbreak.
   b. A **trade-off** is an exchange of one outcome for another—giving up something that is a benefit or advantage in exchange for something that may be more desirable. What are the trade-offs of your recommendations?
3. Think about the outbreak of the disease in the community compared with just one person getting sick with the disease. What information can you get from the outbreak that you could not get from one sick person?