1 Disease Outbreak

INVESTIGATION

2–3 CLASS SESSIONS

ACTIVITY OVERVIEW

NGSS CONNECTIONS

Students participate in a model of the spread of an infectious disease. They analyze data from the model to identify patterns, and then use the patterns supported by the data to determine the cause of the spread of the infectious disease. The problem of diagnosing and treating infectious diseases provides a context for the exploration of cell structure and function that follows.

Prepare to teach the unit by reviewing the *Quick Start to Issues and Science*, found at the front of this Teacher Edition. This guide breaks down the resources and equipment needed to teach the unit. It calls out critical planning tools including the *NGSS Overview*, the *Phenomena, Driving Questions, and SEPUP Storyline* overview and the *SEPUP Scoring Guides*. For more detailed information on the program as a whole, see the "Issues and Science Program Overview" section of the *Teacher Resources*.

If this is your **first** SEPUP unit, read through "Planning for First-Time Users," found on the last page of the *Quick Start*.

NGSS CORRELATIONS

Performance Expectations

Working toward MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Disciplinary Core Ideas

MS-LS1.A Structure and Function: All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

Science and Engineering Practices

Analyzing and Interpreting Data:

Construct and interpret graphical displays of data to identify linear and nonlinear relationships.

Analyze and interpret data to provide evidence for phenomena.

Using Mathematics and Computational Thinking: Use mathematical representations to describe and/or support scientific conclusions and design solutions.

Constructing Explanations and Designing Solutions: Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events.

Crosscutting Concepts

Patterns: Patterns can be used to identify cause and effect relationships.

Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Scale, Proportion, and Quantity: Phenomena that can be observed at one scale may not be observable at another scale.

Connections to Nature of Science: Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

Common Core State Standards— ELA/Literacy

RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

INVESTIGATIVE PHENOMENA AND SENSEMAKING

Investigative Phenomena, Sensemaking

Some diseases can be spread from person to person.

Students engage in sensemaking as they bridge any gaps in their knowledge regarding infectious disease. They develop questions that need to be answered before they can fully address the phenomenon presented in the opening vignette. They discuss their current knowledge about disease and disease transmission. They begin to reflect on and make decisions about methods to reduce disease spread.

WHAT STUDENTS DO

Students model the spread of an infectious disease by simulating participation in various activities that could expose them to infectious agents and then use a model disease indicator to find out if they were infected. Based on the results, the class discusses how infectious diseases are spread, laying a foundation for further analysis of the causes and transmission of infectious diseases.

MATERIALS AND ADVANCE PREPARATION

- *For the teacher*

  1 Visual Aid 1.1, "Tracking the Disease: Collecting Data"
  1 Scoring Guide: ANALYZING AND INTERPRETING DATA (AID)
  1 Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T)
  Driving Questions Board cards and instructions

- *For the class*

  15 number cubes
  5 Place signs
  1 set of 15 Event and Action dropper bottles
  2 dropper bottles of Disease Indicator (phenolphthalein solution)
* 1 bucket (or other similar container) to collect liquid waste
* distilled water

- *For each group of four students*

  1 50-mL graduated cylinder
  1 set of colored pencils

- *For each student*

  1 Student Sheet 1.1, "Tracking the Disease: Collecting Data"
  1 Student Sheet 1.2, "Tracking the Disease: Analyzing Data"
  1 Student Sheet 1.3, "Guidelines for Safety in the Science Classroom" (see Safety Note below)
  1 Scoring Guide: ANALYZING AND INTERPRETING DATA (AID) (optional)
  1 Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T) (optional)
  1 9-oz plastic cup
* 1 pair of chemical splash goggles
* graph paper
* paper towels
* 1 lab apron (optional)

* *not included in kit*

The ANALYZING AND INTERPRETING DATA (AID) and EVIDENCE AND TRADE-OFFS (E&T) Scoring Guides can be found in the Assessment tab in the back of this Teacher Edition.

Laminate the five Place signs, if desired, and place them in different locations around the room. Place the dropper bottles for the appropriate "Actions" under each Place sign. Place three number cubes at each station.

Parts A and B should be completed during one class session, and Part C should be completed during the following class session. This will prevent students from one of your classes telling other students the results before they collect their own data.

The Driving Questions Board cards and instructions can be found in the front pouch of your printed Teacher Edition or as a download on the "Tools and Resources" page in your online Teacher Portal.

SAFETY NOTE

Develop a classroom safety plan. Review any safety materials provided by your district. Select the safety contract and guidelines that you will use in this course—either developing your own, using those provided by your district, or using Student Sheet 1.3, "Guidelines for Safety in the Science Classroom." Copy the materials for each student. Students can find "Science Safety Guidelines" in Appendix B: Science Safety in the Student Book.

Make sure that students wear chemical splash goggles and use caution when handling solutions. The chemicals used in this activity are sodium carbonate (in the bottle for Activity 1 Location C) and phenolphthalein pH indicator (the "Disease Indicator"). These chemicals can cause skin irritation. Thoroughly rinse any area that comes into direct contact with laboratory chemicals, and make sure that students wash their hands thoroughly. We recommend the use of lab aprons in this activity.

DISPOSAL

At the end of the activity, direct students to dispose of all solutions in the waste container. It is safe for the solutions in this laboratory—2% sodium carbonate and phenolphthalein solution—to be disposed of by diluting and pouring them down the drain, but it is important to model the proper collection and disposal of liquids, especially those that have not yet been identified by students.

To ensure that "infection" occurs, at least four students must visit the "Picnic at the Lake" place on each simulated day. Monitor their movements to make sure that there are several students at each station each day.

If you have more than one class, consider combining their data or obtaining data from another teacher teaching the same class in order to increase the sample size for the simulation.

TEACHING SUMMARY

GET STARTED

1. (LITERACY) Engage students' interest by introducing the issue used to drive their learning in this unit.
    a. Have students read the vignette that opens the unit.

b. Identify the societal issue that students will explore in the unit: how the study of cell structure and function can be used to treat infectious disease.

c. Begin a Driving Questions Board.

d. (SENSEMAKING) Initiate students' sensemaking by eliciting their ideas about infectious disease.

DO THE ACTIVITY

2. Introduce or review safety in the science classroom.

   a. Distribute the safety contract and guidelines you are using, and review your expectations for classroom safety.

   b. Have students sign and take the safety agreement home for a parent or guardian to read and sign.

3. Students conduct the activity to model an infectious disease outbreak.

   a. Hand out Student Sheet 1.1, "Tracking the Disease: Collecting Data," and explain how students will model the "outbreak" of an infectious disease.

   b. Point out the Place signs around the room, and have student groups decide where they will go on the first day.

   c. Have students continue to move among locations and roll the number cube to determine their three actions.

   d. Let students know where to go for "testing" after visiting three locations.

4. The class analyzes its data to determine the source of the disease.

   a. Display Visual Aid 1.1, "Tracking the Disease: Collecting Data," as you collect and record the class data.

   b. Support students as they construct and discuss a bar graph of the number of infected people at each location.

   c. Discuss students' results by asking, "What patterns do you see in the graphs? What do the patterns tell you about how the infection started?"

   d. Collect the class's data about the Action that was the source of the infection.

   e. Have students create a second bar graph of infected people for each Action taken at the site of the infection (the lake).

   f. Introduce scientific evidence, and have students use evidence to determine the source of the infection.

   g. Distinguish evidence from opinion.

BUILD UNDERSTANDING

5. Introduce crosscutting concepts, and explain how scientists use them to think about the natural world.
    a. Explain that crosscutting concepts bridge disciplines.
    b. Give an example that makes sense for students.
    c. Introduce the crosscutting concept of *patterns*, and relate *patterns* to this activity.
    d. Introduce the crosscutting concept of *cause and effect*.
6. The class discusses and analyzes the model.
    a. (AID ASSESSMENT) If you have not previously done so, introduce the SEPUP Assessment System.
    b. Explain the expectations for student growth over time.
    c. Introduce the concept of trade-offs to prepare students for Analysis item 2.
    d. (E&T QUICK CHECK) Use Analysis item 2 to assess students' understanding of the concept of trade-offs.

TEACHING STEPS

GET STARTED

1. (LITERACY) Engage students' interest by introducing the issue used to drive the learning in this unit.
    a. Have students read the vignette that opens the unit.

Anchoring Phenomenon

The vignette of Alex and Dr. Ali discussing illness is related to the magnified and colorized photo of blood on the front cover of the Student Book. (It is a scanning electron microscope image of different components of blood, including red blood cells, white blood cells, and platelets.) After reading the text, ask students to examine the photo and relate it to the vignette by having students share what they know about disease, disease spread, and the human immune system.

Teacher's Note: Students may want to share their experiences and knowledge of the 2020 global outbreak of COVID-19 (novel coronavirus). This is the first of several places in the unit where this may occur. Note that these conversations may require particular care and sensitivity depending on students' individual experiences.

Anchoring Phenomenon

Ask students to generate any questions they have about the phenomena presented in the vignette. If students are not familiar with the term *phenomenon* (or its plural form, *phenomena*), explain that a phenomenon is an observable fact or event. In this unit, the focus is on investigating

phenomena related to how organisms as different as humans, plants, and many of the microorganisms that make people sick are all made of cells.

b. Identify the societal issue that students will explore in the unit: public health, preventing the spread and the treatment of infectious diseases.

Defining Issues

Have students read the description of what they will investigate in this unit on the bottom of the same page and discuss how the unit may or may not answer the questions they just posed. Explain this issue in broad terms. Let students know that they will look at how infectious disease is spread, and learning about the cellular nature of many disease-causing organisms help scientists treat infectious diseases.

c. Begin a Driving Questions Board.

Driving Questions Board

In SEPUP, the Driving Questions Board elicits students' initial wonderings about the unit issue and the investigative phenomena. Throughout the unit, the class is prompted to revisit the Driving Questions Board. Students may generate and answer questions, such as: How are the cells of various organisms alike? How are they different? How do these similarities and differences relate to the functions of these cells? Ideally, student questions generated at the start of each learning sequence can be condensed through class discussion into a unified driving question. As a scaffold to teachers who are new to this teaching strategy, Driving Questions cards are provided for each learning sequence and can be displayed as the unified driving question.

The driving questions are also identified on the Phenomena, Driving Questions, and SEPUP Storyline overview found in the NGSS and Common Core tab in the back of this Teacher Edition.

d. (SENSEMAKING) Initiate students' sensemaking by eliciting their ideas about infectious disease.

Ask students to think about the causes of five or six diseases, such as cardiovascular disease (which can cause heart attacks), lung cancer, the common cold, diabetes, stomach ulcers, the flu, or COVID-19. If there have been other diseases in the news lately, consider adding them to this list. Use this list of diseases and students' ideas to develop the idea that diseases are caused by several factors, including "germs" (colds, most stomach ulcers), genetic factors (some heart attacks), the environment (some cases of lung cancers), lifestyle (some heart attacks, some cases of Type II diabetes, some cases of lung cancer), or a combination of these causes.

Vocabulary Approach

Introduce the term *infectious* or *infectious diseases* to describe diseases such as colds and the flu. When words are formally defined in an activity, they appear in bold type in the Key Vocabulary list. Encourage students to use these words when talking or writing about science. During discussions,

to see if students are using them correctly. Decide how you will support students' understanding of the vocabulary—perhaps by setting up a word wall in the classroom.

Students are likely to suggest that diseases are caused by bacteria, viruses, and germs. Explain that the germs that cause diseases are often called *infectious agents*. Ask students if they know any more about what these agents are or how they work. Accept students' answers for now, and explain that they will learn more about infectious agents and about how they make people sick during this unit.

Expand the discussion of infectious disease by asking, "In what ways are people exposed to infectious diseases?" Students are likely to focus on the idea that infectious diseases are those that are spread directly from person to person. Ask them if the type of contact—direct vs. indirect—affects whether a disease is considered infectious. Infectious diseases are transmitted by either direct or indirect contact. Some are transmitted only through direct person-to-person skin contact (e.g., impetigo—a bacterial skin disease) or through contact and the exchange of bodily fluids (e.g., AIDS). However, others are transmitted via contaminated food or water or by touching contaminated surfaces. Raise the issue of diseases transmitted by other organisms, such as insect-borne diseases. Ask if students would categorize those as infectious, and tell them that scientists typically do.

DO THE ACTIVITY

2. Introduce or review safety in the science classroom.

   a. Distribute the safety contract and guidelines you are using, and review your expectations for classroom safety.

      Use Student Sheet 1.3, "Guidelines for Safety in the Science Classroom" or a similar form you may already use in your classroom. Explain that students are required to know and understand all classroom expectations for safety. If you have previously introduced these procedures, review them as you think necessary. Students can also find "Science Safety Guidelines" in Appendix B: Science Safety in the Student Book.

      Point out the locations of safety equipment in the classroom, and review when and how to use all safety equipment. Demonstrate how to use emergency safety equipment, including the safety eyewear, eye-and-face wash, fire blanket, and fire extinguisher.

   b. Have students sign and take the safety agreement home for a parent or guardian to read and sign.

      Tell them to return the signed agreements before the date that you plan to conduct the next laboratory activity.

3. Students conduct the activity to model an infectious disease outbreak.

   a. Hand out Student Sheet 1.1, "Tracking the Disease: Collecting Data," and explain how students will model the "outbreak" of an infectious disease.

      Explain that students will go to a variety of locations (around the room) and participate in actions in these locations that may lead to the transmission of infectious agents. Through their investigation, they will collect evidence and form a hypothesis for how disease is spread.

   b. Point out the Place signs around the room, and have students decide where they will go on the first day.

      It is important that students do not travel together as a group to the same three places; some combination of groups should visit all five places. You may wish to assign each student their first place, or encourage students within a group to go to different places on the first day. After they go to that location, they should follow the directions in the Student Book. Depending on their number cube rolls, they may end up participating in one, two, or three different actions, or repeat some actions at each location they visit. Remind them to be sure to select correctly which numbered bottle relates to their roll of the number cube and the directions in the key.

   c. Have students continue to move among locations and roll the number cube to determine their three actions.

      It is usually best to have students choose their own places to visit, but monitor the class to be sure that students are fairly evenly distributed among locations. Also confirm that students are conducting the model and recording their actions correctly. You may wish to let them proceed at their own pace or to turn the classroom lights on and off to signal the "Days" of the simulation and allow them to move to their next chosen location. A Sample Student Response to Student Sheet 1.1 can be found at the end of the activity.

      Teacher's Note: Be sure students understand that based on their three number cube rolls at each place they visit, they might repeat certain actions while missing others. For example, at The Restaurant, they might eat a fish sandwich and get two mosquito bites, while never eating any corn on the cob.

   d. Let students know where to go for "testing" after visiting three locations.

      Tell students where you will be stationed. As students come to you for disease testing, check their Student Sheets to be sure that they visited three locations and recorded their actions. To prevent other classes

from finding out where students became infected, it is best to wait until the next day to begin compiling and analyzing the class's data. If your students tend to misplace their work, collect their Student Sheets, and keep them until the next class session.

4. The class analyzes its data to determine the source of the disease.

   a. Display Visual Aid 1.1, "Tracking the Disease: Collecting Data," as you collect and record the class data.

Science and Engineering Practices

This exercise helps student engage in the science and engineering practice of *analyzing and interpreting data*. There are several ways to collect students' data: Have students stand or raise their hands, use clickers, or use a survey instrument, such as Survey Monkey. The following assumes that you will have students stand. For each location (e.g., Place A, The Restaurant), have students who participated stand as you count them. If they became infected, ask them to remain standing while uninfected students sit. In this way, you can fairly quickly collect the data.

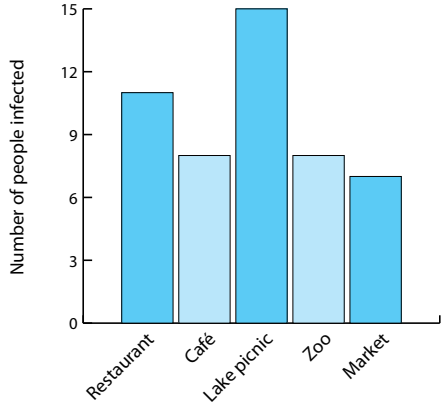
Record the number of students who visited each place and the number of students who were infected at each place. As you project these data to the class, students should also record them on Student Sheet 1.2, "Tracking the Disease: Collecting Data," in the table titled "Analyzing the Locations." Support students as needed to calculate the percentage of infected individuals by dividing the number of people infected by the number of people who visited the site.

Sample results for Student Sheet 1.2 are provided at the end of the activity. This sample assumes that approximately equal numbers of students visited each location.

   b. Support students as they construct and discuss a bar graph of the number of infected people at each location.

In Procedure Step 9b, students create a bar graph of infected people at each location. Use the "Bar Graphing Checklist" in Appendix C of the Student Book, as needed, to help students create their graphs.

PROCEDURE STEP 9b SAMPLE STUDENT RESPONSE



c. Discuss students' results by asking, "What patterns do you see in the graphs? What do the patterns tell you about how the infection started?"

Students should recognize that in the scenario for this activity, the likely source of the infection is the place or places that had the highest number of people infected. If you have time, let students suggest which places to analyze. Unless students made errors when choosing the activity bottle, the Picnic at the Lake is likely to show the highest rate of infection. However, it is statistically possible that another site will have a higher rate than the remaining sites. If time is short, guide students toward analyzing Picnic at the Lake. If they are having trouble determining that the lake was the likely location, have all students who did not become infected stand. Ask them which two places they did not visit. It is likely that most of them did not visit the lake. A few exceptions due to errors in selecting activity bottles are possible.

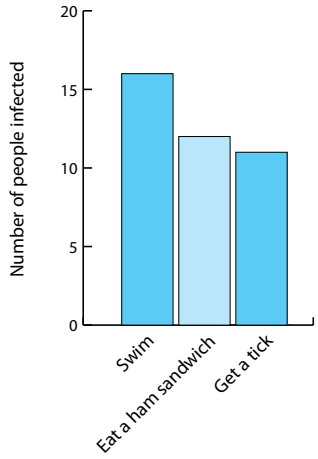
d. Collect the class's data about the Action that was the source of the infection.

Collect students' data about each action similarly to how you collected the data for each location. For each action at a location (e.g., Place A, The Restaurant, Action 1: Eat a fish sandwich), have students who participated stand as you count them. If they became infected, ask them to remain standing while uninfected students sit. In this way, you can fairly quickly collect the data. On Student Sheet 1.2, record the data on the first table for analyzing the actions. If you choose to analyze two places, record the data from the second place on the second table for analyzing the actions. Support students as needed in calculating the percentages for the last columns of their tables by dividing the number of people infected by the number of people who participated in each action.

e. Have students create a second bar graph of infected people for each Action taken at the site of the infection (the lake).

For Procedure Step 9e, students create a graph and analyze these data to determine the action that was the source of the infection. Since the lake is the source, 100% or nearly 100% of students who went swimming should be positive for infection. Note that a few students who went swimming might be negative because they took drops from the wrong bottle (or vice versa). Explain that not everyone exposed to an infectious agent gets the disease. In some cases, the immune system is able to fight the disease before any symptoms develop. It is also possible for an individual who didn't attend the picnic to have become infected in another way, such as touching a surface contaminated by an individual suffering from the disease.

PROCEDURE STEP 9e SAMPLE STUDENT RESPONSE



f. Introduce scientific evidence, and have students use evidence to determine the source of the infection.

In the final step of the Procedure, students discuss what the data they have collected suggests about the source of the disease. Review the definition of *evidence* provided in the Student Book. Explain that scientists collect information (data) with various tools and strategies, including observation and experimentation. Explain that in this activity, students will use the data they collected from the model about who became infected as evidence to make conclusions, or claims, about the source of the disease. The consideration of evidence is a key step in scientific reasoning and decision making.

g. Distinguish evidence from opinion.

Explain that *evidence* is information that supports a claim. In contrast, an *opinion* is a view someone takes about a certain issue based on their

own judgment. An opinion might not be based on evidence. An informed opinion might be based on evidence; however, another person may have a different opinion based on the same evidence. To distinguish evidence from opinion in science, it is helpful to determine if a statement describes information gathered through reliable and appropriate procedures and is likely to be reproducible. The question is: Could someone else gather similar information under similar circumstances? If the answer is yes, the statement is not opinion and is likely evidence.

BUILD UNDERSTANDING

5. Introduce crosscutting concepts, and explain how scientists use them to think about the natural world.

Crosscutting Concepts

   a. Explain that crosscutting concepts bridge disciplines.

      They can be a lens or touchstone through which students make sense of phenomena and deepen their understanding of disciplinary core ideas. Refer students to Appendix G: Crosscutting Concepts in the Student Book, and point out the symbols and definitions provided.

   b. Give an example that makes sense for students.

      For example, in this activity, students used two crosscutting concepts: *patterns* and *cause and effect*. They used patterns in graphed data to look for cause-and-effect relationships between activities and the disease outbreak. Both patterns and cause-and-effect relationships help scientists across disciplines think about their data and how it might explain scientific phenomena.

   c. Introduce the crosscutting concept of *patterns*, and relate *patterns* to this activity.

      Display the definition and symbol used for patterns in Appendix G. Explain that a pattern can be structural, as shown in the diagram, or a pattern in events, such as the phases of the moon or patterns in a disease outbreak. Point out to students that seeing patterns in nature can lead scientists to organize and classify their observations. It can also lead them to ask questions about relationships and the causes of patterns. Students will look for patterns when they analyze and interpret data, ask questions about the patterns they observe, and suggest cause-and-effect relationships to explain patterns.

   d. Introduce the crosscutting concept of *cause and effect*.

      Scientists investigate and try to explain how things work, and try to figure out what causes various events and patterns. Review the symbol for *cause*

and effect in Appendix G—a simple diagram where A (the cause) might or might not cause B (the effect) to happen. In this activity, certain actions might have caused the disease outbreak to happen. That is an example of a simple cause, but sometimes more complex causes or chains of events can cause an effect.

6. The class discusses and analyzes the model.

   a. (AID ASSESSMENT) If you have not previously done so, introduce the SEPUP Assessment System.

SEPUP Assessment System

   Explain that Analysis item 1 is the first assessment in this unit, and you will use it to introduce the SEPUP Assessment System to your students.

   Before assigning the assessment, distribute the analyzing and interpreting data (AID) Scoring Guide and use it to model how the system works. Point out the levels in the first column of the Scoring Guide. Tell students that these levels are the same for all Scoring Guides and range from 0 to 4. Review the descriptions of each level. For example, a Level 4 response is "complete and correct" in all Scoring Guides. Point out that the scores (0–4) are based on the quality of students' responses and do not correspond to letter grades. Allow students to refer to the Scoring Guide as they prepare their answers. Be sure they understand that the Scoring Guides do not include the specific content that students must provide in their responses, but instead explain the overall expectations for responses at various levels of performance on the task.

   b. Explain the expectations for student growth over time.

   Explain to students that they aren't expected to always produce complete and correct work on their first attempts. Instead, they should work toward developing consistent Level 3 and Level 4 answers as they become more proficient with the concepts (both disciplinary core ideas and crosscutting concepts) and the science and engineering practices being assessed. It is not necessary (or even expected) that an "A" student will always write Level 4 responses, especially at the beginning of the course or when they are introduced to a new Scoring Guide.

   c. Introduce the concept of trade-offs to prepare students for Analysis item 2.

   One goal of this curriculum is to teach students that decisions often involve trade-offs and that identifying trade-offs involves analyzing evidence. *Evidence* is information that supports or refutes a claim.

Evidence and Trade-Offs

In this activity, students review the trade-offs involved in preventing the spread of the disease they modeled. In a decision involving trade-offs, something is given up to gain something else. Since many decisions involve trade-offs, students should understand that a perfect choice is often not possible. It is possible, however, to recognize and analyze the trade-offs associated with each decision. For example, when asked, "Paper or plastic?" at a store checkout counter, most shoppers make the choice quickly. But there are several trade-offs attached to choosing paper or plastic. A shopper who chooses paper over plastic may do so to avoid generating plastic waste. In requesting the paper bag, though, they are contributing to other environmental problems, such as increased water and energy use, and the higher amounts of solid waste and CO_2 emissions associated with making paper bags. Neither choice is particularly beneficial for the environment, and both choices have a downside. Identifying the trade-offs helps clarify the reasoning that is being applied to make a decision.

To further explore trade-offs, brainstorm with the class a list of decisions they make every day that involve trade-offs. Choose one and talk through the associated trade-offs of deciding one way or another. This practice will familiarize students with ways to identify and consider trade-offs in this and subsequent activities.

Quick Checks

d. (E&T QUICK CHECK) Use Analysis item 2 to assess students' understanding of the concept of trade-offs.

Analysis item 2 can be used as a formative assessment and a Quick Check to gauge students' understanding of trade-offs.

STRATEGIES FOR TEACHING DIVERSE LEARNERS

Below are suggestions for differentiating instruction and assessment in this activity for diverse learners in your classroom:

Differentiated Instruction

- Students with learning disabilities: Work as a class to analyze the data. Guide students to develop a hypothesis about how the disease was spread, and clearly describe how the data does or does not support a particular hypothesis.
- English learners: Introduce a class word wall for the FROM CELLS TO ORGANISMS unit as a visual reminder of the new key scientific terms and to make words easily accessible. Begin constructing it for this activity with the words *evidence*, *infectious*, *pattern*, and *trade-offs*, and continue to add terms throughout the unit. Consider adding an explanatory picture or diagram for some (or all) of the terms. Have students enter the words and their definitions

in the glossary in their science notebooks or in their personal vocabulary logs. One version of a personal vocabulary log is shown here:

Vocabulary Log

Vocabulary Log

Word *infectious*

It is related to *disease that spreads from person to person.*

The context in which I first encountered the word or phrase *is in the news when they were talking about coronavirus.*

I first thought it meant *a disease that would cause death.*

The correct definition is *a disease that is caused by an organism and can be spread from one organism to another.*

It reminds me of *contagious.*

Here is on way to use the word in a sentence *The flu is infectious but heart attacks are not.*

- Academically gifted students: Have students compare the model of disease spread in this activity with real-life cases of infectious disease spread, using their personal knowledge and/or what they learn from online research.

These icons, ● ● ●, indicate opportunities to formatively assess students' proficiency with the three dimensions: ● = SEP, ● = DCI, ● = CCC.

SAMPLE RESPONSES TO ANALYSIS

●● 1. (AID ASSESSMENT) Use your graph of the class results to answer the following questions.

a. Where did people get the infectious disease? Describe the evidence that supports this claim.

Students' responses will likely vary, depending on how well they separated from one another to visit the five places. Sample responses are shown below.

SAMPLE LEVEL 4 RESPONSE

People got the disease at the Picnic at the Lake. The evidence is that a large percentage of students who visited there became ill. You can see the data in the graph we made.

b. From what action did people get the infectious disease? Describe the evidence that supports this claim.

SAMPLE LEVEL 4 RESPONSE

People got the disease from exposure to water at the lake. The graphs we made provide the evidence. Most, if not all, students who swam at the lake became infected, and people who did not swim at the lake did not become infected.

c. How certain are you of your answers to a and b? Explain.

Students' responses will likely vary, depending on the class data. A sample response is shown here:

The high percentage of infections for those who swam compared with participation in other activities makes me pretty sure that it was from swimming at the lake.

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.

I would recommend that people stay away from the lake. I would put up warning signs around the lake. I would publicize this problem through the Internet, newspapers, and radio stations and suggest that anyone who has recently visited the lake seek medical attention if they become sick.

b. (E&T QUICK CHECK) A **trade-off** a desirable outcome given up to gain another desirable outcome. What are the trade-offs of your recommendations?

The trade-off is that people cannot use the lake for swimming or picnicking, and so a recreational area has been taken away from everyone. Swimming is good exercise, and people might not have another place to swim. Publicizing this problem may help people get treatment faster, but it might keep people from using the lake even after the outbreak ends.

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?

An outbreak can provide evidence of the location and type of action that resulted in the spread of the disease. Scientists can identify general symptoms and track the progress of the infection over time. This is because there are more data from lots of people over time than if there is only one infected person.

4. How well did this activity model the spread of an infectious disease? Share your ideas with the class.

This activity modeled the spread of the disease from a single source (the lake), but did not model the spread of disease from person to person. It also modeled the way that not everyone exposed to a disease gets sick (not everyone at the lake was infected). The activity did have everyone participating in different activities, but I think it would be much harder to identify the source of infection in real life because people do a lot more things.

5. a. How might knowing more about the cause of a disease help stop its spread?

Knowing what causes the disease can help doctors treat it. Knowing the cause can also result in strategies to reduce its spread (if it's an infectious disease).

b. What questions do you have about the causes of an infectious disease and how it spreads?

Students' responses will likely vary. A sample response is shown here:

Why do some diseases spread more easily than others? Why do some diseases cause death in some people and not others? Why does it matter what caused a disease? Why does it take so long to develop vaccines and other treatments?

REVISIT THE GUIDING QUESTION

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

Students gathered and analyzed data on an infectious disease outbreak to determine its likely source. This activity modeled one process by which scientists collect and analyze data to determine the spread of an infection.

ACTIVITY RESOURCES

KEY VOCABULARY

evidence

infectious

outbreak

pattern

trade-offs

BACKGROUND INFORMATION

SPREAD OF INFECTIOUS DISEASES

Statistics compiled from large closed populations (which have no interactions with other populations) during an epidemic of an infectious disease show a bell-shaped curve of the number of infected people over time. Epidemics initially spread slowly; they accelerate as more and more people become infected. This results in an exponential increase in infections until almost all susceptible people in a population have contracted the disease. This activity models only what would

in a population have contracted the disease. This activity models only what would happen up to this point in the spread of an infectious disease and does not simulate recovery. In a closed population, the rate of new cases declines once all people have been exposed.

The speed with which an infectious disease spreads will be affected by the infectiousness of the disease, the density and frequency of susceptible people, and the behavior of the susceptible people. The height of the plateau will be affected by how many susceptible people there are. The number of susceptible people is related to the number who have not been vaccinated or have not been exposed to the infectious disease before (e.g., when a new disease enters a population or when many individuals have been born since the last epidemic of the disease).

Name_____ Date_____

STUDENT SHEET 1.1

TRACKING THE DISEASE: COLLECTING DATA

A. The Restaurant
B. The Cafe
C. Picnic at the Lake
D. The Zoo
E. The Market (convenience store)

Day	Place (where I went)	Action (what I did)
Day 1		**1.**
		2.
		3.
Day 2		**1.**
		2.
		3.
Day 3		**1.**
		2.
		3.

Do you have the disease? _____

Name_____ Date_____

STUDENT SHEET 1.2

TRACKING THE DISEASE: ANALYZING DATA

Analyzing the Locations

Place	Number of people who visited	Number of people who became infected*	Percentage of people visiting who became infected
A. Restaurant			
B. Cafe			
C. Picnic at the Lake			
D. Zoo			
E. Market			

Based on the data above, which place(s) do you think were most likely to be the source of the infection?_____

Use the tables below to analyze the most likely place(s) to find out what action caused the disease.

Analyzing the action at: _____

Action	Action name	Number of people who did the action	Number of people who became infected*	Percentage of people participating who became infected
1				
2				
3				

Analyzing the action at: _____

Action	Action name	Number of people who did the action	Number of people who became infected*	Percentage of people participating who became infected
1				
2				
3				

* Use these columns of data for your bar graphs.

Name_____ Date_____

STUDENT SHEET 1.3

GUIDELINES FOR SAFETY IN THE SCIENCE CLASSROOM

Before the Investigation

- Listen carefully to your teacher's instructions, and follow any steps recommended when preparing for the activity.
- Use only those materials or chemicals needed for the investigation.
- Know the location of emergency equipment, such as a fire extinguisher, fire blanket, and eyewash station.
- Tie back or remove dangling or bulky items, such as long hair, jewelry, sleeves, jackets, and bags. Do not wear open-toed shoes in the science lab.
- Tell your teacher if you wear contact lenses, or have allergies, injuries, or any medical conditions that may affect your ability to perform the lab safely.
- Make sure both the work surface and floor in your work area are clear of books, backpacks, purses, or any other unnecessary materials.

During the Investigation

- Follow all written and spoken instructions.
- Read the activity procedure carefully.
- Don't eat, drink, chew gum, or apply cosmetics in the lab area.
- Wear chemical splash goggles when using chemicals.
- Do not wear contact lenses when using chemicals. If your doctor says you must wear them, notify your teacher before conducting any activity that involves chemicals.
- Read all labels on chemical bottles, and be sure you are using the correct chemical.
- Keep all chemical containers closed when not in use.
- Do not touch, taste, or smell any chemical unless you are instructed to do so by your teacher.
- Mix chemicals only as directed.
- Use caution when working with hot plates, hot liquids, and electrical equipment.
- Follow all directions when working with live organisms or microbial cultures.
- Be mature and cautious, and don't engage in horseplay.
- Report any accidents to your teacher immediately.
- Not sure what to do? Ask!

After the Investigation

- Dispose of all materials as instructed by your teacher.
- Clean up your work area, wash out trays, replace bottle caps securely, and follow any special instructions.
- Return equipment to its proper place.

I, _____, have read the Guidelines for Safety and have discussed them in my classroom. I agree to follow all these rules during science investigations.

_____ _____
Student Signature Date

_____ _____
Parent/Guardian Signature Date

In case of accident or emergency, contact:

_____ (_____)_____
Name Phone Number

_____ (_____)_____
Name Phone Number

Please list any known allergies or health problems: _____

_____

Name *Sample student response* Date

STUDENT SHEET 1.1

TRACKING THE DISEASE: COLLECTING DATA

A. The Restaurant
B. The Cafe
C. Picnic at the Lake
D. The Zoo
E. The Market (convenience store)

Day	Place (where I went)	Action (what I did)
Day 1	*Zoo*	**1.** *Petted a goat*
		2. *Ate a hot dog*
		3. *Ate ice cream*
Day 2	*Restaurant*	**1.** *Ate corn on the cob*
		2. *Got a mosquito bite*
		3. *Got a mosquito bite*
Day 3	*Picnic at the Lake*	**1.** *Swam in the lake*
		2. *Ate a sandwich*
		3. *Swam in the lake*

Do you have the disease? *Yes*

Name *Sample student response* Date

STUDENT SHEET 1.2

TRACKING THE DISEASE: ANALYZING DATA

Analyzing the Locations

Place	Number of people who visited	Number of people who became infected*	Percentage of people visiting who became infected
A. Restaurant	*19*	*11*	*58*
B. Cafe	*20*	*8*	*40*
C. Picnic at the Lake	*21*	*15*	*71*
D. Zoo	*19*	*8*	*42*
E. Market	*17*	*7*	*41*

Based on the data above, which place(s) do you think were most likely to be the source of the infection? *Lake picnic*

Use the tables below to analyze the most likely place(s) to find out what action caused the disease.

Analyzing the action at: *Lake picnic*

Action	Action name	Number of people who did the action	Number of people who became infected*	Percentage of people participating who became infected
1	*Swim*	*17*	*16*	*94*
2	*Eat a ham sandwich*	*18*	*12*	*67*
3	*Get a tick*	*16*	*11*	*68*

Analyzing the action at: *Lake picnic*

Action	Action name	Number of people who did the action	Number of people who became infected*	Percentage of people participating who became infected
1	*Eat a fish sandwich*	*14*	*6*	*42*
2	*Get a mosquito bite*	*10*	*5*	*50*
3	*Eat corn*	*13*	*8*	*62*

* Use these columns of data for your bar graphs.

VISUAL AID 1.1

TRACKING THE DISEASE: COLLECTING DATA

A. The Restaurant
B. The Cafe
C. Picnic at the Lake
D. The Zoo
E. The Market (convenience store)

Day	Place (where I went)	Action (what I did)
Day 1		**1.**
		2.
		3.
Day 2		**1.**
		2.
		3.
Day 3		**1.**
		2.
		3.

Do you have the disease? _____