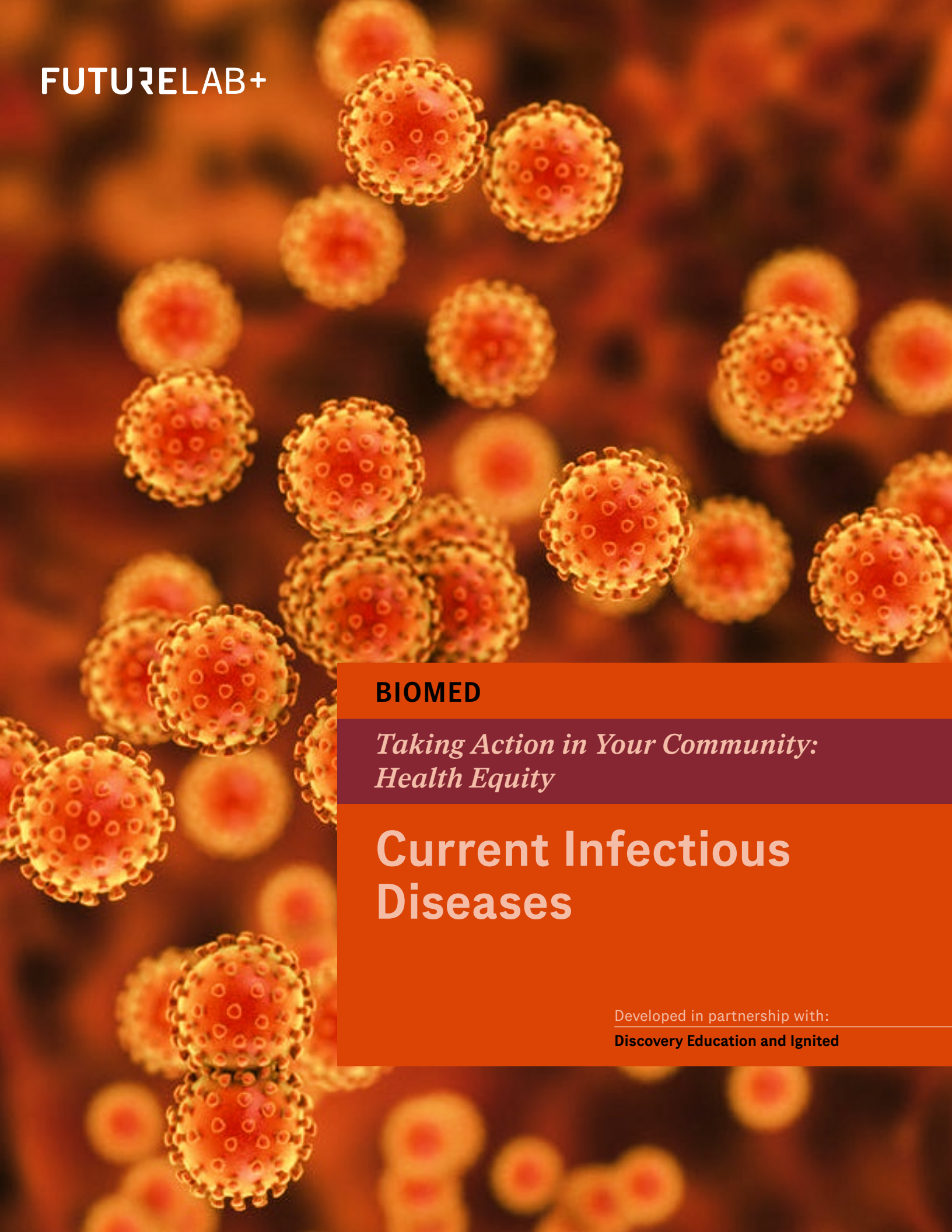
FUTURELAB+



BIOMED

Taking Action in Your Community: Health Equity

Current Infectious Diseases

Developed in partnership with:

Discovery Education and Ignited

In this Lesson Plan:

Print the **Teacher Section** →

Print the **Student Section** →

This document is separated into two sections, For Teachers [T] *and* Student Resources [S]*, which can be printed independently.*

Select the appropriate printer icon above to print either section in its entirety.

Follow the tips below in the Range field of your Print panel to print single pages or page ranges:

Single Pages (use a comma): T3, T6

Page Range (use a hyphen): T3–T6

Cover Image
This is an illustration of coronavirus particles.

BIOMED / TAKING ACTION IN YOUR COMMUNITY: HEALTH EQUITY

Current Infectious Diseases

DRIVING QUESTION

What type of infectious diseases are likely to cause a pandemic?

OVERVIEW

Infectious diseases are disorders caused by pathogens (disease-causing microorganisms) such as viruses, bacteria, fungi, parasites, and prions. These diseases may be passed from person to person or transmitted from animals to humans. Other infectious diseases are caused by consuming contaminated food or water.

In this lesson, students will identify and describe various infectious diseases and assess the impact of infectious diseases on human populations. They will then recommend preventive measures against risk factors of infectious diseases. Students will discover that although infectious diseases can be prevented by vaccines and antibiotics, humankind remains significantly vulnerable to a wide variety of pathogens that cause highly virulent and deadly diseases.

ACTIVITY DURATION

Five class sessions
(45 minutes each)

ESSENTIAL QUESTIONS

What are some of the most prevalent infectious diseases in society?

How have risk behaviors for infectious diseases changed over the years?

What effect has technology had on altering risk behaviors associated with infectious diseases?

OBJECTIVES

Students will be able to:

Identify and describe various infectious diseases.

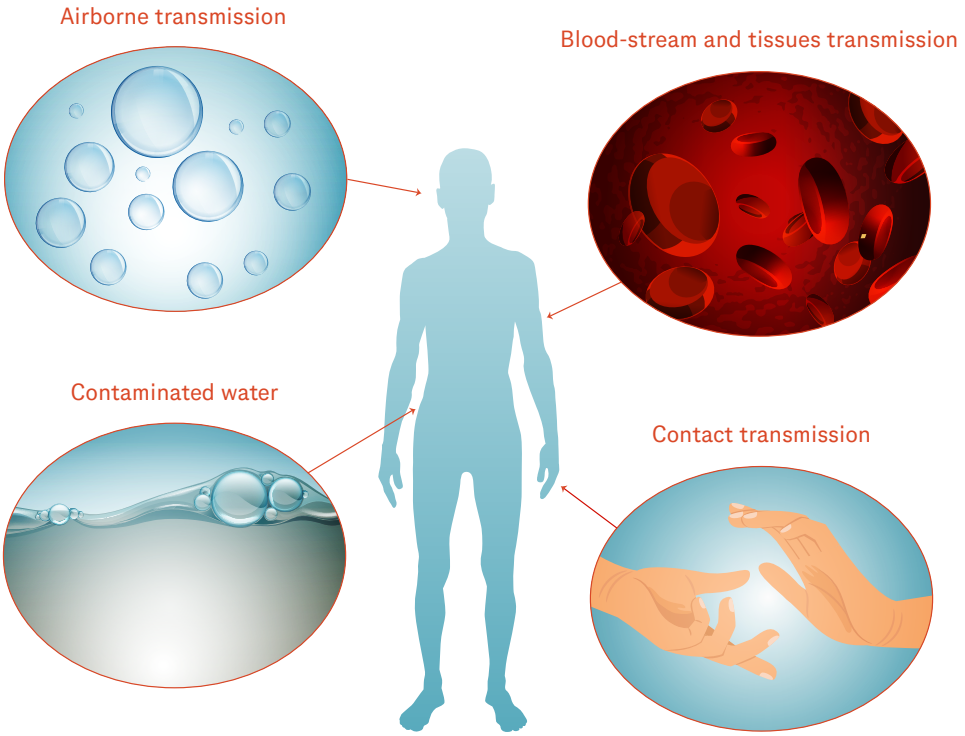
Assess the impact of infectious diseases on human populations.

Recommend preventive measures against risk factors of infectious diseases.

BACKGROUND INFORMATION

Infectious diseases have been responsible for hundreds of millions of deaths in the human population throughout history. Modern medicine and therapeutics have made the diagnosis and treatment of infectious diseases more effective. However, they still pose a dangerous threat to human life, especially when it is easily transmittable from one person to another. Signs, symptoms, diagnosis, and treatment of infectious diseases vary based on the pathogen and the host. Hosts at higher risk are more susceptible to severe illness.

Human Pathogen Transmission



Materials
Computers with Internet Access
Student Infectious Disease Self-Survey
Infectious Disease PowerPoint Presentation Rubric
Infectious Disease Oral Presentation Rubric
Multiplying Microbes Data Sheet
Introduction to Inequity in Healthcare Jigsaw Capture Sheet
Community Profiles
Markers
Notecards
Poster Board
Writing Tools
Design Journal

For Disease Transmission Lab

Pre-Lab

— *Filter paper or coffee filters*
— *Scissors*
— *Paperclips or small envelopes*
— *Baking soda*
— *Water*
— *Measuring cup*
— *Red cabbage*
— *Pot*
— *Kitchen knife*
— *Jars or test tubes or paper cups*

During lab/class

— *Distribution Data Record and Question Capture Sheet*
— *Strips of paper*
— *Pen or pencil*
— *Indicator solution (Note: red cabbage juice may stain clothing)*

Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

It is reasonable to presume that some students or members of their family are or have been directly affected by an infectious disease. In this lesson, students take a self-survey concerning their exposure to infectious diseases. Students will then choose an infectious disease to research further, which will allow them to make socially aware or emotionally relevant connections. In addition, this lesson demonstrates how easy it is for infectious diseases to be transmitted from person to person, which may assist students in their social management for themselves and their families by taking greater safety precautions in real life. Students will be given the option of creating aliases in order to keep anonymity.

COMPUTATIONAL THINKING PRACTICES

In this lesson, students use the computational thinking practices of collecting and analyzing data in many different ways. First, students conduct a self-survey as a way to collect data on what they currently know about infectious diseases. Next, students develop a PowerPoint about infectious diseases as a way to condense data into a form that is easy to analyze. Then, in the "Multiplying Microbes" activity, students analyze data about bacteria reproduction rates in order to make predictions about how environmental conditions impact bacterial growth. Finally, students participate in a classroom activity that demonstrates how diseases spread and they use the computational thinking practices of collecting and analyzing data in order to find patterns in the transmission of the disease.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

The class discussion at the beginning of this lesson centers around the prevalence of infectious diseases in society and how some communities are hit harder than others. Those discussions should lead to students relaying similar information in their infectious disease presentation. Students will communicate how the preventive actions for their chosen disease relate to people of various ethnicities and socioeconomic backgrounds. This lesson provides opportunities for culturally responsive instructional strategies that focus on allowing students to *codeswitch* and bridge the academic content to their real life experience.

ADVANCING INCLUSIVE RESEARCH

Infectious diseases impact people in different ways, depending on a myriad of factors. In the case of COVID-19, the disease appears to impact children and young adults less severely than older adults. In order to understand how infectious diseases impact children and young adults, it is essential to include a wide range of age groups in clinical trials for disease therapies.

CONNECTION TO THE PRODUCT LIFE CYCLE

New infectious diseases may arise as the result of a "crossover event" between humans and animals. Research is ongoing whether COVID-19 is one such example. When new diseases appear, the first thing scientists and pharmaceutical manufacturers must do is conduct research. This process of learning more is a hallmark of the **discovery** phase of the product life cycle.

Have you ever wondered…

How are infectious diseases diagnosed?

Infectious diseases are diagnosed using various laboratory tests. Fluid samples such as blood, urine, stool, and mucus are examined to give information on disease diagnosis.

How can infectious diseases be prevented?

Preventive measures include maintaining hygiene by washing or sanitizing hands: before and after preparing food, before eating, and after using the bathroom. Disinfection of possibly contaminated surfaces and avoiding consumption of contaminated food and water are effective prevention measures as well. Other prevention methods include vaccinations, staying home when ill, not sharing personal items, practicing safe sex, and preparing food safely.

MAKE CONNECTIONS!

How does this connect to the larger unit storyline?

Infectious diseases are the causes of epidemics as well as pandemics.

Knowing how these diseases develop and spread among populations is crucial in understanding the steps needed to prevent them. This knowledge can also mitigate the effects of present and future epidemics, saving precious lives in the process.

How does this connect to careers?

Infectious disease epidemiologists specialize in the study of the source, transmission, and spread of infectious diseases, such as Influenza, COVID-19, and AIDS. They often work with doctors such as pathologists as well as research scientists and public health professionals to ascertain the root causes of these diseases, as well as their effects on public health.

Zoologists and ***wildlife biologists*** study the origins, health, and behavior of animals. Zoologists may study diseases that affect animal populations and may be consulted when there is a "crossover event," or a disease that jumps between species. Zoologists may also study the effects of climate change on animals.

Healthcare marketers develop marketing plans for care centers such as hospitals and nursing homes. They create advertisements, plan events, foster relationships with media outlets, and work closely with providers and patients to share their stories.

How does this connect to our world?

The advent of newer and more effective technological and scientific advancements has helped increase the survival of people with infectious diseases.

People are so closely interconnected that it can take only 36 hours for a pathogen to travel from a remote portion of our world to a major city. It is important to know the risks and how to help prevent possible future pandemics.

Day 1

LEARNING OUTCOMES

Students will be able to:

Identify and **describe** the characteristics of infectious disease.

Compare chronic diseases to acute and infectious diseases.

Prepare a PowerPoint presentation on infectious diseases.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

By learning about health disparities, students explore how social constructs like race and class harm some groups more than others. They will have opportunities to express their own cultural views and use their own language and background.

SOCIAL-EMOTIONAL LEARNING

Discussions around topics like infectious diseases can be challenging for students who have seen their impacts first-hand. By using tools like anonymous surveys and carefully facilitated discussions, students may feel more comfortable and safe to share their experiences.

Procedure

Teacher Note > *Inform students that at the end of this unit, they will write, produce, and record their own film on the subject of infectious diseases. This will be an excellent opportunity to shed light on the inequities of distribution and severity of infectious diseases in both communities of color and poor rural communities.*

Whole Group (25 minutes)	
1	Distribute the *Infectious Disease Self-Survey* as an exercise in self-regulation and self-knowledge on thoughts and practices that may measure students' probability for acquiring an infectious agent.
2	Introduce the class to infectious diseases by playing the video *What You Need To Know About Infectious Diseases* (either on a classroom widescreen or on individual student laptops).
3	Have students discuss the prevalence of infectious diseases in society using the *Give One, Get One* strategy. Brainstorm which sections of the video are relevant to the COVID-19 pandemic and how the sections are relevant.

Teacher Note > *The video runs approximately seven minutes and discusses the various classes of disease-causing organisms that are present within us and in our environment. It discusses how microbes inhabit diverse and extreme ecological niches on the planet. The video touches upon the fact that infectious diseases cause one-fifth of the global deaths annually, and that, currently, influenza remains one of the largest causes of infectious disease-related deaths. Infectious diseases could be transmitted from animals to humans, either directly or through vectors, and thus has the potential to spread far beyond its geographical place of origin. Good hygiene practices for the prevention of infectious diseases, such as influenza, and treatment options, such as antibiotics, are also discussed in the video.*

Teacher Note > *Some students might feel uncomfortable with the discussion of infectious diseases if they themselves had been severely sick from one or if they know a family member who has had one. There is also, often, a cultural hesitance in discussing personal matters in public. The Infectious Disease Survey can be an anonymous survey that will help to make students feel more comfortable sharing.*

Continues next page >

Day 1

Continued

Procedure

Small Group (20 minutes)

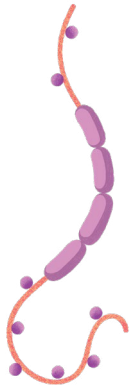
1 In small groups, have students produce a short Infectious Disease PowerPoint presentation. Students should obtain information by gathering, reading, and evaluating scientific and technical information from multiple authoritative sources. Students should also assess the evidence and usefulness of each source as they note each reference. They should include the following in their presentations:

- **a.** Description of what infectious diseases are
- **b.** Statistics about infectious diseases in the United States and in their own state
- **c.** Common care and treatment options for someone diagnosed with an infectious disease
- **d.** Appropriate images of infectious agents and diseases (could be symptoms or risk factors that can lead to chronic diseases)
- **e.** Any applicable video footage that discusses infectious diseases

2 Invite groups to summarize new learning by using the sentence starter: The most important thing I learned today is ___. Three other important ideas from my research are ___, ___, and ___.

COMPUTATIONAL THINKING IN ACTION

This self-survey is a way to practice the computational thinking strategy of collecting data. Data can take many different forms, and quantifying what students know about a subject before beginning a lesson is a powerful way to analyze how much they learn at the end.



Day 2

LEARNING OUTCOMES

Students will be able to:

Research a specific infectious disease.

Design and **present** an oral presentation on that particular infectious disease.

INDUSTRY & CAREER CONNECTION

In this activity, students use the soft skills of communicating effectively, problem solving, troubleshooting, and being detail-oriented. They will also need to stay on task and manage their time wisely since they will be working together in groups.

COMPUTATIONAL THINKING IN ACTION

Here, students are using the computational thinking strategy of collecting data to conduct web research on facts about infectious diseases. A key aspect of this strategy is knowing what quality data looks like, and where to find it. In this activity, students must glean their infectious disease facts from reputable sources.

SOCIAL-EMOTIONAL LEARNING

Assessments that include peer feedback are helpful ways to aid students in establishing the soft skills of effective communication and empathy.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Student presentations encourage forms of expression that are culturally and linguistically diverse. They can also be used to practice codeswitching to more standard English for academic discourse.

Procedure

Individual (10 minutes)

Have students write a five-minute paragraph on what they think an infectious disease specialist does. Allow students to take another five minutes to write any questions they have about infectious disease specialists.

Small Group (35 minutes)

1. Place students in small groups of three or four. Ask students to choose one of the following infectious diseases (no two groups should have the same disease)—coronaviruses, Dengue Fever, *E. coli*, hepatitis, malaria, meningococcal disease, mononucleosis, norovirus, pneumonia, salmonella, shingles, tuberculosis, typhoid fever, or Zika fever.

2. Using web sources, have groups conduct research on their specific disease. The research must include the following information: disease description and details, the pathogen that causes the disease if applicable, risk factors and causes, genetic or hereditary information if applicable, treatment(s), socio-cultural details, physical environment, complications, symptoms, morbidity, mortality, possible preventive measures, and the actions and responsibilities of an infectious disease specialist when treating individual patients as well as outbreaks.

Teacher Note > *This is a productive point at which to collaborate with your school librarian, if you have one.*

3. Groups may create an audiovisual aid to enhance the Infectious Disease Oral presentation, if desired. Be sure they apply the *I.B.I.* test: Interesting But Irrelevant. Any item of information included must pass this test: students must be satisfied that it is not merely interesting but relevant. This presentation can be used as a way to encourage forms of expression that are culturally and linguistically diverse. It can also be used to practice *codeswitching* to more standard English for academic discourse.

4. Set aside time for groups to give an oral presentation of their infectious disease findings to the class. The class should provide peer feedback based on the *Infectious Disease Oral Presentation Rubric*.

5. Distribute the *Design Journal* for students to use throughout the unit. They will refer back to this journal during each lesson and use guiding questions to reflect on the learning objectives related to their culminating social awareness campaign project. Invite students to use their journal to identify infectious diseases, explain preventive measures, and summarize barriers to prevention.

Day 3

LEARNING OUTCOMES

Students will be able to:

Calculate and **graph** the growth of bacteria under various environmental conditions.

Analyze the role of the environment in the spread of disease.

Describe factors that can slow or hasten the growth of bacteria.

COMPUTATIONAL THINKING IN ACTION

As they use the computational thinking strategy of analyzing data to chart the replicating microbes, students are seeing how environmental factors impact the spread of these disease-causing pathogens.

Procedure

Whole Group (5 minutes)

1 Display the time-lapse video *Cell division of E.coli with continuous media flow*.

2 Ask the class to softly *shout out* their estimate of the *E.coli* bacteria reproduction rate. How many bacteria would they guess are present after four hours?

Teacher Note > *The video is just a few seconds so you may have to replay a few times. Students may ask for the amount of time captured in the video to make an educated guess.*

Small Group (40 minutes)

1 Inform students that they are going to calculate how many bacteria exist after four hours, starting with just two bacteria.

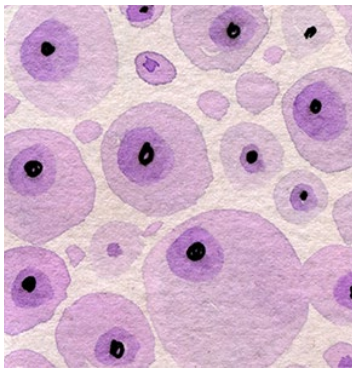
2 Hand out the *Multiplying Microbes Data Sheet*. Students will analyze the data and calculate how many bacteria would be present after four hours under normal growth conditions. Tell students to assume that *E.coli* divides every 15 minutes. A completed chart should look similar to the example below:

Minutes	Number of *E. coli*	Minutes	Number of *E. coli*
0:15	4	2:15	1,024
0:30	8	2:30	2,048
0:45	16	2:45	4,096
1:00 hr	32	3:00	8,192
1:15	64	3:15	16,384
1:30	128	3:30	32,768
1:45	256	3:45	65,536
2:00	512	4:00	131,072

Continues next page >

Day 3

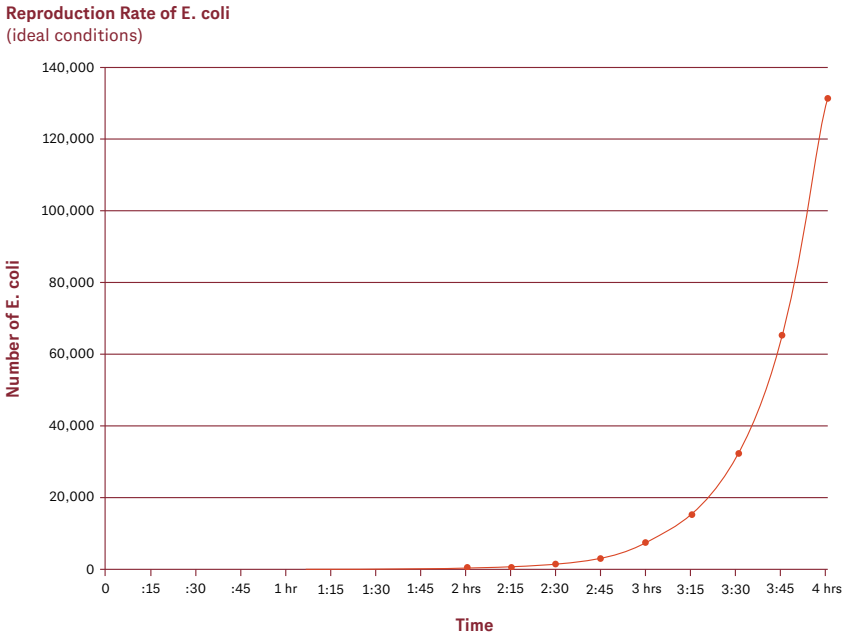
Continued



Procedure

3 Check student calculations.

4 Once calculations are finished, have students create a graph showing their findings. Graphs should be similar to the example below:



5 Ask students: Why haven't bacteria taken over the world? Lead a brief discussion on their answers.

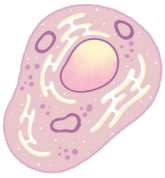
Answer: Student should mention that conditions in the real world are seldom perfect for optimal bacterial growth. Bacteriologists create environments for bacteria to thrive (temperature, nutrients, etc.).

Continues next page >

Day 3

Continued

Procedure



6 Students will now simulate bacteria grown under less-than-ideal conditions. Tell students to assume there was a drop in temperature and bacteria reproduce every 45 minutes instead of 15 minutes. Students will reproduce the earlier chart with the new division rates. How many bacteria would be present after three hours? How many bacteria would be present after nine hours?

Minutes	Number of *E. coli*	Minutes	Number of *E. coli*
0:45	4	5:15	256
1:30	8	6:00	512
2:15	16	6:45	1,024
3:00 hr	32	7:30	2,048
3:45	64	8:15	4,096
4:30	128	9:00	8,192

Answer: After nine hours there are 8,192 bacteria present.

7 Students will graph these new figures of bacteria numbers considering a 45-minute division rate and summarize learning using the questions provided in their handout.

Day 4

LEARNING OUTCOMES

Students will be able to:

Simulate the spread of an infectious disease.

Apply understanding of infectious disease transmission and prevention to health problems relevant to their own communities.

Deduce factors essential in the prevention of infectious disease transmission.

INDUSTRY AND CAREER CONNECTION

In this activity, students will be tasked with using the soft skills of written and oral communication, problem solving, and paying attention to details. These skills, along with the abilities to be organized and take good notes, are an important part of an infectious disease specialist's everyday work.

Procedure

Teacher Note > *This lesson will highlight the method of disease transmission.*

Teacher Note: Prepare in Advance

Preparing Paper Strips

a. Cut up enough filter paper into strips approximately 1 inch by 3 inches so that each student gets five strips of paper. (Coffee filters purchased at the grocery store work fine as the filter paper.)

b. Group five strips together using a paperclip, small envelope, or some other method.

c. Randomly select one group of five strips and dip them into the saturated baking soda solution (directions below) for a few seconds. (The student who gets these strips will be "infected" and the agent of transmission.) For a large class (over 25), you may want to have more than one student receive the "infected strips."

d. Allow the wet strips to dry on a clean surface for about an hour.

e. Regroup the five "infected" strips and assemble in the same way as you did the other packets of five strips so that all the groups of five look alike.

f. If you want to know ahead of time which student picks the infected group of strips, then you can personally pass out the strips, taking note of who gets the "infected" packet.

Saturated baking soda solution for "infected" strips

a. Add two to three tablespoons of baking soda to one cup of water.

b. Stir until baking soda dissolves.

c. Keep adding baking soda until it does not fully dissolve and collects at the bottom of the cup. At that point the solution is saturated. Now dip five strips into the solution for a few seconds.

Continues next page >

Day 4

Continued

Procedure

Red cabbage pH indicator

a. Cut a head of red cabbage in half. Cut the cabbage halves into small pieces with a kitchen knife.

b. Place shredded cabbage into a large pot with water and bring to boil for about 30 minutes.

c. Drain off cabbage and allow the cabbage juice to cool. (The red cabbage solution can be refrigerated and stored for up to three weeks.)

d. On the day of the simulation, place the cabbage juice in a jar in a central location to serve as the "microbe testing station." Alternatively, you can pour small amounts of the cabbage juice into plastic test tubes or paper cups, so that student groups have their own testing station.

Materials and Equipment
Pre-lab

- Filter paper or coffee filters
- Scissors
- Paperclips or small envelopes
- Baking soda
- Water
- Measuring cup
- Red cabbage
- Pot
- Kitchen knife
- Jars, test tubes, or paper cups

During lab/class

- *Distribution Data Record and Data Analysis Sheet*
- Strips of paper
- Pen or pencil
- Indicator solution (Note: red cabbage juice may stain clothing)

Continues next page >

Day 4

Continued

Procedure

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

The protocol of Give One, Get One is a bit like think-pair-share, but it is faster-paced and it focuses more on re-teaching than general sharing. Students are encouraged to use gestures and their own cultural and linguistic means to animate their discussion.

COMPUTATIONAL THINKING IN ACTION

This hands-on activity illustrates how collecting and analyzing data on infectious diseases helps set the stage for the computational thinking strategy of finding patterns. By following the information they record on their Distribution Data Record and Data Analysis sheets, students can find patterns in transmission and locate the source of a disease outbreak.

Whole Group (10 minutes)

Using the *Give One, Get One* discussion protocol, have students conduct a brief review of the previous lesson on epidemiology. Introduce the upcoming lab as a hands-on epidemiologic experiment.

Individual (35 minutes): Laboratory Methods

1	Inform students that they will be receiving five strips of paper that represent an unknown pathogen that can be passed from person to person through touch, the exchange of bodily fluids, or other methods.
2	Pass out the *Distribution Data Record and Data Analysis Sheet*, along with the paper strips.
3	Some students may have had personal experiences with infectious diseases, and may find this activity uncomfortable. Suggest that all students adopt fictitious names or aliases for this activity.
4	Begin the simulation by telling students to trade one strip with another student. On their *Distribution Data Record and Data Analysis Sheet*, they should write down who they traded with, the name on the strip they gave away, and the name of the strip they received.
5	On the first trade, students have to give away one of their own strips. On the following trades, they can give away any of the strips they have (their own or that of someone who has traded with them before) but they must give away only ONE strip per trade.
6	Decide on how many trades or how long the trading will continue. There is enough space for ten trades on the *Distribution Data Record and Data Analysis Sheet*, but you can have students trade as few as six times.
7	Once all trading has stopped, ask students to use the indicator solution (red cabbage juice) to see who is holding the “infected” strips. They should dip each strip one at a time because the color may bleed onto another strip. If the strip turns GREEN, it is one of the infected strips (i.e., it has been soaked in baking soda solution).
8	Using their *Distribution Data Record and Data Analysis Sheet* as a “clues map,” students should be able to determine the first infected person and the path of transmission of the mysterious microbe.

Day 5

LEARNING OUTCOMES

Students will be able to:

Form opinions on why infectious diseases are more prevalent in BIPOC and low income communities.

Discuss strategies to help ensure equity in healthcare and to improve access to medical treatment during a pandemic.

SOCIAL-EMOTIONAL LEARNING

As students think about how different groups and communities are impacted differently by the pandemic, they practice the soft skills of developing empathy and inhabiting different perspectives.

COMPUTATIONAL THINKING IN ACTION

Jigsaw collaborative structures are an engaging way to help students gain experience with the computational thinking strategy of collecting data.

Procedure

Teacher Note > *This assignment may cause student sensitivity, especially if they have been personally impacted by the COVID-19 pandemic.*

Whole Group (5 minutes)

1. As a class, watch the video *Time to build a fairer, healthier world*.
2. Ask students to *Raise a Righteous hand* in order to identify which groups and communities they think were impacted disproportionately by the COVID-19 pandemic both locally and globally.

Small Group (25 minutes)

1. Ask students to form groups of four. Assign each student in the group one of the following videos to view individually.
   - **a.** *Minority Health Disparities | Michelle's Story*
   - **b.** *What We Learned From HIV About Inequality | Global Citizen Explains*
   - **c.** *How COVID-19 is highlighting racial disparities in Americans' health* (Stop at 4:08)
   - **d.** *Fast Facts on Health Inequities*
2. After students have viewed their assigned video, ask them to form a large group with all other students who viewed the same video as they did. Then give each student a copy of the *Introduction to Inequity in Healthcare Jigsaw* capture sheet.
3. In their large groups, ask students to discuss the information in the video and how it is related to inequity in healthcare. Each student should add notes to the *Introduction to Inequity in Healthcare Jigsaw* capture sheet under the column for their video during the group discussion.
4. When large groups have concluded their discussion, ask students to rejoin their original small group of four. Each group member should take turns sharing a brief summary of their video and the information they recorded in their capture sheet.
5. Group members should record the information shared about each video on their jigsaw sheet as well, so that everyone will have a completed sheet after all members have shared.

Continues next page >

Day 5

Continued

Procedure

Whole Group (15 minutes)	
1	Explain to students that now that they have been introduced to the challenges facing disadvantaged groups in relation to disease and healthcare, they will use this information to help them in the final project of this unit.
2	Tell students they will work in their jigsaw groups of four. For the final project, they will play the role of the marketing group of a biotechnology firm that is one component of a multifaceted public health response to a pandemic. The group has been tasked with ensuring equity in the distribution of and access to life-saving medicine to communities with specific barriers to healthcare.

Teacher Note > *Interweaving authentic role play is important for the goal of inclusivity.*

SOCIAL-EMOTIONAL LEARNING

Students are asked to embrace an equity mindset as they begin their project. This encourages students to broaden their perspective and examine how social issues and health issues are interconnected.

3	Display or provide copies of each of the four *Community Profiles* for students.
4	Explain that each marketing group will choose two communities with different equity challenges to focus on for the project. Their job will be to use what they learn throughout the unit to create a social awareness campaign for each community that informs the public about an infectious disease and potential treatment options.
5	Ask groups to take the final few minutes to discuss which *Community Profiles* interest them. Encourage students to think about choosing one profile that impacts the United States and another profile that impacts a global community.. An alternative option is to give students the option of creating a profile of their own community or a demographic within the community.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

The social awareness campaign provides opportunities to validate and affirm the diversity among the students and their communities in positive ways. The campaign should help build trusting relationships with others, while working to overcome barriers to better health initiatives.

6	Explain to students that in order to build a social awareness campaign, they need to take language, culture, and religion affiliation into consideration, as well as any barriers to access. To ensure the success of their campaign, they need to involve religious leaders, community leaders, and local organizations. This will build trust within the communities.
7	Provide time for students to reflect in their *Design Journal*, adding to their initial thoughts from earlier in the week. Students should begin making connections between what they have learned and the social awareness campaign project.

National Standards

Next Generation Science Standards	**ETS1.A: Defining and Delimiting Engineering Problems** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. **Science and Engineering Practices** Obtaining, evaluating, and communicating information Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. **Crosscutting Concepts** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
Career and Technical Education (CTE)	**A1.1** Use data to explain how biotechnology fields such as pharmaceuticals, agriculture, diagnostics, industrial products, instrumentation, and research and development are impacting human life.

Multiplying Microbes Data Sheet

ANSWER KEY | **Do not share with students**

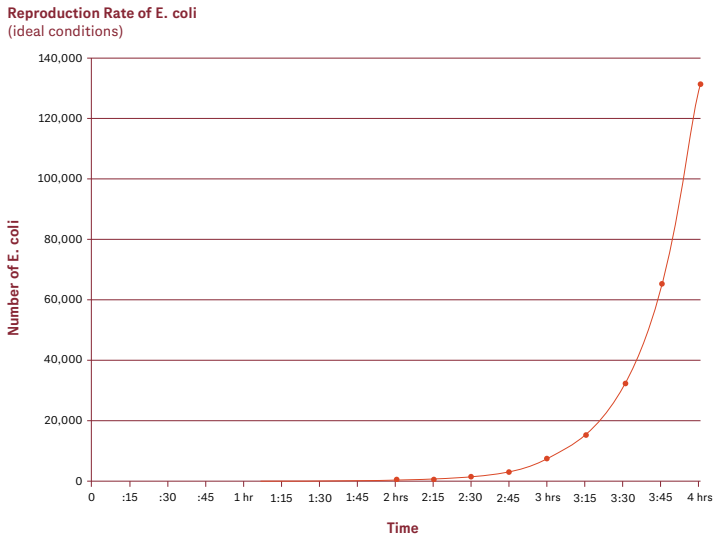
Directions
Calculate how many bacteria would be present in a given situation. Graph the results.

1a. Starting with two cells of *E.coli*, calculate how many bacteria will be present after four hours of growth. Assume that *E.coli* divide every 15 minutes under optimal conditions.

Minutes	Number of *E. coli*
0:15	4
0:30	8
0:45	16
1.00 hr	32
1:15	64
1:30	128
1:45	256
2:00	512
2:15	1,024
2:30	2,048
2:45	4,096
3:00	8,192
3:15	16,384
3:30	32,768
3:45	65,536
4:00	131,072

1b. Graph the data:

Student graph should resemble the graph below.



Continues next page >

Multiplying Microbes Data Sheet

ANSWER KEY **Do not share with students**

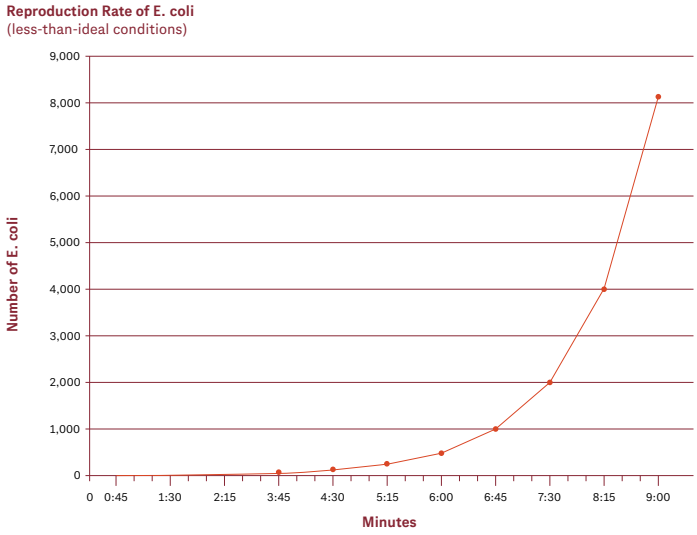
Continued

2a. Now, simulate the growth of bacteria under less-than-ideal conditions. Assume there was a drop in temperature and bacteria reproduce every 45 minutes instead of 15 minutes. Produce a new chart with the new division rates. How many bacteria would be present after three hours? How many bacteria would be present after four hours?

Minutes	Number of *E. coli*
0:45	4
1:30	8
2:15	16
3.00 hr	32
3:45	64
4:30	128
5:15	256
6:00	512
6:45	1,024
7:30	2,048
8:15	4,096
9:00	8,192

2b. Graph the data:

Student graph should resemble the graph below.



Continues next page >

Multiplying Microbes Data Sheet

ANSWER KEY **Do not share with students**

Continued

3. List and describe three factors that affect bacterial growth.

3a.

3b.

3c.

Possible answers may include:

Temperature—All bacteria have a minimum, optimum, and maximum temperature for growth. Below minimum temperature, cell membrane solidifies and becomes too stiff to transport nutrients into the cell, hence no growth occurs. Above maximum temperature, cellular proteins and enzymes denature, so the bacterial growth ceases.

Oxygen requirements—The oxygen requirements for bacteria vary greatly and can be separated into the following categories: Obligate aerobes grow only in the presence of oxygen. Obligate anaerobes grow only in the absence of oxygen. Facultative anaerobes grow with or without oxygen but generally better with oxygen.

pH— Bacteria can be placed in one of the following groups based on their optimum pH requirements: Neutrophiles grow best at a pH range of 5 to 8. Acidophiles grow best at a pH below 5.5. Alkaliphiles grow best at a pH above 8.5.

Osmosis—Bacteria may prefer either isotonic, hypertonic, or hypotonic environments to thrive.

Nutritional Requirements—Different bacteria require different nutritional requirements. The richer the requisite culture media the faster bacterial growth occurs. Conversely, bacteria exposed to a decreased amount of or poorer quality nutrition do not grow effectively.

Distribution Data Record and Data Analysis Sheet

ANSWER KEY **Do not share with students**

Part 1

Directions
After each exchange, write down who you traded with, the name on the strip you gave away, and the name of the strip you received. Then, list below the names on the strips of paper that you ended up with after your final trade.

The two charts dealing with student-to-student paper exchanges will vary by student.

Part 2

Directions
Complete the questions based on the data you collected in Part 1.

1. Who was "Patient Zero" (the original source) of the epidemic?

This will be answered at the end of the lab.

2. Did you get infected?

This will be answered at the end of the lab.

3. Were some people exposed to the infectious pathogen but not infected?

The answer will be affirmative if blank filter paper strips are given along with a few "contaminated" ones in the same envelope. Here you can discuss the concept of asymptomatic infections, and the role of immunity (natural or through vaccines).

4. How many people were exposed to the pathogen?

Varies from group to group

5. What factors may have increased the chance of exposure to the pathogen?

Discuss proximity (higher probability), time of exposure, and infective dose.

6. It was possible to trade with an infected person but not get the disease. How does this relate to real world examples of infectious disease transmission?

See answer to Question 3.

7. Deduce what would happen if two people were the original source of the infection. What about five people?

Discuss how possibilities of an epidemic increase as more people become infected.

8. What affects the amount of exposure to a pathogen in real life?

Discuss natural immunity, how vaccines prevent infections, and the role of hygiene, including handwashing.

FUTURELAB+

Infectious Disease Self-Survey, Part 1

Directions
Complete the questions concerning your exposure to infectious diseases.

1. During the past 30 days, how often did you wash your hands before eating?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Most of the time
- ☐ Always

2. During the past 30 days, how often did you wash your hands after using the toilet or latrine?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Most of the time
- ☐ Always

3. During the past 30 days, how often did you use soap when washing your hands?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Most of the time
- ☐ Always

FUTURELAB+

Infectious Disease Self-Survey, Part 2

Directions
Questions 4–11
From which source of information did you get the most information concerning new and emerging infections in the past year? Circle the one which applies most appropriately for each question.

	Description of source	Nothing	Little	Some	Much	Very Much	Don't Know
4.	Newspapers	1	2	3	4	5	6
5.	Television	1	2	3	4	5	6
6.	Radio	1	2	3	4	5	6
7.	Internet Websites	1	2	3	4	5	6
8.	Your doctor	1	2	3	4	5	6
9.	Governmental agencies	1	2	3	4	5	6
10.	Consumer or patient interest groups	1	2	3	4	5	6
11.	Family or friends	1	2	3	4	5	6

FUTURELAB+

Infectious Disease Self-Survey, Part 3

Directions
Questions 12–19
How much confidence did you have on the information about new and emerging diseases you received from these sources in the past year? Circle the one which applies most appropriately for each question.

	Description of source	Nothing	Little	Some	Much	Very Much	Don't Know
12.	Newspapers	1	2	3	4	5	6
13.	Television	1	2	3	4	5	6
14.	Radio	1	2	3	4	5	6
15.	Internet Websites	1	2	3	4	5	6
16.	Your doctor	1	2	3	4	5	6
17.	Governmental agencies	1	2	3	4	5	6
18.	Consumer or patient interest groups	1	2	3	4	5	6
19.	Family or friends	1	2	3	4	5	6

FUTURELAB+

Infectious Disease Self-Survey, Part 4

Directions
Questions 20–27
Imagine a global outbreak of an infectious disease, which brings a sharp increase in hospitalizations and death from those infected. For each source below, choose the risk factor for infection and disease transmission.

	Description of source	No Risk at All	Very Little Risk	Moderate Risk	Severe Risk	Extreme Hazard
20.	On public transport (trains, buses, airplanes, ships)	1	2	3	4	5
21.	In entertainment places (bars, restaurants, theaters, movie cinema)	1	2	3	4	5
22.	In shops	1	2	3	4	5
23.	At workplace	1	2	3	4	5
24.	At school	1	2	3	4	5
25.	In a hospital	1	2	3	4	5
26.	At home or with friends and family	1	2	3	4	5
27.	At places of worship (church, mosque, synagogue, temple)	1	2	3	4	5

FUTURELAB+

Infectious Disease Self-Survey, Part 5

Directions
Questions 28–35
Which precautionary measures would you take for each location in Part 4 to lessen the chance of infection?

	Description of source	Avoid completely	Avoid unless absolutely necessary	Use sporadically with caution *(wear masks and gloves, practice social distancing)*	Visit and utilize as you normally would
28.	On public transport (trains, buses, airplanes, ships)	1	2	3	4
29.	In entertainment places (bars, restaurants, theaters, movie cinema)	1	2	3	4
30.	In shops	1	2	3	4
31.	At workplace	1	2	3	4
32.	At school	1	2	3	4
33.	In a hospital	1	2	3	4
34.	At home or with friends and family	1	2	3	4
35.	At places of worship (church, mosque, synagogue, temple)	1	2	3	4

FUTURELAB+

Infectious Disease PowerPoint Presentation Rubric

Group Members:

Score	4	3	2	1
Visual Presentation	Presentation is easy to read; text guides the audience and serves as an aid.	Presentation is readable; text guides the audience and presenter.	Presentation is sometimes difficult to follow.	Presentation is difficult to understand.
Oral Presentation	Presenter demonstrates a thorough understanding of content and speaks knowledgeably about content.	Presenter demonstrates a good understanding of content and is able to speak knowledgeably about most talking points.	Presenter demonstrates limited understanding of content and relies upon displayed text for most of the presentation.	Presenter demonstrates little or no understanding of content and reads text directly from presentation to the audience.
Content	Ideas are interesting and thought-provoking. Ideas demonstrate the depth of knowledge.	Ideas are interesting. Some ideas are thought-provoking.	Ideas do not demonstrate a depth of knowledge. Ideas are not particularly interesting or thought-provoking.	Ideas are illogical or unclear.
Organization and Coherency	The presentation moves logically from one idea to the next; ideas build on each other. Ideas are grouped in a way that makes sense.	The presentation is organized well, ideas flow from one to the next, and are grouped logically.	The presentation is disorganized but there is an attempt to make ideas flow.	There is no organization or flow in the presentation.
Multimedia	Effective use of images, videos, and links to enhance and support content.	Presentation includes adequate photos, videos, and links to support content.	More visual elements would add to the presentation.	Presentation does not include visual elements.
Spelling and Grammar	There are no spelling or grammatical mistakes.	There are only minor spelling or grammatical mistakes.	There are some serious spelling or grammatical mistakes.	Spelling or grammar hinders clear communication of ideas.
Originality	Content is original and in the student's own words.	Most content is original. All content is in the student's own words.	Some content is original. Content is in the student's own words.	Content is not in the student's own words.
Final Score				

FUTURELAB+

Infectious Disease PowerPoint Presentation Rubric

Group Members:

Score	4	3	2	1
Organization	The presentation is systematically organized, flows logically, and is clear; conclusions are based on strong, supportive evidence.	The presentation is organized and is fairly logical and clear; conclusions are based on supportive evidence.	The presentation is somewhat organized but lacks clarity; conclusions are drawn with some supportive evidence.	The presentation lacks clarity and organization, and doesn't flow logically; conclusions are drawn without supportive evidence.
Content	The content is complete, well researched, and accurate; the audience can clearly follow, and is very likely to register and learn new facts about the topic.	The content is complete and accurate; the audience can follow, and is likely to learn new facts about the topic.	The content is incomplete, but accurate; the audience can follow, but is likely to learn only a few facts about the topic.	The content is too general or inaccurate; the audience cannot follow and is unlikely to learn anything about the topic.
Delivery	The presenter is confident, comfortable, and relaxed, and speaks clearly, seldom referring to notes; presenter engages the audience and answers questions appropriately.	The presenter is comfortable and relaxed, and speaks clearly, referring to notes infrequently; there is audience engagement.	The presenter is somewhat comfortable and relaxed, but does not speak clearly, somewhat relying on notes; the audience is sometimes lost and ignored.	The presenter is uneasy or does not speak clearly, and relies heavily on notes; presenter ignores the audience and does not handle questions appropriately.
Final Score				

FUTURELAB+

Multiplying Microbes Data Sheet

Directions
Calculate how many bacteria would be present in a given situation. Graph the results.

1a. Starting with two cells of ***E.coli***, calculate how many bacteria will be present after four hours of growth. Assume that ***E.coli*** divide every 15 minutes under optimal conditions.

Minutes	**Number of *E. coli***

1b. Graph the data:

Continues next page >

FUTURELAB+

Multiplying Microbes Data Sheet

Continued

2a. Now, simulate the growth of bacteria under less-than-ideal conditions. Assume there was a drop in temperature and bacteria reproduce every 45 minutes instead of 15 minutes. Produce a new chart with the new division rates. How many bacteria would be present after three hours? How many bacteria would be present after four hours?

Minutes	**Number of *E. coli***

2b. Graph the data:

Continues next page >

FUTURELAB+

Multiplying Microbes Data Sheet

Continued

3. List and describe three factors that affect bacterial growth.

3a.

3b.

3c.

FUTURELAB+

Distribution Data Record and Data Analysis Sheet, Part 1

Directions

After each exchange, write down who you traded with, the name on the strip you gave away, and the name of the strip you received. Then below, list the names on the strips of paper that you ended up with after your final trade.

	Name of person you exchanged with	Name of strip of paper you received	Name on strip of paper you gave away
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

1 .....

2 .....

3 .....

4 .....

5 .....

6 .....

7 .....

8 .....

9 .....

10 .....

FUTURELAB+

Distribution Data Record and Data Analysis Sheet, Part 2

Directions
Complete the questions based on the data you collected in Part 1.

1. Who was "Patient Zero" (the original source) of the epidemic?

2. Did you get infected?

3. Were some people exposed to the infectious pathogen but not infected?

4. How many people were exposed to the pathogen?

5. What factors may have increased the chance of exposure to the pathogen?

6. It was possible to trade with an infected person but not get the disease. How does this relate to real world examples of infectious disease transmission?

7. Deduce what would happen if two people were the original source of the infection. What about five people?

8. What affects the amount of exposure to a pathogen in real life?

FUTURELAB+

Introduction to Inequity in Healthcare Jigsaw Capture Sheet

Directions

After you have viewed the assigned video, discuss the information with your expert group and add notes on how it is related to inequity in healthcare. Then, rejoin your original group and take turns sharing a brief summary of each video, adding notes for each topic.

	Video 1 *Minority Health Disparities | Michelle's Story*	**Video 2** *What We Learned From HIV About Inequality | Global Citizen Explains*
Two-sentence summary of the video		
What are some of the disadvantages for people or groups featured in the video?		
What may be some of the causes or factors that have led to these disparities?		
What changes could be made to help to ensure equity for the people or groups in the video?		

Continues next page >

FUTURELAB+

Introduction to Inequity in Healthcare Jigsaw Capture Sheet

Continued

	Video 3 *How COVID-19 is highlighting racial disparities in Americans' health*	**Video 4** *Fast Facts on Health Inequities*
Two-sentence summary of the video		
What are some of the disadvantages for people or groups featured in the video?		
What may be some of the causes or factors that have led to these disparities?		
What changes could be made to help to ensure equity for the people or groups in the video?		

FUTURELAB+

Community Profiles

Community Profile 1	**Kinshasa**
Region	Continent: Africa Country: Democratic Republic of the Congo (DRC)
Demographics	Total population in 2021: 15 million It is the largest city in Africa. More than 90% of land is rural. Official language: French Economy: manufacturing companies, food processing, construction, and service industries Has the third largest population of poor globally, one in six live in extreme poverty. 175/189 in the 2020 Human Development Index Children considered malnourished: 43%
Access to Healthcare *Inequity Factors for this Community*	While access to healthcare is an ongoing issue for those who live in this community, the cost and availability of internet access is a major barrier to health equity. The Congolese Post and Telecommunications Regulation Authority (ARPTC) estimates that only 17% of the population has online access. Most people depend on cellular data for Internet access and the cost for this is far greater than in most other poor and impoverished countries globally. Another recent report by the International Telecommunications Union also points to the growing digital gender gap. More than 33.8% of men compared to 22.6% of women in Africa have online access.

Continues next page >

FUTURELAB+

Community Profiles

Continued

Community Profile 2	**Flint, Michigan**
Region	Continent: North America Country: United States
Demographics	Total population in 2019: 95,500 Black or African American: 54.1%, White: 39.1%, Hispanic or Latino: 4.5% Unemployment rate: 8% Households with a broadband Internet subscription: 61.2% Persons living in poverty: 38.8% Persons without health insurance: 8.8% County rate of diabetes: 18.6% (highest in state)
Access to Healthcare *Inequity Factors for this Community*	The most prevalent industries are mining, logging, and construction in this community. Many people do not have the ability to find, make, and keep healthcare appointments such as vaccinations or routine checkups, as a high percentage of workers in these industries do not have health insurance. High unemployment, and high poverty rates, as well the number of people without internet access for information may add to the inequity of medical care and disease prevention in this area.

Continues next page >

FUTURELAB+

Community Profiles

Continued

Community Profile 3	**Baltimore, Maryland**
Region	Continent: North America Country: United States
Demographics	Total population in 2020: 575,584 Black or African American: 62.3%, White: 30.4%, Hispanic: 5.7%, Asian: 2.6% Poverty rate by race/ethnicity: Black: 25.6%, White: 11.5%, Hispanic: 23% Unemployment rate: Females: 48.66%, Males: 32% Education: 43% have no post-high school education Population that identifies as LGBTQ: 2%
Access to Healthcare *Inequity Factors for this Community*	Marginalized people such as those in the BIPOC and LGBTQIA+ communities in this area have been disproportionately affected by major health issues, such as the COVID pandemic. This, along with a history of misconduct in medical research against minorities and a lack of economic and opportunity equity, has resulted in a lack of trust in the medical system. In these underserved communities, people are less likely to be vaccinated and take part in clinical studies.

Continues next page >

FUTURELAB+

Community Profiles

Continued

Community Profile 4	**Azad Kashmir**
Region	Continent: Asia Country: Pakistan
Demographics	Total population: 4.45 million Official language: Urdu (also English) Economy: agriculture Literacy rate: 62% Health coverage: one hospital bed per 1,738 people Healthcare: universal, provided by government Population living below poverty line: 36%
Access to Healthcare *Inequity Factors for this Community*	The community has a large population. However, due to its rural nature, many people must travel long distances to reach a healthcare center. These factors have added to the country's low vaccination levels. Community members have limited access to information about vaccination availability because Internet access is frequently unavailable.

Continues next page >

FUTURELAB+

Community Profiles

Continued

Community Profile 5	**White Plains, New York**
Region	Continent: North America Country: United States
Demographics	Total population in 2020: 58,040 White: 59.9%, Hispanic (White or Other): 32.4%, Black or African American: 11.9%, Asian: 8.0% Poverty rate: 11.6% Unemployment rate: Males: 32%, Females: 48.66% Education: High school graduate or higher: 87.9%, Bachelor's degree or higher: 49.5%
Access to Healthcare *Inequity Factors for this Community*	In White Plains, 89.6% of the population has health care coverage, with 52% on employee health care plans. There are many options for health care providers in the area and the physician-to-patient ratio in Westchester County (where White Plains is located) is considerably lower than those in the surrounding counties, with 719 patients to every physician. The income level is also quite high on average for the country with the median household income at $90,427 in 2019. White Plains does not rank in the top counties in the state for any of the reported health risks such as obesity and diabetes. Finally, access to health care for those needing assistance is high, as there are nine reported free and income-based clinics in the city of White Plains.

FUTURELAB+

Rubric for Biotech Unit 2 Challenge

Taking Action in Your Community:
Health Equity

Observable features of the student journal	Meets Expectations 8–10 points	Progressing 5–7 points	No attempt 0 points
Research			
a. Journals show that students have used learning from previous lessons as a foundation for the information in their campaign as well as additional research specific to their chosen community.			
Defining the Problem			
a. Student identifies the problem that needs to be addressed or their community.			
b. Student understands how the components of the campaign can be used to convey information and influence the community.			
Brainstorming			
a. Student shows the purpose and intent for each component of the campaign and how those components will connect to one another to convey the overall idea.			
Final Score			
Grade			

FUTURELAB+

Rubric for Biotech Unit 2 Challenge: Social Awareness Campaign Challenge

Taking Action in Your Community:
Health Equity

Observable features of the student performance	**Meets Expectations** 8–10 points	**Progressing** 5–7 points	**No attempt** 0 points
Uses scientific knowledge to generate the design solution			
a. Students used knowledge about infectious diseases and recombinant DNA technology in education section of media messaging.			
b. Students included information from research in the ad or infographic and used data to convey a clear message to the target audience.			
c. Students included information from research or community profile in the video PSA to influence target audience and support a call for action.			
d. Students created a mock social media profile that contains information from research to communicate information to the target audience.			
Describes criteria and constraints			
a. Students describe criteria (how does this design meet the challenge) and constraints (for example, information about the community, data on inequity) for their campaign.			

Continues next page >

FUTURELAB+

Rubric for Biotech Unit 2 Challenge: Social Awareness Campaign Challenge

Taking Action in Your Community:
Health Equity

Continued

Observable features of the student journal	**Meets Expectations** 8–10 points	**Progressing** 5–7 points	**No attempt** 0 points
Evaluating potential solutions			
a. Students use data and research to determine how their campaign is different or improves on existing similar products.			
b. Students determine their target population or demographic based on research and data showing racial or ethnic disparities in medicine and healthcare locally or globally.			
Refining or optimizing the solutions			
a. Students identify revisions that may be made to their campaign based on testing, peer feedback, and evidence from data collection.			
Final Score			
Grade			

FUTURELAB+

References

Infectious Diseases Society of America,
Facts about Infectious Diseases

U.S. National Library of Medicine,
Science & Society: Preventing the Spread of Disease

Mayo Clinic,
Infectious Diseases

Cleveland Clinic,
Infectious Diseases

Centers for Disease Control and Prevention,
Why It Matters: The Pandemic Threat