NATIONAL GEOGRAPHIC

RESOURCE LIBRARY | LESSON

There's an Outbreak!

In this series of activities, students learn about how microbial diseases are transmitted and start to think about who is involved in a community response to an outbreak of an infectious disease. Students use the case of John Snow to learn how epidemiologists can use maps to locate the source of an outbreak and map a hypothetical pathway of disease transmission for a particular disease. This lesson is part of the *Menacing Microbes* unit.

GRADES

6, 7, 8

SUBJECTS

Biology, Health, Geography, Geographic Information Systems (GIS), Human Geography, Physical Geography, Social Studies

CONTENTS

4 Activities

In collaboration with

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learning that connects

ACTIVITY 1: GETTING SICK: HOW DISEASES SPREAD | 50 MINS

DIRECTIONS

***Menacing Microbes* Unit Driving Question:** *How does a community get ready for an outbreak?*

***There's an Outbreak!* Lesson Driving Question:** *How do diseases spread?*

1. Activate students' prior knowledge with a brief Turn-and-Talk with a neighbor about the last time they remember being sick.

To get students thinking about symptoms and transmission pathways of particular illnesses, ask students to remember the last time they were sick. Have them discuss with a neighbor:

- What were your symptoms (what was happening to their bodies)?
- How long were you sick?
- How do you think you got sick?
- What helped you get better?
- Do you think anyone else got sick from you?

Have students share some of their responses and record them on the board or on chalk paper. You will refer to this at the end of this activity.

2. Play the High Five game to learn about direct contact disease transmission.

Set up:

- Tell students that the class is going to play a couple of games to learn about how different diseases can be spread.
- Give each student an index card that they will use in the next step, Play.
- Have students count off 1-12.

Play:

- Have students walk through the room with their blank index card and something to write with. When they encounter another student, they give each other a High Five and write the other person's number down on their index card. Do this long enough for each student to gather 3-5 numbers on their index cards, about five minutes.
- Have students return to their seats.
- Roll a set of two dice. Tell students what number was infected with the "High Five" sickness. Anyone who has that number on their card has now been infected.

Debrief:

- Introduce the concept of direct disease transmission. Tell students that this is when an infected person makes physical contact with another person.

- Lead a Think-Pair-Share discussion by asking: *What kinds of illnesses do you think are spread this way? What kinds of things could help stop the spread of diseases spread through direct transmission?*
- Have students use hand sanitizer or wash their hands before the next activity step.

3. Play the Bubble Sickness game to learn about indirect disease transmission.

Set up:

- Tell students that you, the teacher, are sick with "Bubble Sickness." You promise not to touch anyone as long as you are sick with "Bubble Sickness." However, if one of your bubbles lands on someone, that person becomes "sick."

Play:

- Have students wander around the room.
- Blow bubbles at the students.
- If a bubble lands on a student, that student becomes "sick."
- After about 30 seconds, have "sick" students stand on one side of the room, and healthy students stand on the other side of the room. Tell students that the bubbles could represent a sneeze or a cough.

Debrief:

- Introduce the concept of indirect and airborne disease transmission. Bring their attention to how many people can get "sick" from one person's sneezes.
- Lead a Think-Pair-Share discussion by asking: *What kinds of illnesses do you think are spread this way? What kinds of things could help stop the spread of airborne diseases?*

4. Facilitate an inquiry discussion to generate students' questions and ideas about how communities respond to outbreaks of infectious diseases.

- Tell students that when someone has a sickness that can spread to other people, they are considered contagious. A germ or microbe that makes people sick is called an infectious disease. Transmission of infectious disease is called contagion. When a lot of people get sick with a particular disease, it is called an outbreak.

- Facilitate a whole group discussion about who in the community (doctors, public health officials, mayor, scientist) might be affected and involved in an outbreak response. Begin by asking: *If you were sick with Bubble Sickness, who would be the first person you would tell?*

Possible prompts can include: *Who would that person tell? If you needed to go to the doctor, how would you get there? What would be the risk that people around you would get sick? Who would the doctor tell? What would those people do?*

- As students respond, create a flowchart on the board to map the direction of both information transfer and decision-making flow.
- Next, ask: *When an outbreak happens in a community, what questions would you ask that could help you stop the spread of the sickness (e.g. How many people are sick? Where are the people getting sick? What are the symptoms? How long are people sick for? Who needs to know about this?).*
- In pairs, have students take five minutes to write down as many questions as they can think of in response to the prompt above.
- Have pairs of students share their questions with a small group and circle questions that they have in common.
- From those circled questions, have students select two questions to share with the entire class and record on the board.

5. Introduce students to the project to anchor all of the learning in this unit.

- Tell students that communities need to have plans in place in case there are outbreaks of infectious diseases. In this unit, students will pick a particular disease to explore in-depth, and develop a community action plan to respond to an outbreak of that disease. All of the learning that they do in this unit will be working toward the development of that plan.
- Distribute and review the Action Plan for Response to Outbreak of Infectious Disease and the Action Plan Research worksheet with the students.

Tip

Create a word wall with the vocabulary used in the activity: airborne, direct transmission, contagious, contagion, outbreak, symptom, infectious disease.

Informal Assessment

Ask students to write a response to the following on the back of the index card that they used for the Bubble Sickness game:

When we started class, you shared with a partner about the last time you were sick.

1. *How do you think you got sick?*
2. *Who else do you think you spread the sickness to?*

Be sure to use either direct or indirect transmission as part of your response.

OBJECTIVES

Subjects & Disciplines

Biology

- Health

Social Studies

Learning Objectives

Students will:

- Describe the complex nature of coordination among individuals, groups, and organizations, needed for effective response to outbreaks of infectious diseases.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Inquiry
- Simulations and games

Skills Summary

This activity targets the following skills:

- 21st Century Themes
  - Civic Literacy
  - Health Literacy

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.SL.9-10.1:**
Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

THE COLLEGE, CAREER & CIVIC LIFE (C3) FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

• **D2.Civ.13.6-8:**
Analyze the purposes, implementation, and consequences of public policies in multiple settings.
• **D2.Civ.6.6-8:**
Describe the roles of political, civil, and economic organization in shaping people's lives.

Preparation

BACKGROUND & VOCABULARY

Background Information

There are many different kinds of diseases that affect people. These include allergic disease, fungal infections, autoimmune diseases, and microbial diseases. In this activity, the focus is on microbial disease. Outbreaks of microbial disease can and do happen during which more people are infected with a particular disease than is typical in a community, region, or time period. One of the first steps in learning how to create an effective plan to stop and prevent outbreaks is learning how microbial diseases are transmitted.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
contagion	*noun*	disease-producing agent, like a virus or bacteria; can also refer to the disease itself or the transmission of the disease.
contagious	*adjective*	capable of being transmitted by contact with an infected person or object.
direct transmission	*noun*	when disease-causing germs pass from an infected person to a healthy person via direct physical contact with blood or body fluids.
indirect transmission	*noun*	when disease-causing germs pass from an infected person to a healthy person via sneezes or coughs, sending infectious droplets into the air or onto objects.
infectious	*adjective*	communicable; passed from one person to another.
microbe	*noun*	tiny organism, usually a bacterium.
outbreak	*noun*	sudden occurrence or rapid increase.
symptom	*noun*	sign or indication of something.

ACTIVITY 2: INVESTIGATING INFECTIOUS DISEASES | 50 MINS

DIRECTIONS

***Menacing Microbes* Unit Driving Question:** *How does a community get ready for an outbreak?*

***There's an Outbreak!* Lesson Driving Question:** *How do diseases spread?*

1. Read about different kinds of disease transmission.

Set the purpose for reading with students by reviewing the project—a community Action Plan in response to an outbreak of a particular microbial disease.

- Tell students that, as they started to learn in the activity, "Getting Sick: How Diseases Spread," not all microbial diseases are spread the same way. They will need to know about the different kinds of disease transmission to create the best outbreak response plan for their specific disease.
- In pairs, have students read the article, Preventing and Containing Outbreaks.
- After reading, ask pairs to discuss: *What new information did you learn about disease transmission? What is the difference between an epidemic and a pandemic?*

2. Read and analyze an infographic to learn more about disease transmission and specific diseases that are spread through each transmission type.

In pairs, have students use the Disease Transmission infographic to discuss the following questions:

- *What is the purpose of this infographic?*
- *How is the information on the infographic different from the information in the reading?*
- *What do you notice about the different kinds of disease transmission?*
- *How can this information help you develop your action plan?*

The goal of this step is for students to learn that the types of transmission are not mutually exclusive. For example, droplets can be indirectly transmitted on surfaces and/or airborne.

3. Explore a variety of resources to learn about specific microbial diseases.

In small groups of three to four students, have groups select one of the following microbial diseases to explore in-depth: influenza, Ebola, Zika, norovirus, measles, varicella, tuberculosis, MRSA, E-Coli, Lyme disease. This will be the focal disease that they will develop their action plans for throughout the Menacing Microbes unit.

Share the following links with students for them to explore and learn more about their chosen disease:

- *This Day in Geographic History: Mar 11, 1918 CE: Flu Pandemic Begins*

- *This Day in Geographic History: May 9, 1995 CE: Outbreak of Ebola Interactive Map: Zika Virus: 1947 to 2016*
- *Article: Zika*
- *CNN Video: What is the Zika Virus?*
- *Encyclopedic Entry: E-Coli*
- *Encyclopedic Entry: Varicella*
- *CDC Fact Sheet: Chickenpox (Varicella)*
- *Encyclopedic Entry: MRSA*
- *Encyclopedic Entry: Lyme Disease*
- *Encyclopedic Entry: Tuberculosis*
- *WHO Fact Sheet: Tuberculosis*
- *Article: How the Measles Virus Became a Master of Contagion*
- *CNN Video: How Measles was Eliminated and Then Came Back*
- *CDC Features: Prevent the Spread of Norovirus*

Have each group use the Disease Profile section of their Action Plan for Response to Outbreak of Infectious Disease to record information from their resources and begin the development of their group's action plan.

Tip

Build a word wall as new vocabulary is introduced (e.g., vector, droplet, fecal-oral).

Tip

Step 1: When reading in pairs, have students either read silently through each section, stopping to summarize and ask/answer questions; or take turns reading aloud, stopping after each section to revisit the purpose.

Tip

Step 3: Think ahead about how you will facilitate students' selection of focal diseases. You may want to assign students a particular kind of transmission from which they can choose a focal disease. That will help to ensure variety across action plans.

Informal Assessment

Collect the Action Plan for Response to Outbreak of Infectious Disease worksheet and assess the Scramble! packet to assess students' understanding of key characteristics and transmission types of their selected diseases.

OBJECTIVES

Subjects & Disciplines

Biology

- Health

Social Studies

Learning Objectives

Students will:

- Understand the difference between a pandemic and an epidemic.
- Identify how different types of diseases are transmitted.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Reading
- Self-directed learning
- Visual instruction

Skills Summary

This activity targets the following skills:

- Critical Thinking Skills

- Analyzing
- Applying
- Understanding

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **Reading Standards for Literacy in History/Social Studies 6-12:**
Key Ideas and Details, RH.6-8.2
• **Reading Standards for Literacy in History/Social Studies 6-12:**
Integration of Knowledge and Ideas, RH.6-8.7

Preparation

BACKGROUND & VOCABULARY

Background Information

One of the first steps in learning how to create an effective plan to stop and prevent outbreaks of microbial disease is learning how they are transmitted. Each disease has a method of transmission based on the nature of the microbe that causes it. Some diseases can be transmitted in more than one way. Knowing all of the different ways that a particular disease behaves helps inform the most effective prevention and response plan.

Prior Knowledge

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Recommended Prior Activities

- Getting Sick: How Diseases Spread

Vocabulary

Term	Part of Speech	Definition
airborne	*adjective*	transported by air currents.

Term	Part of Speech	Definition
disease	*noun*	harmful condition of a body part or organ.
droplet	*noun*	tiny drop (as of a liquid).
fecal	*adjective*	having to do with excrement.
oral	*adjective*	having to do with the mouth or spoken words.
vector	*noun*	animal that transmits a disease from one organism to another.

ACTIVITY 3: ANALYZING DISEASE OUTBREAKS | 50 MINS

DIRECTIONS

***Menacing Microbes* Unit Driving Question:** *How does a community get ready for an outbreak?*

***There's an Outbreak!* Lesson Driving Question:** *How do diseases spread?*

1. Introduce students to the practice of using four-level analysis to interpret patterns in a map.

- Tell students that one of the ways that people solve problems is to look for patterns of data in maps. A useful technique for this is called four-level analysis.
- Draw a large version of the Four-Level Analysis Tool on the board. This should mirror the image on the student handout–a four-square table, each square labeled with a Roman Numeral (I–IV).
- Display the NASA map of the Earth at night.
- Guide the students through a Think-Pair-Share discussion about the projected map using the following four-level analysis questions:
    - *What are you looking at? Where is this? When is this?*
    - *What patterns do you see?*
    - *Why does the map look like this? What are some possible explanations for these patterns?*
    - *Why is this important? What will you remember?*
- Record student responses in the appropriate squares on the large version of the tool.
- Tell students that maps can be a useful tool for identifying the source of a disease outbreak.

2. Use the case of John Snow to learn how maps can locate the source of an outbreak.

- Introduce students to John Snow by having them watch 06:06–7:55 of the Geospatial Revolution video.
- Complete the epidemic Mapping a London Epidemic activity to identify what patterns John Snow might have noticed in order to find the location of the source of the epidemic. This is a stand-alone activity that can either be used in its entirety or by having students complete the following three exercises:
    - Mapping a London epidemic
    - Cholera deaths in Soho
    - Water pumps in Soho
- After completing the activity, have students share what they notice about the different maps.

3. Analyze disease maps to identify patterns in the data.

- There are six maps that students can explore. In pairs, have students access one of the following six maps for their analysis:
    - Flu
    - Measles
    - E-coli
    - Lyme
    - Ebola
    - Varicella
- With their selected map in front of them, distribute the Four-Level Analysis Toolto each pair of students. Have students respond to the following on their Four-Level Analysis Tool:
    - Level I: *What are you looking at? Where is this? When is this?*
    - Level II: *What patterns do you see?*
    - Level III: *Why does the map look like this? What are some possible explanations for these patterns?*
    - Level IV: *Why is this important? What will you remember?*

4. Share the analysis with others to compare information on the maps.

Have each pair of students share their analysis with another pair of students.

- If pairs are comparing the analysis of the same map, have students discuss what was different about their analyses (e.g., explanations for the patterns, reasons why this is important).
- If pairs are comparing an analysis of different maps, ask them to discuss what was different about the maps (e.g., location, scale, interactivity).

Tip

If using the John Snow Story Map, and are not familiar with the GIS technology, walk through the directions in advance so that you can help students when they get stuck. You may want to do this together as a whole class.

Modification

If you need to keep this activity in one class period, show the video of John Snow and then focus class time on the four-level analysis. This is method emphasized in high school advanced geography classes.

Modification

Step 2: In the Geospatial Revolution video, from 7:55 - 10:40 is also about using maps for disease control, but not specific to Jon Snow. If there is time for students to watch it, the Mecca segment makes connections to current contexts and provides a strong connection to Step 3 of this activity.

Modification

Step 2: Mapping a London Epidemic does not require students to use computers. If students do not have computer access, this activity can be shortened to only include the Mapping a London Epidemic resource and printing hard copies of the maps for the four-level analysis.

Informal Assessment

Collect the Four-Level Analysis Tool to assess students' understanding of the method, and the depth of their analysis.

Extending the Learning

If technology is available, The John Snow Story Map uses a GIS heat mapping technique.

OBJECTIVES

Subjects & Disciplines

Biology

- Health

Geography

- Geographic Information Systems (GIS)
- Human Geography
- Physical Geography

Social Studies

Learning Objectives

Students will:

- Identify patterns in disease outbreak maps.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Multimedia instruction
- Reading

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Media Literacy
- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
  - Answering Geographic Questions
  - Asking Geographic Questions
  - Organizing Geographic Information
- Science and Engineering Practices
  - Analyzing and interpreting data

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **Reading Standards for Literacy in History/Social Studies 6-12:**
Key Ideas and Details, RH.6-8.2
• **Reading Standards for Literacy in History/Social Studies 6-12:**
Integration of Knowledge and Ideas, RH.6-8.7

THE COLLEGE, CAREER & CIVIC LIFE (C3) FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

• **D1.His.14.6-8:**
Explain multiple causes and effects of events and developments in the past.
• **D2.His.16.6-8:**
Organize applicable evidence into a coherent argument about the past.
• **D2.His.1.6-8:**
Analyze connections among events and developments in broader historical contexts.

Preparation

BACKGROUND & VOCABULARY

Background Information

Once a disease outbreak has been reported, it is important to identify the source of the outbreak so that a response team can stop the spread of the disease. Epidemiologists often use map data to find the source of outbreaks. There are many different modern techniques for this such as GIS mapping. A historical example of this kind of mapping is the case of John Snow, an epidemiologist who used maps to trace the source of a cholera outbreak to a single water pump.

A method that people use for analyzing maps is called four-level analysis. This is a method that seeks to understand not only what patterns exist on a map, but why they are happening and what might happen next. Geographic patterns and processes are emphasized in advanced high school geography courses. Learning this method can be a valuable skill in preparation for this kind of course work.

Prior Knowledge

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Recommended Prior Activities

- Getting Sick: How Diseases Spread
- Investigating Infectious Diseases

Vocabulary

Term	Part of Speech	Definition
cholera	*noun*	infectious, sometimes fatal disease that harms the intestines.
contagion	*noun*	disease-producing agent, like a virus or bacteria; can also refer to the disease itself or the transmission of the disease.
contaminate	*verb*	to poison or make hazardous.
disease	*noun*	harmful condition of a body part or organ.
epidemic	*noun*	outbreak of an infectious disease able to spread rapidly.
outbreak	*noun*	sudden occurrence or rapid increase.

ACTIVITY 4: MAPPING THE SPREAD OF DISEASE IN A COMMUNITY | 50 MINS

DIRECTIONS

This activity is part of the Menacing Microbes unit.

Unit Driving Question: *How does a community get ready for an outbreak?*

Lesson Driving Question: *How do diseases spread?*

1. Discuss ways to stop the spread of disease in a community.

Reflecting on the work done in the last activity, Analyzing Disease Outbreaks, have students answer the following questions in their project groups:

- *What disease maps did they analyze with four-level analysis?*
- *What actions might need to be taken to stop the spread of the diseases on those maps?*
- *Who would need to be involved in those actions?*

2. Map the route of Patient Zero through the course of a day to track the spread of disease.

To kick off this activity:

- Inform students that they are going to use maps to record pathways of microbial disease transmission and learn the impact of one infected person's behavior on the community.
- Introduce the term, patient zero, and add to the word wall started at the beginning of the unit.
- Provide students with a copy of the community map mark up.
- Go over the directions on the community map for labeling the route and other important moments on the map as a class.
- Explain to students that they will be marking the map to indicate disease transmission points if Patient Zero was infected with their focal disease.

Conduct the Activity:

- Read the story of Patient Zero aloud to the class.
- As you read the story, have students trace the route of their patient through the community.
- Pause after each section to allow students to trace Patient Zero's route on the community map.

Application:

- After Patient Zero's route has been mapped, have students use their disease profile and the directions from the map to indicate moments of possible transmission of their disease on the map.

3. Identify steps that Patient Zero could have taken to prevent the spread of disease.

- In their project groups, ask students to respond to the following question: *What could Patient Zero have done differently to stop the spread of disease?* (Possible answers: wash hands, stay inside, wear bug repellant, wear long sleeves and pants)
- Have groups share with the rest of the class the following information:

    1. Their focal disease
    2. Methods of transmission
    3. Two ways that Patient Zero could have prevented the spread of disease to others

Modification

Step 1: If completing this activity individually and not as part of the unit, skip Step 1.

Step 2: Instead of reading aloud, distribute the student version of the story to each group for students to work on independently.

Tip

Step 2: While reading aloud, pause to allow for groups to discuss and map each section of the story.

Informal Assessment

Have students turn in an Exit Ticket with the answers to the following:

1. *What is the name of your focal disease?*
2. *What is the method of transmission?*
3. *Who else was likely infected by Patient Zero?*

OBJECTIVES

Subjects & Disciplines

Biology

- Health

Geography

Social Studies

Teaching Approach

- Project-based learning

Teaching Methods

- Cooperative learning
- Discussions
- Hands-on learning

Skills Summary

This activity targets the following skills:

- Critical Thinking Skills
  - Analyzing
  - Applying
  - Understanding

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **CCSS.ELA-LITERACY.RH.6-8.7:**

Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

Preparation

BACKGROUND & VOCABULARY

Background Information

Spatial thinking is an important skill for understanding geography and the world we live in. Geoscience requires knowledge of spatial representations and relationships. A map is an essential tool for communicating geographic information and representing spatial thinking. When people think with maps, they become equipped to visualize the world around them and solve problems related to human interactions with the world.

Prior Knowledge

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Recommended Prior Activities

- Analyzing Disease Outbreaks
- Getting Sick: How Diseases Spread
- Investigating Infectious Diseases

Vocabulary

Term	Part of Speech	Definition
disease	*noun*	harmful condition of a body part or organ.
outbreak	*noun*	sudden occurrence or rapid increase.
patient zero	*noun*	person identified as the first carrier of a contagious disease in an outbreak of related cases.
route	*noun*	path or way.
transmission	*noun*	when disease-causing germs pass from an infected person to a healthy person.