

RESOURCE LIBRARY | ACTIVITY : 2 HRS

# Harmful Microbes

Students explore how microbes can be harmful to specific body systems as they engage in a jigsaw reading activity that builds on what they learned in the [Helpful Microbes](#) activity. Students also analyze the design of three public service announcements.

## GRADES

6, 7, 8

## SUBJECTS

*Biology, Health*

## CONTENTS

1 Resource

## OVERVIEW

Students explore how microbes can be harmful to specific body systems as they engage in a jigsaw reading activity that builds on what they learned in the [Helpful Microbes](#) activity. Students also analyze the design of three public service announcements.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/harmful-microbes/>

## In collaboration with



## DIRECTIONS

1. Students learn about harmful microbes from a PSA about foodborne disease that presents a case study about *Escherichia coli*, known as *E. coli*.

- Prepare students to watch the PSA by building background knowledge about *E. coli*. Show a picture of *E. coli* (See "Scanning Electron Microscope (SEM)" image in the slideshow at the top of this page) and ask what students know or can predict about this particular microbe.
- Build on students' prior knowledge as you provide the following information about *E. coli*:  
Scientific name: *Escherichia coli*
  - Scientific classification: Bacteria; one species that is further broken down into specific strains.
  - Where it is found: Normally lives in the intestines of humans and animals and are harmless.
  - Impacts on humans: Certain strains of it can make people sick.
  - How transmitted: By consuming water and food contaminated by infected feces.
- Prompt students to consider the following questions as they watch the Foodborne Diseases video:
  - *What is the purpose of this PSA?*
  - *Who is the intended audience?*
  - *What is its call to action?*
- Analyze the PSA and discuss the potential harm caused by *E. coli* microbes: discuss the following questions in a Think-Pair-Share or whole-class format:
  - *What is the PSA's purpose, audience, and call to action?* (Possible responses: The purpose is awareness and responsibility for prevention; intended audience is consumers; and the call to action is that understanding various factors that can lead to foodborne illness (farm, processing, transportation, vendors, consumers) helps us protect ourselves and communities.)
  - *Based on what you know about bacteria and other microbes, which parts of our food system could help transmit *E. coli*?* (Possible responses: Warm temperatures during transportation and unhygienic conditions at farms and vendors provide optimal environments for bacteria to survive and reproduce.)
  - *During the outbreak discussed in the PSA, lettuce, tomatoes, and sprouts were all considered possible sources. Why do you think fresh vegetables could be carriers for *E. coli*?* (Possible responses: Vegetables that have been exposed to contaminated water

or another source of *E. coli* need to be washed thoroughly or cooked to eradicate the bacteria; this sometimes does not happen with vegetables that are consumed raw.)

- Support students in understanding how *E. coli* infiltrates and impacts the human body, through the lens of body system organization discussed in the [Getting Organized](#) lesson.
- Direct students to the PSA Design Analyzer. Prompt students to use the second design square to note the effectiveness of different design elements in this PSA. Discuss as needed.

## 2. Students learn about specific types of microbes that have harmful impacts on the human body through a jigsaw.

Expert groups collaborate to learn about specific types of microbes that can be harmful.

- Prompt students to return to their Microbes: Our Best Frenemies handout, which students will continue to use throughout this lesson.
- Use the same jigsaw structure and groupings that you used in the [Helpful Microbes](#) activity, follow the steps below to have students engage with and share about different parts of the [Infectious Agents infographic](#).
- Assign each expert group to one type of the following infectious agents. Depending on the number of groups, it is likely multiple groups will be assigned to the same agent.
  - Bacteria
  - [Protozoa](#)
  - Viruses
  - [Fungi](#)
- Since parasitic worms are not microbes, use this part of the infographic to model how students should make sense of the reading and transfer key ideas to Part B of the handout.
- Provide time for expert groups to read about their assigned [infectious agent](#).
- As you circulate to support understanding, prompt students to discuss the main ideas of what they read, define unfamiliar terms, and ensure they are focusing on how microbes are harmful to particular body systems.

Jigsaw groups share what they have learned about harmful microbes.

- Reorganize students into their jigsaw groups. Each group member is now an expert on a different type of microbe and should share out to the rest of the group. Group members should take notes on the remaining microbes listed in Part B of the handout.

### **3. Introduce the immune system and how it helps protect the body from infection or disease caused by microbes.**

- Elicit students' initial ideas about the immune system and how it works.
- Then show the Innate Immune System video to introduce the body's first line of defense against microbes that cause infection or disease.
- Ask: *How does the immune system help the body to protect against the type of microbe that you became an expert in?*
- Then show the Adaptive Immune System video to introduce the body's second line of defense. This is relevant for all pathogens, but will especially help students whose focal microbe was a virus.

### **4. Analyze two sample PSAs about microbes' harmful impacts to help prepare students for their project work.**

- Remind students about the project they will undertake in this unit: Students collaborate in small groups to create a public service announcement (PSA) with an online animation app (teacher's choice) to introduce a particular microbe to their community. Their PSA will include an evidence-based argument regarding the value of eradication of the microbe, based on its various impacts on the systems of the human body.
- Explain that they will watch and analyze two more sample PSAs.
- Direct students to the PSA Design Analyzer. They should use the third and fourth design squares to analyze the following design elements:
  - Visuals / animation
  - Text
  - Information
  - Call to action
- Show the Fight BAC (Bacteria) PSA, prompting students to take notes on the third design square during and after watching. Since this PSA is short (30 seconds), it may be helpful to show it a second time.

- Next, show the [Fight the Bite: Lyme Disease](#) PSA, prompting students to take notes on the fourth design square during and after watching.
- Encourage students to discuss the design elements that they noticed in the sample videos, either in small groups or as a whole class.

## Tip

**Step 3:** In addition to the videos, have students engage more deeply about the immune system and its various lines of defenses by reading the following articles:

- [Microbiology Online: Immune system](#)
- [Microbiology Online: Antibody-antigen complex](#)

## Modification

**Step 4:** If you have time and want students to consider how the same information (preventing Lyme disease) can be presented in very different ways, [this TV news PSA about Lyme Disease Prevention](#) provides a clear contrast to the rap song and music video approach.

## Modification

**Step 3:** In addition to the videos, have students engage more deeply about the immune system and its various lines of defenses by reading the following articles:

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## Modification

**Step 2:** If you are pressed for time, consider re-structuring the jigsaw reading activity. Students can read the infographics in partners or small groups and then come together to share ideas in a whole class discussion.

## Informal Assessment

The *Microbes: Our Best Frenemies* handout can be used to assess students' individual understanding about how microbes harm the human body. Additionally, during the multiple discussions throughout the activity, assess the accuracy of connections that students make between systems of the body and harmful microbes.

## Extending the Learning

Consider framing the ecological relationships discussed in this activity through the lens of symbiosis, emphasizing that the majority of the relationships between microbes and humans are neutral.

## OBJECTIVES

## Subjects & Disciplines

### Biology

- Health

## Learning Objectives

Students will:

- Explain how microbes can be harmful to systems of the human body.
- Understand how the body's immune system acts at different organizational levels to help protect the body from infection and disease.
- Analyze the design of three sample public service announcements (PSAs).

## Teaching Approach

- Project-based learning

## Teaching Methods

- Discussions
- Jigsaw
- Multimedia instruction

# Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Creativity and Innovation
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Health Literacy
- Science and Engineering Practices
  - Obtaining, evaluating, and communicating information

## National Standards, Principles, and Practices

### COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **CCSS.ELA-LITERACY.RST.6-8.2:**

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

- **CCSS.ELA-LITERACY.SL.7.1:**

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on Grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

- **CCSS.ELA-LITERACY.SL.7.2:**

Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.

### NEXT GENERATION SCIENCE STANDARDS

- **Crosscutting Concept 4:**

Systems and system models

- **Crosscutting Concepts: Cause and Effect:**

- **LS1.A: Structure and Function:**

In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

- **MS. From Molecules to Organisms: Structures and Processes:**

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

- **Science and Engineering Practice 8:**

Obtaining, evaluating, and communicating information

## **Preparation**

## **What You'll Need**

### **MATERIALS YOU PROVIDE**

- Printed handouts or digital access to student handouts
- Printed versions of the maps, readings, and diagrams provided, if desired

### **REQUIRED TECHNOLOGY**

- Internet Access: Required
- Tech Setup: 1 computer per classroom, 1 computer per pair, Color printer, Monitor/screen, Projector, Speakers

### **PHYSICAL SPACE**

- Classroom

### **SETUP**

For the harmful microbes jigsaw reading activity in Step 2, print out copies of the *Infectious Agents infographic* and cut into pieces so that each student in a group of four reads about one type of microbe. Note that parasitic worms are not microbes, so plan to use this part of the infographic to model how students should make sense of their reading.



In preparation for Step 4, in which students rank their choice of focal microbe for their projects, decide on the options that you will provide to students. Students should work in project groups of three or four, so you may choose to have all six options listed in Step 4, or omit some of them. Different groups may focus on the same microbe, as they may ultimately reach different conclusions regarding their claim about whether the microbe should be eradicated. The [CDC list of Diseases and Conditions](#) is a good resource, if you would like more microbes from which students can choose. Consider picking microbes that have relatively simple life cycles and that have both helpful and harmful impacts for humans.

## GROUPING

- Large-group instruction
- Large-group learning
- Small-group learning
- Small-group work

## ACCESSIBILITY NOTES

For the jigsaw reading activity in Step 2, consider strategically organizing students in mixed-reading level groups to support readers at all levels.

## RESOURCES PROVIDED: IMAGES

- Infectious Agents

## BACKGROUND & VOCABULARY

### Background Information

Microbes are organisms that are too small to be seen by the human eye and include bacteria, archaea, protists, viruses, and fungi. Although most of microbes' interactions with humans are neutral or beneficial, they also can make us sick by acting as infectious agents. Microbes can cause disease through a variety of body organs and systems, which has cascading effects throughout the whole system and human body.

### Prior Knowledge

# Recommended Prior Activities

- [Deep Dive into the Cell](#)
- [Helpful Microbes](#)
- [Introduction to Microbes and Human Body Systems](#)
- [Microbes Across the Tree of Life](#)
- [The Interconnected Systems of the Human Body](#)

## Vocabulary

<b>Term</b>	<b>Part of Speech</b>	<b>Definition</b>
<b>bacteria</b>	<i>plural noun</i>	(singular: bacterium) single-celled organisms found in every ecosystem on Earth.
<b>disease</b>	<i>noun</i>	harmful condition of a body part or organ.
<b>eukaryotic</b>	<i>adjective</i>	relating to organisms whose cells have a nucleus.
<b>foodborne</b>	<i>adjective</i>	caused by food contaminated with disease-causing germs or toxic substances.
<b>fungi</b>	<i>plural noun</i>	(singular: fungus) organisms that survive by decomposing and absorbing nutrients in organic material such as soil or dead organisms.
<b>immune system</b>	<i>noun</i>	network of chemicals and organs that protects the body from disease.
<b>infectious agent</b>	<i>noun</i>	something (such as a bacterium or virus) that causes disease; also referred to as a pathogen.
<b>ingestion</b>	<i>noun</i>	the act of taking, as food or drink, into the body.
<b>pathogen</b>	<i>noun</i>	organism that causes a disease, such as a virus.
<b>prokaryotic</b>	<i>adjective</i>	relating to organisms whose cells have no distinct nucleus.
<b>protozoa</b>	<i>noun</i>	one-celled organisms in the kingdom protista, such as amoebas. (singular: protozoan)
<b>transmit</b>	<i>verb</i>	to pass along information or communicate.
<b>vector</b>	<i>noun</i>	animal that transmits a disease from one organism to another.

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### For Further Exploration

## Articles & Profiles

- [Microbiology Online: Antibody-antigen complex](#)
- [Microbiology Online: Immune system](#)
- [National Geographic: How Dog and Cat 'Kisses' Can Turn Deadly](#)
- [National Geographic: Bacteria](#)



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