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ACTIVITY : 1 HR

Germs All Around Us

Students are introduced to microbes that cause common illnesses through a book and image gallery. They use an infographic about guinea pigs and influenza to analyze data and findings related to viruses' abilities to thrive in cold and dry conditions. Finally, students learn about writing trivia questions and answers for the unit project through teacher-led modeling.

GRADES

3, 4

SUBJECTS

Biology, Health

CONTENTS

3 PDFs

OVERVIEW

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For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/germs-all-around-us/

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DIRECTIONS

This activity is part of The Truth About Year Round Germs unit.

1. Read a book and use an image gallery to introduce key ideas about microbes and germs.

- Connect to the ideas from the previous activity, *Sick Days*, by asking students to share what they know about how germs make us sick.
  - Reference and leverage ideas and questions that students shared on the class *Know and Need to Know* chart at the end of the previous activity.
  - Sample questions include:
    - *What types of germs are there? Do they all make us sick?*
    - *How do the germs that cause the common cold (or other illnesses, such as COVID-19) make us sick?*
- Read a text that introduces germs and microbes in an age-appropriate way, like the book *Tiny: The Invisible World of Microbes* (7:25). Read the text aloud as a class, pausing as needed for students' reflections and emphasize key ideas from the reading, including:
  - There are many different types of *microbes* (the broader term for organisms that are too small to see with our naked eyes without a microscope).
  - Most microbes don't make us sick and play very important roles in our bodies (e.g., digesting food, absorbing nutrients, protecting us against disease-causing microbes) and ecosystems (e.g., nutrient cycling, reforestation, waste decomposition).
  - Microbes reproduce by splitting in two (aka binary fission), so they can increase their population very quickly (within minutes).
  - *Germs* are microbes that make us sick.
  - Germs can get into bodies through different ways, such as these examples from *Tiny: The Invisible World of Microbes*: through our mouth or nose, a cut or wound, or sometimes through an insect's bite, such as a mosquito.
- Distribute the *Germs All around Us* handout. Show the *Introducing Microbes and Germs Image Gallery* to introduce the three main types of germs that will be the focus of this unit: viruses, bacteria, and fungi.
  - As you show the images and review the accompanying information, connect to the key ideas from the book and prompt students to take notes and write down their questions in Part A on their handout. Emphasize the diversity of microbes (diversity in shape, color,

types, whether good/bad, origin, properties such as being able to survive at hot temperatures or at high pressures, or habitats such as soil, water, animals, plants, humans), and how most microbes are "good" and beneficial or have no effect on humans. For microbes that do make us sick (germs), highlight that different germs cause different types of illnesses. To segue to the next step, emphasize that viruses are one of the main types of germ that cause sicknesses (such as the common cold and flu) that affect us more often during the winter.

2. Use an infographic to analyze experimental data that shows how viruses thrive in cold and dry conditions.

- Use the class Question Quadrant from the *Sick Days* activity to explain that students will be exploring factors related to the Environment quadrant, while the next activity, *Spreading Germs*, will explore factors related to the People quadrant.
- Prompt students to identify the key factors of what weather is like in many areas that experience winter, leading to the factors of low temperature and low humidity.
- Project or distribute the *Guinea Pigs Can Get the Flu, Too!* infographic, which will walk students through an experiment that helps answer the unit driving question.
- As a class, collaboratively read the introduction at the top of the infographic about how Dr. Palese figured out that guinea pigs can get sick with the flu and the experimental set-up.
- Prompt students to use the labeled boxes in Part B of their *Germs All around Us* handout to identify the testable question that Dr. Palese and his team were investigating and make a prediction about what their findings will show.

  - Walk through the definition of *humidity* (how much water vapor, or moisture, is in the air) on the handout as needed with students.

- Support data literacy by using a Think-Pair-Share strategy to interpret the two graphs of the experimental findings as a class, having students share their interpretations of the elements below, based on evidence.

  - Each graph shows a different temperature condition: Cold weather (5°C or 41°F) and warm weather (20°C or 68°F).
  - For both graphs:

    - The x-axis shows the different humidity conditions: Low Humidity (35 percent) and High Humidity (80 percent).

    - The y-axis shows the percentage of guinea pigs that got sick in each experimental condition.
    - What the bars represent: The different percentages of guinea pigs that got sick in each combination of the two environmental conditions: low temperature and low humidity, low temperature and high humidity, high temperature and low humidity, high temperature and high humidity.

- Use the prompts and questions provided on the Understanding Results section of the handout to guide students to understanding the following key findings from the experiment:

    - In the low temperature and low humidity condition, 100 percent (all) of the guinea pigs got sick.
    - In the low temperature and high humidity condition, about 50 percent (half) of the guinea pigs got sick.
    - In the high temperature and low humidity condition, 100 percent (all) of the guinea pigs got sick.
    - In the high temperature and high humidity condition, 0 percent (none) of the guinea pigs got sick.

- Direct students to read the bottom section of the infographic and record their responses and ideas in the next boxes (Interpreting results and revisiting my prediction) on the handout. Lead a debrief discussion to solidify students' understanding of the interpretation of the evidence and how this experiment alone doesn't explain *why* viruses are best able to survive and spread in low humidity and low temperature conditions (but note that the infographic describes follow-up studies that help to explain this). It may be good to mention that in science we are looking for multiple clues (evidence) that support what we think is right or wrong. It is rare that one piece of evidence alone is determinant.

3. Connect to the unit driving question and project work by taking an interactive digital quiz about what students learned about microbes and germs.

- Have students respond to the final prompts on Part C of the handout, the first of which is regarding how the guinea pig experiment may change their ideas about why germs make us sick more often during the winter.

    - Note that students will formally discuss and revisit their initial hypotheses about this phenomenon in the next activity.

- Remind students that they will be sharing what they learn about germs in winter through a Germology Game Show to help educate their community at the end of the unit. Explain that now they will engage in one way to communicate about what they have learned, an interactive digital quiz (which may also be an option for their final product; see the options for the format of the Germology Game Show described in the *Sick Days* activity).
- Provide access to laptops or tablets and give the link to the *Germs All around Us Interactive Quiz*. Collaborate on the six to eight question quiz as a class or have students challenge each other in pairs.
- After the quiz, distribute the *Trivia Question Builder* handout and review the correct answers. Ask students to share what made the quiz both interesting and informative. Record students' answers in a shared document that can be accessed in subsequent activities.

  - Consider also noting the three different question types in the quiz and using the *Trivia Question Builder* to point out to students that they will be using the same formats when they write their own trivia questions and evidence-based answers.

- Finally, lead students through a consensus process to choose two or three of the questions from the quiz that will be included in their Germology Game Show, based on the facts or ideas that students think community members will find interesting or need to know.

  - Have students circle the questions that they chose on their *Trivia Question Builder* handouts; be sure to store these in a safe place so that students can access in subsequent activities.

Informal Assessment

Use students' ideas from the *Germs All around Us* handout and their discussion of the *Germs All around Us Interactive Quiz* to assess their developing understanding about germs and microbes, as well as their ability to analyze and interpret data about what environmental factors affect viruses' abilities to survive and spread. The *Germs All around Us Answer Key* provides sample answers for the handout.

Extending the Learning

To support the focus on viruses in this activity, dive deeper into how viruses survive and reproduce, mutate, and jump between species through the video, *How Do Viruses Jump from Animals to Humans?*, from Ted-Ed and the encyclopedic entry, *Viruses*, from National

Geographic. Consider drawing from what students learned about viruses during the COVID-19 pandemic, being sensitive to any trauma they may have experienced during that time.

OBJECTIVES

Subjects & Disciplines

Biology

- Health

Learning Objectives

Students will:

- Identify key concepts about microbes and germs: the three main types of microbes are viruses, bacteria, and fungi; most microbes do not make us sick; and those that do make us sick are called germs.
- Collaboratively analyze experimental data to understand key findings related to how viruses thrive in cold and dry conditions.
- Connect learning to the unit driving question by considering new ideas about why germs make us sick more often during the winter.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Multimedia instruction
- Reading

Skills Summary

This activity targets the following skills:

- Critical Thinking Skills
  - Analyzing

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.RI.3.3:**
Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
• **CCSS.ELA-LITERACY.RI.4.3:**
Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
• **CCSS.ELA-LITERACY.SL.3.1:**
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
• **CCSS.ELA-LITERACY.SL.4.1:**
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and Effect
• **MS-ESS3-2:**
Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information.

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- *Tiny: The Invisible World of Microbes* by Nicola Davies, or other text to introduce microbes and germs

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, 1 computer per pair, Mobile data device (smartphone or tablet), Projector

PHYSICAL SPACE

- Classroom

SETUP

In preparation for Step 1, select and review a text that introduces germs and microbes in an age-appropriate way. Revise the guiding discussion questions as needed, depending on the details of the text.

GROUPING

- Large-group instruction
- Small-group work

ACCESSIBILITY NOTES

For reading the text in Step 1, consider leading a read-aloud twice; once to introduce the key terms and ideas, and the second time to prompt students' making connections and sensemaking.

BACKGROUND & VOCABULARY

Background Information

Microbes are organisms that are too small to be seen by the naked human eye (without a microscope) and include bacteria, archaea, protists, viruses, and fungi. Although some microbes cause disease, they are also crucial to the functioning of human bodies through processes such as digestion, aiding the immune system, and absorbing nutrients, and ecosystems through processes such as nutrient and energy cycling.

Viruses in particular cause many of the illnesses that make us sick in the winter, such as the common cold and influenza. Lab research, such as the guinea pig study that students learn about through the infographic in this activity, has shown that viruses are best able to survive and spread in environmental conditions that have low humidity and low temperatures, which reflects winter weather conditions in many parts of the United States and around the world. Although the exact mechanism for these findings is not entirely clear and may vary depending on the type of virus, there is some evidence that shows that humid air may change the surface of the virus particle (also known as coating), making it harder to attack our cells. In drier air, viruses can stay active for longer and more successfully infect people. In terms of temperature, some viruses (such as influenza) have an outer envelope that coats the virus particle. In cold winter temperatures, the envelope hardens, which could help the virus spread between people. In warm temperatures, the envelope melts to be more liquid, making it harder to spread. Also, in cold winter conditions people spend more time indoors and with face-to-face contact.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
bacteria	*plural noun*	(singular: bacterium) single-celled organisms found in every ecosystem on Earth.
environment	*noun*	conditions that surround and influence an organism or community.

Term	Part of Speech	Definition
fungi	*plural noun*	(singular: fungus) organisms that survive by decomposing and absorbing nutrients in organic material such as soil or dead organisms.
germ	*noun*	disease-producing microbe.
humidity	*noun*	amount of water vapor in the air.
hypothesis	*noun*	statement or suggestion that explains certain questions about certain facts. A hypothesis is tested to determine if it is accurate.
microbe	*noun*	tiny organism, usually a bacterium.
temperature	*noun*	degree of hotness or coldness measured by a thermometer with a numerical scale.
virus	*noun*	pathogenic agent that lives and multiplies in a living cell.

For Further Exploration

Articles & Profiles

- KidsHealth: Germs: Bacteria, Viruses, Fungi, and Protozoa
- Arizona State University: Puzzling Pathogens
- Small, Small World

Reference

- Arizona State University: Microbes: The Good, the Bad, the Ugly

Video

- TED-Ed: How do viruses jump from animals to humans?
- Misunderstood Microbes

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