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ACTIVITY : 45 MINS

Invisible Villains

Students learn the first step of the engineering design process. They simulate the spread of germs to identify what germ-related problem this poses. Students use a storyboard to record five instances in which they may be contributing to the spread of germs.

GRADES

1, 2

SUBJECTS

Biology, Health, Engineering

CONTENTS

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OVERVIEW

Students learn the first step of the engineering design process. They simulate the spread of germs to identify what germ-related problem this poses. Students use a storyboard to record five instances in which they may be contributing to the spread of germs.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/invisible-villains/

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DIRECTIONS

This activity is part of the Germ Problem-Solvers: Using Engineering to Develop Solutions unit.

1. **Introduce the activity by connecting the engineering design process to the final product of the unit project.**

- Remind students that even though we can't see germs with our naked eyes (without a microscope), they are all around us (microbes can be found in the air, water, soil, trees, animals, humans, etc).
- Tell students: *Today we will be considering problems that we face as we try to stop the invisible villains (or germs) from spreading, so we can stay healthy.* Remind students of the final product of the unit project.
- Tell students they will be using a process called the engineering design process to do this work. Show them the full process using the *Engineering Design Process Cycle Graphic.*
- Introduce the first part of the engineering design process—ask to identify the need. Read the description from the *Engineering Design Process Cycle Graphic* aloud to the class. Let students know that before we can design a way to stop the "big problem" of slowing the spread of germs that make us sick, we have to ask questions to figure out the smaller problems we are trying to solve.
- Ask students to work in small groups to brainstorm ways that they think germs spread. Have them share their ideas with the whole class. Record students' ideas publicly on the whiteboard or chart paper.
- (Students may say: sharing food, utensils, or drinks; coughing or sneezing; not washing hands before eating; touching germy surfaces; or just by being around someone who is sick.)

2. **Lead students in a simulation that will help them see how sneezing spreads germs.**

- Building on their ideas from the previous step, tell students that you will show them one way to see how germs travel if we don't cover our coughs and sneezes.
- Simulate a sneeze with spray bottles filled with water and food coloring. Students should know that this is a model of what happens when we sneeze. Students should pretend that the spray bottle represents our mouths and nose, and the water represents germ-filled droplets that get forced out in a sneeze.
- Have students predict how far they think the droplets will fly before they land.
- Before spraying, put down white butcher paper or other light-colored surface so students can see how far those water droplets travel.
- Ask for a volunteer to help you measure the length the droplets travel.

- Simulate a sneeze with the spray bottle, repeating a few different times. See how close students were in their predictions.
- Ask students what problem this presents with the spreading of germs (as engineers always have to figure out what problem they are solving first), guiding them to the idea that sneezes and coughs cause germs to travel a long distance around us.

3. **Support students as they identify conditions that increase the spread of germs, and ask questions that help clarify the unit problem.**

- Reinforce the idea that germs, both good and bad, are everywhere on various surfaces (including our skin and bodies). Fun fact - microbes can also be found in trees/wood and this is why campsites prefer one buys wood from their area instead of bringing wood from other locations to avoid the spread of foreign germs that may be harmful to the local flora. Ask students to think of times when they might be spreading germs or picking up germs and not even know it.
- Distribute the *Spreading Germs Snapshots* handout. Explain that students will use it to represent moments throughout the school day when germs might spread. After students have considered three moments throughout the day when germs may have spread, have them share their thoughts with a partner, then record their pictures and labels on the handout.
- Next, remind students that in this activity, they are working on the first step of the engineering design process—ask to identify the need—so their focus is on what specific problems we need to solve that will help stop bad germs from spreading. The big problem is slowing the spread of germs that make us sick, but what are smaller problems that contribute to the spread of germs?
- Guide students through the next step on the *Spreading Germs Snapshots* handout: "Review your three snapshots. Now think about the problem that needs to be solved for each one. Write the problems in the spaces below."
- If time allows, ask students to share with the class some of the problems they identified. Explain that in the next activity, *Getting Rid of Gross Germs,* they will be researching solutions that will help solve the big problem: slowing the spread of germs that make us sick.

Tip

Step 3: You may want to work through a document panel from the *Spreading Germs Snapshots* handout with students as an example, adding a picture, the description, and the problem that needs solving.

Step 3: Consider pre-selecting locations and providing images with descriptions in the *Spreading Germs Snapshots* handout. You could provide images of the cafeteria, playground, bus, library, art/PE/music class, or hallway interactions as places for students to start.

Informal Assessment

Class Discussion: Use class discussions to assess students' ability to identify ways that germs can spread, as well as their ability to participate in collaborative conversations.

Students' Handouts: Use students' *Spreading Germs Snapshots* handouts to assess their ability to identify situations when germs spread and identify problems that need to be solved.

Extending the Learning

Show the video *How Germs Spread* (2:04) from Cincinnati Children's Hospital Medical Center.

OBJECTIVES

Subjects & Disciplines

Biology
- Health

- Engineering

Teaching Approach

- Project-based learning

Teaching Methods

- Brainstorming
- Discussions

- Simulations and games

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Creativity and Innovation
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Health Literacy
- Critical Thinking Skills
  - Applying
  - Understanding
- Science and Engineering Practices
  - Asking questions (for science) and defining problems (for engineering)
  - Developing and using models

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.
• **Speaking and Listening Standards K-5:**
Presentation of Knowledge and Ideas, SL.1.6
• **Speaking and Listening Standards K-5:**
Presentation of Knowledge and Ideas, SL.2.6

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and effect: Mechanism and prediction
• **Crosscutting Concept 3:**
Scale, proportion, and quantity
• **Engineering Design:**
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
• **Science and Engineering Practice 1:**
Asking questions and defining problems

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Food coloring
- 8-10 feet White butcher paper or another light-colored surface
- Spray bottle

REQUIRED TECHNOLOGY

- Internet Access: Optional
- Tech Setup: 1 computer per classroom

PHYSICAL SPACE

- Classroom

GROUPING

- Heterogeneous grouping
- Large-group instruction
- Small-group work

BACKGROUND & VOCABULARY

Background Information

The engineering design process is a series of steps that engineers go through to solve a problem. The first step—ask—requires students to ask questions to figure out what problem they are trying to solve, what the goal is, and what the limitations are. In this activity, students consider specific problems that lead to the spreading of germs. Germs are everywhere on various surfaces. Viruses, in particular, can live longer on stainless steel, plastic, and other hard surfaces than on soft materials, and uncovered coughing and sneezing can spread germs. They can live for several hours or up to a few days. For example, an uncovered sneeze can travel as far as 27 feet. As students explore the content about the spread of germs, they will be better able to complete the final product of the unit project of designing a tool or product that helps keep germs from spreading so that they can keep themselves and others healthy.

Prior Knowledge

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Recommended Prior Activities

- Feeling Yucky
- Getting to Know Germs

Vocabulary

Term	Part of Speech	Definition
engineering design process	*noun*	series of steps that guides engineers as they solve problems.
germ	*noun*	disease-producing microbe.
model	*noun*	image or impression of an object used to represent the object or system.

For Further Exploration

Video

- Teach Engineering: Engineering Design Process
- KQED Quest: The Engineering Design Process: A Taco Party
- Science Friday: Challenge: Simulate A Sneeze
- TED-Ed: How Do Germs Spread (and Why Do They Make Us Sick)?