NATIONAL GEOGRAPHIC

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LESSON

Germ-Stopping Solutions

Students learn the final steps of the engineering design process and reflect on an unsuccessful attempt at trying something difficult. After reviewing the final product of the unit project, checklist, and rubric, students finalize their germ-stopping solutions. For their final products, students identify their target audience, prepare outlines, and practice. Students present their designs and complete a unit reflection.

GRADES

1, 2

SUBJECTS

Biology, Health, Engineering

CONTENTS

3 Activities

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ACTIVITY 1: DEVELOPING OUR GERM-STOPPING SOLUTIONS | 45 MINS

DIRECTIONS

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

1. Introduce the next step of the engineering design process—plan by selecting a solution—by reading and discussing a children's book about overcoming obstacles, to prepare students for selecting a possible germ-stopping solution.

- Remind students of the driving question of the lesson (How can we design something that keeps germs from spreading?), the final product of the unit project (to design a tool or product that helps keep germs from spreading), and the problem(s) they are trying to solve.
- Introduce the fourth step of the engineering design process—plan by selecting a solution—by showing students the *Engineering Design Process* poster from Teach Engineering.
- Ask students to think about a time when they tried something difficult and were not successful. Ask students to share that experience with their neighbor or in their small group.

    - Assure students that this is a common feeling in the engineering process, and this step that we are tackling today—plan by selecting a solution—is typically the hardest!

- Introduce a text, such as *Rosie Revere, Engineer* by Andrea Beaty, or a similar story in which a child learns a lesson about engineering from the people in the child's life.

    - Ask students to pay attention to:

        - How Rosie felt throughout the story in response to obstacles and successes.
        - What Rosie learned about engineering.

    - Read the story aloud or show the video *Rosie Revere, Engineer (Read Aloud) by Andrea Beaty* (6:49).
    - Lead a class discussion using the following questions:

        - *How did Rosie feel when she made something for her uncle Fred?* (She was embarrassed and unsure whether he liked her invention or not.)
        - *How did Rosie feel when she made something for her great-great aunt Rose?* (She was embarrassed that her invention crashed and felt like a failure/wanted to give up.)
        - *What lesson did Rosie learn about engineering from her aunt?* (It's a perfect first try! The only failure is quitting.)

    - Let students know that they will apply what they learned about engineering from Rosie to their work in the next step.

2. Facilitate project groups' work on selecting the best solution by providing guiding questions and discussing constraints.

- Share these questions with students to guide their thinking about their solution:

    - *What do we want to design?*
    - *Who is it for?*
    - *What problem are we solving?*
    - *What are the project requirements?*
    - *What are the limitations?*

        - You may need to explain what limitations or constraints are. You might say: *Some examples of constraints or limitations could be money, time, or type of materials. For example, if you were shopping for a birthday gift for your cousin, your constraints might be how much you had to spend, the stores you could shop from before your cousin's birthday, your cousin's age, and your cousin's interests. Limitations help make your solution successful for your context. Let's say your solution is to make hand sanitizer more widely available in your school. One limitation might be HOW MANY dispensers you could have installed. Placing one dispenser every foot would cost a lot of money and probably wouldn't be necessary! However, having a dispenser at the school entry way, one in each classroom, and one before entering the library, office, or cafeteria would be working within the constraints that might limit your design.*

    - *What is your goal? How does your solution help slow the spread of germs that make us sick?*

- Distribute and review the *Selecting a Solution* handout to each student. Help students locate their *Brainstorming Solutions* handout from the previous activity, *Sick Solutions*. Have students work in their project groups to review their previous thinking and discuss their ideas. Students should compare their best ideas using the sentence starters in the *Selecting a Solution* handout and make plans to move forward with one solution per project group. Each student should complete the *Selecting a Solution* handout with their team.
- Let students know that in the next activity, *Designing Our Products*, they will be finishing their solution designs.

Informal Assessment

Class Discussion: Use class discussions to assess students' ability to participate in collaborative conversations in which they demonstrate understanding of key details in a text.

Selecting a Solution Discussion: Use the *Selecting a Solution* small group discussions to evaluate students' ability to follow agreed-upon rules for discussions and build on others' talk in conversations.

Selecting a Solution Handout: Use the *Selecting a Solution* handout to assess students' ability to ask questions, make observations, and gather information about a problem that can be solved through the development of a new or improved object or tool (K-2-ETS1-1), as well as their ability to develop a simple sketch of their tool or product (K-2-ETS1-2).

Extending the Learning

Conduct a focus group or expert review after students select their best solution in their groups or before they make their choice to help students understand the audience and limitations for the solution.

OBJECTIVES

Subjects & Disciplines

Biology
- Health

- Engineering

Teaching Approach

- Project-based learning

Teaching Methods

- Cooperative learning
- Discussions
- Reading

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
  - Life and Career Skills
    - Social and Cross-Cultural Skills
- 21st Century Themes
  - Health Literacy
- Critical Thinking Skills
  - Analyzing
  - Applying
  - Creating
  - Evaluating
- Science and Engineering Practices
  - Constructing explanations (for science) and designing solutions (for engineering)
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.RI.1.1:**
Ask and answer questions about key details in a text.
• **CCSS.ELA-LITERACY.RI.2.1:**
Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
• **CCSS.ELA-LITERACY.SL.1.1.A:**
Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).
• **CCSS.ELA-LITERACY.SL.2.1.A:**
Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).

- **K-2-ETS1-1:**

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

- **K-2-ETS1-2:**

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Preparation

BACKGROUND & VOCABULARY

Background Information

The engineering design process is a series of steps that engineers go through to solve a problem. The fourth step—plan by selecting a solution—includes revisiting needs, constraints, and prior research. In order to design a successful solution, engineers (and students!) have to account for constraints and limitations. In this activity, students collaboratively select the best solution for how to stop the spread of germs to solve a specific problem for a specific context.

Prior Knowledge

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Recommended Prior Activities

- Feeling Yucky
- Getting Rid of Gross Germs
- Getting to Know Germs
- Invisible Villains
- Sick Solutions

Vocabulary

TermPart of SpeechDefinition

ACTIVITY 2: DESIGNING OUR PRODUCTS | 45 MINS

DIRECTIONS

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

1. Connect to the engineering design process and final product of the unit project to prepare students for planning their solutions to keep germs from spreading.

- Remind students of the driving question of the lesson (How can we help our community by designing a germ-stopping solution?), the final product of the unit challenge (to design a tool or product that helps keep germs from spreading), and the problem(s) they are trying to solve.
- Introduce the rest of the engineering design process by showing students the *Engineering Design Process Cycle Graphic.*
- Explain to students that in this unit, they won't fully see through this process since they won't create a prototype, test the prototype, nor improve and redesign their solutions, but they will continue planning their solutions by fully sketching them out and describing them.

2. Provide resources to support students as they create their final products for the unit project.

- Distribute and introduce the *Project Checklist and Rubric*. Review both parts of the document to highlight the different pieces that students will need to complete for their final product and how they will be assessed.
- Distribute the *Final Product* handout. Review the parts of the handout with students:
    - What problem they are solving (and the who/what/where/when/why/how of the problem)
    - Their solution (described in words and labeled drawings)
    - How their solution will solve the problem and slow the spread of germs that make us sick
- As students work in their project groups, prompt them to use their handouts from previous activities to inform their work. Circulate throughout the room to ensure students are adding appropriate detail and using evidence from previous activities as they explain their design solution.

- Let students know that in the next activity, *Sharing Our Solutions*, they will be presenting their solutions.

Informal Assessment

Project Group Discussion: Use students' small group discussions in Step 2 to evaluate students' ability to follow agreed-upon rules for discussions and build on others' talk in conversations.

Final Product Handout: Use the *Final Product* handout and students' collaborative discussions to assess students' ability to ask questions, make observations, and gather information about a problem that can be solved through the development of a new or improved object or tool (K-2-ETS1-1), as well as their ability to develop a simple sketch of their tool or product (K-2-ETS1-2).

Extending the Learning

In addition to the questions listed on their *Final Product* handout, consider asking students how people will feel 1) using their solution and 2) knowing they will keep more people safe. This can connect the beginning and end of the unit with a focus on feelings.

Other options for extensions include a peer review of solutions or creating, testing, and redesigning prototypes of their solutions. Students could progress all the way through the engineering design process and bring their solutions to reality, as time and feasibility permits!

OBJECTIVES

Subjects & Disciplines

Biology
- Health
- Engineering

Teaching Approach

- Project-based learning

Teaching Methods

- Cooperative learning
- Discussions
- Writing

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
  - Life and Career Skills
    - Productivity and Accountability
    - Social and Cross-Cultural Skills
- 21st Century Themes
  - Health Literacy
- Critical Thinking Skills
  - Analyzing
  - Creating
  - Evaluating
- Science and Engineering Practices
  - Analyzing and interpreting data
  - Constructing explanations (for science) and designing solutions (for engineering)
  - Obtaining, evaluating, and communicating information
  - Planning and carrying out investigations

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.RI.1.1:**
Ask and answer questions about key details in a text.
• **CCSS.ELA-LITERACY.RI.2.1:**
Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
• **CCSS.ELA-LITERACY.SL.1.1.A:**
Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).
• **CCSS.ELA-LITERACY.SL.2.1.A:**
Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
• **CCSS.ELA-LITERACY.SL.2.1.B:**
Build on others' talk in conversations by linking their comments to the remarks of other's.
• **CCSS.ELA-LITERACY.W.1.7:**
Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions).
• **CCSS.ELA-LITERACY.W.2.7:**
Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

NEXT GENERATION SCIENCE STANDARDS

• **K-2-ETS1-1:**
Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
• **K-2-ETS1-2:**
Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Preparation

BACKGROUND & VOCABULARY

Background Information

The engineering design process is a series of steps that engineers go through to solve a problem. In this lesson, students build out an explanation and sketch a model of their designs and solutions for how to stop the spread of germs.

Prior Knowledge

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Recommended Prior Activities

- Developing Our Germ-Stopping Solutions
- Feeling Yucky
- Getting Rid of Gross Germs
- Getting to Know Germs
- Invisible Villains
- Sick Solutions

Vocabulary

Term	Part of Speech	Definition
engineering design process	*noun*	series of steps that guides engineers as they solve problems.
limitation	*noun*	something that limits, controls, or reduces; a restrain
solution	*noun*	an answer to a problem.

ACTIVITY 3: SHARING OUR SOLUTIONS | 1 HR 30 MINS

DIRECTIONS

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

1. Assist students as they identify their audience and learn basic principles of public speaking in preparation for presenting their design solutions.

- To prepare for their presentations, students should decide who their audience will be (or you should share the audience you have arranged for them) when they present their products and tools later in this activity. This audience could be their classmates, peers in their school, school administration, their family, experts in public health, or their broader community.

- Once the audience is identified, have students work in their project groups to discuss the following questions:

    - What would this audience want to know?
    - How would our designed solution help them stay healthy?
    - How can we tell the story of how we designed our solutions?

- Next, reconvene the class. Explain that in this activity, they will be preparing to present their solutions to an audience. They will present as a project group. You will share how they will be presenting (in-person to an audience in their classroom, virtually in real-time, via videoed presentations shared online, etc.) Ask students to share what they know about speaking to an audience. Depending on their previous experiences presenting in your class, you might ask questions such as:

    - *What do our voices sound like and not sound like?*
    - *What are our eyes doing and not doing?*
    - *What are our hands doing and not doing?*
    - *What is our message like and not like?*

- Keep a public record of students' ideas on your whiteboard, in a digital document, or on chart paper. (Students may share ideas like:

    - When we present, our voices are strong and clear. We use specific and accurate words to describe our problem and solution. We use school-appropriate words and speak slowly and clearly so that our audience can understand us.
    - When we present, we do our best to look at (or just over) our audience.
    - When we present, our hands can gesture to demonstrate our point, or they can be relaxed at our sides.
    - Our message should be clear and presented in an organized way so the audience can follow along.
    - When we present, we should stand tall and not slouch.)

- Show students the TED-Ed video titled *What Adults Can Learn From Kids* (7:57). Ask students to pay attention to how Adora speaks to her audience, how she gestures, how she stands, and how she uses the visuals to support her speech.

    - Add the principles from the video or article to the students' existing list from the discussion above.

- Encourage students to utilize these principles when they practice their presentations in the next step.

2. Support students as they write their scripts and practice their presentations.

- Explain that one way students can prepare for their presentation is by writing out the main ideas in an outline, or by writing out a script that includes exactly what they will say. Remind students that they are telling the story of how they came to their solutions. If students are presenting in groups, they may decide to have each group member write a different part of the presentation script, but all students in the group should know how the script fits together and provide feedback on the content of their group members' contributions.
- Students should utilize their *Final Product* handout from the previous activity, *Designing Our Products*, to develop their script or outline.
- After developing their script or outline, give students time to practice their presentations with their groups. Remind students of the *Project Checklist and Rubric*, pointing out the final row on the presentation.

3. Lead students in the presentations of their designs.

- Students present their designs using the method most appropriate for your context.
- For external audience members, be sure to introduce (or have students explain) the project and engineering design process that students undertook to design their solutions.
- Provide opportunities for audience members and peers to ask questions of presenting groups.

4. Facilitate students' reflection on the unit.

- Distribute the *Project Reflection* handout. Review the prompts with students. Ask students to complete a self-evaluation/reflection of their work in this project. You may decide to have a whole-class discussion in which students share one or two of their reflections with the class.
- Celebrate the conclusion of the *Germ Problem-Solvers: Using Engineering to Develop Solutions* unit!

Rubric

Public Speaking Discussion: Use the discussion about public speaking to evaluate students' ability to follow agreed-upon rules for discussions, build on others' talk in conversations, and participate in collaborative conversations.

Presentation of Final Product: Use students' presentations of their final product to assess students' ability to ask questions, make observations, and gather information about a problem that can be solved through the development of a new or improved object or tool (K-2-ETS1-1), as well as their ability to develop a simple sketch of their tool or product (K-2-ETS1-2).

Reflection: Use the *Project Reflection* handout to assess students' ability to recall information from experiences or gather information from provided sources to answer a question

Extending the Learning

Students could create, test, evaluate, improve, and redesign their prototypes of their solutions.

OBJECTIVES

Subjects & Disciplines

Biology
- Health

- Engineering

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Modeling
- Reflection

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information, Communications, and Technology Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Creativity and Innovation
  - Life and Career Skills
    - Social and Cross-Cultural Skills
- 21st Century Themes
  - Health Literacy
- Critical Thinking Skills
  - Analyzing
  - Evaluating
- Science and Engineering Practices
  - Obtaining, evaluating, and communicating information

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• **CCSS.ELA-LITERACY.SL.2.1.B:**
Build on others' talk in conversations by linking their comments to the remarks of other's.
• **Writing Standards K-5:**

Research to Build and Present Knowledge, W.2.8

- **Writing Standards K-5:**

Research to Build and Present Knowledge, W.1.8

NEXT GENERATION SCIENCE STANDARDS

- **K-2-ETS1-1:**

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

- **K-2-ETS1-2:**

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Preparation

BACKGROUND & VOCABULARY

Background Information

Scientists communicate their findings with authentic audiences. Additionally, having students share their work with an authentic audience is one of the distinguishing features of project-based learning that makes it authentic and impactful for both students and the community. In short, going public means that the audience for students' work is not confined to their own classroom. They share their work with others, who in turn can provide meaningful feedback about students' ideas, suggestions, and concerns. A public product is a powerful motivator for students. In order to publish a product that they can present to outsiders, students understand that they must hold themselves and their teams to a high standard.

Prior Knowledge

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Recommended Prior Activities

- Designing Our Products
- Developing Our Germ-Stopping Solutions
- Feeling Yucky
- Getting Rid of Gross Germs

- Getting to Know Germs
- Invisible Villains
- Sick Solutions

Vocabulary

Term	Part of Speech	Definition
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