

Engineering Solutions to Freshwater Problems

How do we use engineering to solve location and water-based problems?

Overview

Students brainstorm solutions to location and water-based issues and discuss how these issues were addressed by engineering projects.

For the complete activity with media resources, visit:

<http://education.nationalgeographic.org/activity/engineering-solutions-freshwater-problems/>

Directions

1. Distribute a Student Engineering Projects List handout to each student.

Explain to students that, as a class, you will examine one location and water-based problem, brainstorm potential solutions for this problem, and discuss how engineering was used to actually solve this problem. Then, in groups, students will go through the same process for another project.

2. Introduce the basic problem at the site of one of the projects.

Write the basic problem on the board for one of the projects that you identified in advance from the list that is included on both the Teacher Engineering Project List handout and the Student Engineering Project List handout.

3. Ask students to brainstorm factors that may be important in considering how to address this basic problem.

Below the basic problem, write “Geographic and Environmental Factors” and “Human Factors.” Write an example under each: under “Geographic and Environmental Factors,” write “climate.” Under “Human Factors, write “political issues.” Then ask the students to brainstorm other factors that may be important in considering how to address this problem.

4. Ask students to brainstorm solutions to the problem.

Write “Potential Solutions” on the board. Encourage students, when they are suggesting solutions, to consider the geographic, environmental, and human factors that they have just brainstormed.

Ask: What are ways in which the basic problem could be solved? Do these solutions account for the environmental, geographic, and human factors that we brainstormed?

Possible answers depend on the specific problem discussed but for energy related problems could include ideas such as using solar or wind energy; for water accessibility issues could include ideas such as building wells, using ocean, waste or rain water; and for water storage ideas could include building tanks, digging ponds, filling tanks, and many other responses.

5. Reveal to students how this problem was actually solved.

Read, display, or hand out the description of the solution from the Teacher Engineering Projects List.

6. Discuss how engineering solved this location and water-based problem.

Ask: How does the engineering solution solve the basic problem? Does this solution leave any environmental and/or human factors unaddressed? If so, which? How are your proposed solutions and the actual solution different from or similar to one another? Refer to the group discussion questions on the Teacher Engineering Projects List for topics specific to each project.

7. Introduce the next project.

With students, read through the other projects on the Engineering Projects List handout. Use voting or consensus methods to have students select another project from the handout. Ask one student to read aloud the basic problem of the selected site. Write this problem on the board. Explain to students that they all will work on the same project in their small groups.

8. Ask students to brainstorm in groups.

Ask students to split into groups of two or three and choose a scribe. Tell students to brainstorm factors that might be important in considering how to address this problem. Ask students to consider the Group Discussion Question(s) listed below this project on the Student Engineering Project List handout. After discussing this question or questions, students should brainstorm potential solutions to the problem. The scribe should write the factors and potential solutions down on a sheet of paper.

9. As a class, share factors and potential solutions.

Ask for a representative from each group to share the group's work aloud. Write factors and potential solutions on the board as each representative is speaking.

10. Reveal and discuss how engineers solved this problem.

After each group has had an opportunity to present their findings and solution, read the description of the solution from the Teaching Engineering Projects List handout.

11. Engage students in a concluding discussion.

Use the following or similar questions to engage students in a concluding discussion. Ask: *How did the engineering solution solve the basic problem? Does this solution leave any environmental and/or human factors unaddressed? If so, which? And, what is the potential impact or outcome of leaving this factor unaddressed? Regarding your small group solutions, in what ways did they differ from one another? How did they differ from the actual solution?*

Modification

Throughout the activity, assess student engagement based on amount and quality of participation. When students are brainstorming aloud and in groups, assess answers based on students' inclusion of support, or WHY they made that particular suggestion.

Tip

When planning the lesson, educators should allot about 15-20 minutes for discussion of each project.

Formal Assessment

Have each student select one of the remaining problems and conduct research on the problem and factors impacting the problem. Ask students to prepare a report or presentation proposing a solution to the problem, based on their research.

Extending the Learning

Have upper-level students (grades 11-12) work in pairs or small teams on one of the projects. Ask students to do background research on the project and lead their own class discussions based on how the engineering solution addresses the problem.

Objectives

Subjects & Disciplines

Science

- Engineering

Social Studies

- Technology and civilization

Learning Objectives

Students will:

- Examine different location and water-based problems
- Explore the geographic, environmental, and human factors related to location and water-based problems
- Discuss examples of how engineering can be used to solve location and water-based problems

Teaching Approach

- Inquiry-based learning

Teaching Methods

- Brainstorming
- Cooperative learning
- Discussions

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Learning and Innovation Skills
 - Communication and Collaboration
- 21st Century Themes
 - Global Awareness
- Critical Thinking Skills
 - Analyzing
- Geographic Skills
 - Answering Geographic Questions
 - Organizing Geographic Information

National Standards, Principles, and Practices

National Council for Social Studies Curriculum Standards

• Theme 3:

People, Places, and Environments

National Geography Standards

• Standard 14:

How human actions modify the physical environment

- **Standard 15:**

How physical systems affect human systems

- **Standard 4:**

The physical and human characteristics of places

National Science Education Standards

- **(9-12) Standard F-6:**

Science and technology in local, national, and global challenges

Preparation

What You'll Need

Materials You Provide

- Chalk
- Markers
- Student Handout: Student Engineering Project List
- Teacher Reference: Teacher Engineering Project List
- Whiteboard, chalkboard, or chart paper

Physical Space

- Classroom

Grouping

- Large-group learning
- Small-group learning

Resources Provided: Handouts & Worksheets

- [Freshwater Engineering Student Handout](#)
- [Freshwater Engineering Teacher Handout](#)

Background & Vocabulary

Background Information

An engineer is a person who applies a wide range of science knowledge and skills, problem-solving, information technology expertise, and mechanical expertise to design and build complex products, machines, systems, or structures. Engineers are problem-solvers. Engineering has given us many of the systems and products we rely on daily. Items such as the cars we drive to school, the computers on which we do research, and even the complex systems that bring water and electricity to our homes were all engineered. Engineers apply a wide range of science knowledge and skills, problem-solving, and information technology and mechanical expertise to design and build complex products, machines, systems, or structures. Engineering often involves complex designs that have to be broken down into smaller chunks and problem-solved. Consider reviewing [this engineering process worksheet](#).

All water that flows off land takes pollutants with it. The polluted water flows into small bodies of water

that ultimately lead to larger bodies of water and the ocean. The availability of freshwater is an issue of global significance. It is important to emphasize this to students as you consider why particular projects were developed in certain areas.

Prior Knowledge

["Water Systems", "Renewable Energy Systems"]

Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
algal bloom	<i>noun</i>	the rapid increase of algae in an aquatic environment.
desalination	<i>noun</i>	process of converting seawater to fresh water by removing salt and minerals.
filtration	<i>noun</i>	process of separating solid material from liquids or gases.
potable	<i>adjective</i>	suitable for drinking.
seasonal	<i>adjective</i>	likely to change with the seasons.
sustainability	<i>noun</i>	use of resources in such a manner that they will never be exhausted.

For Further Exploration

Instructional Content

- [National Geographic: Engineering Inspirations from Nature](#)
- [In Your Watershed](#)
- [The Tremendous Travels of Trash](#)

Reference

- [Freshwater](#)

Websites

- [City of Aurora's purification system](#)

None

- [The Role of Water in the Generation of Electricity](#)

