NATIONAL GEOGRAPHIC
Activity*develop*

Using Fresh Water

How is fresh water used on Earth?

Overview

Students explore maps to discover the distribution of fresh water resources on Earth, and they examine graphs to discover how fresh water supplies are used by humans.

For the complete activity with media resources, visit:
http://education.nationalgeographic.org/activity/using-fresh-water/

Directions

1. Engage students in thinking about how fresh water is used.

Tell students in this activity they will be taking a close look at how humans use water—both in direct and indirect ways. They will examine the relationship between freshwater distribution and populations, and they will analyze the costs and benefits of putting dams on rivers and streams. To begin, ask: *How do you use fresh water?* (Student answer will vary, but will include examples like the following: Fresh water is used for drinking, bathing, flushing toilets, and irrigating. Fresh water is also used in electricity production and manufacturing.)

2. Discuss the role of uncertainty in the scientific process.

Tell students that science is a process of learning how the world works and that scientists do not know the "right" answers when they start to investigate a question. We can see examples of scientists' uncertainty in the forecasting of precipitation amounts. Have students go to the NOAA National Weather Service. Ask them to input their zip codes, hit "Go", scroll down to the bottom of the page, and click on the "Hourly Weather Graph". This page shows the hourly weather forecast for your area. The first box shows the predicted temperature and dew point (along with wind chill or heat index, when applicable). The second box shows the predicted wind speed and direction. The third box shows the predicted sky cover (i.e. cloud cover), relative humidity, and chance for precipitation. The boxes below that line show whether the precipitation is likely to be rain, snow, freezing rain, or sleet. Point out the line for precipitation potential (the brown line). Ask:

- *Why is the precipitation shown as a "%"?* (Precipitation is dependent on other factors, such as relative humidity and temperature. It is more likely to precipitate when the temperature is the same as or lower than the dew point.)
- *If there is a likelihood of precipitation, why is the amount of rain/snow shown as ranges?* (The amount of precipitation that will fall is dependent on the amount of moisture in the atmosphere.

The atmosphere is continually changing, so the amounts are guidelines for what could happen rather than perfect predictions.)

**If there is no or low likelihood of precipitation in your area, you may want to find a different location (in the United States) that has a higher likelihood of precipitation. You can look at a current weather map (radar) to find where in the United States precipitation is happening currently. Your students will then be able to see scientists' forecasts of precipitation amounts represented as a range overlaid on the bar graphs.*

Tell students they will be asked questions about the certainty of their predictions and that they should think about what scientific data are available as they assess their certainty with their answers. Encourage students to discuss the scientific evidence with each other to better assess their level of certainty with their predictions.

3. Introduce the concept of systems in Earth's water resources.

Tell students that forecasting what will happen to Earth's fresh water supplies is a complicated process because there are many different interacting parts. Tell students that scientists think about how one part of the system can affect other parts of the system. Give students a simple example of a system, as described in the scenario below.

On an island, there is a population of foxes and a population of rabbits. The foxes prey on the rabbits. Ask:

- *When there are a lot of rabbits, what will happen to the fox population?* (It will increase because there is an ample food supply.)
- *What happens to the fox population when they've eaten most of the rabbits? (The foxes will die of starvation as their food supply decreases.)*
- *What happens to the amount of grass when the fox population is high? (The amount of grass will increase because there are fewer rabbits to eat the grass.)*
- *If there is a drought and the grass doesn't grow well, what will happen to the populations of foxes and rabbits?* (The rabbit population will decrease because they have a lesser food supply. The fox population should also decrease as their food supply decreases.)

Humans introduce dogs to the island. The dogs compete with the foxes over the rabbit food supply. Ask: *What will happen to the populations of foxes, rabbits, and grass after the dogs are introduced?* (The foxes will decrease because they are sharing their food supply, the rabbits will decrease because they have more predators, and the grass will do well because of the lowered impact of the smaller rabbit population.)

Tell students that simple cause-effect relationships can expand into more complex system relationships. Let students know that they will be exploring the relationship between how sediments and rock types affects groundwater movement. Encourage students to think about how human actions play a role in changes in the flow of water and in freshwater availability.

4. Have students launch the Using Fresh Water interactive.

Provide students with the link to the Using Fresh Water interactive. Divide students into groups of two or three, with two being the ideal grouping to allow groups to share a computer work station. Tell students that they will be working through a series of pages of data with questions related to the data. Ask students to work through the activity in their groups, discussing and responding to questions as they go.

Tell students that this is Activity 2 of the **Will There Be Enough Fresh Water?** lesson.

5. Discuss the issues.

After students have completed the activity, bring the groups back together and lead a discussion focusing on these questions:

- *Even if you live in an area where fresh water is plentiful, why do you have to be concerned about the freshwater supply?* (You should still be concerned about the freshwater supply because it can be contaminated by human actions. This would make the fresh water useless even if there was a lot of it.)
- *Are the benefits of dams worth the costs of dams?* (Answers will vary. Some of the benefits of dams are flood control, recreation, and electricity production. Some of the costs of dams are habitat disruption, sediment depletion of river deltas, and loss of surrounding land.)
- *What are some ways that humans have affected the quantity and quality of water supplies around the world?* (Humans have changed the surface, which has allowed less water to infiltrate the surface. They have pulled water out of very deep aquifers in desert areas. They have inadvertently contaminated some water supplies.)

Tip

To save students' data for grading online, register your class for free at the High-Adventure Science portal page.

Tip

This activity is part of a sequence of activities in the lesson Will There Be Enough Fresh Water?. The activities work best if used **in sequence**.

Modification

This activity may be used individually or in groups of two or three students. It may also be modified for a whole-class format. If using as a whole-class activity, use an LCD projector or interactive whiteboard to project the activity. Turn embedded questions into class discussions. Uncertainty items allow for classroom debates over the evidence.

Informal Assessment

1. Check students' comprehension by asking them the following questions:

- How are freshwater resources distributed on Earth?
- What are some direct and indirect uses of water?

2. Use the answer key to check students' answer on embedded assessments.

Objectives

Subjects & Disciplines

Science

- Earth science
- General science

Learning Objectives

Students will:

- describe the relationship between freshwater distribution and populations
- list direct and indirect uses of fresh water
- describe some of the costs and benefits of putting dams on rivers and streams

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Multimedia instruction
- Self-paced learning
- Visual instruction
- Writing

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
    - Critical Thinking and Problem Solving
- Critical Thinking Skills
  - Analyzing
  - Evaluating
  - Understanding

National Standards, Principles, and Practices

National Science Education Standards

• (5-8) Standard A-1:
Abilities necessary to do scientific inquiry
• (5-8) Standard A-2:
Understandings about scientific inquiry
• (5-8) Standard E-2:
Understandings about science and technology
• (5-8) Standard G-1:
Science as a human endeavor
• (5-8) Standard G-2:
Nature of science
• (9-12) Standard A-1:
Abilities necessary to do scientific inquiry
• (9-12) Standard A-2:
Understandings about scientific inquiry
• (9-12) Standard E-2:
Understandings about science and technology
• (9-12) Standard F-4:
Environmental quality
• (9-12) Standard G-2:
Nature of scientific knowledge

Common Core State Standards for English Language Arts & Literacy

• Reading Standards for Literacy in Science and Technical Subjects 6-12:
Craft and Structure, RST.9-10.4
• Reading Standards for Literacy in Science and Technical Subjects 6-12:
Key Ideas and Details, RST.9-10.1
• Reading Standards for Literacy in Science and Technical Subjects 6-12:
Key Ideas and Details, RST.9-10.3
• Reading Standards for Literacy in Science and Technical Subjects 6-12:
Key Ideas and Details, RST.6-8.1

• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.6-8.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.6-8.4
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.11-12.4
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.11-12.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.11-12.1

ISTE Standards for Students (ISTE Standards*S)

• **Standard 3:**
Research and Information Fluency
• **Standard 4:**
Critical Thinking, Problem Solving, and Decision Making

Next Generation Science Standards

• **Crosscutting Concept 1:**
Patterns
• **Crosscutting Concept 2:**
Cause and effect: Mechanism and prediction
• **Crosscutting Concept 3:**
Scale, proportion, and quantity
• **Crosscutting Concept 5:**
Energy and matter: Flows, cycles, and conservation
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 4:**
Analyzing and interpreting data
• **Science and Engineering Practice 5:**
Using mathematics and computational thinking
• **Science and Engineering Practice 6:**
Constructing explanations and designing solutions
• **Science and Engineering Practice 7:**
Engaging in argument from evidence
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

What You'll Need

Required Technology

- Internet Access: Required
- Tech Setup: 1 computer per learner, 1 computer per pair, Interactive whiteboard, Projector

Physical Space
- Classroom
- Computer lab
- Media Center/Library

Grouping
- Heterogeneous grouping
- Homogeneous grouping
- Large-group instruction
- Small-group instruction

Resources Provided: Websites
- NOAA National Weather Service

Resources Provided: Handouts & Worksheets
- Answer Key - Using Fresh Water

Resources Provided: Interactives
- Using Fresh Water Interactive

Background & Vocabulary

Background Information

Freshwater resources are unevenly distributed on Earth's surface. This is due to climatic conditions (precipitation and temperature) and to geological conditions (the ability of water to percolate into the groundwater).

Water is used for many different purposes. Some uses are clear: water for drinking, bathing, and watering plants. Other uses are hidden: industrial processes, electricity production, manufacturing. The obvious uses are called “direct usage”; the hidden uses of water are called “indirect uses”.

As the human population has grown, water use for agricultural, industrial, and municipal uses has increased. Where there is a large amount of water available, there have been relatively few problems. But where water availability is limited, the increased water usage has led some communities to impose bans on unnecessary water use.

Prior Knowledge

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Recommended Prior Activities

- Availability of Fresh Water

Vocabulary

Term	Part of Speech	Definition
agriculture	*noun*	the art and science of cultivating the land for growing crops (farming) or raising livestock (ranching).
aquifer	*noun*	an underground layer of rock or earth which holds groundwater.
dam	*noun*	structure built across a river or other waterway to control the flow of water.
freshwater	*adjective*	having to do with a habitat or ecosystem of a lake, river, or spring.
groundwater	*noun*	water found in an aquifer.
model, computational	*noun*	a mathematical model that requires extensive computational resources to study the behavior of a complex system by computer simulation.
municipal	*adjective*	having to do with local government.
per capita	*adjective*	for each individual.
population density	*noun*	the number of people living in a set area, such as a square mile.
reservoir	*noun*	natural or man-made lake.
runoff	*noun*	overflow of fluid from a farm or industrial factory.
systems-understanding	*noun*	process of comprehending and communicating complex, related sets of information and interactions.

For Further Exploration

Images

- National Geographic: Freshwater Availability

Instructional Content

- National Geographic Education: Our Hydrosphere

Reference

- National Geographic: Encyclopedic Entry: aquifer
- National Geographic: Encyclopedic Entry: watershed
- National Geographic: Encyclopedic Entry: basin
- National Geographic: Encyclopedic Entry: wetland
- National Geographic: Encyclopedic Entry: reservoir

- National Geographic: Encyclopedic Entry: river
- National Geographic: Encyclopedic Entry: lake
- National Geographic: Encyclopedic Entry: water table
- National Geographic Education: Earth's Freshwater
- National Geographic: Encyclopedic Entry: iceberg
- National Geographic: Freshwater Facts and Tips

Partner

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