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LESSON

Water Works

Students compare their own tap water use in light of global freshwater access to develop an understanding of water security. They learn how watersheds work, locate their local watershed, then turn their attention to the importance of Mount Everest's watershed and the people who rely on it. They use a variety of resources to learn about key sources of freshwater. Finally, students collect evidence connecting Mount Everest's ice to water security by exploring maps, analyzing graphs and infographics, reading articles, and more. This lesson is part of the *Peak Water: Mount Everest and Global Water Supply* unit.

GRADES

6 - 8

SUBJECTS

Biology, Ecology, Conservation, Earth Science, Climatology, Geography, Physical Geography

CONTENTS

3 Activities

In collaboration with

educurious
learning that connects

ACTIVITY 1: A DAY WITHOUT WATER | 1 HR 15 MINS

DIRECTIONS

This activity is part of the Peak Water: Mount Everest and Global Water Supply unit.

1. Engage students in a thought experiment to elicit their understanding of their own water usage.

- Ask students to discuss with a partner: *What would happen if you turned on the tap at home and no water came out? What would you do? What if your whole community had no clean water?*
- Prompt students to share ideas and questions in a whole-class discussion.
- Ask students to discuss in pairs and record (on chart paper or scratch paper) when they (or their families) use water throughout the day.
    - Examples of responses may include: showering, brushing their teeth, washing their hands, flushing the toilet, cooking, drinking, laundry, or washing the car.
- On one piece of chart paper for the class, have students write down an estimate of how much water they use in a day, in gallons or liters.
- Discuss the estimates as a class. Ask students if they think the estimates are too high or too low. Ask them how they think those numbers compare to students' water usage around the world.

2. Introduce students to the Sustainable Development Goals and Goal 6: Clean Water and Sanitation.

- Share that, on average, United States residents use about 302-378 liters (80-100 gallons) of water per person per day. Ask students if they think everyone uses the same amount of water around the world. Introduce students to the Sustainable Development Goals (SDGs) before reading the *Goal 6: Clean Water and Sanitation* encyclopedic entry as a class. Ask what is surprising or interesting about this initiative.
- Share the *Clean Water and Sanitation: A Global Report Card* infographic. Have students review the infographic and discuss in pairs what is interesting or surprising to them.
- Introduce the term "Day Zero" with regards to water: the day when citizens run out of clean drinking water.
    - Use Cape Town and India as examples of places that are experiencing crises in accessing reliable water sources.
- Distribute the *Project Journal: A Day Without Water*. Direct students to respond to the first three prompts, and to reflect on their understanding of the infographic, Sustainable Development Goal 6, and the concept of "Day Zero."

3. Show a short video and lead a class discussion for students to build on their understanding of the need for clean water.

- Show the *Why Care About Water* video:
    - Before starting the video, ask these two questions to guide student viewing: *If we have so much water in the oceans, why is freshwater so scarce? How are we using water?*
- Encourage students to share reactions to the video and discuss the questions first with a partner and then as a class.
- Direct students to respond to the fourth prompt in their Project Journal and reflect on the video.

4. Introduce students to the National Geographic and Rolex Perpetual Planet Extreme Expedition to Mount Everest and how it connects to the unit project.

- Ask students to discuss with a partner: *Where do you think the world's freshwater comes from?*
- Tell students that in April 2019, a team of scientists embarked on an expedition to the world's highest peak, Mount Everest, to study the stores and flows of water high in the Himalaya. Show the *Inside the Perpetual Planet Expedition to Mount Everest* video.
- Introduce students to the *Peak Water: Mount Everest and Global Water Supply* unit's driving question (Why does Mount Everest's ice matter?) and project.
    - For the final project, students propose a public education outreach campaign to creatively inform their community about human impacts on water security and inspire citizens to take action.
    - The final project will be guided by an evidence-based scientific argument that explains how increases in the human population and consumption of resources have impacted the glaciers and snowpack of Everest, as well as the water supply in other parts of the world.
    - Outreach teams will identify a key message and objective for their campaign and draft a design for one visual component of their campaign, such as a mural, public art installation, billboard, video storyboard, or other creatively informative project appropriate to their community.

    - In a detailed and annotated sketch of their proposed public education campaign, teams portray how they will communicate one key message that relates to the significance of Everest and the Himalaya or a local water supply issue. in a culminating exhibition, teams pitch their campaign plan by presenting their design sketch and explaining how data and supporting evidence guided their public message and design choices.
    - Students should be challenged to represent a cause and effect relationship between human activities and water supply in their campaign to convey a message about water conservation.
    - Explain that throughout the unit, students will receive a Project Journal after each activity to reflect on what they've learned. Students' journal responses can then serve as the inspiration or basis for their final product.
    - Distribute and review the *Human Impact on Water Security Campaign: Project Rubric* to ensure students are clear on how their final projects will be assessed.

- Create a class *Know and Need to Know* chart based on students' understanding and questions about the *Peak Water: Mount Everest and Global Water Supply* unit.

    - Use the process below to elicit and record students' ideas and questions, which will be revisited throughout the unit.
    - Ask students to discuss the following questions with a partner and then share their responses with the class:

        - *What do we already know about Mount Everest and clean water?*
        - *What do we need to know about Mount Everest and clean water in order to design our campaign and scientific argument that explains how humans impact the water supply?*

Tip

Step 2: To learn more about the Sustainable Development Goals, visit this United Nations site.

Tip

Step 4: To learn more about facilitating a *Know & Need to Know* chart in project-based learning, this PBL Works blog provides explanations and examples. Keep this chart handy, as it will be referred to throughout the unit.

Modification

Students can also sketch in a notebook for the entire unit rather than in the Project Journal handouts for each activity.

Informal Assessment

Students' responses to class discussions provide input on their understanding of water security. Additionally, student responses to the infographic and their thoughts about going without clean tap water for a day will be recorded in their *Project Journal: A Day Without Water*. You may decide to collect these journals at the end of each activity to provide feedback or check for completion, and then redistribute them to the students for use in their final project.

Extending the Learning

If time allows, watch and discuss the *Countdown to Day Zero: Cape Town's Water Crisis* video to continue to make connections to how water conservation is an urgent global issue.

Provide students with the *Sustainable Development Goals* article to further student understanding of the goals and progress towards them.

OBJECTIVES

Subjects & Disciplines

Biology

- Conservation

Earth Science

- Climatology

Geography

- Physical Geography

Learning Objectives

Students will:

- Understand that water is a natural resource on which humans rely.

- Explain the reasons for the urgency of water conservation.
- Orient to the National Geographic Extreme Expedition to Mount Everest and the project for the Peak Water: Mount Everest and Global Water Supply unit.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Reading
- Reflection

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
- Science and Engineering Practices
  - Analyzing and interpreting data
  - Asking questions (for science) and defining problems (for engineering)
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and Effect
• **MS-ESS3-4:**
Construct an argument supported by evidence for how increases in human and natural resources impact Earth's systems.
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 2:**
Developing and using models
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

BACKGROUND & VOCABULARY

Background Information

Millions of people worldwide are without clean water. As more cities, countries, and regions are faced with water shortages, it's critical for water security that we protect our freshwater sources like glaciers, snowpack, groundwater, lakes, and rivers. Cape Town, South Africa, and some regions of India are already experiencing this water scarcity as they approach what some call "Day Zero," the day the water runs out. Mount Everest (and other mountains) contain precious freshwater in their glaciers and snowpack. Some scientists refer to these mountains as "water towers" because they provide freshwater for people in an area, just like human-made water towers store water for people in cities and towns.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
freshwater	*noun*	water that is not salty.
Mount Everest	*noun*	highest spot on Earth, approximately 8,850 meters (29,035 feet). Mount Everest is part of the Himalaya and straddles the border of Nepal and China.
sanitation	*noun*	promotion of hygiene, health, and cleanliness.
water tower	*noun*	elevated structure used for storing water.

ACTIVITY 2: WATERSHEDS | 1 HR 40 MINS

DIRECTIONS

This activity is part of the Peak Water: Mount Everest and Global Water Supply unit.

1. Introduce watersheds, how they work, and why they are important, through a reading activity and video.

- Provide the *Watershed* encyclopedic entry and the *What is a Watershed?* worksheet to students. Explain that the purpose of reading the entry is to understand what a watershed is and why it's important to keep watersheds clean.
- Students should read the article in pairs and capture big ideas in the Frayer Model on their worksheet, to start to understand how water moves through an area.
- Have students watch the *What is a Watershed?* video for a clear, brief description about what a watershed does. Students should add to or change their responses to the Frayer Model as new information or ideas arise in the video.
- As a class, locate the watershed for your school's local area using the U.S. Geological Survey's (USGS) *Watershed Finder*.
- In pairs and using Google Earth with satellite view, have students follow the path of water when it rains in your school's local area to the nearest large body of water. Ask students to identify nearby areas of interest such as major cities, wildlife preserves or forests, wetlands, or industrial areas.

    - Ask students to discuss this question in pairs: *If rain falls over your whole local watershed and drains into the nearest body of water, what could get washed into the water with the rain?* (Students may say pesticides, pollution, animal waste, anything that is on the land.)

2. Lead students through several maps to identify the populations and location of major cities in the Mount Everest watershed.

- Project the *Mapping Mount Everest StoryMap* and navigate to the "The Big Picture" section to illustrate that the Himalaya, of which Mount Everest is the highest peak, are in the headwaters of watersheds, which are home to approximately 630-700 million people. Tell students that since the mountain straddles the Nepal-China border, the mountain is called Sagarmatha in Nepal and Qomolangma in China. Remind students that over the course of the unit, they will explore the health of the watersheds served by Everest and communities that rely on those watersheds. Guide students through the steps below to become familiar with Everest's geography and watershed.

    - First, have students work in pairs to locate Mount Everest on Google Maps. Next, have them find the Sapt Kosi River (sometimes called the Kosi or Koshi River). The Sapt Kosi River can be found in Nepal and India. This river drains the region surrounding Everest and flows into the Ganges (Ganga) River. Have students follow the water from Everest, through the Ganges Basin, to the Ganges River, to the Bay of Bengal. Ask students to identify nearby areas of interest such as major cities, wildlife preserves or forests, wetlands, or industrial areas.
    - Ask students to discuss this question in pairs: *If rain falls over this whole watershed and drains into the nearest body of water, what could get washed into the water with the rain?* (Students may say pesticides, pollution, animal waste, anything that is on the land.)
    - Project "The Himalayan Drainage" section of the *Mapping Mount Everest StoryMap* to show the class the other watersheds surrounding the Himalaya. Read the caption aloud to help students interpret what they are seeing. Have students locate the Ganges-Brahmaputra River Basin. Explain that students will be reading stories of individuals who live here in the next step of this activity.
    - Scroll to the "Downstream Populations" section of the *Mapping Mount Everest StoryMap* to show students how the water from the Himalaya serves large populations (the red shading indicates population levels). Read the caption aloud to help students interpret what they are seeing. Tell students that part of the unit project includes considering what might happen to these individuals if their water source becomes polluted or if there is not enough water for them.
    - Scroll to the "Urban Centers" section of the *Mapping Mount Everest StoryMap* to show students that large cities rely on the water from the Himalaya. Ask students to

locate and identify the populations and names of the three largest cities in the Everest watershed.

3. Facilitate students' investigation of stories of people living in Everest's watershed to illustrate how water plays a critical role in these individuals' lives.

- Distribute the *Living in the Mount Everest Watershed* article which illustrates how water is a central focus of life for bamboo traders on the Sap Kosi River, farmers of the Sapt Kosi River Basin, Hindus visiting the Ganges River, and women and girls collecting water in India.
    - Have students read in pairs one of the four stories of people who rely on water from Everest's watershed.
    - Share that the purpose for reading these stories is to understand how water plays a critical role in the lives of these individuals.
- Students discuss the story with their partner, in preparation for journaling about their own response in Step 4.

4. Prompt students to reflect on what they have learned in this activity in their Project Journal.

- Distribute the *Project Journal: Watersheds* and ask students to reflect on the path of water within their own watershed, Everest's watershed, and the article.
- Additionally, ask students to record evidence from this activity to support the claim that humans impact Earth's systems.

5. Lead a class discussion to revisit the *Know & Need to Know* chart.

- Revisit the class *Know & Need to Know* chart created in the *A Day Without Water* activity for students to see how their thinking and understanding about water is already changing.
- Ask students to discuss with a partner:

    1. *What do we already know about the importance of Everest's ice?*
    2. *What do we need to know?*
    3. *What questions can move from the* Need to Know *to the* Know *column?*

- Prompt students to share ideas and questions in a class discussion. Record new ideas and revise their questions as needed in the *Know & Need to Know* chart.

Tip

Step 1: Read more here to learn more about the purpose of and teaching with the Frayer Model.

Modification

Step 1: You may want to pre-identify difficult vocabulary from the reading (like “endorheic” or “phosphorous”) and visit the links embedded in the reading with students before having students read independently.

Tip

Step 1: Google Earth indicates surface elevation at the bottom of the computer screen when you move your mouse around. Point out that elevation (and slope) can help students figure out the direction of water flow.

Informal Assessment

Students’ responses to class discussions and on the *What is a Watershed?* worksheet provide input on their understanding of watersheds. Additionally, students record their responses to specific prompts in the *Project Journal: Watersheds*. You may decide to collect these journals at the end of each activity to provide feedback or check for completion, and then redistribute them to the students for use in their final project. The *Know & Need to Know* chart also serves as an assessment of their collective learning.

Extending the Learning

As time allows, have students Build a Watershed or complete the *In Your Watershed* activity to relate the components of a watershed to point and nonpoint pollution. You may also want to explore the *Aquifers* article with students so they can understand the movement and sources of underground water.

OBJECTIVES

Subjects & Disciplines

Biology

- Conservation

  Earth Science
  - Climatology

  Geography
  - Physical Geography

Learning Objectives

Students will:

- Understand the role of watersheds in water security.
- Locate their own watershed.
- Understand the impact of humans on water resources within watersheds (in terms of pollution and water availability).

Teaching Approach

- Project-based learning

Teaching Methods

- Multimedia instruction
- Reading
- Reflection

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Environmental Literacy

- Critical Thinking Skills
  - Analyzing
- Geographic Skills
  - Acquiring Geographic Information
  - Asking Geographic Questions
- Science and Engineering Practices
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.SL.7.1:**
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on Grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and Effect
• **MS-ESS3-4:**
Construct an argument supported by evidence for how increases in human and natural resources impact Earth's systems.
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 2:**
Developing and using models
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

BACKGROUND & VOCABULARY

Background Information

Millions of people worldwide are without clean water. As more cities, countries, and regions are faced with water shortages, it's critical for water security that we protect our sources of freshwater like glaciers, snowpack, groundwater, lakes, and rivers. This activity focuses on watersheds and helps students understand what watersheds are, where their watershed is, and where the Mount Everest watershed is. Sometimes watersheds are known as drainage basins or catchments.

Prior Knowledge

["Students should have an understanding of what freshwater is and why freshwater is important."]

Recommended Prior Activities

- A Day Without Water

Vocabulary

Term	Part of Speech	Definition
drainage basin	*noun*	an entire river system or an area drained by a river and its tributaries. Also called a watershed.
Ganges River	*noun*	(2,495 kilometers/1,550 miles) river in South Asia that originates in the Himalaya and empties into the Bay of Bengal. Also called the Ganga.
headwater	*noun*	source of a river.
Mount Everest	*noun*	highest spot on Earth, approximately 8,850 meters (29,035 feet). Mount Everest is part of the Himalaya and straddles the border of Nepal and China.
river basin	*noun*	land drained by a river and its tributaries
tributary	*noun*	stream that feeds, or flows, into a larger stream.
watershed	*noun*	entire river system or an area drained by a river and its tributaries.

ACTIVITY 3: PRECIOUS FRESHWATER | 2 HRS 5 MINS

DIRECTIONS

This activity is part of the Peak Water: Mount Everest and Global Water Supply unit.

1. Guide students in their exploration of maps and diagrams related to freshwater availability and connect it to the Ganges (Ganga) River Basin, one of the most populated river basins in the world and found at the base of Mount Everest.

- Distribute or project the *Freshwater Availability* map. Ask students what they notice about where our readily accessible freshwater is located.
    - Ask students to identify their location on the map.
    - In pairs, have students interpret the map to see if their country is in an area of water scarcity, stress, or vulnerability.
    - Have students work with a partner to find out how much water is available per person in their country, according to the map.
    - Circulate findings to encourage discussion and provide assistance as needed.

- Next, assist students in locating India, where the Ganges River Basin is mostly located, on the map. Explain its source, its connection to the Himalaya, and how it connects to the *Peak Water: Mount Everest and Global Water Supply* unit.
    - In pairs, have students interpret the map to find out if India is in an area of water scarcity, stress, or vulnerability.
    - Have students work with a partner to find out how much water is available per person in India, according to the map.

- Ask students: *Why do you think freshwater is so scarce globally, despite the fact that the Earth is covered in water?* Show the *Water Distribution on Earth* diagram.
    - Have students use the diagram to identify what percentage of Earth's water is saltwater (97.5 percent) and the three major sources of freshwater (lake and river storage, groundwater, and glaciers/snowpack).
    - Ask: *Of the three major sources of freshwater, where is the bulk of freshwater stored? What do you find surprising about this information?*

- Connect the discussion to Everest by asking students: *Which of these three major freshwater sources do you think that people living near Everest rely upon?* (Elicit student ideas; no correct response needed at this point.)

2. Facilitate student learning of groundwater, snowpack, and glaciers as sources of freshwater.

- Highlight the importance of groundwater, snowpack, and glaciers as sources of freshwater in local watersheds.

    - Show students this image of Mount Everest and ask if they think there is any freshwater in this picture.
    - Students should recognize that the snow and ice they see is freshwater. If needed, remind students of the three sources of freshwater, as identified in Step 1: lake and river storage, groundwater, and glaciers/snowpack.
    - Use the EarthPulse *Interactive Everest Map* to show students how the snowpack on Everest and the surrounding mountains contributes to the surface water storage of the surrounding area.

        - Under "Contextual," turn off the "Expedition Route, Camps, and Settlements" widget and turn on the "Basin" widget. Under "Supply," turn on the "Surface Water Storage" widget. Then use the minus sign in the top right corner of the map to zoom out so that multiple peaks and the basin outline are visible.
        - Help students interpret what they are seeing. The bright yellow line indicates the outline of the Ganges-Brahmaputra River Basin. (When the "Expedition Route" widget is turned on, the Nepal-China border is visible in gray, and the expedition route is visible in dark yellow.) Dark blue represents water that is there year-round, whereas light blue is surface water that is there seasonally.
        - Ask students: *What do you notice about surface water in the basin? Are there large reservoirs of surface water?*

    - Now use the map to help visualize snow cover along the expedition route to help students see where most of the water is held.

        - To do so, reload the page to reset the map. The "Expedition Route, Camps, and Settlements" widget will now be on. Under "Supply," turn on the "Snow Covered Area" widget. Use the minus sign in the top right corner of the map to zoom out so that the entire expedition route is visible, and be sure that the legend is also visible.
        - Ask students what they notice about snow cover along the expedition route. How does it compare to coverage by surface water? (Students should see that snow covers more area than surface water.)
        - Repeat the same steps for "Glaciers." Reload the page to reset the map. The "Expedition Route, Camps, and Settlements" widget will now be on. Under "Supply," turn on the "Glaciers" widget. Use the minus sign in the top right corner

of the map to zoom out so that the entire expedition route is visible. Make sure that the legend is also visible.

- Next, visit the EarthPulse *Everest Snow Cover Graph*.
    - Help students toggle between "Yearly Historical" and "Monthly 2018" graphs to visualize trends in snow cover in the Ganges-Brahmaputra River Basin. Ask: *How has snow cover changed over the years in this region? If this trend continues, what might occur?*
- Preview the *Glacier* encyclopedic entry by showing the images and providing the definition of a glacier at the top of the article. Tell students that the Gangotri Glacier is one of the largest glaciers in the Himalaya and one of the major sources of water for the Ganges River. Use the interactive *Mapping Mount Everest* StoryMap to show students the images of the Khumbu Glacier.
- Preview the *Aquifer* article by showing students the diagram and providing the definition of an aquifer at the top of the article.
- Distribute the *Comparing Sources of Freshwater* student worksheet. Direct students to discuss the similarities and differences between a glacier and an aquifer with a partner, and then record their ideas in the first section of the worksheet.

- Follow the steps below to lead students in a jigsaw reading activity.
    - Organize students into groups of four. Assign each student to skim one of the following encyclopedic entries: *Groundwater*, *Snowpack*, *Lake*, and *River*.
    - Explain to students that to skim an article means they will be looking for key facts and concepts, including:
        - The definition of the freshwater source.
        - What uses humans have for the freshwater source.
        - Answers to the prompts in part two of the *Comparing Sources of Freshwater* worksheet.
        - After students skim their article, pair them with others who reviewed the same article to complete the corresponding section in part two of their worksheet, before returning to their original groups.
        - In their original groups, students take turns sharing what they learned about their source of freshwater with the other members and work to complete part two.

- Lead a discussion that synthesizes the importance of these sources of freshwater. Remind students that of the three sources of freshwater, the bulk of freshwater comes from glaciers and permanent snowpack.

3. Assist students as they analyze an infographic and note the connection between the population in the Ganges-Brahmaputra River Basin and the significance of glaciers and snowpack to the rivers.

- Distribute or have students open the *River Basins and their Hydrological Significance* Infographic (found on page 8). Explain that watersheds and river basins (or drainage basins) are sometimes used interchangeably. Explain that hydrological means related to the study of water. Highlight the challenge of flooding in river basins.
- Distribute the *Project Journal: Precious Freshwater*. Support students in interpreting the map by first having them locate the Ganges River Basin.
    - Ask: *What level of significance do the glaciers and snow have on the rivers there*? Students should see that it has a high significance.
    - Ask: *What level is the population, in millions, of that region?* Students should see that it is about 400 million.
- Then have students locate the Brahmaputra River Basin. Working in pairs or small groups, have students answer these questions in section one of their Project Journal:
    - Ask: *What level of significance do the glaciers and snow have on the rivers there*? Students should see that it has a high significance.
    - Ask: *What level is the population, in millions, of that region?* Students should see that it is about 100 million.
- Ask students to summarize the connection between glaciers/snow and the freshwater available to the combined 500 million people. They should be able to note that the glaciers and snowpack are highly significant to the rivers.
    - Ask: *If something were to happen to the glaciers and snow, what would happen to the rivers (and the people who rely on these rivers) in this watershed?* (Suggested response: In the short term, there would be more flooding. In the long term, we are unsure, but water resources coming from glaciers would likely not be available during the dry season.)

4. Prompt students to reflect on what they have learned in this activity in their Project Journal.

- In the *Project Journal: Precious Freshwater*, have students reflect on global freshwater availability and the connections between freshwater availability and human population in the regions around Everest. Additionally, ask students to record evidence from this activity to support the claim that humans impact Earth's systems.

5. Assess students' understanding of *Water Works* lesson of the *Peak Water: Mount Everest and Global Water Supply* unit through an exit ticket.

- Use the questions below to assess students' understanding of the main concepts covered in this lesson. Have students respond individually to the following questions as an exit ticket:
    - You told your older brother that he should turn off the water while he brushes his teeth to conserve water. He said, "Earth is covered in water. Brushing my teeth while I run the water won't hurt anything because water is basically everywhere." Is our supply of freshwater endless? What if everyone on Earth did what he did. Using what you learned in the *Water Works* lesson, write a scientific claim to share with your brother connecting his personal water use to his impact on the environment. Include evidence from the *Water Works* lesson and use reasoning to connect your claim to your evidence.
    - Your neighbor likes to change her car's oil at home and dump it down the storm drain. She also washes her car in the driveway. Your other neighbor puts fertilizer on his grass and runs his sprinklers twice a day. Using what you've learned from the *Water Works* lesson, explain how these actions impact the people, animals, plants, and freshwater sources in your watershed.

Modification

Step 2: For the jigsaw reading activity, you may decide to use this *Rivers* encyclopedic entry if you prefer a shorter version for students who may require reading support.

Tip

Step 3: The River Basins and their Hydrological Significance infographic highlights the challenges of floods—of too much freshwater in the near term—as much as a drought. The Ganges, for example, is expected to see an increase in river flows for most months as the climate warms this century.

Informal Assessment

Students' responses to class discussions provide input on their understanding of freshwater availability. Use the *Comparing Sources of Freshwater* worksheet as an opportunity to understand students' ideas about freshwater, as they analyze and compare the different types of freshwater sources. Students also record responses to prompts in the *Project Journal: Precious Freshwater* related to their readings and maps. Use the exit ticket in Step 5 to assess students' understanding of the main concepts presented in the *Water Works* lesson of the *Peak Water: Mount Everest and Global Water Supply* unit.

Extending the Learning

As time allows, consider leading students through this *Just a Drop in the Bucket* demonstration to help them visualize how freshwater is a limited resource.

Step 1: You may want students to read the *Ganges River Basin* encyclopedic entry to anchor them in the location before looking at the *Freshwater Availability Map.*

Step 2: You may decide to use this *Aquifers* encyclopedic entry instead of the shorter article provided.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology
- Conservation

Earth Science

- Climatology

Geography

- Physical Geography

Learning Objectives

Students will:

- Explain why freshwater is in short supply.
- Identify sources of freshwater.
- Create a cause and effect pathway between the snowpack and glaciers and the population of the Ganges Basin.

Teaching Approach

- Project-based learning

Teaching Methods

- Jigsaw
- Reading
- Reflection

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
  - Applying
  - Understanding

- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
  - Answering Geographic Questions
  - Asking Geographic Questions
- Science and Engineering Practices
  - Analyzing and interpreting data
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.WHST.6-8.9:**
Draw evidence from informational texts to support analysis, reflection, and research.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and Effect
• **MS-ESS3-4:**
Construct an argument supported by evidence for how increases in human and natural resources impact Earth's systems.
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 2:**
Developing and using models
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

BACKGROUND & VOCABULARY

Background Information

Freshwater is water that is not salty and could be used for human consumption. Groundwater, snowpack, glaciers, lakes, rivers, and other forms of surface water are sources of freshwater. Mount Everest and nearby glaciers are a source of freshwater in the Everest watershed, otherwise known as the Ganges (Ganga) River Basin, or more expansively, the Ganges, Brahmaputra, Meghna River Basin. The GBM (Ganges, Brahmaputra, Meghna) River Basin serves an approximate 630-700 million inhabitants. Water demand is increasing for these individuals, yet snowpack and glaciers are threatened. For the Ganges, snow/ice melt is currently a minor input compared to precipitation. The Indus (home to the second-highest mountain in the world—K2, and draining through Pakistan) emerges as extremely glacier-dependent.

Prior Knowledge

["Students will be more successful in this activity if they have a foundational understanding of what freshwater is, what watersheds are, and why freshwater is so scarce."]

Recommended Prior Activities

- A Day Without Water
- Watersheds

Vocabulary

Term	Part of Speech	Definition
aquifer	*noun*	an underground layer of rock or earth which holds groundwater.
Ganges River	*noun*	(2,495 kilometers/1,550 miles) river in South Asia that originates in the Himalaya and empties into the Bay of Bengal. Also called the Ganga.
Gangotri Glacier	*noun*	large glacier in the Himalaya Mountains, the source of the Ganges (Ganga) River.
glacier	*noun*	mass of ice that moves slowly over land.
groundwater	*noun*	water found in an aquifer.
hydrological	*adjective*	having to do with the study of water.
lake	*noun*	body of water surrounded by land.
river	*noun*	large stream of flowing fresh water.
snowpack	*noun*	layers of snow that naturally build up during snowfalls.
water scarcity	*noun*	situation when the amount of water available does not meet the amount of water needed or wanted by a population.

Term	Part of Speech	Definition
water stress	*noun*	situation faced by a nation or community when the amount of available water is less than 1,700 cubic meters per person.
water vulnerability	*noun*	threats to the supply of freshwater such as aquifer depletion, contamination from human and natural sources, and the effects of climate variability and change.