NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
LESSON

A Shift in Supply and Demand

Guided by the National Geographic and Rolex's Perpetual Planet Extreme Expedition to Mount Everest in 2019, students explore the relationship among reduced snowpack, human population, and water security, and how Everest climbers impact watersheds. They explore real-time weather data from the highest operating weather stations in the world, analyze infographics, and engage with interactive maps and graphs. Students write a scientific argument linking the human population to freshwater supply and learn how scientific ideas can be creatively conveyed to the public in preparation for creating their final project. 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

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learning that connects

ACTIVITY 1: WATER TOWERS AND SHRINKING GLACIERS | 1 HR 40 MINS

DIRECTIONS

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

1. Introduce students to the term "water tower" as it relates to Mount Everest and discuss how scientists on the National Geographic and Rolex Perpetual Planet Extreme Expedition to Mount Everest sought to investigate the health of this water tower.

- Tell students that scientists refer to mountains as "water towers" because they hold massive amounts of freshwater in the form of snowpack and glaciers. Provide the *Water Towers* encyclopedic entry for students, and direct them to read it in pairs.
- In a class discussion, highlight the role of "water towers" in water security.
    - Explain that through snowmelt, mountains provide water for people in the surrounding area, just like water towers in the United States hold water for a city. The Himalaya provide water for hundreds of millions of people; as the highest peak of the Himalaya, Mount Everest is one of Earth's most critical water towers.
- During the Perpetual Planet Expedition to Mount Everest, scientists installed the two highest operating weather stations in the world to better understand the health of this "water tower." Show students the *Weather Stations on Mount Everest* map and have them locate the Balcony Station.
- Distribute the *Project Journal: Water Towers and Shrinking Glaciers.* Then have students visit the EarthPulse *Everest Weather Data* to investigate the real-time weather data being collected by the Balcony Station.
    - Students should work in pairs to find the temperature, wind, barometric pressure and relative humidity. (If students need clarification on these terms, preview the terms as a class using the National Geographic glossary.) Have students record these terms in their Project Journal.
    - Have students repeat this process for the other weather stations by selecting them from the dropdown menu. This will illustrate the importance of the network, since data from the network of weather stations is more informative than data from only one station.
    - Then ask them to discuss with their partner: *What is surprising to you, if anything, about this data? What could scientists learn from this data about the relationship between weather and snowpack?*
- Show the *Real-Time Data* video about the installation of these weather stations during the Perpetual Planet Expedition to Everest and the data they collect and transmit. Have students pay attention to *why* explorers are installing weather stations on Everest.

    - Ask: *How does the weather data help people experience Mount Everest?*
    - In pairs, ask students to discuss how real-time data is helpful to scientists and citizens.
    - Encourage students to share big ideas or surprising information with the larger group.

- Prompt students to record their responses in their Project Journal.

2. Facilitate students' investigation of the importance of snowmelt in the Sierra Nevada mountains.

- Turn students' attention to mountains in the United States. Before they read the article or investigate the interactive map, ask students if they think there is a trend toward more or less snowpack in the Western United States. (Some students may predict correctly that there is a trend toward less snowpack overall. However, a correct response is not necessary at this time.)
- Have students read the *Snowpack + Snowmelt = Water* article from the National Oceanic and Atmospheric Administration (NOAA) in pairs.

    - Ask: *How does a water tower's snowpack connect to water availability in the surrounding watershed*? (Less snowpack leads to less water availability.)

- Have students use the *Draining California* interactive to help visualize the geography of the state and how snow in the Sierra Nevada mountains connects to the water needs of farmers and cities in the faraway Central Valley.

    - Begin by showing students the location of the Rubicon Peak 2 snow sensor (in the image on the "Managing Snowmelt" part of the interactive). Connect this snow sensor to the Everest weather stations that students explored in Step 1. Highlight the importance of scientists collecting data on snowfall and reservoir levels.
    - Next, have the students work in pairs to scroll through the interactive at their shared computer. They should read the detailed information on the left side of the interactive.

- Have students navigate to the *When the Snows Fail* interactive and locate and use the *Impact of Snowpack* infographic to interpret trends in snowpack from 1955-2014.

    - Ask: *Overall, is there an increase or decrease in snowpack, based on this infographic?* (Students should see that, according to the infographic, even though there are places

of increased snowpack, the trend in most of the areas reporting snowpack is that there is significantly less.)

- Have students go to their Project Journal to create cause-and-effect pathways, following the snowpack of the Sierra Nevada to the water needs of people in the Central Valley.

3. Help students connect their learning to the Mount Everest watershed and journal their responses.

- Invite students to share their cause-and-effect pathways with a partner or small group. Ask what trend(s) they are seeing in the snowpack of the Sierra Nevada mountains.
- Ask students if they think the same trend they observed from the interactive occurring in the Central Valley (decreasing snowpack in the "water towers" of the Sierra Nevada mountains leading to decreasing water in the surrounding watershed) is occurring in the Everest watershed.

    - In pairs, have students read the segments "People and Glaciers" and "Threats to Glaciers" in the *Glacier* encyclopedic entry.
    - In pairs, have students discuss the following questions and record them in their Project Journal before discussing as a class:

        1. *How do people benefit from glaciers?*
        2. *What threats are there to glaciers? What is the effect of these threats on the glaciers?*
        3. *How will the affected glaciers impact humans and other organisms?*

- Show the Retreat of the Gangotri Glacier from 1780-2001. Have students share their observations by asking: *What do you notice about the trend in this glacier's size over time?* (The glacier is getting smaller as the years go by.)

    - Show students the EarthPulse *Interactive Everest Map*. Under "Supply," turn on the "Glaciers" widget and observe the difference between the glaciers in 1962 and 2015. Ask students: *What do you notice about the trend in these glaciers' size over time?*

- Have students visit EarthPulse *Everest Snow Cover Graph*, either in class or in pairs.

    - Give students time to analyze the graph. Ask them to identify: *What do you notice about the data regarding snow cover over the last few years?* (Students should see

that although there is a large spike in max snow cover between 2016-2018, the mean snow cover over the last 18 years has declined slightly, from 2.9 percent to 2.7 percent.)
    - Have students analyze the EarthPulse *Everest Glacial Extent Graph*. Ask them to identify: *What does this graph show about the projected future size of glaciers in the Ganges (Ganga)-Brahmaputra River Basin?* (Students should use the graph to see that the current glacial extent on the graph is 19,200 km^2 and the projected glacial extent is 6,410 km^2 by the year 2100, which is significantly smaller.)

- Then have students consider human impacts on glaciers and Everest by leading a class discussion. Ask:

    - *What factors are causing glaciers and snowpack to melt?* (Students should note changes in climate; this is also an opportunity for students to brainstorm questions they have about these factors.)
    - *What might happen to individuals' accessibility to water in the short term if these "water towers" lost water too quickly due to melting glaciers?*

        - (In the near-term, we expect river flow to increase for the major Himalayan rivers.)

    - *What might happen to individuals' accessibility to water in the long term if these "water towers" did not have enough snowpack or enough water in glacier stores?*

        - (Reduced snowpack could lead to reduced freshwater availability for humans over the long term.)
        - Remind students about their responses to this question in the *Precious Freshwater* activity, as they may want to add to or revise their answers.

- Students finalize their responses to the prompts in their Project Journal for this activity and share big ideas in a class discussion.

4. Revisit *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 Mount 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 whole class discussion. Record new ideas and revise their questions as needed in the *Know & Need to Know* chart.

Informal Assessment

Students' responses to class discussions will provide input on their understanding of how glaciers and snowpack are being impacted by humans. Additionally, students will journal their responses to the readings and infographics in their *Project Journal: Water Towers and Shrinking Glaciers*, which is to be collected at the close of each activity. The cause-and-effect exercise will help students see the connection between human impacts on the environment and water security. Lastly, students will update their *Know & Need to Know* chart.

Extending the Learning

Keep an ongoing log of weather data from the Balcony Station and other stations on Mount Everest using the EarthPulse *Everest Weather Data* widget for the remainder of the unit and look at trends. Create a data table similar to this one with students. Spend a few minutes each day checking, recording, and discussing the weather with students. You may also decide to have students include a log of local weather for comparison.

OBJECTIVES

Subjects & Disciplines

Earth Science

- Climatology

Geography

- Physical Geography

Learning Objectives

Students will:

- Gather evidence that humans impact the environment and use resources.
- Outline cause-and-effect relationships between snowpack and glaciers and humans.
- Ask questions to clarify factors that have led to increased glacial melting and reduced snowpack over time.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Information organization
- Multimedia instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
  - Evaluating
  - Understanding
- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
  - Answering 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.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.
• **CCSS.ELA-LITERACY.SL.7.2:**
Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and Effect
• **MS. Earth and Human Activity:**
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
• **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 8:**
Obtaining, evaluating, and communicating information

Preparation

BACKGROUND & VOCABULARY

Background Information

Freshwater is stored in mountain glaciers and snowpack, which provides water security for people in the watershed. There is a trend in the Western United States toward less snowpack in the mountains. Reduced snowpack and shrinking glaciers challenges freshwater accessibility for humans.

Prior Knowledge

["Students should understand what freshwater is, the sources of freshwater, and know how Mount Everest connects to freshwater security."]

Recommended Prior Activities

- A Day Without Water
- Precious Freshwater
- Watersheds

Vocabulary

Term	Part of Speech	Definition
barometric pressure	*noun*	atmospheric pressure as read by a barometer.
glacier	*noun*	mass of ice that moves slowly over land.
relative humidity	*noun*	ratio between the amount of water vapor in the air and the air's saturation point. Relative humidity is expressed as a percentage.
snowpack	*noun*	layers of snow that naturally build up during snowfalls.
temperature	*noun*	degree of hotness or coldness measured by a thermometer with a numerical scale.
water tower	*noun*	elevated structure used for storing water.
wind	*noun*	movement of air (from a high pressure zone to a low pressure zone) caused by the uneven heating of the Earth by the sun.

ACTIVITY 2: HOW WE USE WATER I 1 HR 40 MINS

DIRECTIONS

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

1. Assist students as they analyze graphs, maps, and images to learn how people in the Western United States use water.

- Have students work in pairs to make claims about how people in the Western United States use water by analyzing the *Freshwater User in the West* map.
    - Have students look at the map. Ask students to identify:
        - *Which area(s) of the map use the most water?* (Southern California, potato farms in Idaho)
        - *How much water is being used in those areas?* (2,500 million gallons (9,463,529.46 cubic meters) of water a day)
        - *Where does the West get most of its water?* (Reservoirs like Lake Powell, Lake Mead, and Shasta Lake)
    - Have students look at the graphs of water use. Ask students to identify:
        - *How does the public and domestic water use of the western states compare to the rest of the United States?* (The western states use more public and domestic water per person than the rest of the United States, between 50-100 gallons (.189-.379 cubic meters) per person more per year.)
        - *How does the agriculture water use of the western states compare to the rest of the United States?* (The western states use significantly more water per day for agriculture—on average 50 billion gallons (189,270,589 cubic meters) of water per day more.)
        - *How does the industry water use of the western states compare to the rest of the United States? (*The western states use significantly less water for industrial use—close to 20 billion gallons (75,708,235 cubic meters) of water less than the rest of the United States.)
    - Lead a whole-class discussion to have students share what they think these findings mean for water security and water resources for the Western United States. Elicit students' ideas about how to ensure water security and equitable water access for people living in these dry regions.
- Connect this issue to international water security by navigating the *Stunning Inequality in World Water Use* article's slideshow and reading the accompanying captions. Ask students to respond to the following questions in small groups:

1. *What was the least amount of water used, in liters?* (60 liters in Niger)
2. *What was the most amount of water used?* (1,000 liters in New York City)
3. *Besides those two extremes, what was the average amount of water used per family?* (about 160 liters)
4. *Why do you think there are such differences in the amount of water each family uses?*

- Ask students to consider what this might mean for water security and water resources around the world. Distribute the *Project Journal: How We Use Water* and have students record their ideas and responses using Question 1.

2. Facilitate students' exploration of interactives, historical data, and maps to understand the water supply and demand around Mount Everest.

- In pairs, have students view the EarthPulse *Everest Human Water Demand* data.
- Prompt them to consider the specific ways that humans use water from Everest by asking:
    - *What are the three water uses represented by the chart?* (Domestic, irrigation, industrial)
    - *Of those three human water demands, which used the most water?* (Domestic)
        - Brainstorm with students the kinds of tasks that count as domestic.
- Then have students consider water use by other organisms (such as pine trees, yaks, pikas, and snow leopards) in the Everest watershed by analyzing the EarthPulse *Everest Total Water Demand* data and asking: *How does the natural demand for water in the ecosystem compare to the human demand?* (30km^3 less/year)
- Next, either in partners or as a class, direct students to explore the EarthPulse *Interactive Everest Map*. Under the "Demand" category, select "Settlements & Agriculture." Ask students what they notice. Then have them select "Rivers" in addition to "Settlements & Agriculture." Ask students what they notice with this addition, encouraging them to zoom in and out using the plus and minus on the map.
- Ask: *What does this mean for water use in the Ganges (Ganga)-Brahmaputra River region if snowpack is reduced or if glaciers are shrinking?* (This may result in less water availability for people. Water resources may be become less reliable as glaciers retreat.)
- Have students record their responses to these findings using Question 2 in their Project Journal.

3. Help students explore data regarding water usage in the United States over time.

- Visit the *Trends in Water Use* article presented by the United States Geological Survey (USGS) and have pairs of students analyze graphs about water usage over time.

    - Direct students to locate and analyze the *Trends in Population and Freshwater Withdrawals by Source* graph and ask students to identify:

        1. *When was water use at its highest?* (1980)
        2. *When was water use at its lowest?* (1950)
        3. Then have students read the description below the graph and have them identify: *What caused the drop in water use after 2005?* (Decrease in withdrawals for thermoelectric power and a decrease in public supply withdrawals)

    - Have students analyze the *Trends in Total Water Withdrawals by Water Use Category, 1950-2015* graph and ask them to identify:

        1. *What two categories of water use accounted for most of the water withdrawals?* (Irrigation and thermoelectric power)
        2. *What questions do you have for what we can do to ensure we use less water across all categories of water use?* (Answers may vary)

- Help make a connection between population density and water usage by having students visit *MapMaker Interactive* and compare the population densities between where they live and the Everest watershed.

    - On the right-hand side, click "Add Layer," then the "Human Populations" category, then the "Population Density" layer. If needed, define population density.
    - Find Mount Everest on the map by zooming in. Adjust the transparency as needed to find it, then readjust it so the students can see the darker red color. Click "Legend" on the right-hand side.
    - Ask: *What is the population density of the Everest watershed?* (Students should say that it is around 500 persons per square mile.)
    - Students should repeat this process by finding the population density for their local watershed.
    - Ask: *What similarities and differences do you see between population density in your area and in the Everest watershed?* (Answers will vary based on location)

- Have students record their responses to these findings using Questions 3 and 4 in their Project Journal.

4. Prompt students to reflect on their learning in their Project Journal for this activity.

- Students revisit the *Sustainable Development Goal 6: Clean Water and Sanitation* encyclopedic article and record their response to the quote presented in Question 5 of their Project Journal.

Tip

Step 3: This *Groundwater and Surface Water* activity is on the higher end for the middle school level, but could be a good extension or additional resource to include as time allows.

Modification

Step 3: You may decide to do some of these activities as a whole class, like navigating *MapMaker Interactive*.

Informal Assessment

Students show their learning through partner discussions, class discussions, and in their *Project Journal: How We Use Water*. Journals will be collected after each activity.

Extending the Learning

Have students conduct research (e.g., online, surveys, interviews) to find out how their local community or state uses water. Is it on irrigation, industry, domestic use, or something else? Use the *Total Water Use* data-based interactive map from the United States Geological Survey (USGS) to find out how each state uses water.

Step 1: As time allows, read the *Water Inequality* article to delve deeper into why certain countries have access to or use more water than other countries.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

- Conservation

  Earth Science
  - Climatology

  Geography
  - Physical Geography

Learning Objectives

Students will:

- Use tables, graphs, charts, articles, and maps to obtain information about how humans use water.
- Collect evidence that humans impact resources in ecosystems, particularly freshwater.
- Understand that there is inequity in water access across the world.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Reflection
- Visual instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration

    - Critical Thinking and Problem Solving
- 21st Century Themes
    - Environmental Literacy
    - Global Awareness
- Critical Thinking Skills
    - Analyzing
    - Evaluating
- Geographic Skills
    - Analyzing Geographic Information
    - Answering Geographic Questions
- Science and Engineering Practices
    - Analyzing and interpreting data
    - Obtaining, evaluating, and communicating information
    - Using mathematics and computational thinking

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. Earth and Human Activity:**
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
• **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 8:**
Obtaining, evaluating, and communicating information

Preparation

BACKGROUND & VOCABULARY

Background Information

Students should begin to understand the connection between freshwater stored in mountain glaciers and snowpack and water security. Students should see that with an increased human population, there is increased water usage.

Prior Knowledge

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Recommended Prior Activities

- A Day Without Water
- Precious Freshwater
- Watersheds
- Water Towers and Shrinking Glaciers

Vocabulary

Term	Part of Speech	Definition
agriculture	*noun*	the art and science of cultivating land for growing crops (farming) or raising livestock (ranching).
domestic	*adjective*	having to do with the day to day activities and upkeep of a personal residence such as a house, apartment, farm, or other estate.
industry	*noun*	activity that produces goods and services.
inequality	*noun*	difference in size, amount, or quality between two or more things.
irrigation	*noun*	watering land, usually for agriculture, by artificial means.
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.
population density	*noun*	the number of people living in a set area, such as a square mile.

Term	Part of Speech	Definition
thermoelectric power plant	*adjective*	power plant that uses a temperature difference between two materials to generate electricity.

ACTIVITY 3: HOW WE IMPACT THE WATER SUPPLY | 1 HR 15 MINS

DIRECTIONS

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

1. Ask students to read about how Mount Everest mountaineers are impacting the water supply.

- Direct students to read *Trash and Overcrowding at the Top of the World* to learn how mountaineers on Mount Everest are impacting the water supply, and to better understand how human activity can impact the environment, especially the resource of freshwater.
    - Distribute the *Project Journal: How We Impact the Water Supply* and ask students to read the article in pairs.
    - As they read, direct students to respond to the Question 1 prompts on the Project Journal.
    - Lead a class discussion that highlights the big ideas from the reading (e.g., Mount Everest is growing increasingly polluted as the growing number of visitors puts a strain on the natural environment).
- Cycle through the image slideshow from the *Inside the Everest Expedition that Built the World's Highest Weather Station* article to help students envision the area. Have students read the captions for each image.
    - Ask: *How did these images help you understand the impact that mountaineers are having on Everest?* (Some students may say this helps them see how many people are on Everest at once and that all of that waste has to go somewhere.)
    - Ask: *Based on these images, what evidence do you have or what inferences can you make that humans are impacting Mount Everest's water supply?* (e.g., human waste left behind is by far the biggest problem, which has incredibly negative impacts on the watershed)

- Have students respond to the Question 2 prompt on the Project Journal.

2. Facilitate students' exploration of examples of how organizations have educated the public about environmental issues, to inspire their public education outreach campaign for the *Peak Water: Mount Everest and Global Water Supply* unit project.

- Remind students about the project for the Peak Water: Mount Everest and Global Water Supply unit: students propose a public education outreach campaign to creatively inform their community about human impacts on water security and inspire citizens to take action.
- Introduce one example of how people have created art to respond to environmental issues in their community, by showing the short video, LA Water Documentary Part 1. Lead a quick debrief discussion to elicit students' initial reactions.
- Tell students that the next video will highlight an outreach team that has worked together to identify a key message and included visual components in their campaign, just as they will do in their project. Show the Water Tank Project video and use the following questions to debrief:

    - What water-related problem was Mary Jordan trying to solve? (Communicating about how 1 billion people in the world do not have access to clean water, especially in low-income countries.)
    - How did she get the word out about the Water Tank Project? (Parties and events, tours and talks, social media, ad campaigns, tour the campaign around the country)

- Highlight that students' campaigns should be centered around a key message that is rooted in their scientific argument and should inspire action. Show students the Sea Walls: Artists for Oceans video and use the following questions to debrief:

    - How did artist James Bullough view the connection between scientific ideas and public art?
    - (He chose to focus on the problem of ocean acidification, and before diving into his artistic plan, he researched the topic.)
    - How did city councilwoman Maxine Boag view the role of citizens, artists, and the government?
    - (Those who are inspired by the art are now responsible for being politically active and helping make changes. It's not just up to those in charge. It should be a grassroots effort.)
    - How did the murals impact the community and the people who viewed them?

    - (It changed peoples' perception about what could be done. It inspired people and helped them see things in a more sustainable way.)

- Share the following quote from Tré Packard, founder of PangeaSeed Foundation and the person behind the mural initiative in the video, and lead students in a Think-Pair-Share to reflect on if the quote aligns to their own thoughts about public art:

> *"Not everybody is going to walk in off the streets to go into a gallery. Sometimes that can be polarizing," Packard said. "Public art has been utilized for centuries to lead revolutions, to spread messaging and information — so we're not necessarily reinventing the wheel. We're just using it in a different context."*

- Direct students to share what they have for their final products. Prompt students to record their reflections on the videos and new ideas for their final products in Question 3 of their Project Journal.

3. Assist students as they practice developing a scientific argument after learning about Claim-Evidence-Reasoning.

- Present Claim-Evidence-Reasoning to students by discussing the three main components of C-E-R and what each means.

    1. Claim: a statement you make or an answer to a question
    2. Evidence: facts, details, statistics, sources, and more that support your claim
    3. Reasoning: how your evidence logically supports and connects to your claim

- If needed to support students, share or collaboratively create an example of a scientific argument using these three components. Then have students practice writing a scientific argument on a topic of their choice, using the structure provided in Question 4 of their Project Journal.

4. Assess students' understanding of the *A Shift in Supply and Demand* lesson of the *Peak Water: Mount Everest and Global Water Supply* unit through an exit ticket.

- Redistribute students' Project Journals from all prior activities in the *Peak Water: Mount Everest and Global Water Supply* unit, so that they can use their ideas as evidence to support or refute their claim in the first assessment question below.
- Use the prompt and questions below to assess students' understanding of the main concepts covered in this lesson. Have students respond individually to these questions on

an exit ticket:

- Write a scientific argument that claims that the human population and consumption of resources in one location can impact another location's freshwater supply.

    1. Your claim should answer the question: *Do humans in one location impact the freshwater supply in another area?*
    2. Evidence: Use your Project Journals from the *A Shift in Supply and Demand* lesson to provide at least three pieces of evidence that humans impact freshwater resources.
    3. Reasoning: Connect your evidence to the claim.

- How does the claim presented in your argument affect water security for people around the world?
- Draw a diagram to show the connections between humans, freshwater, snowpack, glaciers, and water security. Use arrows, words, and short descriptions of the relationships between each term.

Tip

Step 2: Review the details of the components of the *Peak Water* unit project (listed in the *A Day Without Water* Activity) to anticipate students' questions.

Tip

Step 3: Read more about helping students develop evidence-based arguments from ReadWriteThink.

Tip

Step 3: You can watch a C-E-R framework video before helping students write their scientific argument using the framework. You can also use the *Claims, Evidence, Reasoning* video from Teaching Channel to support your implementation of this step.

Modification

Step 4: As time allows, have students swap their C-E-R arguments and provide each other with feedback.

Informal Assessment

Use the exit ticket in Step 4 to assess students' understanding of the *A Shift in Supply and Demand* lesson of the *Peak Water: Mount Everest and Global Water Supply* unit. Students also add to their Project Journal, which will be submitted at the end of the activity and can be used to assess their understanding and ideas related to their project for the unit.

Extending the Learning

Students could continue researching ideas for their final product using the following sources:

- Arizona Community Foundation: The New Arizona Prize: Water Public Art Challeng
- American Public Health Association: Hard-hitting Public Health Ad Campaign Sparking Awareness: New Tactics Gaining Results
- Centers for Disease Control and Prevention: Gateway to Health Communication—Featured Campaigns

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology
- Conservation

Earth Science

- Climatology

Geography

- Physical Geography

Learning Objectives

Students will:

- Understand how waste can impact watersheds.
- Brainstorm ways science can be communicated through a public outreach campaign.

- Write a scientific argument that claims that human population and consumption of resources in one location can impact another location's fresh water supply.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Reading
- 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
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Applying
- Science and Engineering Practices
  - Constructing explanations (for science) and designing solutions (for engineering)
  - Developing and using models
  - Engaging in argument from evidence
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.WHST.6-8.1.B:**
Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2:**
Cause and Effect
• **MS. Earth and Human Activity:**
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
• **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 2:**
Developing and using models
• **Science and Engineering Practice 7:**
Engaging in argument from evidence
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

BACKGROUND & VOCABULARY

Background Information

Humans are responsible for polluting water, and this can come in the form of plastic, toxic waste, sewage, fertilizer, or other pollutants. Plastic pollution, in particular, can be pervasive in ecosystems. Fortunately, we can communicate scientific ideas to the public to improve education, health, and many other aspects of human livelihood. The successful uptake of new information and practices hinges on a well-crafted and effective communication strategy to translate scientific learning into civic understanding and action.

Prior Knowledge

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Recommended Prior Activities

- A Day Without Water
- How We Use Water
- Precious Freshwater
- Watersheds
- Water Towers and Shrinking Glaciers

Vocabulary

Term	Part of Speech	Definition
argument	*noun*	reason or set of reasons given with the aim of persuading others that an action or idea is right or wrong.
claim	*verb*	to state as the truth.
evidence	*noun*	data that can be measured, observed, examined, and analyzed to support a conclusion.
reasoning	*noun*	process of using evidence to make inferences or conclusions using logic.
upcycle	*verb*	to recycle one or more items to create an object that is worth more than the original product.