

RESOURCE LIBRARY | LESSON

A Ripple Effect

Students learn about droughts and the link between climate change and water access through videos, readings, and discussions. They then brainstorm how to avoid a “Day Zero” in their watershed and how Mount Everest mountaineers can help protect the mountain's watershed. Students draw from their Project Journals to create and present an artistic model and supporting scientific argument illustrating how humans impact water security. This lesson is part of the *Peak Water: Mount Everest and Global Water Supply* unit.

GRADES

6, 7, 8

SUBJECTS*Biology, Ecology, Conservation, Earth Science, Climatology, Geography, Physical Geography***CONTENTS**

3 Activities

In collaboration with



ACTIVITY 1: ENDLESS DRY SPELLS | 50 MINS

DIRECTIONS

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

1. Elicit students’ prior knowledge about droughts and build on their understanding.

- Ask students to think about what they know about droughts and share their ideas with a partner, then have a few volunteers share out with the class. Tell students that in this activity they will be investigating droughts, one threat to water security for people around the world.
- Watch and discuss the [*Climate Change and California's Drought*](#) video. Lead a debrief discussion by asking:
 - *What did you notice about the reservoir? (Students' responses may include: Folsom Lake's water levels were low. The floating docks were sitting on dry land.)*
 - *What do you think caused the water to be so low? (Students' responses may include: Climate change; the drought has gone on for four years; there is low snowpack.)*
- Watch the [*Droughts 101*](#) video. Lead a debrief discussion by asking:
 1. *What causes droughts? (Students' responses may include: Natural and human factors; changing wind patterns causing high pressure weather systems to last for too long; overuse of water supplies)*
 2. *Why do you think droughts are becoming more severe in some places? (Students' responses may include: increasing human populations are using increasing amounts of water, climate change is shifting weather patterns.)*
 3. *Based on what you have learned so far or on your own ideas, how could a drought be prevented for communities surrounding Mount Everest? (Students' responses may include: regulating water use, protecting water sources, monitoring glacier size and snowpack, reducing greenhouse gas emissions.)*
- Distribute the [*Project Journal: Endless Dry Spells*](#) and direct students to record their ideas in Section 1.

2. Invite students to read about Cape Town's "Day Zero" to understand how drought is impacting water security in a particular city.

- Have students read the article [*Why Cape Town is Running Out of Water and Who's Next.*](#)
 - Have students journal their responses to the article and the following questions in Section 2 of their Project Journal for this activity:
 1. *What do you think is causing Cape Town to run out of water? (Students' responses may include: population growth and a record drought, possibly changes in climate.)*

2. *How do you think the residents feel?* (Students' responses will vary and may include: powerless, angry, scared, frustrated.)
3. *How do you think the residents of the Ganges (Ganga)-Brahmaputra River watershed (that you read about in the [Living in Mount Everest's Watershed](#) article during the [Watersheds](#) activity of this unit) would feel if they ran out of water? Try to consider a specific person when you journal your responses.* (Student's responses will vary.)

3. Prompt students to read an article to deepen their understanding of how climate change impacts water security.

- Have students read the [How Climate Change Impacts Water Access](#) article in pairs and discuss the main ideas. Students will complete Section 3 in the Project Journal.
- Guide students in creating a cause and effect pathway connecting climate change and water access in Section 4 of their Project Journal.

4. Revisit the *Know & Need to Know* chart.

- Revisit the class *Know & Need to Know* chart, started in the [A Day Without Water](#) activity and revisited throughout the unit, for students to see how their thinking and understanding about water has continued to change.
- Ask students to discuss with a partner:
 - *What do we already know about the importance of Mount Everest's ice?*
 - *What do we need to know?*
 - *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.

Tip

Step 1: Discuss the nuances of drought with students and the difference between meteorological drought and drought from overuse of water resources. Discuss the impact that climate change may have on short-term and long-term water accessibility. As the climate warms, we expect more (not less) rainfall. Retreating glaciers on their own will not necessarily lead to less water availability. Their retreat will make some people more exposed to drought, though, but only for some mountain catchments in Asia (not necessarily in the Himalaya).

Informal Assessment

Students will contribute to small group and class discussions with their ideas. They will also journal their responses to the reading and video in their *Project Journal: Endless Dry Spells* and submit them for feedback.

Extending the Learning

Step 1: Read about the lack of snow in the Sierra Nevada Mountains in the article *500-Year Snow Fail in California's Iconic Mountains* to connect to previous lessons about snowpack and connect to the drought in this activity.

Watch this three-minute *Extreme Weather: Droughts* video about how droughts link to forest fires in California.

Read the full *Drought* encyclopedic entry.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology
- Conservation

Earth Science

- Climatology

Learning Objectives

Students will:

- Explain what a drought is and what kinds of factors cause droughts.
- Develop a cause and effect pathway between climate change and water security for people around the world.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Information organization
- Reading

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
 - Understanding
- Science and Engineering Practices
 - Constructing explanations (for science) and designing solutions (for engineering)
 - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- CCSS.ELA-LITERACY.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

Droughts are a complex phenomenon to understand. Fortunately, the goal of this activity is not to fully explain droughts themselves, but to provide students with a baseline understanding of what causes them (the demand outweighs the supply and changing weather systems). There are different "types" of drought. A meteorological drought, for example, is not at all impacted by humans' use of water. Climate change is worsening the duration and severity of droughts occurring today. Water security, according to the United Nations, is "The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability." Water security will continue to be an issue as the human population rises and the threat of drought continues.

Prior Knowledge

["Students should know what freshwater is, how people use water, and where most fresh water comes from. They should have a sense of how the National Geographic and Rolex's Perpetual Planet Extreme Expedition to Mount Everest connects to water security."]

Recommended Prior Activities

- [A Day Without Water](#)
- [How We Impact the Water Supply](#)
- [How We Use Water](#)
- [Precious Freshwater](#)
- [Watersheds](#)
- [Water Towers and Shrinking Glaciers](#)

Vocabulary

Term	Part of Speech	Definition
climate	<i>noun</i>	all weather conditions for a given location over a period of time.
climate change	<i>noun</i>	gradual changes in all the interconnected weather elements on our planet.
drought	<i>noun</i>	period of greatly reduced precipitation.
Himalaya Mountains	<i>noun</i>	mountain range between India and Nepal.
reservoir	<i>noun</i>	natural or man-made lake.
weather system	<i>noun</i>	movement of warm or cold air.

ACTIVITY 2: AVOIDING “DAY ZERO” | 50 MINS

DIRECTIONS

This activity is a part of the [Peak Water: Mount Everest and Global Water Supply](#) unit.

1. Assist students as they research and compile a list of ways they can conserve water to avoid a “Day Zero.”

- Introduce students to the term [conservation](#). Let students know that in addition to industries and lawmakers making big changes that will impact our climate, they can take individual action to protect our water resources.
- Have students test their knowledge of ways to conserve water by working with a partner to play the [Test Your WaterSense game](#).

- Elicit students' ideas about what they learned about water conservation and what new ideas they have for saving water at school and at home (as well as what farmers, governments, businesses, and nonprofit organizations can do).
- Distribute the [Project Journal: Avoiding "Day Zero."](#) In teams of 2-4, have students research ways to conserve water using the following resources:
 - [EPA: WaterSense for Kids](#)
 - [TED: 3 Thoughtful Ways to Conserve Water](#)
 - [American Rivers: 10 Ways to Save Water at Home](#)
 - Students may choose to research other ideas beyond these resources. They should keep track of their ideas in Section 1 of their Project Journal.

2. Facilitate students' exploration of Mount Everest Base Camp images to better understand how humans impact the Everest watershed.

- Have students browse the [slideshow](#) and read the captions in the [Here's what it's like to live at Everest Base Camp](#) article.
- Share these portions of the article with students:
 - "According to popular Everest blogger Alan Arnette, Nepal's Ministry of Tourism has issued 375 Everest climbing permits for the 2019 spring season; on the North side, there are reportedly 144 foreign climbers. It's illegal to simply show up at base camp with a climbing permit, pitch a tent, and try to climb the mountain. All foreigners must climb the mountain through a locally licensed logistics company, which supply base camp accommodations, meals, and basic bathroom facilities. For every one foreign climber, there are three to four local workers living in base camp as well—either climbing Sherpa working on the mountain itself or base camp staff—the cooks, dishwashers, servers, and team managers who all look after the guided clients."
- Share with students that about 500 hikers a day use the Everest Base Camp trail during the busy season.
- Ask: *What impact do you think the thousands of Everest Base Camp trekkers, over 500 foreign climbers, and 1,500 or so local workers—have on Mount Everest?* (Student responses may vary, but could include impacts due to water usage for meals and waste or wastewater produced by toileting.)
- Have students add to Section 2 of the Project Journal.

3. Have students read with a partner the “Bad News for the Himalayas” section of the *Inside the Everest expedition that built the world’s highest weather station* article.

- Debrief by asking students:
 - *Based on the article, how will the new weather stations on Mount Everest help scientists understand water security for the Ganges (Ganga)-Brahmaputra River watershed? (Students may answer: Climate scientists can better understand the subtropical jet stream and collect long-term data on this influence on growing seasons and storm tracks. The weather stations will help scientists understand how snow accumulation and ice/snowmelt respond to climate variability and change.)*
 - *Other than physical waste, what is the largest threat to Mount Everest’s watershed’s water security? (Human waste or reduced water held in glacier/snowpack due to climate change)*
- Let students know that in the next section, they will be researching and brainstorming ways to solve water security problems for the Ganges-Brahmaputra River watershed.

4. Support students as they research ways Everest mountaineers can help minimize human impact on the quality of water supply for those living in this region.

- Students can use any of these resources as they research different ways Everest mountaineers can help minimize human impact on the quality of water supply for those living in this region:
 - *EOCA: Cleaning Up Mount Everest*
 - *UIAA: Everest summiteers required to help clean Mount Everest by bringing out garbage*
 - *ABC News: Mount Everest tackles 60,000-pound trash problem with campaign to clean up waste*
 - *Evening Standard: Human waste left by record number of Everest climbers 'threatens local drinking water'*
 - *Mount Everest Biogas Project: Healing the Human Impact on Everest*
- Ask students to share: *What ideas do you have from reading these articles about how to clean up Everest to protect the water?*

- Let students know that their ideas can be used for inspiration in their art for their final product.
- Direct students to complete Sections 3 and 4 of the Project Journal. They may decide to revisit the images from the [How We Impact the Water Supply](#) activity for inspiration as they sketch images.

5. Prompt students to revise the *Know & Need to Know* chart for the last time.

- Revisit the class *Know & Need to Know* chart, initially completed in the [A Day Without Water](#) activity, for students to see how their thinking and understanding about water has changed throughout the unit.
- Ask students to discuss with a partner:
 1. *What do we already know about the importance of Everest's ice?*
 2. *Is there anything else you 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.

Tip

Step 1: If you want students to complete a paper version of the [Test Your WaterSense](#) game, you can print out the quiz. Otherwise, be sure to have the newest version of Flash installed on students' devices before the activity.

Informal Assessment

Students will compile a list of ways they can conserve water to avoid a “Day Zero” and ways Everest mountaineers and Base Camp trekkers can help minimize human impact on the quality of water supply for those living in this region. They will record this list in the *Project Journal: Avoiding Day Zero*. The journal should be collected and reviewed at the end of this activity.

Extending the Learning

Step 1: Have students read the [Conserving the Earth](#) article.

After the activity: Encourage students to share the [EPA WaterSense Pledge](#) with their families.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

Earth Science

- Climatology

Geography

- Physical Geography

Learning Objectives

Students will:

- Explore and evaluate solutions for conserving water.
- Review the human impact on Mount Everest's watershed using a hyper-local lens.

Teaching Approach

- Project-based learning

Teaching Methods

- Brainstorming
- Multimedia instruction
- Research

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
 - Creativity and Innovation
 - Critical Thinking and Problem Solving
- Life and Career Skills
 - Leadership and Responsibility
- 21st Century Themes
 - Environmental Literacy
 - Global Awareness
- Critical Thinking Skills
 - Analyzing
- Science and Engineering Practices
 - Constructing explanations (for science) and designing solutions (for engineering)
 - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **CCSS.ELA-LITERACY.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

The connection between the weather station on Mount Everest and water security can be difficult to understand. The key to the connection can be found in the [Inside the Everest expedition that built the world's highest weather station](#) article:

“The reason any of this was worth the effort, risk, and cost is because only Mount Everest and a few of its Himalayan cousins are tall enough to reliably pierce the subtropical jet stream—one of the narrow bands of powerful winds that circle the globe at high altitudes, influencing everything from storm tracks to agriculture growing seasons. For climate scientists, there are few more pressing phenomena to understand than the jet stream, and the weather station would provide scientists an important new tool with which to gather data about it.”

Because jet streams affect temperature and precipitation, they impact the water available in a watershed. To read more about jet streams, you can visit this [Jet stream](#) encyclopedic entry or this [Jet Streams](#) article from the North Carolina Climate Office.

Prior Knowledge

["Students should have a basic understanding of their project work for the unit and how Mount Everest connects to water conservation issues."]

Recommended Prior Activities

- [A Day Without Water](#)
- [Endless Dry Spells](#)
- [How We Impact the Water Supply](#)
- [How We Use Water](#)
- [Precious Freshwater](#)
- [Watersheds](#)
- [Water Towers and Shrinking Glaciers](#)

Vocabulary

Term	Part of Speech	Definition
conservation	noun	management of a natural resource to prevent exploitation, destruction, or neglect.
Sherpa	noun	people and culture native to the Himalayan region of Nepal and China. Sherpa often serve as mountaineer guides and porters on mountain-climbing expeditions.
water conservation	noun	process of lowering the amount of water used by homes and businesses.

ACTIVITY 3: MODELING HUMAN IMPACT ON WATER SECURITY 1 2 HRS

DIRECTIONS

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

1. Assist students as they refer to the Project Journals they completed throughout the *Peak Water: Mount Everest and Global Water Supply* unit and the scientific argument they previously drafted in the *How We Impact the Water Supply* activity to create their artistic responses about the ripple effect that human activity can have on water security.

- Remind students of the parameters for their artistic model:
 - Students can focus on the significance of Mount Everest and the Himalaya or represent a local water supply issue of their choice.
 - Students can produce a collage, a drawing, a painting, digital art, or three-dimensional creation of their choice.
 - Students should be challenged to represent a cause-and-effect relationship in their art or send a message about water conservation.
- Revisit the *Modeling Human Impact on Water Security Project Rubric* to ensure students are clear on how their final products will be assessed.
- Allow students at least 60 minutes in class to work on their artistic models using the available materials (including those they are upcycling). Some students may need an additional class period to produce their artistic models.

2. Facilitate as students share their art and scientific arguments.

- Decide in advance if you will have students share their projects one at a time or if you will have a Gallery Walk style presentation.
 - Have students brainstorm two to three focus questions to elicit feedback from their classmates/audience and record these in a visible place.
- Distribute the *Modeling Human Impact on Water Security Project Rubric* and the focus questions that students brainstormed; students and other audience members will use them to evaluate the artistic models and the students' accompanying scientific argumentation.

3. Prompt students to engage in a reflection on the project.

- Lead students in a discussion in which they reflect on the project. Physically move students' chairs in a circle. Use the following prompts as guides for the discussion:
 1. *What are some key ideas that you'll probably always remember from the project?*
 2. *What part was the most challenging?*
 3. *What part did you enjoy most?*
 4. *If you could do something different, what would it be?*
 5. *If you could change one thing about this project, what would it be?*
 6. *What is one thing you'll do differently related to water to ensure water security?*

4. Assess students' understanding of the A Ripple Effect lesson of the Peak Water: Mount Everest and Global Water Supply unit through an exit ticket.

- Use the prompt below to assess students' understanding of the main concepts covered in the *A Ripple Effect* lesson. Have students respond individually to this prompt on an exit ticket:
 - *Using evidence from this lesson's activities, explain:*
 1. *How droughts occur*
 2. *How climate change and human activities can make droughts worse and make them last longer.*

Tip

Step 1: Provide additional examples of artistic projects that are grounded in science:

- [Artists Inspired by Science](#)
- [Art and Climate Change](#)
- [Washed Ashore](#)

Modification

You may decide to have students use the [Modeling Human Impact on Water Security Project Rubric](#) to do a peer review of the artistic models and arguments before the presentations.

Rubric

Use the [Modeling Human Impact on Water Security Project Rubric](#) to assess students' understanding of the key concepts of the unit via their artistic models and scientific arguments. Additionally, the audience feedback, student responses to the final reflection questions, and/or the peer evaluations can all be used to inform your final assessment of each student's individual understanding and contribution to the project. Use the exit ticket in Step 4 to assess students' understanding of the [A Ripple Effect](#) lesson.

Extending the Learning

Share students' work in a public location, such as a library, watershed center, science museum, or other visible location.

OBJECTIVES

Subjects & Disciplines

Biology

- [Ecology](#)
- Conservation

Earth Science

- Climatology

Geography

- [Physical Geography](#)

Learning Objectives

Students will:

- Produce a collage, a drawing, a painting, digital art, or three-dimensional creation of their choice.
- Share their artistic model and scientific argument with an audience.
- Provide feedback on other students' projects.
- Reflect on the project.

Teaching Approach

- Project-based learning

Teaching Methods

- Hands-on learning
- Self-directed learning

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Learning and Innovation Skills
 - Communication and Collaboration
 - Creativity and Innovation
- 21st Century Themes
 - Environmental Literacy
 - Global Awareness
- Critical Thinking Skills
 - Applying
 - Creating
 - Evaluating
- Science and Engineering Practices
 - 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.SL.3:**

Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence. SL.6.3 / SL.7.3 / SL.8.3

- **CCSS.ELA-LITERACY.SL.7.4:**

Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

- **CCSS.ELA-LITERACY.SL.7.5:**

Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

- **CCSS.ELA-LITERACY.SL.7.6:**

Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 7 Language standards 1 and 3 here for specific expectations.)

NEXT GENERATION SCIENCE STANDARDS

- **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

The production of a scientific argument and engaging in feedback or review of one's work are authentic to the work of scientists. Students are taking the roles of artist, presenter, and audience member in this activity, which are all authentic roles that can be found in the world outside the classroom. These roles are relevant to the student because they will be invested in the artistic work they create. Students will find presenting their art and argument relevant if the audience is authentic, and they will find the role of audience member to be relevant if they are able to provide meaningful feedback to their peers.

Prior Knowledge

□ Recommended Prior Activities

- [A Day Without Water](#)
- [Avoiding "Day Zero"](#)
- [Endless Dry Spells](#)
- [How We Impact the Water Supply](#)
- [How We Use Water](#)
- [Precious Freshwater](#)
- [Watersheds](#)
- [Water Towers and Shrinking Glaciers](#)

Vocabulary

Term	Part of Speech	Definition
Mount Everest	<i>noun</i>	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.
upcycle	<i>verb</i>	to recycle one or more items to create an object that is worth more than the original product.

