

RESOURCE LIBRARY

ACTIVITY : 1 HR 40 MINS

Water Towers and Shrinking Glaciers

Students learn the term “water tower” as it relates to Mount Everest and other mountains with snowpack and glaciers. They investigate real-time weather data from Everest in order to understand the health of that water tower. Students investigate an interactive map to understand the cause-and-effect relationships between reduced snowpack and water security, then make those connections to Everest’s snowpack and glacial data.

GRADES

6 - 8

SUBJECTS*Earth Science, Climatology, Geography, Physical Geography***CONTENTS**

4 Resources, 6 Links, 1 PDF

OVERVIEW

Students learn the term “water tower” as it relates to Mount Everest and other mountains with snowpack and glaciers. They investigate real-time weather data from Everest in order to understand the health of that water tower. Students investigate an interactive map to understand the cause-and-effect relationships between reduced snowpack and water security, then make those connections to Everest’s snowpack and glacial data.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/water-towers-and-shrinking-glaciers/>

In collaboration with

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 km² and the projected glacial extent is 6,410 km² 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

What You’ll Need

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per pair, Monitor/screen, Projector, Speakers

PHYSICAL SPACE

- Classroom

GROUPING

- Heterogeneous grouping
- Large-group learning
- Small-group learning
- Small-group work

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

For Further Exploration

Articles & Profiles

- [National Snow and Ice Data Center: All About Glaciers: Glaciers and Climate Change](#)
- [National Geographic: Life at the Extremes](#)

Images

- [National Geographic: Vanishing Ice](#)



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