

Climate Change and Rising Seas

How does melting ice cause sea level rise?

Overview

Students identify the difference between global warming and climate change. They learn what causes global rise in sea level, and they test predictions about sea level rise through a hands-on experiment.

For the complete activity with media resources, visit:

<http://nationalgeographic.org/activity/climate-change-and-rising-seas/>

Funder



Directions

1. Introduce the concepts of global warming and climate change

Introduce students to the terms “global warming” and “climate change.” Although this activity focuses on one effect of global warming, it’s important for students to understand the difference between these two terms and that they should not be used interchangeably.

Write the terms “global warming” and “climate change” on the board. Ask for volunteers to define the two terms. Ask:

- Do you think the terms mean the same thing?
- If not, how are they different?

Say to students: *Global warming is the increase in the average temperature of Earth's air and oceans and that climate change is a long-term change in the Earth's climate, or of a region on Earth. Global warming refers to surface temperature increases, while climate change includes global warming and everything else that increasing greenhouse gas amounts will affect—like melting glaciers, heavier rainstorms, or more frequent drought.* (Source: [“What’s the difference between global warming and climate change?”](#), NOAA, Climate.gov)

Show students the [“Global warming cartoon”](#) and ask them to describe how the cartoon illustrates what they have learned about global warming and climate change.

2. Delve deeper into the causes and effects of climate change (optional)

(NOTE: Use this step if your students have not studied the causes and effects of climate change. If you have already covered these topics, you might choose to move on to the next step.)

Have students read the following resources that define climate change—causes and effects.

- Climate Change: Encyclopedia Entry
<http://nationalgeographic.org/encyclopedia/climate-change/>
- A Student’s Guide to Global Climate Change
<http://nsdl.oercommons.org/courses/climate-change-kids-site/view>

Divide students into small groups and have each group work together to complete a four-column chart with the headings Natural Causes, Human Causes, Effects, and Solutions. Ask students to include as many items as possible in each column. When finished, ask the groups to share a summary of their charts and discussions.

3. Discuss the causes of sea level rise

Remind students that the two major causes of global sea level rise are thermal expansion caused by the warming of the oceans (since water expands as it warms) and the loss of land-based ice (such as glaciers) due to increased melting.

Tell students that "... records and research show that sea level has been steadily rising at a rate of 0.04 to 0.1 inches per year since 1900. Since 1992, new methods of satellite altimetry (the measurement of elevation or altitude) indicate a rate of rise of 0.12 inches per year. This is a significantly larger rate than the sea level rise averaged over the last several thousand years."

(Source: "Is Sea Level Rising?", NOAA)

Ask: *Which type of melting will cause a greater increase in sea level?* Have each student make a prediction.

4. Investigate predictions on causes of sea level rise

Tell students that they are going to see a demonstration that illustrates how melting ice impacts sea levels and test their predictions.

Lead students in conducting the following activity that demonstrates a cause of sea level rise.

Directions:

- Use the clay to build “land” on one half of each tub. Form the clay to represent land rising out of the ocean. Label one tub “Ice on Land” and the other “Floating Ice.”
- Place stick pins close to the edge of each land mass.
- Place four ice cubes on top of the land mass in one tub and on the bottom of the other tub.
- Pour water into the Floating Ice tub until the ice floats. Be sure to add enough water so the ice is floating, not resting on the bottom.
- Pour water into the Ice on Land tub with the ice resting on the clay (be careful not to disturb the ice cubes) until the water levels in the two containers are equal.
- Set the tubs side by side
- Wait for the ice to melt. Take photos of the changes in the level of the water in the tubs or note changes in the levels in a chart.
- When all the ice has melted mark the new water level on each tub. Note the change(s).

5. Discuss students’ observations and learning

Lead students in a discussion using the following or similar questions:

- *In which situation did the water level rise more? (“Ice on Land” container)*
- *How do the results compare with your predictions?*
- *Why do you think this happened? (When ice cubes sitting on the modeling clay melt, the water runs off and adds to the volume of water in the “ocean.” Conversely, floating ice is already taking up space in the water—displacing a mass of water that is equivalent to the mass of the ice. When the ice melts, the water fills that existing space. Make sure students don't confuse this with rising sea level that results from water expanding as it warms. This*

experiment only deals with the result of melting land ice.)

To wrap up the activity, show students the ["Why Melting Glaciers Matter to Coasts"](#) video and discuss how rising sea level impacts coasts around the world.

Modification

If you do not have time or resources to conduct this investigation in class, you may choose to show the video ["Why Melting Glaciers Matter to Coasts"](#) to students instead. You can still use the prediction component of the activity by stopping the video before the ice begins melting, asking for predictions, and then leading the discussion after the end of the video.

Tip

Preview the ["Why melting glaciers matter to the coasts"](#) video yourself to get a visual representation of the finished products for this activity.

Alternative Assessment

Informal assessment options might include:

- Have students create a presentation on the causes and effects of climate change or global warming, including suggestions for solutions.
- Have students create a short video, drawing, cartoon, or other visual media artifact illustrating the impact of sea level rise.
- Have students conduct the demonstration for younger students, explaining the concepts in terms appropriate for the age group.

Extending the Learning

Use the Assessment ideas to extend the learning.

Objectives

Subjects & Disciplines

Science

- Earth science
- Ecology
- Environmental
- General science
- Oceanography

Learning Objectives

Students will:

- describe the differences between global warming and climate change
- recognize causes and effects of climate change and global warming
- identify causes and effects of sea level rise

Teaching Approach

- Learning-for-use

Teaching Methods

- Demonstrations
- Discussions

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Learning and Innovation Skills
 - Creativity and Innovation
- Critical Thinking Skills
 - Analyzing
 - Applying
 - Understanding
- Science and Engineering Practices
 - Analyzing and interpreting data
 - Asking questions (for science) and defining problems (for engineering)
 - Constructing explanations (for science) and designing solutions (for engineering)
 - Planning and carrying out investigations

National Standards, Principles, and Practices

National Science Education Standards

- **(5-8) Standard A-1:**

Abilities necessary to do scientific inquiry

- **(5-8) Standard B-1:**

Properties and changes of properties in matter

- **(5-8) Standard D-1:**

Structure of the earth system

- **(5-8) Standard F-3:**

Natural hazards

- **(9-12) Standard A-1:**

Abilities necessary to do scientific inquiry

- **(9-12) Standard B-6:**

Interactions of energy and matter

- **(9-12) Standard F-3:**

Natural resources

- **(9-12) Standard F-5:**

Natural and human-induced hazards

Ocean Literacy Essential Principles and Fundamental Concepts

- **Principle 1d:**

Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools.

- **Principle 2e:**

Tectonic activity, sea level changes, and force of waves influence the physical structure and landforms of the coast.

- **Principle 6a:**

The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.

- **Principle 6d:**

Much of the world's population lives in coastal areas.

- **Principle 6e:**

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

- **Principle 6f:**

Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm surges).

Common Core State Standards for English Language Arts & Literacy

- **Reading Standards for Informational Text 6-12:**

Integration of Knowledge and Ideas, RI.6.7

- **Reading Standards for Informational Text K-5:**

Integration of Knowledge and Ideas, RI.5.7

ISTE Standards for Students (ISTE Standards*S)

- **Standard 3:**

Research and Information Fluency

- **Standard 4:**

Critical Thinking, Problem Solving, and Decision Making

Next Generation Science Standards

- **Crosscutting Concept 1:**

Patterns

- **Crosscutting Concept 2:**

Cause and effect: Mechanism and prediction

- **Crosscutting Concept 4:**

Systems and system models

- **Crosscutting Concept 7:**

Stability and change

Preparation

What You'll Need

Materials You Provide

- Clay
- Fine-point black marker
- Ice cubes
- Plastic tubs, see-through, mid-size (2)
- Push pins

- Water colored blue

Required Technology

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

Physical Space

- Classroom
- Home
- Laboratory space
- Meeting space
- Museum
- Other

Grouping

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

Background & Vocabulary

Background Information

Global warming is the increase in the average temperature of Earth's air and oceans and climate change is a long-term change in the Earth's climate, or of a region on Earth. Global warming refers to surface temperature increases, while climate change includes global warming and everything else that increasing greenhouse gas amounts will affect—like melting glaciers, heavier rainstorms, or

more frequent drought. (Source: [“What’s the difference between global warming and climate change?”](#), NOAA Climate.gov)

The two major causes of global sea level rise are thermal expansion caused by the warming of the oceans (since water expands as it warms) and the loss of land-based ice (such as glaciers) due to increased melting. Melting sea ice, on the other hand, does not contribute to sea level rise. "Melting sea ice has no impact on sea level rise because it's already floating in the ocean. Like a glass of water. As it warms, the ice in the glass melts, but the total volume of water does not change. (Source: ["Loss of Land Ice \(Not Sea Ice\) = More Sea Level Rise,"](#) Yale Climate Connections. Put another way, "The melting and growth of sea ice...does not affect sea level because the sea ice is already floating in the ocean and is in equilibrium with it. Sea ice is nonetheless still important in the context of climate change. Sea ice, with its high reflectance and the insulation it provides between polar atmospheres and oceans, is a key part of the climate system." (Source: NASA Earth Observatory: ["Global Warming and Land Ice."](#))

Records and research show that sea level has been steadily rising at a rate of 0.04 to 0.1 inches per year since 1900. Since 1992, new methods of satellite altimetry (the measurement of elevation or altitude) indicate a rate of rise of 0.12 inches per year. This is a significantly larger rate than the sea level rise averaged over the last several thousand years. (Source: ["Is Sea Level Rising?"](#), NOAA.gov)

Prior Knowledge

[]

Recommended Prior Activities

- None

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.
glacier	<i>noun</i>	mass of ice that moves slowly over land.
global warming	<i>noun</i>	increase in the average temperature of the Earth's air and oceans.
sea level rise	<i>noun</i>	increase in the average reach of the ocean. The current sea level rise is 1.8 millimeters (.07 inch) per year.
thermal	<i>adjective</i>	having to do with heat or temperature.

For Further Exploration

Articles & Profiles

- [National Geographic Education: Encyclopedia—Climate](#)
- [National Geographic Education: Encyclopedia—Climate Change](#)
- [National Geographic Education: Encyclopedia—Global Warming](#)

Images

- [National Geographic Environment: Arctic Climate Change Photos](#)

Instructional Content

- [Climate Change: Collection](#)

Interactives

- [Climate Change Quick Quiz](#)
- [Climate Change Quick Quiz: Difficult!](#)

Funder



© 1996–2016 National Geographic Society. All rights reserved.