SPRINTT Student Polar Research with IPY National (and International) Teacher Training presents teachers'domain

Melting Ice and Changing Coastlines

Text and Activities Adapted from: Teachers' Domain, Texas A&M University: Ocean Drilling Distance Learning Program, The New York Times, Center for Remote Sensing of Ice Sheets (CReSIS), the Natural Resources Defense Council, and Answers.com

Overview:

Ice in the ocean is melting faster than it has in past years. Scientists are able to observe fascinating ice events using satellites, allowing them to better understand the impacts of global warming on sea levels. In this lesson, students will simulate the effects of sea ice melting. They will read current scientific articles on the issue and conduct an investigation to demonstrate the different effects of land ice melting versus sea ice melting.

Key Concepts:

In this lesson, students will learn about different types of ice masses, investigate the impact of melting sea and land ice, and examine the details of rising sea levels on specific coastal areas.

Time: 2, 45-50 minute class periods

Materials:

For Part II, one set of materials per group

- ☐ Beaker half full of water (simulates ocean)
- ☐ Masking tape used to mark water level (simulates sea level along a coast)
- ☐ Sponge, rock or other object (used as landmass to support glacier)
- ☐ 4-6 Ice cubes (simulates glacier and sea ice)

For Part III

- ☐ Computer with internet access
- ☐ Chart Paper

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Content Background:

There are several different types of ice masses on Earth including glaciers, ice shelves, sea ice, and icebergs. Sea ice and icebergs float in the oceans like an ice cube in a glass of tea, and they are already displacing their volume of water. So if sea ice or icebergs melt it does not alter the volume of water in the ocean. Ice resting on a land mass is a different story. When glaciers melt, the melt water enters the ocean as new water, thus increasing the volume of water and raising the sea level along continental coasts.

Aim:

How does melting ice in the ocean effect sea level?

Objectives:

Students will be able to:

- perform an experiment to learn how melting ice affects water levels.
- differentiate between sea ice and land ice.
- analyze the effect of se level rise on coastal areas around the world.

Activities:

Part 1: Types of Ice Formations

Hand out the ***Melting Ice Student Handout***, and ask students to volunteer to read the handout aloud to the class. Throughout the reading, lead students to consider the impact each of these ice masses would have on sea level if they melt. When the students have completed the reading and discussion, have each student answer the discussion questions at the end of the handout. Check the answers before going on to Part 2.

<u>Handout Question Answers:</u>

? How has satellite technology improved scientific research on ice formations?

Scientists can view and record amazing events such as large pieces of ice breaking away from ice shelves and glaciers. This allows them to better understand what is happening on our planet as a result of global warming.

? Why are scientists concerned about blocks of sea ice collapsing and falling into the ocean?

This is a sign that the climate is warming. If sea ice continues to melt, the sea level will raise impacting humans and other species.

? How might a decrease in sea ice in the Arctic and Antarctic affect wildlife?
Ice is the habitat for different species including polar bears and penguins. A decrease in the amount of sea will change their habitat. Increasing temperatures that causes sea ice to melt also effect the survival of species.

? What is the difference between how an iceberg forms and how sea ice forms?
An ice berg breaks of from a glacier or ice shelf on land. Sea ice is formed by freezing sea water.

Part 2: Investigation: Melting Ice and Sea Level

1. Ask students: "Can you predict what would happen if sea ice, glaciers, or icebergs where to melt?"
   Answers will vary.

2. Group students into teams of three or four students and distribute a set of materials to each team.

3. Tell students: "During this investigation, you will use materials to simulate the effect of sea ice and glacier ice melting on sea levels."

4. Go over the following procedure with the class:
   - Mark the level of the water in the beaker with masking tape or a grease pen.
   - Place the sponge in the beaker and saturate it with water.
   - Place three ice cubes on top of the sponge. The sponge represents land. Remember that the glacier sits on the land rather than in the water.
   - Allow the ice cubes to melt.
   - Mark the level of the water on the beaker after the ice cubes melt.

5. Ask students before beginning: "How do you think the water level will change after adding three ice cubes to the cup?
   Answers will vary

   "How do you think the water level will change when the ice cubes melt?"
   Answers will vary

6. After completing the lab activity, ask the students to compare their previous answers to what they observed during the activity.

7. Show students the following ***Ice Shelf and Ice Sheet Simulation*** video clip comparing melting of floating ice to "landmass" ice.

   To access the video clip:

   a. Go to **Resources** on the SPRINTT website and login.
   b. Select **Phase II**.
   c. Select **Ice Shelf and Ice Sheet Simulation**.

Screenshot of the
Ice Shelf and Ice Sheet Simulation

Discussion Questions:

? Did the water level change as the ice melted?
The level changed when the "glacier" melted but not when the floating sea ice melted.

? Do you think an analogy could be drawn between this experiment and the melting ice shelves in Antarctica, the glaciers, or the sea ice? Explain your reasoning.
Answers will vary but students should conclude that the sea level is only altered from melting ice on the land.

? Do you think that this experiment is an accurate simulation of melting glaciers and sea ice? Why or why not?
Answers will vary.

Part 3: Melting Sea Ice and Coastal Areas

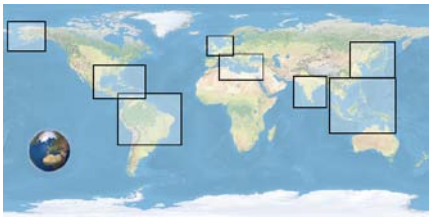
1. Explain to students that during this activity they will learn about the impact of sea level rising on various coastal areas around the globe.

2. Form student teams and assign each team to a region of the world: Southeast Asia, Southeast USA, Alaska, Northern Europe, East Asia, South Asia, Mediterranean, and the Amazon Delta.

3. View the ***Map Animation of Sea Level Rise***.

   To access the map:

   a. Go to **Resources** on the SPRINTT website and login.
   b. Select **Phase II**.
   c. Select **Map Animation of Sea Level Rise**.



Screenshot of the
Map Animation of Sea Level Rise

4. Once the animation opens, “Check” on the LandScan (population) and City Labels options.

5. Direct students to click on their assigned region of the world to analyze the effects of a two meter and a six meter sea level rise.

6. Instruct students to research the human impact of the changes in coast line. Direct them to identify major population centers which would be affected by coastal changes. If the students have time ask them to research current populations in the centers that would be affected by both a two and six meter sea level rise.

7. Direct student teams to write and present to class a summary of the effect in their assigned region of a two meter and six meter sea level rise.

8. Use the student reports and their presentations to the class to initiate a discussion of short term and long term global issues resulting from sea level rising.

Assessment:

Students will write a paragraph answering the following questions using complete sentences.

1. Compare and contrast the impact of glacial melting and sea ice melting.
   Glacial ice melt will significantly raise sea level; sea ice melt will have little effect.

2. Summarize the impact of sea level rising on the region of the globe you have investigated.
   Student responses will vary.

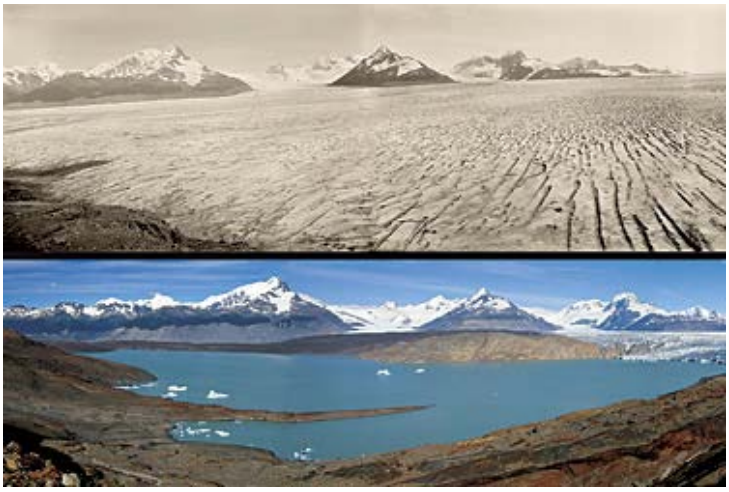
Melting Ice Student Handout

The Antarctic

The following article was written in 2008 by the Associated Press.

Satellite images show the runaway disintegration of a 160-square-mile chunk in western Antarctica, which started February 28, 2008. It was the edge of the Wilkins ice shelf and has been there for hundreds, maybe 1,500 years.

This is the result of global warming, said British Antarctic Survey scientist David Vaughan. Because scientists noticed satellite images within hours, they diverted satellite cameras and even flew an airplane over the ongoing collapse for rare pictures and video.



The photograph taken in 1928 (above) shows how the Upsala Glacier in Argentina, used to look. It was covered by glaciers. The ice on the Upsala Glacier shown in 2004 (below) is retreating at least 180 ft. per year. *Credit:* Greenpeace

"It's an event we don't get to see very often," said Ted Scambos, lead scientist at the National Snow and Ice Data Center in Boulder, Colorado. "The cracks fill with water and slice off and topple... That gets to be a runaway situation."

While icebergs naturally break away from the mainland, collapses like this are unusual but are happening more frequently in recent decades, Vaughan said. The collapse is similar to what happens to hardened glass when it is smashed with a hammer, he said.

The rest of the Wilkins ice shelf, which is about the size of Connecticut, is holding on by a narrow beam of thin ice. Scientists worry that it too may collapse. Larger, more dramatic ice collapses occurred in 2002 and 1995. Vaughan had predicted the Wilkins shelf would collapse about 15 years from now. Scientists said they are not concerned about a rise in sea level from the latest event in Antarctica, but say it's a sign of worsening global warming. Such occurrences are "more indicative of a tipping point or trigger in the climate system," said Sarah Das, a scientist at the Woods Hole Oceanographic Institute.

Arctic

Average temperatures in the Arctic region are rising twice as fast as they are elsewhere in the world. Arctic ice is getting thinner, melting and rupturing. For example, the largest single block of ice in the Arctic, the Ward Hunt Ice Shelf, was 3,000 years old before it started cracking in 2000. Within two years it had split all the way through and is now breaking into smaller pieces.

The polar ice cap as a whole is shrinking. Images from NASA satellites show that the area of permanent ice cover is contracting at a rate of 9 percent each decade. If this trend continues, summers in the Arctic could become ice-free by the end of the century.

The melting of once-permanent ice is already affecting native people, wildlife and plants. When the Ward Hunt Ice Shelf splintered, the rare freshwater lake it enclosed, along with its unique ecosystem, drained into the ocean. Polar bears, whales, walrus and seals are changing their feeding and migration patterns, making it harder for native people to hunt them. And along Arctic coastlines, entire villages will have to move because they're in danger of being swamped.

Text Adapted from: Natural Resources Defense Council

Icebergs

An iceberg is a large mass of freshwater glacial ice broken off and drifted from parent glaciers or ice shelves along polar seas. Icebergs are classified by shape and size. The lifespan of an iceberg may be very long while the berg remains in cold polar waters, eroding only slightly during summer months. But under the influence of ocean currents, an iceberg that drifts into warmer water will melt rapidly.

A large iceberg in the Arctic Ocean that is melting because it is in warmer waters. *Credit:* Earth and Space Research (ESR)

In the Arctic, icebergs (see illustration) originate chiefly from glaciers along Greenland coasts. It is estimated that a total of about 16,000 bergs are calved (broken off) annually in the Northern Hemisphere, of which over 90% are from Greenland. There are not many icebergs drifting in the North Pacific Ocean, except a few small bergs each year that calve from the mountain glaciers along the Gulf of Alaska.

Sea Ice

Ice in the sea includes sea ice, river ice, and land ice. Sea Ice is formed by the freezing of seawater. Land ice in the ocean is mainly in the form of icebergs. River ice is carried into the sea during spring break up and it is important only near river mouths. The greatest part, probably 99% of ice in the sea, is sea ice.

The sea ice is a mixture of recently formed ice and old ice which has survived one or more summers. Except in sheltered bays, sea ice is continually in motion because of wind and current.

Text Adapted from: Answers.com

Discussion Questions:

? How has satellite technology improved scientific research on ice formations?

? Why are scientists concerned about blocks of sea ice collapsing and falling into the ocean?

? How might a decrease in sea ice in the Arctic and Antarctic affect wildlife?

? What is the difference between how an iceberg forms and how sea ice forms?