CLEAN Link

Land Ice/Sea Ice/Grounded Ice

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Land Ice/Sea Ice/ Grounded Ice

Preview

Students will build 3 models to compare how different kinds of melting ice will affect sea level.

Background

Results from recent ice core discoveries suggest that climate can change in as little as decades—not the tens of thousands of years believed not so long ago. In addition, over one-third of humans (almost 2.4 billion people) live within 100 km (60 miles) of an ocean coast. (NASA) Why is it important to understand how melting ice might affect humans?

All around the world, scientists are measuring the amount of ice that is melting each year and are learning that almost all glaciers are retreating, and that Arctic sea ice melts more during the summers than is reformed during the winter. Because the open ocean water in the summer absorbs heat, it causes what is known as a "positive feedback" loop: more ocean water—more heat—more heat—more melt—more melt—more open ocean water. Scientists expect that we will see an ice-free Arctic Ocean perhaps as soon as 2030-2050.

The ice sheet in Greenland is also melting and is showing signs of accelerating. In the Southern Hemisphere, Antarctica has ice sheets on land, floating ice shelves and sea ice like the Arctic Ocean in the north, and "grounded," ice or the submerged boundary between the floating ice shelf and its land based glacier that flows into the ice shelf. How will melting ice affect our coastlines and sea level?

Key Concepts

Materials

For whole group demo:

3 clear shoe box sized plastic containers

For each small group of students:

3 clear square plastic "sandwich" sized containers

Enough gravel to fill ½ of each container to about 1-2" from the top

Water to fill each container

Ice for each container—cubes for 2 containers and a frozen block of ice for 1 of the containers

Marker to mark the water line after ice is added

Chart

Post Its—3 per group

- There are many different types of ice on Earth: Ice that floats: icebergs, sea ice, ice shelves
  Ice that is land-based: glaciers, snow on mountains, ice shelves
  Grounded ice: ice that is frozen to the bedrock under the ocean forming the boundary between the floating ice shelf and the land-based glacier

Activity Directions—

1. This is an activity that can be used as a demonstration, or as a hands-on activity by small groups. Use the bigger plastic tubs for whole group demos, and the smaller plastic containers for hands-on presentation.
2. Because it needs time to melt, it should be set up at the beginning of class and observed at the end—or set it up one day, and check it the next.
3. Check out "tips and tricks" for ways to make ice melt faster or slower to meet your needs.
4. Fill ½ of each of the 3 clear square plastic "sandwich" sized containers with gravel. This will represent the "land."
5. Fill the containers with water but leave the surface of the gravel above the water line.

Large containers for classroom demonstration.

Small containers for individual or small group hands-on presentations.

6. Write "Land-based Ice" on one Post-it, "Floating Ice" on another, and "Grounded Ice" on the 3rd. Place the Post-its in front of their appointed containers.
7. Add ice to the gravel of the "Land Ice" container. Put as much ice as you can on that side without any in the water.

8. Add ice to the water of the "Floating Ice" container. Put in as much ice as you can without it touching the bottom—it all needs to be floating.
9. Place the block of ice in the 3rd container with gravel on one side of it. Add water slowly to fill as much of the container as you can without making the ice float. It must stay sitting on the bottom.
10. Mark a line on all 3 containers to show the "sea level" after the ice is added.
11. Students should sketch the model and label what each part represents in the real world.
12. As a group, make a prediction to the following questions and add their Post-it "vote" to the appropriate column on the classroom chart:
    How will melting land-based ice affect sea level? (raise it; lower it; stay the same)
    How will melting floating ice affect sea level? (raise it; lower it; stay the same)
    How will melting grounded ice affect sea level? (raise it; lower it; stay the same)

Labels at the top of the chart:

How will melting ice affect sea level?								
Land-based ice **Glaciers, ice sheets, snow**			**Floating ice** **Icebergs, ice shelves, sea ice**			**Grounded ice** **Boundary between an ice shelf and is glacier source**		
Raise it	Lower it	Stay same	Raise it	Lower it	Stay same	Raise it	Lower it	Stay same

13. After most of the land-based ice has melted, discuss what is observed.
14. Look at the chart. Do their predictions change with this new evidence?
15. Main ideas:
    - As it melts, land-based ice will flow into the ocean and will raise sea level.
    - Floating ice is already displacing its own volume, so when it melts, it will not raise sea level.
    - Grounded ice will raise sea level as it melts.
    - Sea level has risen during the 20th and 21st centuries, but the rise has been mainly caused by warmer waters expanding. (thermal expansion)

- As more and more land-based ice melts, sea levels will rise accordingly.
- If all the land-based ice on Greenland and Antarctica melted, scientists estimate that each would add this much volume to the oceans:

  Greenland—about 7 meters (23 feet)
  West Antarctica—about 7 meters (23 feet)
  East Antarctica—about 70 meters (230 feet)

Tips and Tricks

1. A solid ice block (example: freeze ice in a plastic cup) will melt slower than small ice cubes or shaved ice. Example: If you have a 50 minute class, use shaved or crushed ice; if you are doing a presentation in a museum and want slower melt times so that you use less ice, use blocks of ice. Use this for the grounded ice—it needs to have enough mass to sit on the bottom without floating.
2. If you are doing a demonstration in a large classroom setting or in an auditorium, use large glass containers like a fish tank.
3. For younger students, do only the models for land ice and sea ice.

Next Generation Science Standards (NGSS)

Science and Engineering Practices:

- Asking questions
- Using models
- Constructing Explanations

Crosscutting Concepts

- Cause and effect
- Stability and change

Additional Resources

There are many different types of ice on Earth. Here are some resources for learning about ice.

- National Snow and Ice Data Center (NSIDC) http://nsidc.org/
- Poster: Antarctica's Ice on the Move http://www.andrill.org/flexhibit/flexhibit/materials/index.html
- What the world would look like if all the ice melted: http://www.nationalgeographic.com/magazine/2013/09/rising-seas-ice-melt-new-shoreline-maps/
- Warming Seas and Melting Ice Sheets www.nasa.gov/feature/goddard/warming-seas-and-melting-ice-sheets