

HOW DO MELTING POLAR ICE CAPS AFFECT SEA LEVELS?

Have you ever noticed that if you leave an ice cube on the kitchen counter and come back to check on it in a while, you find a puddle? The same thing happens to ice in nature — if the temperature gets warm enough, the ice melts. In this science activity, you will explore what happens to sea levels if the ice at the North Pole melts, or if the ice at the South Pole melts. Does melting ice at either cap contribute to a rise in sea levels?

GRADE LEVELS: K-8

VOCABULARY



Polar Ice Caps- *high-latitude region of a planet, dwarf planet, or natural satellite that is covered in ice.*

Sea Level- *the level of the sea's surface, used in reckoning the height of geographical features such as hills and as a barometric standard.*

Climate Change- *a change in the average conditions — such as temperature and rainfall — in a region over a long period of time.*

MATERIALS

- Play-Doh® or modeling clay
- Measuring cup
- Butter knife
- Clear plastic or glass containers, approximately 2 ¼ cups in size (2). Smaller or larger containers can be used, if they are both the same size, but you will need to scale up or down the amount of dough you add to the containers. Since you will be marking these containers with a permanent marker, make sure they are containers you can mark.
- Colored tape or permanent marker (if you do not mind marking your containers with marker)
- Tap water
- Ice cubes

INSTRUCTIONS



PREP WORK

1. *If you are using containers that are not 2 ¼ cups in size, scale up or scale down the amount of dough you use in the activity's procedure.*

PROCEDURE

1. *Put one cup of Play-Doh or modeling clay into one of the clear containers. This container will be a model of the South Pole, with the mound representing the continent of Antarctica. Use a butter knife to scrape around the sides of the measuring cup, if necessary. Make the top of the dough flat and level. Leave some space between the sides of the dough and the wall of the container all around, so that you can add water later.*
2. *Take your model of the South Pole and carefully add around ¼ cup of water around the sides of the dough, so that the water level comes up about one-third to half of the way up the dough mound. The water represents the ocean.*
3. *Place two ice cubes on top of the dough, lightly pressing them down into the dough. Immediately mark the water level on the side of the container with the permanent marker or colored tape. The ice cubes represent the southern polar ice sheet in this model of the South Pole.*

What do you think will happen as the ice cubes melt?

4. *Take the second, clear container and fill it about one-third to half full of tap water. The water represents the ocean. Add two ice cubes to the container and immediately mark the water level on the side of the container with colored tape or a permanent marker. This container is a model of the North Pole, where the ice cubes represent the floating northern polar ice cap.*

What do you think will happen as the ice cubes melt?

5. *Allow the ice in your models to melt in a place where they will not be disturbed. Keep an eye on the ice cubes in the South Pole model to make sure they stay balanced on the dough, and that the water from these melted ice cubes can drain off of the dough.*
6. *Once the ice has completely melted, check the water level in each container again.*

Has the water level risen in either of the containers? If it has, why do you think this is and what do you think the implications are for changes in sea level in the real world?

CLEANUP

1. *If you would like to re-use the Play-Doh or modeling clay, let it dry off a little bit before sealing it in its storage container.*
2. *If you used permanent marker and would like to try to remove the marks, try wiping them with rubbing alcohol.*

WHAT HAPPENED?

The ice on the North Pole is in the form of a floating polar ice cap, while the ice on the South Pole is mainly in the form of an ice sheet on top of the continent of Antarctica. As floating ice melts in water, the space the ice took up is replaced by water, so the water level in the North Pole model should not increase as the ice cubes melt. However, when an ice sheet on a landmass (such as in Antarctica or Greenland) melts, this does cause an increase in the water level. This is what you should have observed in the South Pole model, with an increase of around one centimeter, depending on the shape of the dough landmass and ice cubes. It is thought that if all of the ice on the poles melted, sea levels would increase by at least 200 feet, due entirely to the ice on the South Pole melting, although the ice on Antarctica is not considered to be in danger of melting any time soon.

THE SCIENCE BEHIND IT

If you have ever been to a beach, you may have noticed that the ocean waves come farther up the beach at certain times of the day than at others — this is due to daily tides, caused mainly by the gravitational pull of the Moon. Tides are a normal daily rise and fall of the ocean surface.

Scientists are concerned, though, that there may be a different kind of rise in the ocean surface — one not due to the Moon's pull, but due to the warming of Earth's global climate. Since the 1950s, this warming has been thought to have been caused mainly by things that people do, like burn gas to drive cars, burn coal to make electricity, burn oil or natural gas to heat homes, or burn forests to make room for growing crops. The burning of all these things creates gases that trap heat from the Sun. As more gases are created, more heat is trapped in Earth's atmosphere, and the average temperature of Earth's air and oceans increases. One concern with the warming of Earth's global climate is that as the average temperature increases, this will cause ice to melt, which could make the sea level rise.

Many people around the world enjoy living near coasts, but even a small rise in sea levels will cause flooding of areas that are at a low elevation and close to the sea. In 2007, a study reported that around 634 million people (about 1 in 10 people in the world) live in locations that are less than 30 feet above sea level and are consequently at more immediate risk from rising seas.

EXTENSIONS

- *Repeat this activity two more times. Do you get the same results each time?*
- *Create a different South Pole ice model in which two ice cubes are placed on the dough continent to represent the ice sheet and one ice cube is placed in the water to represent floating ice shelves surrounding and attached to the continent of Antarctica. What do the results of doing this new activity tell you?*

RESOURCES

- <https://www.sciencebuddies.org/stem-activities/polar-ice-caps-melting#summary>

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