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**Helping Kids Learn – Post #17 5/20/20** See also companion lesson Post #24

# STEM: Earth & Space Sciences – Polar Ice Caps

If I ask you to draw a picture of a scientist, your picture might show a person in a white lab coat with test tubes and other lab equipment. Certainly, many scientists work in such an environment. Many other scientists work in *the* environment – the natural world. This exploration looks at one kind of these scientists. Explanations are clustered in **What's the Science?**. For extensions, see **Lift the Level** below.

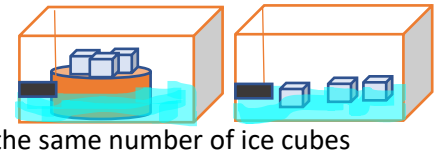
## Be a Climate Scientist – Exploring Polar Ice Caps

**Weather** is the conditions in our atmosphere such as air temperature, humidity (amount of moisture in the air), and wind speed and direction. It is usually used to refer to short-term conditions: today, tomorrow, next week. **Climate** describes weather conditions over time, usually 30 years or more.

You hear a lot in the news about climate change. Regardless of the underlying causes, it is easy to see that our weather conditions have changed across time. One way of seeing this is to look at the ice at the top and bottom of Earth – the polar ice caps.

**Investigation 1** You will need a few things to do this investigation. You won't destroy them (except the ice cubes) but ask permission before you use stuff from your kitchen!

- ✓ a small can or cup heavy enough to sit in water without floating
- ✓ 2 containers the same size and shape, big enough for the can/cup to fit in with a $^1/_4$ inch on all sides
- ✓ 4-6 same-size ice cubes
- ✓ some water
- ✓ 4 inches of tape or a marker



Put the can in one container. Add water around it and about half-way up the side of the can. Mark the water level with a piece of tape on the outside of the container. Carefully add ice cubes to the top of the can. They must stay on top. Put the other container next to the first one, add the same number of ice cubes in the bottom and fill with water to the same depth. Mark with tape.

Drink a glass of water yourself (you need to stay hydrated!) and check on the two containers in 30 minutes. At least some of the ice should have melted in each container. If not, wait another 15 minutes. Mark the container with tape to show the new water level.

Write your observations and wonderings:

| **Container with can** | **Container without can** |
|---|---|
| **I wonder:** | **I wonder:** |

You may need help to filter or boil water

**Investigation 2:** You will need a little water (filtered or boiled and cooled works best), a clear or translucent container about 1 inch on each side (1 $in^3$, the size of an ice cube), and about 10 drops of food color (blue works well but any color is OK), a toothpick or stirring stick and a flashlight.
Put the container on a table or countertop that can get wet. Pour water into the container about $^7/_8$ full. Hold the flashlight parallel to the table. Shine the light through the water. Write what you observe below.

Add the food coloring and gently stir. Shine the light again and write your observations and wonderings. *Keep the colored water!*

| **Water without coloring** | **Water with coloring** |
|---|---|
| **I wonder:** | **I wonder:** |

**Investigation 3:** Freeze the colored water from Investigation 2. You may have to leave the rest of this Investigation until tomorrow. You can do a **Lift the Level** activity or explore **STEM Online** if you have time now.

Once the water is frozen, take it out of the container and observe it closely. Shine the flashlight on it. Write your observations:

| **I observe:** | **I wonder:** |
|---|---|
| | |

## What's the Science?

In all three Investigations you **simulated** (created "laboratory" conditions like) polar ice and water.

Investigation 1: The container with the can represents Antarctica. It is a **continent** (large land mass) covered in ice. The container without the can represents the Arctic Ocean. It is water with floating ice. Together, they are known as the **polar ice caps** (South Pole & North Pole, respectively). They hold a LOT of Earth's water.

The ice is melting due to warmer climate, a thinning of the **ozone layer** (layer of atmosphere surrounding Earth) and other factors. (See Investigation 3 below)

However, the effect of the melting ice is different for the two poles. When ice melted in the Arctic, "just water," container, its volume was replaced by slightly *less* volume of water because water expands as it freezes. You saw this phenomenon in Investigation 3. The second piece of tape was probably almost on top of the first one.

When ice melted in the "can" container, some of it stayed on the top of the can. That represents the

thawing land below the ice absorbing some water. The rest went into the water surrounding the can – oceans surrounding Antarctica. That raised the ocean level so the second tape was above the first.

Investigation 2: The clear water in the container let light shine through. It represents **meltwater** – the water that is being added to the ocean in Investigation 1. The water with food coloring represents water with some particles in it – they could be plankton, dissolved minerals, or pollutants such as microplastics. Shining a light through the colored water makes it easier to see floating particles and somewhat more difficult to see through it. We'll say more about that after Investigation 3.

Investigation 3: As water freezes, particles/pollutants are pulled toward the center. You should have been able to see in your ice cube that the water at the edge was clearer than the water at the center.

As the ice cube warms, the first meltwater is clear. This lets more sunlight shine into the ocean water, warming the ocean water more than was occurring 30 or more years ago. (Remember, climate is measured in intervals of 30 years or more.) The warmer water touches the Antarctic ice cap and the continent (land) beneath it and warms them, causing even more rapid melting. Also, carbon dioxide ($CO_2$) which is trapped in polar ice is being released into the atmosphere as polar ice melts.

Scientists who study ancient climates, **paleoclimatologists,** and scientists who study the climate of recent times, **climatologists, meteorologists,** and **oceanographers,** to name only three, work at the poles, on research ships and in laboratories to discover these and many other phenomena associated with changes in our climate. They wonder, too. And their wonderings lead them to more study, more investigations, and more discoveries that will help all of us continue to live on Earth, even as it changes.

## Lift the Level

You can make this lesson deeper and/or suitable for older students by any of the following:

1. Scientists wonder all the time. And that leads them to new investigations and discoveries. Use your Wonderings from Investigations 1, 2, and 3 to do more research. Share it with your family or classmates.
2. In Investigation 2 we could have added salt to simulate the salinity in ocean water (although the salts are more complex than just NaCl, table salt). However, this would have impacted Investigation 3. Explain. (See **STEM Online** below.)
3. There are many branches to the study of climatology. Snow and the crystalline structure of snowflakes is one. Research snowflakes, some of the people who studied them, including Snowflake Bentley and Roger Graham Barry, and/or make your own snow. Then create a slide show or video to teach others what you have learned.
4. Major research centers, some sponsored by governments, others by universities, are doing major research on climate change. One is the Lamont Dougherty Earth Observatory of Columbia University. Go to their website (see **STEM Online**) and choose one topic of their research to investigate. Create a "research poster" to summarize what you learn.
5. Paleoclimatologists study ancient climates. How does one study, for example, rainfall or volcanic eruptions or earthquakes or ocean currents that took place thousands of years ago? And why?

Investigate this field which informs the science of climate change for today. Write a 1-page summary or poster explaining paleoclimatologists' work and its impact on current research.

## STEM Online

These are suggestions only and no endorsement is implied. Although they have been screened for appropriateness before posting, parents should vet the websites their children use as they may change over time.

Snow http://snowflakebentley.com/ https://en.wikipedia.org/wiki/Wilson_Bentley https://www.thoughtco.com/make-real-snow-yourself-609165 https://en.wikipedia.org/wiki/Snowmaking

Lamont Doughty Earth Observatory https://www.ldeo.columbia.edu/

Salinity and freezing points https://sciencing.com/freezing-point-water-compared-salt-solution-16047.html

Paleoclimatology https://en.wikipedia.org/wiki/Paleoclimatology https://www.ncdc.noaa.gov/data-access/paleoclimatology-data https://www.sciencedaily.com/terms/paleoclimatology.htm https://www.ldeo.columbia.edu/research/topics/paleoclimatology

## NJ Student Learning Standards

Science: K-ESS2-1; 2-ESS1-1, 2-ESS2-1, 2-ESS2-2; 3-ESS2-1, 3-ESS2-2, 3-ESS3-1; 4-ESS3-2; 5-ESS3-1; MS-ESS2-2, MS-ESS2-4; HS-ESS1-5, HS-ESS2-4, HS-ESS2-5