

WHAT IS CAUSING SEA

LEVELS TO RISE?

Observation:

Sea levels are rising at an alarming rate. Glaciers and arctic sea ice are melting rapidly due to global warming. Global warming is the increase in the average temperature of the earth's air and oceans, and is known to be just one of the aspects of climate change. Climate change is the overall long term change in the earth's climate.

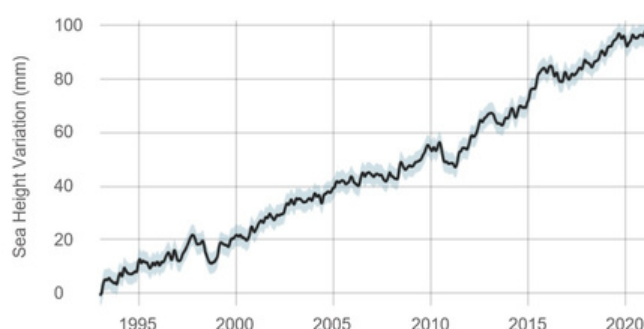
In the following experiments you explore three potential ways Earth's ice is melting and what happens to sea levels as it melts.

SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.
Credit: NASA's Goddard Space Flight Center

RATE OF CHANGE

↑ **3.4**
millimeters per year



Objective:

STEMforGIRLS members brainstormed some variables that we are going to test collectively in the month of February 2022. Each student should complete experiment one and can then choose between experiments two, three or a unique experiment testing a different contributing factor of the rising sea levels.

Independent variables

Independent variable is the one thing you are going to change/what you are investigating. You only have one independent variable for each experiment.

- Water temperature
- Amount of ice cubes (Experiment 1)
- Heat (Experiment 2)
- Representation of land (Experiment 3)

Dependent variable

Dependent variable is what you are focusing on to see what changes.

- Water or "sea" level

Controlled Variables

Controlled variables are what should remain constant across the control and the experiments. In essence, everything that is not the independent variable.

- Containers (identical needed)
- Size and shape of ice cubes (only number of ice cubes change in experiment one)
- Temperature (except in experiment 2)
- Initial water quantity
- Measurement units
- Times measured



Experiment 1: Floating Ice Cap

For our first experiment we will add ice cubes to two containers of water to determine if the water level will rise when the ice melts. The ice cubes will represent arctic sea ice and the water in the container will represent the ocean.

We will control this experiment by making sure the water in each container is the same temperature, that the water poured in is from the same source (i.e. your kitchen sink), the same amount of water is poured in each container, the ice cubes float and are the same shape and size (from the same ice cube tray).

Materials:

- Two clear plastic containers of the same shape and size (540ml). *Note: containers will be marked with permanent marker*
- Cold tap water
- Ice cubes (about 8 per experiment, but have extra just in case you need them. Ensure they are all about the same shape and size, or from the same ice tray, for accurate results)
- Permanent marker
- Ruler
- Camera
- Lab notebook

Time saver idea:

Experiment two - add a third container with no ice / no light. Compare the ice / no light container to this one for experiment one results. Note: experiment two still compares the container with light & ice to the container with ice / no light.

Experiment three - add a third container with "land" / no ice. Compare the container with the ice next to the land to this one for experiment one results. Note: experiment three still compares the container with the ice on the land to the container with ice next to the land.

Part 1: Prepare your North Pole models.

1. Fill two containers about halfway with cold tap water. Be sure to begin your experiment somewhere it won't be disturbed. The water represents the oceans.
2. Add an equal amount of ice cubes to each container and ensure they float. The ice represents the floating Ice cap.
3. Use your ruler to immediately measure exactly how deep the water is, record it in your notebook and mark the water level on the side of your containers with your permanent marker.
4. If possible, record the water level every 15 mins until ice is melted.
5. When ice is melted, record final water level in each container and compare to starting water level.

Hypothesis One: What do you think will happen?

Observation: How did the water level in the container change, if at all, during the experiment? Did the water level go up, or down, or stay the same?



Experiment 2: Thermal Expansion

Our second experiment will test whether or not our ocean water will expand when it's warmed up. Temperature is created through the "dancing" of atoms and molecules. When they are exposed to the energy provided by heat, they become agitated and move around, taking up more space than if they were cold and moving slowly. This is a process called thermal expansion. As climate change takes effect and the earth's atmosphere becomes warmer which in turn warms up the Earth's water.

Materials:

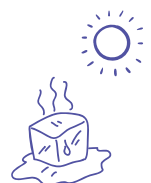
- Two clear plastic containers of the same shape and size (540ml). *Note: containers will be marked with permanent marker*
- Cold tap water
- Ice cubes (8 per experiment, but have extra just in case you need them. Ensure they are all about the same shape and size, or from the same ice tray, for accurate results)
- Permanent marker
- Ruler
- Camera
- Lab notebook
- Non-LED Lamp / Any lamp that produces heat when switched on

Part 1: Prepare your models.

1. Just as you did in the previous experiment, fill two containers about halfway with cold tap water. Be sure to begin your experiment somewhere it won't be disturbed. The water represents the ocean.
2. Add an equal amount of ice cubes to each container and ensure they float. The ice represents the floating Ice cap.
3. Use your ruler to Immediately measure exactly how deep the water is, record it in your notebook and mark the water level on the side of your containers with your permanent marker.
4. Place one container under the warm lamp and the other container a few feet away from the heat of the lamp.
5. If possible, record the water level every 15 mins until ice is melted.
6. When ice is melted, record final water level in each container and compare to starting water level.

Hypothesis Two: *What do you think will happen?*

Observation: *How did the water level in the container change, if at all, during the experiment? Did the water level go up, or down, or stay the same?*



Experiment 3: Ice Sheet



For our third experiment we will be using play dough to represent a land mass underneath the ice. You can make your own dough at home using the recipe below, or just use Play Doh. Ice sheets in Antarctica and Greenland rest on land, which means they are not floating in the ocean like ice caps.

Homemade dough recipe:

(Please make dough with adult supervision!)

You will need: a measuring spoon, wet and dry measuring cups, large mixing bowl, a butterknife, fork and a large spoon.

Ingredients:

3 1/2 cups all purpose flour

1/2 cup salt

3 tbsp cooking oil

2 cups boiling water

Directions: Mix flour, salt and oil in large bowl with a fork. With an adults help carefully add 2 cups of boiling water and stir with a fork or large spoon until the mixture forms a dough.

⚠ Use caution so as to not get burned! ⚠

Allow the dough to cool to room temperature.

*If you are unable to purchase or make dough, you can try this experiment by loosely putting a piece of plastic wrap over the top of the glass, poking a hole in it and placing the ice on top.

Part 2: Prepare model

1. Pack one cup of dough into measuring cup.
2. Remove the dough by scraping around the sides with a butterknife, and set the dough in the center of your container, (the lump of dough represents Antarctica) make sure the dough is flat and level on top and be sure to leave space between the dough and the sides of the container so you can add the water. Repeat for both containers.
3. Add about 1/4 cup of water around the sides of the dough, so the water level comes up about a third or half way up the dough. ****Ensure the water level is the same in each container.**
4. In one container place two ice cubes on top of the dough. Press cubes lightly into the dough, the ice cubes represent the Antarctic ice sheet.
5. In the second container place the ice cubes in the water next to your dough. This is to ensure an equal comparison.
6. Immediately measure the water level on with your ruler and mark the level on the side of your container with permanent marker.
7. Repeat steps 1-6 for one more ice sheet model. Make them one at a time and use the water level mark on the first one to help you fill the other so they contain approximately the same amount of water.

Hypothesis Three: *What do you think will happen?*

Observation: *How did the water level in the container change, if at all, during the experiment? Did the water level go up, or down, or stay the same?*





Testing your ice model

1. Allow the ice in your models to melt in a place where they won't be disturbed.
2. Once the ice has completely melted, get down to eye level with the water and see if the water level has risen in any of the containers. If the water level has risen, measure and record the amount of rise with a ruler and record the data in the table below or in a notebook.

Note:

1. **In experiment two** Keep an eye on the cubes on land to make sure they stay balanced on the dough and the water from the melted cubes is able to run off the dough.
2. Evaporation may occur if you leave any model for a significant time period before measuring. However, your control will experience the same evaporation. Remeasure your control and **add** any loss of water to your experiment to account for evaporation.

	Amount water rises Experiment 1	Amount water rises Experiment 2	Amount water rises Experiment 3
Trial 1			
Trial 2			

Do you think there are other factors contributing to rising sea levels? What are they?

Why do you think rising sea levels are important to study? What effects will rising sea levels have on humans? Marine ecology? Coastal ecology? Meteorological events?

Gamification

Share your results to earn gamification points. If you have the "Pheedloop Go" App on a device take a photo of your experiments and post them to the photo booth in the Clubhouse with a 1-2 sentence caption (about your results and/or answer one of the questions above). Or email your photo and caption to stemforgirls@wrdc.ca (we'll post them to the photo booth for you). Compare results with us LIVE 28 February 2022 at 4pm NST in the Clubhouse for even more points!

