

MIT Blossoms: Sea Level Rise – The Ocean’s Uplifting Experience

Teacher Guide

NGSS-PE (Performance Expectation)

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

[Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

Learning Objectives:

1. Ss will use an investigation of a glacial model to predict what will happen in reference to changes over time.
2. Ss will predict results of an investigation related to the water height and temperature variables.
3. Ss will use real world data to identify patterns and trends, and create a model to explain their predictions.

Introduction:

This activity series is one that I have been doing with students for many years to address misconceptions related to sea level rise. The video involves a series of investigations in which each activity is described and students are asked to make a prediction. After the investigation is performed, students are asked to record their observations and create models of their predictions.

Over time, I realized that there were many misconceptions that needed to be addressed, so adding in time to revise models, discuss with the class or with a partner, and think aloud as a group are all good ideas of

best practice while working through a concept such as sea level rise as related to climate change .

A good place to start is by having students complete a quick Think-Pair-Share on climate change and sea level rise. A graffiti wall of vocabulary words may also be a helpful starting point to get students thinking of proper terminology. Once the concept is evident amongst the group, begin the BLOSSOMS video lesson.

Activity 1: Glacial Meltdown Demo

Purpose: Highlight concept of sea level rise

Materials:

- permanent marker,
- 2 unopened tuna cans
- 2 identical medium bowls
- crushed ice
- water
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Procedure:

1. Make a mark in the same spot approximately half-way up both tuna can labels.
2. Set the bowls side by side on a level surface and place a can in each one of the bowls.
3. In the first bowl, pile as much crushed ice as possible on top of the can without letting any spill off.
4. In the second bowl, sprinkle ice in the bowl around the can so that it comes about halfway up to the marked line.
5. Pour water into both bowls, stopping when you reach the half-way mark on each label.
6. Give the ice time to melt completely, then recheck the water levels.

Once the two setups are completed let the students know that this investigation will be ongoing throughout the lesson.

- This investigation will be revisited at the end of the BLOSSOMS lesson.

As the students are engaged in the lesson the teacher should prompt the students with the following:

- What will happen to the water levels in each bowl over time?
- What could be some possible causes for your predictions?
- Develop two models explaining what is causing changes in each of your setups to match your predictions.
- Students will record their ideas in a lab notebook as they develop their model. Encourage students to develop models with components labeled and the process described.

Additional Teacher Notes:

Summarize concepts students may have expressed. Many students will believe that as the ice melts, both bowls will experience a water level rise. The difference has to do with ice on land melting & contributing to sea level rise vs. ice in water in both containers melting and replacing its own volume. Ice on top of Antarctica melts and contributes to sea level rise. Ice that is part of the Arctic melts, but replaces its own volume, therefore it does not change the water level.

Some Tips To Set Up Demo

In the first bowl, place as much ice as possible on top of the container, whereas in the second bowl, I did not place any ice on top of it, but there is ice in the water. Ask the students to suggest which of the polar regions each of the bowls represent? (The first bowl with ice is to represent Antarctica, a continent covered with varying amounts ice depending on the season. The other bowl is to represent the Arctic, a general area in the northern hemisphere that is not marked by a true land-based continent, but still has varying amount of sea ice depending on the season.)

Prepare students for the next dual activity using questions related to factors that cause sea level rise such as:

- Is there a pattern related to temperature change and water level rise that can be measured? What and how causes this occur?

As this is a lab activity, students may be placed in lab groups ahead of time and all set ups should be ready to go beforehand

Activity 2: Is There a Relationship Between Temperature and Water Level Rise?

Purpose: Identify relationship between variables

Materials:

- Rigid water bottle
- straw/graduated (or pipette/plastic pipette)
- wax or putty
- #3 two-holed stopper or flip top water bottle
- adhesive thermometer or digital thermometer
- ruler
- food coloring
- permanent marker
- blow dryer or lamp

Directions:

1. Unscrew flip top from water bottle & insert straw (If using water bottle & stopper, insert thermometer & pipette into stopper).
2. Ensure straw is vertical and inserted so that 2-3 inches of the straw are down into the bottle when the cap is on, and seal flip top with putty.
3. Adhere thermometer to side of bottle (A digital thermometer may be added with the straw through the bottle for true data collection & analysis).
4. Add water to the bottle and 2 drops of food coloring (easier to see water against ruler).
5. Continue to fill the bottle with water until it is completely full to the top. Screw top on bottle, being careful to watch for the overflow.
6. Make a line using the permanent marker to represent where the present water line is on the straw.
 - a. A ruler can also be taped or held to the top of the bottle for easier measurements
7. From a uniform distance, direct a heat source at the bottle (blow dryer, lamp) Measure over time (every 30 seconds, or every 1 minute) how much the water level rises in cm. Temperature may also be recorded as an additional data set.

Be cautious of air bubbles in set up, and to ensure the initial glacial melt down demo from activity 1 is safely far enough away from this activity as a blow dryer and lamp will be used.

Measurements: Have students record observations to help make sense of the phenomena they are seeing. Have students compile data into a class data table for discussion & analysis.

Sample data table:

Observation Number	Temperature (°__)	Height (cm)
1		
2		
3		
4		
5		

Additional Teacher Notes:

- Review group findings from the previous activity. Question what factors students notice that are contributing to their investigation and how it would compare to sea level rise. Explain that scientists use data as a way to monitor sea level rise over time. How do we know that sea level is truly rising over time vs. short sea level rise daily due to occurrences such as tides?

- As students heat the water, ensure they begin to take measurements at set intervals of time.
- Encourage the students to record their data in a data table.

Activity 3: What are Some Possible Causes of Sea Level Rise?

Purpose: Use real world data to predict outcomes

Materials: Computer, data file

Data file:

https://docs.google.com/spreadsheets/d/1RVZCz9DfzMVMEunDJo_u1mYCGyzZIS0HNTC2piHRILo/edit?usp=sharing

Students will examine data sets of global sea level rise over time in groups. Data is contained in two columns.

The first column contains date information. The first four-digit number is the year. The following four decimal places represent a percentage of the year that has passed in days, falling approximately on the middle of each month. For Example:

1880.0417 = Jan 1880 ($365 \text{ days} \times 0.0417 = 15.22 \text{ days}$ = January 15).

The second column is the Global Mean Sea Level (GMSL) in millimeters, compared with the average level in 1990.

Students will analyze and interpret any patterns and/or trends in the data by looking at the raw data set. Prompt students with group classroom discussion questions such as:

- What relationships can you see in the data?
- Do you notice any patterns in the data set?
- What could cause these patterns to occur?

Students will then create a graph of the raw data (using Google Sheets or Excel). Students will analyze and interpret data from their graph. As they examine the data, they will insert a trendline, and obtain the equation of the linear trend to determine the slope. The slope will show the overall sea level rise over time.

Additional Teacher Notes:

If time or resources are limited, teachers may graph the data ahead of time for students, and provide copies of the graphs for students to interpret.