

SEA LEVEL ACTIVITY 2 JUST HOW MUCH ICE IS THERE IN THE POLAR ICE SHEETS?



Background Summary: An ice sheet is a large expanse of ice measuring a minimum of 50,000 km² (20,000 miles²) or about twice the size of New Jersey. Today there are three polar ice sheets remaining on Earth— one on Greenland in the North and one each on West & East Antarctica in the South. These ice sheets have been in existence for millions of years and will be around for many more years, yet they are changing as the climate warms, melting and calving adding more ice into the global oceans. When ice from the ice sheets moves from the land where it is formed into the ocean as melt water or as chunks of calving ice it displaces ocean water and affects sea level. Just how much sea level rise is in the ice in the polar ice sheets?

Goal: This activity looks at just how much ice is frozen into the polar ice sheets. Using small display tubs with a photo of an iconic bridge that students will be familiar with students add water equivalent to the amount of ice in each of the 3 ice sheets to see the impact in the global oceans. Note: A few sample bridge images are attached. In order to scale the activity the important consideration is what the clearance is below the bridge.

Materials Needed:

At home alternatives noted in italics

- Small plastic rectangular ‘bug’ boxes or terrariums (5"X7"X4") one per set up.



Alternative to ‘bug’ boxes: clear casserole dish or clear mixing bowl. Remember that the proportions must remain the same, so if the volume of the container increases so does the water added per ice sheet.

- Print & laminate images of the bridge you chose to display (sample photos attached at the end)

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No access to lamination? Simply cover the image with clear package tape to seal it or clip the bridge printout onto the container and try to prevent it from getting wet.

- Container for water, such as a *large mixing bowl*
- Set of plastic measuring cups (1/4 cup, 1/2 cup and 1 cup)
- Clips or tape to hold the bridge image to the back of the rectangular bug box

*Tappan Zee (NY), Delaware or Chesapeake Bridges are attached to this write up but any bridge can be used as long as you know the clearance of the bridge above the water surface so that you can determine the impact if the volume of ice in the ice sheets was added to the oceans. The ‘bug box’ is 7 inches wide, so plan to print your image so that it spans that distance in width and ~5 inches in height. You will need to adjust your image size when printing. Depending on your containers you may need to redo the calculations for how much water to add for each ice sheet but if you consider the span of the bridge, and the amount of melt from each ice sheet (listed below) it is not hard to do the calculations. Recall the East Antarctic Ice Sheet has ~7 times that of each of the other ice sheets.

Introduction to this Activity: The Tappan Zee Bridge has a span clearance (the base of the bridge above the water) of 138 feet above the water and the top of the towers reaches up to 239 ft. It will take a large change in sea level to affect this but if the ice sheets were to melt it would affect the bridge.

Set Up: Clip an image of the bridge to the back of the tub. Add water until it just reaches the footings of the bridge. (The resolution on these is pretty coarse so if they are close that is fine.)



These students are using simple math to calculate their ice sheet input.

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You may want to label the span clearance of the bridge you use. Set out a card or piece of paper with the Ice Sheet water equivalents and the amount of water to add for each one:

- **The East Antarctic Ice Sheet holds 170 ft. or 52 meters of equivalent SLR** (1 $\frac{3}{4}$ cups of water when adding to the box)
- **The West Antarctic Ice Sheet holds 19-21ft. or 6 meters of equivalent SLR** (just under 1/4 cup of water when adding to the box)
- **The Greenland Ice Sheet holds 24 ft. or 7 meters of equivalent SLR** (1/4 cup of water when adding to the box)

Activity: Each tub should start with water up to the waterline in the photo. Students will then add water into the tubs equal to the amount of ocean sea level held in each ice sheet (see following amounts). After each addition they should line their eyes up with the water level to see the effect on the bridge.

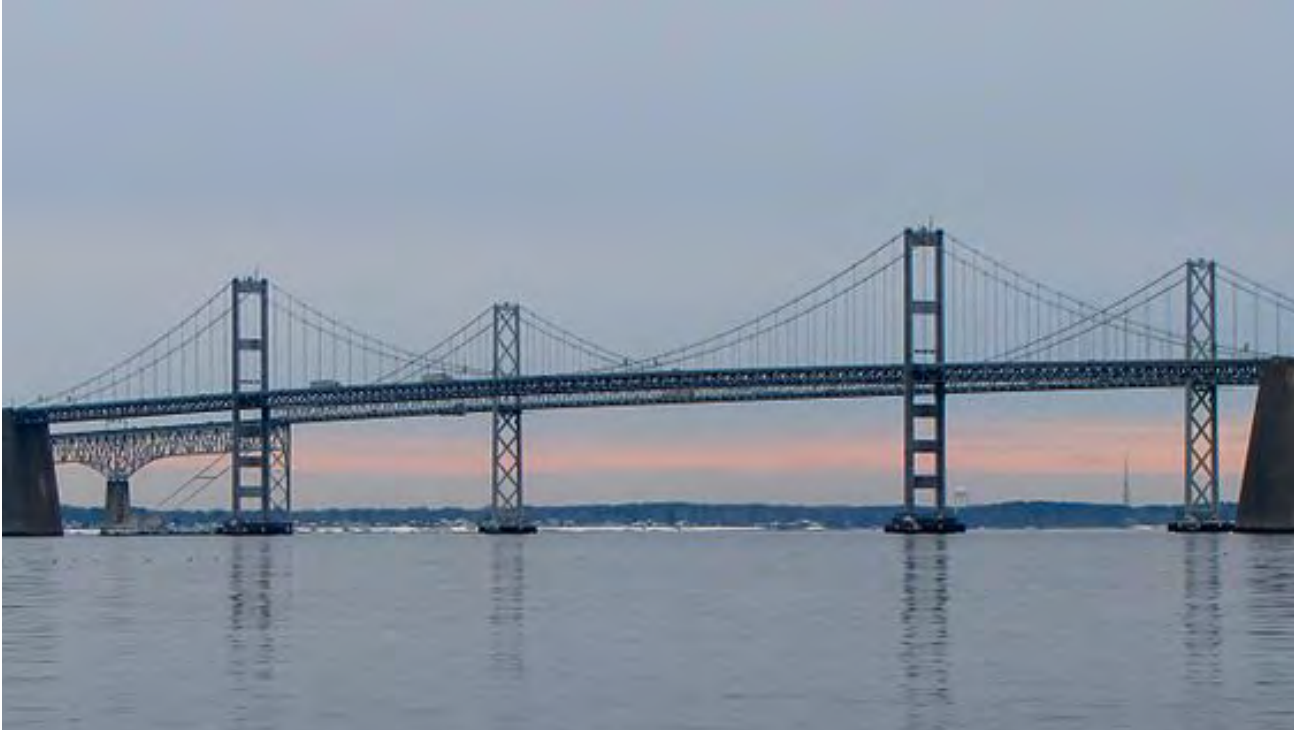
- a. $\frac{1}{4}$ cup is Greenland (24 ft./7 m)
- b. A little less than $\frac{1}{4}$ cup is West Antarctica (19-21 ft./6m)
- c. 1 $\frac{3}{4}$ cups is East Antarctica (170 ft./52m)

Discussion: This activity focuses on the **potential** tied up in the polar ice sheets. The ice sheets have been around for millions of years (Greenland has had ice for ~ 4 million and Antarctica has had ice for ~34 million years and a large amount of ice for ~ 14 million) and would not melt completely for many, many thousands of years if at all.

Note: This activity connects back to the “Oceans Connect Us All to the Ice in the Polar Regions” activity on how water in the hydrosphere moves between a liquid state in the oceans and a frozen state in the ice sheets, and ties well into the next activities: “Time Traveling With Sea Level” that looks at variations in sea level through different geologic time periods, and “Predicting Future Sea Level Rise” which asks students to consider what has happened with sea level in their region over the past 100 years, and to consider where they think it might go in the next 100 years.



Tappan Zee Bridge clearance 138 feet, elevation mid span 293 ft. (top of spires)



Chesapeake Bay Bridge clearance below is 186 ft. with towers rising 379 ft.



Delaware Memorial Bridge clearance at midspan is 175 ft. and tower height 440 ft.