

## **SEA LEVEL RISE**

This activity was adapted from the Massachusetts Bay Watershed Stewardship Guide, An education: Chapter 13- Planning for a Shifting Shoreline: Sea-Level Rise and Climate Change.

### **Activity Description**

This activity shows how climate change, sea level rise and energy are related. Students learn how sea level rise is connected to the expansion of water as it warms. Students will also learn the difference between melting of floating ice (icebergs) versus melting of land-based icefield's.

### **Take Home Message**

Sea-level rise is a consequence of global warming. This is due not only to melting polar ice adding extra water to the seas, but also due sea water expanding as it heats up. Sea level rise will result in the loss of shoreline and habitat as well as alter global weather patterns. We must all work hard to reduce our consumption of energy (fossil fuels), and encourage our government to pass energy saving laws.

### **Massachusetts Frameworks**

States of Matter 3/ Weather

### **Supplies**

- Graduated beaker filled with water
- Graduated beaker filled with water and ice
- Erlenmeyer Flask
- Stopper fitted with pipette and thermometer
- Hot pot and extension cord
- A basin with ice water
- Tray with land shaped piece of florist foam, painted and decorated with houses.
- Water pitcher
- Tongs

### **Set-up**

1) Beakers: Fill beaker #1 with 50 cc's of water, and beaker #2 with 30 cc's of water, add ice to bring the volume to 50cc's. Prop the poster of Iceberg nearby.

2) Flasks: Fill flask with 100 cc's of water, about ½ way full. Fit with stopper unit. Have hotpot filled and plug in to heat water, place this behind the table to prevent any scalding.

3) Tray with Rock: put foam in tray add water to come up to edged of "beach", have pitcher nearby to recreate sea-level rise.

## Climate Change Background Information

- Climate Change
  - Climate is the long-term average of a region's weather events lumped together. In response to the change in ozone layer from greenhouse gas emission, climate is predicted to change, some places will get more rain or snow and others will get less. Some places may become warmer and others will get colder.
- Crops and food supply
  - The earth may get warmer in cold places. People living in these places may have a chance to grow crops in new areas. But climate change also might bring droughts to other places where we grow crops. In some parts of the world, people may not have enough to eat because they cannot grow the food that they need.
- Human health
  - Heat stress and other heat related health problems are caused directly by very warm temperatures and high humidity. Untreated, heat stress can be a very serious medical problem. Scientists suspect that, in many places, climate change will increase the number of very hot days that occur during the year. More hot days increase the possibility of heat related health problems.
- Sea level rise- Focus of this activity
  - Warmer climate can make glaciers melt. A glacier is a large sheet of ice that moves very, very slowly. When some glaciers melt, they release water into the ocean and make the level of the ocean higher. Water will also expand as the oceans warm up causing sea level rise.

## Activity Procedure/Script

- Does anyone know what the difference between weather and climate is?
  - Climate is the long-term average of a region's weather events, so what happens decade -to -decade or century-to-century or longer. Weather is what happens day-to-day and week-to-week.
- Has anyone heard the term "Global Warning" or "Climate Change"?
  - This is the term used to describe the consequences of greenhouse gas emissions (burning of fossil fuels) on the environment. Scientists have determined that as the earth continues to warm up, a likely consequence will be that the level of the ocean will rise.
- Ask group if they know what sea level rise is, and what makes the sea level rise?
  - Likely answer: melting glaciers/ice or changing tides.
  - *Use simple relief model (foam in tray) to demonstrate that as the sea rises, it covers more and more land. Have student add water to show how shoreline becomes inundated.*
- Explain that there are actually two factors that lead to sea level rising and tell students, we are going to conduct two experiments to show how this happens.

- Sea level rise is a result of the climate warming. Melting of glaciers that are on land, like the Antarctic ice sheet, will increase sea level rise as more fresh water is added to the ocean. Floating ice, like the North Polar ice cap (show the poster), won't make the sea level rise when it melts because the ice is already in the water.
  - *Show students the two beakers of water, one with just water and one with water and ice, tell the students that the ice is supposed to represent an iceberg. Point out that the water level in both beakers is currently exactly the same, then, ask students what they think will happen when the ice melts...will the water level (sea-level) stay the same, go up?*  
*Discuss the students predictions-*  
*Set this aside and come back to it later*
- In addition to ice melting into the oceans, raises in global temperature can make the sea level rise because water expands as it heats up. This is called **thermal expansion**.
- Ask what happens when water heats up, students may recall this from Matter Madness.
  - As water heats, the molecules of water move faster, and farther apart. Explain that the molecules start moving more even before the water evaporates and actually increased the mass of water.
  - *Fill flask with room temperature water to 100cc's. Insert stopper firmly. Have students note both the water level in the pipette, as well as the water temperature. Using the tongs, carefully lower the flask into the boiling water for about one minute. Take out place on table and note the difference in both temperature and the pipette water level measure.*
- Look back at the set of beakers and note changes (should be none) in water levels. Ask if anyone was surprised by what they saw.
- **Summarize Explanation:** Explain that only ice being added to the sea, as chunks of icefield break off and melt, will make the ocean rise, but the icebergs that are already in the ocean will not cause sea levels to rise.
- As the global climate increases, the oceans' water gets warmer. As the water gets warmer, it expands, causing the sea level to rise. Melting polar ice could also affect ocean water movement. It is thought that the Gulf Stream could be diverted further south by the addition of cold water from the north, changing global weather patterns.

**Discuss things that students can do to reduce energy use, and thus help reduce greenhouse gas emissions.**

The trash that we send to landfills produces a green house gas called methane. The animals we raise for dairy and meat products also produce methane. Whenever we drive or ride in a car, we are adding greenhouse gases to the atmosphere. And, when factories make things that we buy and use everyday, they too are sending greenhouse gases into the air.

Driving a car or using electricity is not wrong. We just have to be smart about it. What can you do?

#### Car pool

Four people can ride together in one car instead of driving four cars to work, school or a friend's house.

#### Read

Learning about the environment is very important. There are many good books that will help you learn. To get started, ask a teacher or a librarian for some suggestions

#### Save electricity

Whenever we use electricity, we help put greenhouse gases into the air. By turning off lights, the television and the computer when you are through with them, you can save a lot of energy.

#### Bike, bus and walk

You can save energy by sometimes taking the bus, riding a bike, or walking

#### Talk to your family and friends

Talk with your family and friends about climate change. Let them know what you've learned.

#### Plant trees

Planting trees is fun and a great way to reduce greenhouse gases. Trees absorb carbon dioxide, a greenhouse gas, from the air

#### Recycle

Recycle cans, bottles, plastic bags and newspapers. When you recycle, you send less trash to the landfill and you help save natural resources like trees, oil and elements such as aluminum

#### ENERGY STAR®

Many things, like computers, TVs, stereos and DVD players have special labels on them. The label says "energy" and has a picture of a star. Products with the ENERGY STAR® label are made to save energy.

## MORE BACKGROUND MATERIAL:

Sea level may rise has risen between 4-8 inches in the last century and may rise at an accelerated rate during the next century.<sup>1</sup> What might happen if the sea level rises?

Salt water may flow into areas where salt is harmful, threatening plants and animals in those areas. For example, an increase in the salt content of the Delaware and Chesapeake bays is thought to have decreased the number of oysters able to live in those waters.

Oceanfront property would be affected by flooding, and beach erosion could leave structures even more vulnerable to storm waves.

Coastal flooding also may reduce the quality of drinking water in coastal areas.

The Earth has warmed about 1° F in the last 100 years. Scientists expect the average global temperature to increase an additional 2 to 6°F over the next one hundred years. This may not sound like much, but it could change the Earth's climate as never before. At the peak of the last ice age (18,000 years ago) the temperature was only 7°F colder than it is today, and glaciers covered much of North America!

What kinds of things might cause global warming?

Periods of increased heat from the sun

An increase in greenhouse gases

Have you ever seen a greenhouse? Most greenhouses look like a small glass house. Greenhouses are used to grow plants, especially in the winter. Greenhouses work by trapping heat from the sun. The glass panels of the greenhouse let in light but keep heat from escaping. This causes the green house to heat up, much like the inside of a car parked in sunlight, and keeps the plants warm enough to live in the winter. Gases (water vapor, carbon dioxide, nitrous oxide, and methane for example) in the atmosphere behave much like the glass panes in a greenhouse. Sunlight enters the Earth's atmosphere, passing through the blanket of greenhouse gases where much of it becomes trapped causing the earth to heat up.

Without these gases, heat would escape back into space and Earth's average temperature would be about 60°F colder.

Where do ghgs come from?

Once, all climate changes occurred naturally, but during the Industrial revolution (more than 200 years ago) people began using machines to make life easier. Before the Industrial revolution, human activity released very few gases into the atmosphere. Since

---

<sup>1</sup> Atmospheric Carbon Dioxide and The Greenhouse Effect, 1989, pp 28-31 Office of Basic Energy Science, Department of Energy, Washington, D.C

the Industrial Revolution, the need for energy to run machines has steadily increased. The energy that makes cars run and much of the energy used to make electricity comes from burning fuels like coal and oil, which release greenhouse gases.

## **Clean Up**