Mapping Sea Level Rise

Levels V-VI

Grades 9-12

Overview:

Students create and explore topographical maps as a means of studying sea level rise.

Objectives:

The student will:

- investigate the difference between sea ice and glaciers in relation to sea level rise;
- create a topographical map;
- use a topographical map to predict sea level rise; and
- discuss how sea level rise will affect Alaska's coastline.

GLEs Addressed:

Science

- [9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [10-11] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.
- [9-11] SD2.1 The student demonstrates an understanding of the forces that shape Earth by recognizing the dynamic interaction of erosion and deposition including human causes.

Materials:

- Beaker (one per group)
- Pitcher
- Ice (several cubes per group)
- Potato (1/2 per pair)
- Clear plastic tub with flat bottom and clear plastic lid (one per pair)
- Water soluble marker (one per pair)
- Centimeter ruler (one per pair)
- Kitchen knife
- Water
- Blue food coloring
- White paper
- Scissors
- Clear tape
- *Global Climate* Interactive DVD
- OVERHEAD: "Map of Shishmaref"
- STUDENT INFORMATION SHEET: "Sea Level Mapping"
- STUDENT WORKSHEET: "The Rising Coast"

Activity Preparation:

Prepare water for the student activity by adding blue food coloring to the pitcher until the water is a dark blue color.

Activity Procedure:

1. Remind students that one result of global climate change is rising sea levels. Glacial melting contributes to rising sea levels, which impact coastal communities and ecosystems. As a class, explore the "Climate Change Impacts" Unit "Arctic Region Impacts - Glaciers" section of the *Global Climate* Interactive DVD.

2. Explain that scientists have been mapping and continue to map coastlines to study how sea levels rise or fall. Explain the melting of land-based ice, such as glaciers (not sea ice), is causing sea levels to rise. Ask students why sea ice melting does not impact sea levels.

3. Explain that ice already in the ocean does not contribute to sea level rise because the ice displaces the same amount of water it will contribute when it melts. However, glaciers are formed on land. When glaciers break off into the ocean they displace existing water (just as a person displaces water when they enter a bathtub), causing the water level to rise.

4. Demonstrate this principle by distributing a beaker, plain water, and several ice cubes to each group. Ask students to place a few ice cubes in the water and mark the water level. When the ice has melted, ask students to note whether the water level has changed (it should not have changed). Next, distribute more ice cubes and ask each group to place another ice cube in their water. Ask groups if the water level changed (it should have gone up).

5. Explain that the first ice cubes represent sea ice; they already exist in the water, so when they melt the water level doesn't change. The second set of ice cubes represent glaciers; as they calve off into the ocean, they displace the water, causing sea levels to rise.

Critical Thinking Question: Wait Time Method. Inform students that they will be asked a question and given time to think about their answers; they will not be called on for answers immediately. The wait time can be anywhere from 15 seconds to 5 minutes.
Ask students if increased precipitation adds to sea level rise. Why or why not? When the allotted time is up ask for a show of hands or select a student to answer. (*Precipitation is part of the water cycle. As water evaporates from oceans and rises into the atmosphere, it cools, condenses, forms clouds, and eventually precipitates falling back to Earth as rain, snow, sleet, etc. Although in the short-term there is not complete balance in the cycle, water may evaporate from a lake and fall as snow on a glacier – ultimately the water that evaporates from the oceans will return to the oceans. Thus, sea levels will not rise as a result of precipitation.*)

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6. Divide students into pairs and distribute the STUDENT INFORMATION SHEET: "Sea Level Mapping." Cut potatoes in half, and distribute along with a clear plastic tub with clear plastic lid, marker, ruler, dyed water, and half a potato to each pair.

7. Guide students through the activity, providing assistance as needed.

8. When students are done with the mapping exercise, distribute a pair of scissors, tape, and a white sheet of paper to each group. Ask groups to cut out a white circle and tape it to the back of the container lid to increase visibility of the shoreline (contour lines). As a class, compare students' maps and discuss how they compare and contrast.

9. Show OVERHEAD: "Map of Shishmaref." Explain topographical maps show the elevation, or how high up, geographical features are. Each line on the map represents a change in height, the closer together the lines, the steeper the land at that particular location. The solid lines on this map mark 50 feet of elevation, the dashed lines represent 25 feet of elevation.

10. Explain that in the sea level mapping activity, students created topographical maps of their potato. Scientists can use satellite images and topographical maps to estimate how far inland ocean water will travel if sea levels rise. For example, the steeper the coastline the less inland the sea will travel. However, a shallow coastline will result in more inland flooding.

11. Ask students what will happen if the sea level rises 25 feet. Explain the areas along the coast that are less than 25 feet would be covered in water.

12. As a class, use the map's scale to determine how far inland the ocean would inundate (cover the land) at a particular point if it were to rise 25 feet. To do this, pick a spot on the coast and use a ruler to measure the distance from the edge of the coast to the 25-foot contour line. Use the scale on the map to convert the measurement to an actual geographical distance.

13. Explain scientists project a rise of up to 3 feet during this century. Even this small amount can have a large impact on coastal geography.

Teacher's Note: The *Global Climate* Interactive DVD can be shown on a multimedia projector for the whole class to view. To increase student interest, use a wireless mouse to allow students to take turns using interactive features of the DVD.

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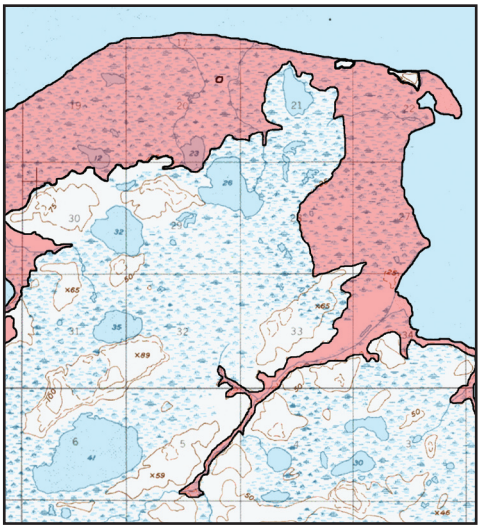
14. Explain while flooding is a concern, so is coastal erosion. As water levels rise, protective sea ice diminishes and storms increase. Coastal erosion will also increase, resulting in building infrastructure damage, road damage, and damage to the coastal ecosystem, such as birds that nest on the shore.

15. Discuss how rising sea levels will influence the local community.

16. Distribute the STUDENT WORKSHEET: "The Rising Coast" and direct students to complete the worksheet individually.

Answers:

1. B. glacial melting
2. See map at right.
3. 3000 feet (answers may vary slightly)
4. Answers will vary.



Sea Level Mapping
Student Information Sheet

Levels V-VI

Directions:

STEP 1. Place the lid on the container and draw a line along the edge of the lid and the side of the container so that they can be matched up later.

STEP 2. Use the ruler and marker to draw a scale in one-centimeter increments along the side of the container.

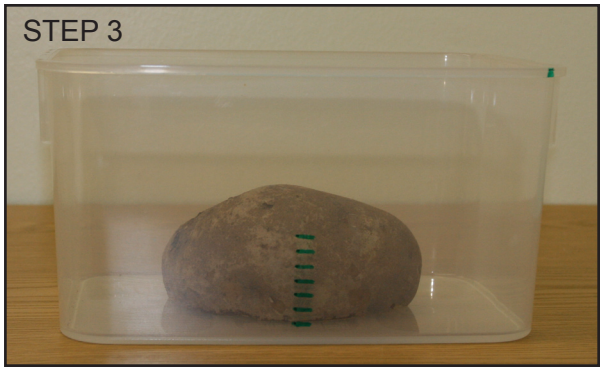
STEP 3. Remove the lid and place the potato, cut side down, in the clear plastic container.

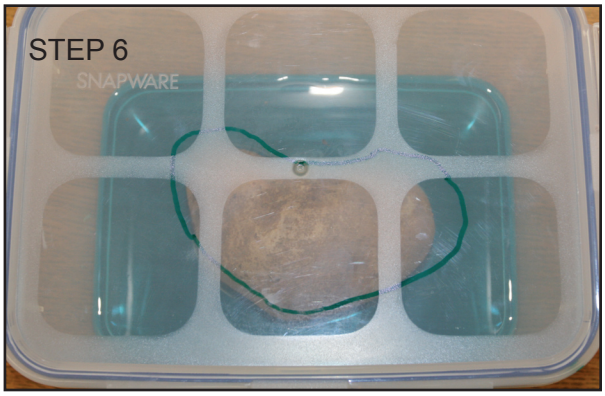
STEP 4. Add colored water carefully until the level reaches the two-centimeter mark. Do not pour water directly on the potato.

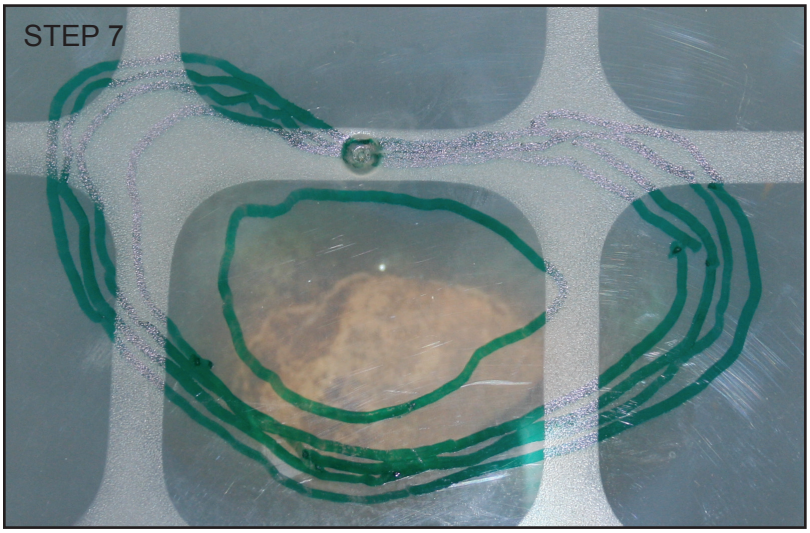
STEP 5. Replace the lid and orient it so that the lines drawn in STEP 1 are aligned.

STEP 6. Look straight down into the container and draw a line that represents where the water meets the potato. This is the shoreline.

STEP 7. Repeat steps 4, 5, and 6, adding one centimeter of water each time until the potato is submerged.







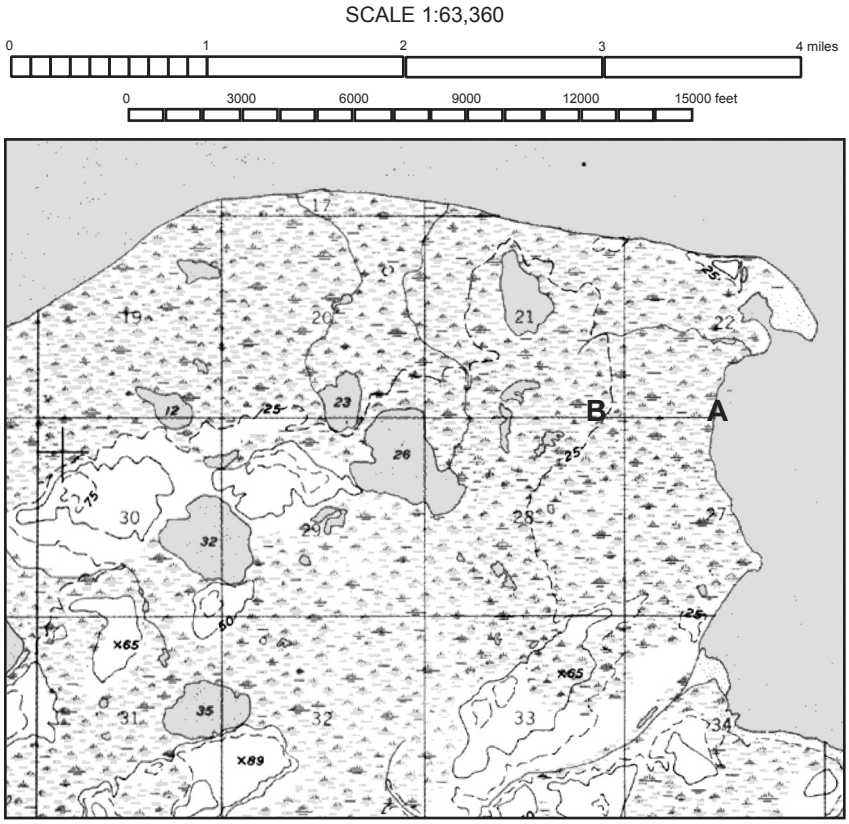
Name:_____

The Rising Coast

Student Worksheet

Levels V-VI

1. Circle the cause of rising sea levels.
   A. glacier formation
   B. glacial melting
   C. sea ice melting



2. On the map, shade in the topography that would be covered with water if ocean levels rose 25 feet.

3. Use the scale on the map to determine the distance from Point A to Point B.

   _____ feet

4. What are some possible impacts of sea level rising on your local community?

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Map of Shishmaref, Alaska
Overhead