



## Seashores on the Move

### Purpose

- To help students understand how sea level rise can affect coastal communities and environments.

### Overview

This activity is comprised of four parts. In Part 1, students read the Elementary GLOBE book *What in the World Is Happening With Our Climate?* and review the cause of sea level rise. In Part 2, students build a model of a coastal community. In Part 3, they make predictions about what features will be at risk of flooding as sea level rises and test their predictions by raising the sea level in their box. In Part 4, students plan for changes that will help keep their community from flooding.

### Student Outcomes

Students will learn that when water is added to the ocean, sea level rises, causing the beach to move inland, which makes a big impact on the lives of people who live at or near the beach. Students will build a model to test their predictions about the impact of sea level rise. Students will learn that communities can design modifications and can decide where to build to help protect coastal environments.

**NGSS PE K-ESS3-3.** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

**NGSS PE 2-ESS2-1.** Compare multiple solutions to slow or prevent...water from changing the shape of the land.

**NGSS PE 2-ESS2-2.** Develop a model to represent the shapes and kinds of land and bodies of water in an area.

**NGSS DCI ESS3.C:** Human Impacts on Earth Systems

**NGSS DCI ESS2.C:** The Role of Water in Earth's Surface Processes

**NGSS ETS1 A:** Defining and Delimiting an Engineering Problem (K), B: Developing Possible Solutions (K), C: Optimizing the Design Solution (2)

**NGSS Science and Engineering Practices:**

- Developing and Using Models
- Obtaining, Evaluating and Communicating Information

**NGSS Crosscutting Concepts:** Cause and Effect, Stability and Change

### Time

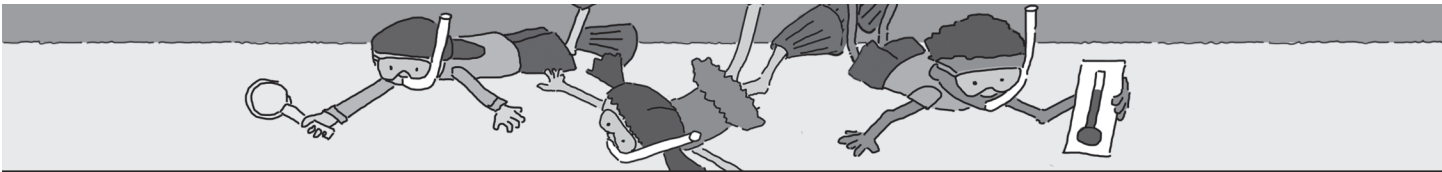
- Part 1: One class period (45 minutes)
- Part 2: Two class periods (45 minutes each)
- Part 3: One class period (45 minutes)
- Part 4: One class period (45 minutes)

### Level

Elementary (most appropriate for grades K-4)

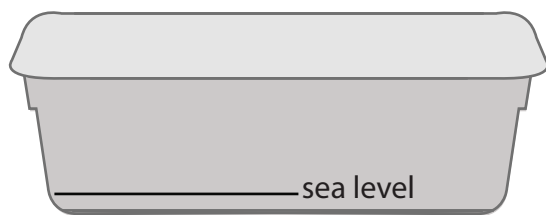
### Materials

- Photos of different types of coastal areas
- Clear plastic shoebox for each group of 4, or one large clear plastic box (36" x 17") for the class
- Play dough
- Sand and pebbles
- Model houses, cars, trees
- Model making materials (such as Legos®, construction paper, wire, popsicle sticks, toothpicks, paper umbrellas, buttons, colored felt, pipe cleaners, cardboard)
- Scissors
- Markers
- Tape, glue sticks
- For each group of four: a paper or plastic cup, a piece of cardboard about 12" long, and three objects that roll, slide, or do both
- Water
- Blue food coloring
- Measuring cup
- Permanent marker
- Ruler
- *Seashores on the Move Activity Sheets 1-5*
- Elementary GLOBE Book: *What in the World Is Happening With Our Climate?*



## Preparation

- Gather supplies for model building.
- Organize a central materials table (or space) for students to collect needed supplies.
- Cover work areas with tablecloths or newspapers.
- Copy *Activity Sheets 1-5* (one per student).
- Collect photos of different types of coastal areas (including rocky coasts, sandy beaches, and cliffs).
- Mark the side of the boxes with a horizontal line to indicate the sea level. Make sure the line is just



above the bottom of the box (so that when water is added later, it will just cover the bottom of the box).

- Make play dough if you don't have it (see recipe below). A model coastline in a plastic shoebox that takes up about half of the box requires about a half batch of dough using the recipe below. (You'll need three batches if you have six groups.)

### Play Dough Recipe

- 2 ½ c flour
- ½ c salt
- 1 tbsp. alum
- 1 ¾ c. boiling water
- 2 tbsp. cooking oil
- food coloring (optional)

Mix flour and salt in large bowl. In a glass measuring cup mix alum, water, oil, and food coloring. Add to the flour/salt mixture. Stir until slightly cool. Knead well adding additional flour until it stops sticking to your hands. Keep in airtight container when not in use.

## Teacher's Notes

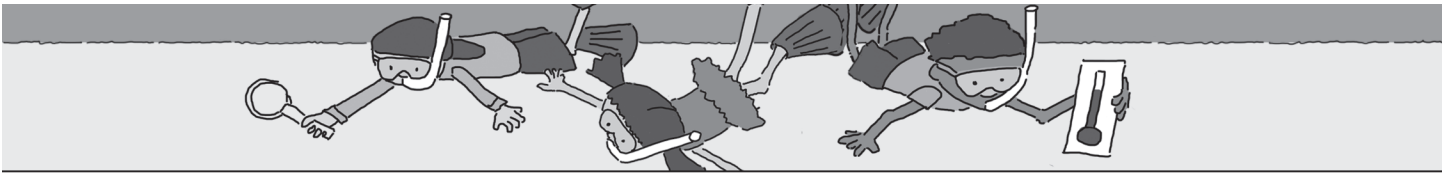
There are two ways that climate change causes sea level to rise. First, as climate warms, glaciers and ice sheets melt, and most of the meltwater makes its way downhill in rivers and streams to the ocean (some of it winds up in groundwater). The additional

water causes the level of the ocean to rise. Second, as Earth's temperature increases, the ocean warms. With added heat, the water molecules move further apart causing the water to expand. This is known as thermal expansion, and it accounts for about half the amount of sea level rise seen today. Melting of glaciers and ice sheets is introduced in this activity and in the Elementary GLOBE storybook: *What in the World Is Happening With Our Climate?*. If you are working with more advanced students who have an understanding of the behavior of molecules, you may wish to include thermal expansion in your discussion of the reasons that climate change leads to sea level rise.

On average, sea level has been rising about about 1/8 inch per year (about 3 mm per year) in recent decades, according to NOAA satellite data and coastal tide gauges. The Intergovernmental Panel on Climate Change estimates that we could see between one and a half to three feet of sea level rise (about 45 - 100 cm) during this century if climate change continues at a rapid pace. If an entire ice sheet melts and the water is added to the ocean, sea level would rise much more.

Coastal areas are more likely to be flooded as sea level rises, particularly during storms when low atmospheric pressure causes the ocean level to be temporarily higher than normal. Vulnerability to sea level rise also depends on the shape of the coastline and the adjacent sea floor, and the range in tides. Many coastal areas around the world are assessing which places are the most vulnerable to flooding and considering how to modify coastal communities to ensure that people and buildings are safe.

**About Making Predictions:** In Part 3 of this activity, students will need to know how to make informed predictions and how to justify those predictions. Predictions are a combination of a student's background knowledge and reasoned thinking put together to make an informed guess. Tell students that a prediction is an educated guess that can be defended. Students may feel that if their prediction does not turn out the way they thought it would that they have made a mistake and that their thinking



is wrong. Teach students that making a prediction, observing, and understanding the results is part of a scientist's job. The prediction-observation-results pattern is a way for scientists and students to learn more about the world around them.

## What to Do and How to Do It

### Part 1: Review the cause of sea level rise.

1. After reading the Elementary GLOBE book, *What in the World Is Happening With Our Climate?*, ask students why homes are flooding in the Maldives. (Consider re-reading page 17 to remind students what Dr. Goma says about the Maldives.)
2. Give each student the *Seashores on the Move Activity Sheet 1*, a pair of scissors, and a glue stick. Have students cut out the possible answers and glue them into the sentence where they belong. Once they have all the answers in place, have the class read the sentence together.

### Part 2: Make a diorama of the coastline.

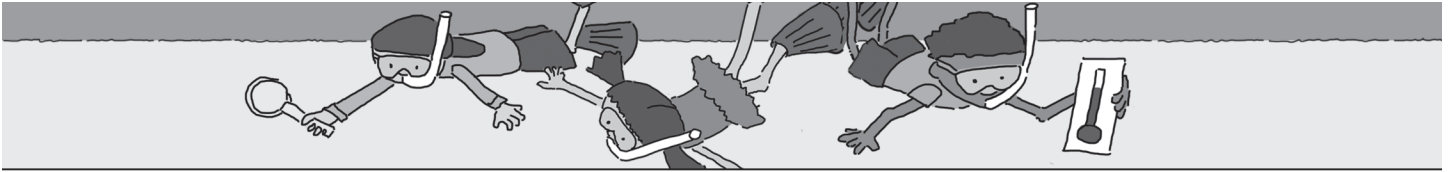
1. Show students pictures of different types of coastlines and coastal communities. Ask students: What do you find at the coast? Have students make a list of the things they see in the pictures (e.g., people, homes, city, boardwalk, rocks, cliff, sandy beach, pier, harbor, turtle nests, lighthouse, lifeguard station) and introduce new vocabulary words as needed.
2. Tell students that in this activity they will make a model of a coastal community - a place that is near the ocean where people live.
3. For students in grades K-1, an option would be to decide what coastal community the whole class would like to design together in one large "under bed" type plastic storage container. After a decision has been made about a coastal community, students can use the ideas from their earlier brainstorming and the *Seashores on the Move Activity Sheet 2* as

a guide to build their beach diorama. Put students in pairs or groups of four and have them decide what they will build in the diorama. You could have student groups each make an island in the box.

4. For 2nd-4th grades, have students form small groups of four and decide, as a group, what they would like their coastal community to include using the *Seashores on the Move Activity Sheet 2* as a guide. Encourage students to research as they plan their beach, looking at books, pictures, videos, or websites. Have students list the natural and human-built parts of their coastal landscape on the activity sheet. (Note: The quantity of items that students should select will depend on the amount of space in the plastic shoebox space and the scale that they use to build their model.)
5. Show students the box they will use to make their coast. Students should make sure that about half of the area in their box is ocean and about half the area is land. Show students the line on the side of their box that indicates sea level. (They will add water to their model once it is complete.)
6. Once student groups have a plan for their coast and its community, provide each group with a plastic box and the materials that they will need to build their beach diorama. Have students make a key/legend for the items on their diorama coast in their science journals or on another piece of paper.

### Part 3: Make predictions about the impact of sea level rise, then test predictions.

1. If students need practice with the concept of making predictions before working with their sea level rise model, provide each student with *Seashores on the Move Activity Sheet 3*, and provide each group of four students the ramp materials (a cup and wood block or piece of cardboard). If students do not need practice making predictions, move on to step 5 below.
2. Have students build a simple ramp using a cup and a cardboard plank or a wooden block, select three objects to use on their ramp, draw them on the activity sheet, and predict whether each will roll or



slide. Model a rolling motion and a sliding motion with your hands to show the difference between each type of motion.

3. After testing their predictions by placing the objects on the ramp, students should document the results on the activity sheet. Encourage students to make multiple trials, placing the objects on the ramp in different orientations.
4. Discuss the results. Ask students whether their predictions were always the same as their results and what they learned when the result was different than the prediction. Tell students that they will be making predictions about the effect of sea level rise on their coast models and then testing those predictions.
5. Have students simulate the ocean by adding water to the level of the sea level line on the side of their box. Prompt students to notice where the water reaches the shore (the shoreline).
6. Ask students the following questions: Which areas of their coast are most vulnerable to flooding as sea level rises? Which areas are least vulnerable?
7. Have students make predictions as to what will happen to their coastal community as sea level rises using *Seashores on the Move Activity Sheet 4*, or discuss predictions together as a class.
8. Have students increase sea level three times in their diorama box and make observations of each sea level rise. For the first increase in sea level they should add a half-cup of water to their ocean and then make observations. For the second increase in sea level they should add another cup of water to their ocean and make observations. Last, for the third increase in sea level, they should add another cup of water to their ocean and make observations.
9. Ask students: As the water rises, what is at risk? What are people losing? (Sea level rise, combined with the high tides and waves of storms makes coastal flooding more likely.) Have students consider how their model is like a real coastal community and how it is different. For example, the materials in the model are representations of other materials (the land is made of rock and soil, not play-dough) and that the ocean is not contained by a box. The model

is like the real world because it is showing that the most vulnerable areas are near the ocean.

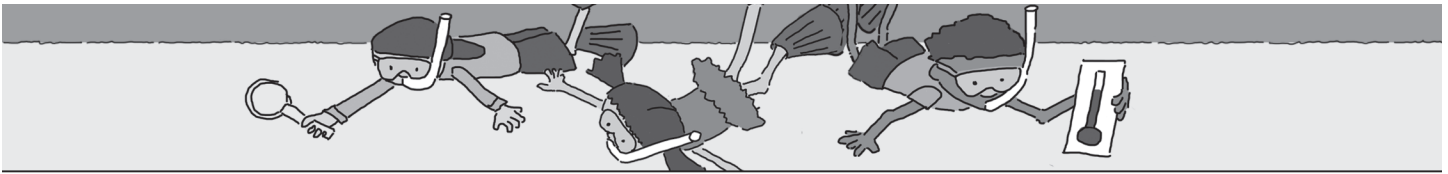
### **Part 4: Plan for changes that will help keep people safe.**

1. Look at pictures/videos of ways that people are adapting to higher sea level in places around the world (for example, floating houses in the Netherlands, the sea wall in the Maldives, and houses on stilts built in New Orleans).
2. Have students consider what they would change in their coastal communities to make people less vulnerable as sea level rises using the *Seashores on the Move Activity Sheet 5* as a guide. If time allows, let students renovate their dioramas according to their plans.
3. Explain that stopping the flooding is another way to protect coastal communities. To figure out how to do that, students need to understand what causes flooding of coasts. Remind students that in the *What in the World Is Happening With Our Climate?* book, something that happens in one part of the world (such as land ice melting) can cause changes in another part of the world (land loss/flooding on low-lying tropical islands).
4. If time allows, have students drain their model and build their adaptations to sea level rise. Then, add more water and see whether their designs keep the community from flooding.

## **Adaptations for Younger and Older Students**

Before younger students try the ramp activity, introduce the concept of making predictions - that a prediction is a good guess.

For older students, extend learning by having students work together to make a map of the coast and community. Instruct students to make a rectangle on graph paper to represent the area in their beach



diorama. Remind students that a map shows a view from above.

With older students, emphasize the use of the coast models to predict areas that are most likely to flood. You may also extend this activity by having students research what might happen as climate changes in their region (such as increases in storms, drought, and heat waves).

### Investigate Further

**Comparing sea ice melt and glacier melt:** In this extension activity, students learn that sea level rises when glaciers (ice on land) melts, but not when sea ice melts.

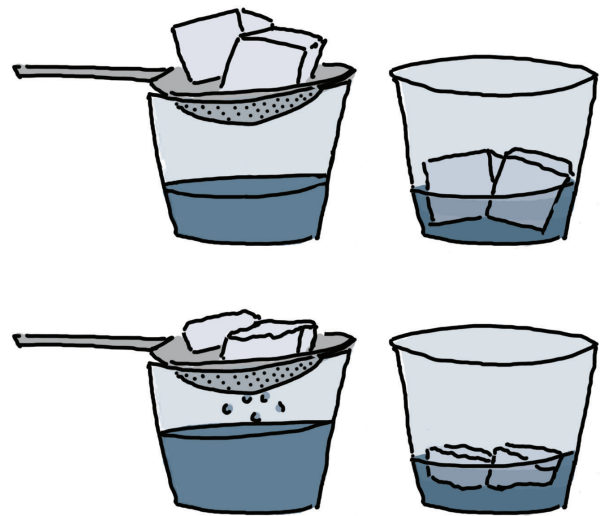
Materials:

- Two clear plastic cups that are the same size
- Four ice cubes
- One tea strainer (or any small strainer that will sit at the top of one cup)
- Two rubber bands
- Water

Begin this activity by reading pages 11-13 of *What in the World Is Happening to Our Climate?* Next, ask students to describe the two types of ice that Simon, Anita, and Dennis saw when they were in Greenland (ice floating in the water, called “sea ice,” and ice on land, called “glacial ice”). Then share with students that the class will recreate the activity that Dennis described in the book, exploring how melting glaciers result in sea level rise, while melting sea ice does not.

Put a rubberband around each cup, two inches from the bottom of both clear plastic cups. Place two ice cubes in one of the cups and state that they represent the sea ice that the kids saw from the boat. Place the other two ice cubes in the strainer above the other cup and share that these ice cubes represent ice on land, which is above the ocean. Pour water in both cups, up to the rubber bands, to simulate the ocean. Inform the students that now they will need to wait for the ice to melt.

Once the ice melts, have students make observations as to what has happened. Students should notice three things: (1) the ice is gone from both the strainer and the cup, (2) the level of the water in the cup that had the glacier ice (above the cup), is higher, and (3) the level of the water in the cup with the sea ice (ice cubes in the cup) should be the same.



*The top two cups show what the model will look like before the ice melts. The cup on the left is to demonstrate glacial ice melt. The cup on the right is to demonstrate sea ice melt. The lower two cups show what the model will look like after some of the ice has melted. Notice that the water level is higher in the cup on the left as melt water is added to the water in the cup.*

Remind students that this is a simple model representing larger-scale concepts. Have a discussion to explore student thinking around the idea of using a model. What concepts do students think the model shows clearly (for example, glacier and sea ice melts in the same way as ice cubes)? What concepts do students think are more complex than this simple model can represent (for example, the ocean is much larger than a cup of water)?



# Seashores on the Move Student Activity Sheet 1

## Cause and Effect

Name \_\_\_\_\_

After you have read the book, *What in the World Is Happening With Our Climate?*, fill in the blanks in the sentence below to summarize the causes and effects in the story. Use the options at the bottom of the page.

In the story, flooding of coastal houses was caused by \_\_\_\_\_,

which was caused by \_\_\_\_\_,

which was caused by \_\_\_\_\_,

which was caused by \_\_\_\_\_,

which was caused by \_\_\_\_\_.

Cut out the phrases below and paste them in the blanks above where they belong.

burning fossil fuels



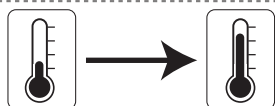
sea level rise



more greenhouse  
gases



warming  
temperatures



melting glaciers





## Seashores on the Move Student Activity Sheet 2

### About Our Coast

Check all that apply.

Name \_\_\_\_\_

Our coast has:

- A sandy beach       Tall cliffs  
 A rocky beach       Other \_\_\_\_\_

It has features like:

- A river that flows into the ocean  
 Trees near the coast  
 Grasses that grow in sand  
 Bird nests in the sand  
 Alligators in a marsh  
 Other \_\_\_\_\_

People live on this coast in:

- A big city with skyscrapers and lots of buildings  
 A large town with houses, hotels for visitors, and many roads  
 A small town with some houses and a few roads  
 Other \_\_\_\_\_

The name of this town or city is: \_\_\_\_\_

It has:

- |  |   |
|--|---|
| <input type="checkbox"/> Houses              | <input type="checkbox"/> Stores             |
| <input type="checkbox"/> Hotels              | <input type="checkbox"/> Traffic lights     |
| <input type="checkbox"/> Apartment buildings | <input type="checkbox"/> A gas station      |
| <input type="checkbox"/> Skyscrapers         | <input type="checkbox"/> A harbor for boats |
| <input type="checkbox"/> Schools             | <input type="checkbox"/> A dock             |
| <input type="checkbox"/> A hospital          | <input type="checkbox"/> It also has _____. |

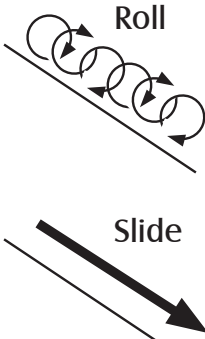
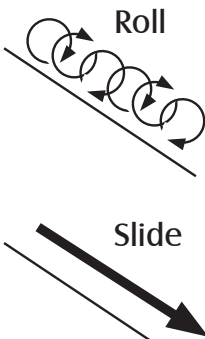
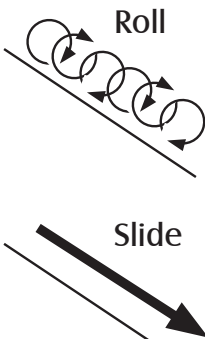


# Seashores on the Move Student Activity Sheet 3

## Rollers and Sliders

Name \_\_\_\_\_

Practice making predictions.

<b>The object</b> Draw a picture of it.	<b>Make a prediction.</b> Circle what you think it will do.	<b>Give a reason.</b> I think this will happen because...	<b>Describe the result.</b> What happened to it on the ramp?
			
			
			





# Seashores on the Move Student Activity Sheet 4

Name \_\_\_\_\_

## Predict and Test

### Make Predictions.

If sea level rises, this is what I think will flood.

The human-built features:

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The natural features:

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### Test Your Predictions.

1. Add water to your model up to the level of the sea level line to represent the ocean.
2. For a **small** amount of sea level rise: add ½ cup more water to your ocean. Record your observations.
3. For a **medium** amount of sea level rise: add 1 more cup of water. Record your observations.
4. For **large** amount of sea level rise: add 1 more cup of water. Record your observations.

	With a <b>small</b> amount of sea level rise	With a <b>medium</b> amount of sea level rise	With a <b>large</b> amount of sea level rise
The human-built features that flooded:  <i>Write or draw what you see.</i>			
The natural features that flooded:  <i>Write or draw what you see.</i>			



What in the World Is Happening  
With Our Climate?

# Seashores on the Move Student Activity Sheet 5

Name \_\_\_\_\_

## Protecting Our Coast

Describe your plan for protecting your coast from flooding caused by sea level rise.

In the box below, draw a map of your coastal area  
and what you would change to stop the city or town from flooding.