

Teacher Guide

Lesson 8: Modeling Hurricane Impacts

SKILLS:



Lesson question: How can we modify our model communities to be less affected by storm surge flooding?

Learning objectives:

- Students create a model to simulate how a hurricane creates storm surge along a coast.
- Students revise their model coast to add adaptations that help prevent flooding with a simulated hurricane.

Timing: One class period

Materials:

- Classroom computer, projector, and Internet access
- Lesson 8 Slides: Being Resilient (download from scied.ucar.edu/HurricaneResilience)
- For each group of three to five students:
 - › Baking tray with raised rim, approximately 12 x 18"
 - › Modeling clay (6-8 ounces)
 - › Hairdryer
 - › About one liter of water
 - › Ten or more plastic Monopoly houses and hotels or building bricks of similar size
 - › Extension cord (if needed to reach outlet)
 - › Paper towels (in case water spills)
 - › Scissors
- Resilience adaptation materials for the class
 - › Sponges
 - › Tongue depressors, popsicle sticks, or nail files
 - › Toothpicks (one to two boxes)
 - › Other materials that students can use to engineer their coast to be more resilient to storm surge (such as pieces of cardboard, small pieces of wood or plastic, plastic building bricks)

Preparation:

- Make a sample model coastline to share with students.
 - › Create a coastline along the short end of the pan using 6-8 ounces of modeling clay. Cover about a third of the pan.
 - › Add at least ten Monopoly houses/hotels or building bricks to your coast to simulate a community.
 - › If you are in an area that has wetlands along the coast, add pieces of sponge to the coast to simulate the wetlands.
 - › Add water to the open two-thirds of the pan to simulate the ocean.
 - › Practice using the hairdryer to simulate how winds push water onto land during a hurricane or tropical storm. (See the Hurricane Resilience website for a video of the demonstration.)
- Review the Being Resilient slides.

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Directions

Survey prior knowledge about hurricane flooding.

- Ask students what they know about flooding due to hurricanes and tropical storms. List what they know and where they learned the information on the board. *(At this point in the curriculum, students have likely heard stories of flooding as they collected interviews, they have seen data about water level and flooding, and they have learned that as the climate warms, the amount of storm surge flooding and rainfall is increasing. Additionally, they may have personal experiences with local flooding during hurricanes and tropical storms.)*

Introduce the physical model that students will use.

- Tell students that they will make a physical model of a hurricane hitting the coast to see the impacts of water level and coastal flooding. Then they will engineer ways for a community to avoid flood damage when a hurricane makes landfall.
- Remind students that they looked at data generated by a computer model in the previous lesson. A physical model represents a system with physical objects, while a computer represents a system with math equations.
- Orient students to the sample model coastline. Review the objects in the model and what each represents.
 - The water simulates the ocean.
 - The modeling clay simulates the coast.
 - Monopoly houses/or bricks simulate houses or other buildings.
 - If you are in an area with wetlands along your coast, use pieces of sponge to simulate the wetlands.
- Introduce the hairdryer, which simulates the winds of a hurricane.
 - Demonstrate by holding the dryer so that water is pushed towards the coast.
 - Show students how the hair dryer can be used to model forward speed, footprint, wind speed, and storm track.
 - Wind speed: change the dryer speed from low to high
 - Forward speed: move the dryer faster or slower towards the coast
 - Footprint: spreads dryer winds wider
 - Storm track: change the angle of the dryer
 - Discuss safety. *(It is essential that the hairdryer not be dropped into, or held in, the water. To reduce the safety concerns, you may wish to have only one hairdryer for the class and be the one to use it to simulate hurricanes for each group.)*
- Discuss how this model does a good job representing the actual coast and a hurricane and where it falls short. *(Students may note that the modeling clay is impervious so water can't sink into it, there are no wetlands or beaches in this model, and that the hurricane winds are going in one direction instead of a spiral.)*



Students modeling storm surge using a hair dryer to push water towards the coast of their models.

Students make models and test.

- Have students work in groups of three to five to create their model coastlines and make their community.
- Once students have made their coasts, have each group add water into the ocean part of their baking tray. (Note that the trays will need to be on a level surface (table or floor) for the "ocean" to fill the area evenly.)
- If you are having each student group use their own hairdryer, they can simulate the hurricane themselves. If you are demonstrating this for students, visit each group and simulate a hurricane with the dryer.
 - Encourage students to take photos or videos to document what happens when the wind of the simulated hurricane pushes the water onto the coast. (Slow motion video works particularly well when documenting how the winds move water onto land.)
- Have students drain out the ocean water and leave their models set-up to use for the next part of the activity.

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To decrease hurricane damage, we can make changes that help keep coasts safe.

- Have students return to their seats so that they can see the screen. Project the Being Resilient slides (**Slide 1**).
- Acknowledge that there was flooding in the model coasts. Have students estimate what percentage of the buildings were flooded by storm surge.
- Tell students that there are strategies that make buildings and communities less vulnerable to hurricane damage, including flooding. This helps us be more resilient, or more able to recover from a storm.
- Define vulnerability with students using the flow chart on **Slide 2**. (See the slide notes for details.)
- Share an example of how design can help a person be more resilient in the case of a breakable glass versus a non-breakable plastic cup (**Slide 3 and 4**). This is the concept of “graceful failure.” Relate the concept to hurricanes: there are things that we can do to make sure that a hurricane hitting our coast is more of a graceful failure than a catastrophic disaster.
- Ask students to name coping strategies that they heard about in the Storm Stories interviews. Then share the examples on **Slide 5** in case there are any that students haven’t mentioned.
- Tell students that now we are going to look at some examples of how a community can become more resilient.
 - › Share examples of community adaptation (**Slides 6-7**), including improving evacuation routes, restoring wetlands, enforcing building codes, and building levees.
 - › Share examples of floodproofing (**Slide 8**) such as designing floating buildings, raising electrical outlets higher on walls, raising homes, and using sandbags
 - › Share examples of windproofing (**Slide 9**) such as storm shutters, stormproof roofing, and tying down belongings in the yard
 - › Share examples of stormwater control, such as rain gardens and permeable pavement (**Slide 10**).



To develop resilience adaptations for their models, students can use a variety of supplies, including clay, toothpicks, plastic blocks, nail files, popsicle sticks, and pieces of file folders.

Students make resilience adaptations to their models.

- Tell students that a hurricane is going to hit their coast. Their goal is to make adaptations to their coastal environment that will help their community survive without flooding during the storm.
- Introduce the additional supplies available for students to plan for resilience. (Don’t explain how they might use the supplies. That’s up to the students.)
- After students have had about 8 minutes to make resilience changes, have them simulate a hurricane using the dryer and take photos/videos to show how their adaptations worked.
- If time allows, have students explain their adaptations to another group.



Students adapt their model to try and prevent flooding due to storm surge by adding sponges to simulate wetlands and popsicle sticks to simulate levees or seawalls.

Clean up

- Instruct students to remove reusable components from the models (houses, sponges, and plastic, wood or metal resilience materials) and then drain the water into a sink or bucket. Dispose of the clay if it has become too saturated to use again.

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Wrap up and transition to the next lesson.

- Discuss as a class what resilience strategies were helpful in the model.
- Optional: Assign the homework (see Assessment below).
- Tell students that in the next lessons, they will make plans for how their community and the places they care about can be less vulnerable to hurricanes and more resilient.

Opportunities for Assessment

- Homework: Help students reflect on this lesson by having them label two of their photos to document their coast before and after resilience adaptations as homework. Labels should note what areas were vulnerable to flooding and which areas were less vulnerable and what resilience strategies were implemented.
- This lesson introduces the resilience portion of the curriculum (Part 3), so opportunities for formative assessment are embedded. Surveying prior knowledge at the start of class provides one formative assessment opportunity. Also, note whether student groups are drawing from the strategies presented in slides or prior knowledge as they design adaptations for their coast.