CENTERS FOR OCEAN SCIENCES EDUCATION EXCELLENCE
BEST OF COSEE HANDS-ON ACTIVITIES

Activity Title: A Hurricane's Storm Surge Affects our Estuaries

Learning Objectives

Ocean Literacy Principles

#1 -- The Earth has one big ocean with many features

f. The ocean is an integral part of the water cycle and is connected to all of the earth's water reservoirs via evaporation and precipitation processes

#3 -- The ocean is a major influence on weather and climate

a. The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems

#6 -- The ocean and humans are inextricably interconnected

d. Much of the world's population lives in coastal areas

f. Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm surges).

#7 -- The ocean is largely unexplored

d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles

National Science Education Standards: NS. 5-12.1, NS. 5-12.6, NS. 9-12.4

Supplies and Materials

(Per group)

- Long plastic container such as an under the bed storage container or stream table
- Milk jug or pitcher
- Sand
- Access to a water faucet or a hose.
- A variety of materials such as Lego blocks, Monopoly houses or other items with which to build houses (such as shells, sticks, rocks, leaves, grass, straws, cardboard, etc.)
- Sponges (to be cut up and placed to represent the marsh)
- Tiny toy animals, people, cars, etc.
- Plastic straws (to place the houses on stilts-optional)

- Block of wood
- Erasable markers
- Paper towels for clean-up

Background

A storm surge is a mound of ocean water created by the winds of a hurricane that travel toward land, coming ashore, and penetrating inland where otherwise no sea water would typically reach. Strong hurricane winds and low pressure cause ocean water to "pile up" in a mound under the eye of the storm. A storm surge can increase water levels over 20 feet higher than normal and the surging water can be up to 50 to 100 miles wide. Though most storm surges are related to hurricanes, some smaller storms can create damaging surges also.

Storm Surges and the South Atlantic Bight

The South Atlantic Bight is an area along the eastern continent of the United States from Cape Canaveral, Florida to Cape Hatteras, North Carolina (see fig. 1). This region is known for its long, gentle-sloping land and is known as the continental shelf. In this part of the ocean, water depth is relatively shallow for 90 to 100 miles off the Georgia coast. When a storm enters shallow water, the wave energy cannot be absorbed thus it grows higher and moves faster towards the shore. Low lying islands and mainland areas that are less than a few meters above sea level are at greater risk of inundation by the storm surge. This explains why storm surges cause even greater damage if they occur at a high tide. When a storm surge reaches land during high tide, the ocean is already high on the beach so the storm surges pushes its way further inland increasing devastation to inland homes and businesses. If a storm surge arrives onshore at low tide, the mound of water may not reach much farther inland than a normal high tide thus decreasing the amount of coastal and inland damage.

Fig. 1, Picture of map with continental shelf taken by Fran Lapolla, University of Georgia Marine

Extensions Service.

Duration

20 minutes to 1 hour

Audience

Grades 5-Adult

Procedure

Procedure:

1. Distribute materials to each group.

Have groups:

2. Fill one half of the large plastic container or stream table with sand. The sand will represent the land and the substrate under the estuaries. The now empty part of the container is where the ocean will be. (Figure 2)

Figure 2. Bin set up

Down the center of the sand create a meandering river by running your finger through the sand – meanders are curves in the river. (you may need to moisten the sand in order to mold it)

4. Near the ocean side of your land, create several smaller, curving waterways that branch off the main river. These are tidal creeks that run through the estuaries and they should also be curved. They should be deeper at the river's edge and become shallower the farther away from the river they go.

5. On either side of your river (near the ocean side) create low areas in the sand and place pieces of damp sponge in these areas. These are the salt marshes. You may add freshwater marshes along the river upland of the ocean.

6. At the mouth of river, use some of the sand to create an oval shaped barrier island. This should be several inches toward the ocean from the mouth of the river. The island should not completely block the mouth of the river, (Some of the ocean water should have access to the river). The estuary exists between the barrier island and the mainland.

7. Slowly add water to the ocean side of your container. You should add enough water to surround the barrier island and enter the mouth of the river. Do not completely cover the island.

8. On the island, add some houses (some should be on stilts), hotels, cars, animals, and people. On the landward side of the island, add sponges to represent the salt marshes. Also add marshes (with sponges) on the mainland side of your island.

9. Along the river add towns (houses, factories, cars, animals and people)

10. On the outside of your container, use an erasable marker and place a mark every inch from the ocean edge of the island all the way up the river. The mark at the edge of the island should be the 0 mark. Label each mark 0, 1, 2, 3, etc. where each mark represents one inch).

11. Use the block of wood and very gently tap the water (ocean) by moving it in an up and down motion to create mild waves. If you are using a hair dryer or some other source for wind, turn it on low. Hold the hair dryer or wind source a little distance away from the water so that the wind you produce will be gentle. Observe what happens to your island and the marshes and mainland behind the island.

12. Next create a mild storm by creating waves with a stronger force. Do this by pushing the block of wood up and down into the water with more force than before – but not too strongly. If you are using a wind source, increase the speed or move the wind source closer to your model if possible. Observe what happens in your model.

13. Next, create a hurricane storm surge. To do this you will need to push water from the ocean onto the island and mainland. Use the block of wood to force the water from the ocean onto the island and mainland. At the same time have another member in the group pour additional water into the model to represent the heavy rainfall during a hurricane

Assessment

The following questions can be asked during or at the conclusion of the activity to make sure the group understands/understood the significance of the events.

1. Describe what happened in your model when you created mild waves (and wind). Describe the flow of water in the marshes and estuary. How far inland did the waters go?
2. Which area of your model received the most effect from the waves? Explain why this happened.
3. Describe what happened when you created a mild storm in your model. Describe what happened in the estuary.
4. Which area of your model received the most effect from the waves?
5. Explain how barrier islands help to protect the mainland from the effect of storms.
6. Describe what happened in the model when you created the hurricane storm surge. Explain what happened in the estuary, inland and up the river.
7. Was any area of your model “safe” from the storm surge during your “Hurricane”? Explain your answer.
8. If an evacuation had been ordered, how far should the people travel from the shore in order to be out of harms’ way? Support your answer using ideas from the model and further research if necessary.
9. What recommendations would you make to a developer who is interested in building on coastal properties?
10. Discuss the effects of pollutants and runoff from the land on the aquatic life in the estuaries.
11. Describe how the aftermath of a storm surge can impact the lives of the people living in that area and the economy of the community.

Additional Resources

Hurricane and Storm Surge Facts and Information:

- http://www.nhc.noaa.gov/

- http://www.fema.gov/hazard/hurricane/hu_surge.shtm
- http://www.marshbunny.com/hurricane/storms.html
- http://www.stormvideo.com/hurricane.html
- http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hurr/damg/surg.rxml
- http://www.aoml.noaa.gov/general/lib/stormf.html

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