

MACGILLIVRAY FREEMAN'S
**DREAM
BIG**
ENGINEERING OUR WORLD

GRADE 2:

SURVIVING STORM SURGE



Grade level: 2

Lesson length: 80 minutes (can be broken down into multiple parts)

This activity gives students an understanding of how storm surges and rising waters affect people's homes and how important it is for engineers to design houses that withstand flooding. Students play the role of engineers as they build a model scene of a paper house on a play dough coast and inundate it with flood water to see if the house they made can withstand the rising tide.

In the Film

In the film *Dream Big*, we see how engineers create innovative ways for tall buildings like the tower of Shanghai to resist strong winds from typhoons. However, most of the damage occurs before and after the storm, when waters rapidly flood coastal areas. Buildings must have a strong enough base to resist the powerful, swiftly flowing water. In this engineering challenge, students investigate ways to engineer buildings that resist flood waters.

NGSS Disciplinary Core Ideas

2-ESS1-1 The History of Planet Earth

Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.

2-ESS2.A Earth's Materials and Systems

Wind and water can change the shape of the land.

2-ESS2-1

Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

NGSS Engineering Practices

ETS1.C: Optimizing the Design Solution

Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Dream Big: Engineering Our World is a film and educational project produced by MacGillivray Freeman Films in partnership with the American Society of Civil Engineers and presented by Bechtel Corporation. The centerpiece of the project is a film for IMAX and other giant screen theaters that takes viewers on a journey of discovery from the world's tallest building to a bridge higher than the clouds and a solar car race across Australia. For a complete suite of *Dream Big* hands-on activities, educational videos, and other materials to support engineering education, visit discovere.org/dreambig. The *Dream Big* Educator Guide was developed by Discovery Place for the American Society of Civil Engineers. ©2017 American Society of Civil Engineers. All rights reserved. Next Generation Science Standards ("NGSS") is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and do not endorse it.

Key Words/Vocabulary

Storm surge: a bulge of water created by hurricane-type storms that moves along the surface of oceans.

Flooding: The rising level of bodies of water that invade areas that are otherwise dry.

Erosion: The slow breaking down of material by mechanical and chemical forces.

Typhoon: The name used in Asia for a hurricane-style storm.

Materials

Per class:

- ☐ Testing bin instructions (included below)
- ☐ Plastic tub, preferably 15" long x 12" wide x 6" high
- ☐ Jug or pitcher for water
- ☐ Play dough or clay
- ☐ Optional: hot glue at teacher station during the student CREATE phase.

Per pair of students:

- ☐ Popsicle Sticks
- ☐ Paper
- ☐ Glue Sticks
- ☐ Masking tape
- ☐ Beach home paper template
- ☐ Scissors
- ☐ Building a Flood Safe Home handout

Teacher Prep Notes

Prepare to discuss why people throughout history have built their homes near bodies of water, despite the dangers of flooding. Teach students about what causes flooding, including a simple, age-appropriate introduction to the science of global warming. Tell students about the ways people have tried to prevent damage to their houses and communities from rising water and floods.

Be ready to show students how to cut out a house from the beach home template and how to put it together.

To Do

Determine the Problem or Question to Solve: 10 minutes

1. Before watching the IMAX movie *Dream Big*, give students an overview of what they are about to experience. This film is about engineering and the ways that engineering can inspire, challenge, and enrich our lives. Give students the following questions to think about as they are watching the film:
 - a. How did nature affect engineering projects in the film? For example, what did hurricanes, floods, and earthquakes do to the projects engineers were working on?
 - b. How did engineers deal with these storms, floods, and earthquakes? Did the engineers use some new and exciting material to build with? Did they change their design?
2. Debrief as a whole class after viewing the film. Allow students to reflect on the guiding questions you gave them.
3. Remind students of the obstacles the engineers faced in the film. Review how large a role nature played in determining the engineers' plans. Specific examples you could bring up: building storm-resistant towers, crossing dangerous rivers, and designing ways for cities to fight against the rising sea levels.
4. Introduce the design challenge. Students will create models of a community along a coast. They will design and build homes for this shoreline community that can withstand flooding from heavy rains, hurricanes, and even the melting of the polar ice caps.

Research and Gather Information: 20 minutes

1. Teach students about different types of flooding and the cause-effect nature that supports flooding. Students should understand that most forms of flooding are caused by bursts of rainwater from storms that increase the amount of water found on land and in bodies of water. Other forms of flooding take place over a longer period of time and are caused by events such as the melting of the polar ice caps via global warming.
2. Show students the images of homes built on shorelines and in flood prone areas in the "Building a Flood Safe Home" handout. Talk about how those homes are built to withstand surges of water and what materials are used. Identify ways that humans add to or change the building of the houses themselves by adding support structures to raise the house. Also discuss ways that humans add shore-stabilizing structures like sea walls to prevent water and erosion from reaching their homes.

Plan a Solution: 15 minutes

Organize students into pairs. They will start by building a paper home as the base of their engineering and design challenge. We suggest that the teacher model for the class how to cut, fold, and assemble a home before allowing the students to do their own. A cut and tape template can be found later in this lesson or students may create their own.

As a team, they will collaborate on a design and drawing to plan what their house will look like and what their strategy will be to protect their new home. Will they raise the house on stilts or try to redirect the waves using a wall? Review from what they learned during the Research and Gather phase that engineers can change the way the home is built and/or add structures to the ocean and shoreline to prevent water and erosion from reaching their home. In addition to the paper house, provide a sample of the materials they will be allowed to use for their modifications, such as 2 popsicle sticks and 1 inch of tape so that they can physically experiment. Note: only provide a limited amount of materials at this phase. This is NOT intended as a building phase.

Make It: 10 minutes

Once students have finalized their plan, allow students to build their home and/or flood protective structures using the materials you have provided. Optional: At one safe location in the room, the teacher or teachers' assistant can operate a hot glue gun for students to use in adhering materials together.

Visit each group and review how its research shaped the overall design and plan for the home. If students are making obvious mistakes based upon your experiences and knowledge, allow them to continue and learn from their mistakes. Avoid offering solutions and instead encourage students to develop a secondary plan that demonstrates the evolution of their ideas and experiences.

Test: 15 minutes

Using the provided graphic in the resources for this lesson, set the stage for the experiment. In a tub, add a play dough base to about $\frac{1}{2}$ - $\frac{1}{3}$ of the tub's base to represent the shoreline. Students should add a group's house and any additional structure to the shore. The teacher will then pour water steadily into the bucket to replicate flooding water.

Evaluate: 10 minutes

Allow students to reflect on the following questions:

1. Did your house stay erect?
2. Did it get wet or retain water?
3. Did it stay in the same location?
4. After viewing the flooding experiment, would you want to live there?



Taking It Further

Show videos of hurricane/storm surge/flooding

Discuss the role civil engineers are playing within the arena of disaster prevention with special sub-disciplines such as hurricane engineering. Hurricane engineering aims to keep people and their property safe through the lens of our natural and constructed environments.

Can you build something in the water to prevent the flooding from impacting your house/property?

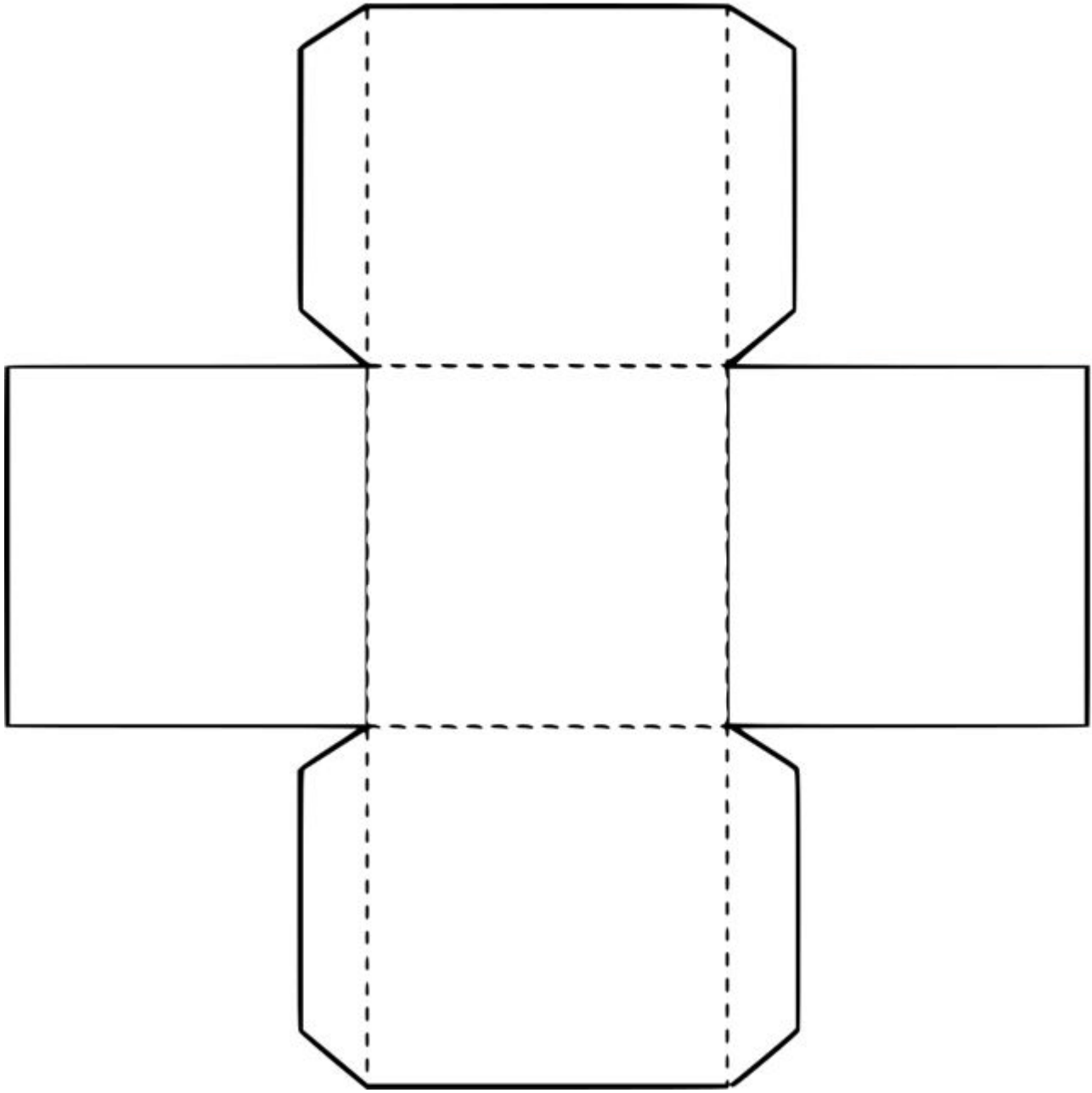
- Review the situations that face Venice, Italy, and the human-made barrier they are creating as a solution.

Document your students' work through our social media outlet: #dreambigfilm



Beach Home Template and Instructions

1. Cut along the solid lines.
2. Fold along the dotted lines to create a box.
3. Tape or glue the flaps to secure.



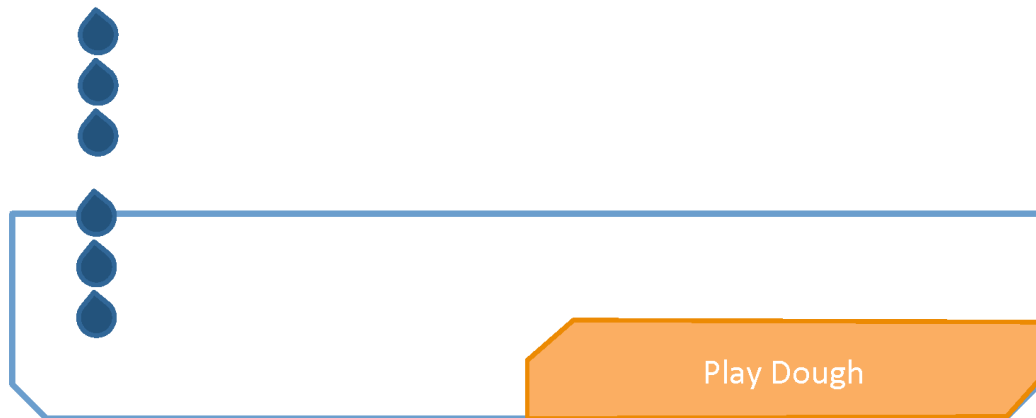
TESTING BIN INSTRUCTIONS

Assembly Directions:

1. Obtain a medium-sized plastic storage bin. Preferably a clear and shallower bin.
2. Fill half of the bin with play dough or soft clay until it is about half way full.
3. Obtain a gallon jug and fill with tap water.

Directions for Use:

1. Have students place their structure on the land portion of the device.
2. Once you are ready, pour the water into the opposite side of the plastic bin and allow the water level to rise until it is 1–2 inches above the play dough level.



DREAM BIG VIDEO SERIES

WATCH QUAKE TAKES:

EARTHQUAKE ENGINEERING

Nobody wants an earthquake or tsunami to hit while they're in a building that can't keep them safe. In the specially controlled settings of a giant shake table in San Diego and a tsunami wave basin in Oregon, engineers study the impact of these natural forces. Watch how engineers are making buildings stronger and safer to protect people from nature's powerful punch. Go to discovere.org/dreambig/media-assets and visit Educational Webisodes.

