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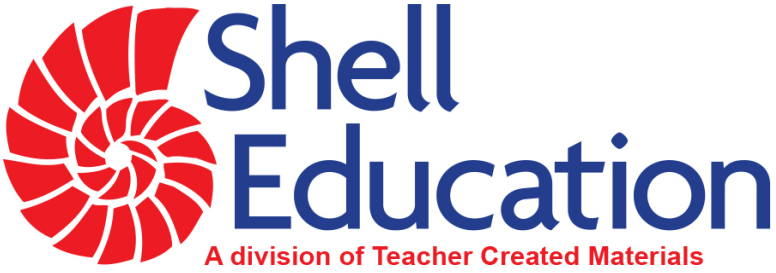


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Shell Education

180 Days of PRACTICE

GRADE 6

# HANDS-ON STEAM

Science | Technology | Engineering | Arts | Mathematics

# Table of Contents

# Plate Tectonics Teaching Support

## Overview of Unit Activities

Students will learn about and explore plate tectonics through the following activities:

- reading about the theory of plate tectonics
- reading about and studying pictures of the effects of plate movements
- piecing together Earth's plates
- creating models of Earth's layers
- analyzing data and mapping major earthquakes
- creating vertical evacuation areas for tsunamis

## Materials Per Group

### Week 1

- basic school supplies
- construction paper
- foam hemisphere
- paint (water-based or acrylic)
- toothpicks

### STEAM Challenge

- basic school supplies
- foil
- index cards (5–10)
- large pan with high sides
- modeling clay
- plastic wrap
- sand (one bag)
- straws (10–15)
- sugar cubes (10)
- washers (2–3)
- water to fill pan
- toothpicks (15–20)

## Setup and Instructional Tips

- **Testing Days:** Testing may result in water on floors and tables. Prepare for this as needed.
- **STEAM Challenge:** The challenge can be done individually or in groups. Students working in groups should sketch their own designs first. Then, have them share designs in groups and choose one together.

## Discussion Questions

- Why do you think people live in areas that are likely to have more earthquakes or tsunamis? Why don't they move to a place that does not have so many?
- How might people have explained earthquakes and tsunamis long ago?
- How can people prepare for earthquakes and tsunamis?
- How have Earth's plates changed over time?
- What evidence is there of Earth's moving plates?

## Additional Notes

- **Possible Misconception:** Tsunamis are always very tall waves.
  **Truth:** Most tsunamis are less than 10 feet (3 m) high when they reach land. Tsunamis are dangerous because of their speed and volume.

## Scaffolding and Extension Suggestions

- Support students as needed by offering lower-level criteria, such as holding fewer sugar cubes or creating smaller "tsunamis" during testing.
- Encourage students to research recent tsunamis and the damage they caused.

## Answer Key

**Week 1 Day 1**

1. D
2. D

**Week 1 Day 2**

1. Two plates are moving toward each other; when plates collide, they sometimes cause the compressed land between them to move up and form mountains.
2. Plate movements can cause earthquakes. Sometimes a plate is pushed upward. This displaces ocean water and sends energy in waves toward land.

**Week 1 Day 5**

1. Earthquakes are located on the borders between tectonic plates. That is because people are living above where plates are sliding past each other or colliding or separating. They feel this plate tectonic movement in the form of earthquakes.

**Weeks 2 & 3**

See STEAM Challenge Rubric on page 221.

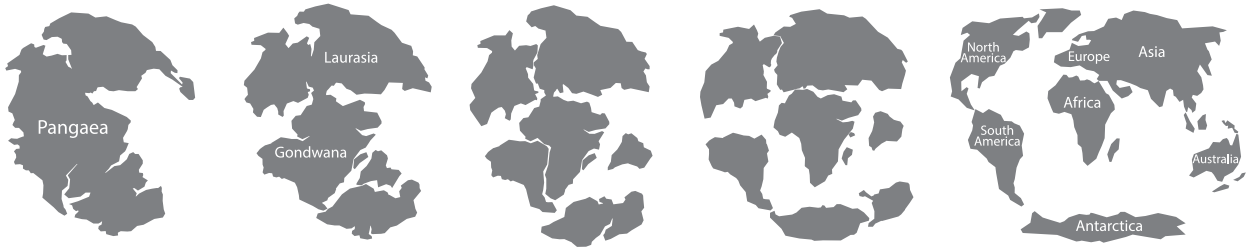
Name: _____ Date: _____

**Directions:** Read the text, and choose the best answer for each question.

We now know that the continents move. But it was not always known. A famous scientist, named Alfred Wegener, suggested that it was because the continents used to be one big continent that broke apart.

Evidence supported this theory. Some of the plant and animal fossils found along the coasts of the matching jigsaw puzzle pieces were the same. Also, matching rock layers were found on each coast, suggesting the rocks broke away from each other.

Eventually, scientists came to agree that the continents were once one big landmass. We call that original big piece Pangaea. Earth's surface is broken into about 20 pieces. Both the land and the oceans sit on top of these pieces. The pieces are called tectonic plates.




Permian period
225 million years ago

Triassic period
200 million years ago

Jurassic period
150 million years ago

Cretaceous period
65 million years ago

Present day

**1.** Which scientist first proposed that the continents were once all joined together?

(A) Albert Einstein
(B) Ellen Ochoa
(C) George Washington Carver
(D) Alfred Wegener

**2.** What evidence supports the hypothesis that the continents were once connected?

(A) People can see the continents moving with their own eyes.
(B) Some fossils in South America were the same as fossils in Africa.
(C) Some rock layers in South America were identical to rock layers in Africa.
(D) B and C
(E) A and C

# Unit 11: Plate Tectonics

Name: _____ Date: _____

Day 2

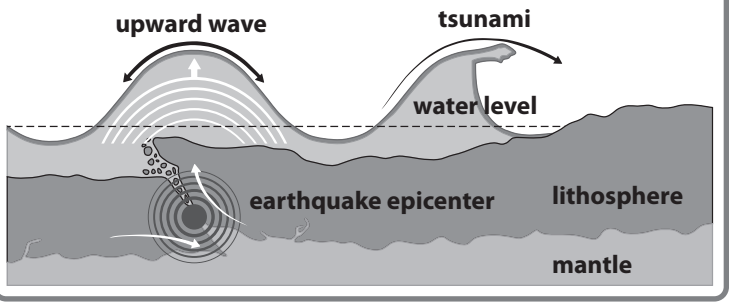
**Directions:** Read the text, and study the picture. Then, answer the questions.

It is very hot beneath Earth's crust—hot enough that even solid rock flows. As rocks heat up, they rise. As they rise toward Earth's crust, they cool and then start to sink again. This causes convection currents in the mantle. The mantle is the layer of Earth below the crust. As these currents move, they cause the plates above them to move.

Tectonic plates move in different directions. Some are moving toward each other. This can cause mountains to form. Some plates are moving away from each other, which can cause valleys to form. In other cases, two plates are sliding past each other.

When tectonic plates move, we sometimes feel it in the form of earthquakes. The energy spreads as a wave. The waves may cause the ground to shake back and forth, move up and down, or move in a circular motion. Earthquakes in the ocean can cause tsunamis. When a plate is pushed upward, it displaces a large amount of water. The energy travels in waves across the ocean until it reaches land.

Volcanoes tend to erupt along plate boundaries too. This is because there's an opening in Earth's crust where magma can get through to the surface. Volcanoes are especially common where two plates are separating or where one plate is sliding under the other.




**1.** Mount Everest is the world's tallest mountain, and it is getting taller. It is located along a tectonic plate boundary. What is one explanation for how or why it continues to grow?

_____

_____

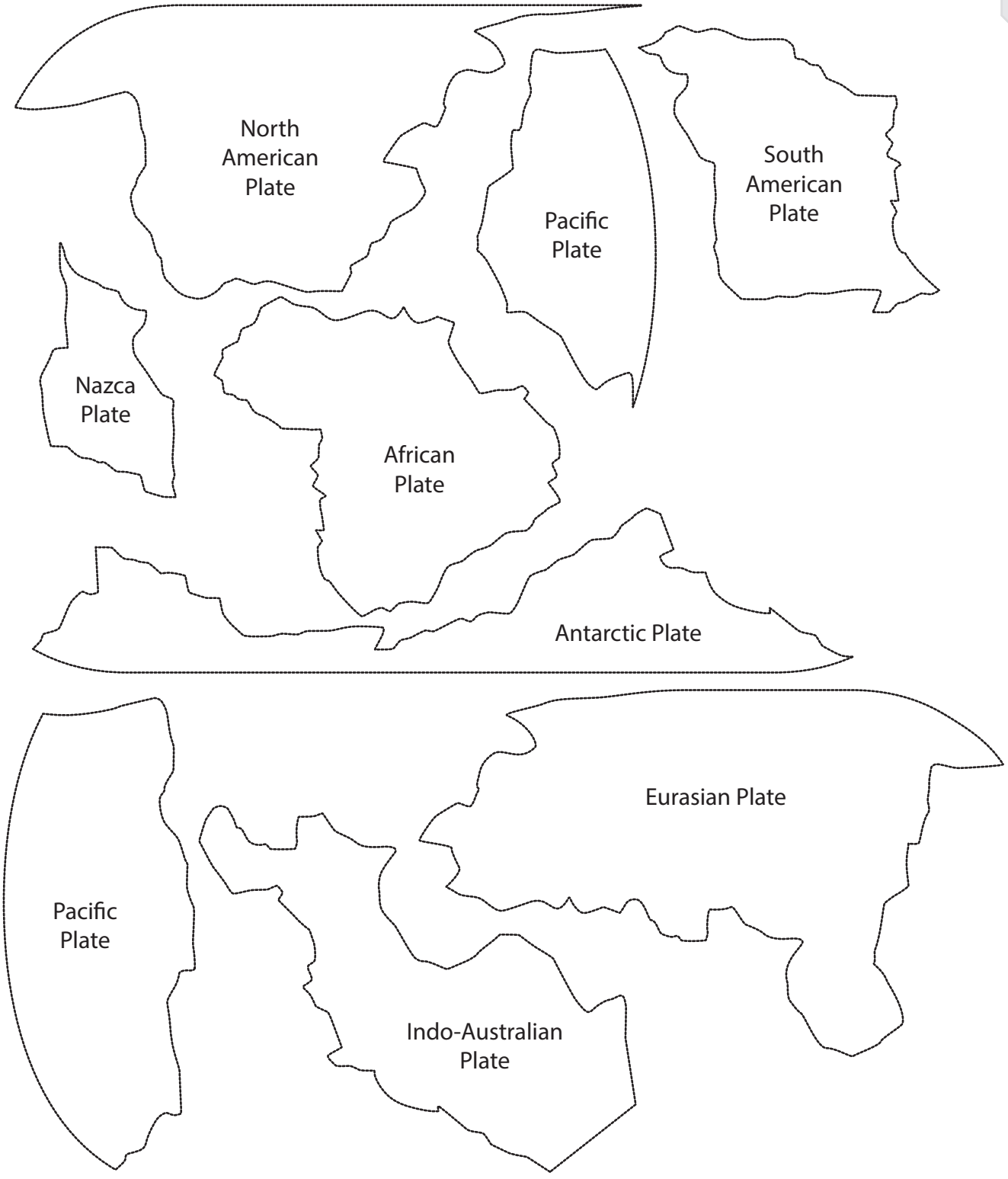
**2.** How can tectonic plate movement cause tsunamis?

_____

_____

**Name:** _____ **Date:** _____

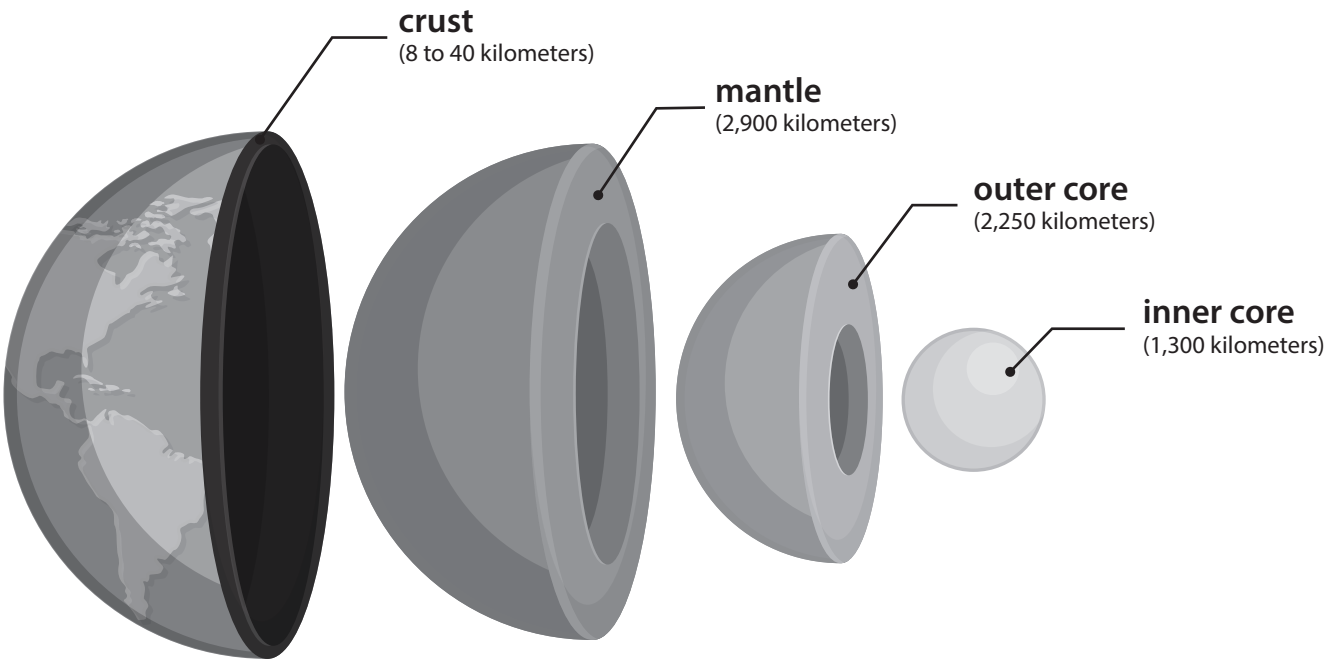
**Directions:** Trace the tectonic plate pieces onto a separate sheet of paper. Label the traced pieces, cut them out, and glue them together on a sheet of construction paper. Note: The Pacific Plate is in two pieces to show the plates of a sphere on a flat surface.



Name: _____ Date: _____

**Directions:** To understand the theory of plate tectonics, it helps to know the structure of the interior of Earth. Study the diagram. Then, use a foam hemisphere to paint a model of Earth. Label the layers with toothpick flags. Then, draw or paint the outlines of the major tectonic plates on one half of the surface of Earth.

**Structure of the Earth**




## Try This!

Try to make the layers proportional to their thickness relative to the other layers. For example, the mantle should be the thickest layer. Add a flag to show where you live.

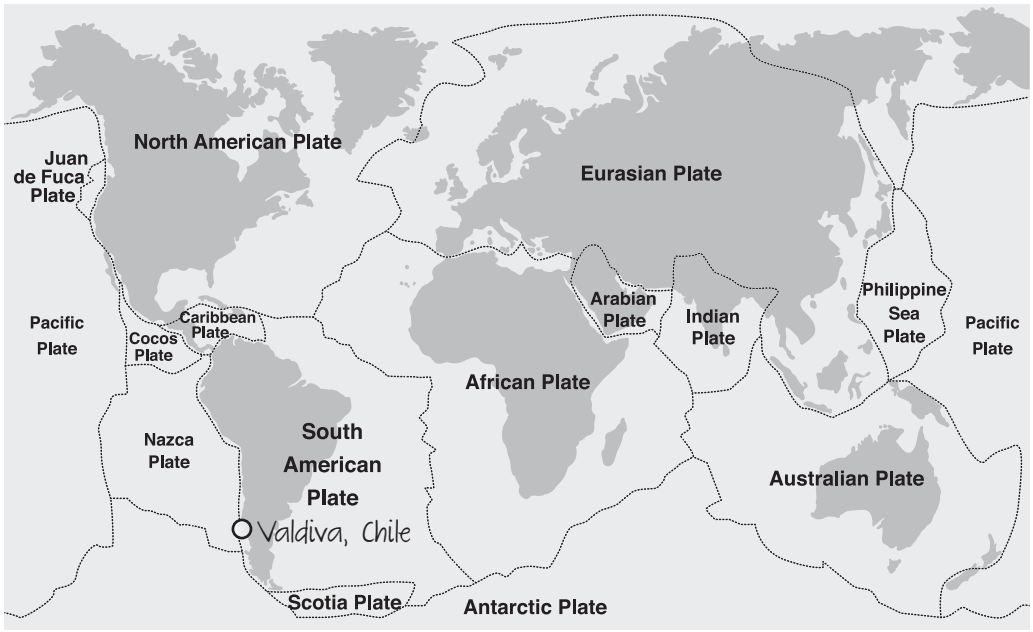
Name: _____ Date: _____

**Directions:** Read the text, and complete the task. Then, answer the questions.

Mapping the world's tectonic plates allows us to better understand why earthquakes are more likely in some areas than others. This helps us predict where future earthquakes are most likely to occur. The table shows the cities with some of the world's major recorded earthquakes.

**Task:** Mark the locations on the map of tectonic plates. Use another map to help you. The first one is done for you.

| Year | Location |
|---|---|
| 1960 | Valdivia, Chile |
| 1906 | San Francisco, California, USA |
| 2011 | Under the ocean close to Sendai, Japan |
| 1964 | Near Anchorage, Alaska, USA |
| 2004 | Under the ocean, close to Sumatra, Indonesia |
| 2010 | Near Port-au-Prince, Haiti |




**1.** What conclusions can you make about the locations of major earthquakes?

_____

_____

_____

Name: _____ Date: _____

**Directions:** Read the text. Record the challenge criteria and constraints in the chart. Summarize the challenge in your own words. Then, write any questions you need answered before you begin the challenge.

# The Challenge

Understanding earthquakes and tsunamis helps engineers find better ways to build structures that can withstand events. They study the local area to learn about the specific needs. Engineers also study materials, shapes, and features that help buildings to withstand these events. For example, sometimes designing ways for water to move past or through buildings can prevent flood waters from knocking down or carrying buildings away.

Your challenge is to build a vertical evacuation area for a community that could be hit by tsunamis. Instead of attempting to flee an area, residents can climb the structure to safety. You will place your structure on a pile of sand and simulate a tsunami. Your structure must withstand the force of the water. It must have room for and support five sugar cubes (people) and keep them dry. The base must fit on the sandy area you will create in one half of a large pan. You will simulate the water movement in a tsunami by lifting the end 1 inch (2.5 cm) high and dropping it.

| Criteria for a Successful Vertical Evacuation Structure | Constraints |
|---|---|
| | |
| | |
| | |

*Note: Your teacher may have additional constraints, such as time limits. You may add criteria if you choose to set additional goals.

**My Summary**

_____

_____

**My Questions**

_____

_____

Name: _____ Date: _____

**Directions:** Research ways engineers design structures to withstand flooding and shaking. Your design is a vertical evacuation, so also research ways engineers build tall structures. Record some of your findings with words and pictures of example structures. Then, brainstorm and record other notes, ideas, or questions for your design. Discuss ideas with others, and add to your brainstorming.

**Research Notes**

**My Vertical Evacuation Brainstorming**

Name: _____ Date: _____

**Directions:** Sketch two or more designs for your vertical evacuation structure. Label the parts and materials. Where appropriate, make note of the purpose for each part. Circle the design you think will work best. Or, circle the ideas you will combine from multiple designs. Then, answer the question.

**1.** What concerns do you have about your design?

_____

_____

Name: _____ Date: _____

**Directions:** Plan the tools and materials you will need. Plan your steps. Then, gather your materials, and build your vertical evacuation structure. Record notes as you build.

### Tools and Materials

| Item Needed | Amount Needed | Item Needed | Amount Needed |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

### Vertical Evacuation Structure Building Plan

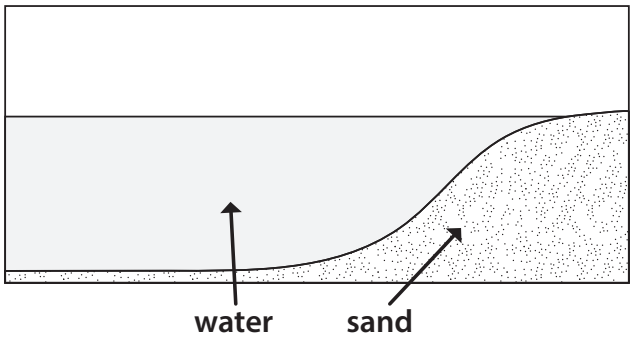
| | Job, Task, or Role | Group Member(s) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |

### Additional Notes

(surprises, problems, solutions, etc.)

Name: _____ Date: _____

**Directions:** Set up your test as shown in the diagram. Place your structure on the sand. Place five sugar cubes on or in your structure. Test your vertical evacuation structure by lifting the opposite end 1 inch (2.5 cm) high and dropping it. (If that did not create enough water to cover the sand, try lifting the end higher). Record the results. Then, answer the questions.




**1.** Draw what your structure looked like after the water settled.

**2.** Did your structure remain standing and intact? yes no

**3.** Did your sugar cubes remain dry and on the structure? yes no

**4.** What did you notice happened to the sand as a result of the tsunami?

_____

_____

**5.** Was your vertical evacuation structure design a success? Explain your evidence.

_____

_____

_____

**Name:** _____ **Date:** _____

**Directions:** Reflect on your design, and answer the questions. Then, plan how you will improve it. Conduct additional research if needed.

**1.** What about your vertical evacuation structure worked well?

_____

_____

_____

**2.** What flaws were revealed during testing?

_____

_____

_____

**3.** What design ideas did you see from others that you might want to try?

_____

_____

_____

Draw a star next to one or more ways you will improve your design.

- My first design did not meet all the criteria because

  _____

  _____

  To improve it, I will _____
- Make it support 10 sugar cubes and keep them dry.
- Include a way for people to get up to and down from the evacuation area.
- My own idea: _____

  _____

Name: _____ Date: _____

**Directions:** Plan your new vertical evacuation structure design. Then, sketch a few new designs. Label the parts and materials. Mark what is new or different, and circle the design you think will work best. Then, complete the sentence.

**In my redesign, I will…**

**add** _____

**remove** _____

**change** _____

**1.** My new design will work better because _____

_____

_____

Name: _____ Date: _____

**Directions:** Plan the tools and materials you will need. Plan your steps. Then, gather your materials, and rebuild your vertical evacuation structure.

**Tools and Materials**

| Item Needed | Amount Needed | Item Needed | Amount Needed |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

**Vertical Evacuation Structure Rebuilding Plan**

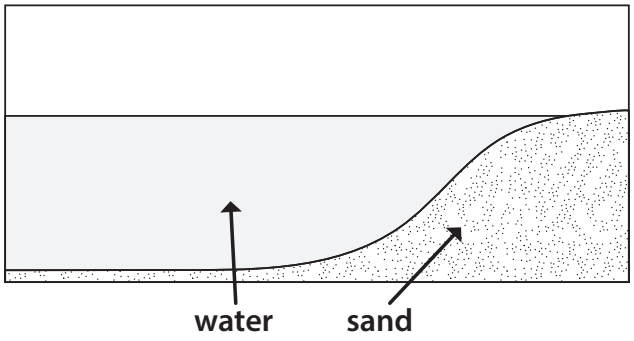
| | Job, Task, or Role | Group Member(s) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |

**Additional Notes**

(surprises, problems, solutions, etc.)

Name: _____ Date: _____

**Directions:** Set up your test the same way as before (see diagram). Place your new structure on the sand. Place 5–10 sugar cubes on or in your structure. Test your vertical evacuation structure by lifting the opposite end 1 inch (2.5 cm) high and dropping it. (If that did not create enough water to cover the sand, try lifting the end higher). Record the results. Then, answer the questions.




**1.** Draw what your structure looked like after the water settled.

**2.** Did your structure remain standing and intact? yes no

**3.** Did your sugar cubes remain dry and on the structure? yes no

**4.** Did your new design work better? Explain your evidence.

_____

_____

_____

**5.** Do you think your design would hold up in a real tsunami? Why or why not?

_____

_____

**Name:** _____ **Date:** _____

**Directions:** Answer the questions to reflect on your vertical evacuation structure.

**1.** What was your favorite part of this challenge?

_____

_____

_____

**2.** Why is testing an important part of the engineering design process?

_____

_____

**3.** What did you learn from this challenge?

_____

_____

_____

_____

**4.** Would you want to be an engineer who designs structures to withstand events such as tsunamis? Why or why not?

_____

_____

_____