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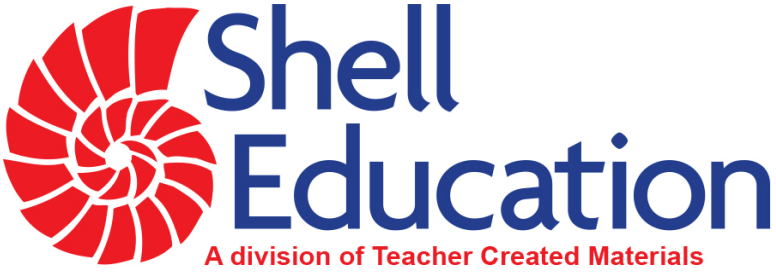

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Shell Education

180 Days of PRACTICE

GRADE 4

HANDS-ON STEAM

Science | Technology | Engineering | Arts | Mathematics

Table of Contents

Earthquakes Teaching Support

Overview of Unit Activities

Students will learn about and explore causes and effects of earthquakes through the following activities:

- reading about and studying pictures of how and where earthquakes occur
- reading about and studying pictures of solutions for making earthquake-safe buildings
- modeling different types of plate boundaries
- drawing earthquake safety posters
- analyzing graphs showing amounts of earthquakes in different U.S. states
- creating earthquake-safe buildings

Materials Per Group

Week 1

- graham crackers (2)
- ruler
- small cup of water

STEAM Challenge

- basic school supplies
- gelatin dessert, such as Jell-O® (prepared in pan)
- miniature marshmallows (40)
- square baking pan
- toothpicks (40)

Setup and Instructional Tips

- **STEAM Challenge:** The challenge can be done individually or in small groups. Students working in groups should sketch their own designs first. Then, have them share designs in groups and choose one together.
- **Testing Days:** You will need to prepare a pan of gelatin dessert to test students' designs. One pan can be used for multiple tests. It is recommended to have at least one extra available.

Discussion Questions

- What is the job of an engineer as it relates to natural disasters?
- How can we decrease the impacts of earthquakes?
- Why are earthquakes mainly found along the boundaries between oceans and continents?
- How can people prepare for earthquakes?

Additional Notes

- **Possible Misconception:** The ground opens during earthquakes.
  Truth: Shallow crevasses may form due to ground failures but Earth's surface does not open up. If it did, there would be no friction and therefore no earthquake.
- **Possible Design Solutions:** Students might connect their toothpicks and marshmallows into cubes or triangular prism shapes to create buildings. They might create buildings with bottoms that are wide and become narrow as they go up.

Scaffolding and Extension Suggestions

- Encourage students to make observations about buildings in their schools, communities, or nearby cities and identify if they are earthquake-proof.
- Challenge students to add floors and/or walls to their structures with materials of their choice.

Answer Key

Week 1 Day 1

1. B
2. A
3. D

Week 1 Day 2

1. Engineers will use bracing and strong bases to make buildings safer. The buildings would also be made of wood and steel.
2. It would be important to have earthquake-safe structures in places near plate boundaries, especially large cities with tall buildings.

Week 1 Day 5

1. California, Alaska, and Nevada have the most earthquakes.
2. The states are on plate boundaries and fault lines so they experience more earthquakes.
3. I would expect to see many more earthquake-safe structures in Alaska because there are so many more earthquakes.

Weeks 2 & 3

See STEAM Challenge Rubric on page 221.

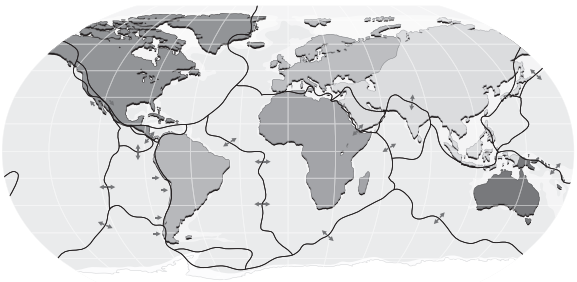
Unit 10: Earthquakes

Name: _____ Date: _____

Directions: Read the text, and study the map. Then, choose the best answer for each question.

An earthquake is a sudden rolling or shaking of Earth's surface. The second layer of Earth is made up of large, broken up pieces called tectonic plates. Tectonic plates are always moving. They move about as fast as your fingernails grow. Most earthquakes occur at the edges of these plates.

As tectonic plates move, they move away from, slide past, or push against each other. A divergent boundary occurs when two plates move away from each other in opposite directions. A convergent boundary occurs when two plates crash into each other. Sometimes one or both plates are pushed up. Sometimes one plate is forced under the edge of the other. This is called a subduction zone. A transform boundary occurs where two plates move against each other side by side.



tectonic plate boundaries

1. What causes earthquakes?

- (A) energy and power
- (B) moving of tectonic plates
- (C) tsunamis
- (D) divergent boundaries

2. What happens at a divergent boundary?

- (A) Plates move away from each other.
- (B) Plates move toward each other.
- (C) Plates stay still.
- (D) Plates slide past each other.

3. If you rub your hands together, what type of boundary are you modeling?

- (A) divergent
- (B) convergent
- (C) adjacent
- (D) transform

Name: _____ Date: _____

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

Earthquakes can cause damage to buildings and homes. Some engineers specialize in earthquake safety. They design and build earthquake-safe structures. We cannot prevent earthquakes. But engineers have developed ways to minimize the damage they can cause. New building designs have strong and light building frames, wider bases, and bracing.

Tall buildings are built to bend or sway during earthquakes. Builders use flexible materials that can bend or sway, such as wood and steel. Large buildings can be placed on rollers, so they move with the ground. To make older buildings earthquake safe, steel or wood is added to reinforce their structures.

Cross-bracing reinforces walls and helps buildings withstand earthquakes.

1. What are some ways engineers create buildings that are earthquake-safe?

_____

_____

_____

_____

2. Where do you think it would be most important to have earthquake-safe buildings? Explain your thinking.

_____

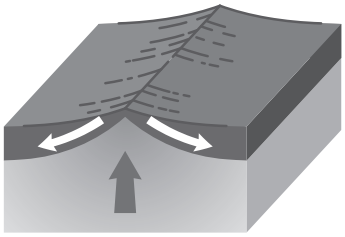
_____

_____

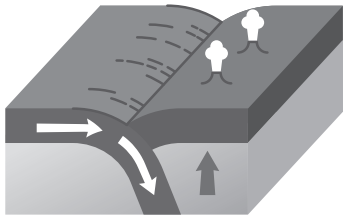
_____

Name: _____ Date: _____

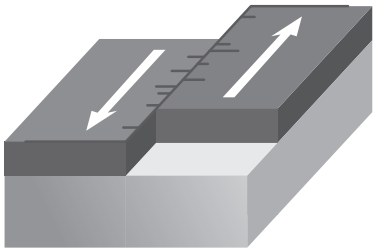
Directions: Follow the steps to model tectonic plate movements. Discuss the questions and your observations with a partner as you go.



divergent



convergent



transform

Materials

graham crackers ruler small cup of water

Steps

1. Break your graham cracker in half. Place your pieces side by side. Rub your graham crackers back and forth against each other.
   - What type of plate boundary did you create?
   - What happened when you rubbed the two crackers together?

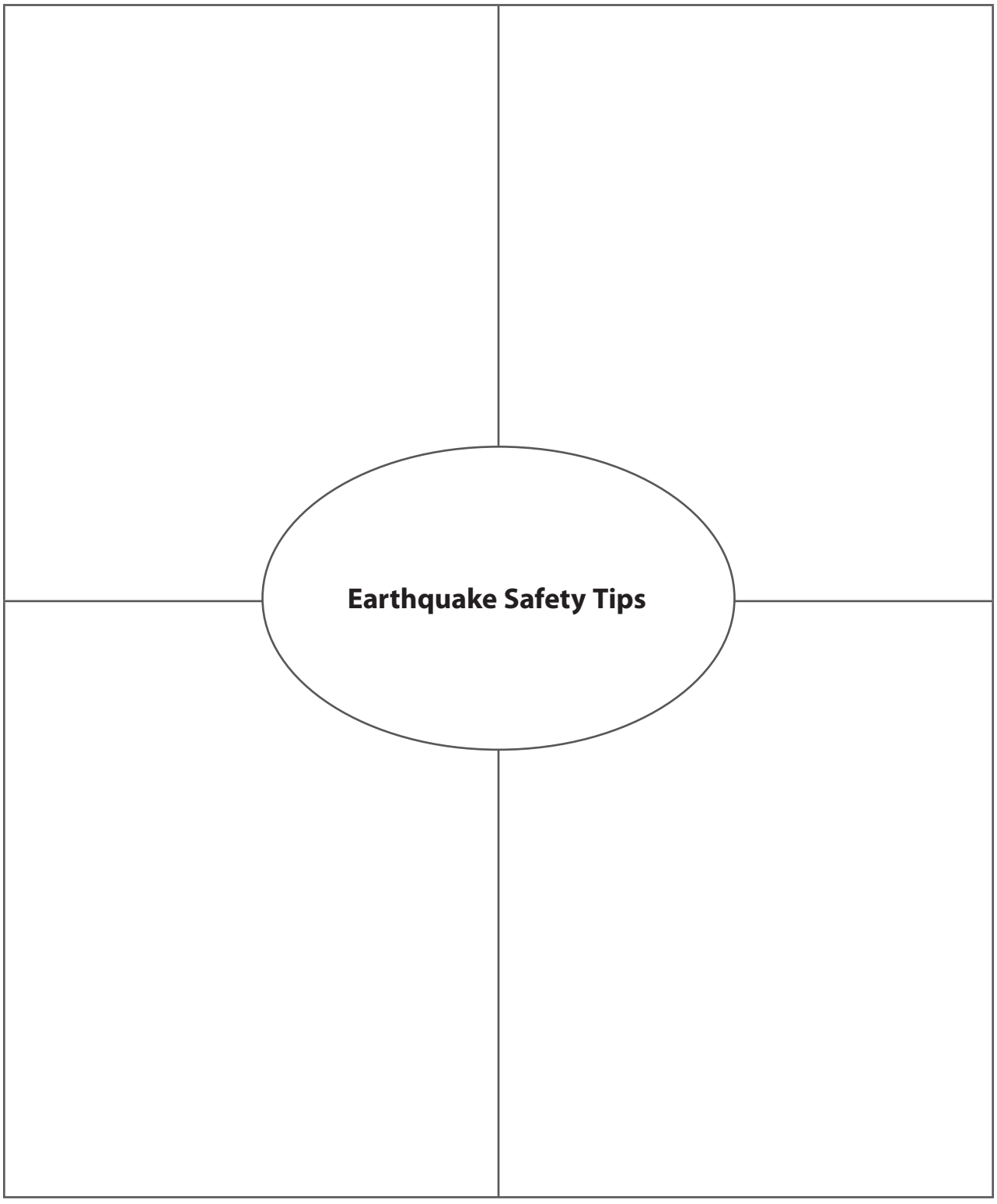
2. Place your pieces side by side and move them away from each other in opposite directions.
   - What type of plate boundary did you create?
   - What do you think might happen when this happens between real tectonic plates?

3. Place two graham crackers on the table 15 cm apart. Slide the two crackers toward each other until they collide. Continue to push them slightly toward each other.
   - What type of plate boundary did you create?
   - What happened when the two crackers collided?

4. Quickly dip one of the crackers in water and repeat the collision.
   - What happened when the two crackers collided this time?

Name: _____ Date: _____

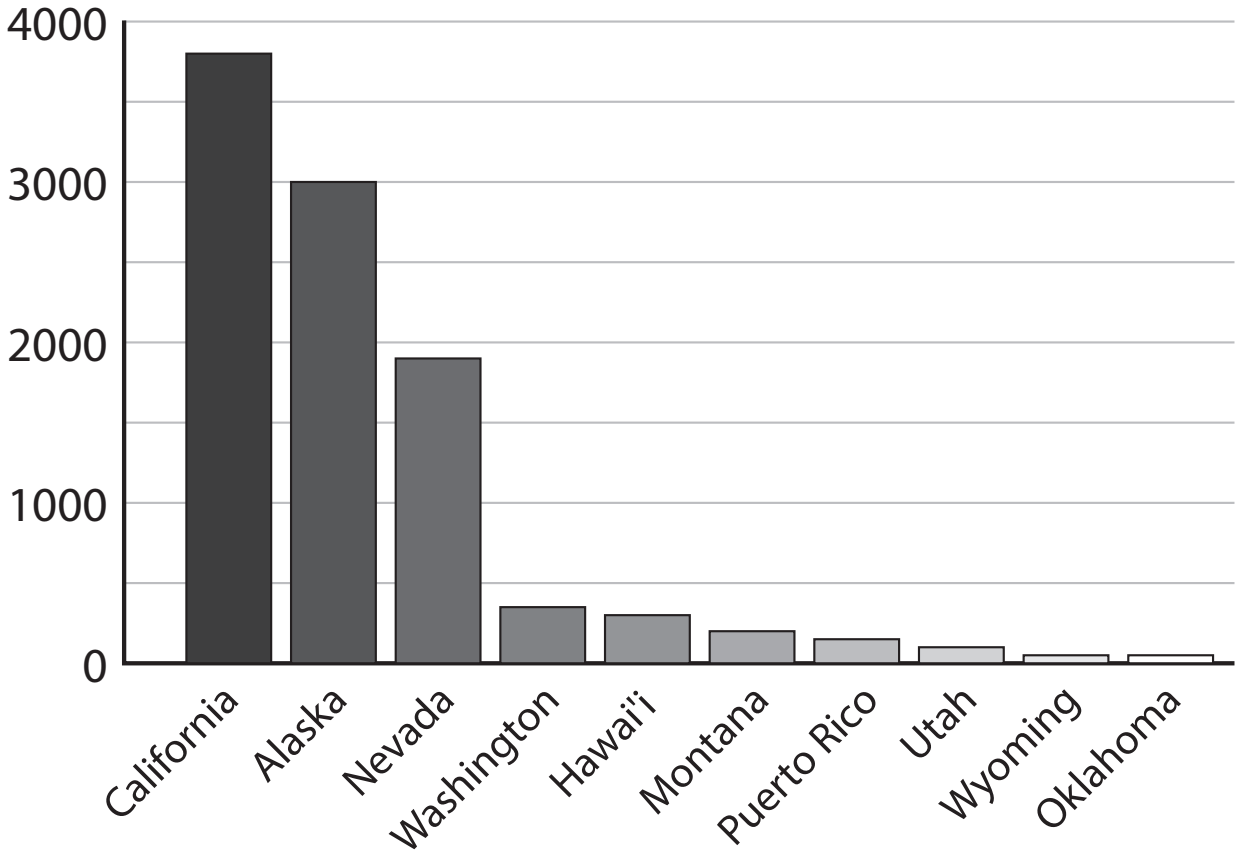
Directions: Create an earthquake safety poster to place in your home or school or to send to a friend that lives in an area with earthquakes. Draw pictures and words in the boxes to inform others how to stay safe during an earthquake in each box. You may want to do some research!



Name: _____ Date: _____

Directions: Study the graph. Then, answer the questions.

Top 10 Earthquake Locations



1. What are the top three states with the highest number of earthquakes?

_____ _____ _____

2. Why do you think these states have high numbers of earthquakes?

_____

_____

_____

3. How might earthquake safety measures differ between Alaska and Utah?

_____

_____

Name: _____ Date: _____

Directions: Read the text. Then, answer the questions.

The Challenge

You are a civil engineer. You have been asked to design and build a model of an earthquake-safe building. Engineers use models to test designs. They use shake tables to model how their earthquake-safe designs respond to shaking. You will test your design by placing it in a pan of gelatin dessert. Then, you will simulate an earthquake.

Criteria

For your earthquake-safe building to be successful, it must…

- be at least 5 inches (13 cm) in height.
- remain standing and intact during a simulated earthquake.

Constraints

- You may only use 40 toothpicks and 40 miniature marshmallows.
- You must build your model in the time frame set by your teacher.

1. What is the problem that you will be solving?

_____

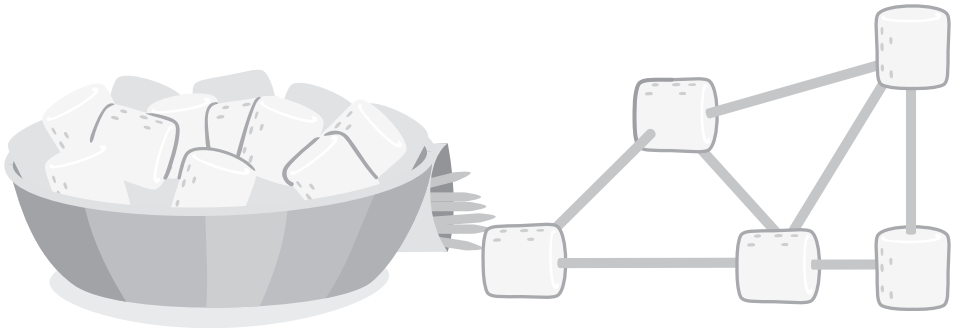
_____

2. What things are you excited to do or try?

_____

_____

_____



Name: _____ Date: _____

Directions: Explore your materials to learn how they work best. Try to make each shape listed in the table. Draw what you made. Record how many toothpicks and marshmallows you used. Then, answer the question.

Square	**Rectangle**
toothpicks: _____ marshmallows: _____	toothpicks: _____ marshmallows: _____
Cube	**Pyramid**
toothpicks: _____ marshmallows: _____	toothpicks: _____ marshmallows: _____

1. What other shapes or ideas do you think might work well?

_____

_____

Name: _____ **Date:** _____

Directions: Sketch one or more designs for your earthquake-safe building. Then, answer the question.

1. What about your design do you think will make it earthquake-safe?

_____

_____

Name: _____ Date: _____

Directions: Gather your materials, plan your steps, and build your earthquake-safe building. Record notes as you build. Make sure that your building is secure and stands freely.

Earthquake-Safe Building Plan

	Job or Task	Group Member(s)
1		
2		
3		
4		
5		
6		

Building Notes
(problems, solutions, changes, etc.)

Name: _____ Date: _____

Directions: Measure and record the height of your building. Place it on top of the gelatin dessert in the pan. Shake the pan back and forth slowly for 5 seconds. Try not to move the pan more than 1 inch (3 cm) in either direction. Record the results. If your building survived the first test, continue to the next one. Then, answer the questions.

Building Height: _____

Test	Seconds of Shaking	Distance of Pan Movement	Did your building stay standing?
1	5; slowly	1 inch (3 cm) in each direction	
2	10; slowly	2 inches (5 cm) in each direction	
3	10; medium speed	3 inches (8 cm) in each direction	

1. What other important observations did you make during testing?

_____

_____

_____

_____

2. What surprised you most during your testing? Why?

_____

_____

_____

_____

Name: _____ Date: _____

Directions: Reflect on your earthquake-safe building design, and answer the questions. Then, plan how you will improve it.

1. What was the weakest part of your design?

   _____

2. What was the strongest part?

   _____

3. Draw two structures you saw from others that you thought worked well. Circle any ideas you want to try in your redesign.

Design 1	Design 2

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

- My first design did not meet all the criteria. To improve it, I will

  _____

- Increase the height of the building to 10 inches (25 cm) or more. (You may use an additional 10 toothpicks and 10 marshmallows.)
- My own idea: _____

Name: _____ Date: _____

Directions: Plan your new building design. Then, sketch your new design. Then, complete the sentence.

In my redesign, I will…

add _____

remove _____

change _____

1. This design will work better because _____

_____

_____

Name: _____ Date: _____

Directions: List and gather your new materials. Plan your steps, and rebuild your earthquake-safe building. Record notes as you build.

New Materials

_____ _____ _____

_____ _____ _____

Earthquake-Safe Rebuilding Plan

	Job or Task	Group Member(s)
1		
2		
3		
4		
5		
6		

Rebuilding Notes

(challenges, observations, concerns, etc.)

Name: _____ Date: _____

Directions: Measure and record the height of your building. Place it on top of the gelatin dessert in the pan. Shake the pan back and forth slowly for 5 seconds. Try not to move the pan more than 1 inch (3 cm) in either direction. Record the results. If your building survived the first test, continue to the next one. Then, answer the questions.

Building Height: _____

Test	Seconds of Shaking	Distance of Pan Movement	Did your building stay standing?
1	5; slowly	1 inch (3 cm) in each direction	
2	10; slowly	2 inches (5 cm) in each direction	
3	10; medium speed	3 inches (8 cm) in each direction	

1. Did your new design perform better? What is your evidence?

_____

_____

_____

_____

2. Would you feel confident being in a building with your design? Why or why not?

_____

_____

_____

_____

Name: _____ Date: _____

Directions: Reflect on the work you did for this challenge. Answer the questions.

1. If you were to make your design into a real building, what materials would you use?

_____

_____

2. What was your favorite part of this challenge?

_____

_____

3. What about this challenge was difficult?

_____

_____

_____

4. Draw yourself testing your design. Add a thought bubble or speech bubble. Write a caption telling what you are doing.

_____