Lesson 4: Earthquakes and Moving Plates

☐ Getting Started

Earthquakes happen quickly, but the pressures that build up to cause them happen over a long period of time as tectonic plates shift. Today you will learn more about what causes earthquakes and how earthquakes can affect the areas where they occur.

Stuff You Need

- ✓ *Dirtmeister's Nitty Gritty Planet Earth* by Steve Tomecek
- ✓ 18-24 sugar cubes
- ✓ clay (kit)
- ✓ newspaper
- ✓ Slinky or Slinky Jr. (kit)
- ✓ 10' piece of rope* (Activity 2 - optional)
- ✓ 3 pieces of cardboard
- ✓ colored pencils
- ✓ sand (kit)
- ✓ soil (kit)

Ideas to Think About

- How has your own environment changed in the past?
- How do sudden changes in the environment affect living things?

Things to Know

- **Seismologists** are scientists who study earthquakes.
- **Plate boundaries** are where tectonic plates meet, while **faults** are breaks in the Earth's crust where rocks can move past each other.
- The **epicenter** is the focus point of an earthquake on the Earth's surface.

☐ Reading and Questions

Read pages 34-39 and 42-43 of *Dirtmeister's Nitty Gritty Planet Earth* and then answer the following questions.

1. What are some situations that can cause an earthquake?

_____

_____

2. During an earthquake, what type of waves typically does the most damage to buildings? Why do you think they are so damaging to buildings?

3. What is the device or instrument that scientists use to measure the strength of an earthquake? What scale is used to communicate that measurement?

4. What are tsunamis?

Activities

☐ Activity 1: Make an Earthquake

Many factors influence how much damage an earthquake does to a building. Two important factors are the strength of the earthquake and how far the building is from the earthquake's epicenter. Other factors can include the ground the building is on, the materials used to construct the building, and the building's shape or design.

In today's demonstration, you will explore how a building's shape and the ground the building is constructed on affect its ability to withstand an earthquake. When you create your buildings, use the same number of sugar cubes each time but vary the shape of the building. One version may be very tall, one may be in a pyramid shape, and another may be a square or rectangle. Follow these steps:

1. Cover the floor with newspaper or do the demonstration outdoors.
2. Place one or more cardboard sheets on a table with 2 inches of cardboard hanging off the end.

3. Put down three separate mounds (about 1" high) on which to build your buildings — use soil, clay, and sand either from near your house or from the science kit. Note: If you use the clay, sand, and soil from the science kit, use just the amount needed and try to keep the mounds separate so that you can sweep the materials back into the bags afterward. You will use the clay, sand, and soil in future lessons.
4. Place 3 buildings made of 6-8 sugar cubes each on top of each mound. Make each building the same size and shape.
5. Tap the bottom of the cardboard. Keep tapping until one or more of the buildings loses some sugar cubes.
6. Repeat Steps 4 and 5 with a different building shape.

Share your observations with a parent. Which type of "ground" provided the most stability? Which building shape was sturdiest? Did the buildings' distance from the "epicenter" (the place you were tapping) make a difference?

☐ Activity 2: Making Some Waves

When an earthquake occurs, a huge amount of energy is released. This energy moves outward from the fault in the form of vibrations or waves. As these strong waves move through the earth, the ground shakes. For this activity, you will create some waves similar to the ones produced by an earthquake.

If you have a long piece of rope (about 10 feet long), try the demonstration found at the bottom of p. 36 in the book. Afterward, follow these steps:

1. Firmly tie one end of the Slinky to the doorknob of a closed door. (If a parent or friend is available to help, that person can hold one end for you. Your helper should keep his or her end of the Slinky firm and steady throughout the demonstration.)
2. While you hold one end of the Slinky, walk away from the door (or helper) so the Slinky isn't slagging in the middle. Do not stretch it all the way out.

3. To make a P wave, quickly push and pull your end of the Slinky toward and then away from the door/helper. Don't let go of your end! Watch as the wave travels down the Slinky. The wave may even bounce at the other end and head back toward you.
4. To make an S wave, jerk your end of the Slinky quickly side to side once. Again, don't let go. The wave should once again travel down the Slinky. Notice how this wave is different from the P wave.
5. If you're having trouble seeing the waves, repeat Steps 3 and 4 at different distances from the door/helper and with different forces of pushing/pulling and jerking side to side. You can also try the demonstration on a table or on a bare floor with your helper again holding one end firm and steady.

Your child used a Slinky to help her better understand the two main types of energy waves (called seismic waves) that occur during an earthquake. If a long rope was available, your child also followed the directions in the book to create waves. Ask your child to explain the differences she saw between the two wave types. She should have noticed that the P wave (push/pull motion) moved the Slinky in the same direction the wave was traveling, but the S wave (side to side motion) moved the Slinky in a different direction than the wave was traveling. If she also did the rope demonstration, ask her how the waves she produced with the rope were similar to or different from the ones in the Slinky demonstration.

☐ Activity 3: Nearby Fault Lines?

Find the "Earthquake Shaking Hazards in the United States" page. First, use colored pencils to color each patterned box of the key. Next, find your state on the map. Follow your key and color in the pattern in your state as well as all adjacent states. (Adjacent states are ones surrounding yours. Some states may have only a few adjacent states while others may have several. Alaska and Hawaii have no adjacent states.) What is the earthquake hazard level for your state? What about nearby states? Are you surprised by the earthquake risk in your area? Share this information with a parent.

☐ Wrapping Up

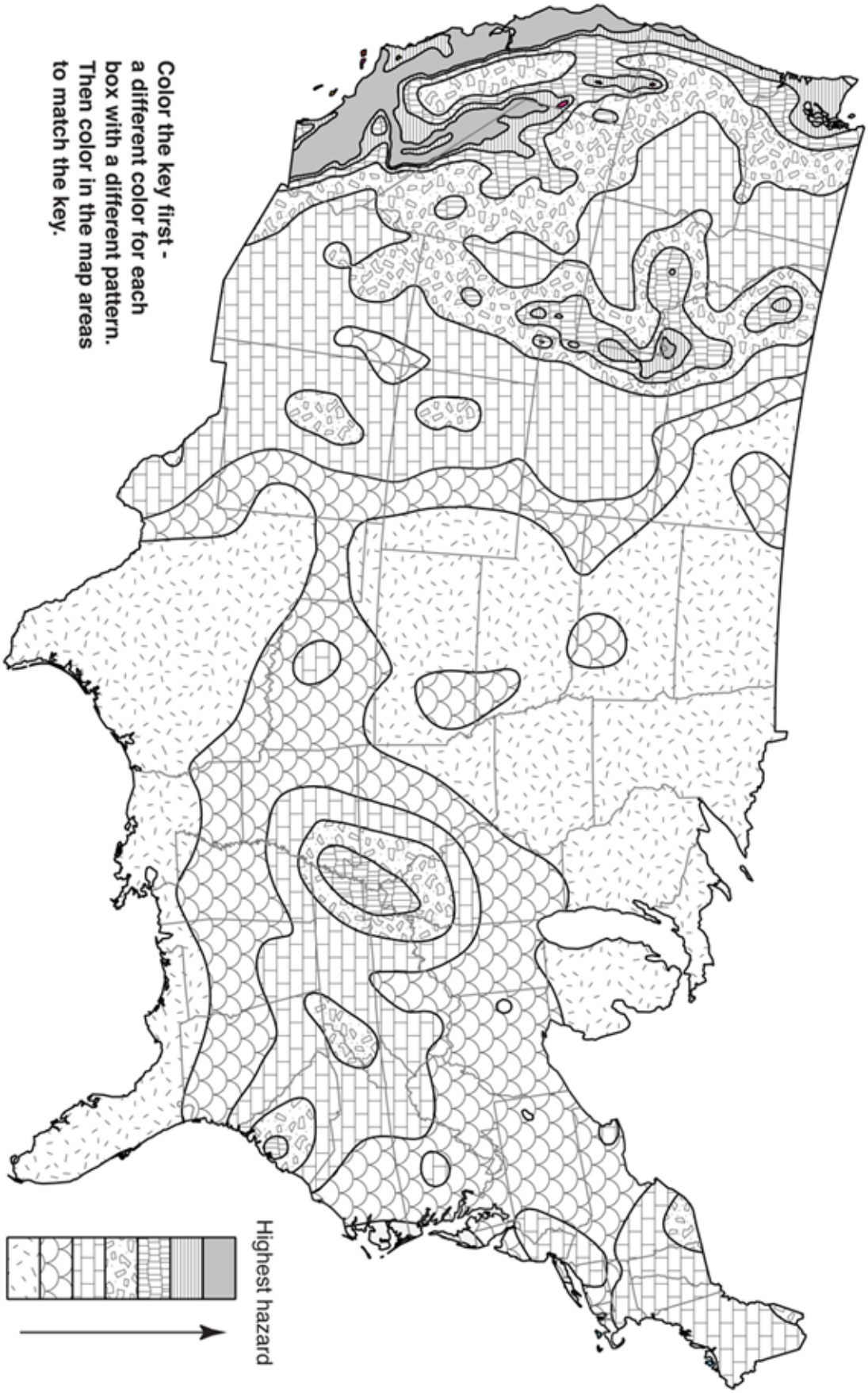
Think about the visible changes that earthquakes make on the surface of the Earth. What did you learn from your experiment? What do you think are the strongest building

shapes for withstanding an earthquake, the best soil/bedrock to minimize earthquake risk, or the difference made by the distance to the epicenter of the earthquake?

Life Application

Watch for depictions of earthquakes in the news, movies, television, and books. Have you been in an earthquake? Do you think the depiction is probably realistic or not?

Earthquake Shaking Hazards in the United States



Parent Overview

Lesson 4: Earthquakes and Moving Plates

Getting Started

? Big Ideas

- How has your own environment changed in the past?
- How do sudden changes in the environment affect living things?

Facts and Definitions

- **Seismologists** are scientists who study earthquakes.
- **Plate boundaries** are where tectonic plates meet, while **faults** are breaks in the Earth's crust where rocks can move past each other.
- The **epicenter** is the focus point of an earthquake on the Earth's surface.

Skills

- Know that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construction in the region. (S)
- Know that lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle. (S)
- Understand that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface. (S)

Introducing the Lesson

Today your child will look at earthquakes and how they are caused by the slow movement of tectonic plates. She will do a demonstration to explore how a building's shape and the material under it affect the building's sturdiness during an earthquake.

Reading and Questions (Answers)

1. What are some situations that can cause an earthquake?
    - Your child should understand that the most common situation is rocks at faults moving against each other. The book also mentions the eruption of a volcano or the collapse of an underground cave as possible causes.

2. During an earthquake, what type of waves typically does the most damage to buildings? Why do you think they are so damaging to buildings?
    - Surface waves. Answers will vary, but your child should understand that these waves occur on the Earth's surface, so the ground right under buildings would be shaking.

3. What is the device or instrument that scientists use to measure the strength of an earthquake? What scale is used to communicate that measurement?
    - seismograph; Richter magnitude scale

4. What are tsunamis?
    - Tsunamis are giant waves caused by undersea earthquakes. They can travel far across the ocean and cause a lot of damage.

Outline of Activities and Answer Keys

Activity 1: Make an Earthquake

Your child will do a demonstration to test the effects of an earthquake. This is a messy activity and should be done outside, in an area easy to sweep, or over newspaper that can be thrown out afterwards. Note that your child can collect sand, clay, and soil from near your house or can use the materials provided in the science kit. If she is using the science kit materials,

remind her to use only part of each bag, and help her keep the 3 mounds separate from one another. After the activity she should sweep each material back into its bag for use in future lessons. (It's ok if a little of one material mixes with another, but they should be kept mostly separate.)

Ask your child to share her observations with you. Also ask her what factors architects and engineers might consider when designing or constructing buildings in areas that tend to experience strong earthquakes.

Activity 2: Making Some Waves

Activity 3: Nearby Fault Lines?

In this activity, your child will investigate earthquake hazard areas and determine the earthquake hazard level in your state and surrounding ones. If your area has a history of earthquakes, share this information with your child.

Wrapping Up

Questions to Discuss

- Explain why a magnitude 7 earthquake is so much worse than a magnitude 6 earthquake. (Your child should understand that a magnitude 7 is 32 times stronger than a magnitude 6. There would be a significant difference in strength and resulting damage.)
- What did you learn from today's activities?
- How can earthquakes that occur in the ocean be dangerous? (Some can result in tsunamis that travel far across the ocean damaging coastal areas and putting people who live in those areas in danger.)

Things to Review

Review the definition of epicenter and the differences between faults and plate boundaries.