

# Investigation Four – Earthquakes

<p><b>Standard II</b> Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth’s surface.</p>
<p><b>Objective 1</b> Describe how weathering and erosion change Earth’s surface.</p>
<p><b>Intended Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>1. Use science process and thinking skills</li> <li>2. Manifest scientific attitudes and interests</li> <li>3. Understand science concepts and principles</li> <li>4. Communicate effectively using science and language and reasoning</li> </ol>

**Standard II**  

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**Objective 1**

## Background Information

Earthquakes are energy waves passing through Earth caused by sudden shifts of crust along faults. You know you are in an earthquake if the ground starts to shake. Tremendous forces under Earth’s surface build up pressure that is released in a fault, which is a crack in the rock that allows the crust to slip. The magnitude of the quake varies according to the amount of energy released by plate interaction. (Science and Children. September 1991 by Garry R. Hardy and Marvin N. Tolman).

There are five ways that Earth’s crust shifts along a fault.

- Tension (sections of Earth’s crust pull apart) 
- Compression (two sections carrying continents run into each other) 
- Over and Under (subduction, a continental section of Earth’s crust collides with an oceanic plate and the ocean’s plate sub-ducts underneath) 
- Shearing (two sections sliding sideways past each other) 
- Underwater Torches or Domes (volcanoes or hot spots under the surface of Earth’s crust). (Ranger Rick’s Nature Scope, Geology: The Active Earth. Volume 3, Number 2)

**Note:**

You may want to use two different flavors of cake mix to represent layers in Earth’s strata. Carefully fill the cake pan halfway with one flavor and complete the cake with the other. The finished cake will have two integrated layers, thus, allowing a more effective demonstration. You will need two foil cake pans for three of the four cakes. Cut one of the foil cake pans from side to side starting just beneath the reinforce rim. (The lateral movement is more effective if the pan is cut diagonally. This will result in a longer, more realistic fracture.) Leave the rim intact to hold the cake in position during baking. Reinforce the cut pan by covering the outside with the sheet of foil. Place the foil-reinforced pan inside the second uncut cake pan. Lubricate the cut pan liberally with cooking spray. Mix and bake the cake according to directions. Before conducting the experiment, remove from the outer pan the cut and reinforced inner pan that contains the cake. Cut the rim at the top of the inner cake pan, pulling it apart. Be careful not to fracture the cake when completing this step.

## Pre-Assessment/Invitation to Learn

Move outside and have the students form two lines facing each other. Tell them that they represent the two side of the San Andreas Fault in California. Have each child join hands with the person opposite him/her and explain that they represent a fence that stretches across the fault. On your signal, have the two lines take ten steps sideways in opposite directions. The “fence” should stretch and finally break during the shift. Explain that this kind of shift occurred in the San Francisco Earthquake of 1906. When the shift was calculated, it measured a record twenty feet (6 meters). Fences, bridges, roads, and buildings that reached across the fault were broken apart.

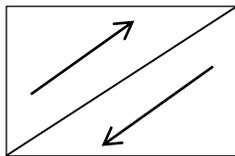
## Instructional Procedure

1. Divide the students into four groups with one sheet cake per group. Give each group enough icing and food coloring to recreate rivers, cities, mountains, and other landscapes.
2. Allow enough time for students to create a scene that includes a water source, land, and human population.
3. Demonstrate the following types of shift movement. Students can either record in journals what is happening in each demonstration, or they can draw pictures of each.

### Materials

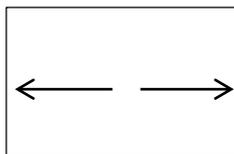
- Foil cake pans
- Cooking spray
- Vanilla icing
- Food coloring (blue for water, green for vegetation, Brown for Earth’s surface)
- Objects to represent people, buildings, cars, etc. (nuts to represent rocks in the soil, or shredded coconut to depict plant roots)
- Extra large balloon
- Drinking straw
- Four sheet cakes

cut cake diagonally



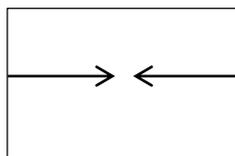
(lateral plate movement)

pull cake apart



(divergent plate movement)

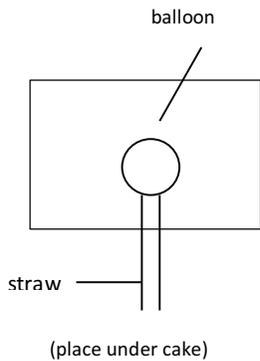
mush cake together



(convergent plate movement)

- A. To demonstrate “Shearing”, have two students firmly grasp the pan containing the cake, at each end. Have one student very slowly move half the pan to the left while the other students slowly moves the other end to the right keeping both cake and pan as level as possible.
- B. To demonstrate “Tension”, have two students, one on each end of the cut pan, hold a second cake. Make sure students grasp the pan firmly enough to keep the cake from sliding out of the pan as they begin to pull on the pan and the cake. Have the students pull outward on the ends of the pan and cake, *slowly, steadily, and without twisting*, until the cake begins to fracture.
- C. To demonstrate “Compression” you will need another cake. Prepare the pan for this one by bending one side slightly so it slides inside the other end when the students apply pressure to both ends of the pan. Have two students hold the cake, one on each end of the cut pan, as in the previous demonstrations. The students need to grasp the pan firmly to be sure the cake does not slide out. Have the students push toward each other with steady, slow pressure. The cake should buckle in the middle, just as the surface of the earth lifts and folds.

D. Some type of magma flows may stop and cool before they reach the surface, forming domes from pushing up a part of Earth's crust. To demonstrate this, carefully lift the cake out of the pan. Securely tape a drinking straw to the opening of a balloon. Then carefully insert the uninflated balloon in the pan slit, and replace the cake. This is easier if the cake is frozen. The stem of the straw should extend from the side of the slit in the cake pan. Next, have two students carefully hold the cake pan while a third student slowly inflates the balloon. The cake should bulge, thus providing a visual image of what can happen to part of the earth when magma escapes and spreads out beneath the surface. The balloon should be inflated very slowly, stopping from time to time to allow students to carefully examine the cake and discuss what is happening.



4. Talk with students about what they have observed. Help them to construct their own meaning about the different landforms that have been created such as mountains, valleys, lakes, and canyons, as well as damage to man-made and natural features.
5. Explain that unless you've seen a volcanic eruption or experience an intense earthquake, it's hard to comprehend the incredible forces that exist within Earth. Violent geological events are rare, but when they do happen they can cause severe damage. You might also mention that in the last few decades, geologists have learned a great deal about how and why these events occur. As we learn more, we will be better able to minimize the damage to human life and property. (Garry R. Hardy and Marvin N. Tolman, Science and Children. Sept. 1991)

## Curriculum Extensions

*Science –*

- Use graham crackers covered with frosting for a less expensive alternative to the cakes. Give each student two graham crackers on a paper plate. The student can use a craft stick to put frosting on both crackers. The students then model the movement of the faults by moving their crackers in the direction given in the cake demonstration. (ILOs 1, 2, 3)

## Assessment Suggestions

Have each student make a personal picture book and draw examples of each of the five plate interactions. Using their journal notes from the demonstrations, students should add a minimum of three sentence descriptions to each of the five plate interaction picture pages.

Reference to Assessment Section

Unit Test	Multiple Choice	Constructed Response	Performance Test
1	4, 5	3, 4	Modeling Landforms Shaping the Land Moving Along
2	4, 5, 6, 7		

## Resources

### *Videos –*

- Earthquakes; Our Restless Planet. Rainbow Educational Media (Free Preview: 1-800-331-4047)
- All About Earthquakes. Schlessinger, 2000
- Earthquakes and Volcanoes. BFA – Phoenix
- Earthquakes – Shake, Rattle, and Roll. Lucerne, 1993.
- Earthquakes. Schlessinger, 2000

### *Books –*

- Copycat Pages, Ranger Rick’s Naturescope: Geology – The Active Earth. Vol. 3, #2
- I Can Read About Earthquakes and Volcanoes. Troll Associates, 1972
- Volcano & Earthquakes. New York: Eyewitness Books, 1992.
- Chambers, Catherine. Earthquakes. Chicago: Heinemann Library. ISBN: 1-57572-427-8.
- Earthquakes by Mark Maslin; Raintree Steck-Vaughn Publishing; ISBN: 0-7398-1327-7