



Earthquakes

Library List

Earthquakes by Trudi Strain Trueit

This book is jam packed with information, but probably too much information for the elementary student to completely absorb. I believe it is best presented by the parent picking out the best portions and either reading it aloud or allowing the child to read it. The glossary in the back is a great resource.

Earthquakes by Seymour Simon

A less dense version of the above book, this would be more easily accessible by children. Parents should be aware that there are several photographs of destroyed houses, streets, and cars in the book.

DK Eyewitness Books Volcano & Earthquake by Susanna van Rose

With lots of pictures, this book gives in depth information on measuring earthquakes and the mechanics of earthquakes.

...If you lived at the time of the great San Francisco Earthquake by Ellen Levine

This gives an in depth look at what life was like directly before, during, but mostly after the 1906 earthquake in San Francisco, CA.

Earthquakes: Let's Read and Find Out by Franklyn M. Branley

Part of a great series, and easy for the newer reader to tackle on their own, includes the causes and effects of earthquakes, preparations, and a list of 10 most deadly (up to it's publication in 2005) earthquakes.

Jump into Science: Earthquakes by Ellen J. Prager

A crow gives kids a bird's eye view of the earth to explain earthquakes. There's even an experiment where kid's can make their own earthquake.

Earthquake in the Early Morning Mary Pope Osborne

If you have a Magic Tree House fan, then, of course, there is a Magic Tree House book on earthquakes. This covers the earthquake of 1906 in San Francisco, and if it is read in conjunction with ...If you lived at the time of the great San Francisco Earthquake , then your child can compare and contrast fact and fiction.

Kingfisher Knowledge Hurricanes, Tsunamis, and other Natural Disasters by Andrew Langley

This gives a brief overview of earthquakes, but goes more in depth about the results tsunamis. Most of the images are from the 2004 tsunami; parents should be aware, like the earthquake book, of the reality of the destruction depicted in the book.

Lessons and Research

Vocabulary

After-shocks: small tremors that occur after a large earthquake. They can happen for days, weeks, months, or even years after an earthquake.

Boundary: the edge or border

Crust: the outermost layer of the earth

Earthquake: the movement on the surface of the earth resulting from underground movement between two plates

Epicenter: the place on the crust directly above the focus of the earthquake

Friction: the force felt when one object rubs against another

Fault: A crack in the crust where two plates meet

Focus: the place an earthquake begins inside the Earth

Liquefaction: when the shaking from an earthquake causes, usually sandy, ground to behave more like a liquid, causing houses or other objects on it to sink

Logarithmic Scale: a graph scale where the divisions are some power of 10

Magnitude: the measurement of the size of the earthquake

Modified Mercalli Intensity Scale: a measurement scale for earthquakes based on people's observations of how the earthquake felt

P waves: the primary (first) waves from an earthquake

Richter scale: a measurement scale for earthquakes based on the size of the waves it produces

S waves: the secondary waves from an earthquake

Sand Boils: when water pushes up through a bed of sand

Seismic wave: aka shock wave, an invisible wave that travels through rock during an earthquake, moving it

Seismologist: a person who studies earthquakes

Seismograph: an instrument that produces a record of the strength of an earthquake

Surface waves: waves that move on the surface of the Earth during an earthquake

Tectonic plates: the divided parts of the Earth's crust

Tremor: a small earthquake

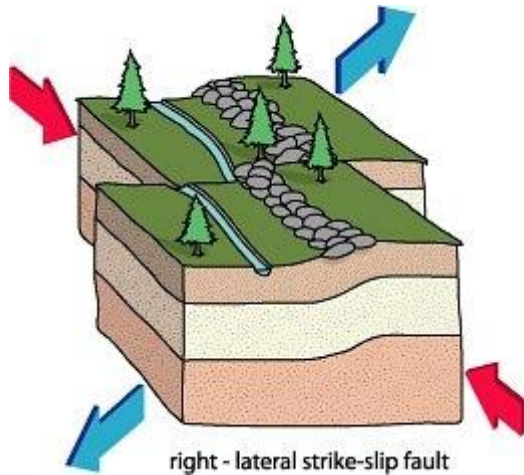
Tsunami: a sea wave caused by the movement of the sea floor during an earthquake or volcano.

Earthquakes occur when the ground unexpectedly moves beneath your feet. Earthquakes take place at areas of the Earth known as faults.

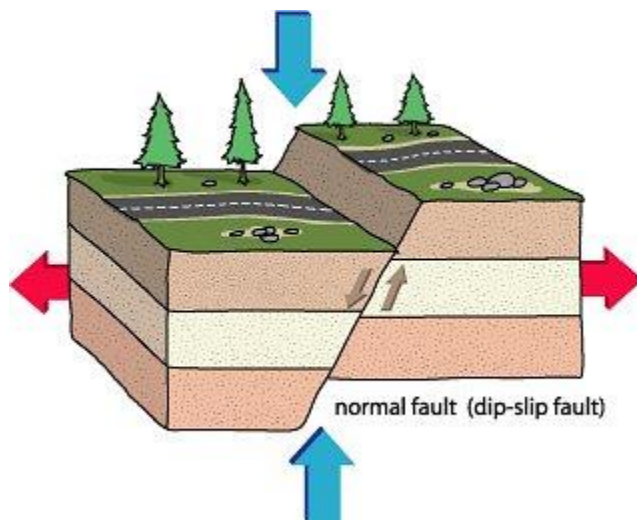
Types of Faults

There are two types of faults: 1) a strike slip fault and 2) a normal fault, also called a dip-slip.

1). At a strike slip fault, the rocks on one side of the fault try to slip by the rocks on the other side of the fault. Friction builds up. Then, like a rubber band releasing, the rocks move and there is a release of energy, which we call an earthquake. An example of this kind of fault is the San Andreas fault in California.



2). At a normal fault, the rocks on one side try to slip up and over the other set of rocks. The Sierra Nevada Mountains are an example of dip-slip faults.



Since every earthquake begins underground at a fault, earthquakes usually happen where two plates come together, at the boundary. Eighty percent of the world's earthquakes occur along the ["Ring of Fire"](#) (known as that because it is also an area high in volcanic activity), border by the Pacific Ocean, stretching from South America, up through North America, to Asia and Japan, then south to the Philippines, New Guinea, and New Zealand.

The place an earthquake begins is called a focus, and the place above ground over the focus is known as the epicenter. The energy released when the rocks moved is released in the form of invisible waves.

Types of Waves

There are three types of waves: P waves, S waves, and Surface Waves.

1. P waves, or primary waves: The first waves to reach the surface and also the fastest moving at 4 miles per second. They push and pull the rock as they move through it, making a the initial jolt that people sometimes report feeling.
2. S waves, or secondary waves, move slower than P waves, at 2 miles per second and move the rock up and down and back and forth.

P and S waves move through the entire Earth, so they, **combined**, are *also known* as body waves.

3. Surface waves travel only on the surface of the Earth. They are made by the P and S waves hitting the surface of the Earth. They make a rolling sensation, sort of like waves in the water. Often, they cause the most damage, because they can last the longest and they hit areas that have already been weakened by the other waves.

Measuring Earthquakes

There are two scales used to measure earthquakes: the Modified Mercalli Intensity Scale and the Richter Scale.

Modified Mercalli Intensity Scale

This is less widely reported because it is considered descriptive and relative. It is measured by having survivors of an earthquake fill out a form reporting how the earthquake felt to them.

I The earthquake is not felt by people but instruments recorded it.

II People resting noticed the earthquake, especially on higher floors. Suspended objects may swing.

III People inside feel a vibration, like a truck passing by. Hanging objects swing. People may not realize there was an earthquake.

IV Feels like a heavy truck hit a building. Dishes rattle, wooden walls shake, standing cars rock.

V Felt outside. Liquid in glasses splashes out; small objects are knocked over. Doors open and shut.

VI Everyone feels it, many people go outside, many are scared. People may walk unsteadily (sea legs). Dishes and windows break, Pictures fall off the wall.

VII Hard to stay standing, furniture breaks, bricks fall, waves on ponds.

VIII Hard to drive. Walls, chimneys, monuments fall. Tree branches break. Changes in flow of wells and springs. Cracks in wet ground.

IX Panic, in people and animals. Major damage to foundations and frames of buildings. Underground pipes break.

X Most brick and frame buildings destroyed. Some well-built wooden buildings destroyed. Large landslides. Water thrown out of rivers and canals.

XI Train tracks greatly damaged. Underground pipes out of service. Highways and roads useless. Ground has large cracks. Many large landslides and rocks falls.

XII Nearly all built structures above and below ground destroyed. Objects thrown into the air. River courses moved.

The more commonly reported scale is the Richter scale. The Richter scale is measured using a seismograph to measure the magnitude, or size, of the waves of the earthquake. The Richter scale is a logarithmic scale, which means that each time you go up one number, the magnitude increases ten times. The Richter scale has no upper or lower limit, however, for most earthquakes, here are roughly what the Richter numbers translate to:

Less than 2— not felt

2-2.9 generally not felt but recorded

3-3.9 often felt but usually no damage

4-4.9 noticeable shaking of indoor things, rattling, usually no major damage

5-5.9 can cause major damage to poorly constructed buildings. At the most, minor damage to well constructed buildings.

6-6.9 can be destructive to areas 100 mi across in populated areas

7-7.9 can cause serious damage over larger areas

8-8.9 can cause serious damage in areas several hundred miles across

9-9.9 devastating in area thousands of miles across

10+ never seen

Measuring Earthquakes

Current seismometers (instruments that record earthquakes) have a recording device, the seismograph, and a record of the earthquake, the seismogram. Many times they are in remote locations, to be away from the vibrations of shaking of cars, trucks, or airplanes. The data is recorded onto magnetic tapes.

Disaster on top of Disaster

Many times earthquakes can trigger other disasters. Some of the problems that can occur as the result of an earthquake are: tsunamis, fires, landslides, mudslides and avalanches, and liquefaction and sand boils.

Tsunamis

A tsunami, which means “harbor wave” in Japanese, occurs when an earthquake under the ocean makes a wave or series of waves that can travel for up to thousands of miles. In the ocean, the crest of the wave is not very high, perhaps only three feet, but it moves very quickly, at speeds up to 500 mph. When the wave reaches the coast, it slows down, the water towards shore draws back and the tsunami gets taller. Most are 50 feet, although they can reach a height of 100 ft. or more.

Fires

Fires are a danger after large earthquakes because of the following reasons: water mains have often broken, cities are left without water supplies, chimneys frequently fall during earthquakes, power lines can fall, and gas lines also frequently burst.

Landslides, Mudslides and Avalanches

The shaking of the ground can loosen any unstable soil or snow causing landslides, mudslides, or avalanches compounding the difficulties already faced by those dealing with the aftermath of an earthquake.

Liquefaction and Sand Boils

When some soils, particularly those with lots of sand grains in them, are shaken by an earthquake, they become like quicksand. Or, sometimes, the sand and mud form little “volcanoes” where the sand appears to boil water, becoming what is known as “sand boils.” When buildings, cars, streets, any structures are built on this kind of soil, damage can occur.

Earthquake Prediction

Only one earthquake has been successfully predicted. On Feb. 4, 1975, scientists in China used a variety of factors: foreshocks, ground tilt, changes in the groundwater, and changes in animal behavior to successfully predict an earthquake in Haicheng and evacuate 1 million people. The next year, however, they failed to predict an 8.0 magnitude earthquake in Tangshan.

With no way to predict the next earthquake, the best thing to do is to prepare.

Earthquake Preparation

If you live in an earthquake zone, one of the most important things you can do is prepare in advance. Some basic things you can do to prepare are:

Know how to shut off the gas, water, and electricity in your home.

Have heavy furniture, glass objects, mirrors, pictures, the water heater, and all breakables appropriately fastened.

Keep a fire extinguisher handy and make sure it is not expired.

Find safe zones in your house, away from windows, under tables, etc. where you can duck and cover. Door jams are not safe zones (even though they used to be recommended). Fingers can get crushed when doors swing and people rarely remember to close them in an emergency.

Make an earthquake kit with enough food and water for one week (water should be 1 gallon per person per day). Don't forget a manual can opener, flashlights, a portable radio, pet food, extra prescriptions, glasses, and batteries. Keep sturdy shoes by your bed. Update your kit every year.

Never go outside during an earthquake. If one hits while you are outside, move out into the open, away from buildings, lights, and wires. Stay away from cliffs, hills, and rivers. If you are near an ocean or other large body of water, get to higher ground.

www.fema.org and www.redcross.org have specific tips on what to put into and earthquake kit as well as other tips on how to prepare for an earthquake.

Major Earthquakes in History

Information on this can be found in Earthquakes by Franklyn M. Branley (the 10 deadliest earthquakes). The information can also be [found in an online search](#) as the ten strongest earthquake by magnitude. Since this information is always changing, the parent will need to find the most up to date information (rather than it being posted in this unit).

Experiments and Activities

1: Liquefaction can be simulated very easily. Most of us have done it without even realizing it at the beach by tapping our foot in the sand until it turns "jelly-like." Use a rectangular or square container that you don't mind getting dirty (or go to the beach) for this project. Add sand and water and start tapping on it with a piece of wood or a brick. For a true effect, add some toy cars, houses and people. Watch what happens and take pictures. Have your child write an explanation and add the pictures to your lapbook.

2. Highway Seismograph

Have your child hold a paper and pen at arm's length as you drive down a bumpy road. It will work best if they can attach the paper to the backseat or if you have an adult do the in the front seat and have the paper on the dashboard (so that they are not holding the paper). As you are driving, their hand will move, marking the paper, the way a seismograph moves in an earthquake.

3. Waves

P waves and S waves can be demonstrated using a slinky. Since surface waves move on the surface and not through the earth (or in this case, the slinky), it's a lot harder to demonstrate. For the P waves, have a person at each end of the slinky and have them move the slinky up and down quickly. For the S waves, have a person at each end of the slinky and have them move the slinky from side to side. Take pictures or have your child describe the experiment.

4. Make your own earthquake using the instructions found in the book, Jump into Science: Earthquakes .

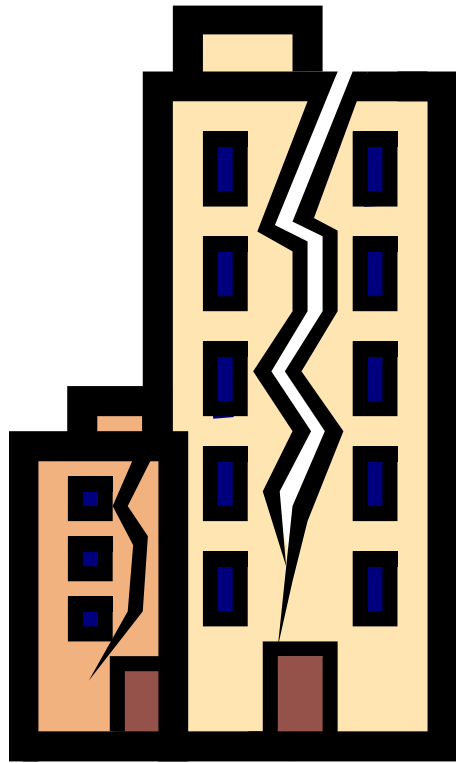
Earthquakes and the Bible

There is a miraculous earthquake which occurs in the Bible at the rising of Jesus from his grave.. Read Matthew 28 1-6.

Materials and information may be used for your own personal and school use.

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TEN MAJOR EARTHQUAKES



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Cut books out on solid lines; fold on dotted lines.



An Earthquake in the Bible

Matthew 28:1-6

After the Sabbath, at dawn on the first day of the week, Mary Magdalene and the other Mary went to look at the tomb. There was a violent earthquake, for an angel of the Lord came down from heaven and, going to the tomb, rolled back the stone and sat on it. His appearance was like lightning, and his clothes were white as snow. The guards were so afraid of him that they shook and became like dead men. The angel said to the women, "Do not be afraid, for I know that you are looking for Jesus, who was crucified. He is not here; he has risen, just as he said. Come and see the place where he lay.

Cut pockets out. Fold back flap up and wrap side flaps around the back and glue down. Glue the back of your pocket into your lapbook. Have student write the answer on back of the card. Store questions in pocket.

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Fact or Fiction



1

The longest recorded earthquake lasted 4 minutes.



2

There are hundreds of earthquakes every year.



3

Some animals behave strangely before earthquakes.



4

A pyramid-shaped building is not very sturdy in an earthquake.



Answers:

- 1) Fact
- 2) Fiction—there are thousands of earthquakes each year
- 3) Fact
- 4) Fiction

A
moonquake
occurs on
the moon.

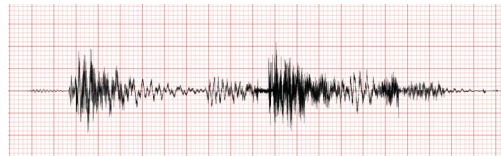


It is
important to
duck and
cover in an
earthquake.



A repeater
is a
machine
used to
measure
Earth's
plate
movements.

The
Richter scale
measures
the power
of an
earthquake.



Answers:

5) Fact

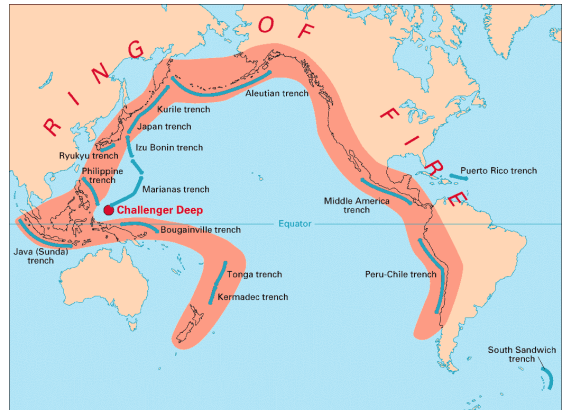
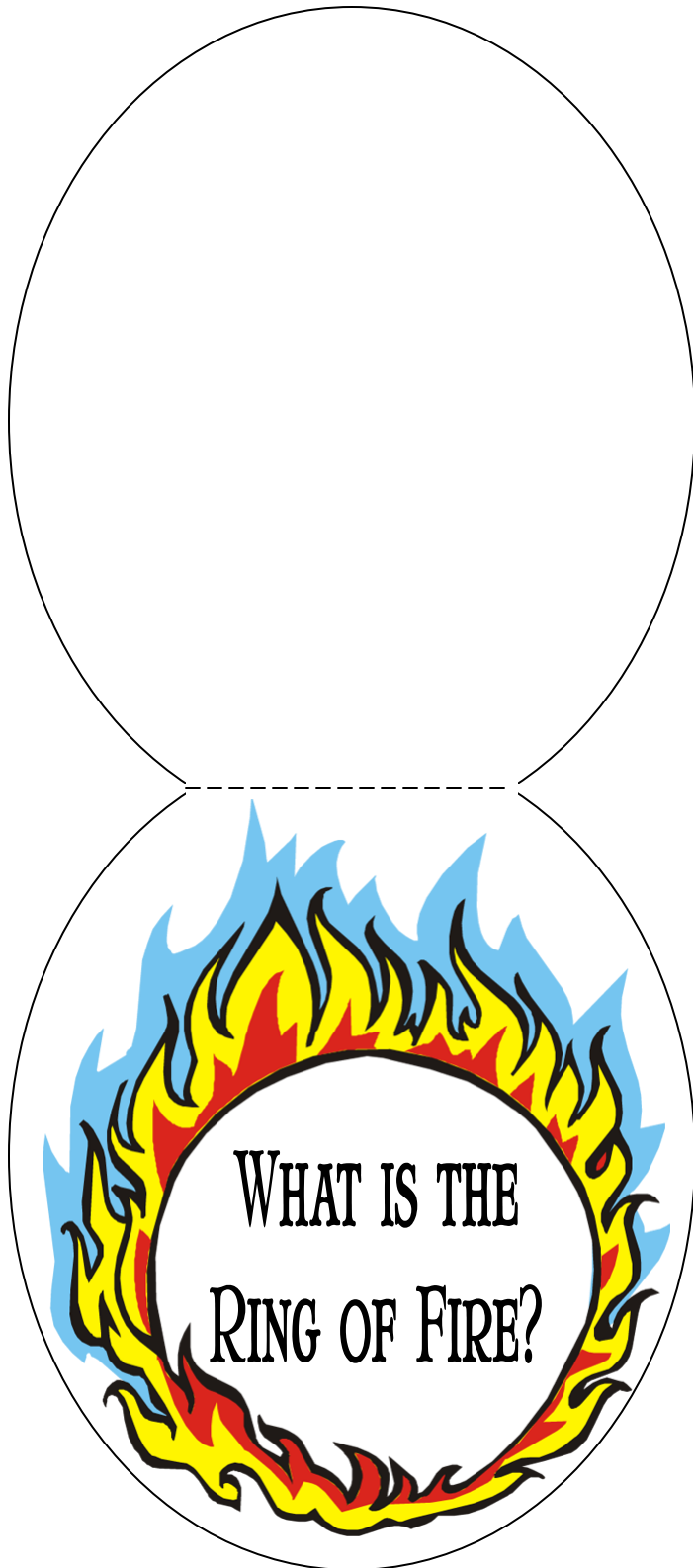
6) Fact

7) Fact

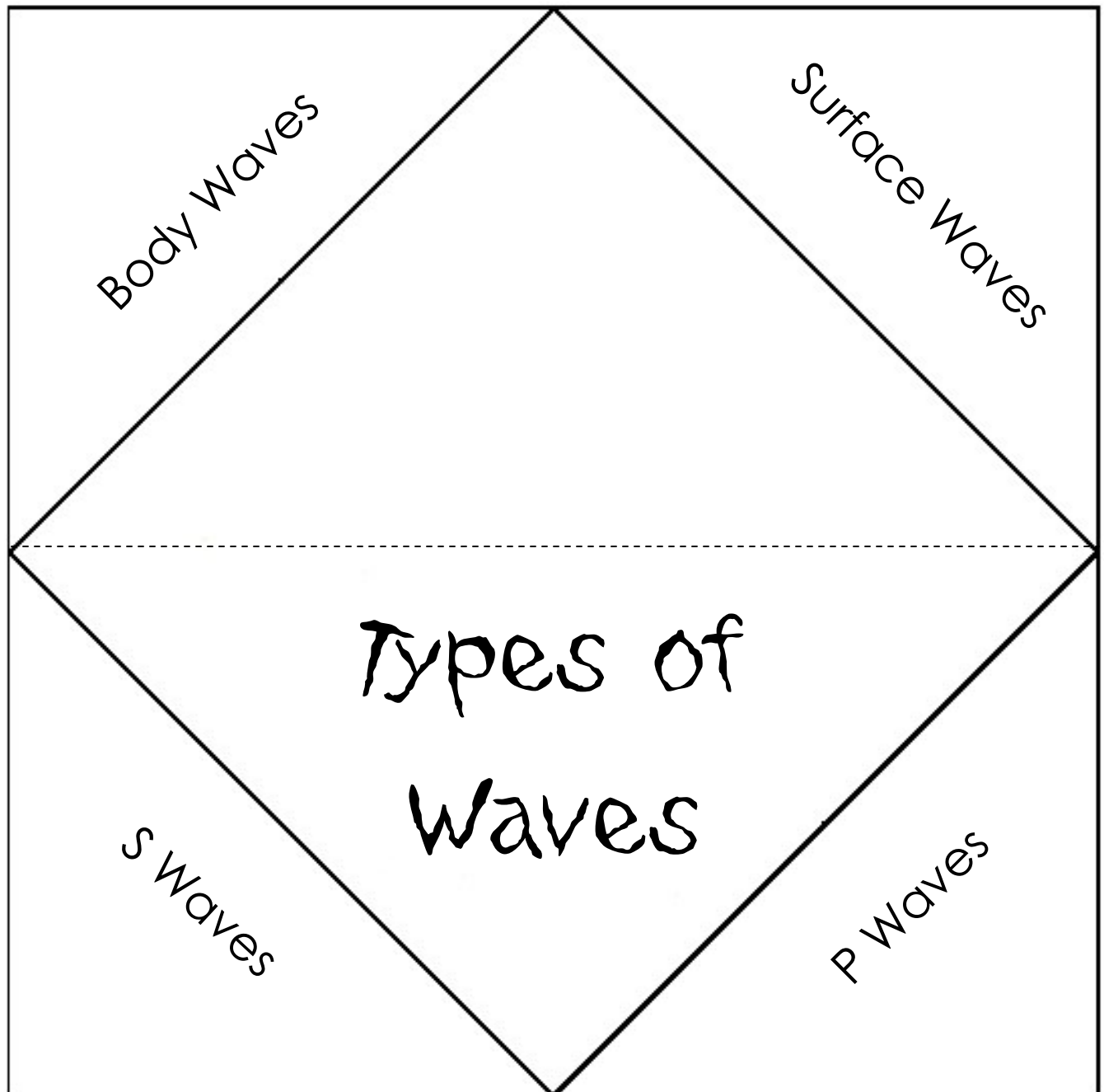
8) Fact

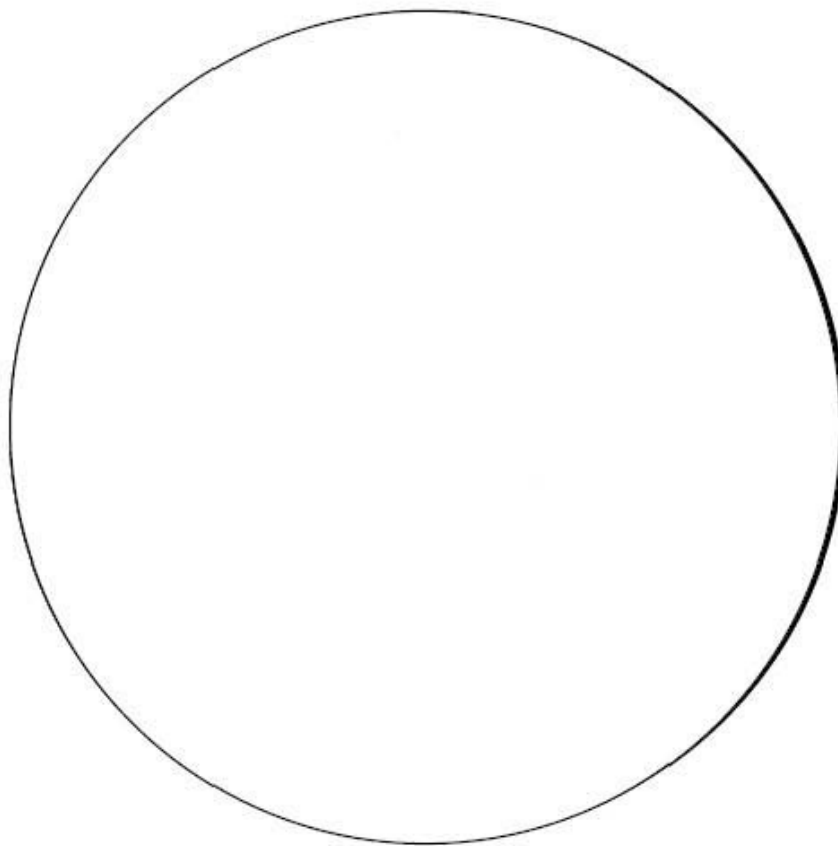
Cut book out as one piece. Fold in half. Write answer inside. Paste graphic inside book.

Graphic courtesy of
<http://pubs.usgs.gov/publications/text/fire.html>



Cut out book. Fold each triangle flap under. Fold book in half on dotted line. When you open the book, there should be four flaps to life and record information.





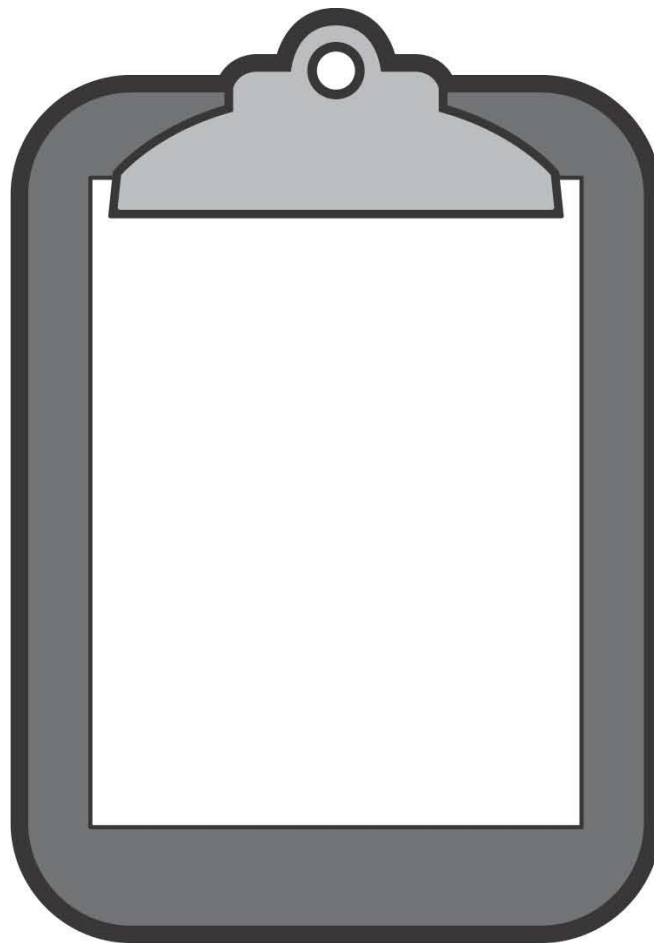
Directions:

Cut out wheels. Cut away extra space on first wheel. Match up wheels and attach together using a brass fastener.

Customize a vocabulary book for your student! Cut out book as one piece. Fold left side in. Fold right side (cover) in. Open. Cut on dotted lines to form flaps. Choose six words. Write them on the outer flaps. Write definitions under flaps.

New words

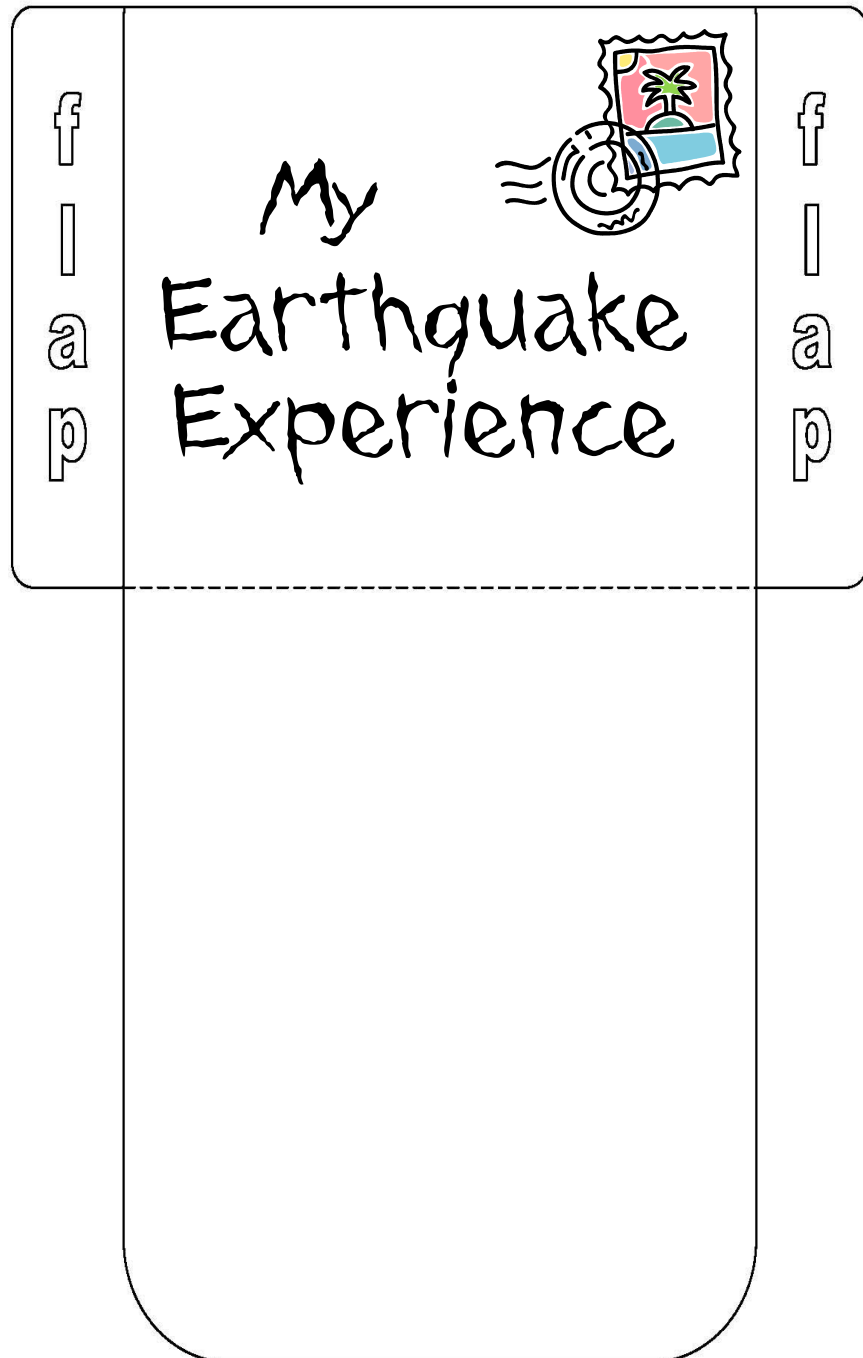




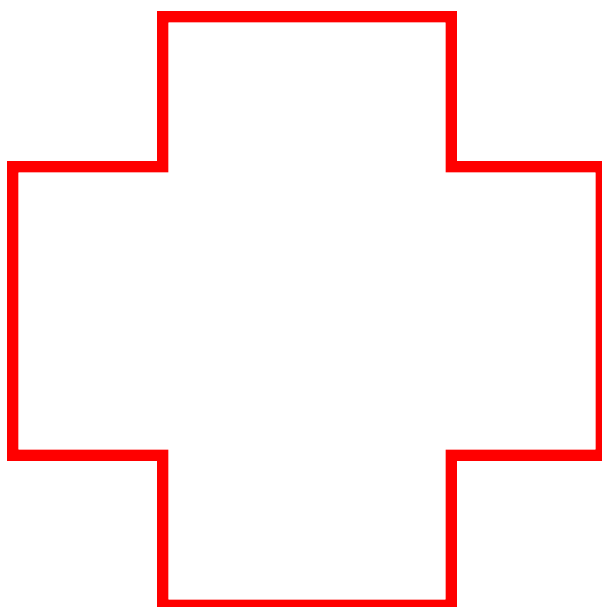
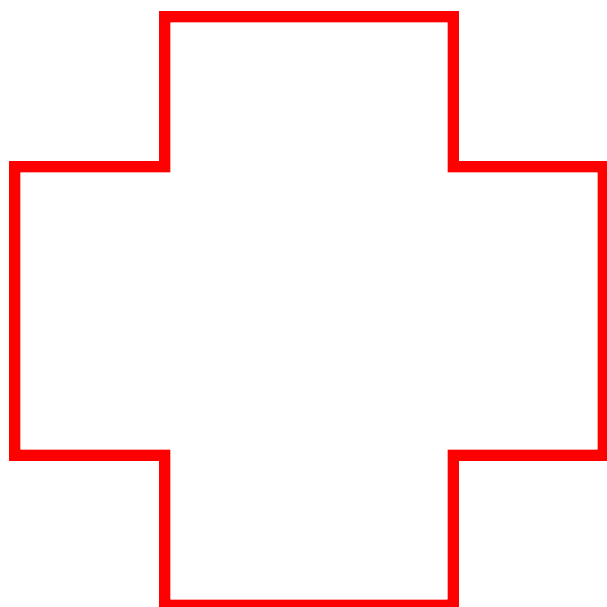
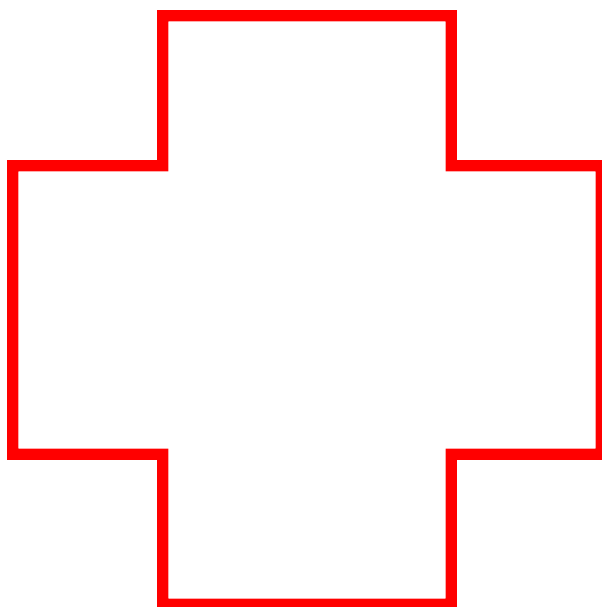
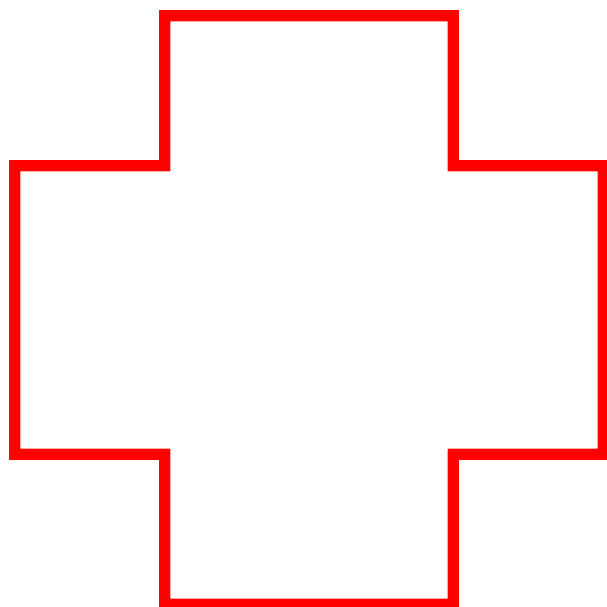
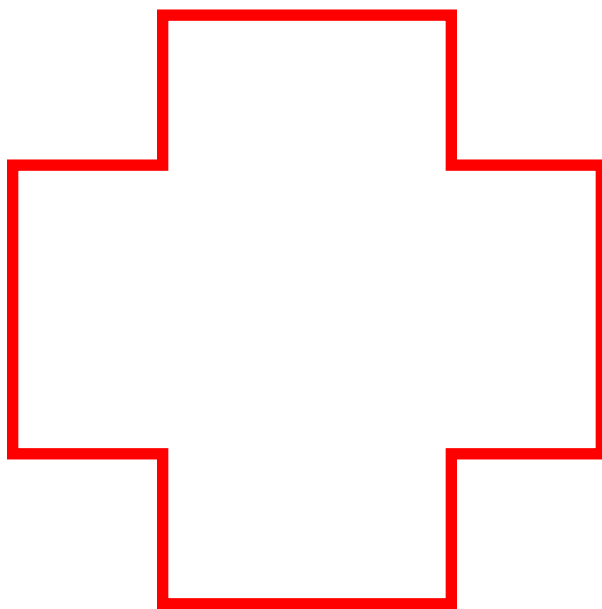
Cut clipboard and cover out. Write answer on cover. Staple cover at the top.

Cut out as one piece. Fold back up on dotted lines. Glue flaps to form pocket.

Have child write a letter as if they had experienced the San Francisco earthquake and store it in the pocket.



Stack and staple. List ways that you can prepare for an earthquake.



Experiment Results



Directions: Cut out file folder book as one piece.
Fold in half.

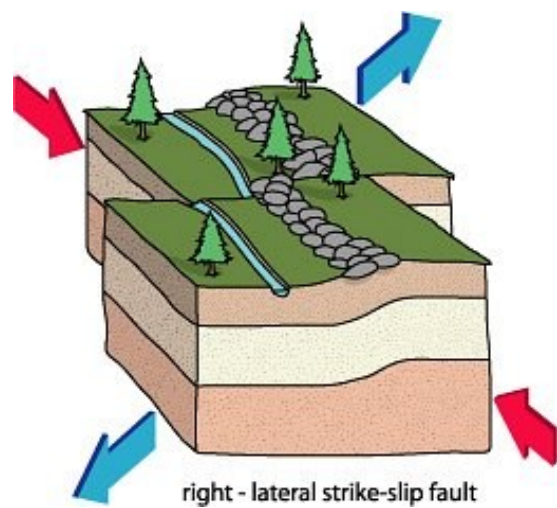
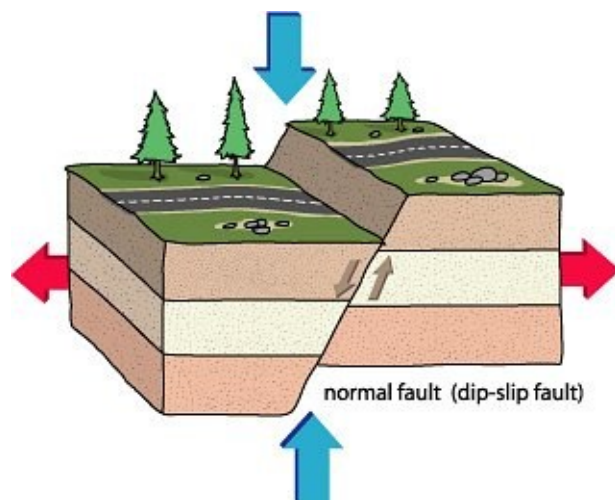
Two Types of Faults



Directions: Cut out cover and pages of this book. Stack together with cover on top and staple on the left side of the book.

Paste images to pages, if desired, and add text.

Strike-slip Fault



Normal Fault

