

Instructional Recipe

What is the Theory of Plate Tectonics?

Grade 9-12

Geology, Oceanography

Cross Curricular Connection: World Geography

Education Service Center Region 20



Online research and information resources available through a partnership between the Texas State Library and Archives Commission, the Texas Education Agency and Education Service Center, Region 20 <http://web.esc20.net/k12databases>

Step 1 – Ask

Objectives: Students will research and describe the historical development of the theories of plate tectonics including continental drift and sea-floor spreading.

Introduction:

For thousands of years, the processes that power the movement of the Earth's continental and oceanic plates were unidentified. As a direct result of continental movement, man has experienced the effects of this movement in the form of earthquakes and volcanic activity. During the 1960's scientists developed the theory of plate tectonics. This theory explains the reason continents move and change our earth's crust.



[Click here](#) to see enlarged imaged with description.

Ask:

- ★ Who discovered plate tectonics?
- ★ How many tectonic plates have been identified?
- ★ What is the Ring of Fire?
- ★ What are divergent plates?
- ★ What is geologic time?

Vocabulary:

- ★ Asthenosphere
- ★ Lithosphere
- ★ Tectonic plates
- ★ Pacific Ring of Fire
- ★ Divergent boundaries
- ★ Convergent boundaries
- ★ Transform boundaries
- ★ Plate boundary zones

TEKS: Geology, Oceanography Science Concepts.

TEKS: 112.49.6.A,B,C

Science concepts. The student knows the processes of plate tectonics. The student is expected to (A) research and describe the historical development of the theories of plate tectonics including continental drift and sea-floor spreading; (B) analyze the processes that power the movement of the Earth's continental and oceanic plates and identify the effects of this movement including faulting, folding, earthquakes, and volcanic activity; and (C) analyze methods of tracking continental and oceanic plate movement.

Cross-Curricular TEKS Geology, Oceanography

TEKS: 113.34.4.B

Geography. The student understands the patterns and characteristics of major landforms, climates, and ecosystems of Earth and the interrelated processes that produce them. The student is expected to: (B) relate the physical processes to the development of distinctive land forms.

Technology Application

TEKS: 126.6.8(A)

(8) Solving problems. The student uses research skills and electronic communication, with appropriate supervision, to create new knowledge. The student is expected to: (A) participate with electronic communities as a learner, initiator, contributor, and teacher/mentor and use technology to participate in self-directed and practical activities in the larger community and society.

Step 2 – Investigate

[Click here for internet links/URLs](#)

K-12 Online Subscription Resources:

From EBSCO: Use search strategies (plate tectonics and Pacific Ring of Fire) (convergent boundaries and plate tectonics) (plate boundary zones and earthquakes)

[Impact of the Earthquake](#). Preview By: Wang Jing. China Today, Jun2008 Supplement, Vol. 57, p24-24, 1p, 1 color; (AN 32109672)

[The Cost of Destruction](#). Preview By: Lan Xinzhen. Beijing Review, 5/29/2008, Vol. 51 Issue 22, p19-19, 3/4p, 1 color; (AN 32507564)

[Earthquake Damage](#). Preview By: Farndon, John. Planet Earth (1-59084-469-6), 2003, p9, 0p; Reading Level (Lexile): **1050**; (AN 9208180)

From Britannica: [Lithosphere: Plates with Hot Spots](#). Online Map/Still. Encyclopædia Britannica Online School Edition, 2008.

[Predicting Earthquakes and Volcanoes](#). Online. Encyclopædia Britannica Online School Edition. 2008.

[Plate tectonics: Theoretical Depiction of Plate Movement](#). Online Art. Encyclopædia Britannica Online School Edition, 2008.

Video clips: [Earthquakes: measuring magnitude and intensity](#); [Earthquake: San Francisco, 1906](#); [Earthquake: S and P waves traveling through the Earth after an earthquake](#);

[Earthquakes: types of seismic waves](#)

Additional Websites: [Maps, Imagery & Publications](#); [Global Visualization Viewer](#); [Earth Explorer](#); [USGS Photographic Library](#); [USGS Photo Gallery](#); [Blogging an Earthquake: China Live](#);

Step 3 – Create

[Click here for internet links/URLs](#)

Read the articles listed in [Step 2](#).

1. Track worldwide earthquake activity for a defined period to distinguish patterns in the earth's crustal activity that will identify the plate boundaries and their different types.
2. Review the [Earthquake: S and P waves traveling through the Earth after an earthquake](#).
3. Review the devastating effects of the [Great San Francisco Earthquake of 1906](#) and then move to a present day earthquake study that includes the 2008 Chengdu, China quake.
4. Use the [U.S. Geological Survey \(USGS\)](#).
5. Investigate and record all earthquakes on the planet above a 4.0 magnitude on the Richter scale. (Look at the [Global Seismic Center](#) map.)
6. Plot the quakes and examine the data for patterns and trends. Do you see a pattern that follows the Ring of Fire? Through these exercises, students will begin to distinguish patterns that follow the "Ring of Fire". Use the [world continents map](#) as a visual reference for the world. ([Other sites to access online maps](#))
7. Use an [interactive Fishbone](#) graphic organizer for this activity to determine the areas that are most affected by earthquake activity.

Technology Link -

- ★ Try a [prediction tree graphic organizer](#) to determine where the next quake will occur.
- ★ More interactive graphic organizers: http://lexiconsys.com/graphic_organizer.html
- ★ [Other sites to access online maps](#); [Global Seismic Center](#)

Step 4 – Discuss

[Click here for internet links/URLs](#)

- ★ Have students identify similarities between the 1906 earthquake and 2008 Chinese. What similarities do the 1906 San Francisco quake and the 2008 China quake have in common?
 - ★ Using the library and K-12 Database resources, set up learning stations for students to study the effects of earthquakes. Explore these links to find more information on the 1906 San Francisco quake:
 - ✚ [How Big Was the Earthquake?](#)
 - ✚ [1906 Seismogram](#)
 - ✚ [Casualties and Damage](#)
 - ✚ [When Will It Happen Again?](#)
 - ✚ [1906 Earthquake Photos](#)
 - ✚ [Eyewitness Accounts](#)
 - ★ Look at the [Regional Maps](#) from the recent quake activity.
 - ★ Discuss the different plate boundaries and have students draw conclusions about the effects of tectonic plate movement.
 - ★ Students will write up the results of the discussion in an online response journal and submit the document to the teacher-hosted wiki space for a grade.
- 🔗 **Technology Link** – Use [Google Earth](#) to see some of the locations with recent seismic activity. Download the free version of Google Earth to see the locations of greatest seismic activity.
- Use [Flickr photostream](#) to see Alaska's Mt. Augustine eruption.

Step 5 – Reflect

[Click here for internet links/URLs](#)

- ★ Read [Understanding Tectonic Plate Motions](#).
 - ★ Once students have completed the assignments of reading and data collection, hold a class discussion about the different types of plate boundaries.
 - ★ Print out a copy of the plate boundaries from the [USGS Plates of the Earth](#) site for each student and also show it on an overhead projector. Students should then compare their earthquake activity map to that of the plate boundaries.
- 🔗 **Technology Link:**
Look at [Earth Through Time](#) Timeline

Internet Links/URLs

Articles may be located by either the accession number (AN) or the persistent URL.

Step 2 – Investigate

- **Impact of the Earthquake**
<http://web.ebscohost.com/ehost/detail?vid=1&hid=6&sid=930331a2-52f1-48c9-82d0-b60fa520e390%40sessionmgr4&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZQ%3d%3d#db=a9h&AN=32109672>
- **The Cost of Destruction**
<http://web.ebscohost.com/ehost/detail?vid=1&hid=6&sid=8cc9c34d-ebcd-4462-a9b7-9bbb65ac4e0a%40sessionmgr4&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZQ%3d%3d#db=a9h&AN=32507564>
- **Earthquake Damage**
<http://web.ebscohost.com/ehost/detail?vid=1&hid=6&sid=dbd5fe8e-02e5-425e-91c6-ed669a05e6c2%40sessionmgr4&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZQ%3d%3d#db=ulh&AN=9208180>
- ***Lithosphere: Plates with Hot Spots***
<http://school.eb.com/eb/art-69411/The-principal-tectonic-plates-that-make-up-Earths-lithosphere>
- ***Predicting Earthquakes and Volcanoes***
<http://school.eb.com/eb/art-94730/How-scientists-gather-their-data-how-they-reveal-the-relationship>
- ***Plate tectonics: Theoretical Depiction of Plate Movement***
<http://school.eb.com/eb/art-49484/Theoretical-depiction-of-the-movement-of-tectonic-plates-across-Earths>
- **Earthquakes: measuring magnitude and intensity**
<http://school.eb.com/eb/art-68349>
- **Earthquake: San Francisco, 1906**
<http://school.eb.com/eb/art-100088>
- **Earthquake: S and P waves traveling through the Earth after an earthquake**
<http://school.eb.com/eb/art-76034>
- **Earthquake: ground movement and seismic waves**
<http://school.eb.com/eb/art-68348>
- ***Earthquakes: types of seismic waves***
<http://school.eb.com/eb/art-68348/Seismic-waves-travel-in-different-patterns-and-at-different-speeds>
- **Maps, Imagery & Publications**
<http://www.usgs.gov/pubprod/maps.html>
- **Global Visualization Viewer**
<http://glovis.usgs.gov/>
- **Earth Explorer**
<http://edcns17.cr.usgs.gov/EarthExplorer/>

- **USGS Photographic Library**
<http://libraryphoto.cr.usgs.gov/>
- **USGS Photo Gallery**
<http://gallery.usgs.gov/>
- **Blogging an Earthquake: China Live**
<http://web.ebscohost.com/ehost/detail?vid=1&hid=3&sid=ae720f48-7af5-4a26-b684-363a68fb8046%40sessionmgr10&bdata=JnNpdGU9ZWZWhvc3QtbGI2ZQ%3d%3d#db=a9h&AN=32038147>

Step 3 – Create

- **Earthquake: S and P waves traveling through the Earth after an earthquake**
<http://school.eb.com/eb/art-76034>
- **Earthquake: San Francisco, 1906**
<http://school.eb.com/eb/art-100088>
- **U.S. Geological Survey (USGS)**
<http://earthquake.usgs.gov/eqcenter/recenteqsww/>
- **Global Seismic Center**
<http://school.eb.com/eb/art-72282>
- **World continents map**
http://www.eduplace.com/ss/maps/pdf/world_cont.pdf
- **Other sites to access online maps**
<http://nationalmap.gov/gio/viewonline.html>
- **interactive Fishbone**
<http://www.readwritethink.org/materials/venn/>
- **prediction tree graphic organizer**
http://lexiconsys.com/graphic_organizers/predictionIndx.html
- http://lexiconsys.com/graphic_organizer.html
- **Other sites to access online maps**
<http://nationalmap.gov/gio/viewonline.html>
- **Global Seismic Center**
<http://school.eb.com/eb/art-72282>

Step 4 – Discuss

[online response journal](#)

- **How Big Was the Earthquake?**
<http://earthquake.usgs.gov/regional/nca/1906/18april/howlong.php>

- **1906 Seismogram**
<http://earthquake.usgs.gov/regional/nca/1906/18april/seismogram.php>
- **Casualties and Damage**
<http://earthquake.usgs.gov/regional/nca/1906/18april/casualties.php>
- **When Will It Happen Again?**
<http://earthquake.usgs.gov/regional/nca/1906/18april/whenagain.php>
- **1906 Earthquake Photos**
<http://www.sfmuseum.net/1906/photos.html>
- **Eyewitness Accounts**
<http://www.sfmuseum.org/1906/ew.html>
- **Regional Maps**
<http://earthquake.usgs.gov/eqcenter/recenteqsww/>
- **Google Earth**
<http://earth.google.com/>
- **Flickr photostream**
<http://www.flickr.com/photos/daveinak/sets/72057594048555926/>

Step 5 – Reflect

- **Understanding Tectonic Plate Motions**
<http://pubs.usgs.gov/gip/dynamic/understanding.html>
- **USGS Plates of the Earth**
<http://geomaps.wr.usgs.gov/parks/pltec/pltec2.html>
- **Earth Through Time**
<http://wrgis.wr.usgs.gov/parks/pltec/sc650ma.html>

Earthquake Recording Data Sheet

Student _____

Date _____ Period _____

Earthquakes recorded in the past 7-30 days.

Date (yyyy/mmm/dd)	Time (hh/mm)	Latitude/Longitude (Degrees)	Depth (KM)	Magnitude	Location

Teacher's Note: