Helping Kids Learn – Post #21 4/6/21 **See also companion lesson Post #23**

STEM: Science – Earth & Space Sciences

If you were asked what makes up Earth, you might answer land and water, or mountains, valleys, rivers and oceans. While all of those answers describe features of Earth, ***tectonic plates*** are what makes up our planet. These investigations will help you learn more. It can be adapted for various ages and levels of preparation. See **Lift the Level** for suggestions.

Be an Geologist – Studying Tectonic Plates

Picture a soccer ball in your mind. If the ball were Earth, the black and white pentagons would represent the tectonic plates – except the plates aren't so nicely shaped and they are constantly *moving!* Where two of the pentagons meet on a soccer ball, there's a seam. Two tectonic plates meet at a *plate boundary.*

There are three kinds of tectonic plates: convergent (subductive), divergent (rifting), and side-slipping (transforming). The names describe the way the plates move at their boundaries. You can model the movement of the three types with just two hands.

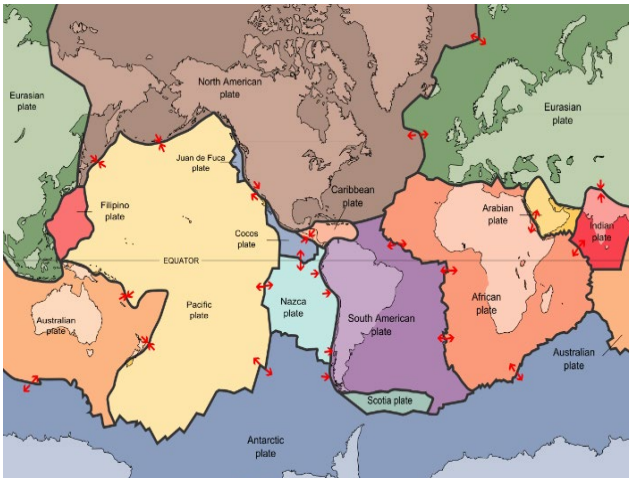
Picture 1

Investigation 1 Convergent Plates - Subduction Hold your hands flat in front of you with the palms facing down as in Picture 1. Where your thumbs touch is the boundary between your hand "plates". Press the sides of your thumbs together, pushing your left hand under your right hand so your right thumb is now completely on top of your left one.

Investigation 2 Divergent Plates – Rifting Hold your hands as in Picture 1 on a flat surface. This time, move your hands apart. Imagine that the space between your hands is filled in with rocks and other material from the crust below the Earth's surface.

Investigation 3 Side-slipping Plates – Transforming Hold your hands as in Picture 1 again. Hold your right hand still and move your left hand closer to your body and then farther away so your left thumb slides along your right thumb. This mimics the *transforming* movement at the plate boundary.

Huge amounts of *potential energy* are stored in the Earth and released when plates move. There is a very close relationship between certain plate movements and the occurrence of volcanoes, tsunamis, and earthquakes. The map shows a simplified view of the principal tectonic plates. Red arrows show direction of plate movement at tectonic boundaries. Continents are in pale outline on the plates.



Derived from: Tectonic plates.png, Public Domain, https://commons.wikimedia.org/w/index.php?curid=535201

Investigation 4 Identifying Plate Boundaries 1. Find and label each kind of plate movement on the map using the letters **C, D,** and **S.**
2. What do you notice about the Nazca Plate off the west coast of South America? Is it unique (the only one that has this characteristic)?

Where's the Science?

Investigation 1 Subduction causes one plate to thrust upward as the other plate is forced under. Tremendous pressure builds up before subductions occur. The resulting release of energy is explosive, causing mountain ridges to form, earthquakes and tsunamis to occur, and volcanoes to erupt. It's also important to keep in mind that although your thumbs are smooth surfaces, plate boundaries are anything but – they are comprised of giant rocks and other geologic features that grind and strain.

Investigation 2 Rifting causes an expansion of the Earth's surface with the formation of new land at the divergent plate boundary. Iceland's Thingvellir National Park is located at the divergent plate boundary between the North American and Eurasian plates. Rifting causes new land to form, water to change course, and triggers earthquakes and volcanic eruptions.

Investigation 3 In the United States, we are aware of the energy release in the form of earthquakes resulting from side-slipping at the boundary of the North American and Pacific plates – the San Andreas fault. If you repeat Investigation 3 using a lot of force, you can begin to appreciate the energy release that occurs.

Lift the Level

You can make this lesson deeper and/or suitable for older students by any of the following. **STEM Online** may help you find explanations.

1. Different forces are at work in the three kinds of plate movements. Explain.
2. Energy is transferred during a plate movement. Use mathematics to explain the potential energy stored in the plates and its change to kinetic energy.
3. Heat is also an essential factor in tectonic movement. Explain.
4. The Thingvellir area in Iceland is historically as well as geologically important. Research the political history of Thingvellir and create a slide show about what you learn.
5. People in various branches of geology study plate tectonics: geodynamicists, structural geologists, seismologists, vulcanologists, and geophysicists to name a few. Research at least 3 careers that involve the study of plate tectonics and create an advertisement to share with your classmates or family.
6. Different plates are made of different rocks and other materials. Make a chart showing the composition of the crust at each of the three types of plate boundaries.
7. Explore what measures people are taking to prevent or mitigate the effects of earthquakes or volcanoes. Then design a solution of your own.
8. Research early warning systems for detecting plate movement and describe your improvements.

9. Ecosystems along plate boundaries vary greatly. Describe and explain the different ecosystems and answer the question: Are the ecosystems similar for divergent plate boundaries around the globe?
10. Can you find any evidence that human activity near plate boundaries has any impact on their motion? You might consider the San Andreas Fault, for example.
11. Earthquakes can occur away from plate boundaries. Some are felt and do damage. They make the news. Others (typically below magnitude 2.0 on the Richter Scale) are not felt or do minimal damage. We seldom hear about them. In Oklahoma, for example, in the period from March 6, 2021 to April 5, 2021 there were 2 earthquakes of magnitude 3.0 or greater, 80 of magnitudes between 2.0 and 3.0, and 123 below magnitude 2.0.[1] Report on your research to learn if this quantity is typical and to what the quakes may be attributed.

[1]Source: https://www.volcanodiscovery.com/earthquakes/oklahoma.html

STEM Online

These are suggestions only and no endorsement is implied. Although they have been screened for appropriateness before posting, adults should vet the websites children use, as they may change over time.

Earthquakes https://earthquake.usgs.gov/earthquakes/map/?extent=11.95335,-148.44727&extent=57.79794,-41.57227, https://simple.wikipedia.org/wiki/Earthquake, https://simple.wikipedia.org/wiki/Richter_scale

Tectonics https://en.wikipedia.org/wiki/Plate_tectonics, https://www.thingvellir.is/en/history-nature/nature/continental-drift/, https://www.iris.edu/hq/inclass/animation/what_are_the_forces_that_drive_plate_tectonics, https://www.worldatlas.com/articles/what-causes-tectonic-plates-to-move.html, https://www.thegreatcoursesdaily.com/the-movement-of-plates-plate-tectonics-mechanism/, https://www.preceden.com/timelines/71083-plate-tectonics-theories-and-scientists, Quizlet on plate tectonics: https://quizlet.com/264605236/plate-tectonics-flash-cards/

Thingvellir, Iceland https://en.wikipedia.org/wiki/%C3%9Eingvellir, https://guidetoiceland.is/connect-with-locals/jorunnsg/ingvellir-national-park

NJ Student Learning Standards

Science: Physical Science K-PS2-1, K-PS2-2; 3-PS2-1; 4-PSS3-3; 5-PS1-3; MS-PS2-1; HS-PS2-3, HS-PS3-2

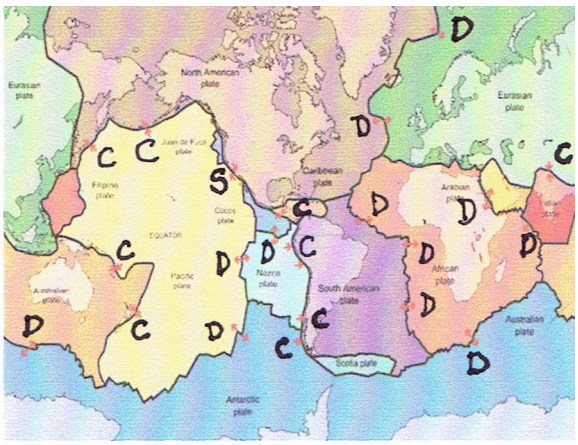
Life Science HS-LS2-7

Earth & Space Science 2-ESS1-1, 2-ESS2-2; 3-ESS3-1; 4-ESS1-1, 4-ESS2-2, 4-ESS3-2; 5-ESS2-1; MS-ESS2-2, MS-ESS2-3, MS-ESS3-1, MS-ESS3-2; HS-ESS1-5, HS-ESS2-1, HS-ESS3-4, HS-ESS3-6

Engineering Design K-2-ETS1-1; 3-5-ETS1-2; MS-ETS1-2; HS-ETS1-1

Solutions

Investigation 4



1. See letters on the map.
2. The Nazca Plate has more than one type of plate boundary: Convergent and Divergent. No, it is not unique. Look at the Pacific Plate, for example, which has all 3 types.