

# Plate Tectonics & Earthquake Safety

## HASPI MS Medical Earth Science Lab 03

MS-ESS1-1, MS-ESS2-2, MS-ESS2-3



### Introduction

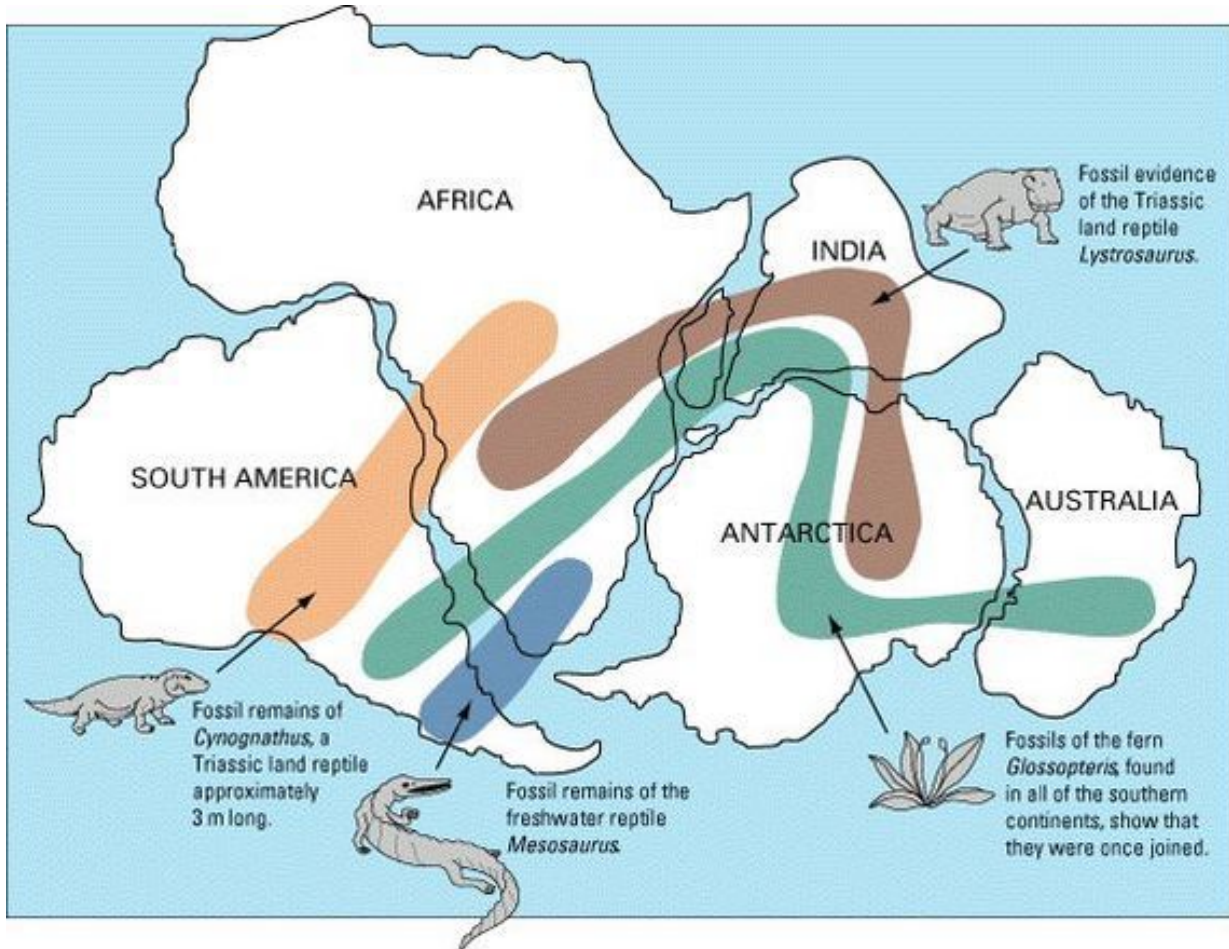
#### Tectonic Plates

While we don't always feel it, the surface of the Earth is in constant motion. The Earth is actually made up of layers starting at the central core, and moving out to the mantle and crust. Parts of the Earth are fluid, called the **asthenosphere**, which allows the upper mantle and crust, called the **lithosphere**, to move. The lithosphere is actually made up of floating plates, called **tectonic plates**. There are 8 major plates and multiple smaller plates. It is hypothesized that tectonic plates are able to move because of a combination of density differences, seafloor spreading, gravity, and the rotation of the Earth.



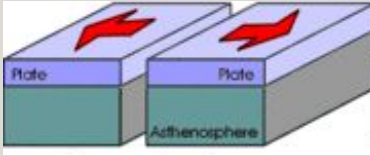
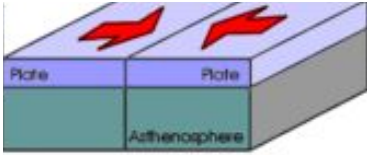
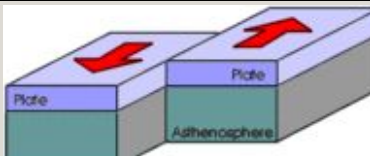
Plates have been on the move throughout Earth's history. **Continental drift** is the theory that the continents have drifted greatly throughout time, and will continue to do so. The distribution of fossils and rocks, continental shapes, and seafloor structures such as trenches and mountains provide evidence of continental drift. The diagrams below demonstrate how the shapes of the continents are complimentary as well as how the distribution of certain fossils indicate that the continents were once connected.

[http://www.dailygalaxy.com/my\\_weblog/2011/07/new-force-driving-earths-tectonic-plates-discovered.html](http://www.dailygalaxy.com/my_weblog/2011/07/new-force-driving-earths-tectonic-plates-discovered.html)



## Plate Motion

The area where tectonic plates meet is called a **boundary**, and it is here where most of the movement and changes to the Earth's surface related to tectonic plates occurs. There are three different types of boundaries. The table below summarizes plate boundaries, locations where these boundaries exist, and what commonly occurs at each.

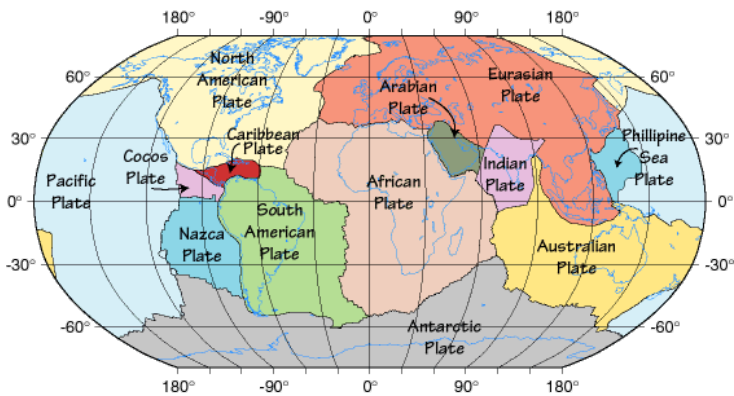
| Plate Boundary | Description                             | Diagram   | Examples   | What Occurs Here?   |
|----------------|---|---|--|---|
| Convergent     | Plates slide towards one another        |  | Cascade Mountains, Alps, Marianas trench                       | Subduction zones, trenches, volcanoes, earthquakes                                |
| Divergent      | Plates slide away from one another      |  | Mid-Atlantic Ridge, East African Rift, East Pacific Rise       | Sea floor spreading, rifts, ocean basin formation, volcanoes, shallow earthquakes |
| Transform      | Plates slide or grind along one another |  | San Andreas Fault, East Pacific Ridge, Ascension Fracture Zone | Strong earthquakes  |

<https://ehsgeowiki.wikispaces.com/file/view/boundaries.jpg/32572271/348x212/boundaries.jpg>

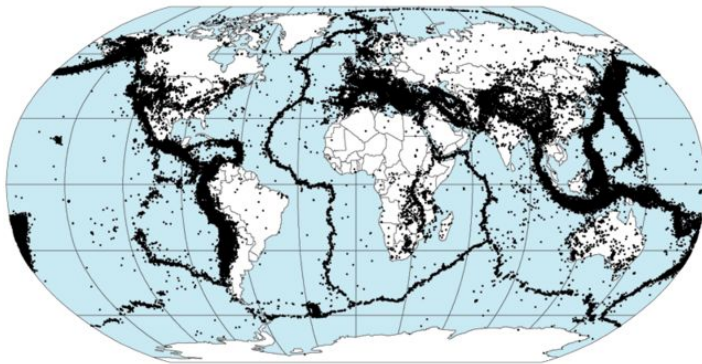
## Earthquakes & Earthquake Safety

An **earthquake** is the sudden shaking of the ground caused by the movement of tectonic plates or volcanic activity. Earthquakes can be minor, only lasting a few seconds and cause little to no damage, or they can be major and cause complete destruction. You may not even feel some earthquakes, while others will throw you to the ground. When tectonic plates move, energy is suddenly released. The exact location where the earthquake occurs underground is the **focus**, the location on the surface of the earth is called the **epicenter**, and the energy radiates out from the epicenter are called **seismic waves**.

These waves can be measured as **seismic activity**, which can provide information about the frequency, size, and type of earthquakes that occur in an area. Earthquakes are then rated on a scale, most commonly the moment magnitude or Richter magnitude scale, which ranges from 1 – 10. A magnitude 2 to 3 earthquake may not be felt, while a magnitude 6 to 7 may cause damage, and a magnitude 8 to 9 can result in serious destruction. Notice the similarity in location of plate boundaries on the image to the left, and the black dots that indicate earthquake epicenters on the right.



Preliminary Determination of Epicenters  
358,214 Events, 1963 - 1998



[http://eqseis.geosc.psu.edu/~cammon/HTML/Classes/IntroQuakes/Notes/Images\\_specific/plates.gif](http://eqseis.geosc.psu.edu/~cammon/HTML/Classes/IntroQuakes/Notes/Images_specific/plates.gif)

There are many health hazards associated with earthquakes. Millions of people are at risk from earthquake related hazards due to that fact that many highly populated cities are built atop of fault lines. As of 2015 the population of Tokyo was approximately 38 million, New York more than 20 million, and Los Angeles over 10 million; all of which are located on fault lines. Populated areas with poorly built structures cannot withstand the energy produced by earthquakes, which can result in mass casualties and injuries. From 2000-2010 earthquakes resulted in more than 780,000 deaths, which accounted for nearly 60% of all deaths related to disasters. The following list summarizes some of the common health risks that have been found to be associated with earthquakes:

- Death
- Internal bleeding and sepsis
- Fractures and lacerations
- Respiratory distress
- Interruption of medical facilities and care
- Lack of care or medication for chronic diseases (diabetes, heart conditions, etc.)
- Crush injuries that result in kidney failure
- Rise in infectious diseases, such as flu and cholera, due to overcrowding and unsanitary conditions
- Post traumatic stress and mental health issues
- Rise in heart attacks, arrhythmias, and blood pressure



<http://www.aidi.org/wp-content/uploads/4.29.15-Bhaktapur-Nepal-earthquake-destruction-4-Photo-Natalie-Hawwa-USAID-OFDA.jpg>

## Review Questions

1. What is the difference between the asthenosphere and the lithosphere?
2. What are tectonic plates and how do they move?
3. What is continental drift?
4. Why do scientists believe continental drift has occurred? Give at least 2 examples.
5. Explain how fossil remains on different continents supports the theory of continental drift.
6. What is a boundary?
7. Compare and contrast convergent, divergent, and transform boundaries.
8. What is an earthquake?
9. Draw a diagram and label the focus, epicenter, and seismic waves of an earthquake.
10. What is seismic activity, and how can it provide information on the magnitude of an earthquake?
11. What can be said about the location of plate boundaries, and the location of earthquake epicenters?
12. Why are so many people at risk from earthquake-related health hazards?
13. List 3 health risks associated with earthquakes. For each risk, hypothesize why an earthquake could cause it.