

Plate Motion, Earthquakes and Vectors or CRASH BOOM BANG!

Objectives:

- To use inquiry and discovery methods to determine the possible motion of tectonic plates and thereby, two sides of a fault.
- To use vectors to describe the motion of faults.
- To develop an understanding of right angles.
- To use vector addition to understand how fault motion can be described (advanced).

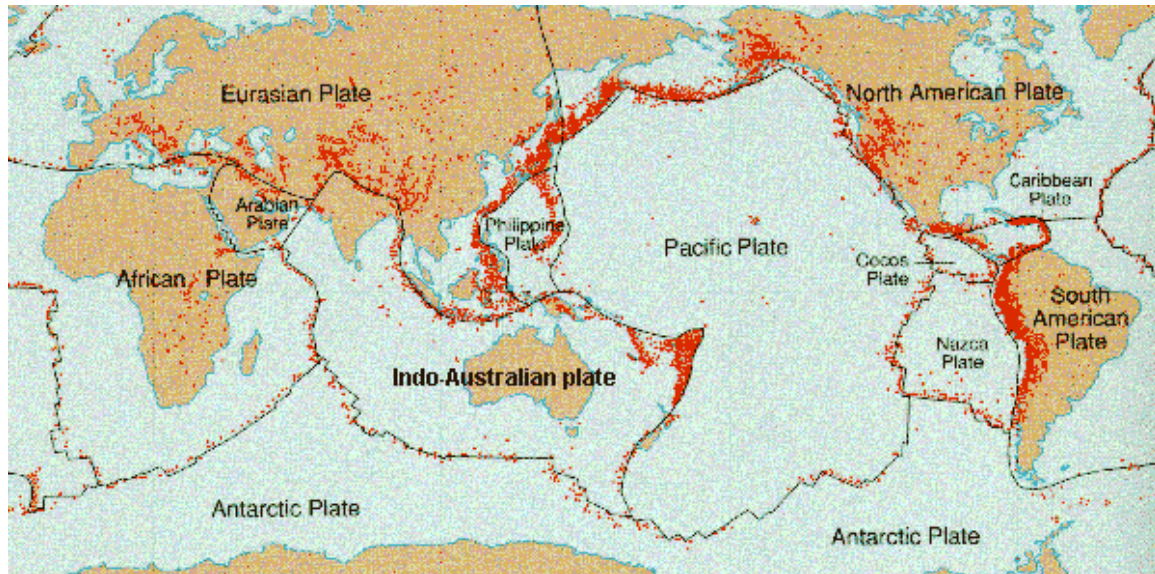
Standards:

- Science (5-8/9-12):
 - Science as Inquiry: Abilities necessary to do scientific inquiry
 - Physical Science: transfer of energy and interactions in energy and matter
 - Earth and Space Science: Energy in the earth system
 - Science in Personal and Social Perspectives: Natural hazards
- Math (9-12)
 - Number and Operations: Understand vectors and matrices as systems that have some of the properties of the real-number system
 - Connections: Recognize and apply mathematics in contexts outside of mathematics

Background:

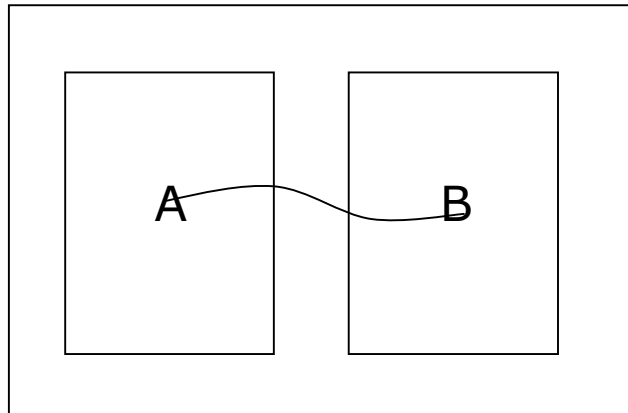
The surface of the Earth is covered in a thin shell called the lithosphere, which is broken into many pieces that are all slowly moving across the surface. These moving pieces are called plates. Each plate is defined by its edges, which are moving past other plates. The lithospheric plate can consist of ocean and continent, just ocean, or just continent. An important note is that the continents and oceans don't actually tell us where the edges of the plates are! So how can we tell where the edges of the plates are if the edges of continents and oceans don't always mark them? Because they are solid rock when these plates slide past each other they grind and pop...creating earthquakes! This is one of the main ways that scientists can tell where the edge of the plates are; since the plates are solid, the most earthquakes should occur where they are moving past each other. You can see on the map below that the earthquakes (shown as little dots) outline the plates.

<http://www.cessind.org/images/images/earthquakeglobal.gif>

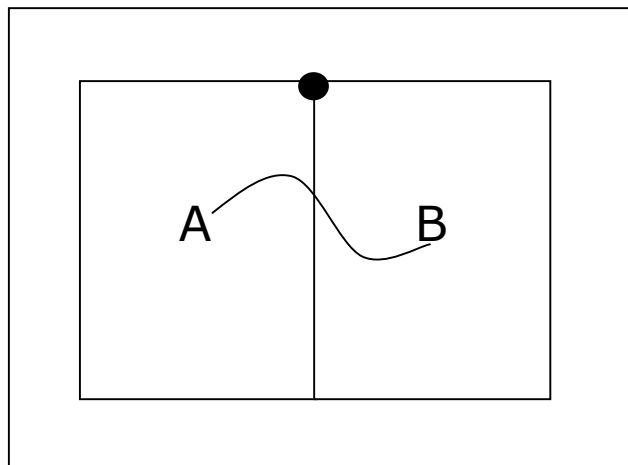


Classroom Activity:

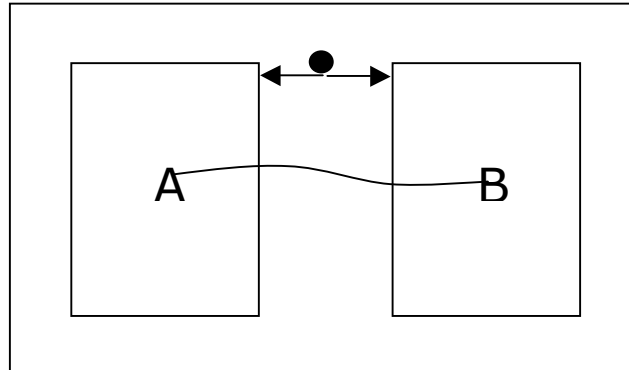
Set-up Each student should have two index cards lying flat on the table on top of a piece of blank paper next to each other with a rubber band that has been cut in half taped (or otherwise affixed) between the cards, when the cards are pulled apart the band should be 2 inches long. One plate should be labeled A and the other B.



Activity One: Describing the motion between plates Have each student start with their two plates side-by-side on the desk with the center edges lining up with a dot on the surface of the paper.



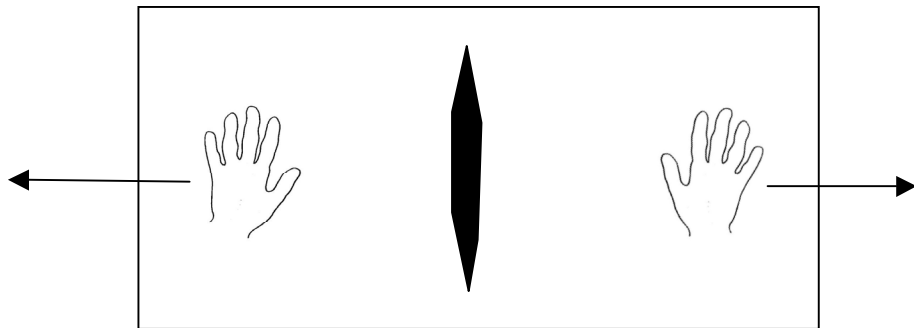
Test One Now have each student gently pull the two cards apart. Ask the students to describe in their own words how the cards are moving relative to each other (how did B move relative to A?) what happened to the rubber band? To help them visualize have them draw arrows from the dot to the top inside corner of each card. This is a good time to start the discussion of what a vector is.



In geology we call this motion between plates “divergent” or “extensional”. Use this opportunity to discuss what these words mean and why scientists use these words to describe this motion.

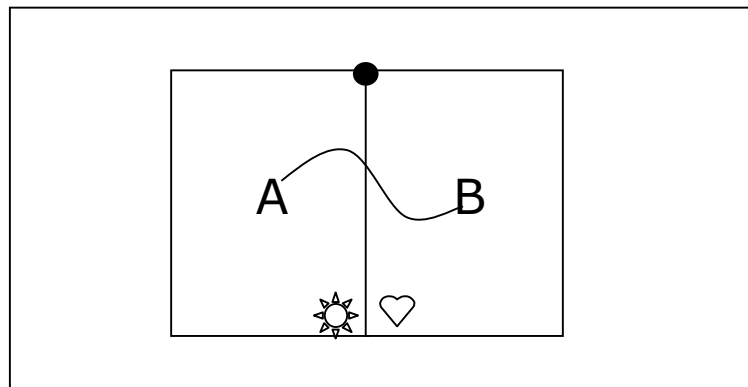
Why would this cause an earthquake? It is sometimes hard to understand how moving two plates apart could cause an earthquake. The key is that when the plates are together they get stuck to each other, thus when you pull them apart it is like pulling a brownie or muffin apart, only instead of soft dough cracking and tearing it is rock! Rock tearing releases energy and causes earthquakes! If your students want a demonstration have each student take a separate piece of paper and make a slit in the center that doesn't reach

either end, then put the paper flat on the table and pull it apart. It should tear audibly, instead of sound waves though rock tearing releases earthquake waves!



Test Two Have the students return the cards to their original position. This time they should mark the edge of the bottom of the cards where they meet with a symbol of their choosing.

Now the students should push the B card over the



A card and observe what happens to the rubber band. Ask the students to describe in their own words how the cards are moving relative to each other (how did B move relative to A?) What happened to the rubber band? In geology this is called a "convergent boundary".