Module Plate Tectonics: Investigating Plate Boundaries

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Introduction: The rigid outer shell of Earth, called the lithosphere, floats on a softer partially fluid layer of Earth’s mantle called the asthenosphere. Earth’s outer shell has layers that behave by breaking or stretching. The rigid lithosphere is cracked and broken like the shell of a hard-boiled egg. These curved pieces of the outer shell move around on the asthenosphere as the interior of the earth moves via convection through heating in the earth’s interior (*pressure and radioactive decay*) and slab-pull at subduction zones. The upper most part of the plates is called the crust. There are two types of crust: continental (granitic) crust and oceanic (basaltic) crust. These crusts collide and form three types of convergent plate boundaries. The question this lab will answer is: Why do these boundaries behave the way they do?

**Preliminary Questions –** Answer orally with your partner.

* 1. What is the outer shell of the Earth called?
  2. Describe the process of how the outer shell moves?
  3. What drives the movement of the interior of the Earth?
  4. What is the partially molten layer on which the plates move called?

**Materials:** ▪ Foam (2) ▪Wood (2) ▪Sponge (1) ▪Aluminum Foil (2 pieces) ▪Graduated Cylinder ▪Displacement Container ▪Triple-Beam Balance **▪**2 samples of Granite and Basalt

**Procedure:**

Using foam, wood, sponges, aluminum foil and a box of water, we will explore the nature of how things float and become familiar with the movement of the Earth’s tectonic plates. You and your partner will complete all Parts of this Module. Record all your answers and lab write-up on paper.

**Predictions**

1. Place the three materials presented in order from most to least buoyant. Record your prediction.
2. Do you think foam, wood or sponge with float the highest? Lowest?

**Part 1:** Place the foam, wood and sponge in the box of water to determine which floats the highest and lowest.

1. Were your predictions correct? Explain
2. In our model of the Earth which materials would represent the lithosphere? The asthenosphere?

**Part 2:** Use the floating materials to determine the various ways that pieces of lithosphere can interact.

1. What happens when you push the sponge and the foam together? What type of plate boundary does this represent? What feature would form at the surface at this type of boundary?
2. What happens when you push two pieces of foam or wood together? What type of plate boundary does this represent? What feature would form at the surface at this type of boundary?
3. Another way that plates can interact is by moving away from each other. What is this process called? When plates move apart what material fills the space between them?

**Part 3:** Using two pieces of aluminum foil, roll one into a ball and make a boat out of the other. First put the ball on the water and observe what happens, then place the boat on the water and see what happens. Finally, load your boat with some marbles and see what happens.

1. Why does the aluminum foil behave differently in its two different shapes?
2. Why can a metal ship float in water?
3. When you load a boat what happens to it? What about when you unload it?
4. List two ways continents can be loaded. How would it change the behavior at plate boundaries?

Part 4: Density of Oceanic Crust compared to Continental Crust.

# **Purpose:** On Part 4 you will compare the density of two different types of crust (2 samples of each) and analyze how they behave when they collide.

# **MASS ÷ VOLUME = DENSITY**

(grams) (ml) g/ml

**Procedure:** (Determine the density of the two rocks that make-up the Earth’s crust).

1. Read through the procedure and develop a data table to collect data outlined in procedure.
2. Weigh each rock provided using the triple-beam balance. Record the weight of the rock in grams to the nearest 0.1 grams in the data table.
3. Place the same rock into the displacement cylinder. Measure the amount of water displaced using a graduated cylinder. Record the volume of the rock to the nearest 0.1 ml in the data table.
4. Repeat this procedure for each rock sample and record all trials in the data table. You should have two samples of granite and two samples of basalt.

**Analysis:**

1. Calculate the density for each trial of each rock and record in analysis section.
2. Average the densities for both rocks of granite and then average the densities for both rocks of basalt. Record and label these densities in the analysis section.

**Conclusion questions: All answers need to be in a complete sentence.**

1. Compare the average densities of the two types of rocks.
2. Which type of rock would you expect to subduct at a trench? Why?
3. If two oceanic plates of different ages collided, which one (younger or older) would subduct under the other and why?
4. Why is there no subduction at convergent Continental-Continental Plate Boundaries?
5. Write out two quality “why” questions about this lab (based on average densities, your data, the appearance of the rocks, or anything related to the lab). These should be questions that you don’t know the answers to. You do not need to answer your questions.