



Beavertail Geology



Isostasy

What comes to your mind when you think about floating? Perhaps yourself in an inner tube on a lake or pool? Probably the last thing you would think of would be a rock or mountain.

But life is strange. Floating or sinking depends on the *density* of the object and the density of the surrounding fluid. Here are three simple rules:

Objects that are less dense than the surrounding fluid will float.

Objects that are more dense than the surrounding fluid will sink.

Objects whose density is equal to that of the surrounding fluid will drift weightlessly between surface and bottom.

Note that no rule mentions anything about water or inner tubes! It happens that mountains and all of the continents of the world are less dense than the underlying fluid mantle of Earth. According to the rules above, that means that mountains float on the mantle.

Activity Overview

In this activity, you will explore the relationship between the height of a mountain and its depth into the mantle below. You will use a fish tank and wood blocks to explore the concept of *Isostasy* (I-sos-ta-see).

Materials

Newspaper

Fish tank half-filled with water

4 wood blocks

Plastic metric ruler

Instructions

First read all of the steps and think through what you are going to do. Now you are ready to begin.

1. Gather all of the materials that you'll need.
2. You will be taking measurements as the activity progresses. Set up a data page so that you can accurately record these readings. Divide your data page into four sections. Label the sections "One block", "Two Blocks", "Three Blocks", and "Four Blocks." In each section provide a place for "Height above water" and "Height below water."
3. Be certain to take all measurements in millimeters! You'll make easy calculations very much more difficult and error-prone if you use English units.
3. Measure and record the thickness of any block. They're all the same.
4. Place the first block in the fish tank. Measure and record the following:
 - The height of the top of the block above the water.
 - The depth of the bottom of the block below the water.
5. Carefully place a second block on top of the first. Take and record the same measurements for the pair of blocks as you did in Step 4.
6. Add a third block to the growing stack and repeat the measurements for all three blocks.
7. If you can balance a forth block on the stack, again record the measurements for four blocks. You may find that four blocks are just too tippy to take

good measurements.

Calculations

1. Find the percentage of the first block above the water:
 - Divide the height above water of the first block by the thickness of the block.
 - Shift the decimal two places to the right.
 - Round off to the nearest whole number.
2. Now find the percentage of the block below the water. Use the below-water measurement and the same process that you used in Step 1.
3. Repeat both calculations for the two block test, the three block test, and the four block test (If you were able to float four blocks). **Important** - divide by the total thickness of the blocks in each set of calculations.

Observations

Examine the percentage heights above water of the one, two, three, and four block test. Are they very different or fairly close?

Examine the percentage depths below water of the one, two, three, and four block test. Are they very different or fairly close?

Conclusions

For a given material, in this case wood, what can you say about the percentage of its thickness that stands above the fluid that it is floating in?

For a given material, in this case wood, what can you say about the percentage of its thickness that extends below the fluid that it is floating in?

The Rocky Mountains are the highest mountains in the continental United States. What can you say about the underside of these mountains compared to the underside of the Plains States?

The Appalachian Mountains were once as tall as the Rockies, but have since eroded to a much lower height. What can you say about the change in the underside of these mountains as they have eroded?

Words to Know and Understand

Crust - The outermost layer of Earth.

Density - The ratio of the weight of an object to its volume.

Isostasy - The floating balance of different pieces of Earth's crust over Earth's mantle.

Mantle - The plastic Earth layer under the crust. The mantle behaves like a fluid over millions of years.

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