SEDIMENTARY SUCCESSIONS IN A BOTTLE

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Have you ever looked at a cliff or a road cut and noticed layers of sedimentary rocks? Some layers are made up of very fine grains, while others might be made up of big boulders mixed together with sand. This layering of rocks is known as a sedimentary succession. In this activity we will look at what kinds of processes can cause this kind of layering in a fun and edible way.

Equipment needed

- 12-16 oz Clear plastic bottles
- funnels
- sand
- gravel (colored aquarium gravel works well)
- Powdered clay or other very fine grained material like Portland cement
- Colored water

Background:

A sedimentary environment is an area of the earth's surface where sediment is deposited. It can be distinguished from other areas on the basis of its physical, chemical, and biological characteristics. Some examples of sedimentary environments include rivers, floodplains, alluvial fans, lakes in humid and arid climates, reefs and the deep sea. Our activity today will focus on the sedimentary environment that you might find around an ocean beach.

Imagine you are standing on the beach, the ocean waves are just a few feet away.

1. What material are you standing on? Sand
2. Where has the sand come from? Rivers and streams bring material from inland.
3. Why is the sand all the same size? The waves sort material, breaking up the bigger rocks into small pieces, and also carry away the fine material out to sea where it is laid down in deep water.

➢ Pour a good layer of sand into the bottom of your bottle. This represents the sand that you are standing on. Mark on the outside “Beach”

Imagine that sea level starts to rise and you do not move from the spot you’re standing. Pretty soon the ocean surface is several hundred feet above you (we’re also imagining that you can breathe underwater!)

1. What material are you standing on now? Mud or silt

2. Why is there only fine-grained material here? Because only the small particles stay suspended in water and make it out this far. The heavier particles (e.g., sand) sink closer to the shoreline.

➢ Put a layer of Portland cement or powdered clay onto the sand layer. This represents the mud and silt that you are standing on. Mark on the outside "sea floor"

Now, imagine that the sea retreats, and again you don't move. You are back to standing on the beach.

1. What material are you standing on? Sand

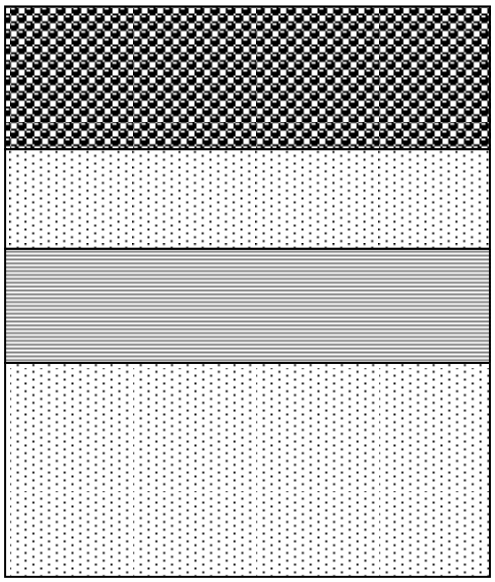
➢ Put another layer of sand in your bottle. This represents the sand that you are standing on. Mark "beach" on the outside of the bottle

Now, let's suppose that the sea level keeps falling, and now the ocean is several hundred yards away but you still haven't moved.

1. Where are you standing now? Maybe you are standing in or near a river that brings sediment into the ocean.
2. What kinds of materials do you see around you? Sand, gravel, rocks, plant debris.
3. What sizes and shapes are these materials? All sizes.

➢ choose from the selection of materials in front of you that best represents the kind of sediments that you see.

Let's look at your cup from the side. What kind of layering do you see? It should look something like this:



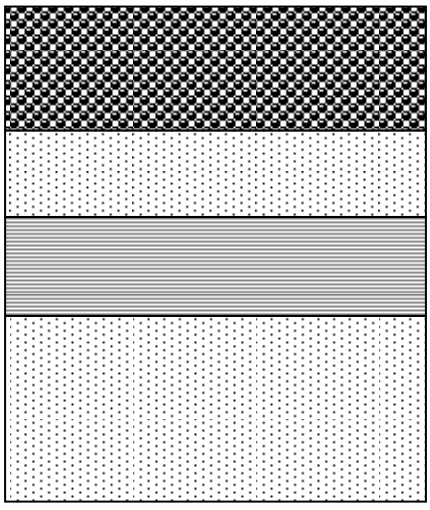
If you gently jiggle your cup you can see that all the cereal is loosely packed and is not bound together in a solid mass like we see in a cliff. **Lithification** is the process by which loose, unconsolidated accumulations of sediment actually becomes a consolidated rock. It involves compaction of sediment and usually the binding together of particles by **cement**, the glue of sedimentary rocks. Calcite, silica (quartz), and iron oxides are common cements.

We can compact our sediments by adding more weight to the top. In natural systems this happens as more and more sediment is piled on top so that the bottom layers are squeezed together. In this experiment, we are going to try and press down from the top and compact our sediment column.

The minerals that make up the cement are usually dissolved in the groundwater (like salt dissolved in seawater) that percolates through the sediments. If you have ever been in a cave, perhaps you have seen how mineral rich water can form stalactites or stalagmites. As the mineral-rich water flows through the sediments, deposits of calcite, quartz, or other minerals, are left behind, cementing the rock together.

We are going to use colored water to demonstrate how a mineral-rich fluid gets in-between all the grains. Slowly pour the water in and watch as it penetrates throughout the bottle.

The process of lithification converts unconsolidated sands, muds, and gravels into sandstone, mudstone, and conglomerate. In the case of our sedimentary succession we now have:



You can continue to build your model by imagining changing environments. For example, what happens if you have a flash-flood? What kinds of materials might you find? What about a long drought? Where might you find fossils preserved?