SEDIMENTARY SUCCESSIONS IN A CUP

STANDARDS

See summary of National Science Education Standards.
Original: http://books.nap.edu/readingroom/books/nses/

Standard Concept	General standard	Specific standard	General standard	Specific standard	General standard	Specific standard
Grade Level		K-4		5-8		9-12
Science as inquiry (A)	Abilities … to do … inquiry	A.1.4.1	Abilities … to do … inquiry	A.1.8.4	Abilities … to do … inquiry	
		A.1.4.2				
	Understandings about … inquiry	A.2.4.2	Understandings about … inquiry	A.2.8.1	Understandings about … inquiry	
				A.2.8.5		
Physical Science (B)	Properties of … materials	B.1.4.2				
Earth Science (D)			Structure of Earth system	D.1.8.3		
				D.1.8.4		
			Earth's History	D.2.8.1		
	Changes in Earth and Sky	D.3.4.1				

SEDIMENTARY SUCCESSIONS IN A CUP

INTRODUCTION

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 the types of processes can cause this kind of layering in a fun and edible way.

OBJECTIVE

Students will become familiar with sedimentary succession by modeling the processes using food.

MATERIALS (for each group or individual making the model)

- 12-16 oz Clear plastic or glass cups
- spoons
- Rice Krispies
- Finely crushed chocolate wafers, Oreos, thin mints
- Granola, M&M's, flaked coconut, chocolate chips, small marshmallows
- Milk

BACKGROUND:

A sedimentary environment is an area of the earth's surface where sediment is deposited. This environment 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.

PROCEDURE (for teacher, with some suggested answers)

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.*

1) Put a layer of Rice Krispies in the bottom of your cup. This represents the sand that you are standing on.

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.

2) Put a layer of crushed chocolate wafers in your cup. This represents the mud and silt that you are standing on.

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*

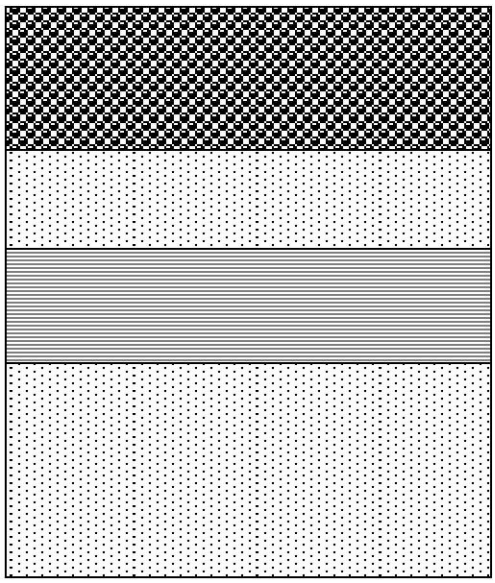
3) Put another layer of Rice Krispies in your cup. This represents the sand that you are standing on.

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 the 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*.

4) Choose from the selection of granola, M&M's, coconut, etc. that best represents the kind of sediments that you see.

5) Look at your cup from the side. What kind of layering do you see? It should look something like this:



Top: Mix of cereal and other goodies = gravel, sand, and rocks (river channel)
Next layer down: Rice Krispies = sand (beach)
Next layer down: Crushed wafers = mud (sea bed)
Bottom layer: Rice Krispies = sand (beach)

In the model so far, the particles are not bound together in a solid mass like we would see

in a cliff. **Lithification** is the process by which loose, unconsolidated accumulations of sediment actually become a consolidated rock. Lithification involves the 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.

In sedimentary systems, lithification happens as more and more sediment is piled on top so that the layers are squeezed together.

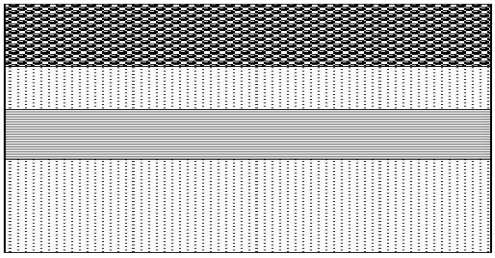
6) In this model, gently press down from the top and slowly compact our cereals and goodies as if the weight of sediments were pressing down (but not too much, we don't want a bunch of dust!).

The cement might be calcium carbonate (a 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.

In our model, we will use milk (a combination of water + fat) to get in between all the grains.

7) Slowly pour the milk and watch as it penetrates throughout the cup.

This compression (step 6) and cementing (step 7) represent lithification. Now we have sandstone, mudstone, and conglomerate. In the case of our sedimentary succession we now have:



Here, the symbols now represent
Top layer: Conglomerate
Next layer down: Sandstone
Next layer down: Mudstone
Bottom layer: Sandstone

8) Take your spoon and dig in!

PROCEDURE (for students)

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

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2. Where has the sand come from?
3. Why is the sand all the same size?

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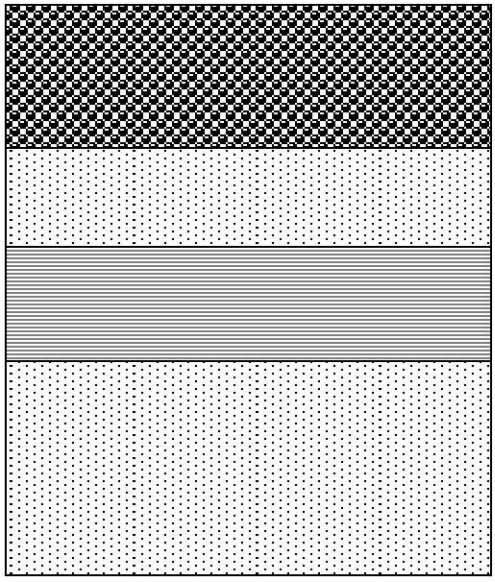

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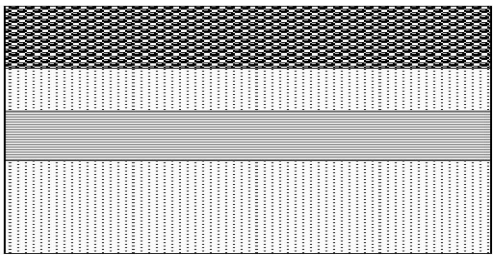

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EVALUATION

- What layer got deposited first?
- What sort of environment of deposition does the first layer of Rice Krispies represent?
- If you find that same material in a layer in the cliff face in a different location, what sort of depositional environment might you expect?
- What types of depositions might happen if the sea encroached on the land yet another time?
    - If that were the case, what layers would you add to your model in the cup?