THE TRICKLE DOWN EFFECT

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Purpose

This exercise demonstrates how sediments are deposited.

Definitions

Sediments - materials deposited by gravity from a fluid: air, water, or ice.
Graded Bedding - layering in a rock that is coarser at the bottom and gets finer upwards, larger grains at the bottom and smaller ones upwards.

Teacher Information

After erosion has occurred, material (rocks, sand, clay, and/or dissolved material) is carried as long as the transporter can carry them. This transported material is called the load. The load consists of a variety of sizes of particles, the size depending on the material available and the energy of the transporting medium. The transporting medium can be water, wind, or glacier ice. As the carrier loses energy, it cannot transport as much material and starts to drop some of its load. The heaviest particles get dropped first because they are the hardest to carry, then smaller and smaller until only dissolved material is left.

In the case of a stream carrying rocks, pebbles, sand, silt, clay, and material in solution (salt, calcite, gypsum, etc.), as the stream looses energy it drops the rocks, then the pebbles, and so forth. In the spring when you have lots of rain and lots of water in a stream, the stream can carry everything that you find in its channel. But as the rains stop and the water level in the stream drops, it starts to drop its load. In the drier summer, you find pebbles in the stream bed in the mountains where the stream is steep and the energy high; sand, silt, and clay in the low lands where slope of the stream is flat and the energy is low.

Another example occurs when a river that can carry all of its load (rocks, pebbles, sand, silt, clay, and dissolved material) reaches the ocean (or a lake). The surface of the standing body of water is a flat surface and therefore has no energy. So the stream drops everything at once, all together. But now the energy of the ocean reworks the load. The highest energy area of the ocean is where the waves break (try body surfing sometime and get caught in a breaking wave). The water energy decreases outward from the beach. Therefore, the largest particles will be deposited on the beach where the waves break and will get finer as you go offshore. The beach is usually sand, then there is mud, and reefs made of dissolved material are beyond the mud.

As a stream loses energy, all the particle sizes will be deposited in one place. Say you are standing by a stream carrying rocks pebbles, sand, clay, and dissolved material. When it loses energy, the rocks will be deposited in front of you, but all the rest will be carried past you. As the energy the stream will no longer be able to carry pebbles and they will be deposited on top of the rocks, then sand on the pebbles, next clay, and finally calcite will come out of solution when the stream stops flowing, the water evaporates and dissolved material is deposited. So in a vertical sequence you will have graded bedding from rocks at the bottom to limestone at the top.

Clay size particle are so small that they have excess negative charge around them. They tend to repel each other. The result is that clay floats a long time in fresh water. Salt is sea water neutralizes the negative charge, gets the clay particles to clump together, and lets clay sink.

Materials

Water
Salt
Dirt - The ideal material will have pebbles, sand and mud in it.
Jar with a Tight Fitting Lid - plastic peanut butter or mayonnaise jars are ideal; the jar may slip out of the student's hands.
Towels to wipe up the mess.
Optional – a flashlight

Student Exercise

The students may make their own sediment jars out of the materials listed or you may make them yourself. If the students make them you can have them take them home and will not have to figure out where to store them. They will also have something to show their parents.

Fill the jar about one third full with dirt. Then fill it the rest of the way with water. PUT THE TOP ON TIGHT.

The next thing they are going to do is shake the jar. HAVE THE STUDENT HOLD THE JAR TIGHT WHILE THEY ARE SHAKING IT. Then they will put the jar down and make some observations. They can shake the jar up as many times as they want. The results will always be the same. They love to shake it so let them prove it to themselves.

The students are asked to see if the water becomes clear. If you have dirt with a lot of fine mud in it, it will take a long time for the water to get clear. It may take overnight or it may stay cloudy.

In the second part of the exercise have the students add a little salt to the water in the jar. This will make the clay particles clump together, sink more rapidly, and the water will clear up much more quickly.

WORKSHEET

Fill the jar about 1/3 full of dirt. Almost fill the jar with water. Put the top on TIGHT and shake the jar well. Set the jar on the table and watch what happens in it.

1) What size particles settle out first? _____

2) Is the water clear or cloudy? (Try shining a flashlight through it)

_____

What causes this?

_____

How long do you think it will be before it will be clear?

_____

Let it sit undisturbed in one place and see how long it takes to become clear. How long did it take?

_____

3) Make a sketch showing the differences in the sizes of particles in the jar.

4) Why do you think the pebbles or the sand sink so quickly while the smaller particles take much longer?

_____

5) Add salt to the water in your jar. PUT THE LID ON TIGHT. Shake it up again. Does the water get clear more quickly or more slowly than when plain water is used?

_____

In salt water the tiny particles of clay minerals clump together. Would this make them sink fast or slow?

_____

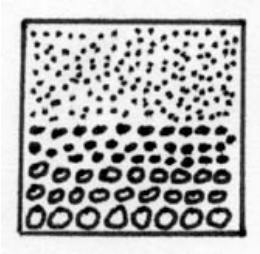
6) After a storm stirs up the mud at the bottom, would you expect a freshwater pond or a saltwater pond to clear more quickly?

_____

The difference in speed with which different sized particles settle is a useful tool for a geologist. Sediment that forms in the way you have just seen is called "graded bedding". The largest grains are always at the bottom and they get smaller upward, so an arrow drawn from coarse to fine points up. If a geologist comes on rocks that have been folded, he or she can tell which way was originally up, even if the rock has been turned upside down.

7) Put an arrow showing the direction that was originally up.

a)



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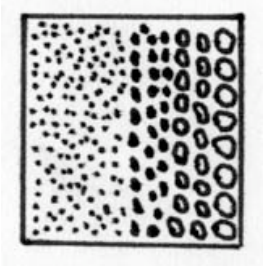

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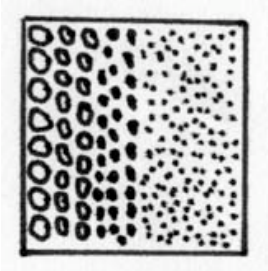

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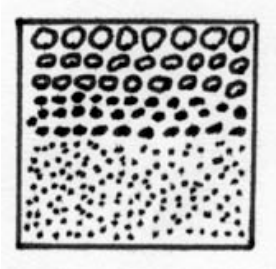

ANSWER SHEET WORKSHEET

Fill the jar about 1/3 full of dirt. Almost fill the jar with water. Put the top on TIGHT and shake the jar well. Set the jar on the table and watch what happens in it.

1) What size particles settle out first? ____**The biggest**_____

2) Is the water clear or cloudy? (Try shining a flashlight through it)
___It may be cloudy_____

What causes this?
___Clay or mud_____

How long do you think it will be before it will be clear?

___It could be a long time_____

Let it sit undisturbed in one place and see how long it takes to become clear. How long did it take?
___Fill in the answer____

3) Make a sketch showing the differences in the sizes of particles in the jar.

4) Why do you think the pebbles or the sand sink so quickly while the smaller particles take much longer?

___They are bigger and heavier_____

5) Add salt to the water in your jar. PUT THE LID ON TIGHT. Shake it up again. Does the water get clear more quickly or more slowly than when plain water is used?

___More quickly_____

In salt water the tiny particles of clay minerals clump together. Would this make them sink more slowly or rapidly?
___Rapidly_____

6) After a storm stirs up the mud at the bottom, would you expect a freshwater pond or a saltwater pond to clear more quickly?

___Saltwater_____

The difference in speed with which different sized particles settle is a useful tool for a geologist. Sediment that forms in the way you have just seen is called "graded bedding". The largest grains are always at the bottom and they get smaller upward, so an arrow drawn from coarse to fine points up. If a geologist comes on rocks that have been folded, he or she can tell which way was originally up, even if the rock has been turned upside down.

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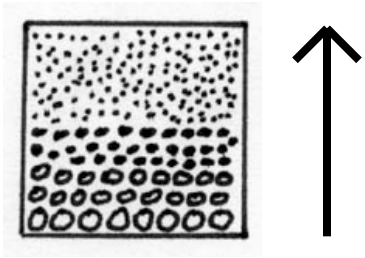

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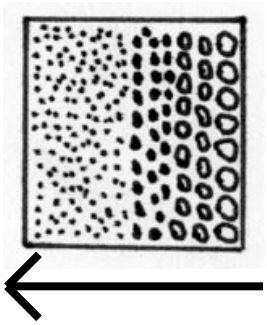

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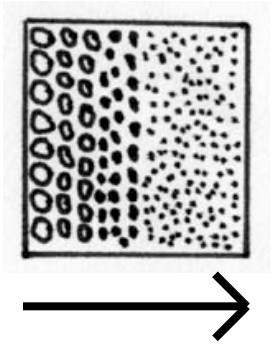

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