

Modeling Anchialine Pools

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Two Explorations

1. We will model an anchialine pool in both map view and cross section.
2. We will simulate saltwater, brackish water, and freshwater.
3. Observe the effects of overuse of groundwater.

Physical Model

The ground beneath our feet looks different in different parts of the country. In cities, a thin layer of concrete or asphalt covers a layer of soil. Below the soil is bedrock. Soil layers are thicker in flat, moist regions and thinner in arid regions or on steep slopes. Bedrock could consist of igneous, metamorphic, or sedimentary rock. Some common sedimentary rocks such as conglomerate and sandstone can allow water to soak through the large pores. Siltstone, limestone, and igneous and metamorphic rocks have much smaller pore space that limits the rate at which water can flow through. Using sand, we can make a simple model that behaves like our local ground.

Scale

Our model will have the following scale: 1 cm on the model = 2 meters in the real world. Because we are using sand to represent either soil, sandstone, or conglomerate, we have to consider the scale of the pore size in the sand. Since our sand is loose and does not contain a lot of silt, our porosity is probably higher than what might be found in the ground. The effect of the scaling of the pore size is to speed up the rate at which the groundwater moves. This is a good thing for us, because if we used real rock, we would have to wait a long time to see changes. In the real world, groundwater moves very slowly (centimeters/day). After we do some experiments with just sand, you can create more sophisticated models using layers of silt to model impermeable layers such as siltstone, limestone, igneous rocks, and metamorphic rocks.

Exploration #1:

Map view of Anchialine pool

Materials you need:

- Square plastic petri dish
- Cloth bag with 10-15 pieces of lava
- Cup of sieved beach or river sand
- 2 pipettes
- Plastic spoon
- Cup of blue water
- Cup of yellow water
- Jar of rock salt
- Pencil
- Catch basin

Step 1: Put 3 pieces (~0.5 grams) of rock salt into the cup of blue water and stir with pipette. Arrange the pieces of lava in a circle in the petri dish. Add sand to the model leaving a clear depression in the middle of the circle.

Step 2: Put a pipette in each cup of colored water. Try not to mix up the pipettes. Add a dropper full of yellow (fresh) water to one corner of the model. Then add a dropper full of blue (ocean) water to the opposite corner. Alternate back and forth between the two colors slowly, observing what happens as you go. Record your observations in your science notebook. Be sure to draw detailed pictures of your setup. When your model is almost full with water. Move on to step #3.

Step 3: Now you will use your yellow pipette in reverse, as a pump. Squeeze the bulb, insert it into the freshwater corner and release. You should see yellow water being sucked up into the bulb. Empty the pipette into your catch basin, not the cup of yellow water. Whenever you remove one pipette full from the freshwater corner, add another dropper full of blue water to the ocean corner. Repeat. Record your observations in your science notebook.

Step 4: Try it in the opposite direction. Pump out the ocean water and add freshwater.

Step 5: What do you notice about the water in the pool? Can you use the pipette to sample the water from different depths? Record your observations in your science notebook.

Clean up: Dump the sand into the sand recycling bin. Rinse off the lava and return them to your cloth bag.

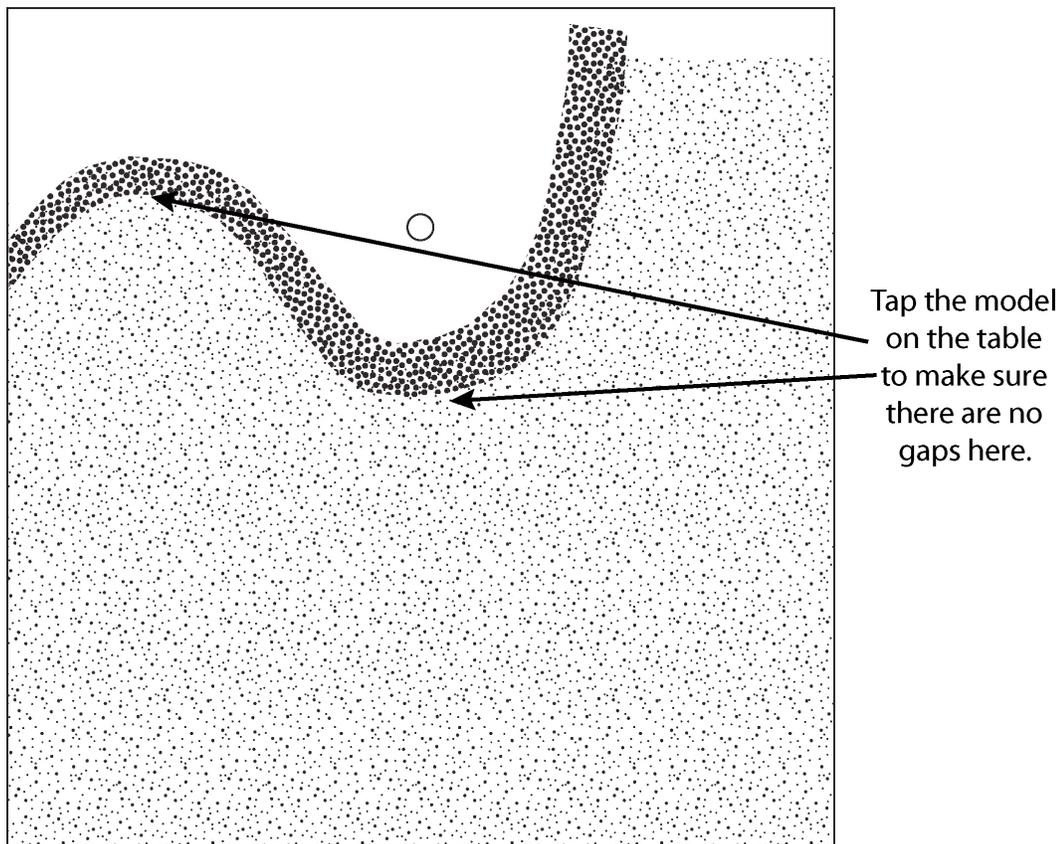
Exploration #2:

Cross section view of Anchialine pool

Additional materials you need:

- Acrylic Groundwater Model
- Black spongy foam thing

Step 1: Setup your groundwater model to match the diagram below. Start by using the eraser end of a pencil to carefully position the black foam. Be careful not to rip the foam. Then use the plastic spoon to add dry sand to the model. Tip the model to get the sand to fill the hump. Be sure that the sand in your hump rises a little higher than the hole.



Step 2: Use the pipettes to add blue saltwater (ocean) to the left side of the model. Use the other pipette to add yellow freshwater (groundwater) to the right side of the model. Alternate between the two types of water until the anchialine pool begins to fill. Do this in the catch basin. Draw a detailed picture of what is going on in your science notebook.

Step 3: Continue to add water until the hole in the middle of the anchialine pool begins to leak. Add a few more droppers of each type of water.

Step 4: Next, use the yellow pipette as a pumped well. Squeeze the bulb, insert it into the sand as seen on the diagram on the next page. This may take two hands and two people! Don't let go of the bulb until you have it inserted to the depth shown on the diagram. Now let go. The bulb will suck up the groundwater just like a real groundwater well. Have your partner keep the ocean at a constant level.

Step 6: Observe what is happening and draw a detailed picture in your science notebook.

Clean up: Dump the sand into the sand recycling bin. Rinse off your materials.

