Weathering and Erosion activity

Model how weathering and erosion work

Kit contents: Vinegar (acid), goggles, sugar cubes, 2 pieces of chalk, ziplock bag, pebbles, 2 plastic cups, clear plastic container with lid

Key concepts: weathering, erosion, how landforms change over time

Science Standards:
Student knows that the surface of the Earth is in a continuous state of change as waves, weather, and shifts of the land constantly change and produce many new features (SC.D.1.2.4).
Student knows that some changes in the Earth’s surface are due to slow processes and some changes are due to rapid processes (SC.D.1.2.5).
Student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results (SC.H.1.2.2).
Student knows that through the use of science processes and knowledge, people can solve problems, make decisions, and form new ideas (SC.H.3.2.4).

Basic Procedure

Discuss how the chalk will represent land or rocks and the vinegar will be the “weather” that will produce change to the land or rocks. Ask students how they think particle size affects changes to the Earth’s surface. (Hypothesis)

1. Fill cups ½ full with vinegar.
2. Give each group of students two pieces of chalk (break one piece in half). Have students place one piece of chalk in ziplock bag. Apply pressure to break the chalk into pieces. DO NOT CRUSH INTO POWDER
3. Give each group of students two cups with vinegar.
4. Have students put the piece of whole chalk into one cup of vinegar and all of the broken pieces of the other piece of chalk into the other cup.
5. Allow chalk to stay in the vinegar for 10 minutes.
6. During this time, discuss the variables (Vinegar and time are controlled variables, particle size is the independent variable (the one that you change between experiments), the amount dissolved is the dependent variable (what you measure)) and weathering.
7. After 10 minutes allow students to observe cups.
8. Discuss observations and make conclusion.

Discuss what would happen if you stirred (wind) or used heated vinegar (independent variables.) You can do this if time permits and teacher has a microwave to heat the vinegar.

Erosion Activity

Show students sugar cubes and pebbles. Put 10 sugar cubes and 10 pebbles into the container and put on lid. Shake the container and then pass the container around the room allowing students to shake during the 10 minutes. Discuss erosion with students.

Key Knowledge

Vocabulary
weathering - process of wearing away rocks by natural processes
erosion - process of wearing away and removing sediment by wind, water, or ice
landform - a natural land shape or feature
topography - all the kinds of landforms in a certain area
sand dune - sand hill that is made and shaped by wind
sinkhole - large hole caused by the collapse of the roof of a cave

Key Concepts
Weathering is the loosening of a particle of rocks. Once that particle starts moving, it is considered erosion.
The movement of wind or water is a common cause of weathering and erosion.

Changes in the earth's surface can be caused by physical changes (abrasion of sand on rocks breaking off pieces of rock) as well as chemical changes (reaction of water with limestone changing the structure of limestone molecules).

**Science Background**

**Pensacola Barrier Islands**

The sediment that reaches our beaches comes from a very small drainage area. In fact, virtually all the particles are from erosion of the southernmost portion of the Appalachian Mountains. The fast moving streams bring mostly grains of clear white quartz the short distance across the coastal plain to the Gulf. The westward longshore current deposits it as pure white sand along the coast and barrier islands of the seashore. Seashells contribute to the white sand of the west coast of Florida, but their sand isn't as white as Pensacola beaches. (See [http://www.nps.gov/archive/guis/extended/MIS/MNature/Geology.htm](http://www.nps.gov/archive/guis/extended/MIS/MNature/Geology.htm)).

**Physics of erosion**

Much of weathering and erosion is related to physical concepts. For example, the amount of rock that weathers in a sand storm is related to the mass of the sand and the speed with which it hits the rock. The size of particles that a stream can carry is related to speed of the stream. The energy of the stream comes from the conversion of its potential energy from being on a mountain to kinetic energy.

**Karst topography**

Limestone is easily dissolved by acids produced by organic matter. In some places the limestone is covered by sandstone or other harder, less dissolvable rock. If water, particularly acidic water, can get through the upper stone layer, it can dissolve and erode the limestone. This process can result in the formation of caves. If the upper rock is thin, the roof of the cave can cave in, resulting in a sinkhole. Florida has a lot of limestone which has resulted in many sinkholes in the state, though they are not so common in northwest Florida.

**Chalk and limestone**

In this experiment we use chalk instead of limestone. Both are calcium carbonate. (Some chalk is now gypsum, hydralated calcium sulfate.) Calcium carbonate is the main component of seashells, snails, and eggshells. It is common as an antacid and in some toothpastes. Calcium carbonate reacts with vinegar to create carbon dioxide (the bubbles you see) and calcium acetate. The calcium carbonate that becomes limestone is created by single cell organisms that take up calcium from sea water to create calcium carbonate shells. When they die or discard their shells, the shells fall to the sea floor. Over time they are compacted to become limestone.

**Script Idea**

Today's topic--weathering and erosion

What is topography? Do the students know the names of any topographic features in the world? (Mountains, valleys, canyons, etc.). Can they think of any unique topography in Pensacola? (Hills, bluffs, beaches, marshes.)

Where do our beaches come from, where is the beautiful white sand from? Quartz from the Appalachian Mountains. How do we get the quartz from the Appalachian Mountains? Weathering and erosion. Let's explore. Demonstrate the weathering of the sugar cubes by the pebbles. Put a few sugar cubes in a plastic cup with a few pebbles. Put on the lid. Shake. What happens to the sugar? What causes the change?

How does the quartz from the mountains get to Pensacola? Water. Why does it stop just as it gets to the Gulf? (Water loses energy due to collisions with with Gulf water and the potential energy is zero at sea level so you have no new generation of kinetic energy.)

Now, what factors affect our beach? Wind and water. Let's investigate how wind affects our beaches, since water would be messy....

Demonstrate the barrier island activity. What do the different things symbolize in this model? (Sand is beaches, empty box space is water, blowing is wind.) What does the wind do to the sand? Our barrier islands aren't just sand. What other things are on our beaches? Houses, plants, fences, seawalls (we don't really have them on the beach, but they are on the bayous. why aren't they on the beaches?).

Let's find out how those things affect the natural changes of the beaches. Present the assorted objects to put in the sand, explaining what each symbolizes. Have the student groups choose which objects they want. Have them hypothesize what will happen to the sand near each object. Caution the students to only blow from one direction. Ask the students in advance what kind of data they will record. (A sketch of the final outcome, perhaps.)

If students wish to investigate further, they could explore how the topography of the beaches (the dunes, the sound) affect the mainland. Also, they might discuss how a hurricane affects the topography of the island, with or without dunes, houses, etc.
Barrier Islands Activity

Materials: cardboard box (bottom of shirt box); sand; food coloring; straws; shells, coins, or similar; long, narrow piece of cardboard or similar

Before class, prepare some colored sand. Put some food coloring and a little water in a small amount of sand. Be sure to have the sand dry before class. You may wish to make 2 or more different colors.

For the initial demonstration, make a sand dune with one color. Right behind it make another sand dune. Blow on the sand through a straw. Have students observe what happens to the sand.

Students can try placing objects in the sand, multiple dunes, or a "body of water" (empty space). Coins or dice can symbolize houses, strips of cardboard can be fences or jetties, perhaps grass clipping placed on top of the sand can be plants.

Have students note the distribution of colored sand and uncolored sand. Also, they might observe the sand particle sizes. How can they relate particle size distribution to what they know about physics (less force needed to move a smaller mass) and what that might mean for beaches or the movement of sediment in rivers? What effects might real plants with roots changing on the right time scale have?

A hair dryer could also be used. Caution students to try to blow consistently. This activity will result in fine sand blowing out of the box, so bring a dustpan and broom or try to do the activity outside.

Alternate Ideas

Clay Caves -- demonstrate how caves form.
Beach Erosion with Water -- could get messy!!

Clay Caves

[More details through links in Alternate Ideas.]

Materials: sugar cubes, clay, see-through bowls, water, toothpicks

Students flatten clay into a pancake. They stack 3-6 sugar cubes in the see-through bowls, then mold the clay over the top. Students poke several large holes in the clay. They gently spoon or drop water on top of the clay, making sure some seeps in through the holes. After a period of time they observe what happens to the sugar cubes.

Two types of rock make up many caves. One is softer and easily dissolved by water (limestone); the other is harder and on top of the limestone (sandstone and shale). It takes a lot longer for water to dissolve this sandstone caprock. In this model, the sugar is the limestone and the clay is the sandstone.

Beach Erosion

[More details through links in Alternate Ideas.]

Materials: stream table or other large rectangular container, block sand ruler, watch or clock with second hand

1. Tape or plug the drain of the stream table.
2. Pour approximately 2.5 cm of water in the container.
3. Add clean sand to one end to simulate a beach.
4. Sketch Beach Profile 1.
5. Place block in end of stream table opposite the beach.
6. Move block very slowly to create small waves for 3 minutes. The waves should be just large enough to move the sand a little bit.
7. Observe and sketch Beach Profile 2.
8. Leave new beach in place.
9. Move block more rapidly to create large waves for 3 minutes.
10. Observe and sketch Beach Profile 3.