Sand Study **Primary Audience: 7th-12th**

Description: By identifying components of sand we can tell what sand is made of and where it probably comes from. Sands can be classified by the source into two types. The first type, called abiogenic sand, is made of eroded pieces of rocks. The second type, called biogenous sand, is made of the skeletal remains of plants and animals.

Keywords: sand, rock, earth

Concepts:

- How can we learn when sand came from?

Background:

Abiogenic sands

Abiogenic sands are inorganic mineral sands. Abiogenic sand particles are formed as rocks break down through the processes of weathering and erosion. Weathering is the slow breakdown of rocks caused by water, chemicals in the air and in plants, and by temperature changes. Erosion refers to the work that water and wind does to level the land. Loose fragments of broken rocks are called sediment. Sediment is of any size including boulders, gravel, sand and mud.

Abiogenic sands are formed from rocks in the continental crust of from rocks in oceanic crust of the earth. The continental crust includes most of the major dry continental land masses of the world. Mountains in the continental crust are composed mostly of granite. Mineral sands formed by the breakdown of granite usually contain quartz and feldspar. Quartz and feldspar break down more slowly than does mica or dark minerals like magnetite, which are also common in granite. Because they resist chemical and physical breakdown, quartz and feldspar are referred to as resistant minerals. Most sand beaches along the coasts of the continental U.S.A are called quartz sands because quartz is the most abundant resistant component.

The oceanic crust is the second source of abiogenic sand. The oceanic crust is made up of volcanic material called basalt. Volcanic islands, lava from volcanic eruption and the bottom substrate of the ocean basins are all made of basalt. Basalt is denser than granite and it is darker in color (black, grey or brown) because it is richer in minerals containing heavy metals such as iron and manganese. Basalt contains no quartz, but it does contain resistant minerals called olivine and obsidian (volcanic glass). Smaller amounts of other less resistant inorganic minerals are also found in basalt sands.

Biogenous Sands

The skeletal remains of plants and animals are a second source of sands. Biogenous sands are also called organic sands or biological sands. They are sometimes called calcium sands (or limey sands) because the chemical composition of most of the skeletal remains is calcium carbonate, the same material our bones are made of.

A simple chemical test that can be performed to distinguish calcium biogenous sands from inorganic sands is to drop vinegar or other acid onto a pinch of sand particles. If the sand contains calcium carbonate, the particle will react with the acid to form bubbles of carbon dioxide.

Most biological sands are composed of fragments of corals, coralline algae, and mollusks. They also include other resistant biological fragments such as sea urchin spines, and sponge spicules. Some of the components are the skeletal remains of entire organisms such as the mircomolluscs or the single-celled foraminifera. Usually biological sands are described by their largest component, as for example coral sands or coralline algae sand.

Materials:

- 1 sand sample
- 1 petri dish
- Toothpicks
- Diluted white glue (in small container)
- 1 small capped vial (for picked specimens), optional

Instructions:

1. Read this description of sand components given in Table 1. Refer to this information as you carry out the procedures below.
2. Learn to identify the common components found in sand.
    a. Obtain samples of different kinds of sand. If not already done, rinse each sand sample with fresh water and air dry before continuing.
    b. Place 10-20 grams of a sand sample into a clean, dry petri dish. Clearly number and label the dish telling where the sand came from. Also, record sample number and source in Table 1.
    c. Using a stereo dissecting microscope, view the sand at 10X or 20X. Be sure the sand is spread out in a thin layer in the petri dish. Use a toothpick to move the sand particles.
    d. Locate the components of sand. Look at the color and shape of the grains. Compare what you see with descriptions in Table 1.
    e. Glue several grains of each sand component that you find in the sample into Table 2.
        i. Place one drop of diluted white glue in the appropriate square
        ii. Transfer the sand particles; touch them with the moistened end of a toothpick. The particles will cling to the toothpick. Use your fingers or another toothpick to brush the particles off the moistened toothpick into the glue.

iii. Allow the glued samples to dry.

f. Repeat procedures a-e using other sand samples. If possible, include sand from lakes, rivers, and several different seashore locations.

Possible Interactive Questions:

- Describe each of the sand samples you analyzed in terms of components of sand. What components did you find that are not listed in Table 1? (Use other reference books.)
- Compare the components of sand samples from continental beaches of offshore areas with volcanic island beaches or offshore areas. Compare the biogenous components of sands from the temperate zone with sands from tropical areas.
- How do you think particle size is related to the slope of a beach?
- Use references to find out the following: How do loose unconsolidated sands and sediments become sedimentary rocks, including beachrock, mudstone, sandstone, and limestone? What fossils are often found in these rocks? How does weathering are erosion break down and transport rocks? How does sand get to the shoreline and what happens to it after it gets there?

What's Going On?

Further Exploration:

1. Make a report on the economic importance of sand. Report on one of more of the following:
    a. How valuable sandy beaches are to people in real estate, or in the recreation or tourist industry.
    b. How sand is used in making products such as glass, crystal, or cement, and abrasives.
    c. How and where people are sieving sand today fro heavy minerals (such as gold) and for gems (such as diamonds).
    d. How the petroleum industry analyzes dredged of drilled sediment specimens for evidence of petroleum or glass.
2. Find out how oceanographers and geologists have used sand and sediment sample in such studies as (a) ancient seas (b) changes in the earth's climate (c) shifts in the earth's magnetic poles and (d) continental drift.
3. Find references describing and explaining (a) the "painted desert" and (b) acoustical sands that make sounds when walked on (such as Barking Sands Beach on the island of Kauai in Hawaii).
4. Make a report describing your local beach. Include (a) average size of sand particles on the beach (b) sand composition (c) width and elevation of the berm (d) slope of the foreshore and inshore (e) the existence (or lack) of a bar, sand dunes and a sea cliff or bluff.
5. Design a project to verify the relationship between particle size and slope. (Measure slope angle, and collect data on particle size.)

6. Start a class “Sand Bank”. As you or your friends and relatives travel, bring back sand samples to deposit in the collection. Show the location of each sand sample on a large world map.

Relevant Ohio Science Content Standards:

Table 1. Glossary of Common Components of Sand

Components of Terrigenous Sand
Basalt: Black lava flows are basalt. As they erode, they may form dull black, grey, or brownish red colored grains of gravel and sand.
Feldspar: Feldspar is clear, yellow, or pink squarish crystals with smooth, glossy or pearly luster.
Garnet: Garnets are usually amber or beer bottle color, but some are light pink. Look for diamond-shaped grain with twelve faces. Perfect crystals are rare because the ocean waves round off the edges rapidly. (Frequently used in making sandpaper.)
Granite: Grains are usually light-colored to pink with a salt and pepper pattern made up of inter-grown mineral crystals all about the same size.
Magnetite: Magnetite is an iron ore which forms a black crystal resembling a double pyramid. It shines like a metal and is attracted to a magnet.
Mica: Shiny, paper thin, flexible sheets; light colored or white, translucent.
Olivine: Olivine is a shiny crystal colored various shades of green that may be transparent or translucent, found in basalt.
Quartz: Quartz grains are clear of transparent resembling small pieces of broken glass. Quartz comes from granite and sandstone erosion. It is the most abundant mineral found in continental sand.
Volcanic Glass: Hot black lava forms black, shiny glass particles when rapidly cooled.
Other: “Beach glass” is formed when broken shards of man-made glass are rounded and frosted by wave action. Other man-made substances may also be found on the beach.

Components of Biogenous Sand
Bivalve Mollusk fragments: Pieces of clam, oyster or mussel shells may appear white, grey, blue or brown. Usually not shiny. Slow to dissolve in acid.
Coral: Fragments of coral rubble are common in tropical sand. Even when worn smooth, coral may be identified by its many small rounded holes where individual coral polyps used to live.
Coralline Algae: Common types are (1) finely branches or coral-like stone plants that are colored white or pink to lavender (2) flakes or plates of tan to brown from Halemida and (3) encrusting lavender coats over rocks or coral that bleaches to white when dried.
Foraminifera: called “Forams” for shor, these are the skeletons of one-celled animals (protozoans). They may be white and shiny, clear or covered with sand grains. They look like tiny shells except that their aperatures are small and slit-like or pore-like. Forams have a small hole where the living animal extended false feet to catch food.
Micromolluscs: Tiny shells of all types with large aperatures.
“Puka” Shell: “Puka” is Hawaiian for “hole”. These “shells” appear like shiny pearl-like

discs with a puka in the center. They are the tops of cone shells.
Sea Urchin Spines: Spines may be white, purple, black, beige, or green. These needle-like structures may appear to have designs. Viewed under a microscope, tiny sea urchin spines may appear to have a crystalline structure.
Sponge Spicules: Usually clear and transparent or whitish, large sponge spicules may resemble the three-pointed logo for the Mercedes Benz automobile.
Miscellaneous: Tiny Shells of all types with large aperatures.

Table 2. Microscopic Identification of Sand Components

Components of Sand	Sand Sample Location			
	1.	2.	3.	4.
Abiogenic Components				
Basalt				
Feldspar				
Garnet				
Magnetite				
Mica				
Olivine				
Quartz				
Other				
Biogenous Components				
Bivalve Mollusk Fragments				
Coral				
Coralline Algae				
Foraminifera				
Micromollusks				
“Puka” Shell				
Sea Urchin Spines				
Sponge Spicules				

Dirt:

Other animal parts				