Name____________________

SAND STUDIES

INTRODUCTION

Sand is a very common substance, yet few people really stop to look at sand. This lab will show what sand is made of and how it differs from place to place.

Scientists who specialize in the study of sand are called arenologists. Long ago all sports arenas were covered by sand. Sand is also of interest to geologists and oceanographers who seek to learn more about the earth and its ocean basins.

Part I

OBJECTIVE

Identify common components of sand using stereo dissecting microscope.

BACKGROUND

By identifying components of sand we can tell what sand is made of and where it probably came 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.

ABIOGENIC SANDS

Abiogenic sands are inorganic mineral sands. Abiogenic sand particles are formed as rocks break down through the process of weathering and erosion. Weathering is the slow breakdown of rocks caused by water, chemicals in the air, and 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 can be of any size including boulders, gravel, sand, and mud.

Abiogenic sands are formed from rocks in the continental crust or from rocks in the 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 usually containing quartz and feldspar. Quartz and feldspar break down more slowly than 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 USA are called quartz sands because quartz in the most abundant resistant component. Another name for abiogenic sands is Terrigenouous Sands.

PROCEDURE

1. Read the description of sand components given in table I-A. Refer to this information as you carry out the procedures below.
2. learn to identify common components found in sand.
   a. Obtain sample slides of different kinds of sand.
   b. Record the sample number on the Hand in Sheet.
   c. Using a stereo dissecting microscope, view the sand.
   d. Locate the components of the sand. Look at the color and shape of the grains. Compare what you see with descriptions in Table I-A.
   Record the information about each sample in Table I-B (handin sheet)

SUMMARY QUESTIONS-will do on answersheet….

1. Compare sand samples from throughout the world. Include sand from the seashores, lakes, rivers, and deserts.
2. Describe each of the sand samples you analyzed in terms of components of sand. List the largest % of each component in each sand sample (slide).

3. Compare the components of sand samples from the continental beaches or offshore areas with volcanic island beaches or offshore areas. Compare the biogenous components of sands from the temperate zone with sands from the tropical zones.

TABLE I-A GLOSSARY OF COMMON COMPONENTS OF SAND

Components of Terrigenous Sand or Abiogenic Sands

Basalt: Black lave 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 a diamond-shaped grain with twelve faces. Perfect crystals are rare because the ocean waves round off the edges rapidly. (Used in sandpaper)

Granite: Grains are usually light-colored to pink with a salt and pepper pattern made up of inner-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 color with various shades of green that may be transparent or translucent, found in basalt.

Quartz: Quartz grains are clear or transparent resembling small pieces of broken glass. Quartz comes from granite and sandstone erosion. It is the most abundant mineral found in the 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 become 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 holed where individual coral polyps used to live.

Corlalline Algae: Common types are (1) finely branched or coral-like stone plants that are colored white or pink to lavender (2) flakes or plates of tan to brown from Halmida and (3) encrusting lavender coats over rocks or coral that bleaches to white when dried.

Foraminifers: Called "Forams" for short, these are skeletons on 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 any type with large aperatures.

"**Puka" Shell:** "Puka" is Hawaiian for"hole". These shells appear like shiny pearl-like discs with a puku 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 crystaline 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.

Sand Lab Key

1. South Africa
2. Destin FL
3. Australia
4. Bermuda

5...Hawaii big island-black sand

6.Koko Head Hawaii

7. Big Island Hawaii
8. North Sea
9. India
10. New Smyrna
11. Cancun Mex.
13. Bahamas
14. Cuba
15. Huntington Beach California
16. Spain
17. Puerto Rico
18. Sanibel Island Fl

19 France

20 Ireland

21 Myrtle Beach, SC

22. Marco Island FL
23. Fraiser Island, Australia

24 Rhode Island

25 Jeffery's Bay SA

26. Wildwood NJ
27. Bahrain, Persian Gulf
28. Lake Erie
29. Daytona Beach, Fl
30. Biloxi, MS
31. Key West
32. Cocoa Beach, FL
33. Shell Island, Panama City Beach
34. Jamaica
35. Cayman Islands

36 Marineland, Florida

	NAME AND ESTIMATE The Percentage of the most abundant sand components															
Sample Number																
A. Abiogenic Components																
Basalt																
Feldspar																
Garnet																
Magnetite																
Mica																
Olivine																
Quartz																
Other																
B. Biogenous Components																
Bivalve Mollusk																
Fragments																
Coral																
Coralline Algae																
Foraminifera																
Micromolluscs																
"Puku" shells																
Sea Urchin Spines																
Sponge Spicules																
Other Animal Parts																

The Case Of The Disappearing Shoreline

Humans change the earth's climate in many ways. One change is the increase of carbon dioxide in the atmosphere. As we burn more fossil fuels, we release more and more carbon dioxide into the atmosphere. Most scientists think that, over time, this will change the earth's atmosphere. Some say it will make the earth become warmer; others think it will make the earth become cooler. In either case, small temperature changes can have large effects on the earth's geography. For example, if the average annual temperature increases, more ice and snow at the poles will melt. This would cause a rise in ocean levels all around the world. Some coastal cities might be flooded.

In this activity, imagine that larger amounts of carbon dioxide will cause a warming trend in the atmosphere. You will study the effects such a change might have on the Virginia shoreline.

Procedure

1. Assume that each 0.1 °C rise in the earth's a. 0.1 degree C annual temperature, will cause the sea level to b. 0.2 degree C rise by 1.0 m. Diagram A shows a cross-section c. 0.4 degree C of Norfolk. On the diagram, show what will d. 0.7 degree C happen for each of the temperature changes at e. 1.0 degree C the right. Use a different color for each temperature rise.

2. Suppose Diagram B shows part of the southeastern shoreline. The elevation of a number of points is given. Draw what you think the new shoreline would look like if the annual average temperature rose by each of the amounts given in step 1. For each temperature rise, use a different color.

Analysis

1. List problems that might occur along the southeastern coast if the earth's annual temperature rose by 0.2 degrees C.

2. Suppose the prediction we used above is wrong and increasing amounts of carbon dioxide cause the earth's annual temperature to go down. This would cause the polar ice caps to grow. How would that change your shorelines on Diagrams A and B?

3. What advantages and disadvantages are there if the earth's average temperature increases by 0.4°C? Answer this (a) for people living near the shore and (b) for people living 200 km inland.

Beaches, Sand, and Currents

The United States coast from New Jersey to Florida has many sandy beaches. But these -beaches are not all alike. Where wave action against the beach is heavy, the sand grains are large. The beach itself slopes sharply into the sea. Less exposed beaches tend to have wide, shallow shores with gentle slopes.

The most common mineral in sandy beaches is quartz, which comes from inland on the continent. Rock fragments are eroded away by rivers and carried down to the ocean. When these pieces of rock reach the ocean, they are pounded into tiny grains by the movement of waves against the shore. Other sources of materials for sand are rock outcroppings along the shore and the shells of marine animals. Along the coast of North Carolina, for example, as much as 10% of the beach materials are ground-up shells. Farther south the sands are made from weathered rocks carried by rivers from the Appalachian Mountains. Still farther south the eastern beaches of Florida can be almost pure quartz or quartz mixed with shell and coral.

Some of the most beautiful and valued beaches in this region are on barrier islands. These are islands of sand built up by the ocean and parallel to the mainland. Barrier islands are formed along gently sloping sandy coasts where the water remains shallow far from the shore. Their name comes from the fact that these stretches of sand are between the ocean and the mainland. Figure C shows barrier islands, the lagoon behind, their inlets, and a river that empties into the lagoon.

Once formed, barrier islands are far from permanent. Giant winter storms with their huge waves can form new inlets or close older ones. During these storms, large amounts of sand can be dug from one place and deposited elsewhere along the beach. Even during the calmer weather of summer, the ever-present surf is constantly reshaping the islands. Breaking waves carry sand with them as they run back into the sea. Longshore currents pick up this sand and move it down the coast. Since the longshore currents in this area usually move southward, they are slowly carrying the barrier islands in that direction. Where there is an arm of land into the ocean or an inlet, sand is deposited on the north side and eroded away on the south side. This constant migration of sand can cause entire sections of beach to disappear or the mouths of inlets to move as much as 25 meters a year.

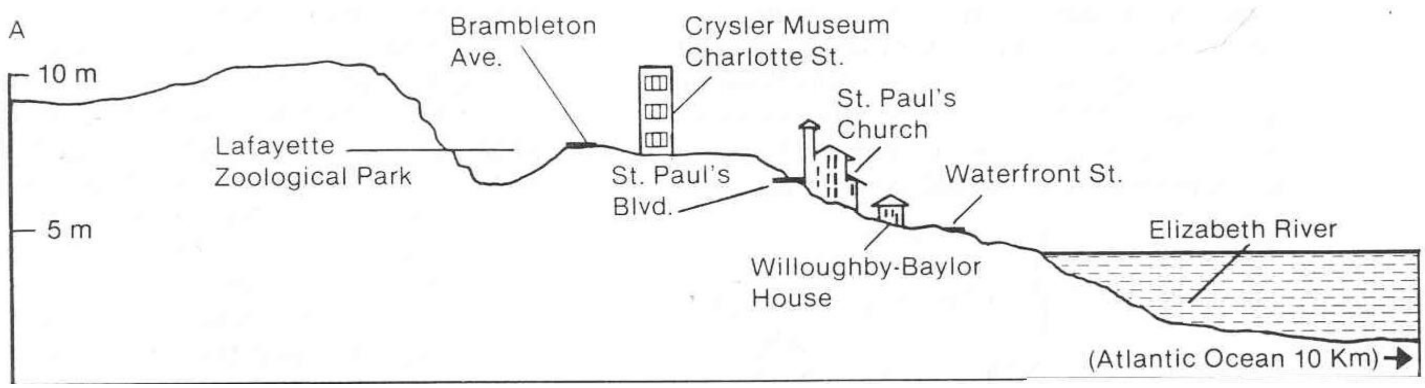
Because barrier islands are such splendid areas, many people want to live and work on them. To do so, they try to change the island to fit their needs. Figure D shows how the people who live in Fishville plan to change Blue Inlet. They want to stop the migration of the inlet by putting in jetties, or walls, along the inlet. Should this plan be carried out? Look at the diagrams and the information, then answer the questions below.

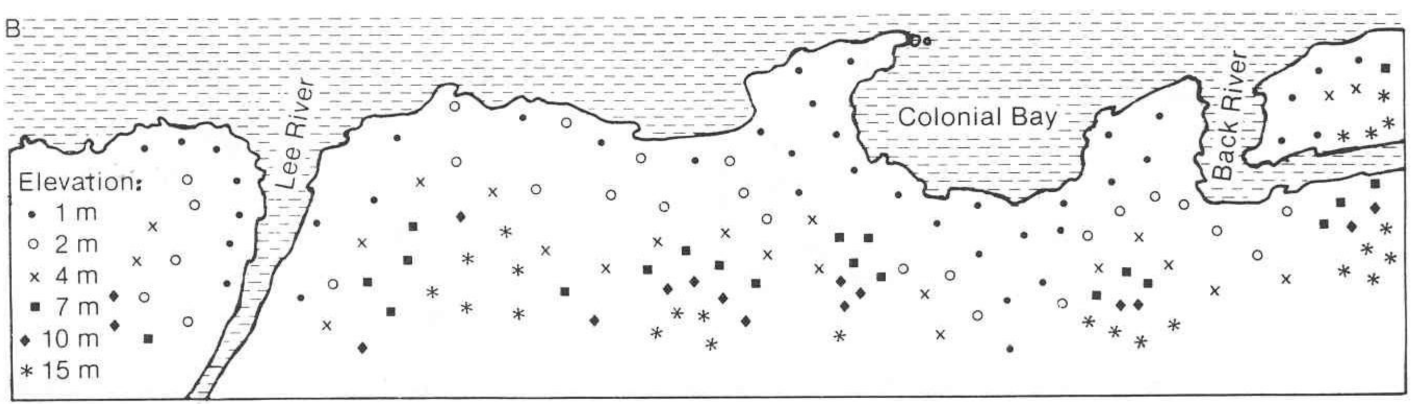
1. How does the Blue River contribute to the formation of barrier islands?

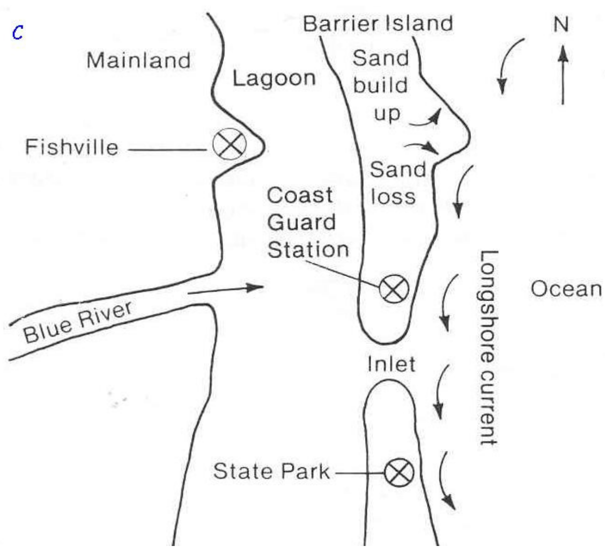
2. Why do you think people at Fishville are concerned about the movement of Blue Inlet?

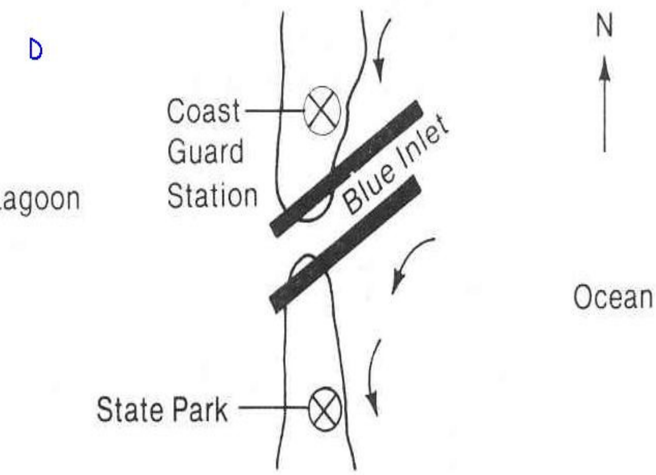
3. If you were the State Park Director how would you react to the plan? Why?

4. If you were in charge of the Coast Guard Station how would you react to the plan? Why?









Sand Slope

This week's experiment is a result of taking some time off. I spent most of today working, but I took some time to go to the beach and relax. As I sat there watching the waves, I was also playing in the sand. It was not serious playing, just scooping up sand and letting it fall through my fingers. As I sat there, the sand took more and more of my attention, and soon I had this week's experiment. You will need:

paper tape a plate 2 cups of sand, salt or sugar Corn chips, potato chips or corn flakes M&M's or other round candy

Roll a sheet of paper into a tube about two inches in diameter and tape it so that it does not unroll. Stand this tube upright in the center of a dinner plate. Carefully pour about a cup of either sand, salt or granulated sugar into the tube. Slowly lift the tube and watch what happens. The sand spills out the bottom. OK, so what is so special about that?

The sand formed a cone shaped pile on the plate. Notice the angle of the slope. If you have a protractor, you might want to measure the angle. Try adding some more sand, to make a steeper slope. What happens? As you add more sand, it slides down and the slope stays about the same. You can make the pile taller, but the slope of the sides stays fairly constant.

That slope is called the angle of repose. If you play with different materials, you will find that each has its own angle of repose. Some will form steeper slopes, while others form much flatter slopes. For example, I poured a pile of corn chips onto the plate and got a nice, tall, fairly steep angle of repose. I tried the same thing with M&M candies and got a very flat slope. What is the difference between the two? Their shape, of course. The rough shape of the corn chips helps them interlock, forming a nice, steep slope. The rounded shape of the candy lets them slide past each other, so you get a much flatter angle of repose. No matter how hard you work, you can't pile the candies to get a nice, steep slope made of M&M's.

Other things also have an impact on the angle of repose. Instead of using the smooth plate, try stacking the M&M's on a rough textured mat or a piece of course cloth. It is easier to get them piled into a slope, because the friction helps keep them in place.

Moisture also plays a part. If you have ever built sand castles, you know that it is much easier to build tall castles if you use wet sand. The water holds the grains together to form very steep slopes. On the other hand, too much water makes it soupy, so that it will not form a slope at all.

All this is interesting, but is it useful? Yes. The angle of repose explains the shape of sand dunes and snow drifts, but it also tells builders how steep a slope you can safely build a house on. Sometimes builders ignore this, which is why you sometimes hear about houses sliding down hillsides in California. Each type of soil has its own angle of repose. If you form a slope that is steeper than this critical angle, eventually, nature will take over and things will shift.

When you finish, be sure to clean up your mess. Take the sand outside. Since you have handled the corn chips and candy, probably no one else will want to eat them, so you might as well eat them yourself. After all, you would not want them to go to waste.