SAND ON STAGE

FOR THE TEACHER

Discipline
Earth Science

Themes
Scale & Structure, Evolution

Key Concept
Sand grains can be made of many things, and come in many different shapes, sizes and colors. These differences can be clues about the origin and evolution of the sand.

Synopsis
Students, using magnifiers and working in small groups, compare the color, size and shape of several sand samples to determine their origins.

Science Process Skills
observing, comparing, inferring

Social Skill
Encouraging

Vocabulary
erosion, waves

MATERIALS
INTO the activities
• pictures of sandy beaches from various parts of the world
• large shallow sand table or tub filled with sand
(note: you can purchase bags of sand from a building supply company.)
• Anticipatory Chart: chart paper or overhead and pens, or chalk board optional
• funnels, spoons, sieves, cups, feather, shells, rocks, litter for sand play
THROUGH the activities
• at least six different sand samples--the more the better. You don't need much of each sample. Ziplock sandwich bags or film containers work well for storage.
(note: If you don't have your own samples, sand kits can be ordered from The Math/Science Nucleus, 3710 Yale Way, Fremont, CA 94538, (510) 490-MATH)

• a SAND ON STAGE WORKSHEET for each student
• Sand Display: large piece of construction paper with a small amount of sand from each sample glued to it. Label each sample with the location from which it came. (OPTIONAL)
• hand lens or magnifier for each pair of students (a dissecting microscope makes the activity particularly dramatic, but is not necessary)
• magnet in a plastic bag for each pair of students
• 1 small jar with lid for each group of six
• 1 "slide" per student: 1"X3" strips of white or black construction paper
• several bottles of white glue

INTRODUCTION

Nearly all solid materials in the world, both living and non-living, will eventually be eroded into sand. Rocks, shells, corals, bones, metals and glass are all worn down over time by wind, waves, rivers, earthquakes and other forces into smaller and smaller particles. For this reason, sand is often said to be the Earth in miniature. The story of a grain of sand can be the story of the evolution of the crust of the earth. Thousands or millions of years may pass as a sand grain transforms and travels from a mountaintop to a sandy beach and finally into a submarine canyon where it again might be compressed into rock and be uplifted into a mountain. It is no wonder that sand, whether found on a beach, in a child's sandbox or in Native American paintings, is often associated with soothing feelings such as drifting, shifting, timelessness.

The sand on every beach has its own unique history. Detailed observations combined with some good detective work, however, can often allow us to make some reasonable hypotheses about where the sand originated, how old it is, and perhaps even from what part of the beach it came. Sand from the remains of plants or animals is referred to as "biogenic," while sand from non-living sources is called "abiogenic." A closer look at sand, through a hand lens or dissecting microscope also reveals the striking beauty of individual grains. Some sand is produced right at the shore where waves crash on rocks, headlands and reefs. For example, black or red sand beaches in Hawaii and the Galapagos are found directly next to or on top of lava flows of the same color. White sand beaches in Florida and in the Caribbean are primarily made of eroded coral reefs. Parrot fish, which eat coral polyps, grind up the corals with their sharp teeth, and can excrete up to 100 pounds of coral sand per year. Pink sand might be full of coralline algae fragments. Other sand comes from far inland. Mountains are weathered by freezing, wind, rain and streams, and their fragments are carried down streams and rivers to the seashore. Quartz, a glasslike mineral, is often the most common component of these transported sands. Quartz is the most common mineral on earth, and it is nearly insoluble in water. Most light colored sand beaches contain large amounts of quartz.

Sediments are classified by particle size, from mud to gravel. Particles are generally called sand when they are between .06-2mm. Where particles are deposited depends on the speed of the water carrying them. In fast moving river or ocean water only the largest, heaviest grains settle out. On wave impacted outer coast beaches, only large grains or even gravel will be found. The smaller the particle, the slower the water must be moving for it to settle out. Mud grains are only found inside protected bays or far offshore on the deep bottom.

On a normal coastal beach, no individual sand grain stays in the same place for long. Each wave picks up thousands of grains and deposits them somewhere else. If a prevailing wind causes waves to strike the coast from the same angle, sand can be slowly transported great distances along the coast. The finest grains of sand can become airborne in the wind, and are often deposited high up on the beach in the dunes. Dune sand is usually noticeably lighter than beach sand.

Sandy beaches surround the edges of nearly every coastline, but each is unique, and tells a different story about the history the continents. They are a shared resource, and are firmly embedded in the psyche of people from many cultures.

INTO THE ACTIVITIES

Sand Collecting

Several weeks or months before conducting this activity alert students and parents (and your friends) that the class will be studying sand, and to be on the lookout wherever they travel for samples of sand. On trips to the coast, lakes, rivers or deserts, or even at playgrounds, have students collect small bags of sand. Be sure to label each sample with: where and when it was collected, and who collected it. Does anyone have a friend in another state or country that can send an exotic sample? Discuss each sample as it arrives.

Sand Play

Set up your sand table or tub, and simply encourage students to explore it individually or in small groups. You might put out water, funnels, sieves, spoons, cups, etc. Encourage students to "get a feel for sand."--to look closely, run it through their fingers, make sand sculptures, look for evidence of life. Put out drawing paper and pens for students to spontaneously write descriptions or illustrate sand related images. Every day or so, add a new item to your mini-beach: a shell, feather, rock or piece of litter.

Partner Parade

See Teaching Strategies section for how to present this activity.

1. When was the last time you visited a sandy beach? Where was it?

2. What do you think of when you hear the word "sand?"
3. What do you like about sand? Is there anything you do not like about it?
4. Describe all the different places you might find sand (seashore, lakes, deserts, sandboxes, playgrounds, etc.).
5. What color is sand?
6. Where do you think sand comes from? What is it made of?

Anticipatory Chart
Have students sit down with their final Tea Party partner. Show them your Anticipatory Chart poster--chart paper divided in half lengthwise by a line. At the top of one column, write, "What do we already know about sand?" At the top of the other, "What do we want to find out about sand?" If students are comfortable writing, have them create their own chart copying yours onto a piece of paper.

Give each pair a few pictures of different beaches to look at. Tell them to discuss the two questions and, if possible, write notes on their chart. Each pair can swap pictures with another pair and discuss again.
Lead a class discussion about the two questions, and record group's ideas on the Anticipatory Chart poster. Display the poster and refer back to it throughout the activity.

PORTFOLIO ASSESSMENT
Active participation in all activities
Did student bring in sand samples?
Drawings and writings from Sand Play
Anticipatory Charts
Teacher observation of Encouraging, especially in Sand Play and Anticipatory Chart work

THROUGH
THE ACTIVITIES

Sand Display
Have students work together in cooperative groups of six. Each group can have six different small sand samples (if you have at least six different types of sand). Have each group first compare their six samples to each other and to the sand in the sand table. How are they similar? How are they different? Discuss with students the different things that sand can be made of (rocks, shells, bones, coral, glass, etc.), how it is made (erosion, waves crashing, animals dying, etc.), and how it arrives at the beach from mountains or from the ocean (by streams, rivers, wind, ocean currents, etc.). Tell students that if they are good, observant scientists, they may be able to piece together a story about the history of their sand.

OPTIONAL: Show students your Sand Display, and tell them to look at how different some types of sand can look from others.

Have each student or pair of students choose one of the samples in their group to work with, and give each student or pair a SAND ON STAGE WORKSHEET. Now they can make a "sand slide" from their sample. If their sand is light colored, they take a dark strip of paper, and vice-versa. Put a very small dab of white glue on their slide and smear it in a small circle with a finger, then sprinkle a little sand on the glue. Students can label their slides with where it came from and their names.

On first glance, what color does each sample appear to be? Have each student/pair write the overall color of their sample on the worksheet. Now have them look closer at their sand slide with a magnifier, and write down all the different individual colors that they see. Have students compare their findings to those of the others in their group. Explain why different sands might be different colors. Can each group categorize their sands into light and dark categories? Are there some samples which are difficult to categorize? Why?

The next few tasks take some extra concentration, so tell students they might need to offer extra encouraging to their group members. Have students look again at their slide through a magnifier (or a dissecting microscope). This time look specifically at the shape of individual grains. Have students draw several examples of the exact shape of their grains on their worksheet. Explain that the degree of roundness can tell us how old the sand is. Very round grains have been worn smooth for hundreds or thousands of years, while angular grains may have broken off a rock or shell quite recently. Have students compare their grains to those shown on their worksheet. Is their sand very old or very young?

Students can now measure the size of their grains. Have them record their findings on their worksheet. If their grains are very large, they could be from an outer coast, wave tossed beach; small grains might be from a protected bay beach or a pool in a slow moving stream.
What materials can students find in their sand--what is it made up of? small rocks? shells? wood? glass? plant material? How do they become part of sand?

Have students drag a magnet wrapped in a plastic bag through their sand. Are any grains attracted to it? If so, this is evidence that the sand contains some metals, such as iron. What color is the metallic sand?

Explain that sand is almost always in constant motion, and that the sand grains on a beach one day, might be entirely replaced by others in a few weeks. How does sand move? Have one student/pair in each group put a little sand in

a bowl and gently blow on it. The wind blows almost all the time at the beach. What effect does this have on beach and dune sand? Now a different student/pair in each group can put about an inch of sand in a jar and fill it half full with water. Pretend a wave is crashing in your seashore--shake it and watch what happens to the sand. Thousands of waves crash of a beach each day. What effect does this have on sand?

Oil on the Beach
Imagine there was an oil spill from a ship or an offshore oil rig, The oil washes in with the tide. Imagine your sand covered with oil and waves crashing on it. What would happen to the sand? To the animals living in the sand? Could you clean up the oil? Tell students that later on they will get the chance to create an oil spill and to try to clean it up.

Now have students discuss with each other, and then with the class, what the place where their sand came from looks like. Is it on the seashore or a river? Are there big waves crashing? Is it a sunny warm place or a cold one? And what was the source of the sand? A coral reef? A mountain? A lava flow? Clam and snail shells? Have each student illustrate the place their sand came from, and then on a separate sheet, the source of their sand. Post the student art around the room next to the sand sample it illustrates.

Discuss with students why sand is important to people. It creates fun and beautiful places for us to walk and play. It is an important home to many, many plants and animals. It is important for oil and cement production. Glass is made from melted and reformed sand. Sand is used for sandblasting and on sandpaper. If it wasn't for sand, we might not have paved streets, tall buildings, concrete sidewalks or glass windows.

ASSESSMENT
Participation in all above activities
Teacher observation of encouraging
Completed worksheets
Final artwork

BEYOND
THE ACTIVITIES

Have students continue to collect sand samples. Find a class in another region with which you can establish pen pals, and send each other sand samples. Create a sand exhibit, with descriptions of each sample.

Students can go to the library and find books about sand and sandy beaches. After they have read a few, they can classify them into groups: fiction, non-fiction, about people, about other animals, etc. Now students can write a book of their own. Try small group books, or a class book.

Other activities in this guide, such as OIL ON THE BEACH, can be seen as "Beyond" activities for SAND ON STAGE.

Take a field trip to a sandy place. Students can act as detectives to determine if the sand has a source which is close by or far away. What evidence can they find about its origin and evolution? What clues are observable (rocks, cliffs, shells, streams, etc.) Is the beach "cleaned?" By who or what? (people, birds, currents, high tides).

Have students make their own sand. Bring in rocks, shells, bones, plastic, pencils, etc. They can wrap them in pillow cases or towels and break them up with hammers. Make sure they keep a secret list of all their "ingredients," and see if other students can discover what they are by examining the new sand. Make exhibits in class to display the new sand samples next to a list or picture of the ingredients.

SAND ON STAGE!

1. What color is your sand? Overall, is it light colored or **dark** colored?

2. Now look closely at your sand with a magnifier. List all the different colors you see?

3. What are the shapes of your sand grains? Draw a picture of a few different grains.

4. Compare your sand grains to the roundness chart. Are they rounded or not very rounded?

O not very rounded
O a little rounded
O very rounded

5. Compare your sand grains to the size chart. How big are your grains?

6. Which of the following things can you find in your sand?

O small rocks
O pieces of glass
O pieces of plants
O other things...
O pieces of shells
O pieces of wood
O pieces of plastic

7. Is your sand attracted to a magnet? Why?