GUIDE TO
SAND KIT

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SAND

Enclosed are written materials that will help you use the items in your kit. This is an outline to help guide your use in the classroom. Please remember that the copyright allows you as a teacher to reproduce for use at your school or for your class. For more information on how to incorporate sand into an entire elementary school science curriculum we refer you to the Integrating Science, Math, and Technology Program. Contact the Math/Science Nucleus for more information.

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List of items in your kit, if any are missing please write us, or if items were damage during shipping we will replace.

II. LOCATION MAP

Identifies sand localities from California.

III. ACTIVITIES USING SAND KIT

Goes over basic information on the sands in your kit and how you can direct discussions with your students on the specific sands in your kit.

IV. SAND - EARTH SCIENCE IN MINIATURE

Information on the formation of sand and how you can develop other science ideas in your classroom.

V. SEDIMENTARY ROCKS

VI. ROUNDNESS, SIZE, AND SORTING CHARTS

VII. LAB SHEETS

These can be used in the classroom using a variety of items from the kit. The answers depend on what sands you use and how the children interpret how you present the information. A short lecture before each lesson is required. You can also include local sands.

A. Characteristics
B. Sand Kit
C. Sedimentary Rocks
D. Why are rocks rounded?

SAND ACTIVITY KIT
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1. Cleone Mendocino County, California	Northern California
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4. Eel River Humboldt County	Northern California
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6. Fort Bragg Mendocino County, California	Northern California
7. Half Moon Bay San Mateo County, California	Central California
8. Long Beach Los Angeles County, California	Southern California
9. Montara Beach San Mateo County, California	Central California
10. Monterey Monterey County	Central California
11. Santa Cruz Santa Cruz County, California	Central California
12. Oakwood Heights Beach Staten Island, New York	New York
13. Ocean Beach San Francisco County, California	Central California
14. Rodeo Beach Marin County, California	Central California
15. San Luis Obispo San Luis Obispo County, California	Southern California
16. Santa Barbara Santa Barbara County, California	Southern California
17. Ventura Ventura County, California	Southern California

SAND LOCALITIES

(numbers refer to number given on content list)

ACTIVITIES USING YOUR SAND

Key characteristics of each of the sands in your kit are listed below. Comparing and contrasting these sands is the most important activity you can do with your students. Have them discuss why one looks different than another sample. Answers in most of these cases are immaterial to the learning and observation skills you are teaching them.

You can have them tell or write a story about the Mother Rock an how the baby rocks were born. Use magnets to find out which sands have magnetic components. If you wish to test if the sand is magnetic, you do not have to take the sand out of the bag, the magnet will work through the plastic. Have your students lay out all the sands (in the bag of course) and have them match similar sands. See if the Mother Rocks were similar. Group them according to grain size and see if you can see a difference between size and content. You can have the students compare and contrast with other parameters such as which sands have shells or which sands have plant fragments.

Teachers are referred to the information article to help understand how sand can be used to teach children about the Rock Cycle.

BODEGA, Sonoma County, California - .25-5mm; poorly sorted; subrounded to angular. Contains chert, basalt, serpentinite, quartz, feldspar, and greywacke. (If you are not familiar with rocks, we recommend you look at the Mineral and Rock Kit, which can be purchased from the Math/Science Nucleus). Along the Sonoma coast, you can see the high energy waves eroding the rocks along the coast. The common rocks in this general area are basalt, serpentinite, chert, and greywacke. The quartz and feldspar are eroding from the chert or the greywacke.

CLEONE, Mendocino County, California -.25-0.5mm; well sorted; subangular - subrounded. Contains quartz, feldspar, serpentinite, chert and basalt. The dark color is due to over abundance of basalt, serpentinite and chert. Also may contain pieces of shell material. Type of rock in area are basalt, serpentinite and chert.

EUREKA, Humboldt County, California - 0.1-5mm; well sorted, subrounded. Contains quartz, basalt, chert, and serpentinite. The components reflect the general rocks in the area of basalt, chert, and serpentinite. Also in this area are Cenozoic sandstones which probably accounts for the particles of quartz.

DEL MAR, San Diego County, California - .25-.5mm, well sorted; subangular - subrounded. Contains quartz, feldspar, mica, and a dark mineral which is probably some type of amphibole (hornblende). This sand is eroded from local sandstones that are near the beach area.

EEL RIVER, Humboldt County, California - .25- greater than 7 mm; angular - subrounded. Contains basalt, chert, serpentinite, greywacke, sandstone, and quartz are the main components. Remember that a river can cut through many different types of rocks as it moves from the source of the water to another river.

FORT BRAGG, Mendocino County, California - 0.1 - 0.5mm, very well sorted, subangular -subrounded. Contains quartz, feldspar; minor amount of shell fragments, basalt, and magnetite. Although Fort Bragg is not far from Cleone there is a big difference. At Fort Bragg, you do not have the influence of basalt, chert and serpentinite. A sandstone probably derived from a granitic rock explains whey Fort Bragg has a larger component of quartz and feldspar.

LONG BEACH, Los Angeles County, California - .25 - 3mm; poorly sorted; subangular. Contains mica, quartz, feldspar, magnetite and shell fragments. The Mother Rock for the sands in this area are sandstones that were originally derived from granite. Offshore from these beaches are basins that are slowly filling up due to the introduction of sands from the continental area.

HALF MOON BAY, California - 0.1 - .25 mm; very well sorted, subangular to subrounded. Contains quartz, feldspar, mica and minor magnetite. The cliffs along Half Moon Bay reveals the Mother Rock for this sand. The cliffs releases millions of sand grains to re-enter the rock cycle.

MONTARA BEACH, California - 0.1 - 7mm; very poorly sorted; subrounded. Contains quartz, feldspar, and small pieces of granite with mica and hornblende. This sand is eroded directly from granitic rock very close to the beach. This is near the famous "Devils Slide" area, where very badly weathered granite have created very spectacular cliffs.

MONTEREY, California - 025 -7mm; very poorly sorted; subangular. Contains quartz, feldspar and pieces of granitic rock. The Mother rock is a granite, but unlike Montara Beach sand, Monterey has not been chemically weathered. Abrasion of large boulders of granite along the coast have mechanically broken this sand.

OAKWOOD HEIGHTS BEACH, Staten Island, New York -0.25 -1mm; well sorted; angular - rounded. Contains quartz, feldspar and magnetite. This sand is eroding from a sandstone that probably had a granitic origin, which has more pinkish/orange feldspars in it, then the California counterpart.

OCEAN BEACH, San Francisco, California -0.1 -0.5mm; well sorted; subangular to subrounded and crystals. Contains quartz, mica, feldspar and magnetite (magnetic) Derived from sandstones exposed along cliffs south of Ocean Beach.

RODEO BEACH, Marin County, California -0.1 -7mm; poorly sorted; angular - rounded. Contains chert, serpentinite, quartz, basalt, magnetite. This beach is in a cove behind the Golden Gate Bridge, where very high energy waves erode the rocks exposed along this coast. The source rocks include chert, serpentinite, and basalt.

SAN LUIS OBISPO, California - 025 - 1mm; moderately sorted; subangular - subrounded. Contains quartz, mica, basalt, dark minerals, and magnetite. Cliffs along Avila Beach, where this was collected is composed of a sandstone, that reflects the sand make-up.

SANTA BARBARA, California - 0.1 -1mm; well sorted; subangular - subrounded. Contains quartz, mica feldspar and some dark minerals. Eroding from nearby sandstones.

SANTA CRUZ, California - 0.1 -.25mm; well sorted; angular -rounded. Contains quartz, feldspar and magnetite. Eroded from the sandstones that make up some of the cliffs in that area.

VENTURA, California - .25 -.5mm; well sorted; subrounded. Contains quartz, feldspar, mica, some dark minerals, magnetite. Eroding from nearby sandstones.

SANDS - EARTH SCIENCE IN MINIATURE

Sand has been used to describe many human qualities. A vagabond has been referred to as "driftless like ...sand;" endless time is "sand that drifts forever;" we are all but a "grain of sand on the beach." Children can spend endless hours on the beach, creating sand castles, or digging to reach the other end of the world. It can cover you up, but not make you dirty. Sand is clean to play with. Children look at sand falling through an hour glass fascinated by every grain that falls and some paint with different color sands to create works of art. Sand is loved so much by children that adults have created sand boxes, so their children can play.

Its funny to think that sand can be associated with two very opposite climatic conditions. Water that crashes upon beaches along the ocean, lake or river with the hot sun and wind that shifts sand in deserts like Death Valley and the Sahara Desert. But if you understand the process that creates sand, you can see that in both situations some kind of erosion of the surrounding rock is creating the sand.

Sand is but the Earth in miniature. Every rock which makes up the earth, succumbs to erosion and will become sand with time. (This process is part of the rock cycle.) Mighty mountains are slowly chipped away by natural forces like wind and rain; and over long periods of time, the mountains will become sand. It is this information that makes the poem "Little Things" by Julia A. Fletcher change into something much larger.

LITTLE THINGS

Little drops of water
Little grains of sand
Make the mighty ocean
And the pleasant land.

Thus the little minutes,
Humble though they be,
Make the mighty ages
Of eternity.

Julia A. Fletcher

There is so much sand that it will be here for eternity; so little an object but so dramatic in its effect. Robert Frost, an American poet, captures the beauty of sand, as it symbolizes the ever-changing shape of sand dunes and how with every change the consequences can be felt by mankind.

SAND DUNES

Sea waves are green and wet,
But up from where they die
Rise others vaster yet,
And those are brown and dry.

They are the sea made land
To come at the fisher town
And bury in solid sand
The men she could not drown.

She may know cove and cape,
But she does not know mankind
If by any change of shape
She hopes to cut off mind.

Men left her a ship to sink;
They can leave her a hut as well
And be but more free to think
For the one more cast-off shell.

HOW IS SAND CREATED?

Sand is any loose, granular material within an upper and lower size range (in the United States - 1/16mm - 2mm; in Europe .2mm - 2mm). Sand is created generally by weathering or crushing of larger rocks; pellets produced by organisms; or precipitation from solution. These processes will all produce sand-size materials. Let's look at each process a little closer.

WEATHERING is physical or mechanical breakdown of rocks. It can be caused by freeze-thaw action or hydration (water fills pores) as rock disintegrates into a loose, granular mass. Decomposition of a rock can convert less resistant minerals into clay, allowing the more resistant minerals to fall out.

EXPLOSIVE action caused by volcanoes can create sand size particles of glass, crystal fragments and lava particles, as the volcano is violently erupting. The particles will settle out onto the continent or more commonly under the sea when an underwater volcanic eruption takes place.

CRUSHING of rocks is a mechanical or physical breakdown of the rock. Glaciers are capable of this kind of mechanism that will actually shatter larger rocks into sand size particles. Abrasive action results in clay size particles. Wind can also break a rock into sand size particles, small particles are loosened and then carried by the wind, which "sandblasts " other rocks.

PELLETS created in the guts o little organisms can also create sand size particles. Many organisms on the bottom of the ocean are debris feeders, scooping up mud, digesting it for food and excreting the other material in pellet form. There are vast portions of the ocean floor that are literally covered with sand size pellets that act just like sand grains.

PRECIPITATION of a supersaturated water, mainly in warm waters with a high calcium carbonate content, creates oolites. Oolites (means egg shaped) are inorganic, sand-size particles that me up vast areas of beaches in places like Florid and Australia. Skeletons of marine critters can also be broken up to create a beach of sand-size shell fragments. Most people think skeletal refers only to vertebrate bones.

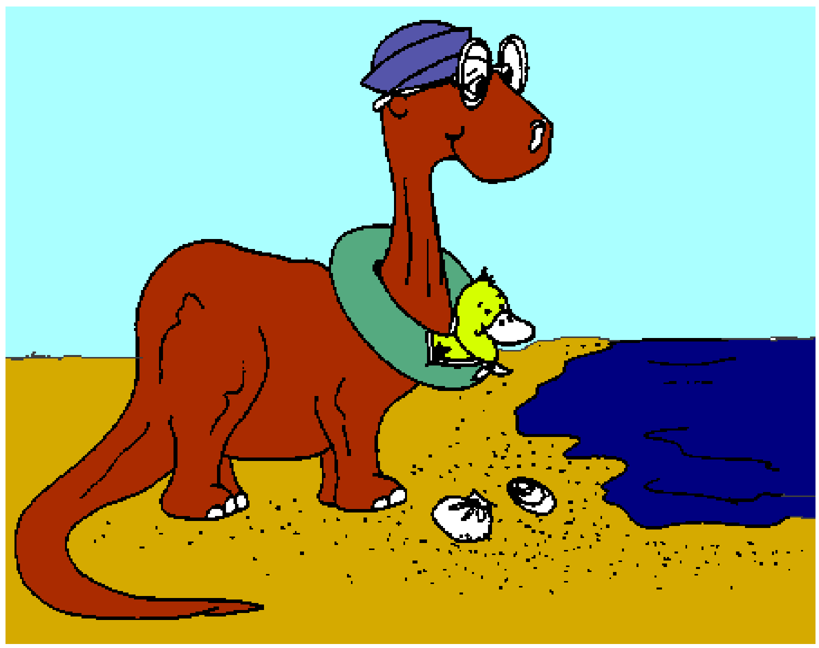
WHY IS SAND IMPORTANT?

Sand is very important in the manufacturing and oil business. Pure quartz sand is used in glassmaking (because quartz is chemically made of the same components as glass), sandblasting and sandpaper industries (because of the hardness of quartz). Other sands are also used to make pottery, to line the hearth of acid steel furnaces, for molding metal casts, abrasives (garnet predominately). Sand is very important to the cement business. Without sand you could have no concrete. Imagine an industrialized country without concrete. Think of America without concrete...no large buildings, no highways, no slab housing, no large pipelines (especially sewage), and on and on.

Deposits of sand under the surface of the Earth are also important because between the grains of sands there are lots of pore space that can be filled up with water or oil. Sand acts like a holding tank for these liquids, just waiting for humans to tap them.

HOW MUCH SAND IS THERE?

Horn and Adam (Pettijohn, Potter and Siever, 1973) estimate that the total volume of sediments in the world is 522,000,000 cubic kilometers. If a third of this is sand, the total volume of sand is about 147,000,000 cubic kilometers...total mass of this sand is 120,000,000,000,000,000, metric tons. If an individual sand grain (1mm in diameter and density of 2.7) has a mass of about .0014 grams, there would be some 857,000,000,000,000,000, 000,000,000 grains of sand on the earth. As most sand grains are of smaller size, the total number would be much larger (8 times if diameter was .5mm, 16 times if grains were .25mm in diameter.



No wonder people have written about sand for centuries. Watching it, playing in it, using it...creates a respect for an item so small, but oh so powerful in numbers.

DRIFTING SANDS AND A CARAVAN

Drifting sands and a caravan, the desert's endless space. Lustrous eyes 'neath Eastern skies, and a woman's veiled face.

Brigands bold on their Arab steeds, tramping all in their wake. From out of the mystic Eastern lore one page from the book we take.
The sands of time move slowly in the hourglass of life.
But not on the desert's drifting sands, where bloodshed is and strife.
Out from the cruel, lashing sting of the worlds's merciless hate,

The soul of a man to the desert came to grapple its change with Fate.
Ruthless, daring, brutal and suave the outer husk became,

But deep down in his innermost heart the man was just the same,
So the drama unfolded for you is set where in days of old Eastern kings of culture and wealth lay buried in tombs of gold.

Drifting sands and a caravan, the desert's endless space.
Lustrous eyes 'neath Eastern skies, and a woman's veiled face.

Yolande Langworthy

AND SO THE SAND DRIFTS ON....

SEDIMENTARY ROCKS

Sand eventually will make sedimentary rocks. Sedimentary rocks are formed in 2 major ways: (1) clastic material (pieces of other rocks or fragments of skeletons) cemented together, and (2) chemical means (usually precipitation). Usually sedimentary rocks are associated with water (erosion, settling, and cemented together). However, other sedimentary environments include wind erosion, and glacial movement.

The best way to illustrate sedimentary rocks is to use pictures that show where water is found. Figure 1 illustrates how sediments are brought to a lake or ocean and settles out. The heaviest grains settle first and as you go away from the source, the finer the particles become. If these sediments become rocks by being cemented together, the gravel and pebbles will be called a CONGLOMERATE, the sand will be called SANDSTONE, the mud size particles will become MUDSTONE, and the silt size particles will become SILTSTONE.

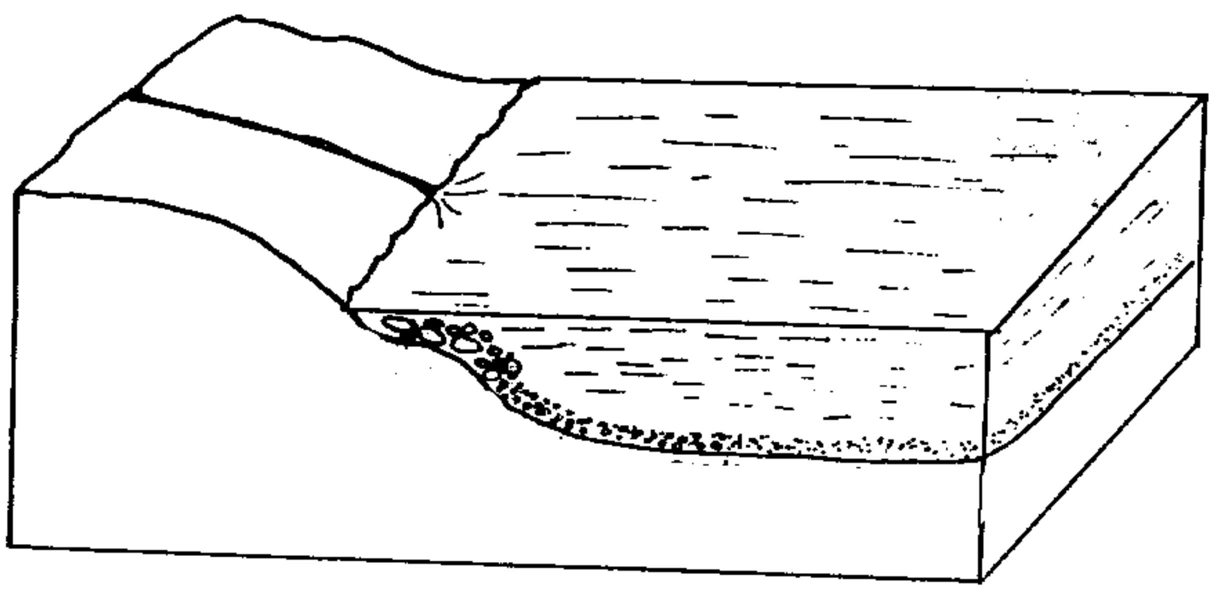


Figure 1. Sediments travel from the land to the ocean by water. These sediments will settle out in the ocean or lake from heaviest to lightest.

Figure 2 shows different environments of deposition for sedimentary rocks. This is a good way to discuss environments of deposition. Identification of sedimentary rocks is based on whether they were formed by the breaking of other rocks (clastic or mechanical), by organic matter (bioclastic), or by chemical means (non clastic). The identification of clastic sedimentary rocks depends on the size of the grains of rocks and the mineral composition. The rock names reflect a combination of both requirements. Sand size particles when cemented together make a sandstone. Smaller than sand size make a shale, siltstone or mudstone. Larger than sand size make a conglomerate or breccia.

As long as you teach your students a consistent process, they will have the power to realize different systems. Recognizing the non-clastic system is mainly by getting familiar with those rocks.

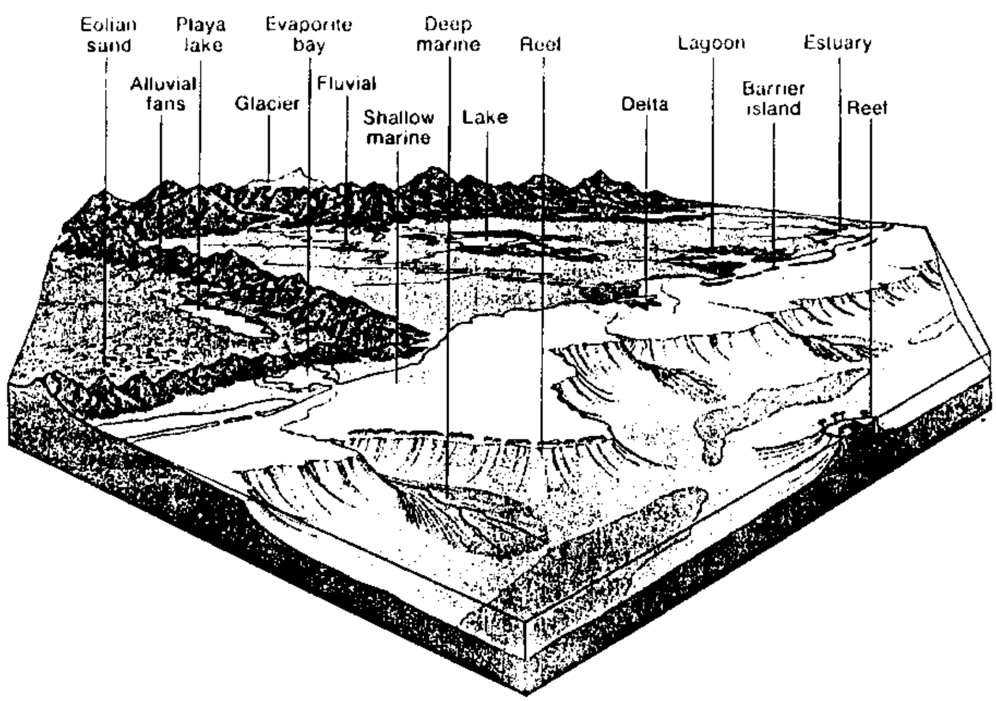


FIGURE 2. Environments that produce sediments that will later become rocks.

ROUNDNESS, SORTING, AND SIZE

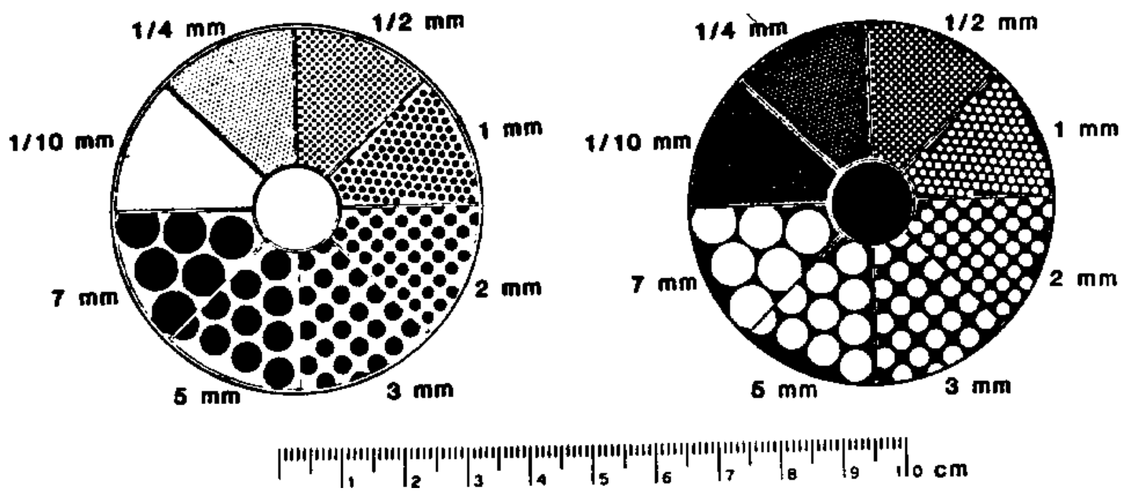
This exercise is for the upper primary grades. For 4th graders you can give each student a different packet of sand. In the 5th and 6th grades increase the number of sands they look at. If you have a microscope in your classroom, the students will be amazed at what they see. You can have them view the sand by having the student put a little on tape (or any sticky surface) and glue it to an index card. The main point you should emphasize is that sand is different...some more than others. It is this difference that we are looking for in this exercise. You might want to get sand that is local...even if it is river sand, lake sand or sandbox sand and have each student compare their sand with the "control." See if you can compare the other sands by comparing it to the control. Each student can report to the rest of the class and have them locate the areas where these were found. Have them bring in sand the next time they go to the beach and have them compare it to the sands in your classroom.

Enclosed is a master of size, sorting, and roundness chart. Each group of children should have a copy of this chart. Have them sprinkle a little sand on the sheet and then compare. They can return the grains to the bag.

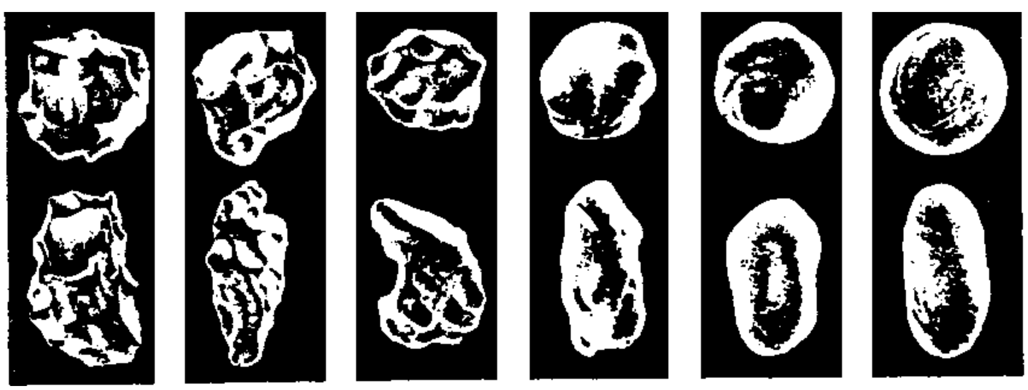
If you have a microscope or a set of hand lenses, have the students try to record what kind of "little rock" they see. In many cases color will help you identify the different types of rocks (ie. the red grains). Have them record these rock types of (by color that is) and see if one red rock from one sand looks like the red rock from another sand.

HOW TO FIND SIZE, ROUNDNESS AND SORTING.

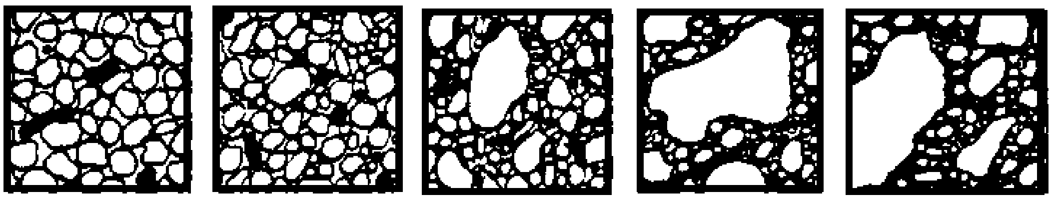
SIZE: You have two circles with dots that are the size that is written along the outside of the circle. There is a dark circle and a light one...only because light sands are seen lighter backgrounds. Have them sprinkle a little on the paper and find the size that the particles fit into. In most cases their will be a range of sizes. Size just tells you how long a particle has been eroding...the longer it has been moving around the smaller it will be in general.



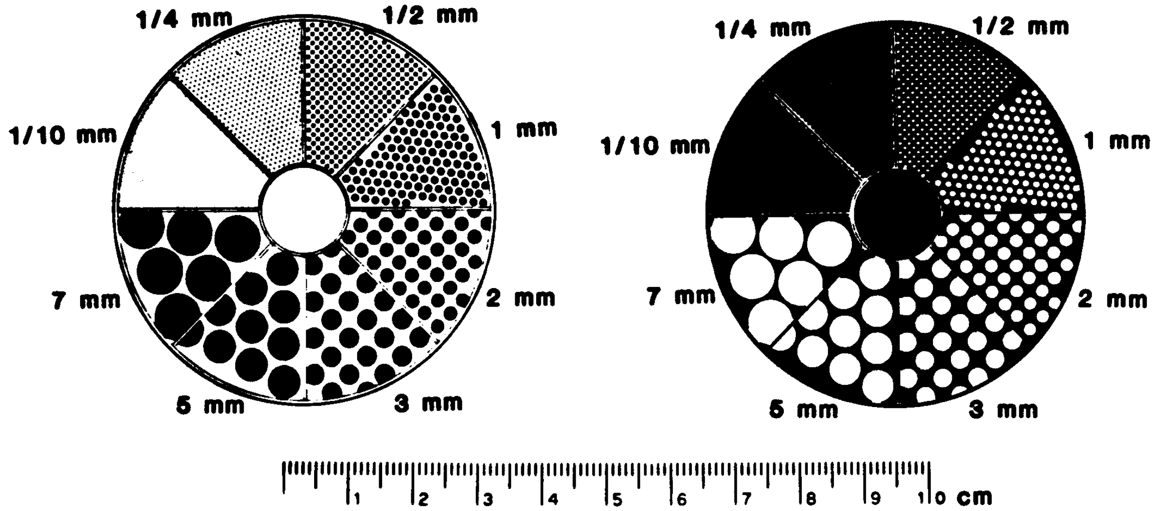
ROUNDNESS: Have the students compare the particles in their sand with the pictures of roundness. You might need a magnifying glass...but a little imagination is fine. The rounder a particle, the longer it has been moving. In the diagram below the most rounded are on the right, the most angular is on the left.



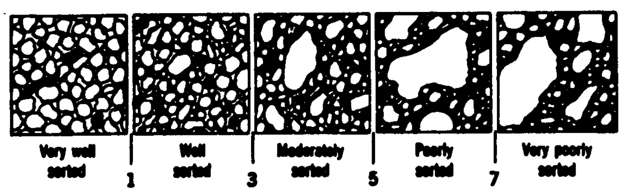
SORTING: Sorting refers to the range in size of particles. If a sample has big and little pieces it is not well sorted, but if all the particles were of the same size it would be very well sorted. Sorting is due to how the sand particles settled down...if it was turbulent sand would not be well sorted, if in a quiet setting it would be well sorted. Also, wind can carry small particles to areas on a beach that are controlled by the wind, like dunes, and these tend to be well sorted. In the diagram below poorly sorted is on the right, and well sorted is on the left.



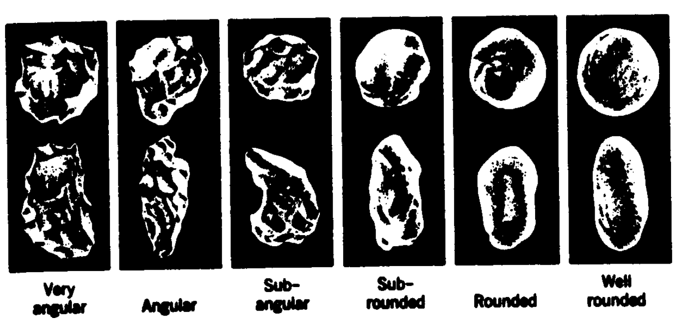
ROUNDNESS, SORTING, AND SIZE CHART



sorting



roundness



LAB SHEET
CHARACTERISTICS

WHEN PEOPLE REFER TO SAND THEY RARELY THINK OF WHAT SAND IS MADE OF. IN THIS EXERCISE WE WILL SEE IF ALL SAND IS THE SAME OR WHETHER THERE ARE SOME DIFFERENCES. MANY OF THE SANDS IN THIS EXERCISE COME FROM CALIFORNIA; ONE IS FROM NEW YORK.

HOW CAN WE MEASURE HOW LARGE A GRAIN OF SAND IS?

HOW CAN WE DETERMINE IF A GRAIN OF SAND IS ROUND OR ANGULAR?

WHAT DOES IT MEAN A "WELL SORTED" SAND?

SAMPLE #1

LOCATION: ______

SIZE ________ ROUNDNESS __________ SORTING_____________

SAMPLE #2

LOCATION:______

SIZE ________ ROUNDNESS __________ SORTING_____________

WHAT ARE THE MAJOR DIFFERENCES BETWEEN THE TWO TYPES OF SAND?

LAB SHEET
SAND KIT

RECORD THE INFORMATION ABOUT THE SANDS THAT YOUR CLASS HAS LOOKED AT. FIND THE LOCATION OF EACH SAND ON THE MAP PROVIDED.

sand location	size	sorting	roundness	characteristics

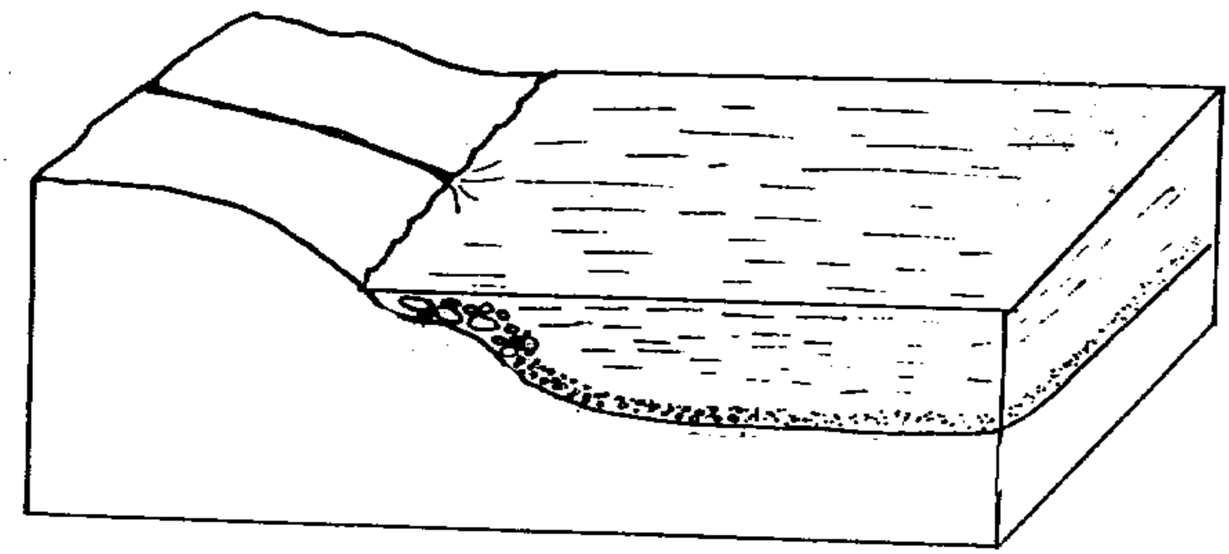
MAP OF CALIFORNIA
Locate where the sands came from.

LAB SHEET

WHERE ARE SEDIMENTARY ROCKS FORMED?

This figure shows that heavy and large particles, are moved by a river to the ocean, drop out first on the ocean bottom., The smaller the particles the longer it takes to settle out the water. SEDIMENTARY ROCKS form when particles (broken down rocks) are glued together by natural cements. PLACE A NUMBER ON THE DIAGRAM WHERE YOU WOULD FINED THESE SEDIMENTARY ROCKS:

1. SILTSTONE
2. CLAYSTONE
3. SANDSTONE
4. CONGLOMERATE (hint: cemented together gravel)



WHY ARE ROCKS ROUNDED?

BILLY FOUND THESE PEBBLES ALONG A RIVER. SOME WERE VERY ROUNDED AND OTHERS WERE NOT. HE PUT THEM IN ORDER FROM ANGULAR TO ROUNDED. CAN YOU THINK OF THE REASON WHY THIS CAN HAPPEN AND WHY THEY CAN BE FOUND TOGETHER?