Sand Activity

Lawrence Hall of Science

This activity outline was developed for use in a variety of informal venues. By design, it provides the content, pedagogy and strategy necessary for implementation by both the novice and experienced informal educator. It is expected that this outline will be adapted and improved upon by the user. We welcome your feedback!

Synopsis of the Activity:
Learners observe a variety of sand samples with the naked eye and up close (with hand lenses and microscopes). They investigate what their sand is composed of and make inferences about the process and forces that made it.

Audience:
Ages 5 and up in groups of 1-10 for 2 facilitators. (The learner's ability to view through a magnifier or microscope is beneficial, although comparisons of color, size and shape differences with the naked eye is enough for this activity.)

Setting
Anywhere in the science center or aquarium where a table can be set up. Seating may be helpful if they are going to be using individual microscopes.

Activity Goals
Learners will become aware that sand can differ in size, shape, and color. They will then be more likely to develop an interest in investigating how those differences occur by asking questions such as what kind of material is it composed of and how do the characteristics of the local geology, weather and ocean affect the attributes of sand on a particular beach.

Concepts
• The world's beaches are composed of sand that is made from biotic and/or abiotic materials.
• Materials on a beach can come from local or distant places and from land or marine sources.
• The attributes of the sand in a particular location are affected by the local geology, weather and water action.
• Sand can also be found along ponds, rivers and lakes.

Ocean Literacy Principles
2c Erosion- the wearing away of rock, soil, and other biotic and abiotic materials occurs in the coastal areas as wind waves and currents in rivers and the ocean move sediments.
2d Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand is eroded from land sources and carried to the coast by rivers, but sand is also eroded from coastal sources by the surf.

Materials
- 2 sets of 6 small resealable bags containing different sand samples labeled with their location

- 5 bottles of white glue
- a few packs of index cards (1/2 white, 1/2 colored)
- 5-10 hand lenses
- "scope on a rope" with monitor and/or individual microscopes
- 5 rock and mineral kits
- collections of small samples of marine animal "hard parts" -coral, shells, sand dollar test, exoskeletons of crabs, bones
- 2 sets of sand samples (see Procedure and Set up section below)
- crayons, colored markers and pencils
- sand shape sign, and sand size gradient sign
- pictures of the locations where your sand samples are from
- pictures of sand or sand poster
- copies of the Mystery Sand worksheet
- Optional, but helpful: Globe or world map, blank paper

Procedure and Set up

1. Assemble materials (worksheets, geology kit, pictures of sand and beaches especially beaches where your sand samples are from, glue, crayons or colored pencils, hand lenses, scope on a rope, microscopes).

2. Make Sand Samples:
   - Use 8 or more 4x4" pieces of heavy stock paper or posterboard, or note cards.
   - You will need at least 4 very different types of sand to make at least 2 sets of sand samples.
   - Make at least 2 samples of each type of sand by smearing a tiny drop of white glue onto the paper and liberally spreading sand onto the glue. Dump the remaining sand back into its container. Allow the card to dry. Label the card with the location that the sand is from.

Guiding Questions

Have you ever been to a beach?
What did you see there?
What color was the sand?
What did the sand feel like?
What do you think sand is made of?
How could we find out what sand is made of?
How might natural and manmade materials be broken down into sand?
How do you think some of these items may have come to the beach?

Activity Description

Note: The activities below are suggestions for possible avenues to pursue. The number of activities and the order of them will be different for every group. Facilitators should "read" the learners and introduce new activities only if the learner is still interested and able (no time constraints, etc) to continue. We would not expect that all learners would do all of the described activities. See Attachment A for more information on the activity's flow.

1. **Greet the Learner.** Invite visitors to your table by asking them if they want to look at sand up close. Introduce yourself and ask them if they have ever been to a beach or where they have seen sand before. Prompt them to tell you where they were and what they saw. (See Guiding Questions) Tell them that you have samples of sand from different places (perhaps from all around the world) for them to look at today.

2**. Introduce the sand cards.** Bring out the sand cards and give the learners a minute or two to explore with their naked eye and with a magnifying lens or a microscope. Ask them questions and observe their reactions to the sand cards to gauge if they have seen this diversity of types of sand.

Note: Expect that different learners will give you more or less of a response depending on many factors, including experience and interest. You may find that you have to probe more or jump to the next phase.

Suggested questions/discussion threads:

a. Talk about what looks like "regular" sand that they have seen before and encourage them to describe other samples and how it surprised them.

Educator What is it about this sand that makes you say it doesn't look like sand?
Learner Oh, it's really big and white. I've only seen small brown sand before.
Educator I see what you mean. What do you think it might be made out of?
Learner I thought sand was tiny pieces of rock, but this doesn't look like that.
Educator How do you think we could figure out what this sand is made of?
Learner Maybe we could look at it a little more closely.
Educator You could use this hand lens/microscope if you like to look more closely. What do you notice?
(In this case skip to step 4.)

b. Encourage learners to describe the differences between the sand samples by having them group or order the samples. Depending on their level of interest and initiative you can have them focus on the samples in a number of ways. Here are two ideas:

i. Have them choose any criteria and sort their cards. Then have them explain (or have another learner guess) their criteria (size, color, sand and not sand). Have them resort if they have the interest.

ii. If they have already noticed one attribute of the sand, e.g. size, have them order their samples smallest to largest. Have them tell you why they think sand may be different sizes in different places.

3. **Composition of sand.** Ask the learners if they have an idea of what these sands are made out of and how it might have been made into sand. Allow them to compare and contrast all samples or, especially for younger audiences, have them focus on one sample. Have them explain a few of their ideas and ask them how we might discover what the sand is made of.

4. **Comparing Sand.** Many learners will want to look at a few samples. Encourage them to do this and ask them to compare attributes of the different samples (color, shape, size). Suggest that they might want to take turns observing samples and sharing their descriptions with others at the table.

5. **Introducing Rock and Mineral Kits.** Have the rock and mineral kits and any animal hard parts (coral, shells, sand dollars) accessible so that they can note similarities to these materials. (They may have noticed and used them already.)

6**. Refocus discussion on composition of sand**. Refocus the discussion on what the sand is made from and how it is formed.

Educator So what do you think this kind of sand is made from?
Learner Shells and this pink rock here.
Educator How did you figure that out? *or* Why do you think that? *or* What evidence did you have that it was shell and pink rock?
Learner From here it just looks white, but when you look through the scope, you can see these clearish/pinkish bits that look just like this rock sample here.
Educator Interesting. What did ***you*** notice under the scope? (Directed at another learner.)
Educator So how do you think the rock and shell got to be this size?

7. **Discussion about how sand became sand-sized.** Encourage the learners to discuss their ideas about how materials came to be "sand sized" with each other in pairs or small groups. Then have the learners share out their ideas with the whole group.

Learner I think that erosion made the rock or shell smaller
Educator What is erosion? How does it work?
Learner Erosion happens when things are worn away or made smaller by wind or water or other hard materials moving past or smashing into an object.

Take a poll to find out which factors (wind, water, smashing rocks) could be found at a beach. Ask learners how wind or water action would affect the different sizes and shapes of sand. "What would happen to the tiny grains or the big grains in waves or wind?" Have them think about how rock may have arrived at the beach and how it became so small.

Sample discussion:

Ask the learners to imagine they are a very tiny sand grain, about the size of the smallest grain in their group's samples.
Educator What might happen to them if they were hit by a large wave or were in a fast rushing river? Do they think they would be able to stay in one place? What about if they were one of the larger grains?
Learner If I was smaller I think I would move a lot, but if I was larger, I might stay put because I'm heavier.
Educator What could the size of the sand grain tell you about the kind of place your sand sample was from?
Learner These grains are very small, they were probably from an area with slow moving water such as a protected bay beach or a pool in a slow moving stream. Large waves or fast water would pick up small grains and carry them away down the river or off the beach and out to the ocean. So if there were a lot of wave action the grains would probably be bigger.
Educator Are there any sand samples that we know are from a place that has slow moving water?
Learner Yes the one from the Lake, the water doesn't move much there.
Educator So how do those grains compare with the other beaches?
What other factors might affect sand size?

8. **The Sand's location.** Have the learner look at the globe/world map and find the location of the place that their sand is from. Provide a beach picture from that location to perhaps confirm some of their findings or spark more conversation.

Learner The mountain behind that beach is completely black rock, just like the sand. Maybe the sand eroded from that mountain and made it's way to the beach.

Educator How would sand have gotten to the beach?

Applications:

Use one or more of the following activities as a reflection and take home piece for the visitor if they have an interest.

Imagine the Beach

After exploring the sand and discussing what sand is made of and what physical forces affect the size and shape of sand, have the learner pick their favorite sand sample and imagine the beach it came from. Have them incorporate their ideas about the make up of their sand and the physical forces on that beach into a picture of that beach. Example: a beach scene with large waves, and high wind with a volcano in the background.

Make a Sand Sample to Take Home

If the visitor is interested, show them how to make a sand sample to take home.

a. Choose a small ziplock bag of sand.

b. Select an index card and place a quarter-sized smear of white glue in the center of the card. If the chosen sand is dark in color, choose a white card. If the sand is light in color, choose a colored card.

c. Carefully open the ziplock bag of sand and sprinkle a pinch or two of sand onto the glue. Completely close the ziplock bag.

d. Have them put their name and the location from where the sand was taken on the card. (You may also need to have a space set up for visitors to leave the samples while they dry.)

Mystery Sand Sample

1. Introducing the Mystery Sand. If the learner is still engaged, challenge him/her with a new "mystery" sample. Tell them that this is a mystery sample and they are going to use all the techniques and tools they used earlier to try and figure out 1) what this sand is made from, 2) what the local conditions are at that beach (windy or not, how strong is the wave action) and 3) how this material got to the beach.

2. Learners make mystery sand card. See "Sand Sample to Take Home" directions and have the learners make a sand card with the mystery sand. (Omit labeling with the location of where the sand came from.)

3. **Introduce Mystery Sand Worksheet.** Introduce the learner to the worksheet. Be available to answer any questions they might have.

Note: This may be a good time to allow them to investigate on their own while you engage new learners in the activity. But be sure to reengage the independent worker by asking what they have noticed/discovered, or what they think about this new sample.

4. Investigate the Mystery Sand. Challenge learners to use the same

observation skills they used to sort the sand samples. They can use these skills to help them match their "mystery sand" to one of the known samples. Remind them to use the worksheet to help them find out as much as they can about their "mystery sand".

5. Imagining the Beach. As they finish, ask them to imagine the beach where their sand came from. What does it look like? Is it a sunny warm place with tropical animals or a cold one? Where did the sand come from? A coral reef? A mountain? A lava flow? Clam and mussel shells? Is the sand very old or very young? What **evidence** do they have for each inference? Are there big waves or small waves?

6. **Draw a Picture.** If possible, have each learner draw a picture of what their beach looks like. Have them label their drawings with the name of where the sand came from. Remind learners they can take their "mystery sand" sample home with them.

Prep Section
Collect sand samples from a variety of locations. Put samples into small resealable bags and label with the location, or an identifying number mark if you prefer them to be mystery samples. The more diverse the collection is in material, size and shape the more interesting the experience will be for the visitor. Even "regular" sand looks very interesting under a microscope.

Related Activities/Extensions/Modifications
For younger audiences (ages 7 and below) they will need lessons on how to use a hand lens and will likely need you or another adult to focus the microscope for them. Have them describe what they see in the scope to insure they are actually able to see the sample in focus and that they are looking through it properly. Be prepared to instruct everyone on use of the microscopes.

For all ages it is recommended to have pens and paper available so that they can draw the location that their sand came from. This may be best stationed at a nearby table on busier days to clear the main table for sand viewing and discussion. Usually kids will be the most interested in doing the drawings, but adults enjoy this exercise as well.

Additional Resources
<u>On Sandy Shores</u> Teacher's Guide LHS GEMS ISBN 0-912511-98-2

Background (from On Sandy Shores GEMS Teacher's Guide)
Note: This is meant as background information for educators to give them a broader knowledge base with which to facilitate discussion and discovery by the learners. This is not meant to be read to the learners.

Nearly all solid materials in the world, both living and non-living, will eventually be eroded into sand. Mountains, rocks, minerals, 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.

Beaches can form wherever water moves loose material onto a shore. Rivers, lakes, ponds, and oceans can all have beaches. These beaches can be made of sand, gravel, or cobbles-these terms refer only to the size of the individual grains on the beach.

Some sand is produced right at the shore where waves crash on rocks, headlands and reefs. For example the red sand beaches on the Hawaiian and Galapagos islands 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 the coral polyps, grind up the corals

with their teeth and can excrete up to 100 pounds of coral sand per year. Pink sand might be full of coralline algae fragments. Other sands come from far away inland, when mountains are weathered by freezing, wind, rain, and running water and the fragments are carried down streams and rivers to the seashore. Once the pieces of rock reach the ocean, the strong, continuous force of the ocean waves sorts the particles by size. Quartz, a glass-like mineral, is the most common mineral on earth and is nearly insoluble in water. It is often the most common component of these transported sands. In fact 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 0.06 -2 mm. Where particles are deposited depends on the speed of the water carrying them. In fast moving river or ocean water only the largest, heaviest sand grains settle out. On wave impacted outer coast beaches, only large sand grains or 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 ocean bottom where the water is barely moving.

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 the waves to always strike the coast from the same angle, sand can be slowly transported great distances along the coast. (Sand grains can be hit by as many as 8000 ocean waves a day!) The finest grains of sand can be carried in the wind and are often deposited high up on the beach in the dunes. Dune sand is usually noticeably finer and lighter than beach sand.

Vocabulary

Sand-small substrate particles between the size of silt and pebbles. (For your own reference between 0.0625 and 2 millimeters in diameter.)

Erosion – the wearing away of rock, soil and other biotic and abiotic material due to interaction with wind, water, ice and other forces.

Abiotic- nonbiological, not involving or produced by an organism, never-alive

Biotic- biological, living, produced by an organism, or once alive

MYSTERY SAND

1. What Is Your Sand Made From? What's In Your Sand?
Look carefully at your sand sample with your magnifier (or microscope if you have one). Which of the following things are in your sand (you can circle more than one).

• small rocks • pieces of shells • pieces of glass • pieces of wood

• pieces of plants • pieces of plastic • other things (name them):

2. Sand Shapes. Draw some sand grains. Draw them BIG!

3. Sand Shapes. When sand first breaks off from rocks, it's usually sharp and pointy. The longer sand moves around, the more rounded it gets. How old do you think your sand is?

not rounded– a little rounded– very rounded–

usually "young"

usually a little "old"

usually "old"

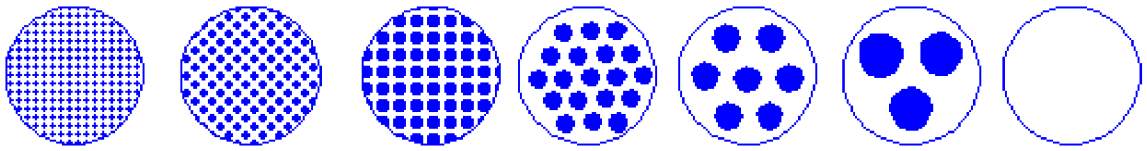
Hint: River sand is often young sand, and ocean sand is often old.

4. Sand Color. What color is your sand? Look closely at your sand with your magnifier. List the colors you see or use crayons to show all the different colors of your mystery sand.

5. Sand Origins. Where do you think your sand came from?

White rock sand is mostly quartz from mountains.
Colored rock sand is from other kinds of rocks from mountains.
Black sand is usually from lava from volcanoes.
Reddish orange sand is usually from lava from volcanoes.
White coral/shell sand is usually from coral and shellfish in the ocean.
Colored coral/shell sand is usually from colored coral and shellfish.
Colored glass or plastic is broken glass and plastic from human garbage.
Wood is from plants.

6. Sand Size. **Compare your sand sample to the size chart below**. Imagine the black dots are grains of sand. Which group of dots are about the size of your sand grains? If your sand is not like any of these use the empty circle to draw how yours looks.



tiny grains (no waves) | small grains (small waves) | big grains (big waves)

7. Sand Size – Big Waves, Small Waves, or No Waves?

Do you think your sand came from a beach with big waves, small waves or no waves?

Big grains of sand are usually from a beach with bigger waves (big waves wash away small grains).
Small grains of sand are usually from a beach with small waves.
Tiny grains are from protected bays where there are no waves.

8. Imagine the beach.

What do you think the beach where your sand came from looks like?
Is it a sunny warm place with tropical animals or a cold one?
Where did the sand come from? A coral reef? A mountain? A lava flow? Clam and mussel shells?
Is the sand very old or very young?
Are there big waves or small waves?

Now draw a picture of the beach your sand might have come from.

The Learning Cycle and the Sand Activity

INVITATION

Welcome: "Hi my name is _____.
I have some sand samples here from around the world.
Where have you seen sand before? What did the sand (or place) look like?
What do you think sand is made of?
Go ahead and take a look at these samples. They are from Belize and The Mediterranean...here this one is really neat. Take a look under the microscope."

FREE EXPLORATION

Observing Samples: "What do you notice?"
Visitor Notices: Color, Shape and Size

GUIDED EXPLORATION

Communicating observations
"What colors did you notice?"
"What shapes are the grains?"
"Are all the grains the same size?"

Noticing Different Attributes
"How do you think this other sample will look under the microscope?"
"Do you think it will look the same or different?"

Comparing Samples: Have learners group or order cards by color, shape or size.
"Which ones are light colored? Which are dark?"
"Did you notice the shape of the grains in that sample?"
"What do you think the different sands are made of?"

CONCEPT INVENTION

Considering composition (what the sand is made of):
"Why do you think the sand samples are different colors? sizes?" shapes?"
"Would sand made from shells be the same color as the sand made from rocks?"

Considering erosion and the forces that make sand:
How can all these different things become grains of sand?
"Why do you think one beach has tiny grains of sand and another beach has larger grains?"
"How would wave action affect the size of the grains of sand on the beach?"
"How did all the rocks/shells get to the beach?"

APPLICATION

Completing Mystery Sand Worksheet:
Imagine and draw a beach where your sand came from.

Attachment A

The difficulty in writing guidelines for an informal interaction with learners is that each interaction is different and each visitor brings a variety experiences and ideas that they (and you) can draw from when investigating sand. An additional complicating factor is that the informal learner is in charge of their own time, unlike a formal education situation where the learner has a dedicated amount of time for an activity, which puts a greater emphasis on keeping the learner engaged. Keeping the learner interested in the activity often involves a great deal of interaction on the part of the facilitator to personalize the lesson for the visitor. Due to the fluid nature of these interactions it is often difficult to "script" a lesson. What we have done for the Sand activity is to break the interaction down into layers and demonstrate how the facilitator can use the learner's ideas, observations and questions to guide their investigation of a subject.

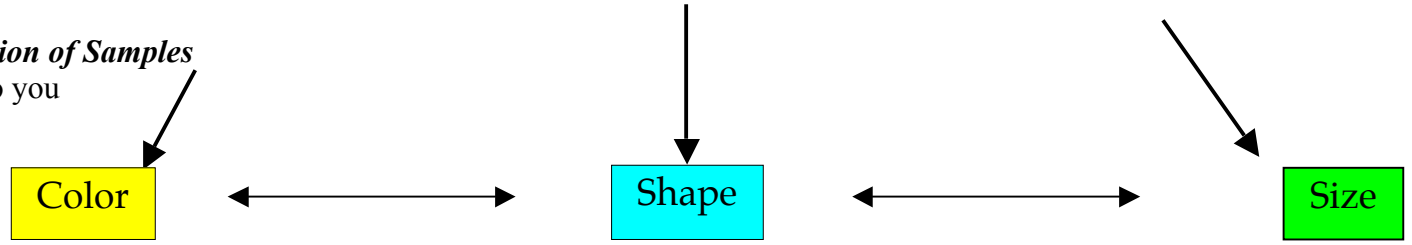
Following is a guide map to the activity. Graphically, it represents the fluid nature of the interaction. In it, the activity is broken down into three layers. In the first layer, the visitor observes the sand samples (one or more) with the naked eye, or with microscopes/hand lenses. The second layer has visitors focusing on details by having them describe the attributes (size, color, shape) that they observe and make comparisons within and between samples. In the third layer, the visitor considers the causes of the traits found in their sand sample, using the similarities and differences between samples as well as new information to refine their ideas about how sand forms and what factors affect the sand at a certain location.

Facilitators should allow the visitors time to explore the sand, encourage them to share their observations and ideas and play off their observations to delve further into the question "what is sand and how does it form?". Another major roll of the facilitator is to gauge when it is advantageous to go more deeply into the subject, by following one attribute through the layers, or to direct the visitor's attention to another attribute, at any layer.

Welcome: "Hi my name is _____. I have some sand samples here from around the world. Where have you seen sand before? What did the sand (or place) look like? What do you think sand is made of? Go ahead and take a look at these samples. They are from Belize and The Mediterranean...here this one is really neat. Take a look in the microscope."

Layer 1:
Observation of Samples
"What do you notice?"

Visitor Notices



Layer 2: ***Communicating observations.***
"What colors did you notice?" "What shapes are the grains?" "Are all the grains the same size?"

Encourage learner to compare samples and notice different attributes
"How do you think this other sample will look under the microscope? Do you think it will look the same or different?"

Have the learner group or order sand samples by color, shape or size.
"Which ones are light in color? Which are dark?" "Did you notice the shape of the grains in that sample?" What about the size?
"What do you think sand is made of?"

More observations compare/contrast *More observations compare/contrast*

Layer 3: ***Considering Causal Factors***
"Why do you think they are different colors?" "Why do you think they are different shapes?" "Why do you think they are different sizes?"

Visitor Response: *What sand is made of.* *What sand is made of &/or forces of water/wind.* *What sand is made of &/or forces of water/wind*

Depending on visitor's responses/interest, ask some of the following questions to help visitor think about causal factors:
"How could being made of rock cause the differences (variation) in color and/or shapes?"
"Would sand made from shells have the same shape/color as the sand made from rocks?"
"Would the stuff that sand is made from affect the size of the grains? How?"
"Why do you think one beach has tiny grains of sand and another beach has larger grains?"
"How do you think wave action might affect the size of the grains of sand on the beach?"
"How do you think rocks/shells get to the beach?"