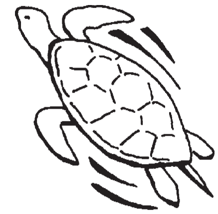


Sand Analysis Lab Procedures & Resources

Materials

- Student Page “Sand Analysis Lab Data Sheet” and the Sand Size Grid (pp. 14-15,19)
- Two 1/4 cup samples of sand, one each from Oneuli and Oneloa beaches
- Two sheets of notebook paper or white paper
- Millimeter ruler (ideally with fractions of millimeters marked)
- Teaspoon
- Two petri dishes or small bowls
- Two tbsp. vinegar
- Two hand magnifying lenses or dissecting microscopes (higher magnification is better)
- Forceps capable of picking up one grain of sand
- Two weighing papers or small squares of construction paper
- Magnet
- Glue and a few toothpicks OR cellophane tape

Sand-Size Lab Procedure

1) Spread out a small amount of sand from the first sample on the provided sand size grid. Use the forceps to select 25 grains of sand from the sample, and measure each using your sand-size grid. Record your measurements on the data sheet. Calculate the percentage of grains that fall into each size range given on the lab data sheet. Repeat this procedure for the second sample.

2) Now, observe the color of each sand sample, recording your observations on the data sheet.

3) Record your group’s hypothesis about which sample contains the most “biogenic” sand components, based on comparing the color of the samples. Explain your reasoning. Biogenic sands are made up of the remains of once-living organisms such as shellfish, coral, coralline algae, and sea urchins.

4) Using the hand lens or dissecting scope, observe each sample for remains of plants and animals. Use a forceps to pick up individual sand grains for closer inspection. See the lab resource sheets for images of some of the biogenic sand components you might see. Estimate the percentage of biogenic sand in each sample based on your observations.

5) Place 1/4-1/2 teaspoon of sand from each sample into a clean, dry petri dish (or bowl). Label each dish with the corresponding beach name. Spread the sand out into an even layer in the bottom of the dish. Pour one tablespoon of vinegar into each dish.

   Vinegar and calcium carbonate, the major component of the shells and skeletons that make up biogenic sand particles, react chemically when exposed to each other. The bubbling you will see is the evidence of that reaction. Observe both samples and note whether one of them bubbles more than the other. Record your observations and note which samples seem to contain the most biogenic components.

6) Place a small amount of each sand sample on a weighing paper (or square of construction paper). Hold a magnet under the weighing paper and look for particles of sand that are attracted to the magnet. If you find any of these, they are probably magnetite, a mineral that is an oxide of iron. Note their presence on the data sheet.

7) Using the hand lens or dissecting scope, look for particles of rocks or minerals in each sand sample. These are “detrital” sand components, meaning they are produced by disintegration or erosion. These components are also referred to as “terrigenous” (originating from land) or “abiogenic” (of a non-living origin). Use the reference sheets provided to help you identify different components. Place samples of your findings on the data sheet with tape or glue.

8) After you have finished identifying sand components, answer the questions that follow the data tables.

Lab Resource Sheets

Common Biogenic Sand Components

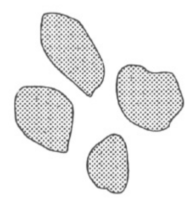
Some animals (such as corals and molluscs) and plants (including some algae and coralline algae) that live on reefs and in shallow marine waters make hard skeletons of calcium carbonate. Fragments of their skeletal remains form much of the sand found on Hawaiian beaches.

Corals and coralline algae build the framework of reefs, which are then broken down into sand by "bioerosion" and "mechanical erosion." Bio-erosion refers to the actions of animals that break down the reef, such as grazing fish and urchins, boring sponges and worms, and bivalves that attach themselves to the reef. Mechanical erosion refers to the forces of wave action.

Some living organisms, such as molluscs, "echinoderms" (a phylum of marine animals including starfish, brittlestars, sea urchins, and sea cucumbers), and other plants and animals that form "calcareous" (calcium-based) skeletons, contribute to sand production directly as their remains are broken and polished by wave action and washed up on beaches.

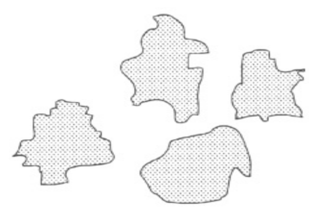
Fragments of coralline algae

These marine algae secrete large quantities of calcium carbonate to form a robust skeleton. Although they are reddish while they are alive, the skeletal fragments are orange, tan, gray, or whitish.



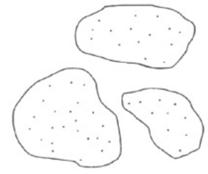
Coral fragments

Countless individual polyps secrete calcium carbonate to form the reefs in which they live. This reef structure is broken down into pieces and grains of various sizes primarily by the action of waves and marine animals. These fragments are white to gray in color and feel gritty.



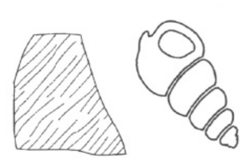
Calcareous algae

Halimeda is a genus of green algae that secrete small amounts of calcium carbonate to form a delicate skeleton. The fragments of these skeletons are a whitish color.



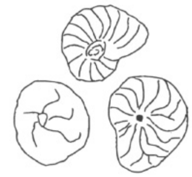
Molluscs

Marine organisms such as cowries secrete protective shells of calcium carbonate.



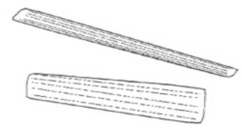
Foriminifera

These tiny "shells" are actually skeletons of single-celled animals, "foriminifera." They are usually tan to yellow in color, and generally round, smooth, and shiny.



Echinoderm spines

Fragments of sea urchin skeletons (or "tests") and spines are common sand components. They range in color from reddish to greenish, brown, or gray. They may be ornamented with beadlike dots.



Images: Jodi Harney

Common Detrital Sand Components

Other sand components are formed as volcanic land wears down through the weathering and erosive forces of running water, plants, temperature changes, chemical reactions, and wave and wind action. These components are referred to as abiogenic, terrigenous, or detrital grains.

Basalt

This is the primary component of lava flows. Eroded basalt forms dull black, gray, or brownish red grains of sand.

Garnet

These crystals are usually amber-colored but may range to a light pink color. Perfect crystals, which have 12 faces, are rare because wave action rounds off the edges quickly.

Olivine

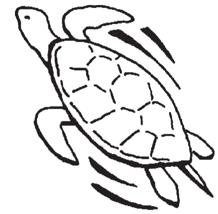
This is shiny, transparent or translucent crystal sometimes found in basalt. It varies from olive green to brownish, and may contain specks of other crystals.

Magnetite

This is a common magnetic mineral with opaque black crystals resembling double pyramids.

Volcanic glass

These shiny, black, irregular particles have sharp edges and are formed as hot lava cooled rapidly, often from contact with water.



Sand Analysis Lab Data Sheet

Record your Hypothesis here:

	Oneloa Beach		Oneuli Beach	
1) Sand grain size	# of grains > 1.5mm	% >1.5mm	# of grains > 1.5mm	% >1.5mm
	# of grains 1-1.5 mm	% 1-1.5 mm	# of grains 1-1.5 mm	% 1-1.5 mm
	# of grains .5-1 mm	% .5-1 mm	# of grains .5-1 mm	% .5-1 mm
	# of grains < .5 mm	% <.5 mm	# of grains <.5 mm	% .<.5 mm
Sand size description	Circle the description that best fits: Coarse=>1.5mm Medium=.5-1.5mm Fine=<.5mm Mixed=grains range from coarse to fine		Circle the description that best fits: Coarse=>1.5mm Medium=.5-1.5mm Fine=<.5mm Mixed=grains range from coarse to fine	
2)Sample color				
3) Comparison of sample colors				

	Oneloa Beach	Oneuli Beach
4) Based on color, circle the percentage range that reflects the best proportion of biogenic components? Explain.	0%- 10% 10%-25% 25%-50% 50%-75% 75%-100%	0%- 10% 10%-25% 25%-50% 50%-75% 75%-100%
5) Based on the vinegar test, circle the percentage range of biogenic components. Explain.	0%- 10% 10%-25% 25%-50% 50%-75% 75%-100%	0%- 10% 10%-25% 25%-50% 50%-75% 75%-100%
6) Magnetic metals present? Circle the percentage range of the sample that is magnetic.	0%- 10% 10%-25% 25%-50% 50%-75% 75%-100%	0%- 10% 10%-25% 25%-50% 50%-75% 75%-100%
7) Detrital components Tape or glue and label an example of each one you find: • Basalt • Garnet • Olivine • Magnetite • Volcanic glass		

Questions Following the Sand Lab

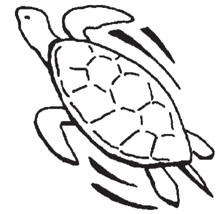
1) Write a one paragraph description of each sand sample you analyzed. Include information about location, particle size, color, and composition.

2) Compare the two samples you analyzed.

3) Based on your analysis, was your hypothesis correct? Explain.

4) Based on the differences in sand grain size between Oneloa and Oneuli beaches, develop a hypothesis about the environmental conditions at both beaches.

5) What could explain a seasonal variation in sand grain size on many sandy beaches?



6) Scientists who study sand and coastal areas have observed that the average size of particles on a beach is correlated to the slope of the beach. In general, the steeper a beach is, the larger the particle size.

The table below shows part of the Wentworth scale, a system of classifying sediments by particle size. Look at the table and think about how you would set up a study to test whether these relationships are accurately described. Write a description of this study.

Type of sediment	**Diameter (mm)**	**Average beach slope**
Cobble	65-265	19°-25°
Pebble	4-64	13°-19°
Granule	2-4	11°
Very coarse sand	1-2	9°
Coarse sand	0.5-1	7°
Medium sand	0.25-0.5	5°
Fine sand	0.07-0.25	5°

Wentworth grain size scale adapted from E. Barbara Klemm, et al., The Fluid Earth: Physical Science and Technology of the Marine Environment, *Curriculum Research and Development Group, University of Hawai'i, Honolulu, 1990, p. 139.*

Sand– Size Grid

1.5 mm ■
1.0 mm ▪
0.5 mm ·

For Sand Analysis Lab

Sand– Size Grid

1.5 mm ■
1.0 mm ▪
0.5 mm ·

For Sand Analysis Lab

Sand– Size Grid

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