

Activity #1

Sand Analysis Lab

●●● Class Period One *Sand Analysis Lab*

Materials & Setup

- “Oneuli and Oneloa Beach” images (pp. 7-8)
- Projector and screen
- Map of Maui

For each lab group of three to four students

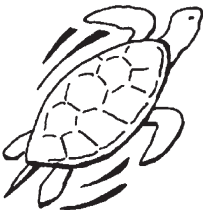
- Student Page “Sand Analysis Lab Procedures and Resources” (pp. 11-13)
- Student Page “Sand Analysis Lab Data Sheet” (pp. 14-15)
- Student Page “Sand-Size Grid” (pp. 19)
- Two 1/4-cup samples of sand, one each from Oneuli and Oneloa beaches (included with this curriculum; instructions for collecting more in “Guidelines for Collecting Sand,” p. 4)
- Four 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

For each student

- Student Page “Questions Following the Sand Lab” (pp. 16-18)

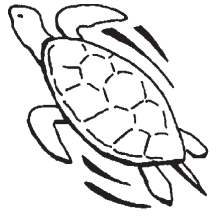
Instructions

- 1) Before beginning the lab, ask students to think of their favorite beaches on Maui. What makes these beaches stand out from the others?
- 2) Have each student identify a familiar beach and write a description of the sand at that beach. Challenge students to make that description as detailed as possible. (If students are keeping a journal, have them write these descriptions as entries.) If students are having difficulty, ask them questions such as:
 - What does it feel like when you walk or sit on it? Is it smooth, sharp, gritty?
 - What color or colors is it?
 - Is the sand uniform size, or are there larger pieces of rock, coral, or shells mixed in with smaller sand grains?
 - Does it stick to your body or is it easy to brush off?



Activity #1
Coastal Unit 1

- Are the grains coarse or fine? How do they compare with other beaches?
- 3) Ask several students to share their descriptions until you have heard some clear contrasts. Then have the class draw comparisons among the sandy beaches described. Ask students to brainstorm about what might cause these kinds of differences in sands at different beaches. Write their ideas on the board or overhead.
 - 4) Have students brainstorm what sand is made of and record those ideas as well. (There are two basic components of sand: “Biogenic” components are the fragmented or whole remains of marine animals and plants that have hard skeletons of calcium carbonate. These organisms include corals, molluscs, sea urchins, single-celled animals called “foraminifera,” and algae. “Detrital” components are fragments of rock that have been worn down through weathering and erosion. They include eroded basalt, the most common material in lava flows; sharp fragments of lava called volcanic glass; and minerals such as garnet, olivine, and magnetite.)
 - 5) Have students brainstorm what could cause differences in grain size (how coarse or fine the sand is) at different beaches. (Particle size is influenced by the materials from which the sand is made and how easily they are broken and worn down. Another key factor in determining particle size is wave size and energy. Each crash of a wave on shore temporarily suspends some sediment—sand—in water. The amount of sediment is directly proportional to the size of the wave. The size of the sediment that can be transported by a wave is also proportional to its size and energy. A beach subject to large crashing waves will generally have coarser sand than one that is lapped by small calm swells because the larger waves can transport the finer sediments out to sea. This factor can account for seasonal differences in the sand size at beaches, as well.)
 - 6) Display the images of Oneuli and Oneloa beaches. Locate the beaches on the map of Maui (they are just north and south of Pu‘u Ōla‘i, near Mākena). Find out if any students have been to these beaches. They may know the beaches by other names. Oneuli is sometimes called “Black Sand Beach.” Oneloa is also known as “Big Beach.” Tell students they will be studying these two beaches more during this activity.
 - 7) Divide the class into lab groups of three to four students. Make sure they have all of the equipment they need and hand out the Student Pages “Sand Analysis Lab Procedures and Resources” and “Sand Analysis Lab Data Sheet.”
 - 8) Pass out labeled sand samples from Oneuli and Oneloa beaches. Ask students to look at the beach photos (leave the images up) and the sand samples. Ask them to generate hypotheses about the composition and relative grain size of the sand at each beach, and record these hypotheses on their group’s lab sheet.
 - 9) Run the sand analysis lab, following the instructions on the Student Page “Sand Analysis Lab Procedures and Resources.”
 - 10) As homework, assign the Student Page “Questions Following the Sand Lab.”

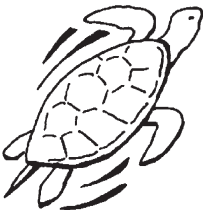


Journal Ideas

- Go to a beach and write down everything you can observe about the sand. Think about why it might be the size and composition that it is, and write your ideas.
- Write a chant or a poem about the sand on Oneuli or Oneloa beach.

Assessment Tools

- Participation in class discussion
- Lab conduct
- Student Page “Sand Analysis Lab Data Sheet”
- Student Page “Questions Following the Sand Lab” (teacher version, pp. 6-7)



Teacher Background

Guidelines for Collecting Sand

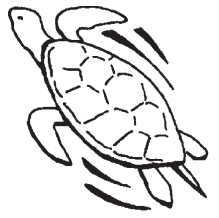
Sand samples are provided for the lab in this activity. These guidelines are intended for enrichment activities or if you need to replenish the samples that came with this curriculum.

- 1) Collect small samples, about 1/4 cupful of sand for each lab group.
- 2) If you are taking samples from more than one beach, collect the samples in approximately the same location at each beach (e.g. near the water line, middle beach, or near the back of the beach). This will make your samples more comparable.
- 2) Place each sample in a clean plastic bag or covered container. Seal the container and label it with the following information:
 - The name of the beach
 - The date of collection
 - The location on the beach (e.g., swash zone, middle beach, near the back of the beach)
- 3) Take the sand samples home, rinse each one in fresh water, and spread them out to dry on newspapers or paper towels in a sunny, protected spot. When they're completely dry, put them back in their dry containers.

Conservation Note

Even though it may seem as though you're taking a very small amount of sand from the beach, please be careful to take only as much sand as you need. Unless you are saving it for future classes, please return the sand after you are finished using it. Think about what would happen to our beaches if many people were removing sand from them.

Teacher Background



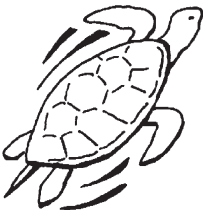
General Outcomes for the Sand Analysis Lab

Although specific lab results will vary, student observations will probably be similar to those given below.

Oneloa Beach

- Smaller grain size—averaging around .5 mm (.02 inch)
- Golden color with some white and black flecks
- Higher percentage of biogenic components
- A few magnetic grains present
- Larger grain size—averaging between .5 and 1 mm (.02 and .04 inch)
- Brown-black color with red, white, and orange flecks
- Lower percentage of biogenic components
- Many magnetic grains present

Oneuli Beach



Teacher Version

Questions Following the Sand Lab

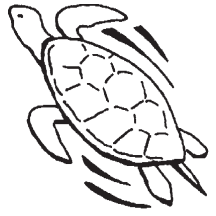
Questions 1-3: Use “General Outcomes for Sand Analysis Lab” .

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

Well-reasoned responses are acceptable. The finer sands at Oneloa suggest smaller, less energetic waves overall than at Oneuli, where the sediments are larger.

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

Well-reasoned responses are acceptable. Stormier weather during the winter tends to bring larger waves, increasing sand grain size on beaches. As gentler summer swells again predominate, sand grain size decreases again. The seasonal effects differ from beach to beach, depending upon how exposed they are to winter storm waves.



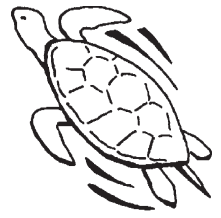
- 6) Scientists who study sand and coastal areas have observed that the average size of particles on a beach is correlated to the slope of the beach. In general, the steeper a beach is, the larger the particle size.

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.

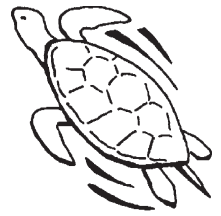
Well-reasoned study designs are acceptable. The essential components to study would be slope and sediment size, across a range of slopes and sediment types.



Oneuli Beach



Photos: Allison Borell



Oneloa Beach



Photos: Allison Borell