ABSTRACT

Curriculum reform efforts focus on project-based learning and problem solving activities. *Exploring the Beach* is one such activity that also integrates mathematics, science, and technology skills. Middle school students apply their skills and knowledge in real-life problem solving investigations outside the classroom, and participate in studies just as scientific research teams do. At a beach, refuge, or similar area, students analyze sand grain size, construct a beach profile, identify various aquatic species, and scour the beach for unnatural materials.

TIES TO CURRICULUM

This lesson fulfills several of the *National Science Education Standards*. Students explore a marine ecosystem and learn about the change, cycles, and relationships of the natural world. *Exploring the Beach* calls upon scientific inquiry skills such as data organization and analysis, using appropriate technologies and materials. Students represent data in tables and graphs, and make inferences and predictions. In addition*, Exploring the Beach* incorporates these science and math concepts with technology skills, since students communicate data through computer software programs.

LEARNING OBJECTIVES

In this lesson, students will

- identify characteristics of beach zones;
- classify marine organisms;
- investigate the relationships between organisms in these ecosystems;
- observe the impact of human populations on a natural habitat;
- represent data in tables and graphs;
- make inferences and predictions based on the data; and
- communicate data through graphic and written means.

NUMBER OF LAPTOPS AND GROUP SIZE

Each group of five students needs one laptop computer.

TIME REQUIREMENT

Exploring the Beach takes approximately 6½ hours:

Task	Time	Location
Introduction	1½ hours	Classroom
Sand grain analysis	45 minutes	Beach
Beach profile	45 minutes	Beach
Beach sweep	45 minutes	Beach
Species identification	45 minutes	Beach
Data analysis	1½ hours	Beach
Group presentations	30 minutes	Beach/classroom

LESSON DESCRIPTION

MATERIALS

- Laptop computers
- Wordprocessing, spreadsheet and image manipulation software
- Digital camera
- Scale
- Graduated sieve
- Shore J (see Figure 2)
- Seine net
- Marine species identification book
- Trundle wheel or 100 meter tape
- Trash bags
- Gloves

Teacher Preparation

Develop the spreadsheets for data recording. Depending on their computer experience, students may be able to create spreadsheets.

Introduction

Review the detailed procedures for each investigation. Guide the class through inputting data onto the computer spreadsheet. Divide the class into groups of five. Explain that there will be four stations set up along the beach, and groups will rotate through the activities. After completing each activity, groups analyze the data and answer the analysis questions.

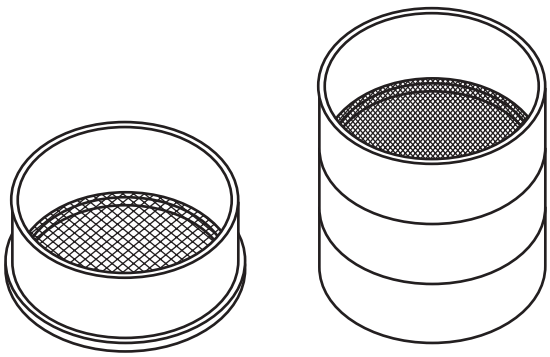
Activity

Sand Grain Analysis

Choose three sites along the beach at varying distances from the water. At each site, weigh each section of the graduated sieve while empty, and record its mass. Fill the top of the sieve with sand and shake until the sand is sifted through all screens (see Figure 1). Remove each section of the sieve, weigh each section, and record the data on the spreadsheet. Using the formulas in the spreadsheet, calculate sand weight and percentages for each site, and create a bar graph to compare samples (see Appendix).

Analysis Question: What is the most common sand grain size at each site? Given the location of the site, why might it be the most common size?

Figure 1: Graduated sieve



Beach Profile

Place the first pole of the shore J at the water's edge (see Figure 2). Spread the other pole until the string is pulled tight. Move the string up or down on the second pole until it is level. Measure the distance of the second pole from the first pole and record data in the spreadsheet. Measure the distance of the string on the second pole from the top of the pole and record data. This will identify the rise over run, or the slope. Move the first pole up to the second pole and repeat the process. Input the data into the pre-pared table to calculate the total distance and slope. To illustrate the beach profile, convert the data into a line graph with distance (m) on the x-axis and rise (m or cm) on the y-axis.

Analysis Question: What portion of the beach had the greatest slope, and why? If you were to move the Shore J backward into the water, what would you expect the slope to be?

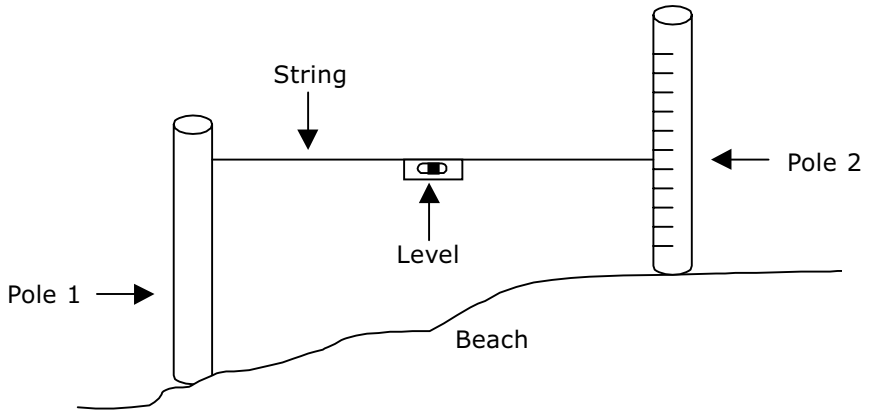
Beach Sweep

Set up an 100 m transect along the beach, running parallel to the water. Ask students to predict the number of each type of unnatural item they think they will find in that transect. Each group should walk up the beach in a straight line for 50 m, at varying distances

SUGGESTIONS

- Borrow scientific equipment from a high school or university.
- Choose sites along the beach before the activity.
- Involve parents and/or math teachers as chape-rones and guardians.
- Wear water shoes or old sneakers at the beach.
- After each group completes all four activities, the class can combine data to find class averages.
- Combine the activities with a campout on or near the beach to immerse students in the investigation.

Figure 2: Using the shore J tool



The string of the shore J tool is attached to Pole 1, and can slide up and down Pole 2. To measure the slope of the beach, move the poles to a new position, adjust the string on Pole 2 until level, and take a measurement reading.

from the water, picking up any unnatural items and putting items in the trash bag. Students should wear gloves when handling any garbage. Set a time to return to the starting point and sort items by type of material. Record the number of each item found in the spreadsheet. Calculate percentages, create a pie chart to analyze data, and compare the predictions to the actual results. After data analysis, the whole class should scour the beach for any unnatural items they may have missed, to clean up the beach.

Analysis Question: What was the most common trash found on the beach, and why? If the class had collected 100 items, how many items would you expect to be in each category?

Species Identification

Each group should choose two members to use the seine net to collect marine animals from the water. The two students hold on to each end of the net and walk backward through the shallow water dragging the net on the ocean floor. Walk up the beach to the edge of the water. Other group members identify the different species in the net. Students choose some organisms to briefly examine and photograph by carefully placing organisms in a bucket filled with ocean water. Quickly return aquatic life to water unharmed. Insert the picture of the identified species into a word processing document. Using the photos and field guide, write a descriptive paragraph about one of the species, including an answer to the analysis question.

Analysis Question: What species did your group choose, and what is its role in the ecosystem?

ASSESSMENT

Base student assessment on teamwork, participation in the activities, clarity of data, and answers to analysis questions. You can also assess student performance on mastery of each of the science, mathematics, and technology standards.

REFERENCES

Books

National Council of Teachers of Mathematics. *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: NCTM, 1989.

National Research Council. *National Science Education Standards*. Washington DC: National Academy Press, 1996.

Web sites

The Bridge. Ocean Sciences Education Teachers Resource Center: http://www.vims.edu/bridge/

U.S. Fish and Wildlife Service's Coastal Habitat Conservation Programs: http://ww.fws.gov/cep/coastweb.html

APPENDIX

Table 1. Sand grain analysis, step 1 – spreadsheet showing formulas

	A	B	C	D	E	F	G	H	I	J	K
1	Sieve	Sieve Weight	Total Weight Site A	Total Weight Site B	Total Weight Site C	Sand Weight Site A	Sand Weight Site B	Sand Weight Site C	% Weight Site A	% Weight Site B	% Weight Site C
2	All	765	965	909	927	=C2-B2	=D2-B2	=E2-B2	=F2/F2	=G2/G2	=H2/H2
3	1	179	189	193	186	=C3-B3	=D3-B3	=E3-B3	=F3/F2	=G3/G2	=H3/H2
4	2	165	177	171	185	=C4-B4	=D4-B4	=E4-B4	=F4/F2	=G4/G2	=H4/H2
5	3	154	316	269	276	=C5-B5	=D5-B5	=E5-B5	=F5/F2	=G5/G2	=H5/H2
6	4	139	152	148	152	=C6-B6	=D6-B6	=E6-B6	=F6/F2	=G6/G2	=H6/H2
7	5	128	131	128	128	=C7-B7	=D7-B7	=E7-B7	=F7/F2	=G7/G2	=H7/H2

Table 2. Sand grain analysis, step 2 - spreadsheet showing values

	A	B	C	D	E	F	G	H	I	J	K
1	Sieve	Sieve Weight	Total Weight Site A	Total Weight Site B	Total Weight Site C	Sand Weight Site A	Sand Weight Site B	Sand Weight Site C	% Weight Site A	% Weight Site B	% Weight Site C
2	All	765	965	909	927	200	144	162	100	100	100
3	1	179	189	193	186	10	14	7	5	10	4
4	2	165	177	171	185	12	6	20	6	4	12
5	3	154	316	269	276	162	115	122	81	80	75
6	4	139	152	148	152	13	9	13	7	6	8
7	5	128	131	128	128	3	0	0	2	0	0

Figure 3: Table 2. Sand grain analysis, step 3