The Education Program at the
New Jersey Sea Grant Consortium
22 Magruder Road Fort Hancock, NJ 07732 732-872-1300 njseagrant.org

BEACH PROFILING

OVERVIEW

Waves, wind and currents shape the beach redistributing tons of sand each day. During this activity, students gather data that measures the surface of the beach using a method that simulates the way marine scientists and coastal geologists study our dynamic beaches.

OBJECTIVES

Following completion of this lesson, the students will be able to:

- Understand that waves, winds, currents shape the beach and redistribute tons of sand each day
- Identify storm and tide levels as well as how a beach is changing over time
- Make and record observations
- Graph the beach profile.

GRADE LEVELS

6^{th} -12^{th} grades

NJCC STANDARDS

Science Indicators:
5.1: End of Grade 4: B1, A2, B2; End of Grade 8: A2, B3; **5.3:** End of Grade 4: D1, B2; End of Grade 8: A1; **5.4:** End of Grade 2: C2; End of Grade 4: B1; **5.5:** End of Grade 2: B1; End of Grade 8: B3; **5.7:** End of Grade 2: A2; End of Grade 4: A1, A2, B1; End of Grade 6: A2; End of Grade 8: A1, A3; **5.8:** End of Grade 4: A1, A2, A4; **5.10:** End of Grade 2:A1; End of Grade 4: A1, B1; End of Grade 6: A1, B1.

Mathematics Indicators:
4.1: 6C3, 6B1; **4.2:** 2A4, 4A5, 12A4, 4D2, 4D5, 8A5, 2D1, 2D2, 4D4, 6D5, D3; **4.3:** 2A1, 4A1, 4C1, 12D3; **4.3:** C3, C4, 4A1, 6C1;
4.4: 2A1, 4A1, 6A1, 12A5; **4.5A:** 2, 3, 4, 5 ; **4.5B:** 1, 2, 4; **4.5C:** 3, 4, 6; **4.5D:** 1, 2, 3, 5; **4.5E:** 1, 2, 3; **4.5F:** 1, 2, 4, 5.

MATERIALS

- One set of profile sticks per student team
- To make a set of profile sticks you will need: Two wooden sticks (1"x 2" x 8 ft pieces of wood cut down to 2 meters) marked and numbered with lines at ten centimeter intervals starting from zero at eye level (four feet from the bottom is adequate, drill a hole there to aid in sighting the horizon). Number intervals using positive numbers (+10, +20, etc.) from zero point down to bottom of pole. Number intervals above the zero point using negative numbers (-10, -20, etc.).

- Data sheet included in this lesson plan to record measurements.
- Pencil, clipboard, graph paper.

PROCEDURES

To get started, students make a line, either visual or actual from the base of dunes in a straight line (as straight as possible) to the water's edge. Students will take measurements along this line at two meter intervals. To measure the beach, place one pole near the base of the dunes and
place the second pole two meters ahead going in the direction of the ocean. Use one pole to measure the distance to the other pole. Using the horizon (where the SKY meets the SEA) as the constant, line up the horizon to a reading on the first pole. Use the hole at the zero mark to make sighting easier. Match up where the horizon sights from the first pole facing the ocean to the second pole closer to the ocean but with the measurements on the pole facing towards the dunes and the person taking a reading from pole one. Record this plus or minus number in the space on the data sheet numbered "site one." To get to site two, take the first pole and place it two meters (or one pole length) closer to the ocean in front of the second pole (in a leap frog manner). Take a reading from the second pole, "site two" and record the results. Proceed in this manner, switching poles along an imaginary straight line and taking readings until the water's edge is reached. As students work their way towards the ocean, they should also record comments and observations about each site as the readings are recorded. As the students move forward, have them gather a sand sample four times (one sample each the base of the **dunes, backshore** or **berm**, **foreshore**, **nearshore**. Beach zones are not always readily distinct and do not coincide with profiling sites. The data worksheet provides a helpful diagram of the four beach zones.
After all sites have been recorded, students can graph the data to provide a visual representation of the beach profile.

BACKGROUND

Beaches are always moving. Winds, waves and currents shape and reshape the beach throughout the year. Seasonal patterns develop in response to waves that are observable. In summer, waves are generally far apart, low and gentle. These waves tend to flatten the beach--just in time to make room for the chairs and umbrellas of beachgoers. As winter approaches, waves become shorter, choppier and more frequent as well as more forceful. These fall and winter waves create a cliff or beach scarp on the **berm crest** (located in the **backshore** zone). This cliff tends to protect the landward portions of the beach, including the **dune** area, from the force of the sea. The **littoral drift** or **longshore current** moves sand year-round and at Sandy Hook this current flows in a northerly direction moving tons of sand along with it.

Making a beach profile gives a recording of the surface or profile of the beach and is an excellent way to determine beach topography. It can also be used to measure the rate of change to a beach if subsequent visits can be made throughout the year.

VOCABULARY

Beach - Sediment seaward of the coastline through the surf zone that is in transport along the shore and within the surf zone. Also called the berm.

Berm - In the summer the berm is low and wide. It is the beach on which beach-goers sunbathe and frolic. The winter berm is higher and narrower, as most of the sand moves underwater to create the off shore sand bars.
The reason for the shift is the change in wave action with the season.
Backshore - The part of the beach located above the mean spring high tide line and covered by water only during storms with extreme high tides. Also called the spray zone.

Dune - A hill or ridge of sand piled up by the wind. At Sandy Hook, seeds from birds planted vegetation which stabilized the shifting sands. As more plants grew, sand grains were blown across the beach and trapped. Repeated burials enhanced the formation of a primary sand dune barrier, thus reducing erosion by the ocean waves.

Foreshore - The part of the beach between the normal high and low tidal marks. Also called the intertidal zone.

Littoral Drift - The movement of sediment by the longshore current. Littoral drift accounts for the movement of more than 370,000 cubic yards of sand per year along New Jersey beaches

Longshore Current - A current located in the surf zone that runs parallel to the shore. It is the result of waves breaking at an angle on the shore. On the North Jersey coast, the longshore current runs north from Manasquan to Sandy Hook, redistributing tons of sand with it each year.

Nearshore – The area that is just underwater at high tide and accessible during low tide from the water's edge to an offshore depth of about 50 feet.

In the classroom use trays filled with sand to make models of the profiles found on the beach. While still on the beach, use collection bags to pick up trash found on the beach. Discuss how the trash got there and what can be done to improve the trash problem.
Make a collection of shells found on the beach and identify each one.

REFERENCES

Willard Bascom. 1980. Waves And Beaches. Anchor Press/Doubleday Publishing Company.

Harold V. Thurman. 1993. Essentials of Oceanography. Fouth Edition. Macmillan Publishing Company.

Karl Nordstrom. Paul Gares. Norbert Psuty. Orrin Pilkey, Jr. William Neal. Orrin Pilkey, Sr. 1986. Living with the New Jersey Shore. Duke University Press Durham, North Carolina

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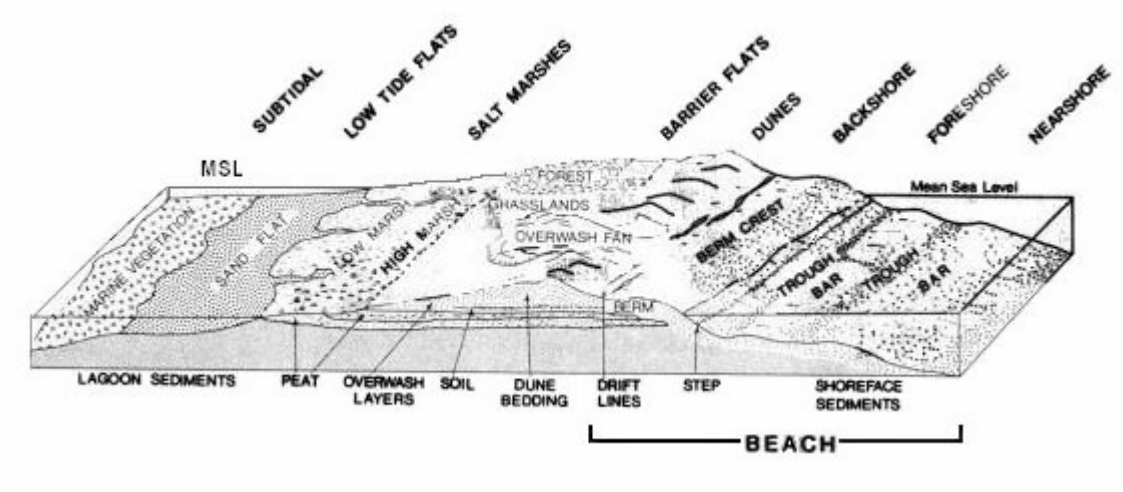
BEACH PROFILING DATA COLLECTION SHEET

Waves, winds and currents shape the beach, redistributing tons of sand each day. A beach profile gives you a side view of the shoreline's surface topography. This data can help you determine storm and water levels but more importantly, when data is gathered seasonally at the same location, you can document how the beach is changing.

DIRECTIONS: Use sighting poles to record the elevation of each site at two meter intervals (or one pole length). Readings should start at the base of the dunes (site #1) and go in a straight line to the water's edge. In addition to elevation data, record observations of each site. Examples of observations might include sand conditions (wet, dry, etc.), sand grain size (fine, coarse, rocky, etc.), evidence of human activity (tire-tracks, debris, structures, etc.) and evidence of plant or animal life. Through observation, try to locate four beach zones and gather a small sand sample at each zone; dunes, backshore, foreshore and nearshore. The following diagram will help you identify these zones, as well as provide you with a crossection of a typical barrier island, such as Sandy Hook.



The New Jersey Sea Grant Consortium (NJSGC) is an affiliation of colleges, universities and other groups dedicated to advancing knowledge and stewardship of New Jersey's marine and coastal environment. NJSGC meets its mission through its innovative research, education and outreach programs. For more information about NJSGC, visit njseagrant.org.

SITE #	READING	OBSERVATIONS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
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LOCATION PROFILED: _____

DATE: _____ **WEATHER CONDITIONS:** _____

TIME OF DAY: _____ **TIDAL STAGE:** _____

DATA COLLECTORS (name): _____

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GRAPHING THE BEACH PROFILE

After completing profiling on the beach, use the numbers from the profiling data collection sheet to make a graph illustrating a side view of the beach. If the numbers are graphed and this data gathered throughout the year, you can see and plot changes to the beach over time. Different seasons have different effects on the shoreline and your graphs will reflect these changes.

To explain how to go about making this graph we used as an example a sample of data collected from a school group at North Beach in October. The beach profile data collection sheet shows the first reading at site one as –5. This is a critical reading because all of the data on the graph will be adjusted starting from this number. The reading from site two is 0. There has been no change from the first reading. To graph this, the first point would be –5 and the second point would also be –5. There was no change in elevation between the first two readings. The reading from site three is also 0 and represents no change. Site four has a reading of –2. This means the elevation at site four dropped two centimeters. This two-centimeter drop is in addition to the initial five-centimeter drop from the reading at the first site. To accurately graph this as the fourth point you would plot the point at –7.

$$-5 + (-2) = -7$$

The reading from site five is –10. Remember each site reading is actually an adjustment, either plus or minus, from the previous reading. In our example, site four is –7 and our current reading at site five is –10.

$$-7 + (-10) = -17$$

We will plot our fifth reading at –17 on the graph. Continue in this manner until the data stops at the edge of the water. If you look at the rest of the readings on the sample graph below, you will notice that there are some numbers that are not negative or zero. For example the reading at site ten is 2. How would you graph this?

Site #	Reading	Observations
1	-5	Base of Dunes
2	0	Flat Beach
3	0	More Flat Beach, Few Shells
4	-2	Bird Foot Prints
5	-10	Tire Tracks, Scattered Shells

Using the same technique as before, rely on the previous data and add the new reading. Site nine reads 0, there is no change from the cumulative elevation loss of –35. With an adjustment of 2 at site ten we get the following:

$$-35 + 2 = -33$$

Your point for site ten will be plotted at –33. Before beginning your graph, please look at the profile elevation data and graph provided to be certain you understand how the data is processed into a graph using the collected data. If you plan on collecting data from a particular spot on the beach over time or seasonally, be sure to identify a non-moving landmark. Use this as the starting point of your readings each time you collect data. This will provide a more accurate representation of how the beach is changing over time. As readings are made, observe and note anything of interest at each of the sites. The data you accumulate will be a record of the dynamic changes to the beach seasonally or yearly. If you have access to the Internet, we have a spreadsheet online. You can enter your profile data information and generate a graph. Go to the website www. NJMSC.org and look under teacher resources, beach profile zip.

6	-10	Footprints of people
7	0	Seagulls on the beach
8	-8	Plastic trash on beach
9	0	Old log washed up
10	2	Half buried shoe
11	10	Horseshoe crab shell
12	2	Lots of surf clam shells
13	-10	Poles marking nesting area
14	0	Plastic bag in sand
15	0	Strapping tape in sand
16	-2	Lots of moon snail shells
17	6	Tide line of grass, shells
18	10	Darker sand right here
19	-15	Fishers using clams as bait
20	-40	Sand wet more shells
21	-18	Sand very wet
22	-15	Almost in the water
23		
24		

Site#	Graph Plot
1	-5
2	-5
3	-5
4	-7
5	-17
6	-27
7	-27
8	-35
9	-35
10	-33
11	-23
12	-21
13	-31
14	-31
15	-31
16	-33
17	-27
18	-17
19	-32
20	-72
21	-90
22	-105