The Ever-Changing Beach

Beach Activities for Middle School Teachers and their Students

By Betsy Sheffield

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The Ever-Changing Beach, Third Draft
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Acknowledgements

There have been many influential people who helped get this project underway. Thank you for all your help, edits, and suggestions!

Thanks first and foremost go to Dr. Leslie Sautter, my advisor, for the idea, support and motivation for this project, not to mention her *numerous* edits and comments on this work, and her advice. Together we created the pre-field exercise for Activity #1. The COASTeam Program is her creation and I am honored to have contributed to it!

Thank you to Arla Jessen of Dewees Island, SC, for use of the Burney Fair Environmental Education Center and the resources of Dewees Island. These activities could not have been written without the cooperation and assistance of the staff of Dewees Island, for use of golf carts, the trailer, and occasional overnight accommodations, and the tolerance of concerned residents phoning the office to report that someone was trying to frighten the osprey nest with a long pole (that was my crew and I, surveying the beach using a twenty-five foot stadia rod).

Dr. Marlene McCauley and Dr. Lynn Moseley of Guilford College (Greensboro, NC) exposed me to the study of beach profiling and collection of life along it during a 1994 field course at Bogue Banks, NC. It was an experience I never forgot, and I am grateful to them for that early exposure to the value of barrier island profiling.

The data tables for Activity #2 were adapted from the activity "Beach Exploration" by Wendy Allen and Patty Owens-McLaughlin, found in a S.C. Sea Grant publication entitled *Sea Sampler*. Thank you, Wendy and Patty! Two figures from *Of Sand and Sea: Teachings from the Southeastern Shoreline*, by Paula Keener-Chavis and Leslie Sautter, were used in this guide, and many definitions found in the glossary at the end of this guide were taken from *Of Sand and Sea*.

Thanks also to Elizabeth King, Elizabeth Rogers, and Kathryn Treml at the Lowcountry Hall of Science and Math for their input, editing, and contributions to the activity packet.

I also was assisted by numerous people who helped me survey two sites at Dewees in the heat and humidity, with threatening summer thunderstorms, and freezing cold winters: Jon Fero, Glen von Rosenberg, Ernie Nelson, Stacia Russo, and Mike Jordan. Two Dewees Island residents, Jill and Jim Cochrane, also aided me and were the first participants in the workshop.

Two dozen middle school teachers gave me their feedback in the preliminary stages of these activities; these comments helped to produce a better product. Angela Mills was one of them and provided the photo in Activity #4. Six more teachers participated in the first hands-on workshop using this guide in March, and their feedback and experience was very helpful.

A special thanks goes to my husband, Jon Fero, for wading into cold water in the dead of winter so that I could get more data, for his edits, words of encouragement and advice, and willingness to help in this project. Also, thanks to Jon and my parents, Rhon and Cliff Sheffield, who patiently allowed me to photograph them as they performed the survey in *The Dynamic Beach*.

Preface

The beach is a wonderful outdoor classroom, more than just a destination for summer vacation. Many children raised on the coast are not educated on the unique habitat and environment of the barrier islands; some have never seen the ocean! Hopefully this set of beach profiling activities will be a first step in remedying that situation. What's more, most students can describe little more than just sand on the beach. How do islands form? What makes sand move? Does anything live on the beach and in the sand? What makes dunes important? These simple questions deserve answers, and this activity packet leads you and your students to them. You will discover what lives on the beach, the various sizes and constituents of sand, how dunes form, and how to survey the beachfront.

This set of activities resulted from almost a year of work and brainstorming. Realizing that a field trip to the beach with middle school students can be a daunting task, these activities require multiple groups to keep everyone busy. Additionally, each activity is correlated with the final version of the South Carolina Science Curriculum Standards (June 2000) for grades six through eight. The strands addressed by each activity are listed in the box at the beginning of the activity. Words that are in **bold** are defined in the glossary.

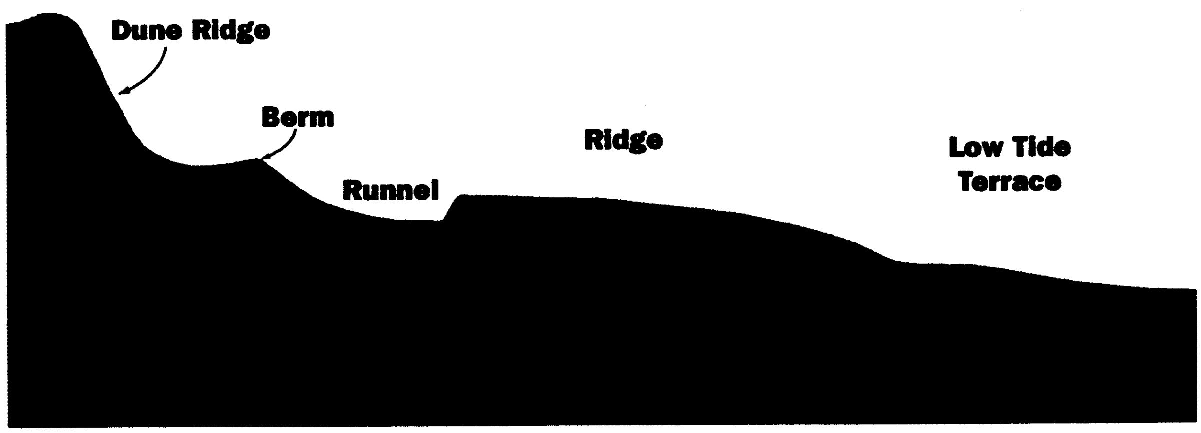
This packet includes a classroom exercise as an introduction to the concept of profiling the topography of the beach. Before entering the field, familiarize your students with the activities you will complete in the field. The field portion of the activities can take three to four hours total, depending upon how thorough you and your students are. Four of the five activities should be done simultaneously, so you will have several groups of students working at once. For best utilization of field time, divide your students into groups in the classroom, and ensure that they understand what their tasks will be in the field. Once data are collected, there are evaluation activities that require your students to demonstrate in the classroom what they have learned in the field. The final result is a wall display illustrating the section of the beach that your students studied. Included on the display in the proper locations along the survey transect line will be samples of dune plants, animals and their tracks, and samples of sand grains. Your students will be proud to display this as the fruits of their labor! The following table describes the purpose of each activity in the big picture of making the final product.

Activity Name	Purpose
The Dynamic Beach	Survey transect
You Live Where?	Location of flora and fauna
The Bath Tub Ring	Location of wrack line
Sifting Sands	Location of sediment type
Constructing a Profile of the Beach Environment	Construction of final product

Additionally, your students can compare the survey data they gathered to previous surveys of the same transect. Data are available on the Internet and from local state agencies and can be plotted to show change in beach topography over time. Data are available from all over the world as well, giving your students the opportunity to learn about distant shorelines.

I hope you enjoy this collection of beach activities and that you will utilize the activities in your classroom and in the field. There is so much to learn about the beach, and the sooner that children are exposed to it, the more they may learn.

Betsy Sheffield
June 2000



Typical summer beach profile. From Keener-Chavis and Sautter, *Of Sand and Sea: Teachings from the Southeastern Shoreline*, S.C. Sea Grant, 2000.

Activity #1: The Dynamic Beach
Beach Profiling

By Betsy Sheffield, COASTeam Program, College of Charleston, Charleston, SC

Subjects: Science, Math
Skills: Analysis, description, listing, research, small group work
Duration: 2 to 3 hours
Group size: 5-10 students
Setting: Part I: in classroom, Parts II and III: outdoors
Vocabulary: accretion, benchmark, berm, dune, erosion, hurricane, nor'easter, swale, transect
SC Science Standards: Grade 6: IA1a1,2; IA1b1; IA1c1; IA1d1; IA1e1; IA2a,b,f; IA3a; IA6a; IA8a; IC3a. Grade 7: IA1a1,2; IA1b1; IA1c1; IA1d1; IA1e1; IA2a,b,f; IA3a; IA6a; IA8a; III (Ecology – Abiotic) A1a,b,c,d. Grade 8: IA1a1,2; IA1b1; IA1c1; IA1e1; IA2a,b,f; IA3a; IA6; IA8a; IB1a; IB2,3; ID3a.

Objectives

Students will learn:

1) survey techniques and methods;
2) how to measure distances and elevation; and
3) to observe dune and beach environments.

Students survey and record the topography along a segment of the beach.

Background

Barrier islands are changing environments. Wind and waves constantly batter the coastline, depositing and eroding sediment. Severe storms, like **hurricanes** and **nor'easters**, tremendously alter the shape of a beach, often eroding sand from dunes. Winter brings the ocean's fiercest winds, while summer conditions are more mild. The shape of the beach therefore differs with the seasons. This activity will show students how to plot the topography of a local beach. If possible, study the beach over the school year and give your students the opportunity to predict and identify seasonal changes of the beach face.

In South Carolina, the Department of Health and Environmental Control's Office of Ocean and Coastal Resource Management (DHEC - OCRM) is responsible for monitoring the changes of the state's coastline. Twice a year, this office uses points of known elevation, called **benchmarks**, to determine changes in elevation on each of South Carolina's barrier islands. The data are collected by making a **transect**, or line of data collection points, from a benchmark in the island's dunes perpendicular to the ocean surf. Each transect is compared with past transect data and these are used to make conclusions about the general changes of each island. Islands may lose sand due to **erosion**, gain sand (**accretion**), or remain unchanged in various locations along the length of the island.

OCRM's data are gathered using units of feet and inches, the standard for U.S. cartography. If you want your students to survey using metric units, you may convert OCRM's benchmark data into meters and use meters when collecting data on the beach. The conversion factor is 1 foot = 0.3048 meter. (Metric units are included in parentheses.)

Materials:

Part I

- Activity #1 Worksheet 1, pages 7 and 9
- graph paper, page 13

Part III

- one 10 ft (4 meters) section of PVC pipe (referred to as the "long rod")
- one 5 ft (1.5 meters) section of PVC pipe ("short rod")

- thick nylon rope marked off in 1-foot increments, with a knot tied every 15 feet (10 meters)
- lightweight cotton string
- line level (available at hardware stores)
- clipboard with attached pencil (less likely to be lost that way!)
- two or three copies of the Beach Profiling Data Sheet, page 21
- compass (optional)

Procedure

Part I – in the classroom

Before you take your students to the beach, make sure you present the profiling activity to them! In the classroom, familiarize your students with the concept of beach profiling. It is really a simple method, but sometimes difficult to understand at first try. A classroom exercise is included on pages 7 and 9. Have your students go through this in class before attempting to profile in the field. The directions are on the worksheet, and an answer key is provided. Once they are familiar with the concept in the classroom, they will be able to reproduce it in the field.

Secondly, have your students plot this small amount of data on an x, y graph. Plot "actual elevation" on the y-axis and "cumulative distance" on the x-axis. Use the graph paper included on page 13. See Figure 1 for a graph using that data. Your students should plot a line similar in shape to Figures A through E on Worksheet 1.

As an extension, give them data from other benchmarks to plot. Data can be found on the web (see Resource Index). The purpose of these beach profiling activities is to familiarize students with the beach, its shape and the life found on it. As they graph more data, the students will recognize the common shape of the beach, and discover its variations through the seasons.

As an additional extension, have your students construct a profile of the classroom, using data points from chairs and tables in the room. This activity is good for a rainy day, and it will test their understanding of profiling.

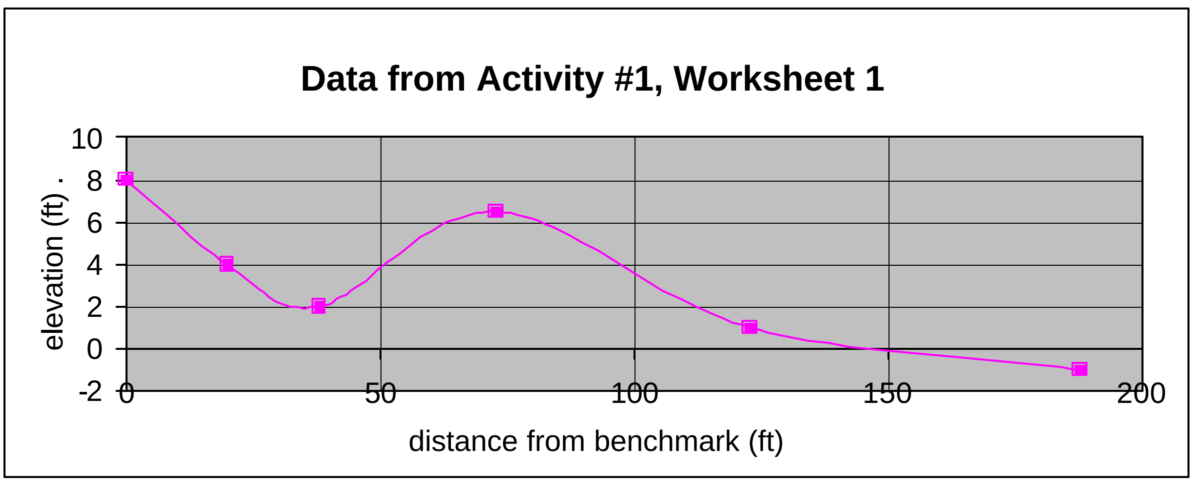


Figure 1-1: Graph generated using data from Activity #1 Worksheet 1.

Part II – preparation

Before the class field trip, choose a location for your study. For more information on locations of benchmarks, see the Benchmark Box, page 5. The best time for surveying is at low tide, when the maximum amount of beach is exposed. Consult a tide chart when planning the field trip.

Part III – in the field, with your students

Begin at your chosen benchmark. Remind your students to be very careful to avoid stepping on plants when performing this beach study.

Step 1: If the benchmark cap is higher than the land surface, measure vertically from the cap down to the land surface to find the actual elevation of the land.

Step 2: Subtract that vertical distance from the benchmark elevation to find the elevation of the land surface (see Figure 2).

Step 3: Enter that number on line A on the BPEW, in the "actual elevation" column.

Step 4: Otherwise, if the benchmark cap is on the land surface, enter the benchmark's elevation in the "actual elevation" column.

The short rod is used as the sighting point and the long rod as the one to which you sight. Both rods should be marked with feet and tenths of feet. You may use meters as your measurement; however, tenths of feet is the increment used by OCRM in their annual beach profiles, and therefore will be easier to compare.

Starting at the benchmark, sight a line directly to the shore. Find a point between the benchmark and the horizon that can be used as a marker to guide the profile transect in a straight line. Or, take a bearing with a compass and follow that bearing to the sea, producing a straight transect.

The person at the short rod sights from the top of that rod to the long rod, which is placed between the short rod and the water. Read the value on the long rod where the horizon appears to intersect the rod. The horizon serves as a level line (see Figure 3, next page). Record the measurement from the long rod on line B in the column marked "reading on long rod."

At times you may find that the view of the ocean is obscured. If the horizon cannot be seen, use a line level to determine differences in elevation. The line level can measure elevation change only between short distances (no more than 10 feet, and less on a windy day). A light cotton string works well. Hold the line at the top of the

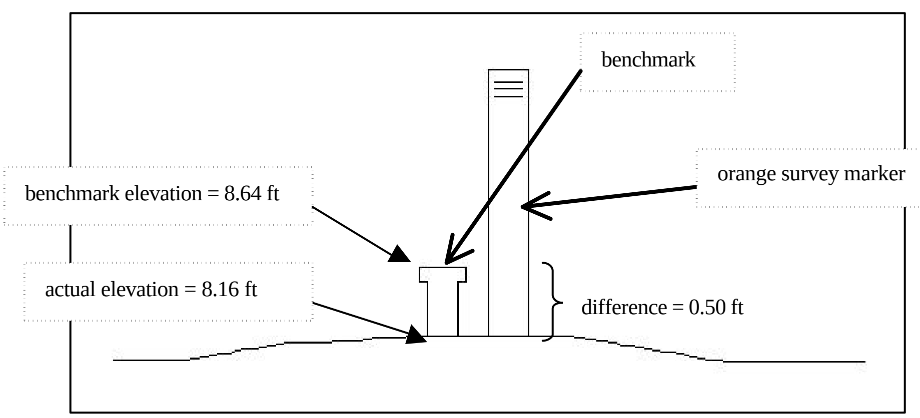


Figure 1-2: Find the vertical difference between the benchmark elevation and the land surface to determine the land surface elevation. In this example, subtracting the vertical difference (0.50 ft) from the benchmark elevation (8.64 ft) results in an actual elevation of 8.16 ft.

short rod and give the other end to the person holding the long rod. Place the line level in the middle of the cotton string; move the line up and down the long rod until the level reads as "level." (See Figure 4 and Figure 5.) Record the number

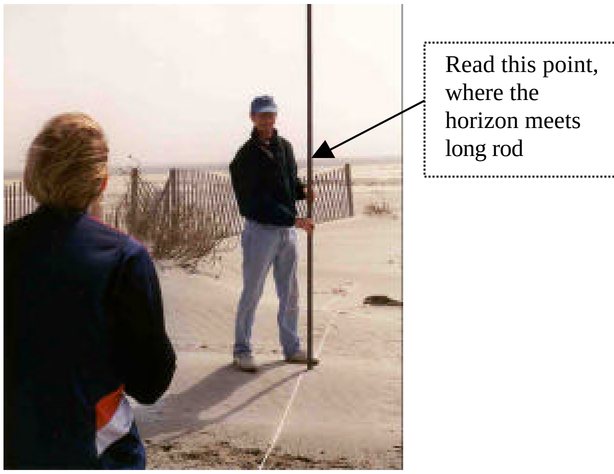


Figure 1-3: The woman is sighting a line from the short rod to the long rod, directly towards the horizon. The arrow indicates where the man will read the measurement.

measured on the long rod in the data table. For the next measurement, keep the long rod in place and move the short rod up to meet the long rod. Then move the long rod to the next obvious change in elevation, keeping the long rod in line with the benchmark and with the short rod. You may use an incremental distance (such as 15 feet, or 5 meters) and take measurements at that interval, or you may move to the next point

Figure 1-4: Using the line level to measure elevation change when the horizon is not in view.

of significant elevation change (dune or swale or edge of the berm). Measure the distance with the rope that has the foot increments marked. Do not move more than 30 feet (10 m) at one time. Sight again, using the horizon and/or compass to produce a straight line transect.

End the transect when you reach the ocean, or keep on going if you and your students are equipped to enter the water, and are feeling adventurous!

Figure 1-5: The line level is "level" and the string is used to determine the elevation reading on the long rod.

Simultaneous Activities

This activity guide, *The Ever-Changing Beach*, was designed to involve all of your students in some capacity. The following activities provide that opportunity for the students who are not associated with the recording of elevation data in this activity. Have those students assist in surveys of the plants and animals along the profile transect, and by collecting sediment samples. Survey the flora and fauna that are adapted to each location in Activity #2, *You Live Where?* Collect sediment samples on the dunes, swales, high tide line and low tide line, and use a set of sieves to sort them for comparing the grain sizes at the different zones of the beach in *Sifting Sand*. Synthesize all the collected data in *Constructing a Profile of the Beach*

Environment. See the following pages for detailed descriptions of these activities.

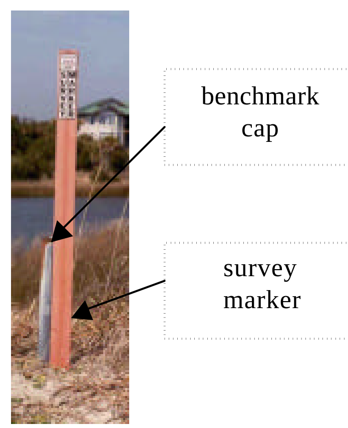
These provide opportunities for all the students in your class to observe the geology and biology of the beach.

Figure 1-6: The rods are spaced at a measured distance.

Benchmark Box

Before you begin, consult OCRM for the location and elevation of the island benchmarks in your area (see Resource Index). They have maps and directions on how to find each benchmark, as well as the elevation of each. Find the benchmark yourself before you take your students to it. Choose the benchmark based on its ease of access, the distance from it to the ocean, and the amount of elevation change. You probably will not want to choose a profile that is longer than 800-1000 feet, particularly if it is a hot day.

You will recognize a benchmark by the thin orange survey marker. Next to the marker is a pipe with a cap at its mouth. The cap is inscribed with a number characteristic to that location. The benchmark elevation provided to you by OCRM is the elevation above approximate sea level of the benchmark cap.



Activity #1 Worksheet 1 Instructions

Part I – In the Classroom

This is a classroom activity to familiarize you with the concept of beach surveying. The charts on the following page are diagrams of dunes. In the field, you will use two rods and the horizon to measure the elevation of the beach at locations spaced apart at a measured distance.

1. Start with Figure A. The short rod is drawn at the starting point, at the benchmark, where the elevation is known (8 feet). The short rod is 5 feet long.
2. The long rod is positioned 20 feet on the ocean side of the starting point.
3. When looking across the top of the short rod toward the long rod, the horizon in the distance crosses the long rod at 9 feet. See diagram.
4. Looking at Figure A, is the new *elevation* greater than or less than that of the starting point? _______
5. Now subtract the reading on the long rod (9 ft) from the height of the short rod (5 ft). It is perfectly fine to get negative numbers because we are looking for *change* in elevation.
6. The answer (-4 ft) is the amount of elevation *change*. The negative number indicates the change is in a downward direction. Place this number in the appropriate box on the chart provided.
7. To find the actual elevation, add the amount of elevation change (either positive or negative) to the previous actual elevation (8 ft). The true elevation at the second point is ____. Does this make sense conceptually? Compare your result to your answer to question 4.
8. Record the horizontal distance (20 ft) and cumulative distance (20 ft) on the chart provided.
9. Go on to Figure B. The short rod is moved to the place where the long rod was in #7. The long rod is shown at the next place of significant elevation change, 18 ft towards the ocean.
10. When reading across the top of the short rod, you read an elevation of 7 feet (where the horizon crosses the long rod).
11. Is the new elevation greater than or less than the previous elevation? __________
12. Again, subtract to find the amount of elevation change and put it in the correct box on the chart.
13. Find the actual elevation (as in #7, above), record the horizontal distance (18 ft) and the cumulative distance (20 + 18 ft).
14. Go on to Figure C. The short rod is 38 ft from the starting point. Draw the long rod at the next point of elevation change, 35 ft towards the ocean.
15. This time the long rod reading is 0.5 feet. Did we go uphill or downhill from the last point? _______
16. Calculate the elevation change and actual elevation, as well as the horizontal distance between rods and the cumulative distance from starting point.
17. Go to Figure D. Now the short rod is moved to the place that the long rod was in #16, and the long rod is moved 50 ft. The reading on the long rod is 10.5 ft. Calculate the actual elevation, the horizontal and cumulative distances.
18. Go to Figure E. The short rod is moved up to meet the long rod. Draw the long rod 65 ft towards the ocean. The reading on the long rod is 7 ft. Calculate the actual elevation, the horizontal and cumulative distances.
19. Plot your data on the graph paper provided.

Good job! Let's practice this on the beach!

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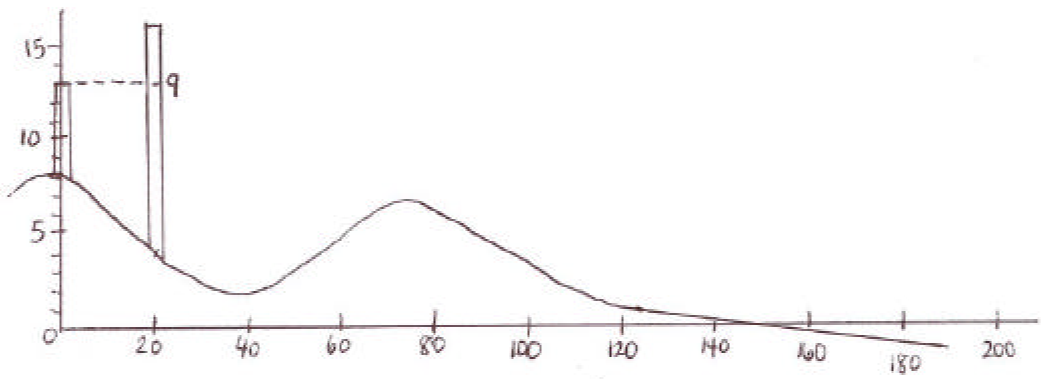
Activity #1 Worksheet 1

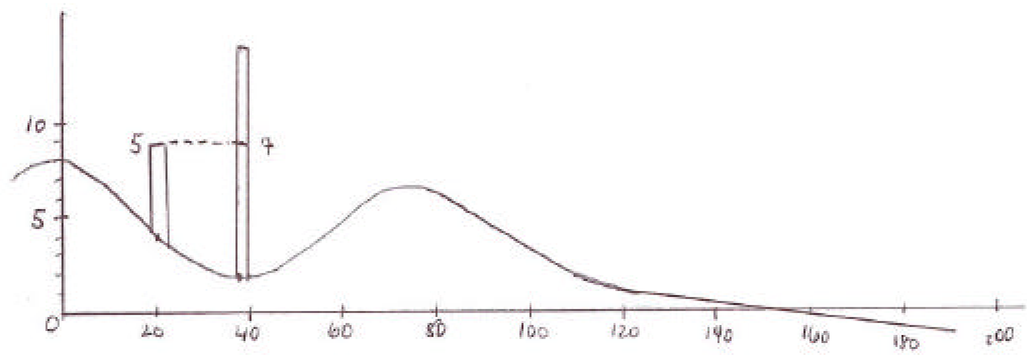
Part I – In the Classroom

Student worksheet

A



B



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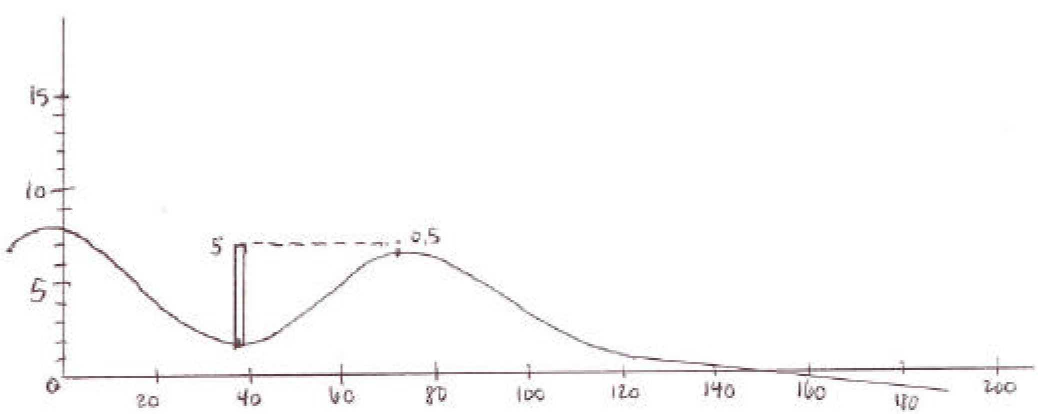
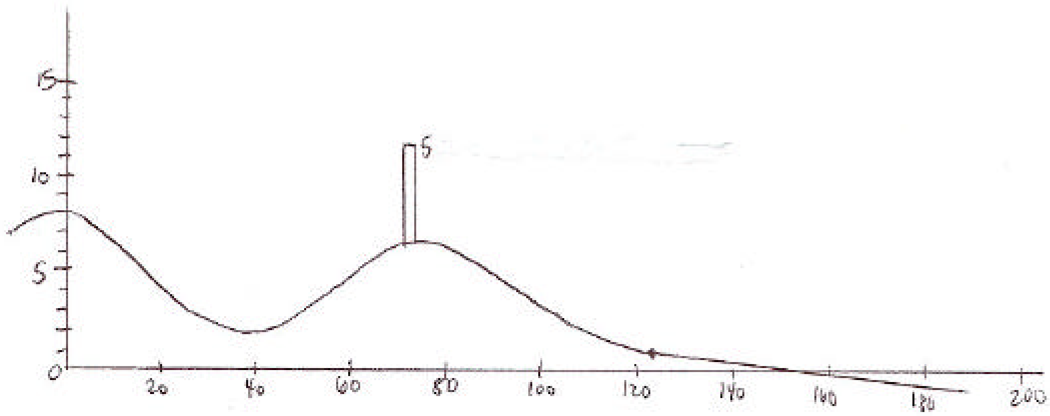


Activity #1 Worksheet 1 (cont'd)

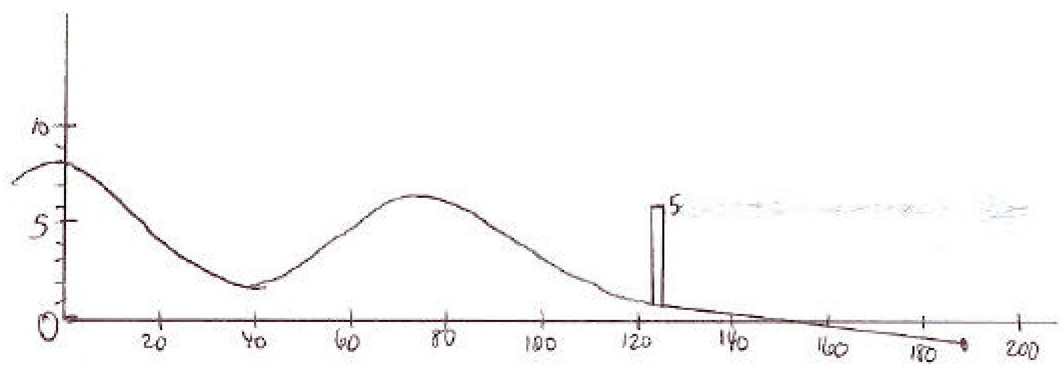
Part I – In the Classroom

Student worksheet

D



E



data points	height of short rod (ft)	-	reading on long rod (ft)	=	elevation change (ft)	actual * elevation (ft)	horizontal distance (ft)	cumulative † distance (ft)
1	5	-		=		8 (at benchmark)	0	0
2	5	-		=			20	
3	5	-		=				
4	5	-		=				
5	5	-		=				
6	5	-		=				188

* Actual elevation is calculated by adding the elevation change (either positive or negative) to the *previous* actual elevation.
† Cumulative distance is calculated by adding the horizontal distance to the *previous* cumulative distance.

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10 Squares to the Inch

Activity #1 Worksheet 1 Instructions

Part I – In the Classroom (teacher's key)

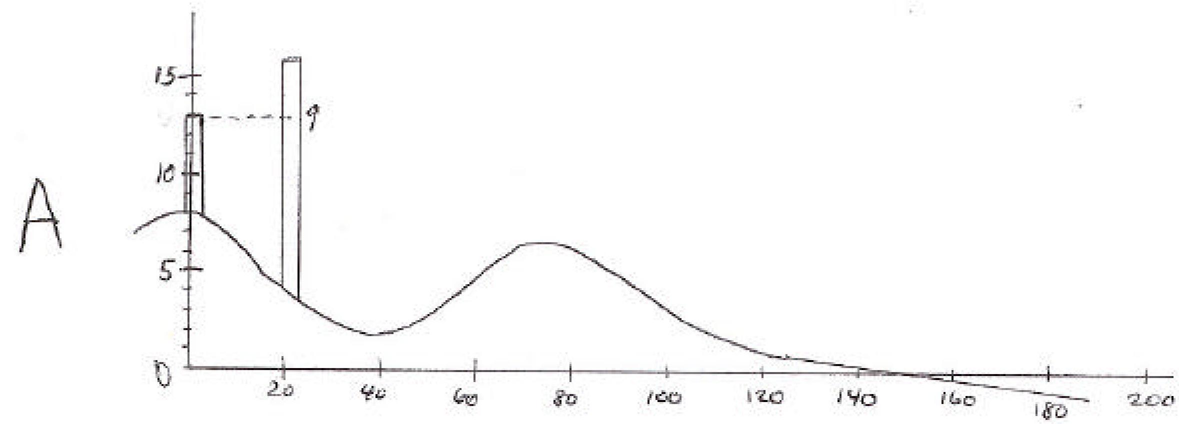
This is a classroom activity to familiarize you with the concept of beach surveying. The charts on the following page are diagrams of dunes. In the field, you will use two rods and the horizon to measure the elevation of the beach at locations spaced apart at a measured distance.

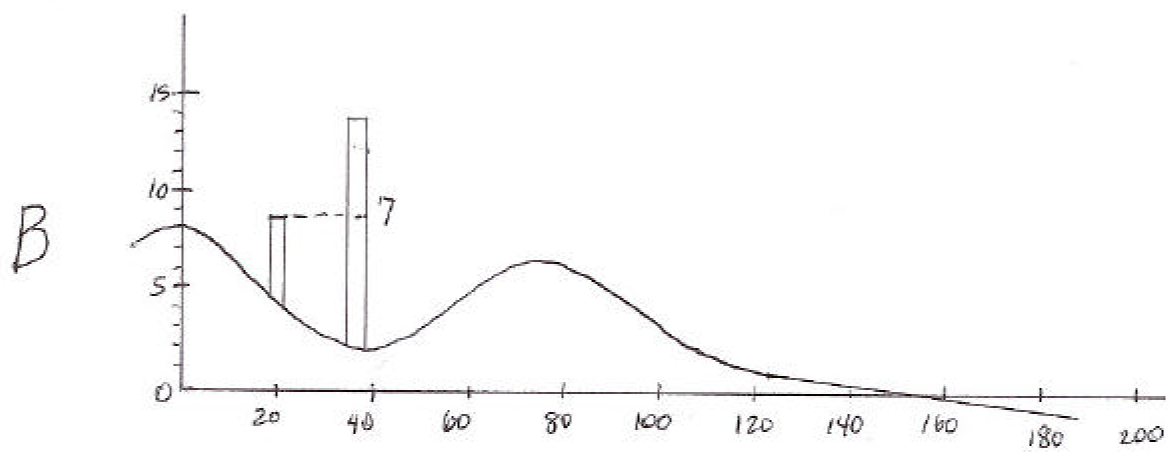
1. Start with Figure A. The short rod is drawn at the starting point, at the benchmark, where the elevation is a known, 8 feet. The short rod is 5 feet long.
2. The long rod is positioned 20 feet on the ocean side of the starting point.
3. When looking across the top of the short rod toward the long rod, the horizon in the distance crosses the long rod at 9 feet. See diagram.
4. Looking at Figure A, is the new *elevation* greater than or less than that of the starting point? **less than**
5. Now subtract the reading on the long rod (9 ft) from the height of the short rod (5 ft). It is perfectly fine to get negative numbers because we are looking for *change* in elevation.
6. The answer (-4 ft) is the amount of elevation *change*. The negative number indicates the change is in a downward direction. Place this number in the appropriate box on the chart.
7. To find the actual elevation, add the amount of elevation change (either positive or negative) to the previous actual elevation (8 ft). The true elevation at the second point is _**4 ft**__. Does this make sense conceptually? Compare your result to your answer to question 4. **[This new point is clearly lower than the starting point. The elevation change of –4 means the second point is 4 feet lower, 8-4=4.]**
8. Record the horizontal distance (20 ft) and cumulative distance (20 ft).
9. Go on to Figure B. The short rod is moved to the place where the long rod was in #7. The long rod is shown at the next place of significant elevation change, 18 ft towards the ocean.
10. When sighting across the top of the short rod, you read an elevation of 7 feet (where the horizon crosses the long rod).
11. Is the new elevation greater than or less than the previous elevation? **less than**
12. Again, subtract to find the amount of elevation change and put it in the correct box on the chart.
13. Find the actual elevation (as in #7, above), and record the horizontal distance (18 ft) and the cumulative distance (20 + 18 ft).
14. Go on to Figure C. The short rod is 38 ft from the starting point. Draw the long rod at the next point of elevation change, 35 ft towards the ocean.
15. This time the long rod reading is 0.5 feet. Did we go uphill or downhill from the last point? **uphill**
16. Calculate the elevation change and actual elevation, as well as the horizontal distance between rods and the cumulative distance from starting point.
17. Go to Figure D. Now the short rod is moved to the place that the long rod was in #16, and the long rod is moved 50 ft. The reading on the long rod is 10.5 ft. Calculate the actual elevation, the horizontal and cumulative distances.
18. Go to Figure E. The short rod is moved up to meet the long rod. Draw the long rod 65 ft towards the ocean. The reading on the long rod is 7 ft. Calculate the actual elevation, the horizontal and cumulative distances.
19. Plot your data on the graph paper provided.

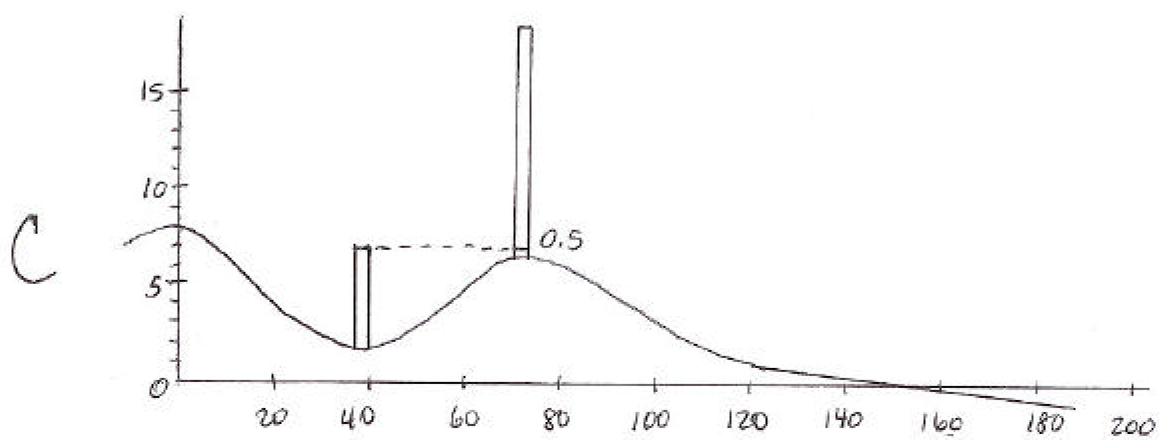
Good job! Let's practice this on the beach!

Activity #1 Worksheet 1

Part I – In the Classroom (teacher's key)

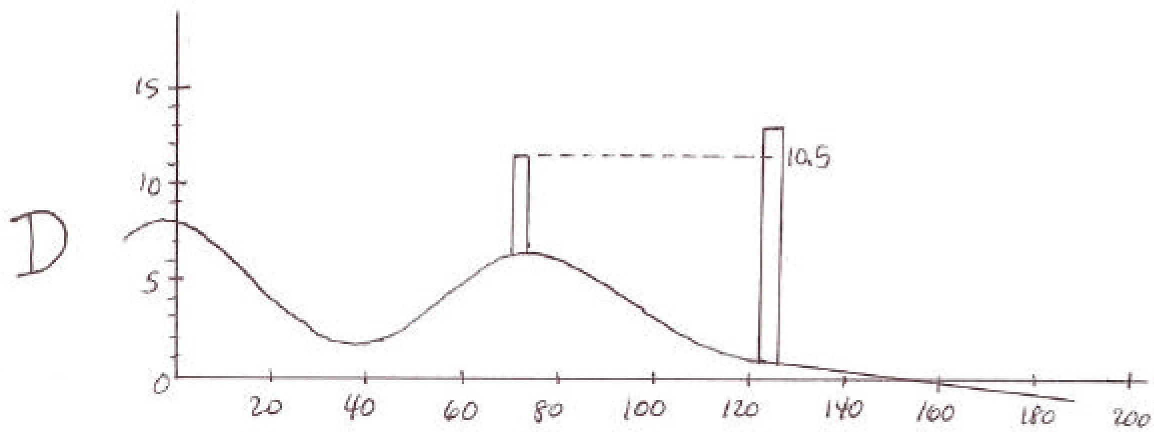


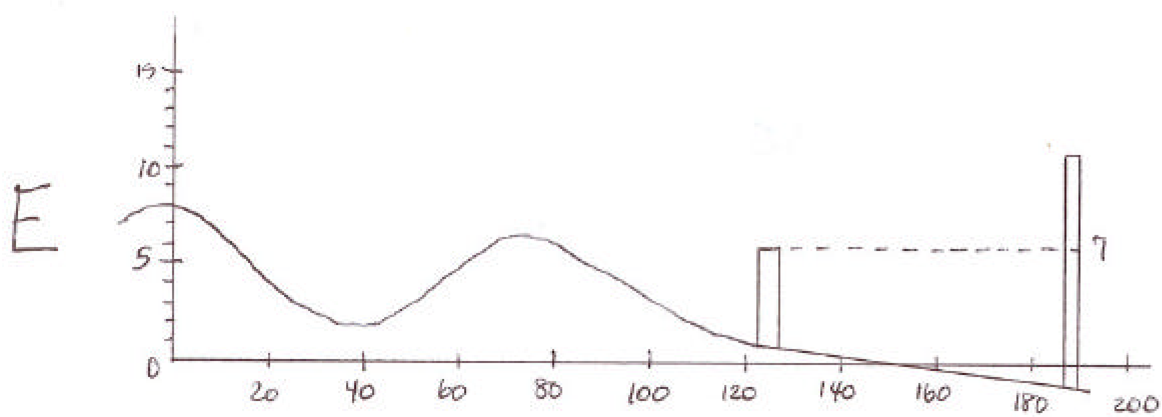




Activity #1 Worksheet 1 (cont'd)

Part I – In the Classroom (teacher's key)





data points	height of short rod (ft)	-	reading on long rod (ft)	=	elevation change (ft)	actual elevation (ft) *	horizontal distance (ft)	cumulative distance (ft) †
1	5	-		=		8 (at benchmark)	0	0
2	5	-	**9**	=	**-4**	**4**	20	**20**
3	5	-	**7**	=	**-2**	**2**	**18**	**38**
4	5	-	**0.5**	=	**4.5**	**6.5**	**35**	**73**
5	5	-	**10.5**	=	**-5.5**	**1**	**50**	**123**
6	5	-	**7**	=	**-2**	**-1**	**65**	188

* Actual elevation is calculated by adding the elevation change (either positive or negative) to the *previous* actual elevation.
† Cumulative distance is calculated by adding the horizontal distance to the *previous* cumulative distance.

Activity #1 Data Sheet 1
Beach Profiling

Location:______________________ Date:______________ Time:_______________
Low tide:______________________ Benchmark elevation:_____________________ Page ___ of ___
Weather conditions:____

data point	height of short rod (ft)	-	reading on long rod (ft)	=	elevation change (ft)	actual elevation (ft) *	horizontal distance between rods (ft)	cumulative distance (ft) †	comments
		-		=		write BM elevation here:	0	0	beginning of transect, at benchmark
		-		=					
		-		=					
		-		=					
		-		=					
		-		=					
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* Actual elevation is calculated by adding the elevation change (either positive or negative) to the *previous* actual elevation.
† Cumulative distance is calculated by adding the horizontal distance to the *previous* cumulative distance.

Activity #2: You Live Where?
Flora and Fauna

By Betsy Sheffield, COASTeam Program, College of Charleston, Charleston, SC

Subjects: Science, Math
Skills: Analysis, classification, comparing, description, identification, listing, small group work
Duration: 1 hour
Group size: 8-12 students
Setting: outdoors for collection
Vocabulary: berm, diversity, dune crest, dune slope, intertidal zone, sand fence, swale, transect, wrack line
SC Science Standards: Grade 6: IA1b2; IA1d1; IA1e1; IA2a,b,c,g; IA3a; IA6a,b; II (Fungi and Plants) C1d; C3c. Grade 7: IA1b2; IA1d1; IA1e1; IA2a,b,c,g; IA3a; IA6ab; II (Ecology – Biotic) D1a, D2a. Grade 8: IA1b2; IA1d1; IA1e1; IA2a,b,c,g; IA3a; IIA2a,b.

Objectives

Students will learn:

1) to identify flora and fauna of the beach;
2) to identify fauna that live beneath the sand;
3) the relationships between beach life and habitat; and
4) proper methods of collecting specimens.

Students survey the plants and animals along a segment of the beach.

Background

This activity is an extension of the previous activity, *The Dynamic Beach*. The beach is a continuously changing environment. In this harsh landscape, plants and animals must be adapted to extremes in temperature, wind, and sunlight. Beach temperatures vary from below freezing in winter to well over 100°F. The beach gets the full effect of strong ocean winds. Sand grains carried by the wind batter everything in their paths, and the moving sand grains cause the land surface to change in elevation and shape. Additionally, salt is an ever-constant threat to plants, forcing all but the hardiest species to grow away from the shore. Fresh water is scarce and lies deep beneath the surface.

This activity allows students to discover the flora and fauna that survive the tough beach environment. They will identify plants and animals and estimate their population densities along a beach profile **transect**. A transect is a study of elevation changes done along a line perpendicular to the shore. Students may then make inferences about the beach environment. Note: Although shells that are deposited on the beach are signs of life, they denote life *in* the ocean, not *on* the beach itself. Thus, seashells should not be included in the data collection. However, remains from ghost crabs or other beach-dwelling organisms may be recorded.

Materials:

- *A Guide to a Georgia Barrier Island* by Taylor Schoettle (photocopy and laminate select pages for ease in identification)
- several hula-hoops for stations
- two buckets
- trowel or large shells for digging
- ruler or measuring tape
- Activity #2 Data Sheet, page 25
- clipboard and pencil
- thermometer
- “wet sieve” or screen
- blank paper to record temperature of sand
- plant press (for extension)

Procedure

As one group of students is making the transect, have another group follow behind them to study life along the transect. Have the group choose several (6 or 7) sites which they would like to compare. Ensure that the sites are different from one another; for example, examine life at the top of a back dune, in a swale, at the top of the primary dune, at the **wrack line**, in the **intertidal zone**, etc. Allow the students to choose a place along the profile transect as their first study site, or station. While the profile transect is occurring, the life science group should record the distance along the profile transect for each station chosen. Place a hula-hoop at each site when distance is measured by the profile transect group in order to mark the site for later study. They will need to choose at least one of each of the following for their study sites: **dune peak, swale, berm, sand fence** (if applicable), and **dune slope**. At each station, the students should tally the different species of plants and any animals or animals signs they see within the hula hoop area. Use "Activity #2 Data Sheet" (page 25) to record the number of specimens observed. Mark them on the data sheet with

Figure 2-1: Identifying plant species and number of individuals within the hula hoop area in the field.

a tick mark, e.g. |. Multiple tick marks should be recorded by fives, e.g. ~~||||~~ . After each station, record the animal diversity and plant diversity. **Diversity** is the number of species (not specimen) found at each station.

Extensions

Have your students study the life *beneath* the sand. If you are surveying at low tide, allow them to choose three intertidal sites to study along the profile transect line. Record the location of each site as a distance from the starting point. These sites should be spaced accordingly: one near the high tide line, one near the surf, and one in between. Mark off a one-square foot area at each site.

Dig down six inches and place the sediment into one bucket, and then dig down another six inches and place that into a different bucket. Measure the temperature of the six different locations and depths. Is there any variation? Is the temperature constant at the same depth? What would that mean for the life beneath the sand? Examine the contents of each bucket. Use the wet sieve (a screen framed with wood) to separate the large items from the smaller ones. This may make it easier to count organisms, such as coquina clams, and also to estimate the amount of shell fragments and the grain sizes found at depth. Compare the results for each site.

You may wish to assist your students in collecting one good specimen of the different plant species they see. (Do not collect sea oats; there is a $200 fine per sea oat!) An easy way to do this is to use a plant press (see Resource Index). Once the plants are pressed, make color photocopies of each specimen, or laminate them, for your collection. The photocopies are useful to decorate the drawing of your beach profile (see *Constructing a Profile of the Beach Environment*).

Activity #2 Data Sheet
You Live Where?

adapted from "Beach Exploration," Wendy Allen and Patty Owens-McLaughlin, *Sea Sampler*.

Station #			YLW 1	YLW 2	YLW 3	YLW 4	YLW 5	YLW 6	YLW 7
Location (distance from BM, or data point number from beach survey)									
Description of location									
number of specimens per unit area	ANIMALS	mole crabs							
		insects							
		polychaetes							
		amphipods							
		ants							
		animal signs (tracks, burrows, fecal matter)							
		other							
		other							
	PLANTS	total % cover							
		sea oats							
		sea rocket							
		pennywort							
		russian thistle							
		beach elder							
		sandspur							
		camphorweed							
		dune spurge							
		beach primrose							
		croton							
		panic grass							
		salt meadow cordgrass							
		other							
		other							
		other							
Animal diversity (number of animal *species* at each station)									
Plant diversity (number of plant *species* at each station)									

Activity #3: The Bath Tub Ring
Examination of a Wrack Line

By Betsy Sheffield, COASTeam Program, College of Charleston, Charleston, SC

Subjects: Science
Skills: analysis, classification, comparing, description, listing, observation
Duration: 20-30 minutes
Group size: one class (30 students)
Setting: outdoors
Vocabulary: anthropogenic, dune, leeward, *Spartina alterniflora*, wrack line (strand line), wind shadow
SC Science Standards: Grade 6: IA1a1; IA1d1; IA1e1; IA2b,g; IA6a; IA7a,b,c. Grade 7: IA1a1; IA1d1; IA1e1; IA2b,g; IA6a; IA7a,b,c; II (Ecology – Biotic) D2a; III (Ecology – Abiotic) A1c,d; A7f. Grade 8: IA1a1; IA1d1; IA1e1; IA2b,g; IA7a,b,c; IB1a.

Objectives
Students will learn:
1) to identify the direction of the wind by observing materials on a beach;
2) that careful observation can often reveal the unexpected;
3) to make inferences about the change in wind direction; and
4) to predict where a **dune** may form over time.

Students observe the debris found washed ashore in the beach's **wrack line**, the extent of sand deposition around the wrack line, and the wind shadows of various objects on the beach.

Background
The ocean and its tributaries contain not only living organisms, but also evidence of their death. ***Spartina alterniflora***, or smooth cordgrass, grows in the marshes behind barrier islands. When it dies, pieces of the grass get carried out to sea by tides and are later deposited on the beach, usually at the high tide line. The remains of this deposition at high tide form what is called a **wrack line**. Other materials are washed ashore as well, such as seashells, whelk egg cases (often called "mermaid's necklaces"), skate egg cases ("mermaid's purses"), seaweed, and human trash and debris. The wrack line can be thought of as being similar to a bath tub ring, a line where the highest water once stood.

A wrack line has the potential to become a sand dune. How? As the wind blows across the beach, sand grains are picked up and transported. Beach debris, shells, or growing plants will block the path of the wind, reducing the its speed. As the wind speed decreases, these grains of sand fall to the ground and are deposited. As more sand is deposited at the wrack line, a barrier forms to block the wind and a preliminary dune begins to slowly grow. Sediment (sand) builds up and can eventually provide protection against waves and storms. If the wrack is left undisturbed by high tides, a dune is able to form. A developing dune can be seeded by windblown seeds. Plants take root and help anchor dunes, providing a windblock that allows for the deposition of more sediment, further building the dune.

Materials
- clipboards (one per person is ideal)
- pencils
- Activity #3 Worksheet and Sketch Sheet (pages 29 and 31)

Procedure
Walk along the wrack line and examine its contents at 10ft intervals. As a group, list the materials that are found within the wrack line (animals, plants, animal egg cases, and manmade products). This line has been created by recent high tides. Notice that the

dead plant material and animal signs were washed *ashore*, and therefore they originated off of the island. **Anthropogenic** products and trash (of human origin) that were littered in the ocean or coastal waterways also are deposited on the beach. Waves and currents carry products, both large and small, to the beach, and these products are evidence for what is found in the ocean.

Have your students find areas of wrack (1) that are just beginning to trap sand, (2) where the beginnings of a dune are forming, and (3) where a prominent (mature) dune has formed, and (4) where vegetation is growing. Predict what change will happen at these locations.

Note on which side of the wrack the sand is being deposited. Is the deposition at the same place on each section of wrack, both in the wrack line and on older parts of wrack deposited further inland? Wind is what carries the sand grains; when the wind is slowed down upon meeting wrack, shells, a sand fence, or anything else in its path, the energy of the wind decreases and the sand falls, being deposited on the **leeward** side of the object, dropping in the **wind shadow**. You can learn much about the changing wind directions by looking carefully at the deposition of sand near wrack. Your students should be able to deduce the prominent wind direction and whether or not it has changed direction recently or if it has been steady, just by looking at sand deposits. Give the students a copy of "Activity #3 Worksheet and Sketch Sheet" to study the wrack line on their own.

Extensions

Ask these questions of your students: Can you identify more than one wrack line? Which is most recent? Are they near each other? What caused this difference? When was the last full or new moon (**spring tide**)? Does the direction of the sand build-up differ at different wrack lines? What would you predict? Have your students take pictures of wrack, preferably high on the beach, beyond the berm. Repeated visits of this site, making photographs or sketches, will show the slow progression of dune formation. Ask your students to collect trash that has deposited in the wrack line. This is a good opportunity to discuss the effects of littering and its harm to animals (sea turtles, birds, fish, etc.).

If you are at the beach on a windy day, place an object on the sand above the wrack line (where it's dry) at the beginning of your field trip. Observe the deposition at the end of the trip.

Figure 3-1: Formation of a dune from a wrack line. Notice that wind-blown sand accumulates on the wrack debris. Source: Keener-Chavis and Sautter, *Of Sand and Sea: Teachings from the Southeastern Shoreline*, S.C. Sea Grant, 2000.

Activity #3 Worksheet
The Bath Tub Ring

1. On the sketch sheet provided, sketch five plant or animal materials observed in the wrack line.

2. For the five signs of life in the question above, describe where each lived before being washed ashore.

3. Observe the wind shadows around the wrack line. Has the wind blown from only one direction or has it blown from more than one? How do you know?

4. Find a pile of wrack that has been on the beach for awhile. How has the wind affected it? If it stays in place, what will become of it?

5. Find a newly formed dune and sketch it on the sheet provided. How may it be associated with wrack?

6. If it is a windy day, create your own mini-dune by letting several fist-fulls of sand blow around a small piece of wrack. Predict what will happen. Observe your creation and draw its formation on the sketch sheet provided.

Activity #3 Sketch Sheet
The Bath Tub Ring

Sketch here for #1

Sketch here for #5

Sketch here for #6

Activity #4: Sifting Sand

By Betsy Sheffield, COASTeam Program, College of Charleston, Charleston, SC

Subjects: Science, Math
Skills: analysis, classification, collection of materials, comparing and contrasting, description, evaluation, graphing, weighing
Duration: Part I: 20 minutes, Part II: 1 hour
Group size: 10 students
Setting: Part I is outdoors, Part II is indoors
Vocabulary: feldspar, ilmenite, quartz, sieves
SC Science Standards: Grade 6: IA1a1; IA1c1; IA1d1; IA1e1; IA2b,f,g,h; IA3a; IA4a; IA6a,b; IA7a,b,c; IA8a,b. Grade 7: IA1a1; IA1c1; IA1d1; IA1e1; IA2b,f,g,h; IA3a; IA4a; IA6a,b; IA7a,b,c; IA8a,b; III (Ecology – Abiotic) A1a,b. Grade 8: IA1a1; IA1c1; IA1d1; IA1e1; IA2b,f,g,h; IA3a; IA4a; IA7a,b,c; IA8a,b; IB1a; IB2; IB3.

Objectives

Students will learn:

1) methods to sort beach sediments by size;
2) to use the scientific method through data collection, data analysis, interpretation, and drawing conclusions; and
3) graphing data.

Students collect beach sediments along a beach transect and compare them by size and mass in the classroom.

Background

The data collection portion of this activity occurs simultaneously with *The Dynamic Beach*. At chosen intervals along the profile transect, students gather sediment samples. Beach sediment primarily consists of sand-sized grains of **quartz**. Other minerals found on the beach are **feldspar** and dark-colored **ilmenite**. The location of the different grain sizes on the beach depends on wind and water energy. The largest grains are found closest to the water, where wave energy is the highest. Wind can carry the smallest sand particles, some of which may be deposited on the dunes.

Back in the classroom, students use a set of four to six screen sieves to sort the dried sediments according to their grain size. Larger particles stay in the upper sieve, while smaller grains sift down through the smaller screens.

Materials

- quart-size zipper lock bags
- permanent marker
- clipboard and pencil
- Activity #4 Data Sheet, page 37
- aluminum foil
- bucket
- weigh paper and balance
- set of 4 to 6 screen sieves (see Resource Index)
- graph paper
- magnet
- tray (optional – for extension)

Procedure

Part I – at the beach

This activity begins on the beach. As one group of students are performing the beach profile transect, have this group collect up to seven sediment samples along the transect in select locations, such as at the dune crest, dune trough, the berm, high tide line, intertidal zone, and low tide line. Take the zipper locking bags with you on the trip to the beach. At each station site, collect a sample of the sediments from the surface (don't dig). Record the location and description for each sample on "Activity #4 Data Sheet" provided. These stations do not need to be the same as those identified in *You Live Where?* Important: Make sure you label each bag with the sample's station number and location along the profile transect, using a permanent marker (i.e., distance from the benchmark). This information will be difficult to remember when you return to the classroom.

Part II – in the classroom
After sample collection, allow the sediments to thoroughly dry before sieving them in the classroom. To speed the process, you may place sediments on aluminum foil and "bake" them in a warm oven.

Weigh the dried sediments on weighing paper to determine the total mass of the sample. Using a set of 6 sieves (screens which vary in size from large to small), pour the sediments into the top of the stack. The dry sediments will then be sorted by gravity (and vigorous shaking!), with the smaller particles falling down to lower sieves, according to grain size. The sieves should easily sort the dry sediments. If the sediment gets backed up in the lower sieves, remove the top sieves, put the cap on top of the remaining sieves, and start shaking the remaining stack.

Weigh the sediments that remain in each sieve. Record the mass on "Activity #4 Data Sheet." The total mass of all size fractions should equal the mass you determined earlier; record this at the bottom of the page. Repeat this process for each sediment sample collected along the profile transect. Next, calculate mass percent. For each size sieve, take its mass and divide it by the total mass of the collected sediment in that sample. The resulting number is a decimal number, the percent of the sample that is found in each size sieve. Record this number on "Activity #4 Data Sheet." This number allows ease in comparing the many collected samples.

Graph the results for each sample on a bar graph, with grain size on the x-axis (horizontal) and mass percent on the y-axis (vertical). A sample graph is shown below.

Observe the six sorted sediment sieves. Does a sieve have mostly dark sediment? If so, test it with a magnet. If it is magnetic, it is ilmenite. Place a weighed amount of the ilmenite into a labeled bag. Put an equal mass of the quartz, the lighter, light-colored

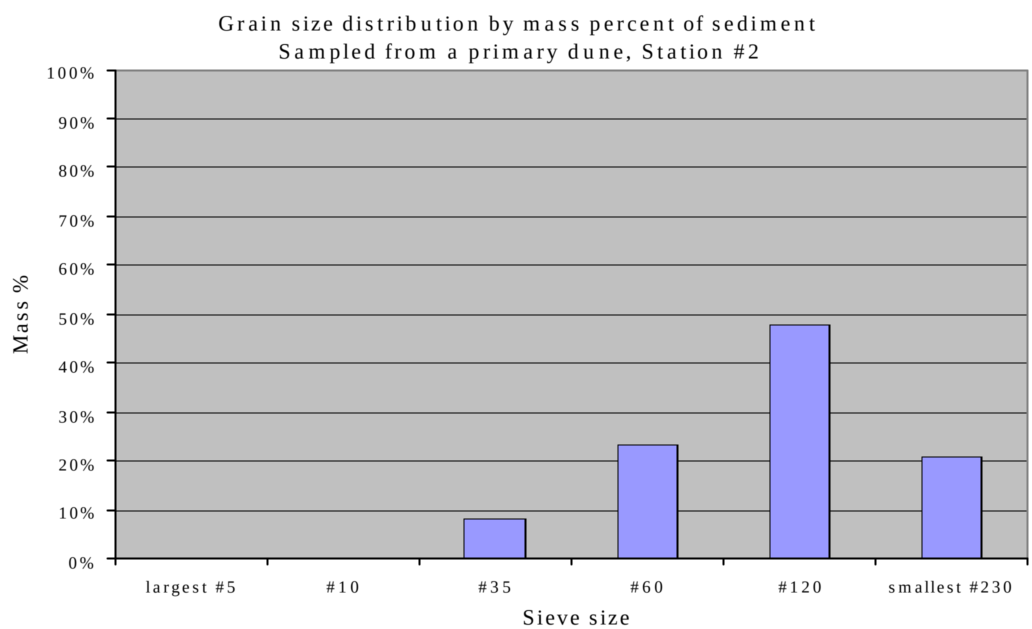


Figure 4-1: The graph shows sediment sieved from a primary dune. Notice that no large sediment particles were found at this dune. The majority of the sediment was of the smaller grain sizes.

mineral you have collected, into another bag. You should be able to identify the denser mineral based on the volume in each bag. Although the masses are equal, you will notice that there is a smaller volume of ilmenite than quartz. Ilmenite is an iron-rich, dense (heavy for its size) mineral. Quartz is made of the element silica, and has a low mass for its size, and much less dense than ilmenite. Density is defined as mass per volume of sediment.

Deposits of ilmenite and other heavy minerals are the result of storm surges and high-energy waves. The mineral is very heavy for its size and it is only carried by high-energy water. As a wave crashes on the beach, ilmenite and other heavy particles are deposited. The heavy minerals remain behind while the receding wave energy carries away the lighter grains.

Glue a small sample of each sediment size onto an index card for display on your profile model. Also, use a piece of clear tape to pick up some loose sediment to examine under a microscope so your students will be able to distinguish between fine- and coarse-grained sand. (See *Constructing a Profile of the Beach Environment*.)

Extensions

Part I

If time permits on the beach, the instructor may wish to perform a quick sieving of sediments. Find the driest sediments on the beach (usually found in the dunes). Set up the sieves with the largest screen on the top of the stack and the smallest at the bottom.

Pour sediments into the top sieve, put the lid on it, and shake it. When it is sorted, observe the sieves. If the sand was collected on a dune, the majority of it should be fine-grained and in one of the smaller sieves. Show your students the ilmenite and its magnetic properties. Repeat at other dry locations and compare.

Part II

Use a variety of graph types to display the data, e.g., bar graph, pie graph, line graph, etc.

Figure 2: Sediment has been sorted and distributed among the six sieves. (Photo courtesy of Angela Mills)

Activity #4 Data Sheet
Sifting Sand

Station #		SS 1		SS 2		SS 3		SS 4		SS 5		SS 6		SS 7	
Location (distance from benchmark, or data point number from beach survey)															
Description of location															
		mass (g)	%	mass (g)	%	mass (g)	%	mass (g)	%	mass (g)	%	mass (g)	%	mass (g)	%
SEDIMENT	(largest mesh sieve) 1														
	2														
	3														
	4														
	5														
	(smallest mesh sieve) 6														
	total mass per sample		100		100		100		100		100		100		100

From The Ever-Changing Beach, Third Draft. By Betsy Sheffield, COASTeam Program, Lowcountry Hall of Science and Math, College of Charleston, Charleston, SC 29424

Activity #5: Constructing a Profile of the Beach Environment

By Betsy Sheffield, COASTeam Program, College of Charleston, Charleston, SC

Subjects: Marine Science, Art, Math
Skills: analysis, classification, description, discussion, estimation, evaluation, graphing, synthesis, visualization
Duration: 1-2 hours
Group size: one class (30 students)
Setting: indoors
Vocabulary: accretion, erosion, shell hash, spring tide, vertical exaggeration, wrack line
SC Science Standards: Grade 6: IA1b1,2; IA1c1; IA1d1; IA1e1; IA2b,f,g,h; IA3a,b; IA4a; IA5a; IA6a,b; IA7a,b,c,d; IA8a,b. Grade 7: IA1b1,2; IA1c1; IA1d1; IA1e1; IA2b,f, g,h; IA3a,b; IA4a; IA5a; IA6a,b; IA7a,b,c,d; IA8a,b; II (Ecology – Biotic) D1b, D2b. Grade 8: IA1b1,2; IA1c1; IA1d1; IA1e1; IA2b,f,g,h; IA3a,b; IA4a; IA5a; IA7a,b,c,d; IA8a,b; IB2,3.

Objectives

Students will learn:

1) to synthesize data collected from previous activities; and
2) to create a mural and visual presentation of the data.

Students blend their beach profiling and other observations of fauna, flora and sediments into a mural that describes the geology and biology of the studied beach along the profile transect.

Background

Bring the beach into your classroom! Now that the beach profile transect is complete, allow your students to present their findings. This final activity is a good wrap-up and also gives students a venue to show off their knowledge. It utilizes sediment samples and specimens of beach plants collected on their field trip. Additionally, it requires math through data interpretation.

Materials

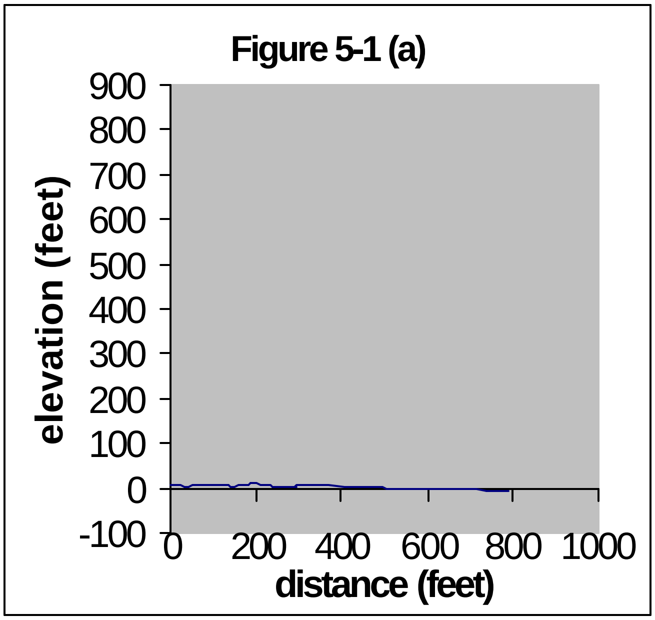
- completed "Activity #1 Worksheet 1"
- completed "Activity #2 Data Sheet"
- completed "Activity #4 Data Sheet"
- graph paper
- butcher paper, or roll of 3 ft wide paper
- pencils, markers, crayons
- straight edge
- measuring tape
- glue
- samples from Activities #2 and #4
- masking tape

Procedure

Part I

To begin, give every student a copy of the completed "Activity #1 Worksheet 1" and a piece of graph paper. Ask them how they should plot the data to give an accurate profile of the beach. Which data columns should they use? How should they scale the data? As they connect the data points, they should remember that they must interpolate the land's surface. They should not connect the points with straight lines, otherwise it will result in a non-natural picture. They should notice that the elevation of the beach ranges from less than zero (below sea level) to 10 or 15 feet above sea level, while the profile was hundreds of feet in length. If they scale the data so that the scales of the vertical and horizontal axes are equal, the profile will not show much variation along its length. See Figure 5-1, next page.

Figures 5-1(a) and 5-1(b) show the difference that scale and vertical exaggeration make. The upper chart is drawn so that the vertical and horizontal scales are equal (i.e., no vertical exaggeration). It illustrates the low elevation of a beach environment and how little the elevation varies over distance. At this scale, there is little variation along the profile, and only the highest peaks are visible. For a beach profiling project, the variation in beach elevation *is* important, especially to determine changes in erosion and accretion of island sediment. The better choice of graphs is Figure 5-1(b), where the horizontal and vertical scales differ and therefore *do* show the changes in elevation that were mapped. The vertical scale was changed to achieve this result. The stretching of the vertical axis is referred to



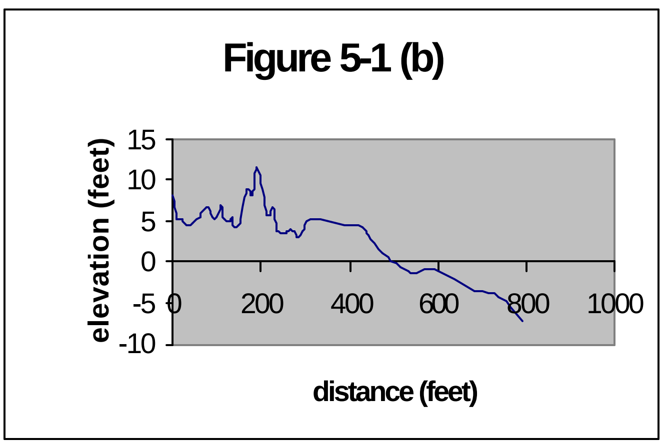


Figure 5-1: (a) Profile of data with equal horizontal and vertical scales, and no vertical exaggeration. (Station 3260, Dewees Is., SC) (b) The same profile with different horizontal and vertical scales, and a vertical exaggeration of 16.9x.

as **vertical exaggeration**. Using a vertically exaggerated scale is often beneficial, particularly in environments with relatively little elevation change.

For a step-by-step guide to vertical exaggeration, see the descriptive box on page 42, titled "Understanding Vertical Exaggeration."

Prepare your students to plot the data on graph paper, instructing them to use the proper axes. Label the y-axis "elevation in feet" (or meters) and the x-axis "location along transect in feet from starting point."

Next, have each student choose a vertical scale to graph the data. You should determine the scale for the horizontal axis; have each student choose his or her own vertical scale and calculate the vertical exaggeration for his or her own graph. They will use the data from the profile data sheet: carefully plot the data from the column "actual elevation" on the y-axis and "cumulative distance" on the x-axis. Collect the graphs, place them at the front of the room, and compare them. There should be a great range of vertical exaggeration, and will allow your students to discover why vertical exaggeration is important in understanding changes along a profile transect. An increase in vertical exaggeration will highly distort the dunes, making them appear steep.

Part II

Using butcher paper, cut a length for display on a wall in your classroom or in the hallway. Draw an x- and y-axis using a yard stick. Label the y-axis "elevation in feet" (or meters) and the x-axis "location along transect in feet from starting point." Ask your students to determine the vertical exaggeration for this project. As they did in Part I, have your students plot the data from the column “actual elevation” on the y-axis and “cumulative distance” on the x-axis. Make sure the students plot the profile carefully.

bird nests, etc. Also, you may wish to glue samples of the sieved sand to your drawing (see *Sifting Sand*) and photocopies or pressed specimens of the collected plants (see *You Live Where?*). Include the sub-surface data gathered at the intertidal zone in Activity #2.

To give an accurate picture of the beach profile, students must interpolate the land surface between collected data points. For instance, when connecting the data points with a line, is the line straight or curved? How do you know how the profile looks when you did not collect data every foot? You *don't* know, but you know enough to make a good interpretation of the data to document it. That’s what some scientists have to do all the time!

Next, at the proper station locations, add the plants and animals you recorded on “Activity #2 Data Sheet.” Remember to indicate any features of interest, such as sand fencing, wrack line, shell fragments,

If your class is able to study the same site many times, you may wish to have them measure the same points again and again for consistency in establishing a study of the beach over time. Compare winter versus summer profiles, before and after a hurricane or winter storm (Figure 5-2), or the effects of **spring tides.**

Extensions

Get data from the web (see Resource Index) for the benchmark that your class surveyed. Make profiles at the same scale as your class’s study using archive data. Plot the data on overlays and color code areas of **erosion** and **accretion**.

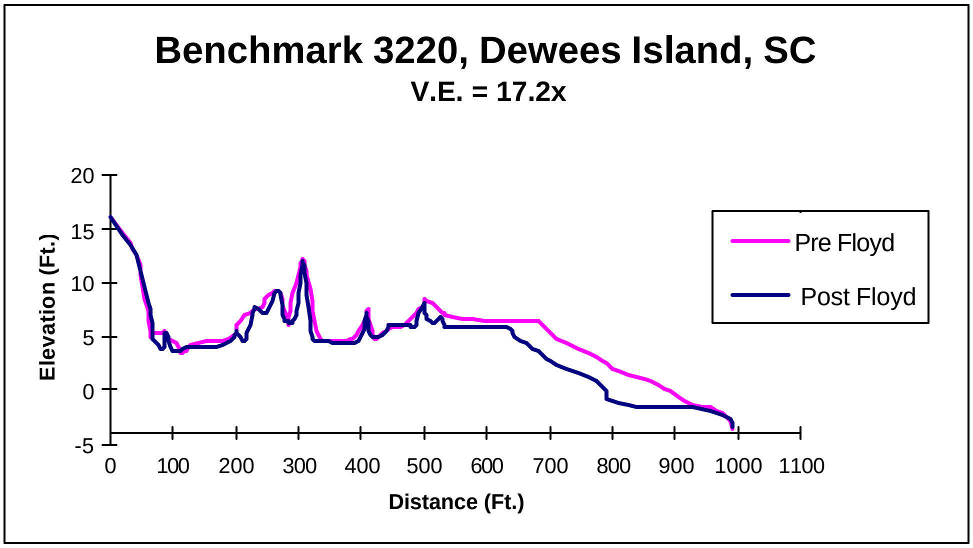


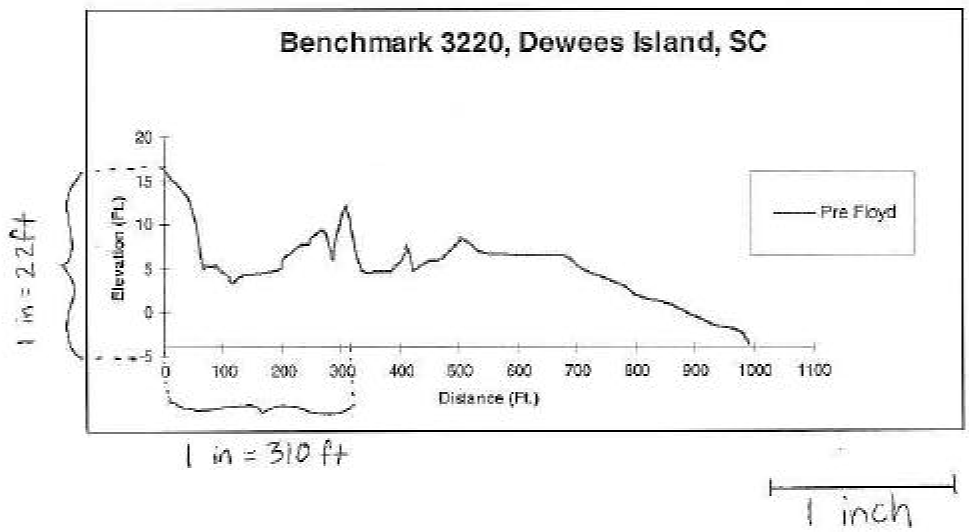
Figure 5-2: This graph compares the profile of the same section of beach a week before Hurricane Floyd with a month after it.

UNDERSTANDING VERTICAL EXAGGERATION

To calculate vertical exaggeration, estimate the amount of feet (horizontal distance) represented by one inch on the x-axis (horizontal axis). Then estimate the number of feet (vertical elevation) represented by one inch on the y-axis (vertical axis). Now divide the horizontal scale by the vertical scale, and you have the vertical exaggeration for the graph! Vertical exaggeration can be abbreviated "V.E" and is written with an "x" after the number, for example, V.E. = 20x. 20x indicates relief shown on profile is twenty times greater than relief in the field. For example, slopes are shown twenty times steeper on the graph than in the field.

In the graph below:

one inch on paper equals *22 feet* on the vertical scale.
one inch on paper equals *310 feet* on the horizontal scale.



$\frac{310 \text{ ft}}{22 \text{ ft}}$ = 14.1 V.E. = 14.1x

The vertical scale is exaggerated approximately 14 times the horizontal scale.

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12-280
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10 Squares to the Inch

Glossary

accretion – the accumulation of beach sediment and sand, deposited by wind or water

anthropogenic – resulting from the influence of human beings on nature

backshore – the upper part of the active beach located landward of high tide, affected only by storm waves

beach – the zone of loose, unconsolidated sediment that is moved by waves, wind and tidal currents, extending landward to the coastline. The seaward limit of a beach, unless otherwise specified, is the mean low water line.

beach erosion – the carrying away of beach materials by wave action, tidal currents, or wind

beach face – the section of the beach normally exposed to wave action

benchmark – a mark affixed to a permanent object in a survey, to furnish a datum level

berm – a nearly horizontal plateau on the beach face, formed by the deposition of beach material by wave action, generally paralleling the water at or landward of the line of ordinary high tide

density – mass per unit volume. Density is related to **specific gravity**.

diversity – the number of species within a designated area

dune – Accumulations of windblown sand on the **backshore**, usually in the form of small hills or ridges, stabilized by vegetation or control structures.

dune crest – the topmost point on a dune

dune slope – the front part of the dune that gradually changes in elevation

erosion – the carrying away of beach material by wave action, tidal currents or wind

feldspar – silicate mineral occurring in igneous rocks that can be found as sand-sized beach sediment

hurricane – A cyclonic storm, usually of tropical origin, covering an extensive area, with winds in excess of 75 miles per hour.

ilmenite – black-colored, slightly magnetic, iron-bearing mineral. Since it is resistant to weathering, it is found washed ashore as beach sediment. Its **specific gravity** is 4.5 – 5.0, making it rather dense.

intertidal zone – The zone between the high and low water marks

leeward – The direction *toward* which the prevailing wind is blowing. Sediment is deposited on the leeward side of objects, such as shells, dunes, and vegetation.

neap tide – tide of decreased range occurring semimonthly as the result of a first or third quarter moon

nor'easter – a storm with winds from the northeast, most often occurring in winter

quartz – one of eight of the most common minerals in the earth's crust. Quartz is a silicate mineral found in many igneous and metamorphic rocks. Its resistance to weathering allows it to be deposited as sediment, and it is the most common mineral found on South Carolina's beaches. **Specific gravity** = 2.65.

sand – a mixture of loose sediment (shell and rock fragments, mostly quartz) consisting of small but easily distinguishable grains ranging in size from about .062 mm to 2.0 mm.

sand fence – a fence designed to trap sand in beach dunes; a fence is constructed at 45-degree angles to the shore

shell hash – the bits of shell material washed ashore on the beach

sieve – a device with meshes through which finer sediment is separated from coarser sediment

Spartina – a grass that grows on barrier islands and in marshes. There are two types of *Spartina* grass, *Spartina alterniflora* (smooth cordgrass) and *Spartina patens* (salt meadow cordgrass). *Spartina alterniflora* is found in marshes and also washed up with the high tide on the beach; *S. patens* grows on a beach's dunes.

specific gravity – ratio of the weight of a material to the weight of an equal volume of water, expressed as a unitless number. **Quartz** has a specific gravity of 2.65, meaning a given volume of quartz weighs 2.65 times that of an equal volume of water.

spring tide – A tide that occurs at or near the time of new or full moon, and which causes the highest high tides and lowest low tides.

strand line – an accumulation of debris (e.g. seashells, seaweed, driftwood and litter) cast up onto a beach, and lying along the high tide line. Also called **wrack line**.

swale – a low-lying or depressed (and often wet) stretch of land

topography – the shape of the land features on the earth's surface

transect – a survey of elevation, usually in the form of a long continuous strip. On a beach, transects are usually measured perpendicular to the shore, to produce a cross-section of the elevation changes in the area studied.

vertical exaggeration – amplification of the y-scale on a graph or a topographic profile to better illustrate the elevation changes along a transect

wind shadow – the area on the **leeward** side of an object (e.g. shells, plant matter) away from the wind, into which sediment is deposited

wrack line – an accumulation of debris (e.g. seashells, seaweed, driftwood, and litter) cast up onto a beach, and lying along the high tide line. Also called **strand line**.

Supply List, by activity

General Supplies

- bug spray
- sunscreen
- water shoes
- hat
- mist bottle
- water
- trail mix
- camera
- appropriate clothes (rain gear, pants, coat, windbreaker, shoes)
- sunglasses
- wet wipes
- tote bags
- backpacks
- additional field guides

The Dynamic Beach

Part I

- Activity #1 Worksheet 1, pages 7 and 9
- graph paper, page 13

Part III

- one 10 ft (4 meters) section of PVC pipe (referred to as the "long rod")
- one 5 ft (1.5 meters) section of PVC pipe ("short rod")
- thick nylon rope marked off in 1-foot increments, with a knot tied every 15 feet (10 meters)
- lightweight cotton string
- line level (available at hardware stores)
- clipboard with attached pencil (less likely to be lost that way!) and with rubber band to prevent papers from blowing in wind
- two or three copies of the Beach Profiling Data Sheet, page 21
- compass (optional)

You Live Where?

- *A Guide to a Georgia Barrier Island* by Taylor Schoettle (photocopy and laminate select pages for ease in identification)
- several hula-hoops for stations
- two buckets
- trowel or large shells for digging
- ruler or measuring tape
- Activity #2 Data Sheet, page 25
- clipboard and pencil
- thermometer
- "wet sieve" or screen
- blank paper to record temperature of sand
- plant press (for extension)

The Bath Tub Ring

- clipboards (one per person is ideal)
- pencils
- Activity #3 Worksheet and Sketch Sheet (pages 29 and 31)

Sifting Sand

- quart-size zipper lock bags
- permanent marker
- clipboard and pencil
- Activity #4 Data Sheet, page 37
- aluminum foil
- bucket
- weigh paper and balance
- set of 4 to 6 screen sieves (see Resource Index)
- graph paper
- magnet
- tray (optional – for extension)

Constructing a Profile of the Beach Environment

- completed "Activity #1 Worksheet 1"
- completed "Activity #2 Data Sheet"
- completed "Activity #4 Data Sheet"
- graph paper
- butcher paper, or roll of 3 ft wide paper
- pencils, markers, crayons
- straight edge or yard stick
- measuring tape or yard stick
- samples from Activities #2 and #4
- glue
- clear tape, and masking tape
- calculators (optional)

Supply list, by quantity

for *The Ever-Changing Beach* field trip

quantity	item
Every student should bring these items	bug spray
	sunscreen
	water shoes
	hat
	mist bottle
	water
	trail mix
	appropriate clothes (rain gear, pants, coat, windbreaker, shoes)
	sunglasses
For teachers	camera
	wet wipes
	tote bags
	backpacks, crates for carrying field equipment
	additional field guides
1	10 ft (4 meters) section of PVC pipe (referred to as the "long rod")
1	5 ft (1.5 meters) section of PVC pipe ("short rod")
1	thick nylon rope marked off in 1-foot increments, with a knot tied every 15 feet (10 meters)
1	lightweight cotton string
1	line level (available at hardware stores)
3	clipboard with attached pencil (less likely to be lost that way!) and with rubber band to prevent papers from blowing in wind
2-3	copies of the Beach Profiling Data Sheet, page 21
1-2	compass (optional)
2 copies of pages	*A Guide to a Georgia Barrier Island* by Taylor Schoettle (photocopy and laminate select pages for ease in identification)
2-4	hula-hoops for stations
2	buckets
3	trowel or large shells for digging
1	ruler or measuring tape (to get dirty)
1-2	copies of Activity #2 Data Sheet, page 25
2-3	thermometers
1-2	"wet sieve" or screen
1-2	blank paper to record temperature of sand
1	plant press (for extension)
1 per child	clipboards (one per person is ideal)
1 per child	pencils
1 per child	copies of Activity #3 Worksheet, and Sketch Sheet (pages 29 and 31)
10	quart-size zipper lock bags
1-2	permanent marker
1-2	copies of Activity #4 Data Sheet, page 37
1	magnet

Supply List, by quantity

for in-class activities

quantity	item
1 per child	Activity #1 Worksheet 1, pages 7 and 9
3 per child	graph paper, page 13
	sand samples for sieving
1	roll of aluminum foil
1	weigh paper and balance
1-2	set of 4 to 6 screen sieves (see Resource Index)
1	tray (optional – for extension)
	calculators
1	roll of butcher paper (3 ft wide paper)
plenty	pencils, markers, crayons
1	straight edge or yard stick
1	measuring tape or yard stick
	plant samples or pictures from Activity #2
2	bottles of glue
1	roll of clear tape
1	roll of masking tape

Resource Index

OCRM. Benchmark information may be obtained from Bill Eiser at the Office of Ocean and Coastal Resource Management (OCRM), of the South Carolina Department of Health and Environmental Control (SCDHEC). Telephone number 843-744-5838, x 120.

Screen Sieves

Hubbard Scientific, P.O. Box 760, Chippewa Falls, WI 54729: item number 3040-4 for 4 sieves, 3040-6 for 6 sieves.

Carolina Biological has 4 sieves (#6, #20, #40, #100) for $28 (BA-GEO9310), or 4 sieves (#5, #10, #60, #230) for $54 (BA-GEO9300), or a set of 6 sieves (#5, #10, #35, #60, #120, #230) for $81.10 (BA-GEO9300A); call 1-800-334-5551.

Plant Press

Build one with the information at http://kidscience.about.com/kids/kidscience/library/weekly/aa082299.htm

Carolina Biological (1-800-334-5551) has plant presses from $14.95 to $47.25.

Books

Tideland Treasures, by Todd Ballentine. Found at your local bookstore.

A Guide to a Georgia Barrier Island, by Taylor Schoettle. For ordering information, call Mr. Schoettle at 912-437-6799 or write him at P.O. Box 1117, Darien, GA 31305.

Of Sand and Sea, by Paula Keener-Chavis and Leslie Reynolds Sautter. Produced by S.C. Sea Grant. Contact the Lowcountry Hall of Science and Math at 843-953-7847 to order.

Nature Guide to the Carolina Coast, by Peter Meyer. Found at your local bookstore.

Websites

http://coastalgeology.org This site can be used to access beach profiling data, including that from Dewees Island, SC.

http://www.hometown.aol.com/scisites/Oceanhome.html Webpage of a past COASTeam graduate.

http://mciu.org/~seastar For further information on beach profiling, see the Seastar website.

References

Allen, Wendy Beard, and Patty Owens McLaughlin, Eds. *Sea Sampler: Aquatic Activities for the Field and Classroom*. Charleston, SC: South Carolina Sea Grant Consortium. For ordering information, please contact Sea Grant at 843-727-2078.

Keener-Chavis, Paula and Leslie Reynolds Sautter. *Of Sand and Sea: Teachings from the Southeastern Shoreline*. Charleston, SC: South Carolina Sea Grant Consortium, 2000. Please contact the Lowcountry Hall of Science and Math at 843-953-7847 to order.

Schottle, H.E. Taylor. *A Field Guide to Jekyll Island*. Athens, GA: Georgia Sea Grant Consortium, The University of Georgia, 1990.

________. *A Guide to a Georgia Barrier Island: Featuring Jekyll Island with St. Simons and Sapelo Islands*. Darien, GA: Darien Printing and Graphics, 1999.

Voigt, B. 1998. *Glossary of Coastal Terminology*. Washington State Department of Ecology, Coastal Monitoring & Analysis Program, Publication No. 98-105.
(see website: http://www.csc.noaa.gov/text/glossary.html)

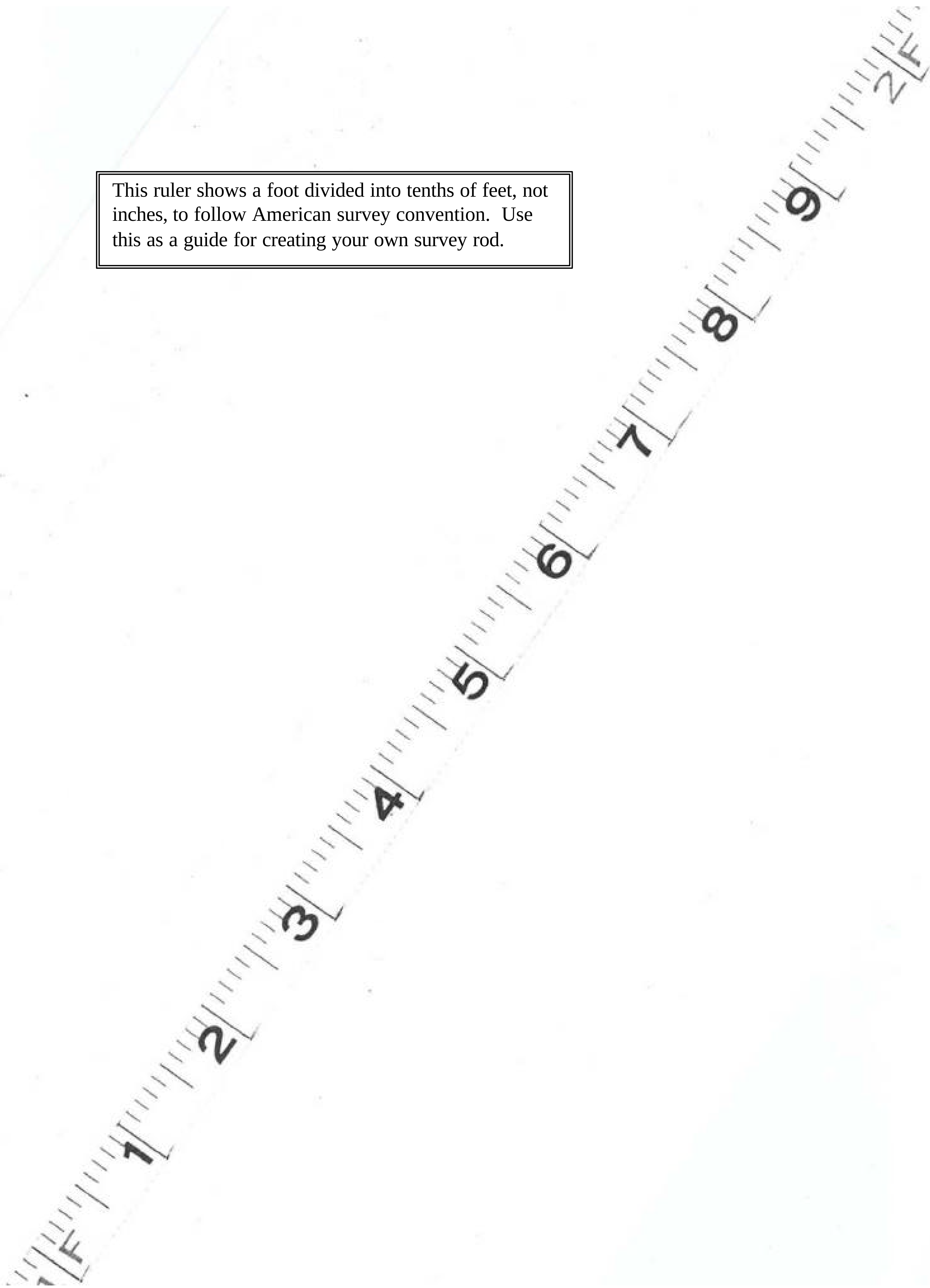
Appendices

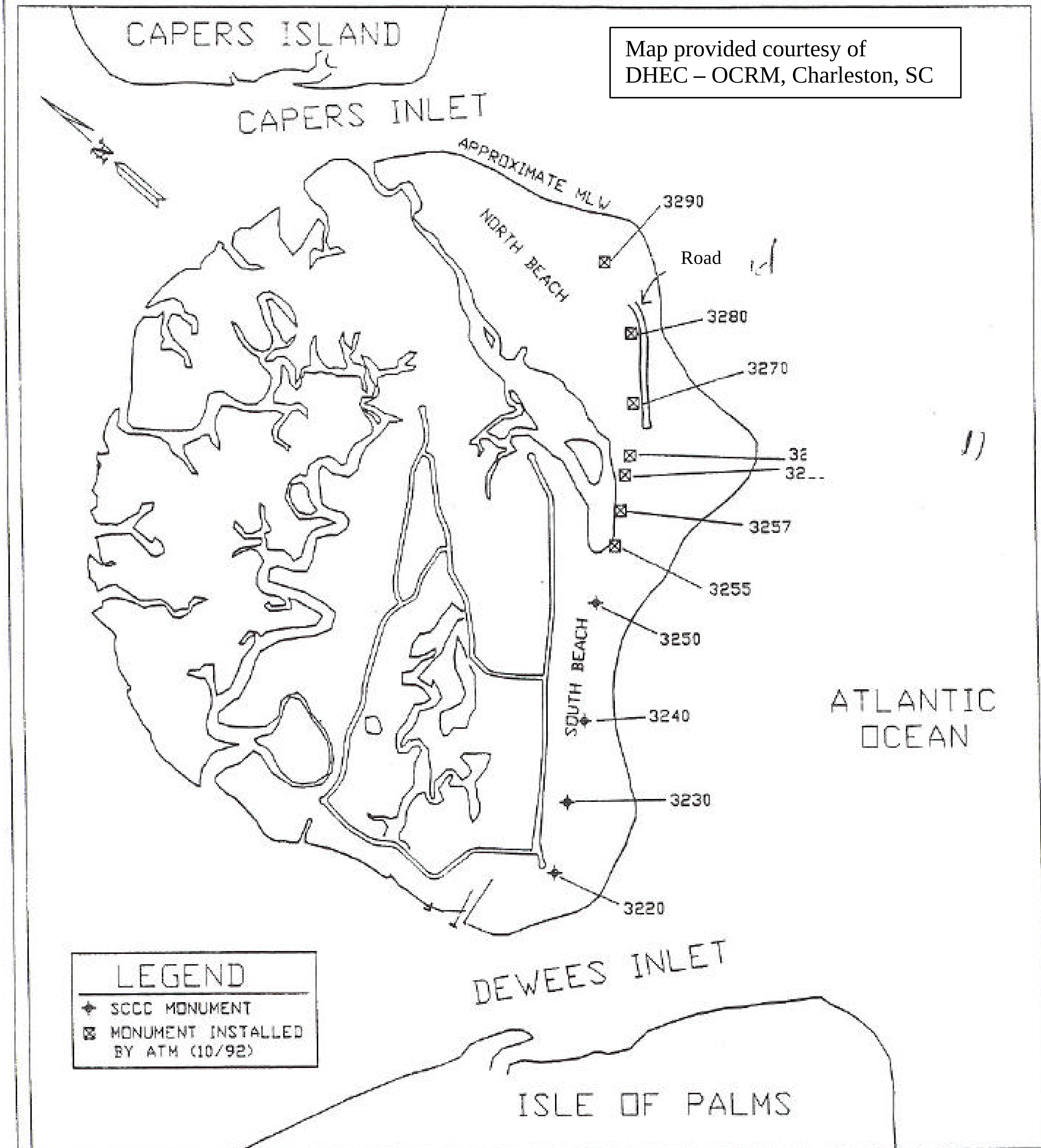
Ruler showing a foot divided into tenths of feet

Map from OCRM of benchmark locations on Dewees Island, SC

Graph of beach profiles from Station 3260, Dewees Island, SC, by OCRM

This ruler shows a foot divided into tenths of feet, not inches, to follow American survey convention. Use this as a guide for creating your own survey rod.





DEWEES ISLAND BEACH SCRAPING
& DUNE RESTORATION

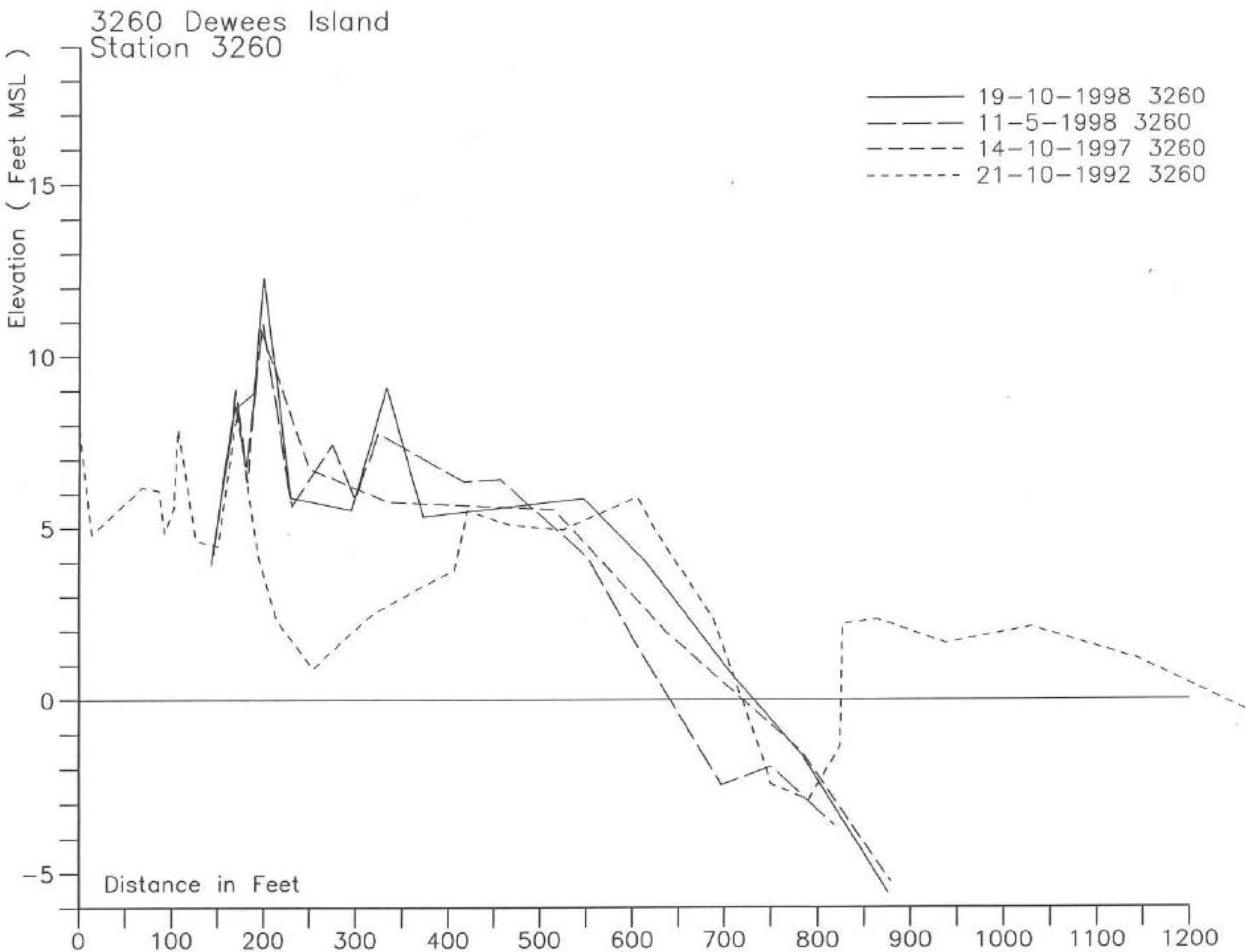
MONUMENT LOCATIONS

SHEET 2 OF 6

PROPOSED ACTIVITY:
DUNE RECONSTRUCTION

APPLICANT:
ISLAND PRESERVATION PARTNERSHIP

COUNTY: CHARLESTON


3260 Dewees Island
Station 3260
19-10-1998 3260
11-5-1998 3260
14-10-1997 3260
21-10-1992 3260
Elevation (Feet MSL)
15
10
5
0
-5
Distance in Feet
0
100
200
300
400
500
600
700
800
900
1000
1100
1200