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ABSTRACT

The ocean affects all of our lives. Therefore, awareness of and information about the interconnections between humans and oceans are prerequisites to making sound decisions for the future. Project ORCA (Ocean Related Curriculum Activities) has developed interdisciplinary curriculum materials designed to meet the needs of students and teachers living in Washington State. Each activity packet provides the teacher with a set of lessons dealing with a particular topic related to the oceans. Included are student worksheets, lesson plans, a vocabulary list, and a bibliography. This activity packet designed for grade levels 8-9 focuses on making measurements on beaches. The activity "Profiles" gives directions on how to measure and record the profile of a slope. In the "Transect" activity, students sample populations using the single line transect-quadrat method. This activity is intended to follow up studies of beach zonation in the packet "Beaches." In addition to measuring and sampling techniques, analysis of the inter-relatedness of beach life and environmental factors is stressed. (TW)

BEACH PROFILES AND TRANSECTS

ORCA

OCEAN RELATED CURRICULUM ACTIVITIES

PACIFIC SCIENCE CENTER / SEA GRANT
MARINE EDUCATION PROJECT

CLAIRE JONES, AUTHOR
ANDREA MARRETT, MANAGER

ORCA PUBLICATIONS

ELEMENTARY

High Tide, Low Tide (4th Grade)
Life Cycle of the Salmon (3rd - 4th Grade)
Waterbirds (4th - 5th Grade)
Whales (4th - 6th Grade)

JUNIOR HIGH

Beaches
Beach Profiles and Transects
Early Fishing Peoples of Puget Sound
Energy from the Sea
Literature and the Sea
Tides
Tools of Oceanography

SENIOR HIGH

American Poetry and the Sea
Marine Biology Activities
Marine Biology Field Trip Sites
Marshes, Estuaries and Wetlands
Squalls on Nisqually: A Simulation Game

PROJECT ORCA

The ocean? It's 2 miles away; it's 200 miles away; it's 2000 miles away. What does it matter to me? For those students who live close to the ocean, a lake or a stream, the effect of water might be more obvious. For the student who lives on a wheat farm in the arid inlands, the word ocean is remote. It may conjure up images of surf, sand and sea gulls, experiences far removed from their daily lives; or it may have no meaning at all. Yet for that same youngster, the reality of the price of oversea wheat shipments or fuel costs for machinery are very real. The understanding of weather and its effects on the success or failure of crops is a basic fact of everyday life. The need for students to associate these daily problems with the influence of the marine environment exists. It requires exposure to ideas, concepts, skills and problem solving methods on the part of the youngsters. It also requires materials and resources on the part of our educators.

The goals of ORCA (Ocean Related Curriculum Activities) are: 1) to develop a basic awareness of ways in which water influences and determines the lives and environments of all living things; and 2) to develop an appreciation of the relationship of water to the study of the natural sciences, social sciences, humanities and the quality of life.

ORCA attempts to reach these goals by: 1) developing interdisciplinary curriculum materials designed to meet the needs of students and teachers living in Washington State, 2) developing a marine resource center, and 3) providing advisory services for marine educators. In conjunction with these efforts, ORCA is coordinating communication among educators throughout the state and the rest of the nation.

The curriculum materials are developed to be used in many areas including the traditional science fields. They consist of activity packets which fit existing curricula and state educational goals and are designed for use as either a unit or as individual activities.

The ocean affects all our lives and we need to be aware and informed of the interconnections if we are to make sound decisions for the future of the earth, the ocean and our own well being. We hope that through Project ORCA, teachers will be encouraged to work together to help students understand and appreciate the ocean and the world of water as a part of our daily existence.

ACKNOWLEDGEMENTS

The Ocean Related Curriculum Activities (ORCA) are a product of a cooperative effort. These materials were developed at the Pacific Science Center. Assistance was provided by the National Oceanic and Atmospheric Administration (NOAA) Sea Grant held by the University of Washington. The Office of the Washington State Superintendent of Public Instruction provided technical support and assistance.

TRIAL TEACHERS

Trial teachers test us and answer the most important question of all: "Does it work?" The teachers who gave their time, effort and advice were:

Lynda Hughes and Allen Husker, Edmonds School District
Lee Boulet; Highline School District
Barbara Deihl and Susan Swenson; Kent School District
Andrea Marlett; Lake Washington School District
Claire Jones and Jenifer Katahira; Pacific Science Center School for Science
Greg Aveleson, Joe Budde and Mary Ketcham; Renton School District
Margaret Bonham, Ivan Ellis, Willim Lippit, Barb Norsen and Jay Sasnett; Seattle School District

CONSULTANTS

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Dave Borden, Director of the Marine Science Center, Poulsbo
Dennis Campbell, Teacher, Edmonds School District
Alyn Duxbury. Ph.D., Assistant Director for New Programs, Division of Marine Resources, University of Washington
Charles J. Flora, Ph.D., Director of Aquatic Studies, Western Washington University
Charles Hardy, Coordinator, Math and Science, Highline School District
Richard Sternberg, Ph.D., Department of Geology, University of Washington

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Elizabeth Sears, Biology Teacher, Edmonds School District
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Sally Snyder, Ph.D., Anthropologist
Hilary Stewart, Author
Jerry Strain and Joel Rogers, Photographers
Terry Taffoya, United Indians of All Tribes

ADVISORY COMMITTEES

The Marine Education project was reviewed annually by the Sea Grant Site Evaluation committee. We thank them for their advice and support.

Continuing guidance for the program direction was provided by the Pacific Science Center Education Committee, the members of which are:

A.D. Ayrault, Jr., Headmaster, Lakeside School
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Charles Hardy, Coordinator, Math and Science, Highline School District
David Kennedy, Supervisor of Science and Environmental Education; Office of Superintendent of Public Instruction
Roger Olstad, Ph.D., Associate Dean of Graduate Studies, University of Washington, Committee Chairperson
Alice Romero, Teacher, West Seattle High School
Sally Stapp, Teacher, Frank Wagner Elementary
William Stevenson, Superintendent, Shoreline School District

STAFF

Finally, our heartfelt appreciation to the staff members who were instrumental in creating, developing and supporting this project. Thank you to the curriculum writers Jenifer Katahira, Claire Jones, Andrea Marrett, Florence Sands and Sally Snyder. We appreciate the efforts of the people responsible for graphics and paste up; Susan Lundstedt, graphics; Luann Bice, artwork; Valene Starrett, covers; and Andrea Marrett and Carolyn Hanson, paste up. We sincerely thank our project investigator, Bonnie DeTurck, Director of Education and Debbie Fowler, the Marine Education Intern at the Pacific Science Center. We wish also to express our gratitude to Patty Kelley, Jan McLachlin, Leslie Wozniak and Peggy Peterson, for their patience in typing, retyping and alas, typing it all over one more time.

A special thanks to my husband, John Pauls, for all the moral support he provided during the development of these materials and his idea-generating questions.

Shirley Pauls
Project Manager
September 1977 to February 1979

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BEACH PROFILES AND TRANSECTS (7-9 days)

ABSTRACT:

To obtain useful information about beaches or any other study site, careful measurements must be taken. The activity "Profiles" gives directions on how to measure and record the profile of a slope. In the "Transect" activity, students sample populations using the single line transect-quadrat method. This activity is intended to follow up studies of Beach Zonation in the packet "Beaches." It requires some familiarity with intertidal organisms. The profile and transect activities can be done together or separately. Activities 1-4 can stand on their own, with no field trip. For the transect activities, however, you will need to take the class to a beach.

Student handouts and teacher information sheets are provided. In addition to measuring and sampling techniques, analysis of the inter-relatedness of beach life and environmental factors is stressed.

SUBJECT AREAS: Biology, Ecology, Math

GRADE LEVELS: 8-9

WRITTEN BY: Claire Jones

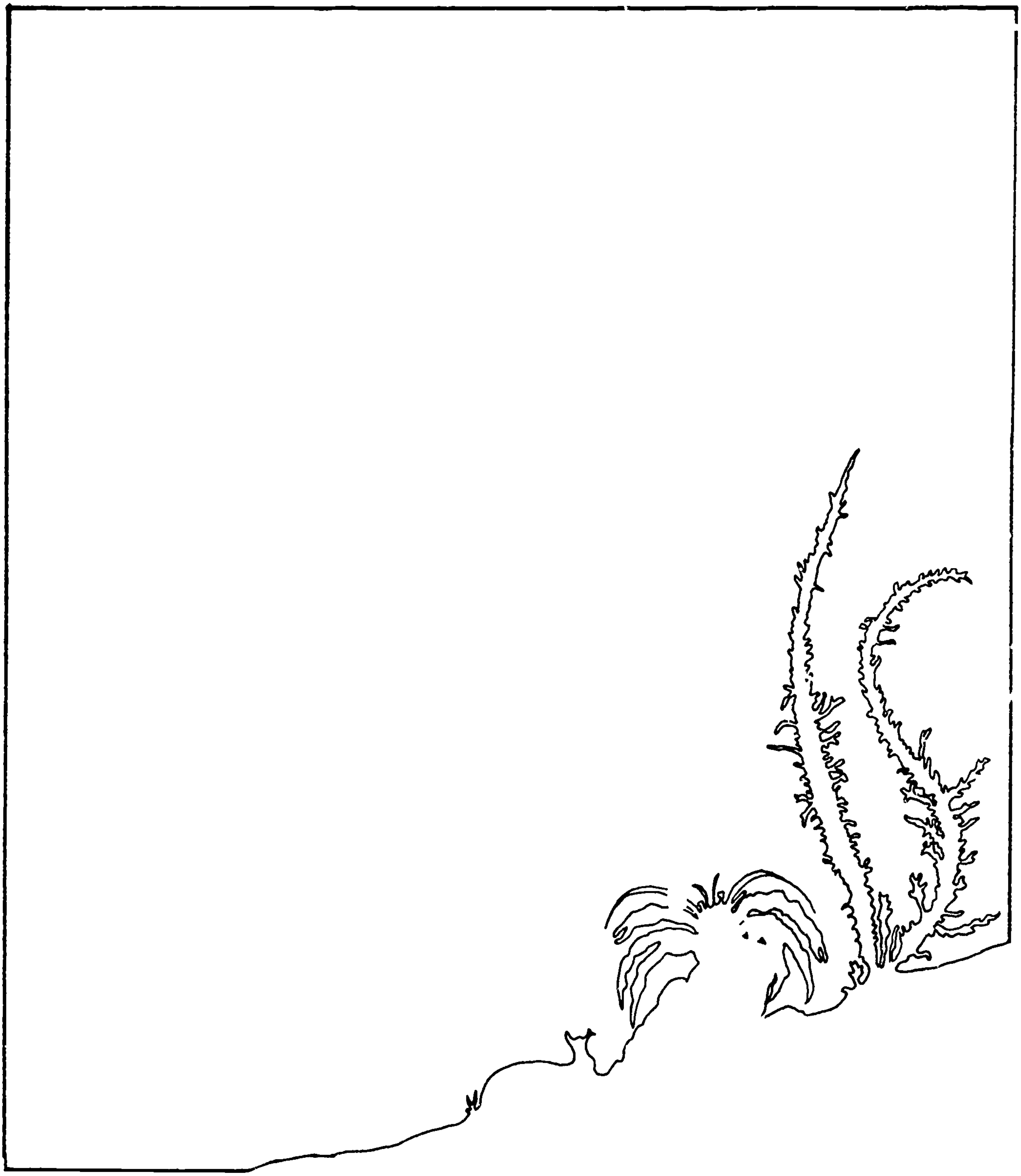
BEACH PROFILES AND TRANSECTS

OBJECTIVES

The student will be able to:

1. name at least three different characteristics of beaches about which useful information might be obtained.
2. name at least two different occupations in which such information is used.
3. describe what a beach profile shows.
4. construct a range pole and sighting device in teams of 3.
5. make fine adjustments on their sighting device.
6. use the profile measuring technique as described here to take readings of the slope of an area.
7. record elevation differences on the beach profile chart.
8. transfer data collected at the site into graph form.
9. explain what the graph shows about the slope of the site.
10. use the profile measuring technique on the beach site.
11. realize that beaches are used by many people. Our beaches are a unique and valuable resource which should be conserved.
12. treat beach animals with respect.
13. be able to state for what purposes the single line transect-quadrat method is used.
14. understand that random sampling is needed for valid population counts of large numbers.
15. use the single line transect-quadrat method to study populations in the intertidal zone.
16. take data on environmental factors - exposure, morphology, salinity, at their quadrat.
17. construct at least one histogram showing the distribution of a population of an organism along a transect line.
18. draw some conclusions about a population as it relates to the environmental factors of slope, sediment size and exposure.

TABLE OF CONTENTS AND OVERVIEW



ACTIVITY 1:

WHO TAKES MEASUREMENTS AT THE BEACH AND WHY (1 day)

ACTIVITY 1: WHO TAKES MEASUREMENTS AT THE BEACH AND WHY (1 day)

CONCEPTS:

1. Careful measurements must be made if information about a beach (or other area) is to be useful.
2. Users of information about beaches might include the State Ecology Department, conservationists, fisherpeople, oil companies, shoreline management agencies, tourists.

OBJECTIVES:

The student will be able to:

1. name at least three different characteristics of beaches about which useful information might be obtained.
2. name at least two different occupations in which such information is used.
3. describe what a beach profile shows.

TEACHER PREPARATION:

See materials list below.

MATERIALS:

1. 2 or 3 pictures or slides of the same beach from different points of view. Your own snapshots or magazine pictures will do.
2. 2 or 3 different maps: road map, contour map, atlas
3. Copies of "Student Guide to Profiles and Transects" for each student.

PROCEDURES:

1. Distribute "Student Guide to Profiles and Transects." Explain that students should be familiar with each objective by the end of the activity packet, and that the guide is for their use so that they know what is expected of them.
2. Show the students the photographs of the beach. Ask them to tell you what they know about the beach by looking at the pictures. They may offer information about whether it is a sandy or rocky beach, the slope, the type of organisms that live there. If not, ask them. Accept only information that can be gained through observation of the pictures. It should become clear that very little useful information is available. At this point, ask what other kind of information could be gathered if they had the time, equipment and know-how. *The exact slope of the beach, composition of the rocks/sand, types of organisms and how many live there, the extent of high and low tides--measurements in terms of numbers must be taken.*
   Who would use this information? Have students come up with their own ideas.
   Examples might be: conservation groups, city planners, shoreline management agencies, ecologists and other scientists, oil companies.
   Why would such information be important?
   Preserving the beach, developing the site, recreational and commercial uses, prevention of exploitation.
   How can the information about the physical characteristics of the beach be given to someone else who has never seen the beach?
   The students might suggest maps, charts, tables and graphs in addition to photographs.

3. Focus the discussion on maps and have them offer suggestions of what information maps give. *Distances, directions, contour of land, relationship of features to one another.* Show 2 or 3 different types of maps. Explain that the class is going to make a type of map showing the slope of an area at school--and at the beach if you can take a field trip.
   Maps which show directions across and down are called cross-sectional maps. If you cut a piece from the end of a log and look at it, what you see is a cross section. The cross-section of an area or beach that they will map will show the slope, or profile, of the beach along the line of cross-sectioning.

Student Handout

NAME____________________

DATE____________________

PERIOD__________________

STUDENT GUIDE TO PROFILES AND TRANSECTS

After completing this unit you should:

1. realize that beaches are used by many people. Our beaches are a unique and valuable resource which should be conserved.

2. understand that beach animals deserve respect.

3. understand that information about beaches is useful to the private citizen, the ecology department, the shoreline management agency, the conservationist, and the oil company, as well as many others.

4. know that we must make careful measurements, record, and analyze them. These three steps make information useful.

5. be able to describe what a beach profile shows.

6. be familiar with the skills needed to collect and present accurate information. These skills include:

   a. using the profile measuring technique to determine the profile of a beach or other slope.

   b. graphing skills such as transferring data collected at the site into graph form.

   c. interpreting the graph of a slope.

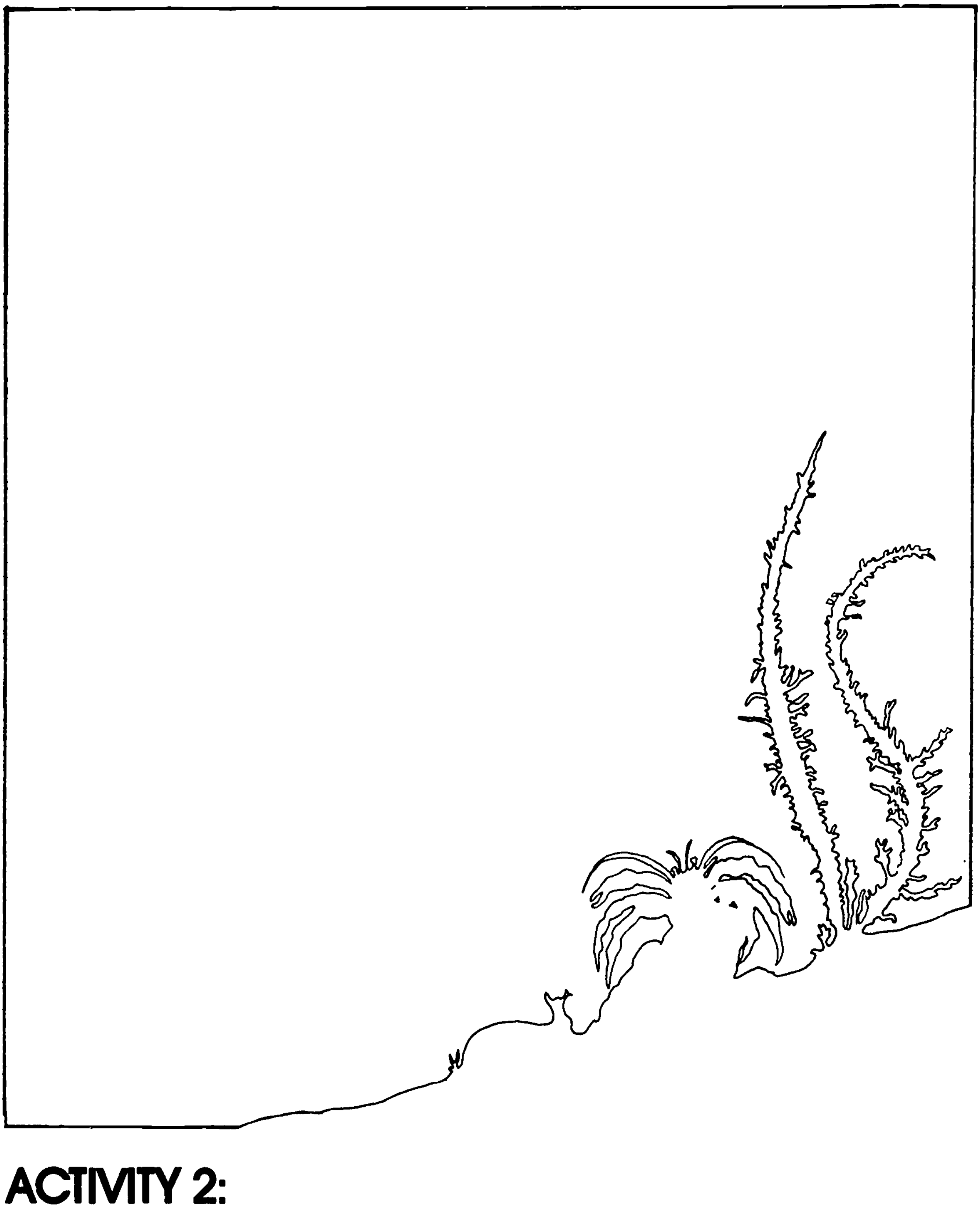
   d. understanding how the quadrat technique is used to count large populations of living things that move slowly or not at all.

   e. realizing that transects show how populations of living things are related to their environment.

   f. realizing that random sampling is needed for accurate population counts of large numbers.

   g. being able to use the single line transect-quadrat technique on site.

   h. being able to draw some conclusions about populations as they relate to environmental factors. Such factors include slope, sediment size, exposure, and salinity.



ACTIVITY 2:

MAKING EQUIPMENT FOR PROFILE MEASUREMENT (1 day)

ACTIVITY 2: MAKING EQUIPMENT FOR PROFILE MEASUREMENT (1 day)

CONCEPTS:

The equipment for one method of taking profile measurement includes a tall range pole, a shorter pole for the sighting device and a stake to mark the starting point.

OBJECTIVES:

Students will:
1. construct a range pole and sighting device in teams of 3.
2. make fine adjustments on their sighting device.

TEACHER PREPARATION:

1. The teacher should familiarize her/himself with the directions for making the equipment (if time allows, make a set yourself beforehand) before leading the students through it.
2. Sharpen the ends of the stakes and the sighting poles (the short poles) so that they can be pounded into the ground.
3. You may wish to paint the range (long) poles white prior to marking to make them easier to spot.

MATERIALS:

1. Run off: one copy of directions for each student
   one copy of patterns for juice cans for each team of three
2. For each team of three students:
   1" x 1" x 8' pine pole
   1" x 2" x 4' pine pole
   orange juice can
   hammer and nails
   sinker (or some small weight)
   cup hook or screw eye
   thread
   red tape
   masking tape
   black grease pencil
   meter stick

PROCEDURES:

1. Hand out directions for making equipment and have students read through it before beginning work.
2. Teams of three are optimum for the measurement activity, so we suggest that the students are grouped in threes now to build the equipment with the same classmates whom they will be working with later on.
3. Pass out the materials.
4. Have the students work through the directions. Here are some things to watch out for:
   a. Before screwing the eye screw (or cup hook) be sure it is far enough below the meter mark on the sighting pole so that it will not get in the way of the juice can (3-4 inches will do).
   b. Ensure that the reference lines are drawn straight and parallel to the long edges of the sighting pole.

c. The students should not tape their juice cans securely until after they have made their fine adjustments. A lot of tape can be wasted if they need to remove it to adjust the cans a fraction of an inch.

d. When making the fine adjustments indoors, it is difficult to hold the sighting pole perfectly straight and perpendicular for a long period of time. The third team member should keep an eye on the plumb and let the sighter know if it is not vertical.

BIBLIOGRAPHY

"Contour Mapping", National Wildlife Federation, Minnesota Environmental Sciences Foundation, Inc., 1972. Available from: The National Wildlife Federation
Educational Servicing
1412 16th Street N.W.
Washington, D.C. 20036

STUDENT HANDOUT

NAME ____________________

DATE ____________________

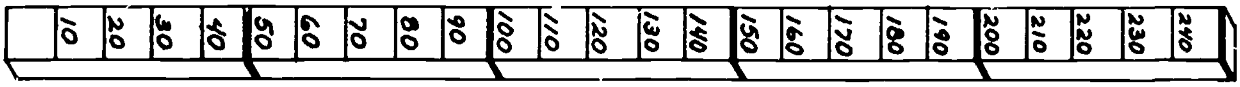
PERIOD ____________________

DIRECTIONS FOR MAKING PROFILE MEASUREMENT EQUIPMENT

You will need four pieces of equipment when taking profile measurements: a range pole, sighting device, stake and meter stick. The range pole is the tall pole and will be measured and marked off along its entire length. The short pole will have the sighting device constructed from an orange juice can and uses a fishing-line sinker as a leveling device.

Range Pole — Use:
- tall pole (8')
- red tape
- pencil
- grease pencil
- meter stick

Using a meter stick, take the tall pole and mark off intervals of 10 centimeters from the bottom. Use the grease pencil to label each mark, starting with 10 centimeters from the bottom. When you get to 100 centimeters, label it 1 meter and wrap red tape around that mark (100 centimeters equals 1 meter). Continue marking in centimeters (110, 120. . .) until you get to 200. Label that 2 meters, and wrap red tape at that mark. The poles will vary, but your last mark should be about 250 centimeters. Also wrap red tape around the marks at 50, 150, and 250 centimeters to make them easier to see.



RANGE POLE

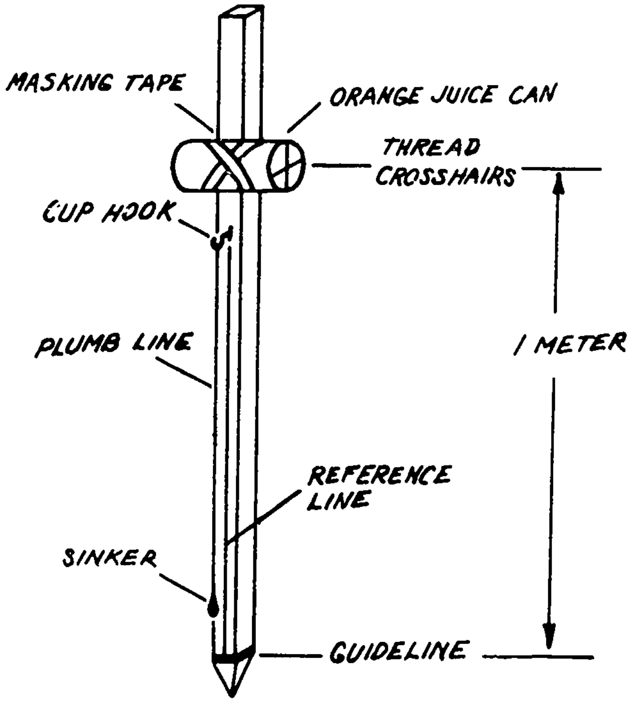
Sighting Device — Use:
- short pole, 1" x 2" x 4', pointed at one end
- orange juice can open at one end
- eye screw or cup hook
- thread
- sinker or weight
- patterns for juice can
- hammer and nails
- grease pencil
- meter stick
- masking tape

The sharp end of the short pole will be driven into the ground. With the grease pencil, mark a line (the guideline) at the bottom of the pole at the point up to which the pole will be driven. Measure exactly one meter up from the guideline, and draw a line across one of the flat 2" surfaces of the pole. Using your meter stick as a straight edge, draw a vertical line down the middle of the same side. This line is your reference line and should be parallel to the lengthwise edges of the pole. Using a hammer and nail, start a hole right on the reference line a few inches below the meter mark. Screw the screw eye (or cup hook) into that hole. Attach the sinker or other weight to a thread a little less than 1 meter long and tie the other end to the hook or eye. The thread will hang down, weighted by the sinker, right along the reference line when the pole is perfectly perpendicular to the ground. The sinker will not touch the ground. This is your leveling device.

The orange juice can is used for a sighting device. Using the patterns, find the exact center of the closed end and hammer a nail partway in to make a hole. The other pattern shows where to punch small holes around the open end. Draw 2 short lengths of string through the holes and tape the ends on the outside of the can. The threads should be tight so that you get a cross-hair pattern with the cross in the exact center of the open end.

Now tape the orange can in position on the meter mark at right angles to the pole. The distance between the center of the juice can (where the cross hairs meet) and the guideline at the base of the pole should be exactly 1 meter.

Sighting Pole



Once the sighting devices are made, they will need to be finely adjusted so the can is exactly at right angles to the pole. This can be done indoors:

1. Measure from the point on the bottom of the pole to the middle of the can. This should be slightly over 1 meter since it includes the end that will be driven into the ground when you use it outside.

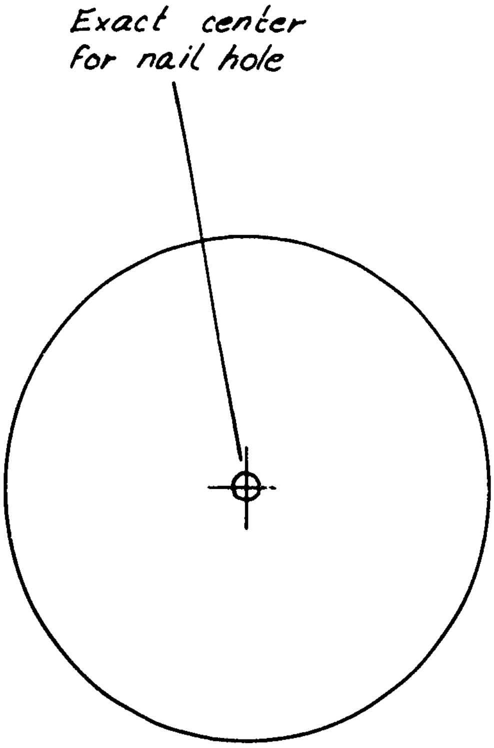
2. Measure and mark with a pencil the same height on the range pole. (Make it temporary, since this mark will only be used once, for adjustment.)

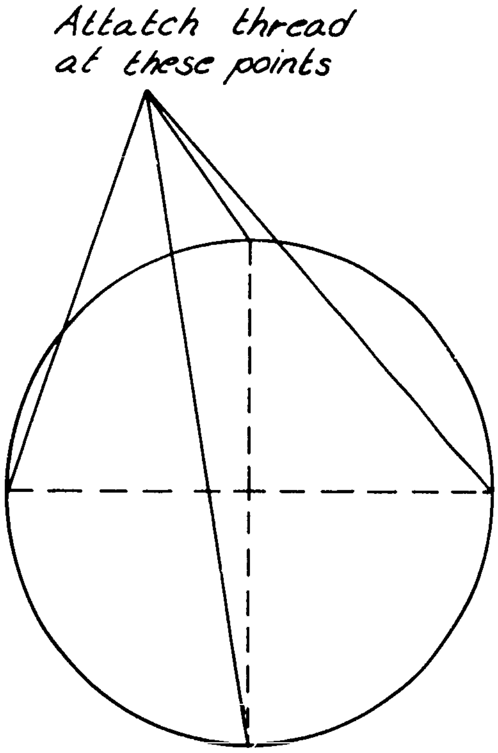
3. Have one member of the team place the range pole against a wall, perpendicular to the floor.

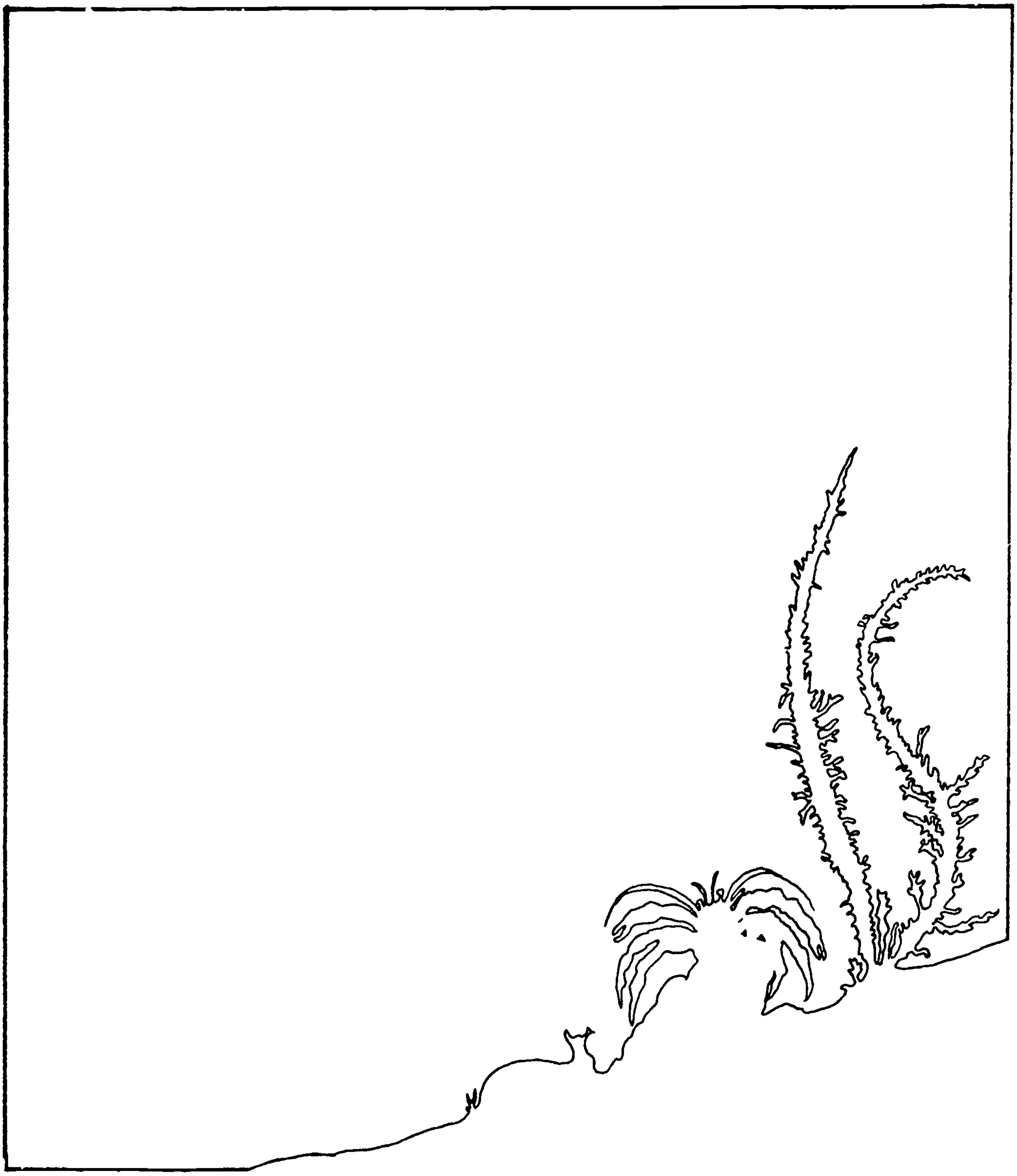
4. Have the second member hold the sighting pole upright a few feet away. The third member should check the plumb line so that it lines up exactly with the reference line drawn on the sighting pole.

5. The second member now sights through the hole in the can to the mark on the range pole (the first member can put his/her hand on the mark on the range pole so it can be clearly seen). If the point where the threads cross lines up exactly with the mark on the range pole, the sighting device is in perfect alignment. The juice can may need slight adjusting. Once the cross hairs line up with the range pole mark, securely tape the can in that position. It is now ready to use outside.

Orange Juice Can Patterns







ACTIVITY 3:

PRACTICE PROFILE MEASURING TECHNIQUE ON OR NEAR SCHOOL GROUNDS (1 day)

ACTIVITY 3: PRACTICE PROFILE MEASURING TECHNIQUE ON OR NEAR SCHOOL GROUNDS (1 day)

CONCEPTS:

1. The technique of taking measurements for a beach profile involves sighting carefully from one pole to another and using a plumb line to ensure that the reading is taken from a true vertical position.
2. The data that is taken represents the difference in vertical elevation between the two poles which are placed 2 meters apart.

OBJECTIVES:

The students will be able to:
1. use the profile measuring technique as described here to take readings of the slope of an area.
2. record elevation differences on the beach profile chart.

TEACHER PREPARATION:

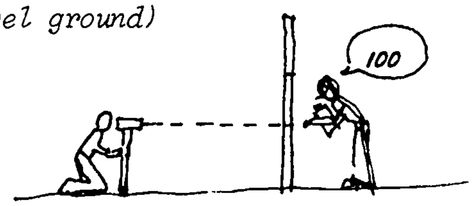
You may wish to practice the technique yourself before introducing it to the students so that you know what it entails and can anticipate difficulties students may have.

MATERIALS:

1. Run off copies of the
   *Student Handout - "Beach Profile"
   *Chart - "Beach Profile"
   *Worksheet - "Taking Readings"--
   you may wish to make a transparency of the drawing.
2. Each team of three will need:
   meter stick
   range pole
   sighting pole
   clipboard or piece of cardboard, pencil
   hammer or heavy object to drive in stakes - sighting pole stake

PROCEDURES:

1. Hand out the directions for beach profile measurement and review with the class to ensure that they understand the technique they will be using. These points will need extra clarification before students go outside with their equipment.
   a. Make sure students understand that the sighting pole must be held straight vertically in order to get a good reading. How do they know when it's straight? *When the thread on plumb line hangs down along the reference line which has been drawn on the pole.*
   b. The relationship between the reading that is taken and the difference in elevation can be confusing. When the reading is 100 cm or 1 meter, as in this sketch, what is the difference in elevation? *(0 - level ground)*



c. What is recorded on the chart? *100 for range pole reading; 0 for elevation differences.*

2. Pass out the student worksheets and call students' attention to Picture B. Does this show a slope? *Yes, uphill.*
3. Have them fill in the reading (75). What does this mean in terms of the difference in elevation of the person holding the range pole as compared to the sighting pole? *They stand higher.* How much higher is the range pole in picture B? *25 cm.*
4. The students should understand that since the sighting device is at 1 meter or 100 cm, a reading of 75 on the range pole shows that it is standing 25 centimeters higher. This is the result of a simple subtraction:

   100 cm (height of sighting device)
   <u>-75 cm</u> (reading on range pole)
   25 cm

   This elevation difference, a positive one, should be recorded on the chart as +25.
   How does picture C slope? *Downhill.*
   What is the reading on the range pole? *130 cm.*
   What should be recorded on the chart for the elevation difference? *-30 cm, result of:* *100 cm*
   <u>*-130 cm*</u>
   - 30 cm
5. Make sure students understand that the positive (+) or negative (-) sign is crucial: "+" for a positive (uphill) slope, and "-" for a negative (downhill) slope.
6. Pass out materials, using same groups of three that built the equipment. Take profile measurements as directed in the student handout in some area near the school which has a measurable slope. The students will gain experience in a team measuring technique and will know what to do if you are able to visit the beach.
   The students should follow directions on the activity sheet and record their measurements on the chart provided. The charts should be saved for the next class session.

EXTENDED ACTIVITIES:

You may wish to use a marked rope, instead of meter sticks, for measuring horizontal distances between readings. A 20-meter length cord or light clothesline should be adequate for each group. Have students mark the rope beforehand at two-meter intervals with tape and waterproof marking pen.

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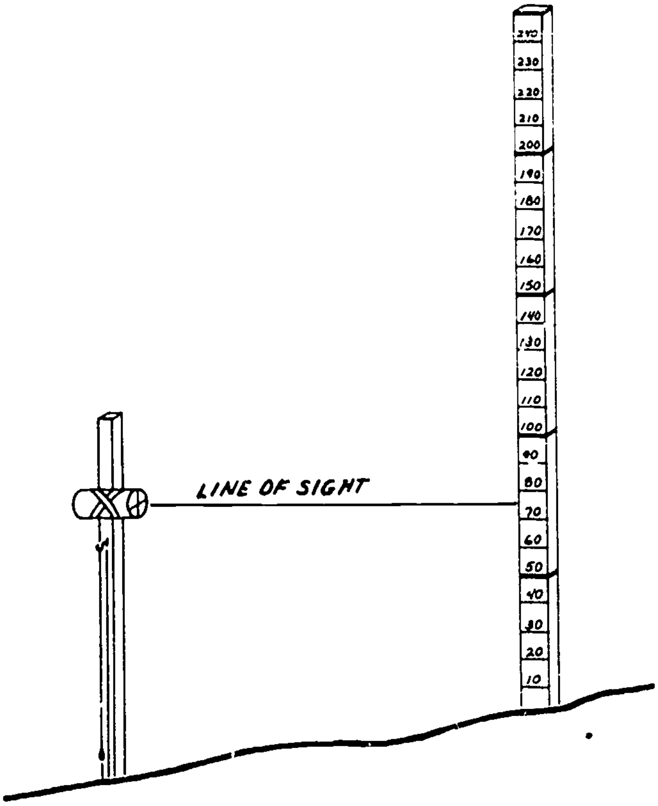
<u>Contour Mapping</u>, National Wildlife Federation, Minnesota Environmental Sciences Foundation, Inc.

<u>Beaches, Shifting, Sands of Gold</u> - Leaflet #3, 4-H Publications #16-3a, May 1976; obtainable from Clemson University Extension Service: Clemson, South Carolina 29631.

Credits and thanks to Margaret Bonham.

STUDENT WORKSHEET - TAKING READINGS

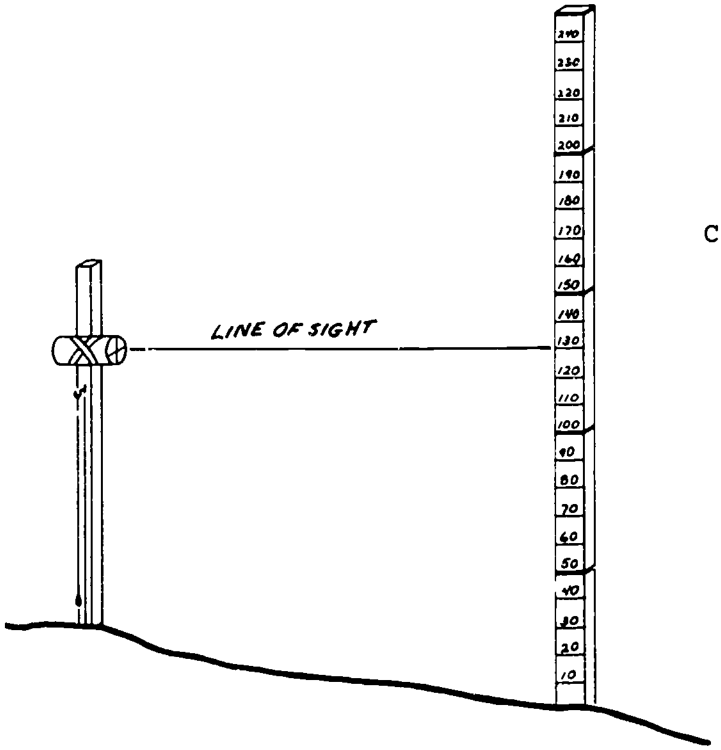


B) What is the reading here?

____

What do you record on the chart?

____



C) What is the reading?

____

What do you record?

____

NAME______________

DATE______________

PERIOD______________

BEACH______________

STUDENT HANDOUT
"Beach Profile"

Materials

For each team of three students:

pencil
clipboard or something to write on
2 meter sticks
level (optional)

Your team will probably work most smoothly if:

one person is the recorder, recording on the chart the range pole reading and the elevation difference given by the sighter. S/he also checks the plumbline to make sure the sighting pole is held vertically.
one person is the sighter, making the sightings to determine the + or - elevation differences.
and one person is the holder, holding the range pole upright so the sighter can make the sightings.
These duties can be rotated so each member gets a chance to do each.

Stand at the water's edge and look up the slope of the beach to the high tide mark. (The high tide line is usually clearly marked by debris.) Describe or sketch it in the space provided.

Is the description true for the entire beach?

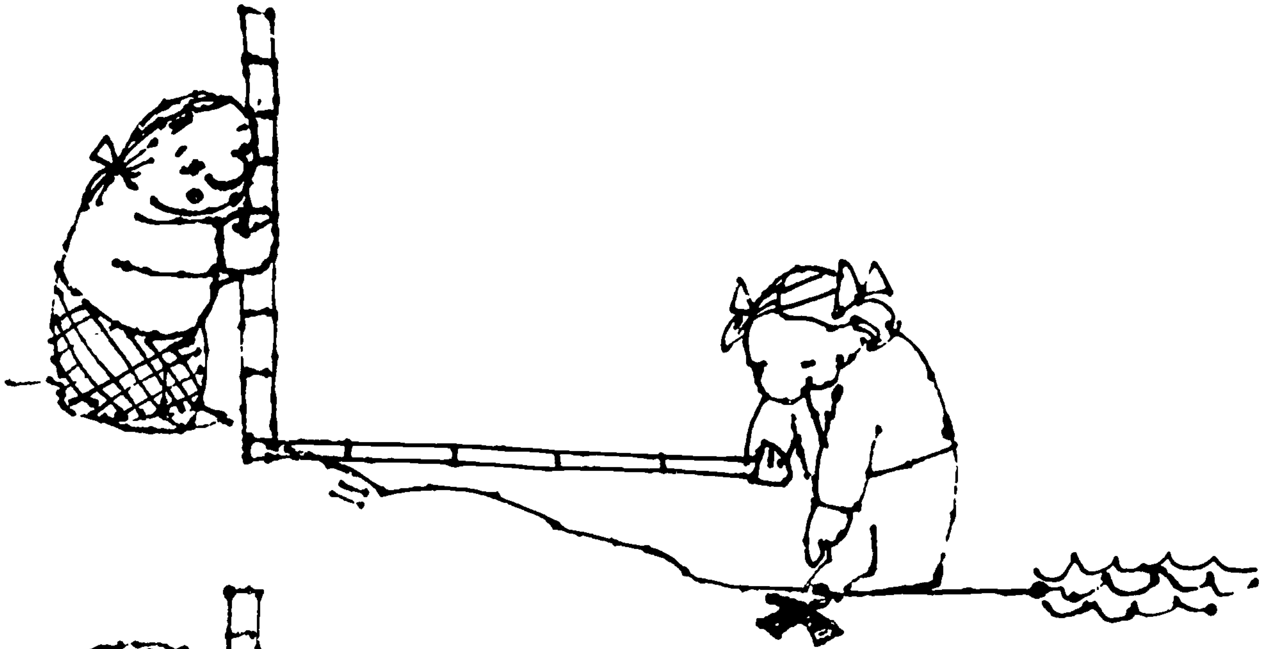
STUDENT HANDOUT - BEACH PROFILE

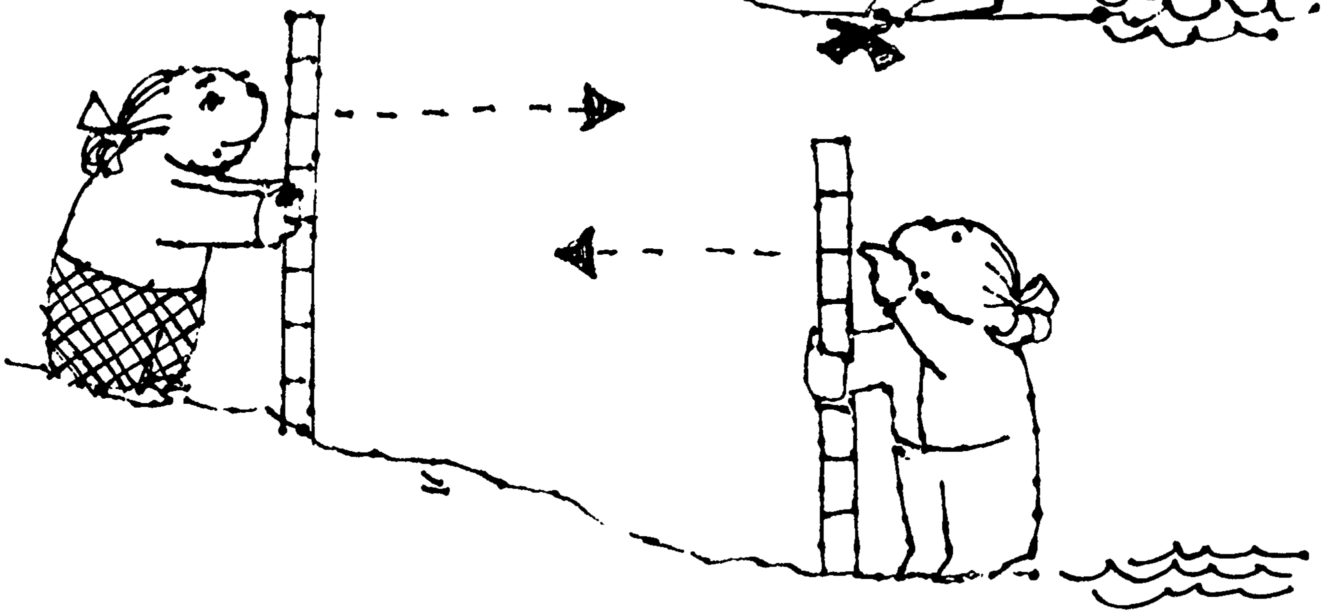
Work will start at the water's edge. This way all groups will be on the same contour level to start with.

1. Sight at right angles to the water line and send one team member up the beach to drive a stake into the ground. This stake will be the goal point toward which the team will work.

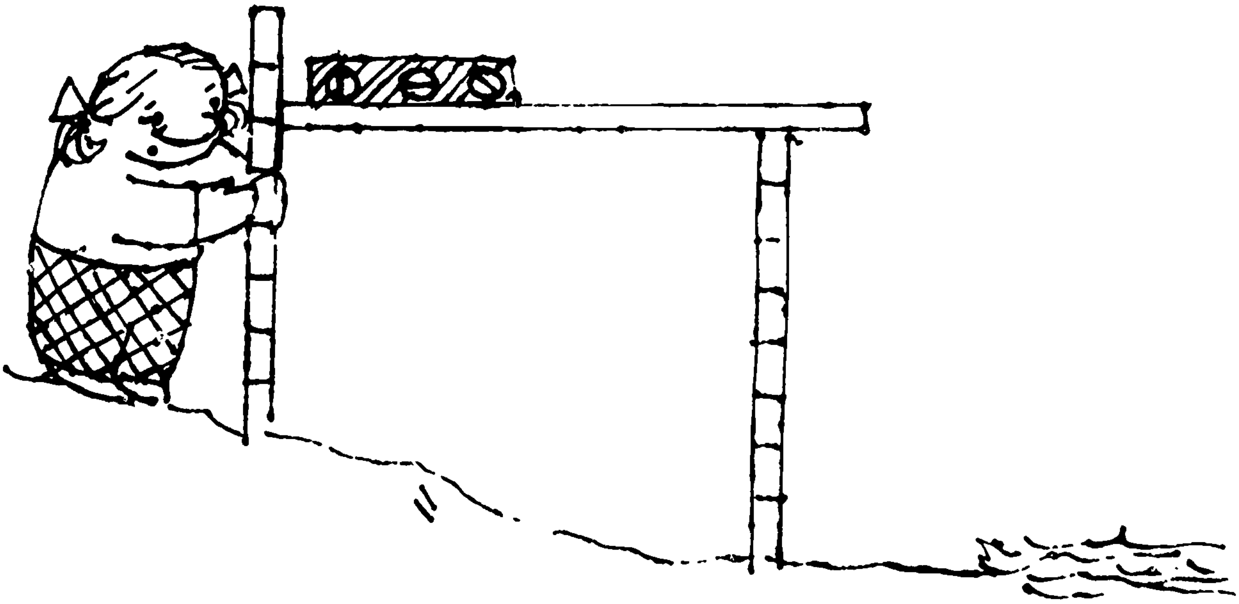
2. The sighter, using the sighting pole, sights on the goal stake and drives his/her pole into the ground up to the guideline. Now the range pole holder stations him/herself 2 meters away from the sighter, between the sighter and the goal stake, so that the sighter can see the range pole through the sighting device.

3. The recorder should check the plumb line on the sighting pole to make sure it is being held perfectly vertical. Adjust, if necessary.





4. The sighter, looking through the nail hole and sighting through the cross hairs of the juice can, should instruct the range pole holder to move his/her hand up or down the pole until the hand is along the same line of sight as the cross hairs.



5. The recorder now records on the beach profile chart the range pole reading and the difference in elevation between the poles. This figure is obtained by subtracting the reading on the range pole from 100 centimeters. (100 cm = 1 meter = height of sighting device.) If the range pole is at a higher elevation, we get a positive (+) figure, if it is at a lower elevation, our difference is negative (-).
6. The sighter moves the sight pole to exactly the same spot where the range pole is placed and drives it in. The range pole now moves 2 meters closer to the goal stake. Repeat steps 3-6 until the goal stake is reached.

STUDENT HANDOUT

NAME ______________________

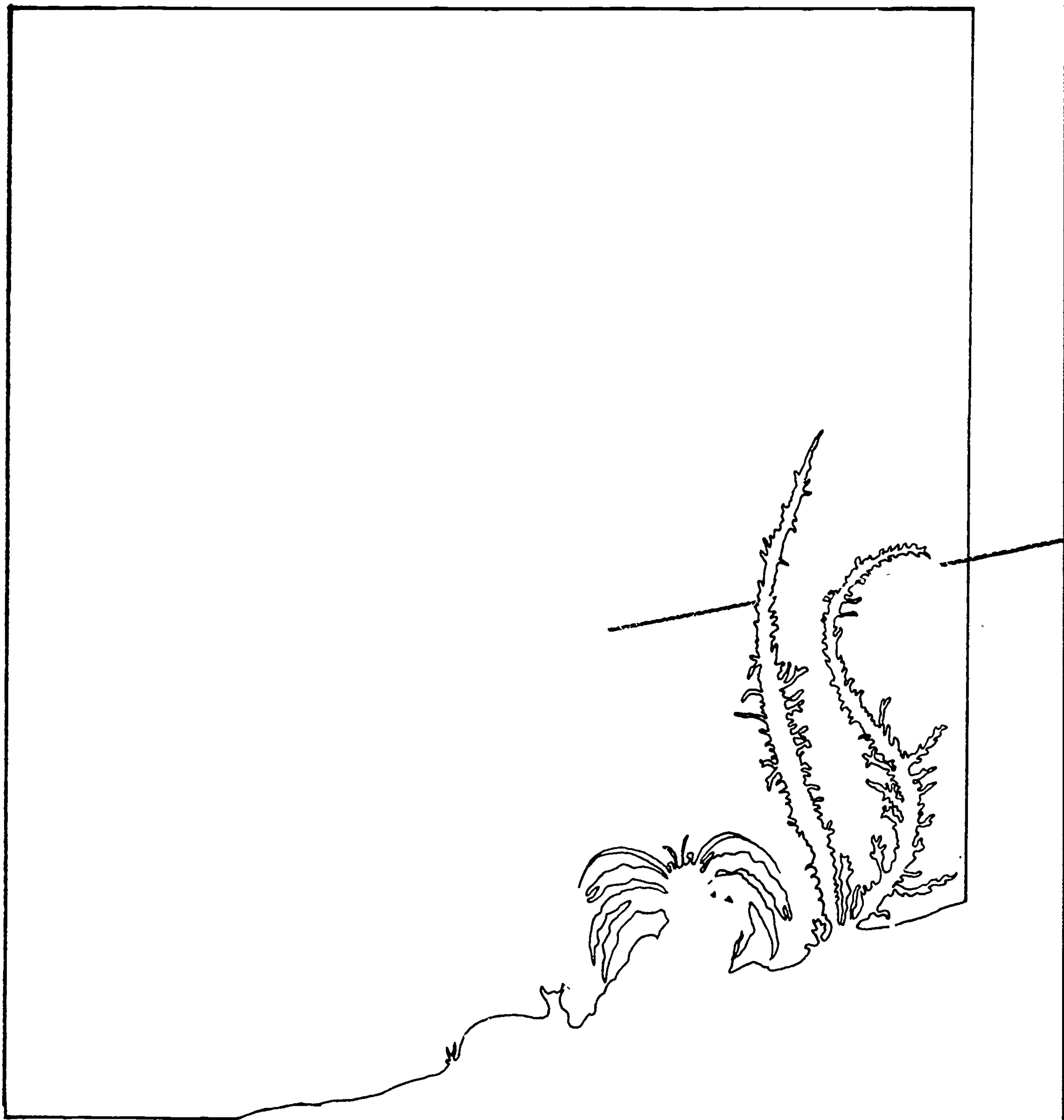
DATE ______________________

PERIOD ______________________

TIDE ______________________

CHART FOR BEACH PROFILE READINGS

READING #	Range Pole Reading	Elevation Difference + or -



ACTIVITY 4:
GRAPHING THE PROFILE
(1 day)

ACTIVITY 4: GRAPHING THE PROFILE (1 day)

CONCEPTS:

1. Data on elevation differences from point to point shows the slope of the site when transferred to graphic form.
2. We exaggerate the vertical distances on a graph to show the change in slope more dramatically.

OBJECTIVES:

The student will:

1. transfer data collected at the site into graph form.
2. explain what the graph shows about the slope of the site.

TEACHER PREPARATION:

If your students are not familiar with the use of scale measurement on a graph, you may wish to do additional learning Activity #1, "Scale Measurement."

MATERIALS:

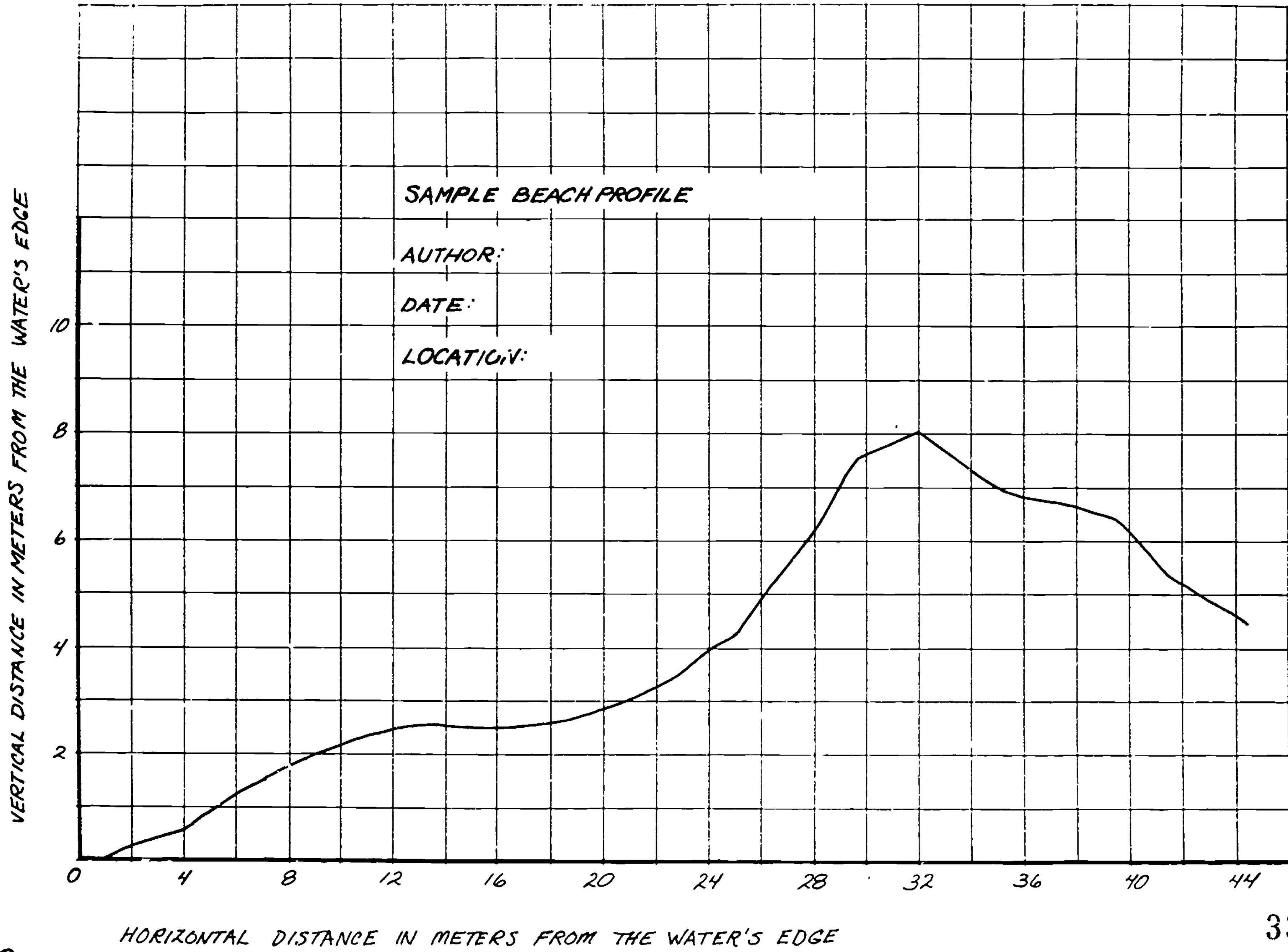
Completed Student Handout chart for "Beach Profile Readings"
cm graph paper - xerox enough for class
rulers
pencils
protractors
Teacher Information Sheet - "Sample Profile" made into transparency

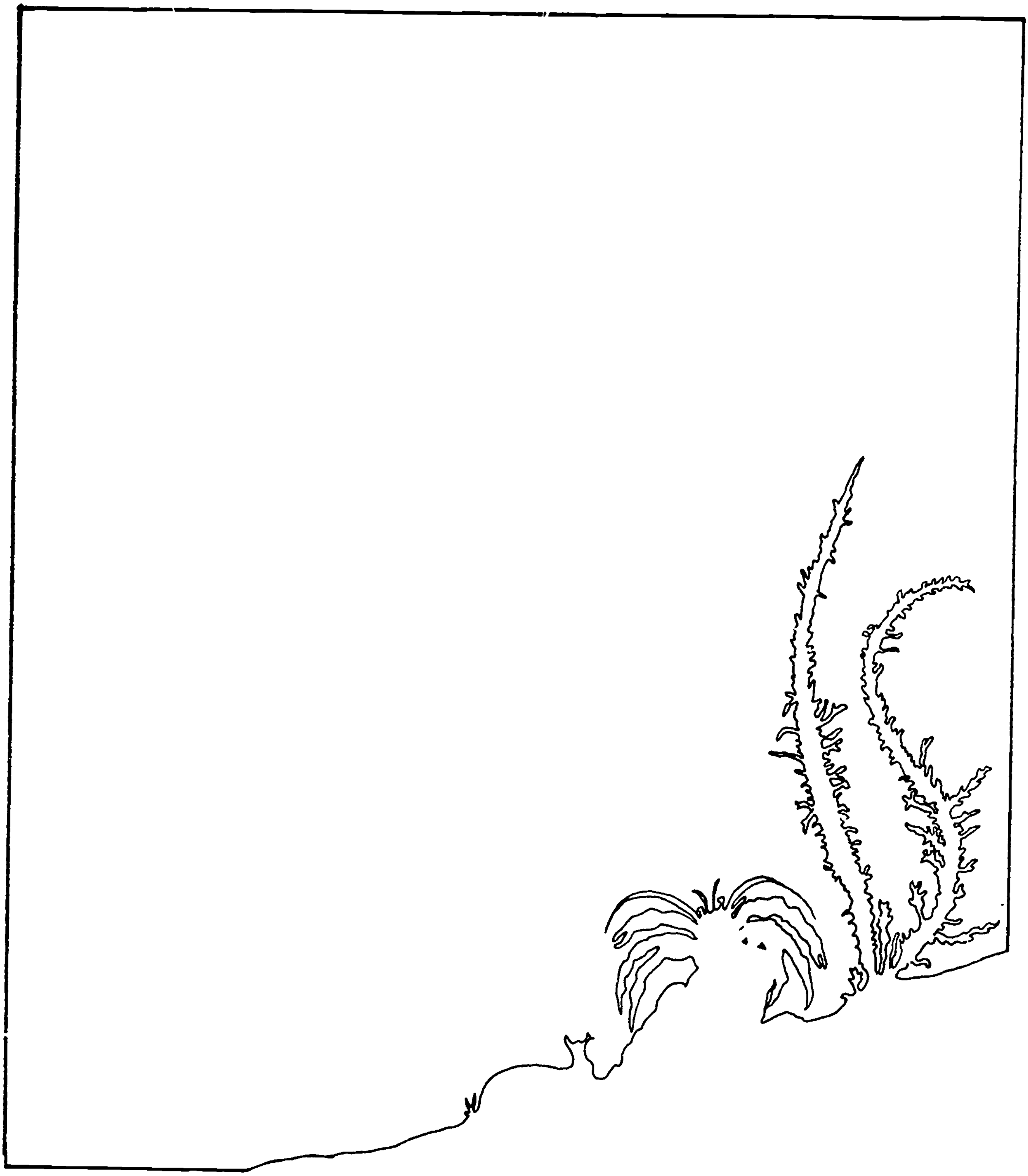
PROCEDURES:

1. The students transfer their table of measurements onto a graph to give a pictorial representation of the slope. The line on the graph will show the same ups and downs as the slope. Show the sample profile to give an idea of what they are to do.
   Make the horizontal axis the horizontal distance (which will be in 2 meter increments) and the vertical axis the elevation difference. Since the data was recorded as the change in elevation from each previous reading, all one needs to do to graph it is to increase two meters from the previous point and then either go up for a positive difference or down for a negative difference. Students should now see why it was important to get the "+" or "-" sign for each reading.
   Since the measurements were taken in metric, we are using centimeter graph paper. A convenient scale to start with is one meter = one centimeter for both axis. After they have completed this, look at the sample profile again. What is the scale here? *2 meters = 1 cm on the horizontal axis; 1 meter = 1 cm on the vertical axis.*
   Note: The vertical distances are exaggerated with respect to the horizontal distances on the graph. Ask the students what reason they can give for such an exaggeration. *To show the change in slope more dramatically, and to fit the graph on a page.*

2. You may now wish to repeat the graphing with exaggeration on the vertical axis. Have the students use whatever scale they wish and compare the resultant graphs. Can the students determine the approximate angle of slope of the area at any given point? *A protractor can be used; if the scale used is the same as the one used in the sample graph, an angle of* 30^{o} *on the graph will actually represent a* 15^{o} *angle at that point on the slope because the vertical change was exaggerated by a factor of two on the graph.*
3. Have the students describe the profile of the area as depicted by their graph. How do their graphs compare to the rough sketch or description they made in the beginning of the activity? Do different students' graphs show a different profile? If so, why? *They were at different places or used a different scale or made an error.*

   If they measured the same spot again in three months, would the profile be the same? Why or why not? *On school grounds or stream banks, rain and people might change the slope.*


SAMPLE BEACH PROFILE
AUTHOR:
DATE:
LOCATION:
VERTICAL DISTANCE IN METERS FROM THE WATER'S EDGE
10
8
6
4
2
0
4
8
12
16
20
24
28
32
36
40
44
HORIZONTAL DISTANCE IN METERS FROM THE WATER'S EDGE



ACTIVITY 5:
BEACH FIELD TRIP
(optional—1 day)

ACTIVITY 5: BEACH FIELD TRIP (optional—1 day)

CONCEPTS:

1. The profile of a beach can be easily measured.
2. Beaches are used by many people. Our beaches are a unique and valuable resource which should be conserved.

OBJECTIVES:

The students will:

1. use the profile measuring technique on a beach site.
2. treat beach animals with respect.

TEACHER PREPARATION:

Read the field trip guidelines for some hints on planning a beach field trip and safety at the site. Visit the beach site beforehand to make sure it is appropriate for the activity.

MATERIALS:

Field Trip Guidelines (same as for Activity 3)
For each team of three:

- fresh copies of chart "Beach Profile"
- meter stick (or marked rope)
- range pole
- sighting pole
- clipboard or piece of cardboard, pencil
- hammer or heavy object to drive in stakes and sighting pole
- stake

PROCEDURES:

1. Prior to a beach trip, go over field trip guidelines. Impress upon the students the value of our beaches as a natural resource and the need to respect the life forms there.
2. If you cannot visit a salt water beach, the shore of a lake or stream will work as well if it has an observable slope.
3. Repeat the activity as directed in the Student Handout. This exercise may be concurrent with other field trip activities. This would reduce the materials needed, since not all students would be doing the same activity at once.

EXTENDED ACTIVITIES:

1. Make graphs of the beach profile as directed for the data from the school site.
   Have students transfer their measurements onto a graph as they did on Day 3 and carry on a similar discussion.
2. Go back and measure the profile in the same place on the beach 3 months later. Discuss the change or lack of it. Study beach processes--see ORCA packet: "Beach Processes".
3. If you are not able to do the ORCA activity packet on beaches, you may wish to show the film "Beach, A River of Sand" at this point and briefly discuss beach processes.

BIBLIOGRAPHY:

ORCA packets: "Beach Processes" and "Field Trip Guide to Puget Sound Beaches", Pacific Science Center, 1978.

FIELD TRIP GUIDELINES

Emphasize conservation

A field trip to the seashore can be an exciting experience as well as a valuable educational tool. We in the Pacific Northwest are fortunate in the extent and variety of tidelands and marine life along our shores. This is a valuable natural resource and it is just as important to conserve seashore life as it is to conserve forests and other wildlife. The attitudes and practices that you, the teacher, display are important, as much of what our students learn about conservation is better "caught" than taught.

1. Take nothing from the beach unless there is a planned use for it. Squelch the "save it and take it home' impulse. Seashore life is best seen and studied in its natural habitat. Unless there is a valid use for a specimen to be brought back into the classroom, leave it undisturbed in its natural setting so it may be observed by others.

2. Replace overturned rocks. Rocks protect many intertidal animals from shorebirds and drying out by sun and wind. If you turn over a rock and do not return it to its original position you expose the creatures sheltering beneath it and at the same time destroy algae and animals that were living on top of it. Imagine what would happen to the marine life on a beach if everyone that visited it turned over a rock and left it that way.

3. Help stamp out litter. Make it a habit to carry a strong bag or other container on all your beach trips. Litter is not only unsightly on the beach, but it may play a part in changing the balance of life on the shore. Encourage students to place litter they find on the beach, as well as their own, into a trash container.

4. Watch your step. One person can do considerable damage to plants and animals by stepping on them, so think what a group of 30 could do. Avoid using rocks as stepping stones, as this concentrates your weight and may crush creatures living under them.

5. Leave things as they are. If students pick up animals and examine them, they should return them to the spot where they found them. Most animals have specific feeding requirements, and live at specific tidal heights. Moving them to another part of the beach may kill them just as surely as removing them from the beach. A good practice for groups is to take one or more large plastic tubs to be filled with sea water and placed in a central location. Interesting specimens can be placed there for observation and returned to their 'home' after observation. Tubs should be in a shaded area, and half of the water should be changed every half hour to keep the temperature cool and to provide sufficient oxygen for the animals.

6. Respect the life forms you find. Handle marine animals carefully if you move them. It is senseless to poke these creatures with a stick or otherwise thoughtlessly disturb and damage them. Some creatures cannot re-attach themselves once they are pried off. Do not pry any thing loose from a rock or shell if it seems firmly attached.

Teacher Information Sheet

For Safety's Sake

1. Take only a group of manageable size to the beach. A group of 30 students or less is a reasonable size. Have an adequate number of adults along to help supervise. One adult for every 5-10 students is a good ratio.

2. Be sure students are dressed properly; long pants, rubber boots or tennis shoes, and a warm jacket are musts for the beach even on a sunny, warm day. It's usually cooler at the beach than elsewhere.

3. Have a first-aid kit along. Algae on rocks can be slippery, and barnacles and mussels are razor sharp.

4. Check weather conditions before starting; a stormy winter beach is not a good place to take students. In the Seattle area, call 662-1111 for the daily weather report.

5. Climbing on rocks, playing on logs near the water, and wading where currents exist are all potentially dangerous activities. Discourage these types of activities.

6. Caution students not to let the tide come in behind them, and to watch for that extra large 'sneaker wave'.

7. Assign students to a buddy system while at the beach. This provides the students with a working partner and eliminates the possibility of losing one student and not noticing it until faced with a distressed parent.

Planning Hints

1. Always visit the site beforehand so that you are certain is is appropriate and can gear your activities and discussion to its unique qualities.

2. Plan to be at the beach an hour before low tide; it is safer to be on the beach with an outgoing tide. Tides of +1 or lower are good for tidepooling trips. These tides usually occur during the daylight hours of fall and spring months. Tidetables are available at sporting goods stores, the chamber of commerce, tourist information offices, or in local newspapers.

3. Schedule a familiarization time when you first hit the beach. Discussion can include these points: What kind of rocks are present? How steep is the beach? What is the surf condition?

4. Divide the class into small groups, each with a specific task. This can make the trip more worthwhile.

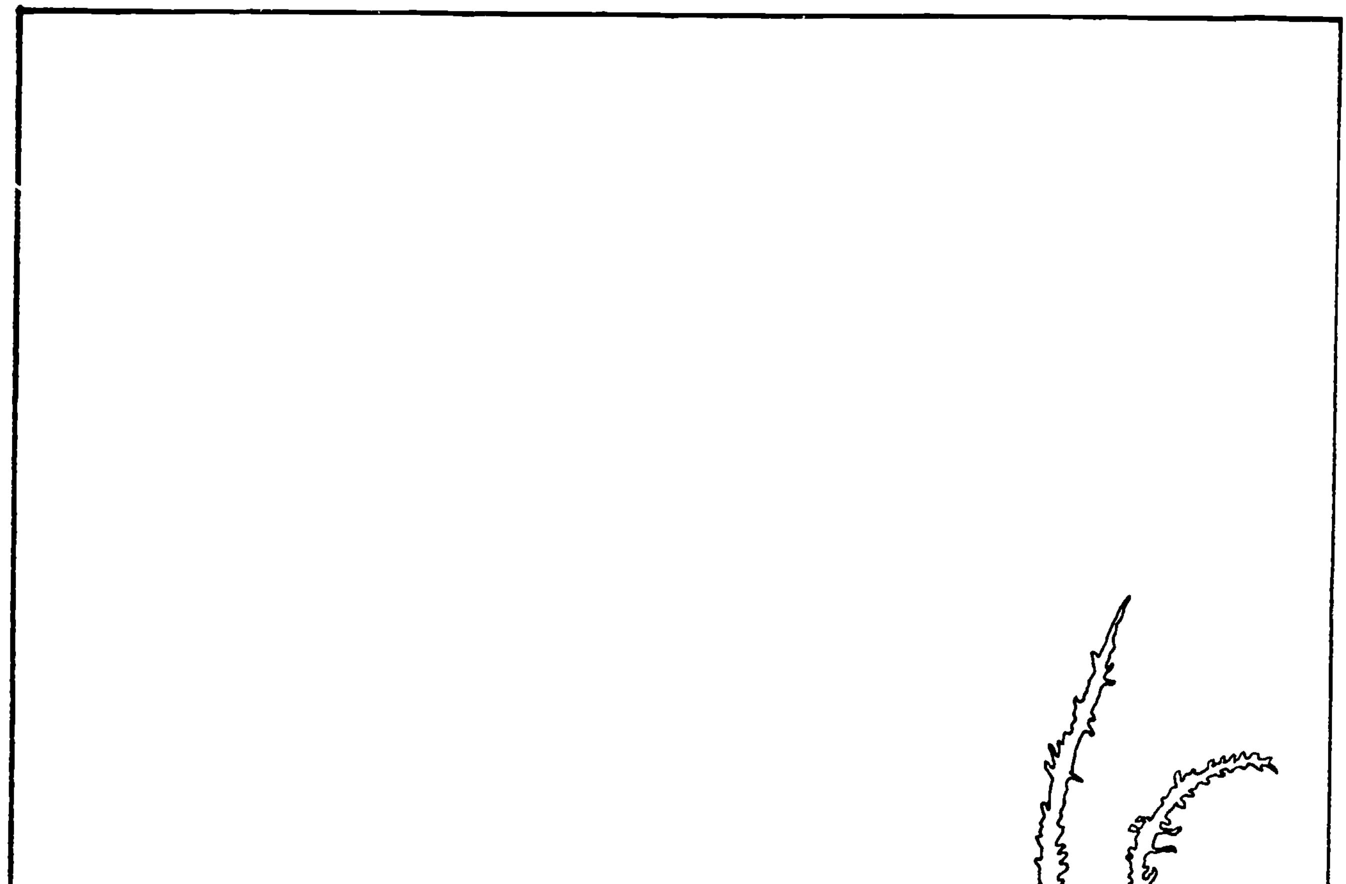
5. Be sure to bring all the materials you need. No matter what the activities, always bring: a large litter bag, first-aid kits, and a tub for observation of good specimens.

Planning Hints (continued)

6. Prepare your class beforehand as to what they can expect to find and what they will be doing. A variety of literature and films is available to use in preparing for the trip.

7. After the trip, do some follow-up activities. You might want the students to share with each other, or with other classes. It's a good idea to keep a file on what you will change the next time you go on a field trip, as well as how you prepared for this one.

Credit to Liz Sears and Oregon Sea Grant Advisory Service.



ACTIVITY 6:

SINGLE LINE TRANSECT-QUADRAT METHOD

(1 day)

ACTIVITY 6: SINGLE LINE TRANSECT-QUADRAT METHOD (1 day)

CONCEPTS:

1. A transect is a line, imaginary or otherwise, used as a guide to study ecological variation.
2. The quadrat technique is used to count large populations that move slowly or not at all.
3. Random sampling is necessary for valid population counts.

OBJECTIVES:

The students will:
1. be able to state for what purposes the single line transect-quadrat method is used.
2. understand that random sampling is needed for valid population counts of large numbers.
3. mark ropes at 2 meter intervals for use as transect lines.

TEACHER PREPARATION:

We suggest that you read the background information on beach transects and look over the student handouts before the session.

MATERIALS:

One rope or heavy twine 10 meters long, per transect
Tape
Meter stick
Waterproof marking pen
Run off: Student Handout on Transects - 1 per student

PROCEDURES:

1. Tell the students they are going to take a census, or count, of some of the animal and plant populations at the beach in order to learn more methods of obtaining useful information about a beach site.
   Can they define a population? *Members of the same species living in a certain area.*
   How could they accurately count a population? *Small populations such as the number of trees in a yard, would be counted individually.*
   Ask for an example of a large population at the beach. *Snails*
   Could they count the entire population very easily? *No.*
   How would they go about estimating such a large number? *Suggestions might include counting only a small section, counting by tens.*
   Explain that the quadrat technique they will be using employs counting a small area of the study site and then multiplying the number of these small areas in the whole study area. The numbers of organisms in each quadrat can be expected to differ as the environmental factors differ.
2. Review student worksheet on beach transects to make sure they understand the techniques. (See teacher background for more information.) Emphasize:
   1. Importance of relating population count to environmental factors to better understand the ecology (interaction of living things and their environment.)
   2. Necessity of random sampling to get accurate counts.
3. Have students mark the ropes to be used for transect lines at 2 meter intervals with tape and waterproof marking pens.

TEACHER INFORMATION SHEET

BEACH TRANSECTS - BACKGROUND

The single line transect-quadrat is one of many methods used by ecologists to study the distribution of organisms in comparison to the environmental factors. It is well-suited to studies of the intertidal area since the life-zones are compressed to a width of a few vertical feet. An additional advantage of the intertidal zone is that the majority of organisms do not move, or they move very slowly and can be easily studied.

Before the beach trip, mark lines for each transect (twine or heavy string) with consecutively numbered tags 2 meters apart. At the beach, run the line perpendicular from the low tide line up an area of the shore which would give the most representative sample of organisms found in the area. The placement of this line is highly subjective. A station may lie on a position that represents a micro-habitat, e.g. a sand pocket tidepool, etc. Ideally, many single line transects should be made across any one shore area.

At each station, the number of organisms in a meter quadrat is determined. The theory behind basing any measure of organisms on the square meter is to be able to relate to the availability of the sun's energy striking the earth on a square meter of surface area. However, since the life in the intertidal zones of beaches in our region is so rich, it is difficult and tedious to count an entire square meter. Instead we will use the area enclosed by a wire coat hanger for sampling at each station along the transect.

By sampling at predetermined distances, you eliminate bad counts which you get by random selection of count sites. This is because in random selection there are always subjective factors: e.g. "There are more snails here", or "It looks easier to dig there." In studying populations you want to know where they are as well as where they are not.

Assign teams of 2 or 3 students to count at each station on the transect as described in the student worksheet. Each team should count 2 or 3 quadrats and the entire class 3 or 4 transect lines in order to get a representative sampling.

STUDENT HANDOUT

NAME____________________

DATE____________________

PERIOD__________________

TRANSECTS

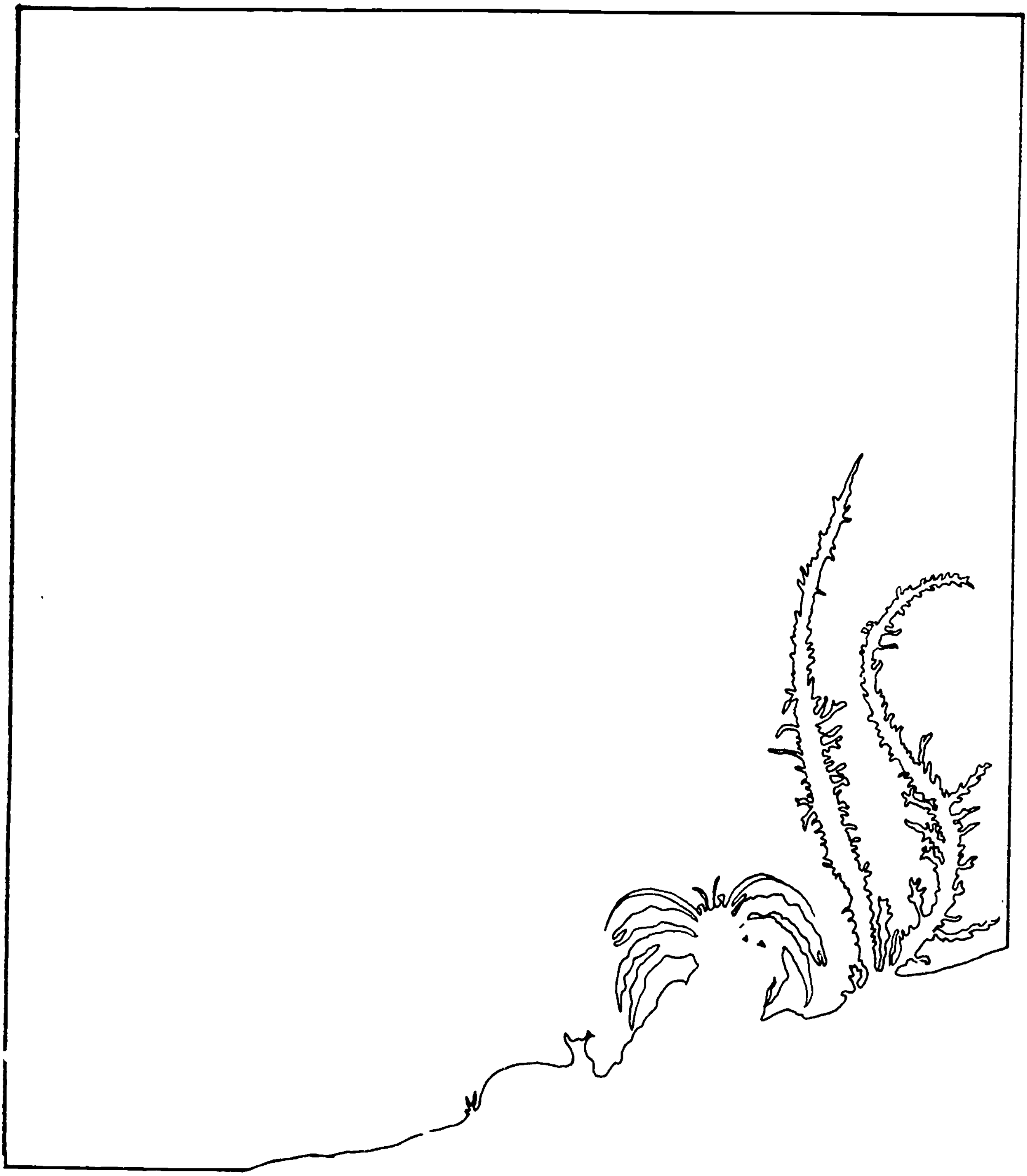
Ecology is the study of the relationships between living things and their environment. An ecologist studies the intertidal zone with these questions in mind:

> Where is an organism found along this shore?
>
> Is the location of an organism affected by wave action? Exposure? Salinity? The surface it lives on (substrate)?

We will be using the transect-quadrat method to count the number of living things in relation to their surroundings. A line called a transect is marked off on the beach; the plants and animals are counted in small plots along this line called quadrats.

The class will lay a transect line at right angles to the water's edge. Stations will be marked every 2 meters. Be sure to mark the distance from the low tide mark to your team's assigned station. Count plots or quadrats in the area enclosed by a wire coat hanger. The coat hanger should touch the transect line at the 2-meter mark.

Sketch your quadrat below. Show surface geology and general location of sea animals and sea plants (algae).



ACTIVITY 7:

BEACH TRANSECT

(1 day)

ACTIVITY 7: BEACH TRANSECT (1 day)

CONCEPTS:

1. Data is taken on environmental factors in order to better understand population distribution.
2. Environmental factors include:
   a. exposure
   b. beach morphology
   c. salinity
   d. moisture - distance from low tide line.

OBJECTIVES:

The students will:

1. use the single line transect-quadrat method to study populations in the intertidal zone.
2. take data on environmental factors - exposure, morphology, salinity - at their quadrat.

TEACHER PREPARATION:

1. This session can be combined with the first session on beach profiles, since both activities are easily done on the same beach at the same time.
2. Familiarize yourself with the classification table of beach rock sizes.
3. Go over the field trip guidelines, if not already done in Activity #5. Impress upon the students the value of our beaches as a natural resource and the need to respect the life forms there. The guidelines also give some hints on planning a beach field trip and safety at the site.
4. Visit a beach site beforehand to make sure it is appropriate for the measurement activity.

MATERIALS:

ted ropes
n stakes
r or heavy object to drive stakes

For each team:

pencils
clipboards or cardboard to write on
wire coat hanger
Student Handouts:
"Beach Transects"
"Beach Environment Data Sheet"
"Population Data Sheet"
Teacher Information Sheet: "Beach Rock Size"

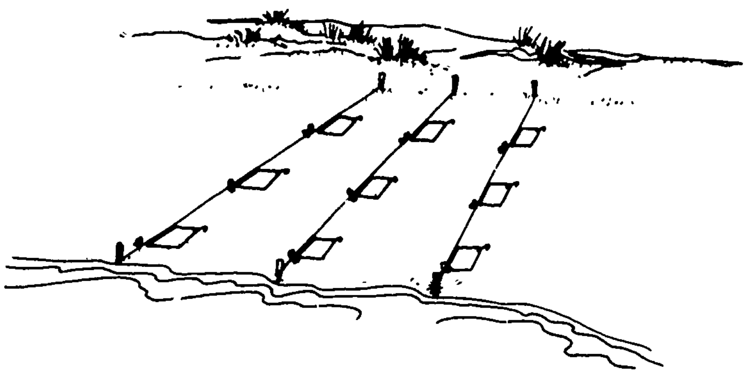
PROCEDURES:

At the beach or transect site:

1. Students may work in teams of two or three. It is desirable to have half the class doing the beach profile, while half does the transect activity, and then switch. This will require only half as much equipment.
2. Have transect lines marked at every 2 meters, and assign teams to each marked "station". Lay out 3 transect lines; the entire class can cooperate on this. Start from the low tide line and lay the lines perpendicular to the water's edge to a point beyond the splash zone. Secure the line with stakes or rocks where necessary.

3. Each team can count 2 or 3 stations or quadrats; have the class complete counts on all 3 transect lines.
4. Students should follow directions on the activity sheet and answer all questions at the beach site. Each team will need to fill out a copy of both worksheets ("Beach Environment Data Sheet" and "Population Data Sheet") for each transect counted. If students have studied the organisms of the intertidal zone, ask them to identify each type found in their coat hanger quadrat. If they have not, ask them to describe and sketch each organism.

Transect lines with stations should look something like this:



EXTENDED ACTIVITIES:

1. If your study area for transects has a sparse distribution of organisms (e.g., a sandy or pebbly beach), use larger quadrats. Students might make square meter frames out of wood or scrap materials, or use old hula hoops. (Remember those?)
2. For closer examination of organisms at the beach, bring along magnifying glasses. Specimens may be put in a tub in a shady place. Once everyone has looked at the organisms, return them to their habitat.

BIBLIOGRAPHY:

Transect Studies, National Wildlife Federation, Minnesota Environmental Sciences Foundation, Inc. Available from:
The National Wildlife Federation
Educational Servicing
1412 16th Street N.W.
Washington, D.C. 20036

Credit to Bob Eacker, Alan Ostenson, and Sam Mitchell.

Teacher Information Sheet

CLASSIFICATION TABLE FOR BEACH ROCK SIZE
(MODIFIED FROM WENTWORTH SCALE)

Name of Particles	Size Limits	Approximate Inch Equivalents
Boulders	>265 mm	>10 in.
Cobbles	64-256 mm	2.5-10
Gravel	2-64 mm	0.08-2.5 in.
Sand	.0625-2 mm	0.002-0.08 in.
Silt	.0039-.0625 mm	0.00015-0.002 in.
Clay	<.0039 mm	< 0.00015 in.

These terms describe the size of particles forming the beach and not the color or chemical composition of the materials.

Student Handout

NAME________________

DATE________________

PERIOD______________

BEACH ENVIRONMENT DATA SHEET

To investigate the effect of the environment on each animal, you will need to take some measurements of the enviro'ment. Later you will compare your population counts with other samples in the transect. If there is a difference, measurements might show why.

1. Geological factors: Slope: Steep__________Medium__________Low__________

2. The surface or substrate has a great effect on determining what organisms may live there. Make a rough estimate of the percentages of these types of surfaces in your quadrat. (i.e., 10%, 25%, about half or 50%, etc.)

Sediment Size	Percent
fine sand	
coarse sand	
gravel	
cobbles	
boulders	
bed rock	

3. Exposure factors: Where is your quadrat in relation to high and low tide levels?

4. If you are not near sources of pollution, test for salinity by digging a hole and tasting the water that flows into it.

Salty__________ Not Salty__________

5. Is your quadrat exposed to the sun or in the shade? How much of the day?

NAME____________________

STUDENT HANDOUT

DATE____________________

PERIOD____________________

POPULATION DATA SHEET

Station #____________________

Distance from low tide line

____________ meters

How many different types of organisms do you count within your coat hanger quadrat?

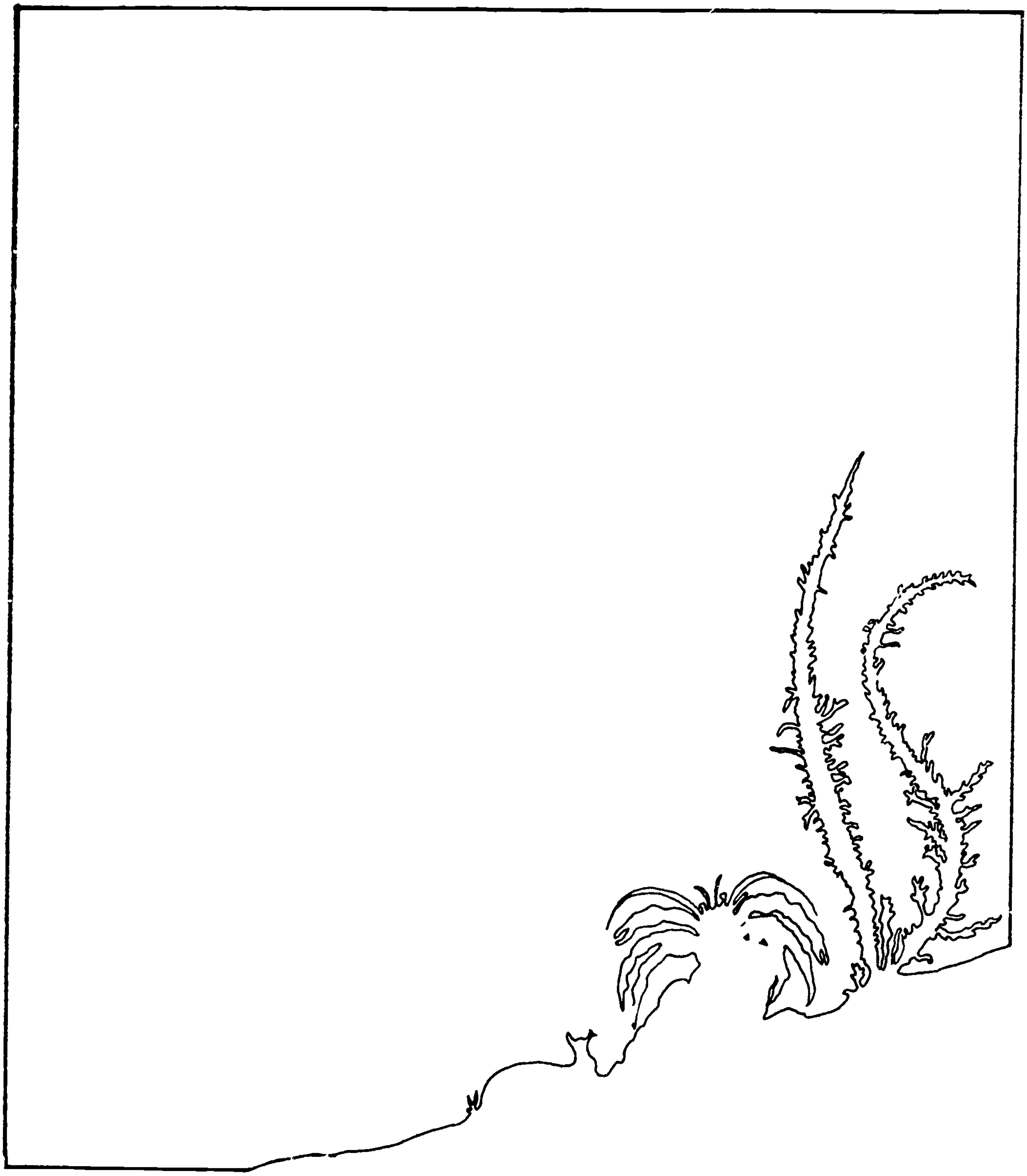
____

Is the Quadrat sparsely or densely populated?

____

Count and record the numbers of each organism you have found and include a sketch and brief description (name it if you know it).

ORGANISM	DESCRIPTION	SKETCH	NUMBER FOUND
1.			
2.			
3.			
4.			
5.			
6.			



ACTIVITY 8:
ANALYZING THE DATA
(1-2 days)

ACTIVITY 8: ANALYZING THE DATA (1-2 days)

CONCEPTS:

1. Factors such as the substrate, exposure and salinity in the intertidal zone may strongly influence the distribution of life.
2. Our understanding of the ecological relationships is limited by the amount of measured data collected.

OBJECTIVES:

The students will:

1. construct at least one histogram showing the distribution of a population of an organism along a transect line.
2. draw some conclusions about a population as it relates to the environmental factors of slope, sediment size and exposure.

TEACHER PREPARATION:

Familiarize yourself with the background information supplied below. There is also a list of animals and descriptions of habitats that you may want to employ.

MATERIALS:

Student Handout, "Beach Environment Data Sheets"
Completed Population Data Sheets from the beach field trip
Centimeter graph paper

PROCEDURES:

1. The class will be pooling their data in order to glean what information they can from it. A master chart (for each transect line) such as the one shown below will clearly show all the population count. (Generally no more than 10 species make up the dominant life forms on any one shore. Your chart doesn't have to be huge. Make a large one on butcher paper and hang it where all can see.

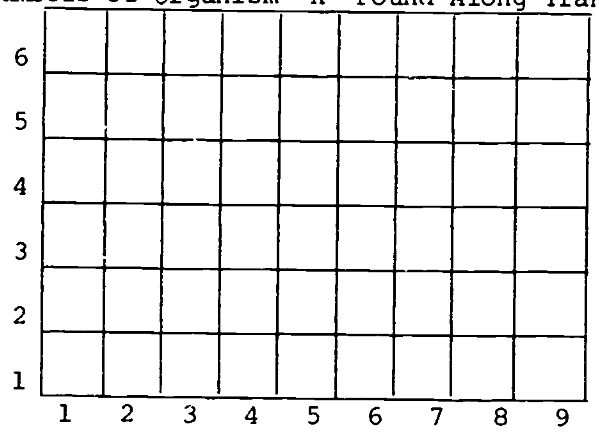
Stations	#1	#2	#3	#4	#5
Organisms Barnacles					
Mussels					
Limpets					
Etc.					

Since the stations are numbered sequentially from shore, this chart gives us information about the distribution of life compared to the distance from the low tide line. What can the students say about the distribution of any one organism relative to the low tide line?

2. It can be misleading to not take other factors, such as the surface (substrate), exposure and salinity into acccunt. Be sure the students realize their conclusions may or may not be correct; many factors can be at work. It is also difficult to lead a discussion about these relationships without steering the students to certain conclusions (e.g., questions like: organism A is always found close to the low tide or covered by water, what do you think this means about its habits?)
To avoid these pitfalls, have each team select one or two organisms and construct a separate histogram for each one (see below). Then, looking at the environmental data collected by the whole class, have each group come to their own conclusions about their one or two organisms. These conclusions can then be shared and discussed with the entire class. The distribution of various species with respect to each other and the environment can be compared, and the life zones delineated. Much useful information can be obtained on the ecology of organisms from such comparisons.

<u>Sample Histogram</u>

Numbers of Organism "X" Found Along Transect Line I

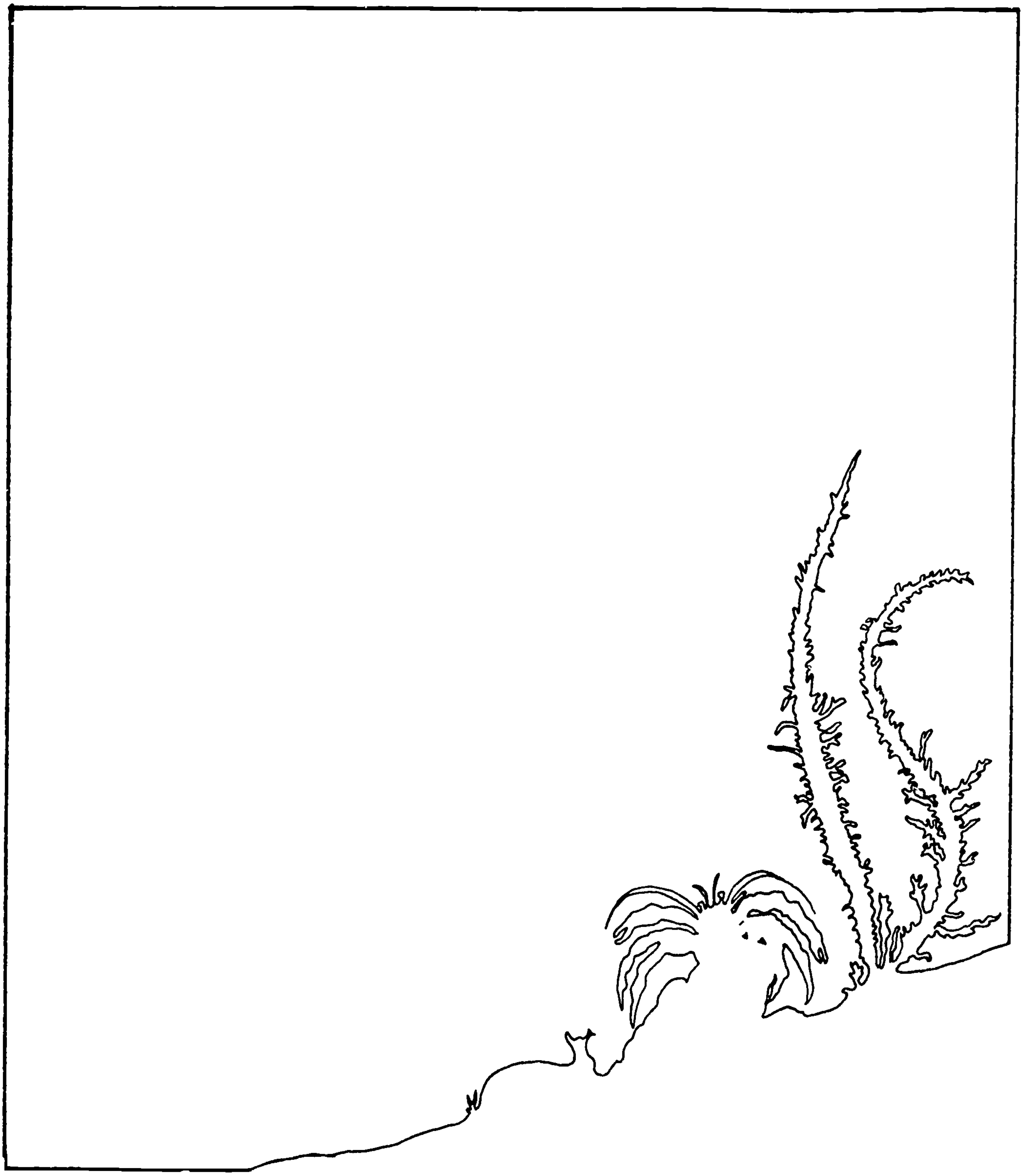


EXTENDED ACTIVITIES:

1. See ORCA activity packet "Beaches" for studies of zonation. Can students identify the zones in their study area?
2. Combine the information gathered about the profile of the beach with the transect study. Are there any relationships between slope and life form?
3. Question for further stimulation: How many animals did you step on yesterday?

BIBLIOGRAPHY:

"Transect Studies", Minnesota Environmental Sciences Foundation, Inc., published by National Wildlife Federation. Available from: The National Wildlife Federation
1412 16th Street N.W.
Washington, D.C. 20036



VOCABULARY

BIBLIOGRAPHY

TEACHER INFORMATION SHEET
Profiles and Transects
Optional Activities

PROFILES AND TRANSECTS

1. Review metric measurement if your students are not comfortable with it.
2. Metric activities.
3. Mapping activities--see "Mapping Small Places," Wentworth (bibliography)
4. Using the graph of the profile from the activity, make a scale model of your beach out of clay, plaster of paris, paper mache, or soft dough.
5. Use several profiles to draw a contour map of the beach you visited. Or map several contiguous quadrats in detail, using symbols for each organism. (See Biological Science Curriculum Study Field Ecology and Contour Mapping, National Wildlife Federation.

1. Scale Measurement

This activity gives practice in using scale measurement in graphing and mapping.

Materials for each student: Centimeter graph paper
Metric rulers
Meter stick and tape
List of items to be measured
Pencil and paper

a. Discuss scale as used in maps and charts. Show sample maps. Most maps would be useless if they were full size (can you imagine putting a map of Seattle in a book?), so units of measurement are reduced in order to fit the map onto a piece of paper. Explain that the class will take some measurements and reduce them proportionally so the lines representing lengths of measured objects can be compared on graph paper.
b. Prepare a list on the board of what should be measured. Use large objects that do not differ too widely in size (chairs, desks, height of wall, etc.). Students should measure in 1 dimension only, i.e., length or height. Have students take their measurements and record them.
c. After measuring and recording, students are given graph paper. Explain scale of measurement by using illustrations on the board. (1 sq. = 10 cm, or 1 sq. = 50 cm, or 1 sq. = 1 meter). Have students use a scale which is appropriate for the measurements taken. Have them transfer their measurements to the graph--one vertical line is drawn for each object measured, similar to a bar graph.
d. To conclude the activity, have students compare their graphs with those of other students' and with the objects measured. Have the students graph the measurements again, using a different scale. Compare the graphs. Which scale gives the larger figure on the graph?

NAME ____________________

DATE ____________________

PERIOD ____________________

NAMES OF ANIMALS AND DESCRIPTIONS OF HABITAT

1. Isopods - under rocks, in sea weed mats, where they may remain moist during low tides. 

2. Shore crabs - tide pools and under rocks. They are able to survive tidal exposure if gills remain moist. 

3. Worms - they live in tubes and are grouped to survive wave shock. They feed only during times when covered with water. 

4. Anemones - they are found attached to rocks and in sand. They close during low tide to conserve water for survival. 

5. Jellyfish - free floating and swimming organisms. They are not accustomed to exposure to air. 

6. Fish - swimmers who need gills covered with water at all times. Found under rocks and sea weed. 

7. Sea stars - found on underside of rocks. They hold water in their water vascular systems to survive exposure to air. 

8. Sea urchins - often bore into soft rock to survive wave shock. May survive some exposure to air. 

9. Barnacles - attached to rocks and other objects by a strong glue-like substance. They live in groups to break wave shock. They can close their tough shells to survive long exposure to air. 

10. Snails - found in rocky and tide pool areas. They are able to withdraw into their shells for extended periods of time. 

NAME ____________________

DATE ____________________

PERIOD ____________________

Names of Animals and Descriptions of Habitat

11. Mussels - live in groups called "beds" attached by byssal threads, which hold them securely to rocks and other strata. Can close shells to conserve water during long exposure to air. 

12. Chitons - mobile organisms with shell plates or tough water covering. Can adhere tightly to rocks with muscular feet for frequent, short exposure to air. 

13. Clams - found in sandy or soft rocky areas. Each has a muscular foot for digging into beach to avoid dessication during low tide. 

14. Limpets - single shells which serve as protection during long exposure to air. Each has a muscular foot which helps it adhere tightly to rock surfaces so that it will not be swept away. 

BEACH PROFILES AND TRANSECTS

VOCABULARY:

Beach Morphology - the physical characteristics of the beach, including slope, geology, the presence of rocks or sand, etc.

Ecology - the study of the relationships among living things and their environment.

Exposure - on a beach, the relative degree of moisture and sunshine available.

Guideline - the line near the bottom of the sighting pole up to which the pole is driven into the ground

Histogram - simple graph showing numbers of something plotted against some other factor (such as distance from low tide line).

Intertidal Zone - area of a beach between low and high tide lines. This area is subject to daily changes in amount of water and is often densely populated.

Leveling Device - some system used to show when an object is held perfectly vertical or horizontal. In our equipment, this function is performed by a plumb line.

Plumb Line - weighted line used to show true vertical. In our case, a string with a sinker attached.

Population - members of the same species living in a given area.

Profile - a cross-sectional map showing the slope of an area.

Quadrat - a small area within a larger one used to sample a population.

Random Sampling - taking data by chance to avoid letting choices you might make interfere with getting true representative data.

Range Pole - tall pole marked in even gradations that you use to sight towards

Reference Line - vertical line drawn on the sighting pole against which the plumb line is compared to find vertical.

Salinity - saltiness of a liquid, usually described as percent of salt in solution.

Sediment Size - size of the particles found on the ground or in rock. On beaches it would range from fine sand, through pebbles and cobbles to boulders.

Sighting Device - on our equipment, the juice can with a nail hole in one end and cross hairs on the open end used to sight accurately from a distance.

Substrate - the surface upon which organisms are living: e.g., rocks, mud.

Transect - a line, imaginary or otherwise, used as a guide to study ecological variation.

BEACH PROFILES AND TRANSECTS

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Books

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The National Wildlife Federation
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