Wells James Barker, THE DEVELOPMENT OF A GUIDE TO FIELD STUDIES FOR THE COASTAL ENVIRONMENT. (Under the direction of Dr. Carolyn H. Hampton) Department of Science Education, April 1981.

The purpose of this study was to develop a field guide to serve as a resource to aid teachers in providing meaningful student investigations on field trips to the coast. The specific goal of this study was to develop a field guide of investigative lessons that:

1. can be infused into the North Carolina eighth grade earth science curriculum;

2. will aid teachers in conducting coastal field trips;

3. will provide teachers with strategies for leading students in studying factors that prevail in coastal habitats;

4. will reinforce earth science concepts appropriate to the grade level;

5. will reinforce marine science concepts appropriate to the grade level.

The field guide was developed by reviewing the associated literature and collecting, modifying and adapting existing classroom and field investigations for studying the coastal environment.

The evaluation of the field guide involved four steps:

1. Trial testing with thirty-six eighth grade earth science students from Kitty Hawk Elementary School, Kitty Hawk, North Carolina, during spring semester, 1981.

2. Individual student evaluation of each lesson/activity in the field guide;

3. Lesson evaluations by Mr. Joe Dzwonek, eighth grade earth science teacher at Kitty Hawk Elementary school;

4. The evaluation by a panel of outside reviewers.

The evaluation of the field guide was completed and appropriate changes were made in the lessons based on the evaluation results.

THE DEVELOPMENT OF A GUIDE TO FIELD STUDIES FOR THE COASTAL ENVIRONMENT

A Thesis

Presented to the

Faculty of the Department of Science Education

East Carolina University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Education

by

Wells J. Barker

April 1981

THE DEVELOPMENT OF A GUIDE

TO FIELD STUDIES FOR THE

COASTAL ENVIRONMENT

by

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I wish to acknowledge my sincere appreciation to my thesis adiviser, Dr. Carolyn H. Hampton, for her guidance, support and endless patience in aiding me in the preparation and completion of this thesis. To the other members of my thesis committee, I would like to extend my appreciation for their valuable suggestions and guidance.

My parents, Mr. and Mrs. Harrell Barker, have provided support and love beyond the call of duty for my entire lifetime. As a small token of my love, I dedicate this thesis to them.

CHAPTER I

INTRODUCTION

Even though the United States began its economy and life directly tied to the ocean and its coastal environment, the average person today is unaware of its continued importance. Goodwin and Schaadt (1978) believe, "Whether it is the water of the global sea or the water of the land, our lives and fortunes depend on it" (p.3). Areas such as lakes, rivers, seas, coastal zones and our near-shore waters make up a system. It is necessary to learn the limits of such a system in absorbing our wastes; providing our food, water and resources; and adjusting to other man-made problems such as extensive development, farming and mining in coastal regions.

Mangone in Goodwin's Americans and the World of Water (1977) makes the statement:

> In fact, more than three-quarters of the population of the United States can be found in those states which bound the Great Lakes and the oceans. Almost half the urban counties of America touch the seas. And the rates of increase in the population of the United States have been greatest in the areas with coastal lands, with about 90% of the increase over the last twenty years or so occurring in coastal states (p. 85).

With this increasing population and other stresses placed on the fresh and salt water system, a basic understanding of this environment is a necessary ingredient to the public's wise use of these areas.

Goodwin and Schaadt (1978) state of American education:

> American education has been that of a land people. We have not been taught the importance or methods of protecting, using, and managing the resources of neighboring lakes, rivers, and seas, coastal zones, and continental shelves. . . . This is not to suggest that marine and aquatic education

> should dominate, only that the importance of water should so condition the subject matter of education that a balance with land and air is restored and water assumes the place its importance warrants (p.4).

This thesis hopefully will provide a step toward attaining this goal of bringing the world of water back to its deserved place of importance.

Purpose of the Study

The purpose of this study was to develop a field guide to serve as a resource to aid teachers in providing meaningful student investigations on field trips to the coast. The specific goal of this study was to develop a field guide of investigative lessons that:

1. can be infused into the North Carolina eighth grade earth science curriculum;

2. will aid teachers with strategies for leading students in studying factors that prevail in coastal habitats;

4. will reinforce earth science concepts appropriate to the grade level;

5. will reinforce marine science concepts appropriate to the grade level.

Definition of Terms

Field Guide

The term Field Guide, as defined for this study, is a directed group of investigations to be used in the particular environment or area that is to be studied.

Coastal Environment

Coastal Environment, as used in this study, is the area of near-shore water, beach area, dune area, marsh area, estuarine environment and the maritime forest area.

Organization of the Study

Involved in the organization of this study were the following steps:

1. A review of the associated literature;

2. Collection, modification and adaptation of existing classroom and field investigations for studying the coastal environment;

3. Development of the field guide;

4. Evaluation of the field guide; and

5. Presentation of the summary, conclusions and implications of the development of the field guide.

Chapter II contains a review of the associated literature.

Chapter III contains a discussion of the trial testing and evaluation of the field guide.

Chapter IV contains the conclusions, implications, and suggestions for further study and development.

A bibliography of references used in the preparation of Chapters I, II, III and IV follows Chapter IV.

Appendix A contains the field guide in its entirety as it is to be used by an earth science teacher. The guide includes a table of contents, a list of figures, a preface, the field lessons (student activities), the appendices and a bibliography.

Appendices B through D contain the instruments used in the evaluation of the field guide.

CHAPTER II

REVIEW OF THE ASSOCIATED LITERATURE

The following review is the result of an in depth manual search of the literature pertaining to this study. Searches were made in the Dissertation Abstracts, 1957-80; the Marine Education Materials System (MEMS), 1977-80; and the Educational Resources Information Center (ERIC) Publications List, 1966-1980.

A variety of widely scattered literature has been published containing field activities for and/or adaptable to the coastal environment. However, to the best of this investigator's knowledge, there have been no coastal investigation guides written specifically for the eighth grade level and correlated with competency goals and performance objectives of an earth science curriculum.

Ingmanson (1965) further supports the need for development of a coastal studies field guide in the statement: "There have been no papers published in the literature similar to this proposed study." His proposed study was a dissertation entitled "Use of the Near-Shore Marine Environment as a Field Laboratory by Science Teachers and Students." Although Ingmanson's study involved the near-shore water, other coastal habitats were not used. Ingmanson did not concentrate on the development of a usable field guide for a particular grade level and a specific science curriculum. His study guide includes activities for physics, chemistry, biology, physical science and earth science. Many activities are exclusively designed for biology such as the foraminifera studies. The activities incorporated in the study are written in such a fashion that they require in depth study by a teacher to extract them from the text.

William A. Andrews (1972) has edited three field guides: A Guide to the Study of Terrestrial Ecology, A Guide to the Study of Soil Ecology and A Guide to the Study of Freshwater Ecology. Some of the field activities contained in these guides can be adapted to an investigation of the coastal environment and have been modified to suit the particular needs of this field guide. In addition to being made more applicable to the particular environment for which this field guide was designed, the activities have been altered to a format more useful for the in-service teacher.

Another field study develpment project is the Outdoor Biology Instructional Strategies directed by Watson M. Laetsch (1975), University of California at Berkley. The investigations contained in Sets I through IV detail valuable outdoor environmental investigations but few are particularly suited for the coastal environment; most are designed to be utilized by community youth groups rather than school classes.

Herbert L. Coon and Charles L. Price (1977) developed a book of activities to help students learn about water resources. It is entitled Water-Related Teaching Activities. The format is usable, yet the collection of activities is designed for a number of grade levels and subject areas.

Dr. Carolyn H. Hampton (1976) in Exploring Your Environment edited a collection of environmental education activities for grades seven through nine. The format designed by Hampton is a workable format for teachers. The design clearly details objectives, materials and procedures, giving teacher and student preparations as necessary. However, as is the case in most of the associated literature reviewed, the collection by Hampton is not designed primarily for the eighth grade earth science course nor the marine environment. Elements of the format have been incorporated into the format design of this investigator's unit. Several activities from Exploring Your Environment were adapted without difficulty to this investigator's study.

A variety of marine investigations have been created by school systems, environmental centers and governmental projects. One such study is Eighth Grade: Beach Investigation published by Martin County Schools Environmental Studies Center in Jensen Beach, Florida (1976). This study covers several of the topics contained in the proposed field guide. The study is well illustrated yet for the majority of the investigations such aspects as materials needed, procedures and background information are all incorporated into the text. This hinders its usefulness to the in-service teacher. Another study was published by Maine: Regional Academic Marine Program. The author of this study is S. Cultrera. It is entitled Field Investigations for the Beach and Marsh (n.d.). This study is limited to the number of activities it covers: tides, waves, currents and area mapping. The format appears difficult for a classroom teacher to use. The materials and directions are included in the text and would require extraction time and effort by a teacher.

Robert A. Bergen (1977) developed a unit on beach investigations.

This unit, The Dynamics of Beaches: Field Investigations is limited to the area of beach sand and its movement. Bergen correlates the beach sand study to biological, geological and physical science concepts.

The main focus of Beaches - Shifting Sands of Gold by Neal Bird (1976) is dune profiling. The study is limited to eight pages and deals almost exclusively with dune profiling and the information that can be gained by repeated dune profiling over an extended period of time.

Carteret County Public Schools, funded by an ESEA Title III Grant, have produced a variety of marine oriented materials: The Field Experience by Larry W. Yeater (1969), Creating Effective Field Experiences for Coastal Schools by Will Hon and Larry Yeater (1969), Dune Detective by Paul J. Godfrey and Will Hon (n.d.) and The Field Approach to Coastal Ecology by Beth Taylor (1969). The Field Experience and Creating Effective Field Experiences for Coastal Schools do not contain activities. The primary content of these works deal with the rationale for field studies and what preparations are necessary for a successful field trip. These would be valuable supplemental materials for a teacher with no experience in planning a field trip. Dune Detective contains six activities to be performed in the sand dune area. Three of these six activities are based on biological/ecological topics. The remaining three activities are mapping, profiling and elevation determinations. Dune Detective is definitely limited in its scope. The Field Approach to Coastal Ecology deals almost entirely with biological/ecological aspects thus making it unusable in this proposed study.

Another marine study, Ocean Study Activities, 6-12, produced by Alamance County Schools, Graham, North Carolina (1979) is, as can be seen by its title, for grades six through twelve. Individual activities do not contain competency goals and the format of the activities is not consistent throughout. In some lessons the objectives, materials and procedures are contained in the text of the lesson creating teacher effort and time in extracting information necessary for preparation.

Investigating the Marine Environment and Its Resources by Violetta Lien (1979) is composed of two volumes containing a total of nine hundred pages. This study is a multidisciplinary collection for elementary grades through high school. The vast majority of its contents are classroom oriented. The format is cumbersome for teachers to use because of the lack of organized teacher preparation information.

COAST (Coastal Oceanic Awareness Studies), directed by Robert Stegner (1977), is a large collection of marine related teaching packets. The program is designed for grades K-12 and is multidisciplinary in scope. Although COAST is divided into a large number of units (packets) on different aspects of marine education, only one is specifically applicable to this investigator's proposed study. Number 240, "Beaches: A Geological Study," covers such topics as beach profiling, tidal measurements, beach layering, wave analysis and core sampling. The number of earth science investigations is limited.

This review of the associated literature has attempted to point out the varied and scattered nature of curriculum materials designed for the coastal environment. There is at present, no teacher's guide to field studies in coastal environments designed specifically for junior high school earth science classes. Further, existing curriculum materials are lacking in suitable formats to facilitate ease of teacher planning and preparation. No available guides included well defined student competency goals. This review demonstrated the need for the development of a guide to field studies for the coastal environment to be used in junior high school earth science classes.

CHAPTER III

FORMATIVE EVALUATION OF THE FIELD GUIDE

The Field Guide: Appendix A was evaluated by several methods. A discussion and summarization of these methods are contained in this chapter.

Trial Testing of the Field Guide

The entire eighth grade from Kitty Hawk Elementary School, Kitty Hawk, North Carolina participated in the trial testing of the Field Guide: Appendix A. The eighth grade included thirty-six students of varying aptitudes and interests. The trial testing involved three half-days in the classroom and three half-days on field trips. The class-days included pretesting, field trip equipment construction and posttesting. The dates of the classroom work were February 17, 19 and March 17, 1981. The field trips were directed by this investigator with the assistance of Mr. Bill Martin, Curriculum Specialist for Project CAPE (Coastal Awareness in Public Education), Dare County Board of Education, Manteo, North Carolina and Mr. Joe Dzwonek, teacher of the eighth grade science class, Kitty Hawk Elementary School.

Several additions and changes were made to lessons in the field guide as a result of this trial testing.

Student Evaluation of Lessons

Each student was asked to rate each lesson/activity on an evaluation card (see Student Evaluation of the Field Guide:

Appendix B) designed by this investigator. The evaluation cards for the lessons performed on a particular day were given to the students at the completion of the lessons at the field trip site. A compilation of the results of the students' evaluations of each lesson/activity can be found in Appendix B.

The student evaluation form was designed so that with the exception of D and H the desired responses were indicated by a higher number (5 being the optimum response to these statements). The means of all student responses fell within the 3 to 4.4 range, indicating an overall favorable student evaluation. The optimum response for statement D would have been a 3 indicating that the activity was neither too difficult nor too easy. The mean of the responses to this statement for all the activities fell in the 3.5 to 4.4 range, higher than this investigator expected. This tendency toward the "easy" end of this differential word pair could possibly have been due to the interest and success shown by the majority of students in accomplishing the goals for each activity.

Recommended changes in response to question H were mainly due to situational problems. The weather was very cold and windy. Several students recommended choosing a "better day" for the field trips. Because of time limitations in completing this study, the weather considerations could not dominate the planning. Another situational problem was the result of the teacher-pupil ratio on one of the trial testing days. The teacher-pupil ratio was eighteen to one due to circumstances beyond this investigator's control. Student recommended changes indicated that "smaller groups" should have been used.

Teacher Evaluation of the Field Guide

A rating of each lesson was obtained from Mr. Joe Dzwonek, science teacher at Kitty Hawk Elementary School. The teacher comments and recommendations have been noted by this investigator and appropriate changes in the field guide have been made. Examples of changes recommended by Mr. Dzwonek and made by this investigator included: (1) Lesson number 16 - increase the size of each water sample from 50 ml to 500 ml so that the samples will vary in the amount of soap needed to be added to create a good lather and (2) Lesson number 19 - use a hammer to drive the cored sample from the corer in very dry soils.

The teacher lesson rating sheet was designed to have "one" indicating a high or positive rating while "five" a low or negative rating. Ninety-five percent of Mr. Dzwonek's responses were in the 1 and 2 categories with 98.5 percent in the 1, 2 or 3 categories. A copy of the lesson rating sheet can be found in Appendix C.

Evaluation by a Panel of Outside Reviewers

A team composed of classroom teachers, school administrators, marine educators and curriculum developers were selected to serve as outside reviewers of the field guide. Members of the review team included Dr. Charles R. Coble, Department of Science Education, East Carolina University, Greenville, North Carolina; Dr. Carol D. Hampton, Department of Science Education, East Carolina University, Greenville, North Carolina; Mrs. Maxine A. Claar, Science teacher at Graham High School, Graham, North Carolina; Dr. Ira Trollinger, Principal, South Mebane Elementary School, Mebane, North Carolina; Mr. Gerry Madrazo, Supervisor, Alamance County Schools, Graham, North Carolina and Rhett B. White, Director, North Carolina Marine Resources Center/ Roanoke Island, Manteo, North Carolina.

Reviewer comments and recommendations were used by this investigator to revise the lessons within the field guide. Two suggested additions to the field guide, lesson/activity completion times and correlation of the lessons/activities with the North Carolina adopted earth science textbooks, were not made because of time limitations.

The results of the evaluation of the field guide by the team of outside reviewers shows that 100 percent of the team believed that (a) the concepts were presented clearly enough for target students to understand and attain, (b) the concepts were appropriate for the majority of target students, (c) the teacher instructions were appropriate, (d) the materials were easily obtainable for the typical classroom teacher, (e) the activities were appropriate in length for the grade level, (f) the activities will be of interest to the target students, (g) the activities will lead to or reinforce the understanding of marine knowledge and concepts, (h) the activities appeared to reinforce the lesson concepts stated at the beginning of each lesson, (i) the activities appeared to adequately accomplish the behavioral objectives stated at the beginning of each lesson, (j) the activities contribute to the mastery of the designated skills, (k) the lessons were well written, (l) the activities noted no marine inaccuracies and (m) the activities noted no sex biases. Fifty percent of the reviewers felt that several of the activities were too sophisticated for students, yet, felt they should not be deleted from the guide. Seventeen percent of the reviewers felt that there were aspects of three lessons to which school administrators might properly object. The reviewers recommended that a cautionary statement be inserted in lessons two, three and four to point out the possible hazards of students working in the ocean to perform the wet methods described in those lessons. Such a caution was added in the appropriate sections in each of the lessons concerned. Fifty percent of the reviewers rated the guide as excellent and fifty percent rated it as very good.

A detailed summary of the comments made by the review team is recorded on a sample reviewer unit evaluation form in Reviewer Evaluation: Appendix D.

CHAPTER IV

CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER DEVELOPMENT AND STUDY

Ingmanson (1965) states:

> The near-shore marine environment offers to the public school a readily accessible source of opportunities for acquiring information, introducing new experiences, stimulating interest, and encouraging exploration and discovery. . . Field work,. . ., is an important aspect of scientific endeavor. Too often scientists, especially physicists and chemists, forget that the basis of science is the natural world (p.210, 211).

Ingmanson has noted the importance of the near-shore environment and field work in the education process. Hopefully the field guide developed in this study will aid in meeting the need for curriculum materials on the near-shore environment. The need for developing curriculum materials for coastal field studies is discussed in Chapter I.

The main purpose of this investigation was to develop a resource guide for teachers who wish to promote, in their students, the acquisition of skills in environmental inquiry and knowledge of the coastal environment. Although the field guide was designed primarily for eighth grade earth science teachers and students, many of the investigations can be adapted for use in other courses. Teachers are encouraged to choose lessons and sequence them to organize a module, adaptable to the habitats available, that will meet the specific needs of the course.

The remainder of this chapter will deal with analyzing and interpreting the important findings of this study, a discussion of the implications of these findings, and recommendations for further development and study.

Summary of the Study

Following a review of the associated literature which showed the need for the development of a guide to field studies for the coastal environment at the eighth grade level, a field guide was developed by this investigator. This guide was trial tested in an eighth grade earth science class at Kitty Hawk Elementary School in Dare County, North Carolina during the spring semester of 1981. The guide was evaluated by thirty-six students, the eighth grade earth science teacher and a team of outside reviewers consisting of classroom teachers, school administrators, marine educators and curriculum developers.

Findings

The student responses to all items evaluated for each lesson contained in the field guide was 3.0 or better. This indicates a favorable response to all lessons. See Appendix B. The teacher evaluation of each lesson resulted in ninety-five percent of all ratings falling in the upper two categories of the differential. One hundred percent of the outside reviewers gave the guide an overall rating of "very good" or "excellent."

Implications of the Study

This study was undertaken out of a recognized need for the development of a field guide of investigative lessons that:

1. can be infused into the North Carolina eighth grade earth science curriculum;

2. will aid teachers in conducting coastal field trips;

3. will provide teachers with strategies for leading students in studying factors that prevail in coastal habitats;

4. will reinforce earth science concepts appropriate to the grade level;

5. will reinforce marine science concepts appropriate to the grade level.

This study has shown that such a guide can be developed.

Conclusions

This investigator feels that a need for a field guide to earth science studies in coastal environments has been established through a search of the associated literature. There is at present, no teacher's guide to field studies in coastal environments designed specifically for eighth grade earth science classes. Further, existing curriculum materials are lacking in suitable formats to facilitate ease of teacher planning and preparation. No available guides include well defined student competency goals.

The positive responses of students, teachers, and reviewers to the lessons in the proposed guide substantiated the value of the guide in today's educational curriculum.

The experience this investigator acquired while trial testing the guide with a group of eighth grade earth science students has led to the belief that the lesson format used in this guide will be a helpful resource to teachers of earth science classes planning coastal field studies. The degree of success noted by this investigator, under often less than favorable conditions, strengthens this belief.

It is the investigator's hope that this guide can and will be used by teachers in leading students in studying the coastal environment.

Suggestions for Further Development and Study

The development of this project was limited in scope by time. However, additional studies have been recognized. This investigator would like to recommend that the following be considered for further study:

1. Correlate each lesson/activity in the field guide to specific chapters in the state adopted textbooks.

2. Determine the length of time for a class to complete each lesson. This would be valuable information to aid teachers in planning time schedules for coastal field trips.

4. The effects of coastal field studies on student motivation.

5. The effect of coastal field studies on student attitudes toward the coastal environment.

6. The effect of coastal field studies on student cognition of coastal environmental concepts.

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APPENDIX A

A GUIDE TO FIELD STUDIES FOR THE COASTAL ENVIRONMENT

TITLE:	A GUIDE TO FIELD STUDIES FOR THE COASTAL ENVIRONMENT
GRADE LEVEL:	8
SUBJECT:	EARTH SCIENCE
AUTHOR:	WELLS J. BARKER

PREFACE

"Coastal Field Studies" has been designed to aid teachers in conducting coastal field studies. This collection of twenty-five activities is not meant to be a complete curriculum in coastal studies; rather, the primary objective is to provide ideas for investigating the environmental factors that prevail in coastal habitats. Each teacher is encouraged to choose the lessons and the sequence to organize a module that will meet the specific needs of the class. Such factors as available time, available resources and materials, skills of the pupils and the types of coastal habitats available will certainly be considered in determining the exact composition of a module to be used on a field trip to the coast.

Many investigative strategies in this field guide have been taken from various sources. In such cases, the sources have been given at the end of the lesson. All lessons have been planned to emphasize certain concepts and to achieve specific learning outcomes or objectives. Each lesson has been structured to reinforce specific competency goals selected from Competency Goals and Performance Indicators, K-12, published by the North Carolina State Department of Public Instruction.

CONTENTS

FIGURES

Page

Lesson Number: 1

LONGSHORE CURRENTS

KEY CONCEPTS

1. There is very often a current running parallel to shore called a longshore current.

2. The speed of a longshore current can be measured.

COMPETENCY GOALS

1. The learner will demonstrate the ability to use space/time relationships.

2. The learner will demonstrate the ability to measure.

3. The learner will demonstrate the ability to interpret data.

4. The learner will develop skill in constructing simple equipment.

OBJECTIVES

1. The student will recognize that longshore currents exist and understand their nature.

2. The student will measure distances and make time distance computations.

MATERIALS

30 m. long string or other comparable measuring instrument (tape measure)
two stakes approximately 1.5 m. long
float (see APPENDIX A: TOOL CHEST)
watch with a second hand or a stop watch
fishing rod and reel with a lure (OPTIONAL)

VOCABULARY

Longshore current - a current running parallel to the beach caused by waves hitting the beach at an angle.

PROCEDURE

1. Pour sand into the jug until a level is reached to keep the jug floating very low in the water. This can be done by checking the float level after adding sand. By adding enough sand to keep the jug fairly low in the water, the effects of wind on the experiment are reduced.

2. Place one stake in the sand on the beach.

3. Using the measuring "string", place the second stake 30 m "up or down" the beach at approximately the same distance from the water.

4. Have one student stand behind each stake sighting directly out into the ocean.

5. Toss the jug float into the ocean (or wade out and place it) beyond the first set of breakers. This should be done outside the stake zone area. If the jug floats away from the stake zone, retrieve it and go to the other side of the stake zone and toss it into the water.

6. Using a watch, measure and record the time it takes for the float to travel from one stake sighting to the other.

7. Follow this procedure several times and average the results.

8. Compute the velocity of the longshore current by using the following formula:

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

9. Record the velocity in your field notebook.

* If the float moves out into water too deep to retrieve safely, a good angler with a fishing rod and reel and hook can retrieve it.

* This activity should be done at several spots along the beach to determine if the speed of the longshore current changes. For example, check the current closer to an inlet or jetty.

SOURCES

Eighth Grade: Beach Investigation. Jensen Beach, Florida: Martin County Schools Environmental Studies Center, 1976, pp.2-3.

Lesson Number: 2

WAVE PERIOD

KEY CONCEPT

1. Wave period is the length of time it takes for one wave cycle (crest to crest or trough to trough) to pass a certain point.

2. The period for an ocean wave can be measured.

COMPETENCY GOALS

1. The learner will demonstrate the ability to use space/time relationships.

2. The learner will demonstrate the ability to measure.

OBJECTIVES

1. The student will measure the period of a wave.

2. The student will use an operational definition of the period of a wave.

MATERIALS

2-3 m long stake (The measuring rod from APPENDIX A: TOOL CHEST can be used.)
watch with a second hand or stop watch

VOCABULARY

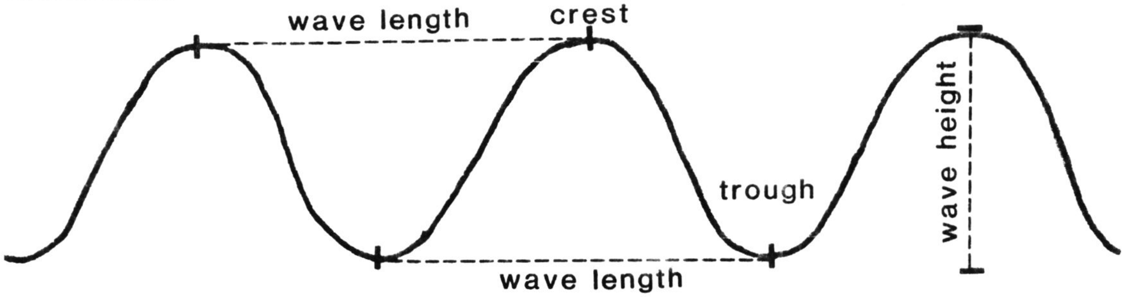


Figure 1. The Parts Of A Wave.

One cycle equals one complete wave (crest to crest or trough to trough).

PROCEDURE

WET METHOD

1. Have a recorder and a timer on the beach.

2. Send one student into the water just beyond the breakers with the stake.

3. Holding the stake vertically, the observer should signal the timer to begin timing when either a crest or a trough is on the stake. When the next crest or trough is on the stake the observer should signal the timer again. The recorder should record the length of time taken. This time is the period of the wave. The period can be calculated using either the crest to crest or the trough to trough time.

DRY METHOD

1. Have a recorder, timer and observer on the beach.

2. The observer should sight off a stationary object in the water as the holder did in step number 3 in the WET METHOD. The period can be calculated using either the crest to crest or trough to trough time as in step number 3 WET METHOD.

CAUTION: Surf conditions may warrant use of the DRY METHOD.

SOURCE

Eighth Grade: Beach Investigation. Jensen Beach, Florida: Martin County Schools Environmental Studies Center, 1976, p.5.

Lesson Number: 3

WAVE HEIGHT

KEY CONCEPTS

1. The vertical distance from the highest point of a wave (crest) to its lowest point (trough) is its height.

2. The height of an ocean wave can be measured.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will demonstrate the ability to use space/time relationships.

3. The learner will develop skill in constructing simple equipment.

OBJECTIVES

1. The student will learn how to measure the height of a wave.

2. The student will learn an operational definition of wave height.

3. The student will make a simple field measuring instrument.

MATERIALS

measuring rod (see APPENDIX A: TOOL CHEST)

VOCABULARY

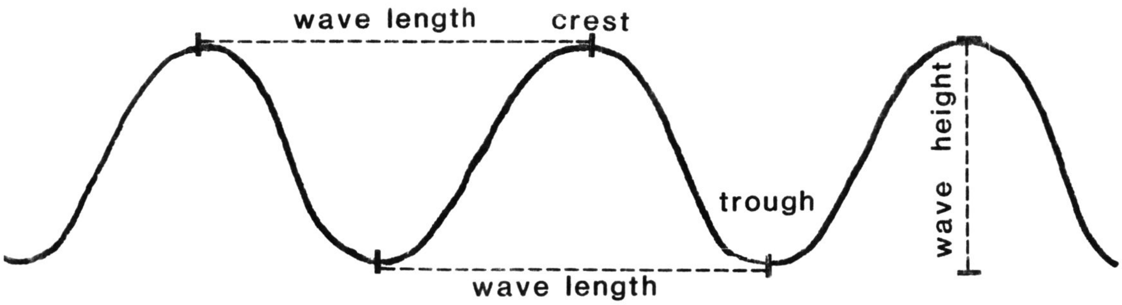


Figure 2. The Parts Of A Wave

PROCEDURE

WET METHOD

1. Have a student recorder on the beach to record the data.

2. Send one student with the measuring rod into the water just beyond the breakers. Have this student measure the distance from the highest point the wave makes on the stick by holding the stick vertically in the sand. The lowest point measurement and the highest point measurement can be called ashore to the recorder to make computation easier on the wet student. The difference between these two amounts will give the height of the wave.

DRY METHOD

1. Locate a piling or some other stationary object sticking up out of the water.

2. Estimate by sight the distance from the water's high point on the piling to the water's low point on the piling. This will give you a rough estimate of the wave height.

* Another way to estimate wave height is to use a straight object (pen, pencil) to sight along. At a location either "up or down" the beach from the piling, hold the pencil out at arm's length. Sight along the pencil so that the top of the pencil corresponds to the highest water point on the piling. When the lowest point on the piling is realized, spot and mark it on the pencil with the thumb. Now the distance on the piling (wave height) corresponds to the distance on the pencil. Move the hand toward shore and have another student measure (by pencil holder's directions) the "pencil distance" horizontally on the beach (use a calibrated stick). The student doing the measuring should be slightly to the other side of the piling from the pencil holder (the distance from the measurer should be approximately equal to the distance from the pencil holder to the piling).

CAUTION: Surf conditions may warrant use of the DRY METHOD.

WAVE FREQUENCY

KEY CONCEPTS

1. Wave frequency is the number of complete wave cycles (crest to crest or trough to trough) to pass a fixed point in a given amount of time.

2. Ocean wave frequency can be computed.

COMPETENCY GOALS

1. The learner will demonstrate the ability to use space/time relationships.

2. The learner will demonstrate the ability to measure.

3. The learner will demonstrate the ability to use numbers.

OBJECTIVES

1. The student will calculate the frequency of a wave.

2. The student will use an operational definition of the frequency of a wave.

MATERIALS

2-3 m long stake (The measuring rod from APPENDIX A: TOOL CHEST can be used.)
watch with a second hand or stop watch

VOCABULARY

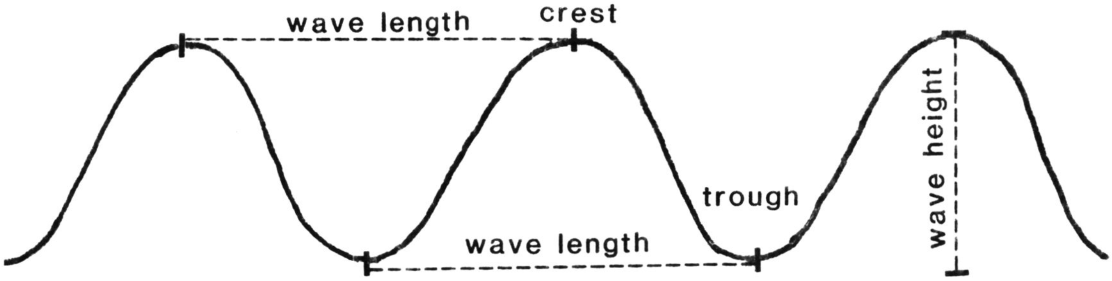


Figure 3. The Parts Of A Wave

One cycle equals one complete wave (crest to crest or trough to trough).

Frequency equals the number of cycles divided by the number of units of time.

PROCEDURE

WET METHOD

1. Place a student recorder and student timer on the beach.

2. Send a student observer into the water just beyond the breakers with the stake.

3. Holding the stake vertically, the holder should signal the timer to begin timing. To achieve the best results, this signal should be given when a crest or trough is on the stake. The observer should count a number of crests or troughs (depending on the one chosen) to pass the stake (maybe 5-10). When the "number" is reached, the observer should signal the timer. The recorder should then record the number of crests or troughs and the time taken.

4. Compute the frequency of the waves using the formula

$$F = \frac{\text{Number of cycles}}{\text{Number of units of time}}$$

DRY METHOD

1. Follow the procedure in the WET METHOD <u>except</u> do not send a student with a stake into the water. Locate a stationary object (piling) in the water. Make sightings off the piling using the same procedure as step number 3 in the WET METHOD.

2. Compute the frequency as in step number 4 WET METHOD.

   CAUTION: Surf conditions may warrant use of the DRY METHOD.

Lesson Number: 5

TIDE STUDIES

KEY CONCEPTS

1. Tides are the alternate rising and falling of the surface of the ocean.
2. There is a low point called low tide.
3. There is a high point called high tide.
4. The vertical and horizontal tidal rises on a beach can be measured.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.
2. The learner will demonstrate the ability to use space/time relationships.

OBJECTIVES

1. The student will recognize that tides exist.
2. The student will recognize that vertical tide-rises in the same general area are equal.
3. The student will recognize that horizontal tide-rises measured on a beach are affected by the slope of the beach.

SITE DESCRIPTION

Select two spots on the beach. Location "A" should have a relatively flat slope and location "B" should have a relatively steep slope.

MATERIALS

tide tables (see APPENDIX C: HOW TO READ AND OBTAIN A TIDE TABLE)
2 stakes (1 m long each)
2 stakes (3 m long each)
waterproof marker

measuring rod (see APPENDIX A: TOOL CHEST)
hammer
roll of strong string

PROCEDURE

1. Try to begin this lesson at low tide.

2. At location "A", drive one 3 m stake into the sand at the uppermost wash of the water at low tide. Make sure it is securely in the sand. Follow the same procedure for location "B".

3. Mark the level of the water (or sand level) on each 3 m stake with the marker.

4. Tie one end of a substantial length of string to the stake at location "A". Stretch the string from the 3 m stake up onto the beach and at some point above the high tide line, drive in a 1 m stake. Tie the other end of the string to it. Follow this same procedure for location "B". See Figure 4.

5. Leave the stakes there and return at high tide.

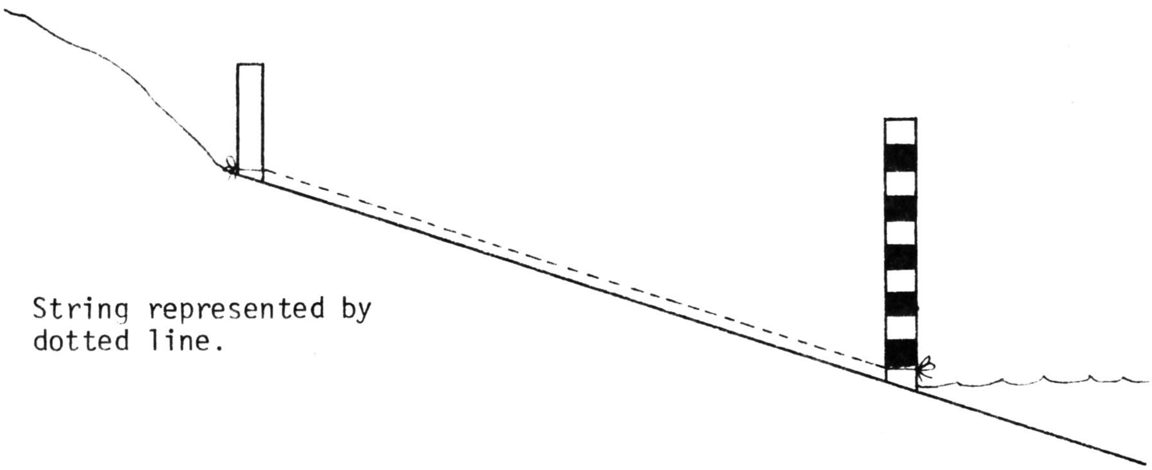
6. At high tide, pull up the 1 m stake and move it to the uppermost wash point of the water on the beach. Retie the string (taunt) to the 1 m stake. Follow this same step for location "B". See Figure 4.

7. Observe and record the highest vertical water level on the 3 m stake at each location.

8. Remove the 3 m stake by pulling on the string.

9. Stretch out the string on the beach and measure the distance between the 3 m and 1 m stakes. This will give the horizontal tide rise. Perform this step and record the data for each location.

Location A or B (Low Tide)



Location A or B (High Tide)

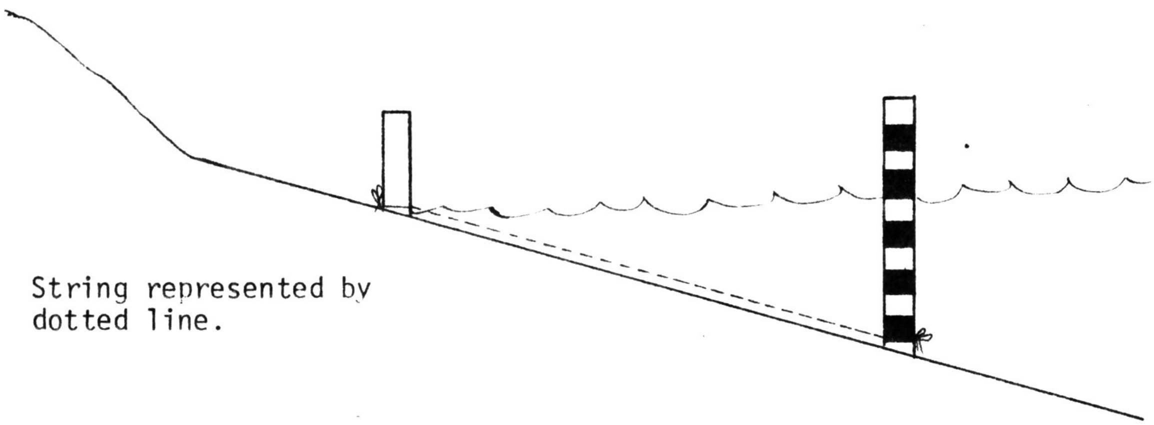


Figure 4. Proper Positioning of Measuring Rod and Stake

Lesson Number: 6

WATER TABLE STUDIES

KEY CONCEPTS

1. There is a point below the ground level that water exists called the water table.
2. The water table is at different depths at different locations.
3. As a general rule on a barrier island, the further toward the center of the island, the deeper the soil is that is overlying the water table.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.
2. The learner will demonstrate the ability to interpret data.

OBJECTIVES

1. The student will recognize what the ground water table is.
2. The student will determine that the water table depth varies from location to location.
3. The student will deduce that as a general rule on a barrier island, the further toward the center of the island, the deeper the water table.

SITE DESCRIPTION

Try to use a beach location with a generally increasing slope from the water's edge to the dune area.

MATERIALS

measuring rod (see APPENDIX A: TOOL CHEST) or meter stick
digging device (shovel)
graph paper

PROCEDURE

1. Starting close to the water's edge (a point where the water table and the ground level are almost the same) measure a distance toward the dune (5-10 m.) depending on the width of the beach.

2. Dig a hole down to the water table.

3. Measure the distance from the ground level down to the top of the water table.

4. Record your data (distance from the original starting point in step number 1 and the distance from the ground level to the water table).

5. Keep performing these procedures at 5-10 m intervals until you reach the dunes or the water table becomes too deep to practicably dig to it.

6. Plot your data on graph paper as follows:

   Vertical distance (Y) = distance between ground level and water table

   Horizontal distance (X) - distance between holes
   See Figure 4.

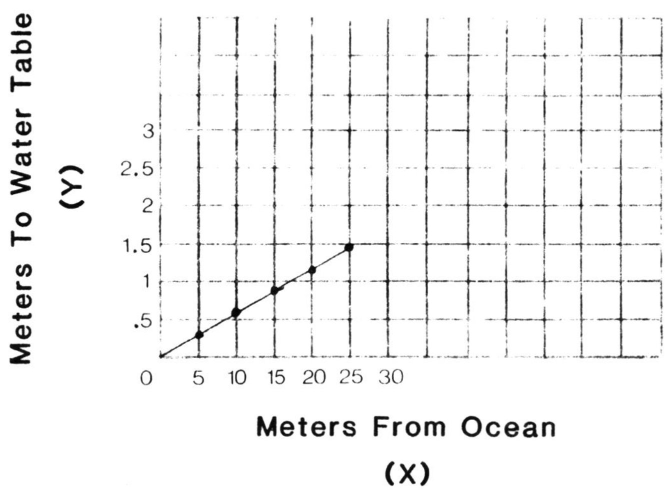


Figure 5. Sample Graph Of Water Table Data

Lesson Number: 7

DUNE STABILIZATION

KEY CONCEPTS

1. Sand dunes are large mounds of sand piled up by the wind.

2. Plants serve as a nucleus around which wind blown sand accumulates.

3. Man, in order to help stabilize sand dunes, has built such devices as sand fences and has planted different types of plants.

COMPETENCY GOALS

1. The learner will demonstrate the ability to observe.

2. The learner will demonstrate the ability to predict.

3. The learner will demonstrate the ability to interpret.

OBJECTIVES

1. The student will define a sand dune.

2. The student will investigate how sand dunes are formed.

3. The student will investigate what attempts man has taken to stabilize the sand dunes.

SITE DESCRIPTION AND RECOMMENDATIONS

Locate an area with a sand fence. Locate an area of vegetation dune stabilization. If at all possible, locate a "blow out" area to show plant root systems so as to minimize effects on the environment. If digging is necessary, take an example of only one plant and replant it when finished.

MATERIALS

field notebook
pencil

VOCABULARY

Blow out - a part of a sand dune that has been blown away, often exposing plant root systems.

BACKGROUND INFORMATION

When man came to the barrier islands, he/she destroyed a lot of the dune plant life. Without this method of stabilization man resorted to other methods: (1) sand fences and (2) artificially planted grasses. Sand fences build up dunes to a certain point but when the sand reaches the top of the fence, a new fence or some other form of stabilization must take place if the dune is to continue to grow. Also, if a sand fence decays, it can cause the dune to lose its stability and blow away. Man has come to regard plants as the best method of stabilization due partly to its root system. As the dune's height increases, the plant's root system adapts. See Figure 5.

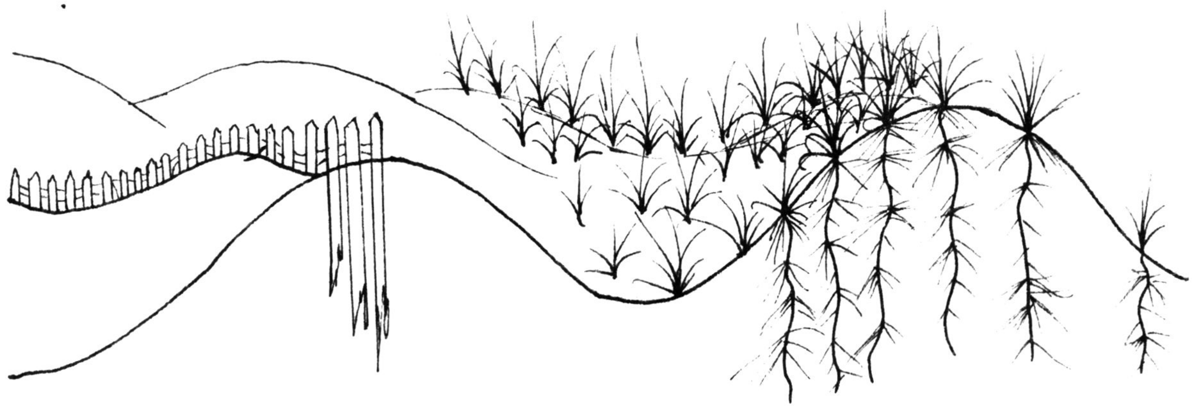


Figure 6. Dune Stabilization

PROCEDURE

1. Observe a sand dune.

2. Observe a plant's root system and its function in stabilizing a dune. Sea oats are good plants to observe.

3. Observe a fence's function in stabilizing a dune.

4. Make a list of the advantages and disadvantages of each method.

SOURCE

Chapman, Frank L. The Sea and Its Boundaries. Carteret County, North Carolina: Regional Marine Science Project of the Carteret County Public Schools, [n.d.], pp.21-22.

Lesson Number: 8

SLOPE DETERMINATION

KEY CONCEPTS

1. The slope of an area can be determined.

2. An instrument to measure the slope of an area, called a clinometer, can be constructed.

3. The slopes of the two faces of a dune, slipface (leeward) and windward are not normally the same. The slipface is usually the steeper face.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will develop skill in constructing simple equipment.

3. The learner will demonstrate the ability to use numbers.

OBJECTIVES

1. The student will determine the slope of an area.

2. The student will construct a clinometer.

3. The student will recognize that the two faces of a dune vary in their slopes.

SITE DESCRIPTION

In determining the slope of a dune, choose a dune with as little vegetation as possible so that little damage will be done to the plant life.

MATERIALS

meter stick
1.5 m of twine
wooden stake (30 cm long)
spirit level or homemade level (see APPENDIX A: TOOL CHEST)
tape

VOCABULARY

Slipface (leeward) - the side of a dune away from the ocean

Foredune (windward) - the side of a dune toward the ocean

Run - horizontal distance

Rise - vertical distance

PROCEDURE

In the Classroom:

1. Tie the string about half way from the top of the 30 cm stake.

2. Tie the other end of the string to the meter stick in such a way that it can slide up and down the meter stick. Make sure the string distance between the two stakes is exactly one meter long.

3. Tape the level to the string at about the 0.5 m point on the string. See Figure 6.

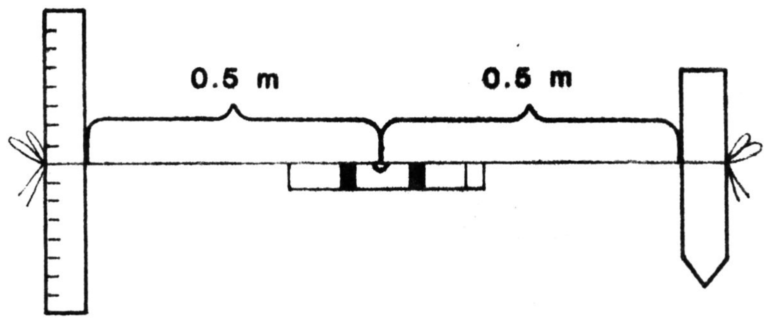


Figure 7. Simple Clinometer

PROCEDURE

At the Coast:

1. In measuring the slope of a dune, start at the ocean side base. Drive the stake into the side of the dune until the string attachment point is at ground level.

2. Holding the meter stick vertical and keeping the string taut, move the string up and down the meter stick until the bubble indicates the level position. When the string is both taut and level, record the reading on the meter stick. See Figure 7.

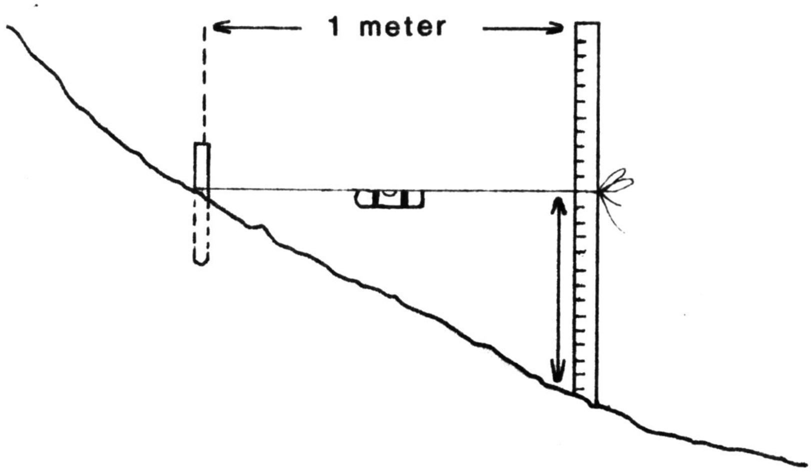


Figure 8. Correct Positioning Of A Clinometer.

3. Since the string is 100 cm (1 meter) long, the number of centimeters on the meter stick will give the percentage gradient (slope). For example, if the reading on the meter stick is 16 cm , the gradient is 16 percent over this one meter stretch of land.

4. Keep performing this procedure traveling up to the top of the dune and recording your location and gradient. For example:

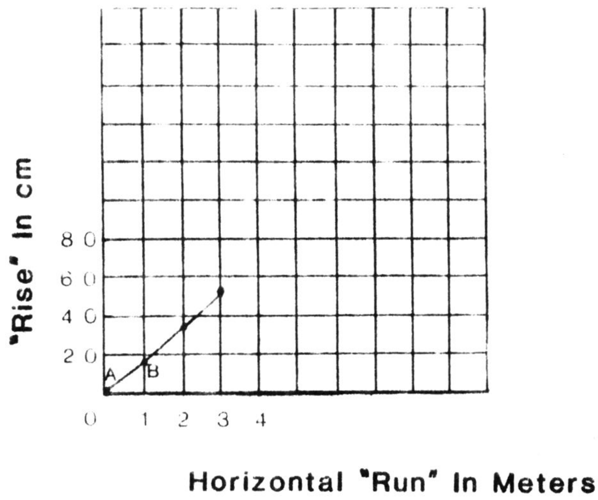
First meter = 16 cm = 16 percent
Second meter = 17 cm = 17 percent
Third meter = 20 cm = 20 percent

Mark the point at which you reach the top of the dune.

5. To determine the average slope of one face of the dune, add up the gradients for that side and divide by the number of meters measured on that face. Compare the results for each face.

RELATED ACTIVITIES

To make a profile of an area using clinometric data, plot the horizontal distance on the horizontal axis of the graph and the height (cm) on the vertical axis of the graph. See Figure 8.



Sample Data	
Run	Rise
1st Meter	16 cm
2nd Meter	17 cm
3rd Meter	20 cm

Figure 9. Sample Graph And Data For Plotting A Profile

Since the rise and run is cumulative, when graphing the data, move from one point to the next. Example: From point A over "1 m", up "16 cm"; from point B over "1 m", up "17 cm"; . . .

SOURCE

Laetsch, Watson M., director. Outdoor Biological Instructional Strategies. Set I. Berkley, California: University of California, 1975.

Lesson Number: 9

DUNE PROFILE EMPLOYING FIELD SURVEY TECHNIQUES

KEY CONCEPT

1. By using field survey techniques, a profile of an area can be made.

2. A profile is a drawing showing a vertical section of the ground.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will demonstrate the ability to define operationally.

3. The learner will demonstrate the ability to formulate models.

4. The learner will develop skill in the use of instruments.

OBJECTIVES

1. The student will use simple field survey equipment.

2. The student will make a profile of a sand dune.

3. The student will use an operational definition of the term "profile".

SITE DESCRIPTION

A relatively high sand dune with as little vegetation as possible. Ask students not to destroy the vegetation on the dune.

MATERIALS

1.47 m long wooden rod (5 cm x 5 cm)
washer
20 cm of string
16 m tape measure
thumbtack
approximately 30 cm long 2-3 cm square stick (perfectly smooth and parallel on any two opposite sides)
6-7 cm long screw
2 small eye screws
*drill and bit (bit size slightly smaller than screw's circumference)
*screwdriver
2 stakes (1 m long each)
100 m of string
graph paper
ruler
pencil

3 m wooden curtain rod (approximately 5 cm in diameter)
outdoor paint
meter stick
marker
paint brush

*For use in the classroom preparation only.

VOCABULARY

Stadia rod - graduated rod used in surveying

PROCEDURE

In the classroom:

1. Make sure the top of the 1.47 m rod is perfectly flat and level. Take this rod and press the thumbtack in the side of the rod about 1 cm from the flat and level end. Leave a slight space between the head of the thumbtack and the rod itself.

2. Construct a plumb line device by tying one end of the 20 cm string to the thumbtack and the other end to the washer. Mark the line straight down from the thumbtack to use in determing the vertical position.

3. Using the drill and bit, drill a hole through the 30 cm long stick in the middle, equidistant from both ends.

4. At approximately 3 cm from each end, insert the eye screws into the top of the 20 cm long stick. Make sure the eye screws are inserted into the wood to the same depth.

5. Drill a hole in the center of the top of the measuring rod.

6. Securely attach the 30 cm long stick to the top of the rod using the screw and screwdriver. Make sure that the screw head is flush with the top of the 30 cm long stick. See Figure 9. Make sure the "T" is perpendicular.

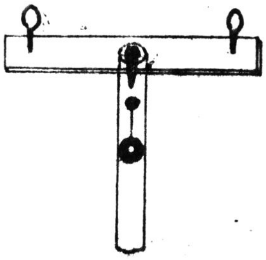


Figure 10. Sighting Rod.

7. Using the meter stick, divide the 3 m rod into 10 cm sections.

8. Paint every other section.

9. Using the marker, mark the rod at 50 cm intervals. Mark a bolder mark (ring) at the 150 cm level. This device is a stadia rod.

PROCEDURE

At the coast: Four students are needed to carry out this procedure; they will be referred to as students M, N, O and P.

1. At about 5 meters from the base of the dune, place a 1 m stake (stake A).

2. At a point on the dune, clearly visible from stake A and in a perpendicular line from the dune's base, place a 1 m stake, (stake B).

3. Attach one end of the string to stake A and run the string to stake B, making sure it is straight. This line will be your reference line along which to work.

For steps 4 - 6, refer to Figure 10.

4. Have M place the "T" sighting rod at stake A and have N sight through the eye screw sights. M should make sure the rod is vertical by watching the washer plumbing device.

5. At the instructions of N, O should place the base of the stadia rod at the point sited by N. This should be along the string (reference line). This point will be designated A(1).

6. Using the tape measure, measure the distance from the top of the "T" rod (at the intersection) to the bottom of O's stadia rod (distance X).

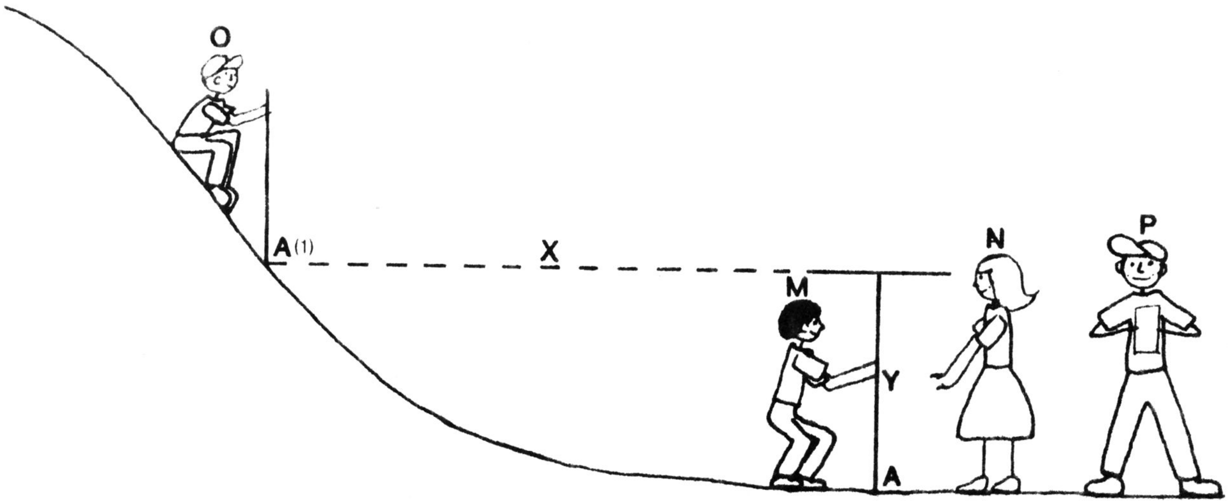


Figure 11. Proper Positioning of Equipment and Students.

7. Have P record the data on a chart. See Figure 11. Designate moving up the dune as positive and down the dune as negative.

Points	Height of sightings Rod(Y)	Horizontal Distance(X)	
A - A(1)	+1.5 m	10. m	
A(1) - A(2)	+1.5 m	10. m	
A(2) - A(3)	+ .5 m	2.5 m	Top of Dune
A(3) - A(4)	-1.5 m	5. m	
A(4) - A(5)	-1.5 m	5. m	
A(5) - A(6)	- .5 m	3. m	

Figure 12. Chart of Hypothetical Data.

8. For the next section, use point A(1) as the sighting location and refer to the new "0 location" point A(2). Follow this procedure until the top of the dune is reached.

9. At the top of the dune, have O vertically place the stadia rod. M should sight through the "eyes" noting the point on the stadia rod that the sight line intersects. Have P record the distance (Y) that this point is from the 150 cm mark on the stadia rod. Using the tape measure, measure the distance from the sighting rod's "T" intersection to the line of sight intersection on the stadia rod. Have P record this distance (X).

10. Before starting down the other side of the dune, move stakes A and B and their connecting string to this side of the dune for a reference line.

11. Instead of sighting the bottom of the stadia rod, sight for the top of the stadia rod recording the distances the same as done in the ascent of the dune.

12. When the bottom of the dune is reached, follow the same directions as given in step number 8.

Graphing the data to obtain the profile:

13. Using the X and Y values, plot the points on a sheet of graph paper. To obtain the profile, connect the points. See Figure 12.

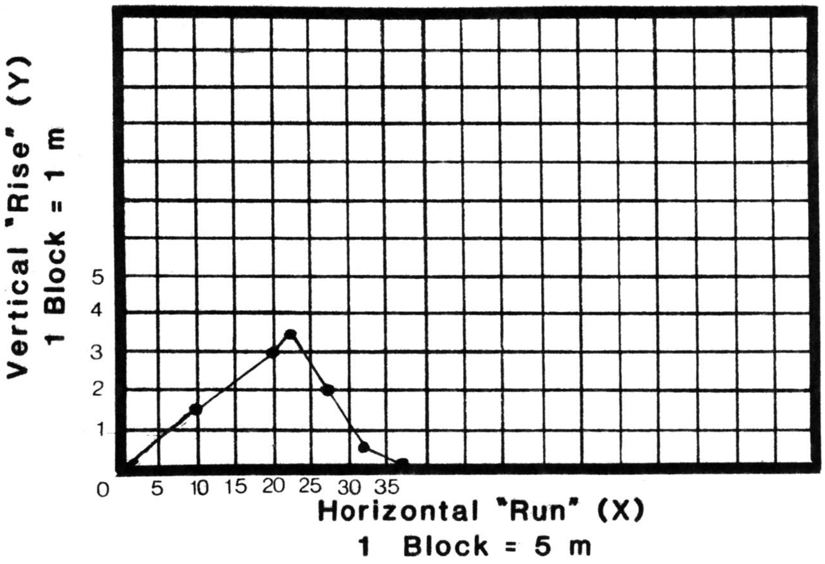


Figure 13. Sample Graph Profile of Hypothetical Data.

Since the rise and run is cumulative, when graphing the data, move from one point to the next. Example: From point A over "10 m", up "1.5 m"; from point A(1) over "10 m", up "1.5 m". . .

SOURCE

Andrews, William A., ed. A Guide to the Study of Terrestrial Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, pp.96-100.

Lesson Number: 10

STRIKE AND DIP

KEY CONCEPT

The strike and dip of a sand dune can be determined.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.
2. The learner will demonstrate the ability to define operationally.
3. The learner will demonstrate skill in the use of instruments.

OBJECTIVES

1. The student will use operational definitions of the terms "dip" and "strike."
2. The student will determine dip and strike.

MATERIALS

compass
clinometer (See Lesson Number 8: SLOPE DETERMINATION)

VOCABULARY

1. dip - the angle of inclination of a dune's face (or rock layer) with respect to the horizontal
2. strike - the compass direction of a line formed where the dune's face (or rock layer) intersects an imaginary horizontal plane

PROCEDURE

1. To determine the dip, simply determine the average slope of the face of the dune that is to be studied. For instructions on how to determine the average slope, see Lesson Number 8: SLOPE DETERMINATION.

2. To determine the strike of a dune, stand on the top of the dune and determine the direction of the alignment of the dune. Sight along the dune with a compass reading with respect to the North. It is a matter of convention to determine the strike in relation to the North. Hold the compass so that the needle points to the North and sight down the long axis of the dune. Read the angle found by the North-South line and the diagonal orientation of the sand dune. For example: if the angle of interaction is 45^{0}, then record the strike as N 45^{0} E. See Figure 13.

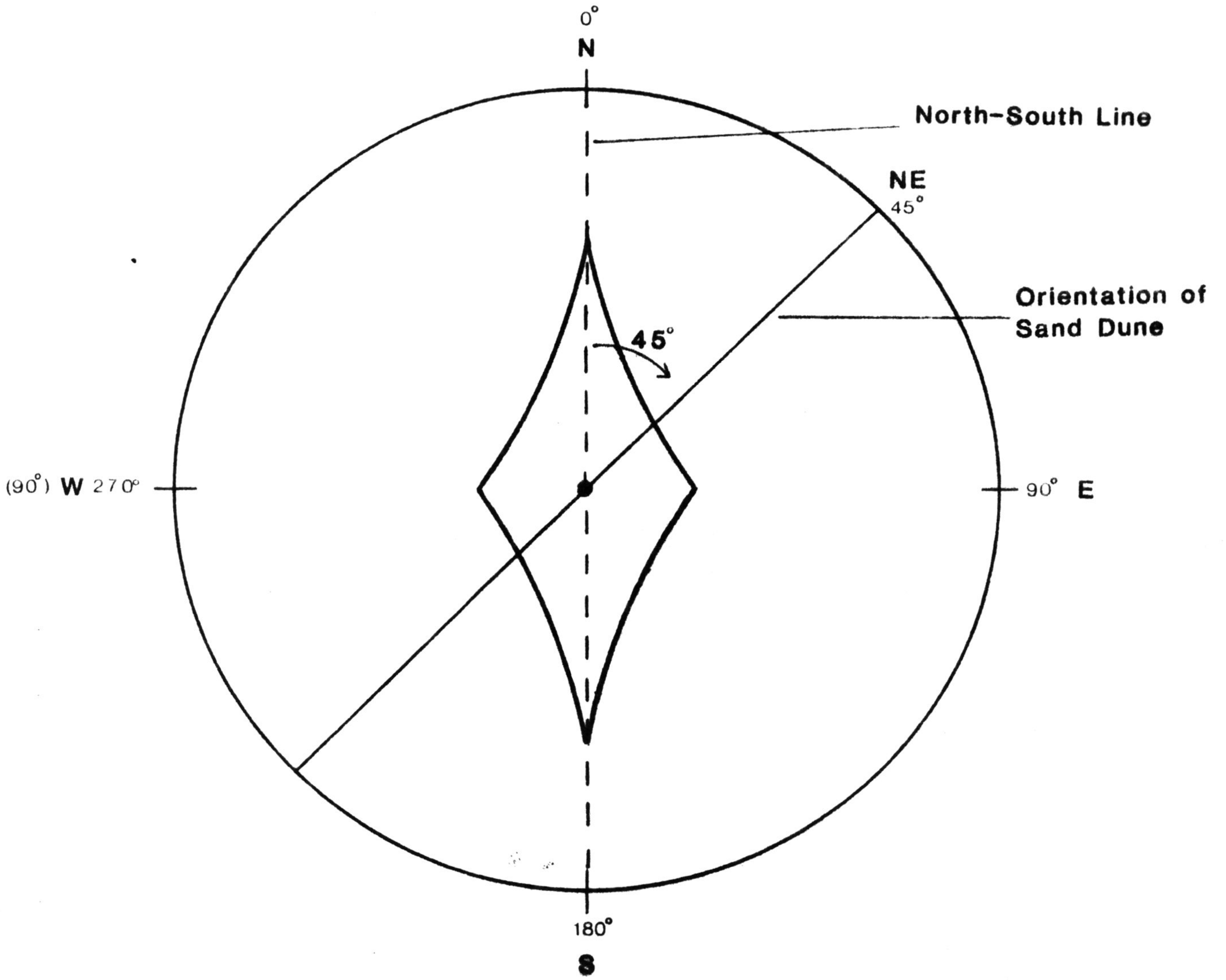


Figure 14. Compass Showing N - S And Dune Orientation

Lesson Number: 11

BEACH SAND GRAIN STUDY

KEY CONCEPTS

1. Beach sands are combinations of particles.
2. The size of the particles at different distances from the ocean varies.
3. In general, the further from the ocean the finer the particles.

COMPETENCY GOALS

1. The learner will demonstrate the ability to observe.
2. The learner will demonstrate the ability to interpret.

OBJECTIVES

1. The student will recognize that beach sands are combinations of particles.
2. The student will recognize that beach grain size generally decreases as distance from the ocean increases.

MATERIALS

hand lens
sand particles from different locations between the water and the dunes (varying distances from the water's edge)
small plastic bags
spoon or trowel (soil sampling tool)
measuring rod (see APPENDIX A: TOOL CHEST) or meter stick

BACKGROUND INFORMATION

Particle size decreases as distance from water increases. This is due to larger particles being deposited first and smaller, lighter particles being carried easier and further by water and wind transport.

PROCEDURE

1. Collect sand samples at different locations using a spoon and place in bags and label. Collect one sample close to the water's edge; the next one, a fourth of the way to the dune; another, half way to the dune; and the last, at the dune's base. Measure and record the distance from the ocean in a field notebook for each sample. See APPENDIX D: THE FIELD NOTEBOOK AND PROPER SAMPLING TECHNIQUES.

2. Using the hand lens, make field observations regarding the size of particles, shape of particles and preliminary identification of particles. Record any observations in the field notebook. *Optional: Take the samples back to school to perform further microscope studies.

   *Optional: Students may enjoy writing to other locations around the United States and to foreign countries for sand samples. A good way to get the samples is to go to a travel agency and obtain the names and addresses of hotels or motels located on the beach in different locations around the world. Usually one will get fairly good responses. Begin this activity at the beginning of a school year since response is often slow.

Lesson Number: 12

STREAM SURFACE VELOCITY

KEY CONCEPTS

1. A stream has a velocity and it can be measured.

2. A Thrupp Apparatus can be used to measure surface velocity.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will demonstrate the ability to use space/time relationships.

3. The learner will demonstrate the ability to use numbers.

OBJECTIVES

1. The student will recognize that a stream has a velocity.

2. The student will calculate the velocity of a stream using the Thrupp method.

THRUPP METHOD

MATERIALS

straight flat bar of wood (30 cm long)
two nails (8 or 10 penny size)
meter stick
hammer
wood glue

BACKGROUND INFORMATION

The Thrupp method is based on a set of ripple patterns formed by a small vertical object held in the surface of a stream. The ripple divergence angle is related to the velocity of the water. By using the Thrupp device (Figure 14.), the formula given in procedure step number 2 and the ripple pattern formed (Figure 15.), the stream's surface velocity can be computed. The formula, as developed by Thrupp, cannot be applied to streams that have a very low velocity or that have a turbulent surface flowage.

PROCEDURE

In the classroom:

1. Make a Thrupp Apparatus. Look at Figure 14.: (A) drive 2 nails through a flat bar approximately 15 cm apart. (B) With wood glue, attach the meter stick to the bar half-way between the nails with the nails pointing upward. The end of the meter stick should be in line with the imaginary line between the two nails. Make sure the bar and the meter stick are perpendicular.

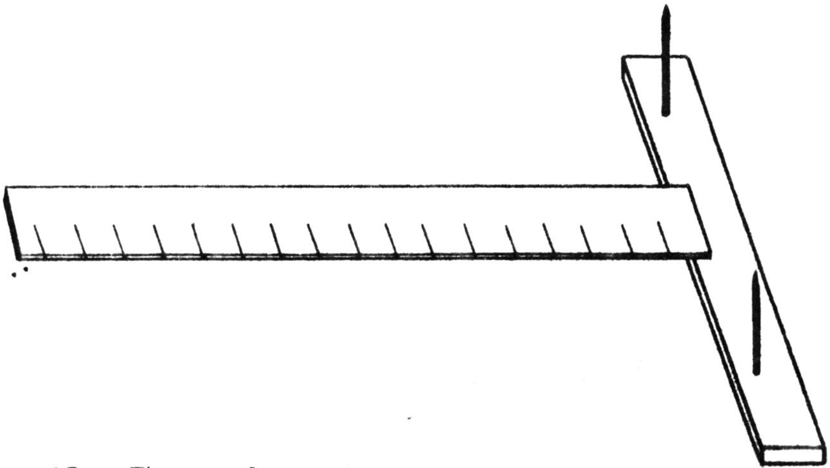


Figure 15. Thrupp Apparatus

At the coast:

1. Place the Thrupp Apparatus in the water with the nail end up-stream. Hold the bar and meter stick parallel to the surface of the water slightly below the surface of the stream. Ripple patterns should be formed as in Figure 15. As the intersection of the patterns (B) moves further down the meter stick, increased velocity is indicated.

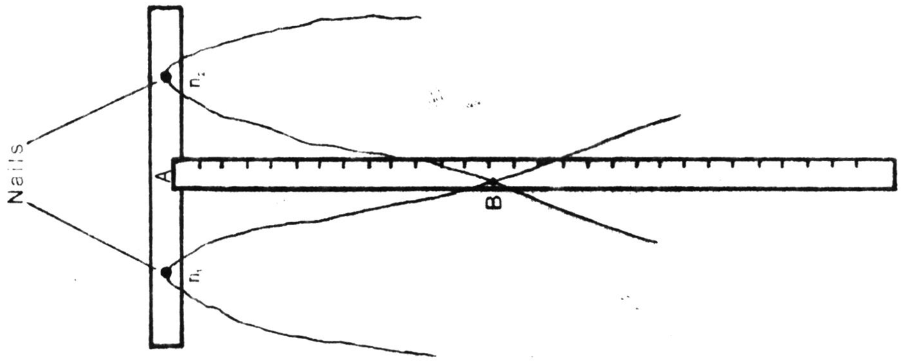


Figure 16. Ripple Pattern Formed by Thrupp Apparatus.

2. Using the formula, Stream Velocity = 0.1466 times the distance AB in centimenters, calculate the stream velocity. The velocity will be measured in meters per second.

FLOAT METHOD

MATERIALS

"float jug" (see APPENDIX A: TOOL CHEST)
string 20 m long or other measuring device
2 stakes (1 meter long each)
timing device (watch with a second hand or stop watch)

PROCEDURE

1. Place one stake in the ground along the edge of the stream.

2. Twenty meters "up or down" the stream, place the second stake.

3. Add sand or dirt to the jug until a level has been reached so the jug floats very low in the water. This can be done by checking the float level after adding the sand or dirt. Adding enough sand to keep the jug fairly low in the water helps reduce the effects of wind on the equipment.

4. Have one student stand behind each stake, sighting directly out over the stream.

5. Toss the float into the stream "up stream" from the staked area.

6. Using the timing device, measure and record the time it takes for the float to travel from one stake sighting to the other.

7. Follow steps (5) and (6) several times and average the results.

8. Using the average time, compute the velocity of the stream by use of the following formula:

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

SOURCES

Andrews, William A., ed. A Guide to the Study of Freshwater Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, pp.101-103.

Welch, Paul S. Limnological Methods. New York: McGraw-Hill Book Company, Inc., 1948. pp.149-151.

STREAM VOLUME OF FLOW
(Knowing Its Velocity)

KEY CONCEPT

A stream's volume of flow can be measured.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.
2. The learner will demonstrate the ability to use space/time relationships.
3. The learner will demonstrate the ability to use numbers.

OBJECTIVES

1. The student will recognize what data are necessary to compute the volume of flow of a stream.
2. The student will compute the volume of the flow of a stream.

MATERIALS

measuring rod (see APPENDIX A: TOOL CHEST)
tape measure or calibrated string

STUDENT PREPARATION

Compute the velocity of the stream using either of the two methods described in Lesson Number 12: STREAM SURFACE VELOCITY. (If necessary, convert the results to m/sec.)

PROCEDURE

1. Measure the width of the stream at representative sites and obtain an average width.
2. Measure the average depth of the stream. Measure the depth at several locations in a cross section of the stream and average the results.

3. Determine whether the floor of the stream is rough (gravel bed) or smooth (sandy, mud or silt bed).

4. Compute the volume of flow using the following formula:

$$r = w\ d\ a\ v$$

Where r = volume of stream flow in cubic meters per second
w = average width of stream in meters
d = average depth of stream in meters
*a = 0.8 if the stream bed is rough <u>OR</u>
*a = 0.9 if the stream bed is smooth
v = velocity of the stream in meters per second

*The two values of "a" are the result of the different amounts of friction created by different stream beds. Smooth stream beds have less friction created than rough stream beds.

SOURCE

Andrews, William A., ed. A Guide to the Study of Freshwater Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, pp.103-104.

MAPPING: USING THE BEARING INTERCEPT METHOD

KEY CONCEPTS

1. Maps can be useful tools in summarizing conditions in a locality.
2. Simple field maps can be constructed.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.
2. The learner will demonstrate the ability to communicate.
3. The learner will demonstrate the ability to formulate models.

OBJECTIVES

1. The student will make a simple field map.
2. The student will recognize that maps are important.

SITE DESCRIPTION

Select a site with several landmarks (trees, shrubs, small hills, etc.).

MATERIALS

two 360° protractors
straight pins
two pinning boards (60 cm square sheets of 0.5" to 0.75" plywood)
two 1.5 m long stakes (2" x 2" sticks sharpened at one end)
hammer and nails
tape measure or measuring rod (see APPENDIX A: TOOL CHEST)
butcher paper
scotch tape
scissors
thumbtacks
ruler
two 60 cm square pieces of cardboard

PROCEDURE

1. Choose two points of reference ("A" and "B") approximately 30 - 50 meters apart. Make sure you have a good view of the area to be mapped.

2. Place a 1.5 m long stake at each point.

3. Measure the distance between the two stakes and record it in your field notebook.

4. Cover one side of each piece of cardboard with butcher paper and tape it down. This can probably best be done in the classroom before the field trip.

5. Nail a pinning board to the top of each stake. The board should be level and nailed in the center.

6. Place a covered piece of cardboard on each pinning board and secure it with thumbtacks.

7. Place a protractor on board "A" and put a pin vertically in the center of the protractor. Do the same on board "B". See Figure 16.

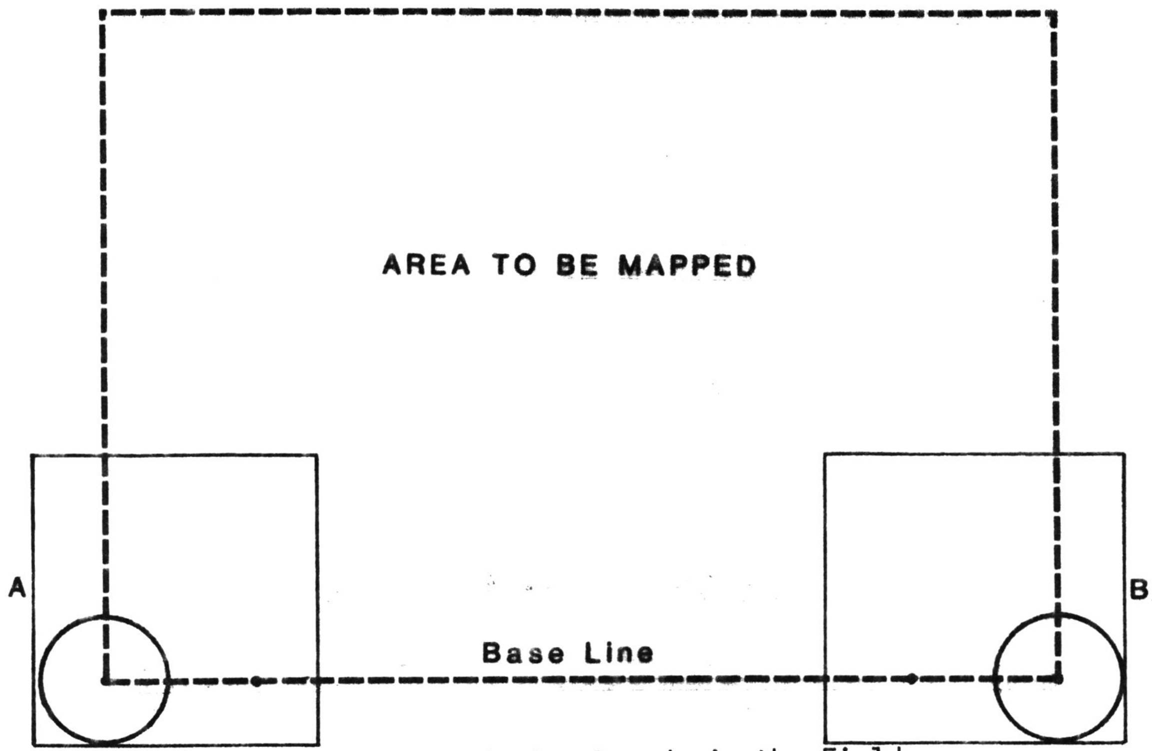


Figure 17. Positioning of Pinning Boards in the Field.

8. Sight along the pin from board "A" by rotating the protractor until the 0^{o} mark is in line with stake "B". Tack the protractor down so it cannot rotate.

9. Sight from board "B" by rotating the protractor until the 180^{o} mark is in line with stake "A". Tack down the protractor so it cannot rotate.

10. Select objects to map and write down a bearing and description for each observation in your field notebook. Sight along the central pin and place a pin approximately 10 cm from the center of the protractor on the appropriate bearing. Do this on each board and record the sighting point ("A" or "B"), the angle, and the observation object in your field notebook. Do not sight objects that are more than 90^{o} on board "A" or less than 90^{o} on board "B".

11. Draw a base line on your map corresponding to your actual base line "A" - "B". Select a scale appropriate to your paper.

12. With a ruler, draw straight lines from the center of the protractor through each sighting pin.

13. Follow procedure steps **9 - 12** for board "B".

14. Remove cardboards and tape the coardboards together (base line to base line). Tape them onto the edge of a piece of butcher paper. The point where the lines for the same object cross represent the location of that object on the map. Label each intersection using the data recorded in the field notebook in procedure step number 9. See Figure 17.

BOARD "A"	BOARD "B"
23° -Small Sand Mound (M)	90° -Small Sand Mound (M)
40° -Short Squatty Shrub (S)	120° -Short Squatty Shrub (S)
56° -Old Post (P)	150° -Old Post (P)

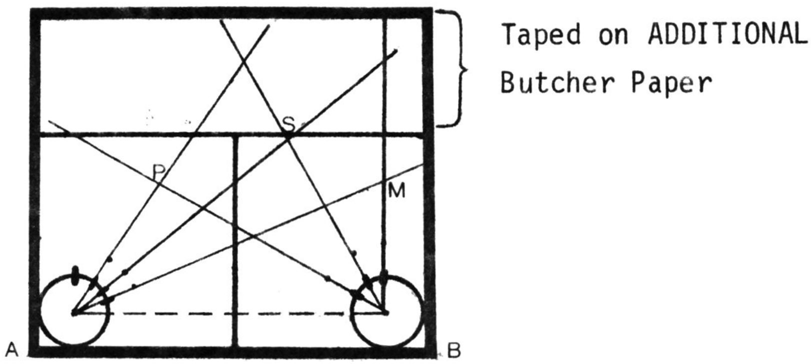


Figure 18. Sample Data and Arrangement of Pinning boards.

SOURCES

Andrews, William A., ed. A Guide to the Study of Terrestrial Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, pp.104-106.

Godfrey, Paul J., and Will Hon. Dune Detective. Beaufort, North Carolina: Regional Marine Science Project of the Carteret County Public Schools, [n.d.], pp.22-24.

Lesson Number: 15

SALINITY

KEY CONCEPTS

1. Salinity of water varies from place to place in the coastal ecosystem.

2. Salinity affects the density of a liquid, thus affecting the buoyancy of the liquid.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will develop skill in constructing simple equipment.

3. The learner will demonstrate the ability to infer.

4. The learner will demonstrate the ability to control variables.

OBJECTIVES

1. The student will make and use a simple salinity measurement device.

2. The student will determine that different locations in the coastal environment differ in salinity.

MATERIALS

salt
water
one 15 cm to 20 cm long candle (approximately 2 cm to 2.5 cm in diameter)
thin conduit nut that will fit on the base of the candle
fine point permanent ink marker
500 ml graduated cylinder
thermometer
source of heat (hot plate or hot water from the faucet)
source of cooling (refrigerator or ice)

BACKGROUND INFORMATION

Salinity and temperature affect the density of water. The higher the salinity, the denser the water. The lower the temperature, the denser the water (down to approximately the freezing point).

The average salinity of sea water is approximately 3.2 percent. Other locations in the coastal environment should have lower salinities.

TEACHER PREPARATION

Try to find out the ocean water temperature for the area at the time you will be at the beach. Local weather stations, TV stations, newspaper fishing sections or writing to the Chamber of Commerce will usually yield this information.

PROCEDURE

SALINITY MEASUREMENT INSTRUMENT

1. Attach a nut to the bottom of a candle by screwing it on or melting the candle.

2. Using a graduated cylinder of fresh water, test the candle to see if it will float (nut is not too heavy). The candle should float upright with the water line somewhere between .25 and .75 of the candle length. See Figure 18.

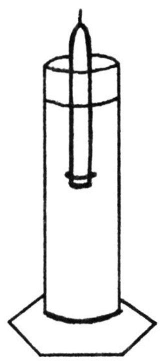


Figure 19. Cylinder with Candle Floating Correctly.

3. Using fresh water at a temperature approximately equal to the expected ocean water temperature, fill the graduated cylinder to the 500 ml level. Mark the candle's water level with a marking pen and label it "0" since it contains zero parts salt.

4. Using water at the same temperature as step number 3, mix a saline solution of 5 ml salt and 495 ml water in the graduated cylinder. Make sure the salt is dissolved in the water. Place the candle into the cylinder. Mark the floating level on the candle and label it 1 for 1 percent salt (5 is 1 percent of 500).

5. Follow the same directions as in step number 4 except make a saline solution of 10 ml salt and 490 ml water. Label this candle level 2 for 2 percent salt.

6. Follow the same directions as in step number 4 except make a saline solution of 15 ml salt and 485 ml water. Label this level 3 for 3 percent salt.

Now you have a simple device to measure salinity at a designated temperature.

PROCEDURE

At the coast:

1. Collect water samples from the ocean, different locations in the water table along the beach (by digging down to the water table), the marsh, the estuary and the different water areas in the maritime forest (if available).

2. Measure the temperature of the sample. Measure the salinity of the liquid using the candle. To obtain a close temperature match, place the water samples in the sun (to warm) or ice bath (to cool).

3. If one is keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record the data in the appropriate spaces.

Lesson Number: 16

WATER HARDNESS

KEY CONCEPTS

1. The relative hardness of water can be determined.
2. Different sources of water have different water hardnesses.

COMPETENCY GOALS

1. The learner will demonstrate the ability to experiment.
2. The learner will demonstrate the ability to interpret data.

OBJECTIVES

1. The student will determine the relative hardness of water samples.
2. The student will conclude that different types of water have different water hardnesses.

MATERIALS

distilled water, ocean water, water from the groundwater table (dig down on the beach), water from the estuary and water from a maritime forest source
liquid dishwashing soap
eye dropper
five containers with lids
funnel
five filter papers (one for each sample)
graduated cylinder

VOCABULARY

1. hardness - total amount of dissolved minerals found in a water sample
2. distilled water - water with all the mineral matter removed.

BACKGROUND INFORMATION

The harder a water sample, the more minerals dissolved in the sample. The softer a water sample, the less minerals dissolved in the sample. When comparing equal amounts of water, the softer sample will produce more suds.

PROCEDURE

1. Filter each water sample to remove any nondissolved materials.
2. Put 500 ml of water from each location in a container. Label each container appropriately.
3. Using the water samples listed in the materials list, perform the following steps:
   a. Add one drop of the liquid dishwashing soap to the sample.
   b. Shake the sample.
   c. Keep repeating step a and b until bubbles (a good lather) remain on the water sample's surface.
   d. Record the number of drops required for each sample and draw conclusions based on your data.
   e. If one is keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record the conclusions in the appropriate spaces.

SOURCE

Namowitz, Samual N., and Donald B. Stone. Earth Science, The World We Live In. New York: American Book Company, 1969.

Lesson Number: 17

SOIL TEMPERATURE

KEY CONCEPT

Different locations in the coastal ecosystem have varying soil temperatures.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will demonstrate skill in the use of instruments.

OBJECTIVE

The student will recognize that soil temperature varies from place to place in the coastal ecosystem.

MATERIALS

soil thermometer
pencil or small stick

PROCEDURE

1. Using a pencil or small stick, make a hole and insert the thermometer into the soil at different points in the coastal ecosystem (open beach area, dune area, interior island, marsh area and a maritime forest area). To get comparative results, temperatures should be taken as near the same time of day and soil depth as possible.

2. If one is keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record these data in the appropriate spaces.

Lesson Number: 18

SURFACE SOIL PERCOLATION

KEY CONCEPTS

1. Different locations in the coastal ecosystem have different percolation rates.

2. Rates of percolation can be compared.

COMPETENCY GOALS

1. The learner will demonstrate the ability to experiment.

2. The learner will demonstrate the ability to infer.

3. The learner will demonstrate the ability to measure.

OBJECTIVES

1. The student will conclude that different locations in the coastal ecosystem have different percolation rates.

2. The student will recognize that rates of percolation can be compared.

MATERIALS

three tin cans of the same size with both ends removed
water
timing device with second hand

VOCABULARY

percolation - to pass or seep into a substance (example: water percolating into the ground)

PROCEDURE

1. At five locations (open beach, dune area, interior island area, marsh area and a maritime forest area), push three cans into the soil about 3 cm deep approximately a meter apart.

2. Pour a measured amount of water into each can (use the same amount of water in each can at each location).

3. Measure the length of time it takes for all the water to be absorbed into the soil. Record the time for each can and average the results for each site.

4. If you are keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record these data in the appropriate spaces.

SOURCE

Andrews, William A., ed. A Guide to the Study of Soil Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, pp.105-106.

Lesson Number: 19

SOIL SAMPLING

KEY CONCEPTS

1. Soil is deposited in layers.

2. Soil samples from different locations have different characteristics.

COMPETENCY GOALS

1. The learner will demonstrate the ability to interpret data.

2. The learner will demonstrate the ability to infer.

OBJECTIVES

1. The student will obtain a soil sample by using a corer.

2. The student will recognize that soil is deposited in layers and can be seen in a core or by digging a hole.

3. The student will determine that different localities have different soil horizons.

MATERIALS

shovel
1 - 1½ meter section of plastic 2" (5.08 cm) diameter ABS pipe
hacksaw (classroom use only)
hand lens
meter stick
hammer or driving device
old piece of cloth (large enough to make a fist size wad)
1.75 meter long stick or metal rod smaller in diameter than 2" (5.08 cm)
newspaper

BACKGROUND INFORMATION

The particles in each layer can be described. Such characteristics as color (light, medium, dark), texture (coarse, medium, fine), composition (mineral type, if recognizable), grain size, particle shape (irregular, round, angular, flaky, etc.), fossil composition (broken shells, bone fragments, etc.) and the presence of organic particles may be used in describing the layers.

CORING METHOD

PROCEDURE

In the classroom:

1. Construct a coring device using the ABS pipe and a hacksaw. Cut the bottom of the pipe at a slant. This makes the driving of the "corer" into the soil easier.

At the beach:

1. Drive the corer into the "soil" at different localities (open beach area, dune area, interior island area, marsh area and a maritime forest area).

2. To remove the corer, wiggle the corer to loosen it from its surrounding soil and pull it up. If it is a soft soil, have one student place a hand over the top hole of the corer to create a vacuum. The soil sample may be removed and logged on the beach or returned in the corer to the classroom for study. (For classroom study, of course, you will need five corers). To remove the soil sample from the corer, place the cloth wad in the top end of the corer and use the stick or metal rod to force the cored material out onto a newspaper. (In very dry soils, the hammer may have to be used to drive the sample out of the corer.)

3. Log the core by measuring each horizon and describing the sediment characteristics of each horizon. This can be done by using the meter stick and hand lens. Record the data carefully.

DIGGING METHOD

PROCEDURE

1. Using a digging tool (shovel), dig a hole at each location producing a wall as close to vertical as possible.

2. Using the meter stick and hand lens, measure and describe each horizon.

3. If samples are to be taken, see APPENDIX D for instructions.

Lesson Number: 20

SOIL HUMUS ANALYSIS

KEY CONCEPTS

1. Soil from different parts of the coastal ecosystem varies in its amount of humus.

2. The relative amounts of humus can be determined for the different locations.

COMPETENCY GOALS

1. The learner will demonstrate the ability to infer.

2. The learner will demonstrate the ability to experiment.

OBJECTIVES

1. The student will determine that different parts of the coastal ecosystem vary in the amount of humus.

2. The student will recognize that relative humus amounts can be measured and compared.

MATERIALS

five 14 dram (25 gram) plastic vials
one digging tool (spoon, stick or trowel)
bucket of fresh water
one small jar of alum (available at most drug stores)
marking pen
ruler
soil from different locations in the coastal ecosystem
teaspoon

VOCABULARY

humus - the rich, usually dark, organic material in the soil

PROCEDURE

1. Mark a point on each vial 1/4 from the bottom.

2. Fill each vial to that level with soil from various coastal ecological locations: beach zone, dune zone, interior portion of island, marsh area and maritime forest area. Collect soil samples from the same depth at each location (top 5 cm).

3. Number each vial and record each one's location.

4. Add one teaspoon of alum to each vial.

5. Complete filling the vials with fresh water.

6. Cover the vial and shake it vigorously.

7. Allow the vial to settle at least one munute.

8. Measure and record the top floating layer in each vial. The thickness of this layer should indicate the amount of humus in the sample (the thicker the layer, the more humus indicated).

9. If one is keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record these data in the appropriate spaces.

SOURCE

Laetsch, Watson M., director. Outdoor Biology Instructional Strategies. Set IV. Berkley, California: University of California, 1975.

HYDROGEN PEROXIDE METHOD

BACKGROUND INFORMATION

A soil that is rich in humus is usually colored dark due to the carbon content. Hydrogen peroxide oxidizes compounds and produces carbon dioxide.

MATERIALS

ten beakers (250 ml) or ten half pint or pint jars
soil samples from different locations in the coastal ecosystem
6% hydrogen peroxide
fresh water

PROCEDURE

1. Label each jar (2 for each site). Site 1-A, Site 1-B, Site 2-A, Site 2-B, etc. The different sites will be from different locations in the coastal ecosystem: 1. open beach, 2. dune area, 3. interior portion of barrier island, 4. marsh area, and 5. maritime forest area.

2. Place approximately equal amounts of soil samples in the jars (half full).

3. To samples 1A, 2A, 3A, 4A and 5A add enough water to cover the soil.

4. To samples 1B, 2B, 3B, 4B and 5B add enough 6% hydrogen peroxide to cover the soil.

5. Allow jars to set until bubbling has ceased.

6. Add water to samples 1B, 2B, 3B, 4B and 5B until they are approximately three fourths full. Allow time for the liquid to clear.

7. Compare the beakers.

SOURCE

Andrews, William A., ed. A Guide to the Study of Soil Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. [illegible] pp. 1[illegible]-113.

Lesson Number: 21

OBSERVATIONAL SOIL ANALYSIS

KEY CONCEPTS

1. Soil is a combination of particles of different sizes that have different settling rates.

2. Different locations in the coastal environment have different compositions.

COMPETENCY GOALS

1. The learner will demonstrate the ability to observe.

2. The learner will demonstrate the ability to infer.

OBJECTIVES

1. The student will recognize that soil is a combination of particles.

2. The student will deduce that different particles have different settling rates.

3. The student will recognize that different locations in the coastal environment have different soil compositions.

MATERIALS

five jars (quart or liter size) with lids
spoon, trowel or other soil digging device
soil from different coastal environment locations
fresh-water
index cards (8" x 5")

BACKGROUND INFORMATION

Soil is made up of a mixture of particles. When this mixture is put into a container, mixed with water and shaken vigorously, the particles tend to settle out in layers. The particles in each layer can be described. Such characteristics as color (light, medium, dark), texture (coarse, medium, fine), composition (mineral type if recognizable), grain size, particle shape (irregular, round, angular, flaky, etc.), fossil composition (broken shells, bone fragments, etc.) and the presence of particles may be used in describing the layers.

PROCEDURE

1. Collect samples from the top 10 cm of soil from five locations in the coastal environment (open beach area, dune area, interior island area, marsh area and maritime forest area)

2. Pour soil in the jar until it is half full. Label each jar according to the location from which it was taken.

3. Fill each jar about two-thirds full with water.

4. Shake the mixture vigorously.

5. Allow the mixture to settle out.

6. Hold an index card along side of each jar and log the contents of each jar, showing the thickness and type of particles in each layer. Label each index card.

7. Comparing soil samples of equal size, the layers can give the percent composition of each type of particle. Example: If the total sample is 12 cm thick and the clay layer is 4 cm, then the percent composition of clay is 33 percent.

REFERENCE

Hampton, Carolyn H. ed. Exploring Your Environment. Greenville, North Carolina: Department of Science Education - East Carolina University, 1976, pp.85-87.

LIGHT INTENSITY

KEY CONCEPTS

1. Light intensity varies from site to site within a coastal ecosystem.

2. Light intensities of areas can be compared.

COMPETENCY GOALS

1. The learner will demonstrate the ability to infer.

2. The learner will demonstrate the ability to communicate.

3. The learner will demonstrate skill in the use of instruments.

OBJECTIVES

1. The student will compare the light intensities of different areas.

2. The student will recognize that different localities in the coastal environment receive different amounts of light.

OZALID PAPER METHOD

MATERIALS

package of Ozalid paper*
small jar of household ammonia
40 cm square piece of cardboard
pins
timing device (stop watch or watch)
gravel
plastic wide-mouth gallon jar with a lid (jar painted black)
heavy black construction paper (approximately 8" x 11")
tape
large paper clips

*NOTE: Ozalid paper (or blueprinter's paper) may be obtained at most architectural supply firms.

PROCEDURE

In the classroom:

1. Fold the construction paper in half (across the width). Fold the 2 opposite unattached double edges over (about 2 cm from the edge). Tape these edges down. This envelop is a light proof package. See Figure 19.

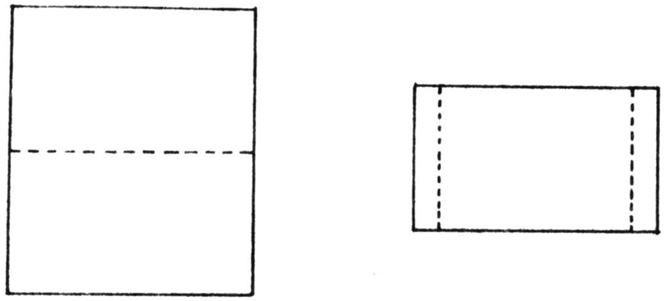


Figure. 20. Light Proof Package.

2. Cut one standard sheet of Ozalid paper into 40 pieces (2 cm x 5 cm). Number each piece in the upper left hand corner (1-40). Cut the paper in a darkened room with just enough light to distinguish the two sides of the paper.

3. Place pieces 1-8 (yellow side up) in a stack, use a paper clip to hold them together and place the stack in the light proof envelop. Do the same for pieces 9-16, 17-24, 25-32 and 33-40.

4. Pour ammonia into the gallon jar to a depth of approximately 1 cm. Add gravel to the jar to depth of approximately 10 cm and shake easily.

At the beach:

1. For five locations (open beach, dune area, interior island area, marsh area and maritime forest area), place one of the eight stacks of Ozalid paper on the ground with the yellow side facing upward. Expose the stack for 20 minutes on a sunny day or 30 minutes on a cloudy day. Record the time exposure began and ended, the numbers of the stack and the location of the exposure in your field notebook. To obtain accurate comparative results, standardize the procedures used (equal exposure time, equal hour of the day, etc.).

2. At the end of 20 minutes, remove the paper clip and place the pieces of Ozalid paper into the plastic ammonia gravel jar and let them develop.

3. Pin the Ozalid strips in numbered sequence on the cardboard.

4. Compare the paper clip design on each piece of Ozalid paper. The further down into the stack the design appears, the higher the light intensity.

5. If one is keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record the results in the appropriate spaces.

*To make a poster showing the different light intensities, just indicate on the cardboard the location where each stack of Ozalid strips was exposed.

SOURCE

Laetsch, Watson M., director. Outdoor Biology Instructional Strategies. Set I. Berkley, California: University of California, 1975.

PHOTO CELL METHOD

MATERIALS

Volt-Ohm meter (VOM)
solar cell
block of wood or some medium on which to mount cell
glue
wire connectors

PROCEDURE

1. Cement the photo cell to the block of wood.

2. Attach the leads of the VOM to the leads of the photo cell.

3. Place cell in direct sun and set the VOM so that the VOM needle indicates slightly less than the maximum capacity of the VOM.

4. Determine the readings at the following sites: open beach area, dune area, interior island area, marsh area and maritime forest area.

5. Record the readings in the field notebook. Don't forget to describe each site.

6. If keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record the relative data in the appropriate blocks.

Lesson Number: 23

RELATIVE EVAPORATION

KEY CONCEPTS

1. Evaporation rates of different areas can be compared.

2. Different sites in the coastal environment may have different evaporation rates.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will demonstrate the ability to infer.

3. The learner will demonstrate skill in constructing simple equipment.

4. The learner will demonstrate skill in the use of instruments.

OBJECTIVES

1. The student will use a simple field evaporimeter.

2. The student will recognize that evaporation rates may vary from place to place in the coastal ecosystem.

MATERIALS

distilled water
small test tube (13mm x 100mm)
marking pen
masking tape
5.5 cm circular filter paper (size can vary)
dowel (rod)
clamp
pipet
paper clip
water
timing device (watch)

PROCEDURE

In the classroom:

1. Place a piece of masking tape (lengthwise) on the side of the test tube (approximately 1 cm wide). See Figure 20.

Figure 21. Test Tube with Proper Masking Tape Position.

2. Using a pipet and water, calibrate the test tube (on the tape) into 0.5 and 1.0 ml intervals (use short lines for 0.5 ml points and longer lines for 1.0 ml points).

3. Attach a bent paper clip to the top of the test tube to act as a clamp. See Figure 21.

   Paper clip should be bent in this fashion: 

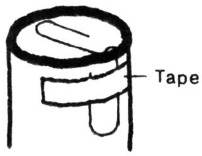


Figure 22. Bent Paper Clip and Proper Position on the Test Tube.

Make sure the part of the paper clip over the test tube end exerts pressure on the lip of the test tube.

At the coast:

1. At each of the following sites, open beach, dune area, interior island, marsh area and maritime forest area, place a dowel in the ground.

2. Attach the clamp to the rod at a certain height from the ground (use the same height at all locations).

3. Fill the test tube with distilled water.

4. Place the filter paper under the paper clip. See Figure 22.

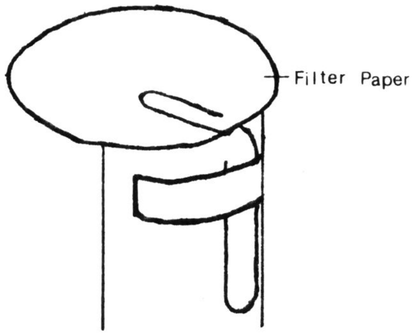


Figure 23. Proper Position of Filter Paper.

5. Invert the test tube and fasten it in the clamp. Record the time in the field notebook.

6. At some point in time, maybe an hour later, return to the site and record the time and amount of water evaporated.

7. If keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, fill in the appropriate information.

Lesson Number: 24

WIND SPEED AND DIRECTION

KEY CONCEPTS

1. Wind speed and direction can be measured using homemade apparatuses.

2. Wind speed can vary from place to place in the coastal environment.

COMPETENCY GOALS

1. The learner will demonstrate the ability to use numbers.

2. The learner will demonstrate the ability to use space/time relationships.

3. The learner will demonstrate skill in the use of instruments.

4. The learner will develop skill in constructing simple equipment.

OBJECTIVES

1. The student will learn how to make an anemometer and a wind vane.

2. The student will use the anemometer and wind vane to compute the speed and direction of the wind.

3. The student will recognize that different areas of the coastal ecosystem can have different wind speeds.

MATERIALS

magnetic compass
2 (16 penny) nails
2 approximately 15 cm x 15 cm x 2.5 cm blocks of wood
2 plastic drinking straws
piece of heavy duty aluminum foil (15 cm x 2 cm)
scotch tape
4 3"x5" index cards
pair of scissors
marking pen (classroom use)
time measuring device (watch with second hand or stop watch)
piece of cardboard (10 cm square)
hammer (classroom use)
2 small washers

VOCABULARY

anemometer - a device to measure the speed of the wind

wind vane - a device to determine the direction of the wind

PROCEDURE

In the classroom:

ANEMOMETER CONSTRUCTION

1. Using the 3"x 5" index cards, make four cones. See Figure 23.

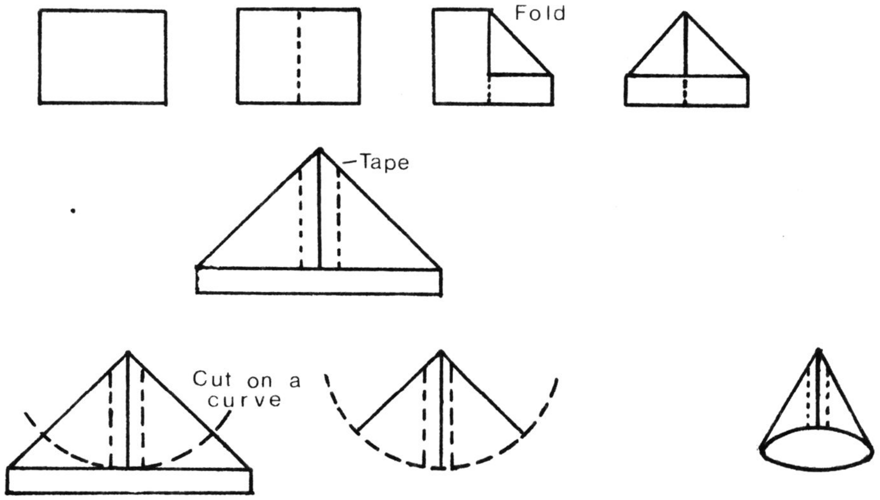


Figure 24. Cone Construction.

2. Cut a straw to a length of 10 cm.

3. Make a cone holder using the 10 cm cardboard square. Draw two diagonal lines (corner to corner). At the point of intersection of the two diagonals, punch a hole large enough to insert the straw for a snug fit.

4. Cut four 1-2 cm slots in the 10 cm square cardboard. See Figure 24.

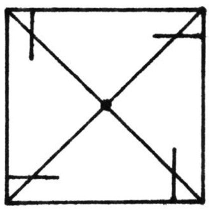


Figure 25. Cone Holder

5. Making sure each cone is facing the same direction, slide the cones into the slots. Put a mark for reference on one of the cones.

6. With the hammer, drive the nail through the center of the wooden block. Place the washer and straw-cone assembly on the nail.

WIND VANE CONSTRUCTION

1. Cut a drinking straw to a length of 10 cm.

2. Bend the 15 cm x 2 cm piece of foil around the straw. See Figure 25.

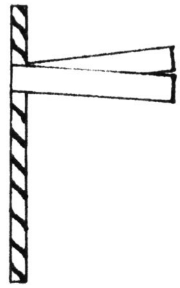


Figure 26. Straw and Foil Assembly.

3. Fold the aluminum foil tightly together and tape them close to the straw. Tape the back portion of the foil on the straw to keep it from sliding up and down.

4. With the hammer, drive the nail through the wooden block. Place a washer and the straw assembly onto the nail. Spread the two pieces of aluminum foil slightly.

PROCEDURE

At the coast:

WIND SPEED DETERMINATION

1. Determine the wind speed in revolutions per minute (rpm) at the following sites: open beach, dune top, interior island area, marsh area and maritime forest area. This can be done by counting the number of complete revolutions (turns) made by the anemometer in one minute.

2. If keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record the data in the appropriate areas.

WIND DIRECTION DETERMINATION

1. Determine the wind direction at the following sites: open beach, dune top, interior island area, marsh area and maritime forest area. This can be done by using a compass and determining the direction the nail end of the aluminum foil is pointing. Since winds are named for the direction from which they blow, this is the direction needed.

ALTERNATE WIND DIRECTION DETERMINATION TECHNIQUE

1. Lick a finger on one side, hold it up in the air and rotate it until it feels cool. The moist side of the finger will then give you the wind direction because when the moist part of your finger is facing the direction of the wind, evaporation increases and thus creates a cooling effect. Use your compass then to determine the actual compass direction of the wind.

SOURCE

Laetsch, Watson, M., director. Outdoor Biology Instructional Strategies. Set I. Berkley, California: University of California, 1975.

Lesson Number: 25

AIR TEMPERATURE

KEY CONCEPT

Air temperatures in the coastal ecosystem can vary from place to place.

COMPETENCY GOALS

1. The learner will demonstrate the ability to measure.

2. The learner will develop skill in the use of instruments.

OBJECTIVES

1. The student will measure air temperature with a thermometer.

2. The student will recognize that air temperatures can vary from place to place in the coastal ecosystem.

MATERIALS

thermometer
aluminum foil
cardboard tube (from the inside of a roll of paper towels)
115 cm long stick
masking tape

PROCEDURE

1. Wrap the tube with foil (reflecting side outward).

2. Tape the tube to the top of the stick in a "T" formation.

3. Record the air temperature at different locations in the coastal ecosystem (open beach, dune area, interior island area, marsh area and maritime forest area) by inserting the stick into the ground 15 cm deep and placing the thermometer into the tube. Make sure the bulb portion of the thermometer is in the shaded portion of the tube. Allow the thermometer to stay in the tube for two minutes and record the temperature.

3. If one is keeping a COASTAL ENVIRONMENT TABULATION CHART: APPENDIX B, record these data in the appropriate locations.

APPENDIX A

TOOL CHEST

HOMEMADE LEVEL

MATERIALS

test tube
water
ammonia
cork to fit test tube
tape (black plastic or colored tape works best)
knife
wax candle
matches
If the test tube has a lip, a popsicle stick will be needed.

PROCEDURE

1. Fill the test tube almost full of water and add a drop of ammonia.

2. Cork the tube so that a small bubble remains.

3. Cut off the top of the cork.

4. Let the wax from a burning candle seal the cork and test tube.

5. If the test tube has a flared lip, tape a popsicle stick to the side as shown in the diagram.

6. Place tape "markers" (A and B) 1.5 cm on each side of the center of the water portion of the test tube. See Figure 26.

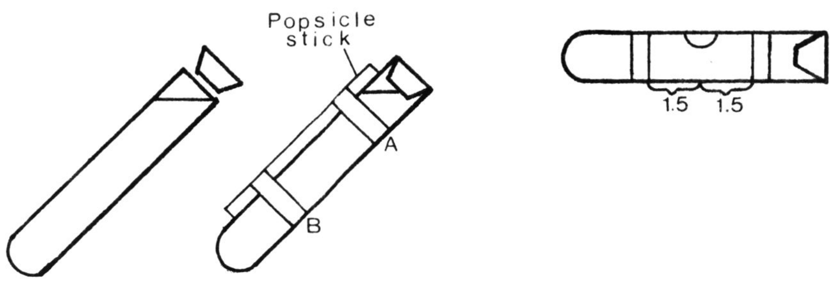


Figure 27. Homemade Level.

SOURCE

Laetsch, Watson M., director. Outdoor Biology Instructional Strategies. Set I. Berkley, California: University of California, 1975.

MEASURING ROD

MATERIALS

2-3 m long stick (a tobacco stick, old broom handle, or 2" x 2" piece of lumber
outdoor paint
paint brush (approximately 2 cm wide)
meter stick
marker (water resistant)

PROCEDURE

1. Divide the rod into sections of 5 cm each.

2. Paint every other interval.

3. Mark a ring with the marker at the meter interval boundary lines. See Figure 27.

Figure 28. Measuring Rod.

SOURCE

Laetsch, Watson M., director. Outdoor Biology Instructional Strategies. Set II. Berkley, California: University of California, 1875.

CURRENT FLOAT JUG

MATERIALS

plastic jug (gallon size milk or clorox jug with lid)
coat hanger
piece of bright cloth for a flag
piece of string
sand (from the beach)

PROCEDURE

See Figure 28.

1. Straighten out coat hanger and attach it to the jug making a loop to fit around the bottom of the jug snugly. This can be done by twisting the wire. Bend the rest of the wire up along the side of the jug.

2. Tie a string from the wire to the jug's handle.

3. Tie a cloth to the top of the wire for the flag.

4. Sand will be added to the jug at the area the float is to be used.

SOURCE

Cultrea, S. Field Investigations for Beach and Marsh. Kittery, Maine: Regional Academic Marine Project, [n.d.], pp.11-12.

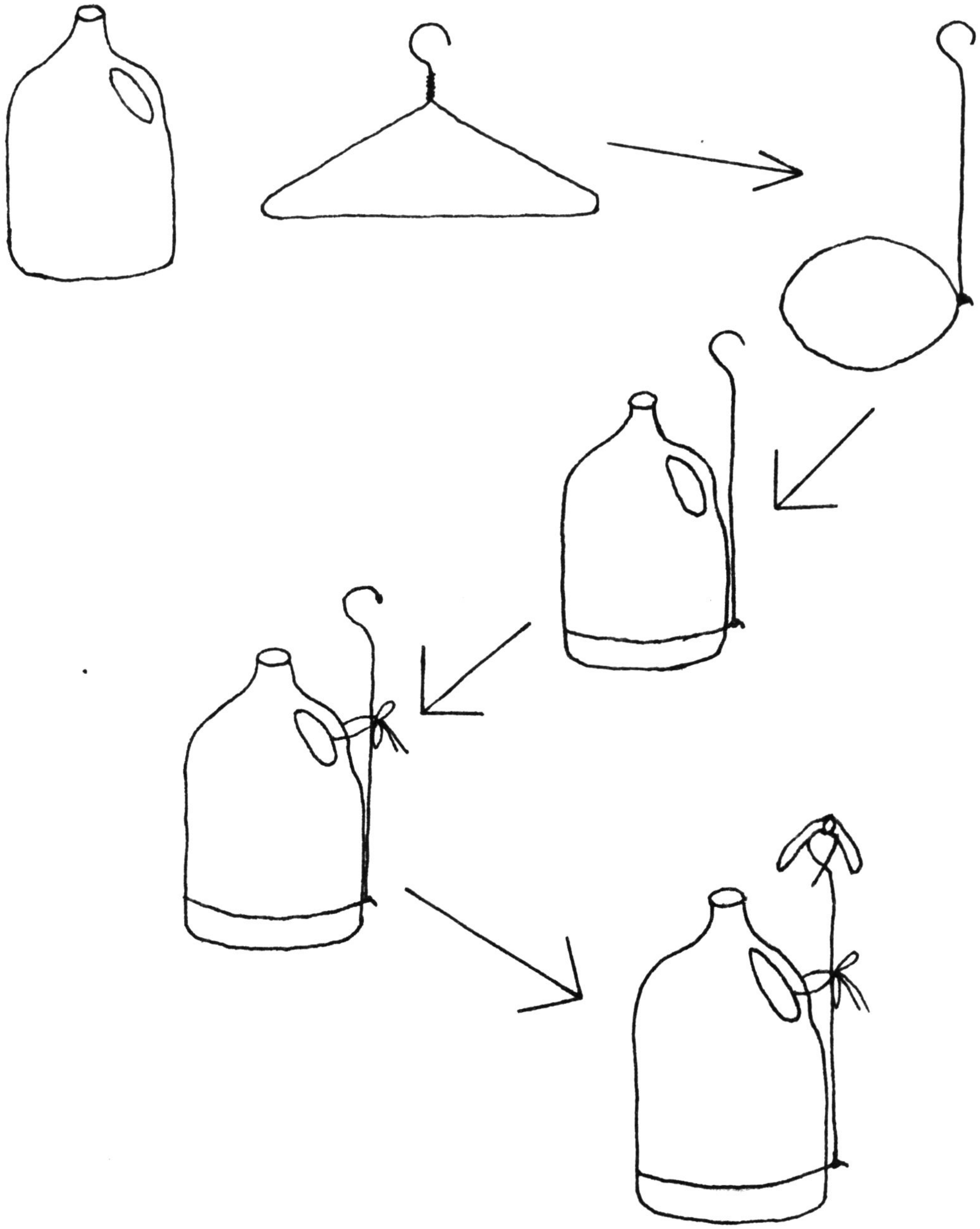


Figure 29. Float Construction.

APPENDIX B

COASTAL ENVIRONMENT
TABULATION CHART

Coastal Environment Tabulation Chart

Student:____________________ Location:____________________ Date:____________________

Environmental Factors	Time of Day	Open Beach	Dune Area	Interior Island	Marsh Area	Maritime Forest	Optional Area
Air Temperature							
Soil Temperature							
Wind Velocity (RPM)							
Wind Direction							
Salinity							
Humus Analysis 1=low levels 2=mod. levels 3=high levels							
Water Hardness 1=hard 2=mod. soft 3=soft							
Percolation Rates (Time Taken)							
Light Intensity 1=low intensity 2=med. intensity 3=high intensity							
Evaporation Rates 1=slow evap. 2=mod. evap. 3=fast evap.							

APPENDIX C

HOW TO READ

A

TIDE TABLE

HOW TO READ A TIDE TABLE

Some lessons should be carried out or started on certain types of tides (high or low). Often it is necessary to know how to read a tide table.

Tide tables can be obtained from boating, fishing and diving shops, coastal city chambers of commerce and some newspapers.

Tide tables give the times of high and low tides. Most tide tables give you these times plus a number for each tide. This number tells one the height of the tide above a reference point called mean low tide. Mean low tide is the average level of low tides. For example, if a tide level is given as 4.3, it will be 4.3 units above this mean low tide reference point. Negative numbers mean the level is below mean low tide. To determine the vertical height of the intertidal zone for any set of high - low tides, subtract the low tide number from the high tide number.

REFERENCE

Laetsch, Watson M., director. Outdoor Biology Instructional Strategies. Set II. Berkley California: University of California, 1975.

APPENDIX D

THE FIELD NOTEBOOK

AND

PROPER SAMPLING TECHNIQUES

THE FIELD NOTEBOOK AND PROPER SAMPLING TECHNIQUES

The Field Notebook is a very valuable tool. Any notebook will do. One with a sturdy back will facilitate writing. The notebook should be kept as neat as possible. It does no good to record data if one cannot read them later. In recording data, make sure that the information is labeled correctly so there will be no doubt as to the interpretation of the data (proper units, etc.). In giving site descriptions, be accurate and specific. With even a short time passage, it may be difficult to remember one area from another. A characterization of an area with accurate data in a Field Notebook makes an excellent permanent record.

In taking field samples, first of all, a good site description should be recorded in the Field Notebook. Secondly, the sample should be bagged and labeled to match a corresponding number in the notebook. When samples are returned to the classroom, it is important to know the exact location from which the sample or specimen was taken. Plastic bags and markers make excellent "collectors" and "labelers". Do not contaminate the samples. For example, in collecting soil samples, make sure the trowel is cleaned before the next sample is taken.

APPENDIX E

PROTECTION OF THE ENVIRONMENT

PROTECTION OF THE ENVIRONMENT

Students running at will over the beach, dunes, etc. can do considerable damage to both plant and animal life and disrupt dune stabilization. Students need to be impressed with the idea that the "beach area" should look as neat or even neater when they leave as it did before they arrived.

Some lessons in this field guide involve digging and walking on dunes. Stress to the students that it is important to avoid walking on vegetation or "homes" of beach animals. Also, make sure all holes that have been dug are refilled.

Remember, there is a great lesson in just learning to appreciate and to preserve an environment.

APPENDIX F

UNIT TESTS

COASTAL STUDIES TEST

Multiple choice - Select the BEST answer. Do not write on this test. Write the letter of the correct answer beside its number on the answer sheet.

1. Longshore currents travel

    a. toward the shore.
    b. away from the shore.
    c. along the shore.

2. The strike is given in reference to

    a. south.
    b. southeast.
    c. north.
    d. southwest.

3. Five wave crests pass a certain point in 40 seconds. The average wave period is

    a. 40 seconds.
    b. 5 seconds.
    c. 200 seconds.
    d. 8 seconds.

4. A vertical measure of a wave from crest to trough is called wave

    a. period.
    b. height.
    c. frequency.

5. Ten wave troughs pass a stationary post in the ocean taking 2 minutes. The frequency of these waves is

    a. 20 cycles per minute.
    b. 12 cycles per minute.
    c. 5 cycles per minute.

6. The saltiest water in the "coastal system" is located in the

    a. ocean.
    b. water table.
    c. marsh.

7. In approximately one day there are

    a. 2 high tides.
    b. 1 high tide.
    c. 3 high tides.
    d. 4 high tides.

8. On a steeply sloping beach the horizontal advance of water between high and low tide lines is (a. more; b. less) than on a very flat beach.

9. As a general rule, moving away from the beach, there is (a. more; b. less) sand overlying the water table.

10. Large piles of sand on a beach are called

    a. hills.
    b. dunes.
    c. tidal flats.

TRUE-FALSE (Use T for true and F for false.)

11. A profile of a sand dune shows an "outline" of the sand dune.

12. Natural dune stabilization by vegetation has advantages over manmade devices such as sand fences.

13. The side of a sand dune toward the ocean is the leeward side of the sand dune.

14. Slipface and leeward are identical terms.

15. All grains of sand are of the same size and type.

16. Accurate measurement is important in mapping.

17. Ocean water is hard water.

18. Soil temperatures in all parts of the beach are the same.

19. All land areas of the coastal system absorb water at the same rate.

20. One method of learning about the subsurface soil is by coring.

21. Different areas of the coastal system have different soil types and layering.

MATCHING (Write the correct letter beside its number on the answer sheet.)

22. Soil humus	a. Wind speed measurement instrument
23. Anemometer	b. Water transformed to vapor
24. Light intensity	c. Organic materials
25. Evaporation	d. Amount of light available to an area

ANSWER SHEET NAME________________

Write the letter of the correct answer.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

21.

22.

23.

24.

25.

Key to Coastal Studies Test

1. C
2. C
3. D
4. B
5. C
6. A
7. A
8. B
9. A
10. B
11. T
12. T
13. F
14. T
15. F
16. T
17. T
18. F
19. F
20. T
21. T
22. C
23. A
24. D
25. B

NAME:_____________________ DATE:______________ SEX: M F ___________
Circle one

COASTAL STUDIES ATTITUDE SURVEY

Directions: Circle the letter that best describes your feelings toward the subject. "C" is neutral.

MEASURING THE MOVEMENT OF TIDES IS . . .

1.	Unimportant	A	B	C	D	E	Important
2.	Boring	A	B	C	D	E	Interesting
3.	Dull	A	B	C	D	E	Fun

MAPPING A DUNE PROFILE IS . . .

4.	Unimportant	A	B	C	D	E	Important
5.	Boring	A	B	C	D	E	Interesting
6.	Dull	A	B	C	D	E	Fun

LOCATING AND STUDYING THE WATER TABLE IS . . .

7.	Unimportant	A	B	C	D	E	Important
8.	Boring	A	B	C	D	E	Interesting
9.	Dull	A	B	C	D	E	Fun

DETERMINING THE STRIKE AND DIP OF SAND DUNES IS . . .

10.	Unimportant	A	B	C	D	E	Important
11.	Boring	A	B	C	D	E	Interesting
12.	Dull	A	B	C	D	E	Fun

ANALYZING SOIL LAYERS IS . . .

13.	Unimportant	A	B	C	D	E	Important
14.	Boring	A	B	C	D	E	Interesting
15.	Dull	A	B	C	D	E	Fun

MEASURING OCEAN WAVE HEIGHT, FREQUENCY AND PERIOD IS . . .

16.	Unimportant	A	B	C	D	E	Important
17.	Boring	A	B	C	D	E	Interesting
18.	Dull	A	B	C	D	E	Fun

DETERMINING SALINITY AND WATER HARDNESS IS . . .

19.	Unimportant	A	B	C	D	E	Important
20.	Boring	A	B	C	D	E	Interesting
21.	Dull	A	B	C	D	E	Fun

COMPARING SOIL PERCOLATION RATES IS . . .

22.	Unimportant	A	B	C	D	E	Important
23.	Boring	A	B	C	D	E	Interesting
24.	Dull	A	B	C	D	E	Fun

DETERMINING WIND SPEED AND DIRECTION IS . . .

25.	Unimportant	A	B	C	D	E	Important
26.	Boring	A	B	C	D	E	Interesting
27.	.Dull	A	B	C	D	E	Fun

MEASURING LONGSHORE CURRENT SPEED IS . . .

28.	Unimportant	A	B	C	D	E	Important
29.	Boring	A	B	C	D	E	Interesting
30.	Dull	A	B	C	D	E	Fun

DISCOVERING THAT DIFFERENT LOCATIONS OF THE COASTAL ENVIRONMENT HAVE DIFFERENT CHARACTERISTICS IS . . .

31.	Unimportant	A	B	C	D	E	Important
32.	Boring	A	B	C	D	E	Interesting
33.	Dull	A	B	C	D	E	Fun

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APPENDIX B

STUDENT EVALUATION

OF THE FIELD GUIDE

STUDENT EVALUATION FORM

FOR THE FIELD GUIDE

Name:________________________________ Lesson Number:___________

Circle the number that best describes your feelings toward the activity.

A. The activity was . . . . .boring 1 2 3 4 5 interesting.

B. The activity was . . . . . . worthless 1 2 3 4 5 valuable.

C. The activity was . . . . .dull 1 2 3 4 5 fun.

D. The activity was . . . . . . difficult 1 2 3 4 5 easy.

E. The directions were. . . . . . unclear 1 2 3 4 5 clear.

F. I participated . . . . . . very little 1 2 3 4 5 a lot.

G. My understanding of the principle involved was . . . . .little 1 2 3 4 5 great.

H. The activity should be changed. _______yes _______no

If you checked yes, write on the remainder of this card how you think the lesson should be changed.

RESULTS OF STUDENT EVALUATION

LESSON NUMBER	MEANS OF STUDENT RESPONSES TO EVALUATION QUESTIONS A	B	C	D	E	F	G	H YES	NO
1	3.6	3.7	3.8	4.0	4.0	3.3	3.7	8%	92%
2	3.7	3.5	3.6	4.1	4.0	3.7	3.9	3%	97%
3	3.7	3.8	3.5	3.7	4.0	3.6	3.6	7%	93%
4	3.4	3.5	3.6	3.9	3.8	3.6	3.5	3%	97%
5	3.5	3.7	3.5	3.9	3.9	3.0	3.5	18%	82%
6	3.3	3.8	3.6	3.5	3.9	3.5	3.5	22%	78%
7	3.7	3.9	3.8	4.0	4.1	3.5	3.7	6%	94%
8	3.7	3.7	3.6	3.7	3.9	3.2	3.5	8%	92%
9	4.2	3.9	4.1	4.3	4.4	4.2	4.1	4%	96%
10	3.7	3.7	3.6	4.1	4.0	3.7	3.6	17%	83%
11	3.6	3.6	3.7	4.4	4.3	4.0	4.1	3%	97%
12	3.7	4.0	3.8	4.4	4.3	3.9	4.0	7%	93%
13	3.7	4.0	3.8	4.2	4.2	4.0	3.9	7%	93%
14	4.0	4.2	4.0	4.2	4.3	3.7	4.0	4%	96%
15	3.4	3.5	3.4	4.1	3.9	3.7	3.9	4%	96%
16	3.5	3.6	3.6	4.0	4.0	3.8	3.9	0%	100%
17	3.5	3.6	3.4	4.1	4.3	3.6	3.9	3%	97%
18	3.6	3.6	3.5	4.1	4.1	3.5	4.0	0%	100%
19	3.2	3.7	3.2	3.8	3.8	3.4	3.8	4%	96%
20	3.7	3.5	3.5	4.1	4.0	3.5	3.8	0%	100%
21	3.9	3.8	3.8	4.1	4.2	3.9	4.0	0%	100%
22	3.5	3.6	3.5	4.0	4.0	3.6	3.8	10%	90%
23	3.5	3.6	3.8	4.1	4.1	3.7	3.7	0%	100%
24	3.6	3.6	3.6	4.1	4.0	3.9	3.9	0%	100%
25	3.8	3.8	3.9	4.3	4.4	4.3	4.3	0%	100%

APPENDIX C

TEACHER EVALUATION

OF THE FIELD GUIDE

PROJECT CAPE

LESSON RATING SHEET (from Hampton, 1980)

Teacher's name ____________________

Grade level ____________________

School ____________________

Date ____________________

TITLE OF LESSON____________________ Lesson Number ____________

Were supplemental materials used?__________ Please evaluate on Supplemental Materials Evaluation Sheet

Were materials added to this lesson? ______ Please describe on Anecdotal Record

Where errors are noted, please suggest improvements in the margin of the unit pages.

Please circle your rating of the unit on this scale:

NOTE: (1) indicates a high or positive rating, while (5) is low or negative

1. Overall reaction as a learning experience . . . .valuable 1 2 3 4 5 worthless

2. Appropriateness for grade level . . . . .high 1 2 3 4 5 low

3. Teacher preparation required. . . . . .acceptable 1 2 3 4 5 too much

4. Stated lesson concepts. . . . clear 1 2 3 4 5 ambiguous

   Understanding . . . . .reinforced 1 2 3 4 5 not reinforced

5. Stated competencies . . . . . . clear 1 2 3 4 5 ambiguous

   Mastery . . . . high 1 2 3 4 5 low

6. Stated objectives . . . . clear 1 2 3 4 5 ambiguous

   Performances. . . . . . . .achieved 1 2 3 4 5 not achieved

11. Teacher background information. .adequate 1 2 3 4 5 inadequate

12. Probability you would use materials again

    Some . . . . .high 1 2 3 4 5 low

    All. . . . . .high 1 2 3 4 5 low

13. Student interest. . . . higher than usual 1 2 3 4 5 lower than usual

14. Teacher interest. . . . higher than usual 1 2 3 4 5 lower than usual

15. Student involvement . . higher than usual 1 2 3 4 5 lower than usual

16. Did the material assist you in:

    individualizing? . . . . . . greatly 1 2 3 4 5 very little

    small group work?. . . . . . greatly 1 2 3 4 5 very little

    large group work? . . . . . greatly 1 2 3 4 5 very little

COMMENTS: ____

APPENDIX D

REVIEWER EVALUATION

OF THE FIELD GUIDE

SUMMARY OF REVIEWER STATEMENTS

UNIT EVALUATION (From Hampton, 1980)

Reviewer's Name________________________ Date____________

Unit Title____

(Use the back of these pages if necessary.)

1. Are the concepts presented clearly enough for target students to understand and attain? If no, please indicate the lessons by number and suggest modifications. YES 6 NO 0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
5	2,21	Background information on waves and soil composition would be helpful.

2. Are the concepts appropriate for the majority of the target students? If no, please indicate the lessons by number and suggest modifications. YES 6 NO 0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
2		It may be necessary for the teacher to do a good bit of preplanning for the activities in order to "fit" them into a larger scheme.

3. Are the teacher instructions in this unit appropriate? If no, please indicate lessons by number and suggest modifications. YES 6 NO 0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
2		Teacher instructions are appropriate for most lessons but in-service training would help.
5	5	An illustration is needed.
5	23	Is the tube inverted?
5	22	Include note on standardization of variables.
5	25	Include proper setup for recording outdoor temperatures.

4. Are the procedures required in the activities for this unit too sophisticated for students? If yes, please indicate the lessons by number and suggest modifications.

YES	NO
3	3

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
2	14,12	These activities are fine as written but I feel generally above the level of most eighth graders. However, I would not omit them.
3	9	The procedures may be too difficult for the average eighth grader. Will they understand the math involved?
4	10	It would not be a bad idea to point out that in a compass, one can easily tell the needle points north because it dips downward when it does.

5. Are the materials easily obtainable for the typical classroom teacher or school system? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
4		You might mention that the N. C. Marine. Resources Center can help provide or lend the equipment or can suggest substitute materials.
5	22	You may want to suggest a place to purchase the ozalid paper.
6		The materials are very easily obtainable.

6. Are the activities appropriate in length for the grade level? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
2		Some activities are rather lengthy but it depends on the group.
4		It would be a good idea to suggest an estimated time for completion of the lesson/activity to help the teacher plan out the trip better.

7. Will the activities be of interest to target students? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
3		All students would enjoy getting outside to conduct class.

8. Will the activities lead to or reinforce understanding of marine knowledge and concepts? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

9. Are there any marine inaccuracies noted in the activities? If yes, please indicate the lessons by number and suggest modifications.

YES	NO
0	6

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
4	2,3,4	Wave labeling might be confusing.

10. Do the activities appear to adequately reinforce the unit concepts stated at the beginning of the unit? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

11. Do the activities appear to adequately reinforce the lesson concepts stated at the beginning of each lesson? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

12. Do the activities appear to adequately accomplish the competency goals stated at the beginning of the unit? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

13. Do the activities appear to adequately accomplish the behavioral objectives stated at the beginning of each lesson? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

14. Do the activities seem to contribute to the mastery of the designated skills? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

15. Are there any sex biases noted in the activities? If yes, please indicate the lessons by number and suggest modifications.

YES	NO
0	6

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS

16. Are the activities well written? (Gramatically correct, well-paced, logically sequenced.) If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
2		They are brief but adequate to cover the meaning-directive.
4	Appendix E	The number of students (30) should be removed.
5	4	Typographical error, "fod" should be "rod".

17. Are the pre- post-test, homework and evaluation questions appropriate? If no, please indicate the lessons by number and suggest modifications.

YES	NO
6	0

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
2		The test does not necessarily evaluate the skills learned but a paper-pencil test does have these limitations.

18. Do you feel there are any aspects of these activities which school administrators would properly object to? If yes, please indicate the lessons by number and suggest modifications.

YES	NO
1	5

REVIEWER	LESSON NUMBER	SUGGESTED MODIFICATIONS
5	2,3,4	The wet methods may be dangerous especially for "in-landers". Cautions should be emphasized to teachers and students who do not have experience in an ocean setting.

19. Overall I would rate this unit: (please circle one)

EXCELLENT	VERY GOOD	GOOD	FAIR	POOR
3	3			

ADDITIONAL COMMENTS AND SUGGESTED MODIFICATIONS

REVIEWER	LESSON NUMBER	COMMENTS
1	4	Typographical error - "fod" should be "rod".
	16	Add to background information: Softer water promotes more suds.
	19,21	More background information needed to describe soil horizons.
	24	"At the Coast" #1: "timing device" in this context is confusing.
		I like this unit and would like to use it with my tenth graders at Manteo in April.

REVIEWER	LESSON NUMBER	COMMENTS
2		I feel this is an excellent resource for teachers of several levels because it has good activities, data collection and recording, etc.
3	8	Sample graph and sample data do not match.
	9	"Equidistance" should be "equidistant".
	12	Reword "At the coast" procedure, step #1.
	21	Reword Procedure steps #1, 2. Figure 22, replace "lips" with "lip".
	23	Typographical error "Evaportation" should be "Evaporation".
		The field guide has potential for wide use in coastal studies by teachers from all parts of the state. Some activities are simple yet sophisticated enough for high school and college level. I would like to have a copy of the field guide for my personal use.
4		I enjoyed this unit. Many activities are familiar exercises I've used during field trips (with some modifications) at higher levels. I would like to see a correlation or referral of lesson/activities to chapters in North Carolina's adopted earth science textbooks.
6		I feel the field guide has several strong points: (1) Any section or even two or three individual lessons/activities can be removed and used at the teacher's discretion; (2) The materials are simple enough for teacher/student construction; (3) Some of the activities could be used with high school classes also without loss of challenge to students.