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ABSTRACT

This teacher's guide, one of nine teacher packages developed for use in the sequential, hands-on, field-oriented, K-8 environmental education program of the Martin County Schools in Florida, was developed for use with secondary children in grade eight prior to and after a visit to an environmental studies center located near an estuarine area. The field experience for eighth graders is a two-day study of a beach. Activities relate to the interaction of beach processes such as longshore currents, waves and wave action, wind action, and dune formation. This guide contains teacher instructions, scripts, tests with keys, and a copy of all student materials. Slide/tape programs are not included. General and specific program objectives are stated and a program outline, including learning activities to be completed at the school and environmental studies center, is detailed. (BT)

8th Grade

Beach Investigation

Martin County Schools'
ENVIRONMENTAL STUDIES CENTER
2900 NE Indian River Drive, Jensen Beach, Florida 33457

TABLE OF CONTENTS AND CHECKLIST

This packet contains teacher instructions, scripts, test with answer key and a copy of all student materials.

We suggest you cover these materials in the order listed in this packet.

In parenthesis after each item is the quantity you will need for your class and whether it is expendable or to be returned.

* Also listed but not included in this booklet are items such as flash cards, slide/tapes, feltboard and pieces, etc.

CONTENTS:

EIGHTH GRADE PROGRAM SUMMARY

GENERAL OBJECTIVE: To acquaint the student with the physical characteristics of a beach as part of his total environment and give him evidence that he is an integral part of it resulting in his successful completion of the performance activities for the specific objectives.

SPECIFIC OBJECTIVES: The student will on the test:

1. identify with 70% proficiency the cause and effect, direction, location, effect of obstructions, and measurement of a longshore current when given diagrams and questions pertaining to longshore currents and choice of possible answers;
2. demonstrate with 70% proficiency knowledge of general beach dynamics when given diagrams of a beach profile, data from a beach survey, and questions pertaining to beach dynamics with a choice of possible answers;
3. demonstrate with 70% proficiency knowledge of wave dynamics when given quantitative problems, field data and diagrams and questions pertaining to wave dynamics and choice of possible answers;
4. identify with 70% proficiency probable causes and possible solutions to environmental problems related to beaches when given the problem and choice of causes or solutions;
5. demonstrate with 80% proficiency knowledge of selected vocabulary words relative to waves, beaches and currents when given a definition or question and choice of words.

PROGRAM OUTLINE:

A. Activities at home school (four weeks)

1. "Longshore Current" booklet
2. Supplementary materials: books, film loops
3. "Beaches and Waves" booklet
4. "Beach Survey" booklet introduces the students to field activities
5. "Sifting Sand", booklet about sand analysis
6. Self-evaluation quiz about sand analysis
7. "Problems" booklet, a slide/tape program
8. Supplementary materials include: glossaries, magazines, books and pamphlets, film (16mm), photos and film loops
9. (Visit to Center)
10. Discussion - all data collected are constructed into a beach profile
11. Sand analysis - samples of sand are dried, weighed and categorized.
12. Post-test

B. Activities at the Center and in the field - two day program (4-5 hours each day)

1. First day

   a. Orientation film - "Beach: A River of Sand"
   b. Operation of wave table to illustrate wave principles, sand disposition, effects of beach obstructions
   c. Beach activity: students divide into 3 groups to work 3 activity stations

(1) Measurement: longshore current, wave length, height, velocity, water temperature and salinity
(2) Identification: studying beach organisms onshore and in water and adaptive means for this habitation
(3) Recording: all data collected is recorded on appropriate data sheets for each activity
(4) Discussion: a review is held of the day's activities and a discussion of the information collected, the effect of man and resulting problems and solutions.

2. Second day

a. Beach activity: beach profile is developed by each student group.
b. Beach activity: the students walk from the previous day's working area to the jetty at the St. Lucie Inlet.
c. Discussion: the effects of the jetty on the surrounding shores is discussed, the effect of the proposed new jetty explored.
d. Discussion: a review is held of the day's activities and a discussion of the information collected, the effect of man and resulting problems and solutions.

EIGHTH GRADE TEACHER INSTRUCTIONS

INTRODUCTION: The staff at the Center has developed five objectives for the Eighth Grade program. The entire preparation by you with the students should require three weeks of science class periods. This will vary slightly depending on the class.

Your visit to the Center will give each student an opportunity to spend two days both at the Center and on the beach.

If we can be of any assistance to you in the successful presentation of this material, do not hesitate to call us.

MATERIALS

Booklet and slide/tape summary

1. "LONGSHORE CURRENTS"
   This booklet is an explanation to the student of:

   a. the mechanics and measurements of longshore currents
   b. effects of obstructions on the longshore current
   c. help aids

2. "A BEACH SURVEY"
   This booklet is an explanation to the student of:

   a. the whats and hows of doing a beach profile
   b. how to use some of the equipment
   c. glossary

3. "SIFTING SAND"
   This booklet is used in conjunction with a beach survey. The LAP will show how to find percentage of sand grain sizes in a sample.

4. "BEACHES AND WAVES"
   This booklet is:

   a. a how-to booklet on wave measurement - height, period, wave length and velocity
   b. also organism adaptation relative to the physical factors measured on the beach
   c. glossary

5. "PROBLEMS"
   This booklet is:

   a. a discussion and question approach to five important environmental areas

      (1) Energy Crisis
      (2) Intracoastal Waterway
      (3) St. Lucie Inlet
      (4) Mother Nature
      (5) Fragile Dune

6. "BEACH JUMBLES"
   Student activities booklet

PROGRAM OUTLINE

OBJECTIVE I - The student will recognize:

a. mechanics of the longshore current
b. how to measure the current
c. the importance and effects of obstructions on the longshore current

1. Two to three class periods are suggested for this objective.

2. Assign the LAP "LONGSHORE CURRENT".

3. Please go over the introduction and help aids that are available.

4. Stress student use of glossary and diagrams.

Recommended Supplementary Material

BOOKS:

a. The Ocean World by Vladimir & Kovalik - Chapters 4-5
b. Waves by H. Zim
c. Waves, Tides & Currents by E. Clemons - Chapter 7
d. Deep Sea World by C. Combs - Chapter 3

FILM LOOPS:

a. Shore Drift
b. The Beach I - Source of Sand
c. The Beach II Profile Study
d. The Beach III Longshore Transport

OBJECTIVE II - The student will become acquainted with:

a. beach and wave terminology
b. measurement procedures
c. relationship of physical factors to organism development and adaptation

1. Two to three class periods are suggested for this unit

2. Assign the LAP "BEACHES AND WAVES" pp. 1 - 3 and discuss

3. Assign pp. 4 - 8 and discuss

4. Please stress many of the activities are field exercises to be done at the beach. The student should be thoroughly acquainted with terms and procedures.

OBJECTIVE III - The student will learn how to:

a. do a beach survey
b. construct a profile of the beach
c. use scientific equipment

1. Three to five class periods are suggested for this objective.

2. Assign the "BEACH SURVEY" LAP . Please explain and discuss the unit as outlined. Stress that this LAP explains procedure for the field trip.

3. Glossary should be utilized throughout.

4. Assign the LAP "SIFTING SAND". The answer key to the self evaluation test is in the student booklet. If necessary please go over the math with the students. This section seems difficult for them.

OBJECTIVE IV - The student will become aware of:

a. suggested environmental problems
b. pros and cons of the effects of environmental problems
c. possible solutions

1. Six to ten class periods are suggested for this unit.

2. Assign the LAP "PROBLEMS". Go over with the class the table of contents and introduction.

3. You might try each day assigning an environmental problem in conjunction with the accompanying help aid sheet. The aid sheets are attached to each environmental problem in the "PROBLEMS" LAP.

4. The slide unit could be shown both at the beginning to introduce the unit and again at the end of the unit to promote discussion and review.

The following environmental problems along with vocabulary and recommended supplementary material are listed in the order in which they should be presented:

A. Energy Crisis

Vocabulary:

extinct - no longer existing in living form
fossil - remnant or trace of an organism of a past geological age

Magazines:

Fla. Naturalist - Aug. '74, "Decisions, Decisions" by Hal Scott
Fla. Naturalist - Aug. '74, "Energy" by Robert Bishop, pp. 6-7
Nat'l Wildlife - Aug.-Sept. '74, "Tapping the Sun's Energy" by David Lee, pp. 18-20

Books & Pamphlets:

Atomic Energy and Your World by Glasstone and Thomas, pp. 2-9; 10-15; 23-26; 49-52
Nuclear Power Plants by Llerly and Mitchell, pp. 15-23
Worlds Within Worlds by Isaac Asimov - Energy of the Sun Chapter, pp. 55-62

Film - 16mm:

"Controlling Atomic Energy" #105 - available from Instructional Center

Other:

Drymounts:

8 x 10 aerial picture of Hutchinson Island - Nuclear Plant
One Earth - Audubon - July '74
Energy Conservation in U.S. Is a Must - Miami Herald - April '74

Speaker from Environmental Center available

B. Intracoastal Waterway

Vocabulary:

brackish - water containing some salt
ecosystem - an ecological community together with its physical environment
meter - a unit of length in the metric system of measurement
spoil island - islands formed in the river by dredging of the intracoastal waterway

Books & Pamphlets:

America's Inland Waterway, National Geographic - Chapter 1 (excellent pictures throughout)

C. St. Lucie Inlet & Artifical Structures

Vocabulary:

breakwater - a barrier that protects a harbor or shore from the full impact of waves
groin - a dam-like structure, usually a few feet high and about 100 feet long, constructed perpendicular to the shoreline
inlet - a channel leading inland, as from the ocean
jetty - a structure projecting into the water from the shore to influence tide or protect a harbor or shoreline
longshore current - a current of water that runs parallel to the shoreline

Books & Pamphlets:

The Ocean World by Vladimir and Kovalik - Chapters 4-5
Waves by Herbert Zim
Waves, Tides, Currents by E. Clemons - Chapter 7
Deep Sea World by C. Combs - Chapter 3
Waves and Beaches by W. Bascome, pp. 232-256

Films - 16mm

"Waves" available from Instructional Center - 16 min.

Film Loops

The Beach IV
Coastline Formation Part II

D. Big Bad Mother (Nature)

Vocabulary:

estuary - an arm of the sea that extends inland to meet the mouth of a river
energy web - a pattern of transfer of energy within a community, an interlinking of food chains
northeaster - a storm or gale from the northeast
nutrients - something that nourishes - aids growth or development
water table - the top of the water in the ground

Magazines:

Nat'l Geographic - Dec. '62, "Our Changing Atlantic Coastline", pp. 860-887
Nat'l Geographic - July '64, "Alaska Earthquake"
Nat'l Geographic - June '62 - "Avalanche"
Nat'l Geographic - July '68 - "Forest Fire"
Nat'l Geographic - July '73 - "Volcano Overwhelms an Iceland Village"
Nat'l Geographic - Jan. '73 - "This Changing Earth"

Books and Pamphlets:

Hurricanes, Storms, Tornadoes - by Putnam Science Survey
Weather - How and Why Wonder Book
Weather - Life & Science Library
Storms and Man by Ross Lothrop
Weather - by Golden Science Guide
Waves & Beaches by W. Bascomb - Chapter 11

Film Loops

Story of a Storm
Coastal Waters - Stormy Weather

E. The Fragile Dune

Vocabulary:

adaptation - anything that is changed or changes so as to become suitable for a new use or situation
eon - longest division of geologic time, containing two or more eras
succession - living things that follow other living things as the conditions of the environment change

Magazines:

Nat'l Geographic - Dec. '62, "Our Changing Atlantic Coastline"

Books & Pamphlets:

Geoglogy, Golden Science Guide, pp. 76-77
Seashores, Golden Nature
Encyclopedia Britannica - your media center
The Wild Young Desert by Atwood
Audubon Nature Encyclopedia - Vol. 3
Ecology by J. Nicklesburg - Chapter 8

Film - 16 mm:

"Dunes" - (no sound) available at Instructional Center

OBJECTIVE V - The objective for this unit is mastery of a selected vocabulary.

1. Time allotted, will be the entire preparation period.

2. New vocabulary will be utilized and stressed throughout all units of the Beach Investigation.

3. To stimulate interest use:

   a. spell down type game substituting word meanings
   b. baseball game activity
   c. small groups working together

4. Field trips and discussions at the Center will further emphasize the vocabulary.

. . . . .

This concludes the classroom Pre-Activities. You should now be fully prepared for a visit to the Environmental Studies Center. Please let us know which activities were/were not successful, and what activities of your own you may have added.

After your visit to the Center and the beach at least one day should be spent as a follow-up to the field activities. The following two activities are suggested:

1. The students should diagram a beach profile based on the data collected on the second day of their field experience.

2. The students should weigh and figure sand grain percentages on the sand samples collected on the second day of their field experience.

We also suggest at least one day of review before giving the test.

TEST

To post-test your student for your records, copies of the test and answers are included. The test is to be given after your students visit the Center. The test mean for 1974-75 Eighth Grade students completing a full program was 62.9.

EIGHTH GRADE CENTER AND FIELD ACTIVITIES

TWO DAYS
5 HOURS EACH DAY

FIRST DAY

I. The students are bused to the Environmental Studies Center where they assemble in the auditorium for a brief orientation to the two days' activities.

CENTER ACTIVITIES

1. Students see the 16mm film, "Beach: A River of Sand". A discussion is held on the longshore current and how it affects the beach formation.

2. Students work with a wave table illustrating wave principles, sand deposition and the effects of beach obstructions such as jetties, groins and breakwaters.

II. LUNCH

Depending upon time and logistics the students may eat lunch at the Center or have a picnic at the beach.

III. The class is bused to a beach area where they are divided into three groups. Each group:

1. locates and measures the longshore current

2. measures the height, period and wave length of the ocean waves

3. measures physical factors of the beach; i.e., air temperature, soil temperature, wind speed and wind direction

4. identifies and notes adaptations of organisms living in the study area.

5. records all data collected by the appropriate data sheets provided

IV. The students are picked up by the bus at the beach and returned to their home school.

SECOND DAY

The second day is spent entirely at the beach. Students are bused directly to the beach area where they:

1. compile a beach survey, which includes measuring and plotting the beach slope and determining the depth, temperature and salinity at the water table at various intervals up the slope of the beach.

2. collect and sieve a measured sand sample for sand grain size analysis.

3. eat lunch - students eat lunch on the beach before their hike to the inlet.

4. hike to the inlet where discussions are held on:

    a. inlet shoaling

    b. the effect of jetties

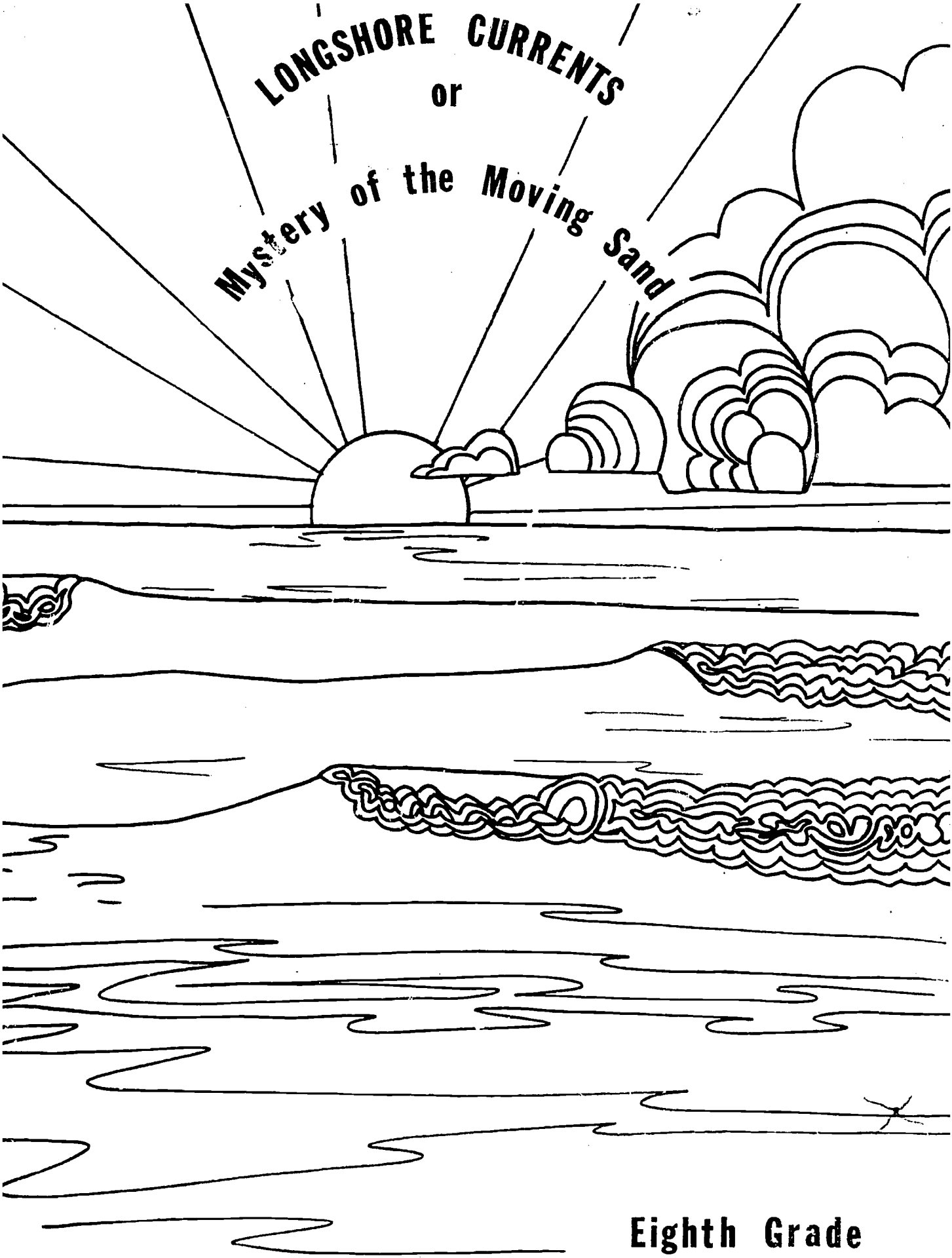
    c. erosion of Jupiter island

    d. construction of a new south jetty

    e. the dune ecosystem.

At the end of the day's activities students are bused directly back to their home school.

LONGSHORE CURRENTS
or
Mystery of the Moving Sand



Eighth Grade

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INTRODUCTION

Did you ever wonder why --

1. you are swimming in the ocean and in a short period of time find yourself much further north or south of the point on the beach where you entered the water?

2. there is a nice wide sandy beach in some areas and a severely eroded beach in other areas?

3. Jupiter Island residents pay large sums of money to dredge sand for their beach?

This is what this unit is all about.

Below are some suggestions to help you become a longshore current expert.

1. Read and discuss the ideas and pictures in this LAP.

2. Ask your teacher for these film loops:

   a. Shore Drift
   b. The Beach I - Source of Sand
   c. The Beach II - Profile Study
   d. The Beach III - Longshore Transport

3. Read:

   a. The Ocean World by Vladmire & Kovalik - Chapters 4 - 5
   b. Waves by Herbert Zim
   c. Waves, Tides and Currents by E. Clemson - Chapter 7
   d. Deep Sea World by C. Combs - Chapter 3

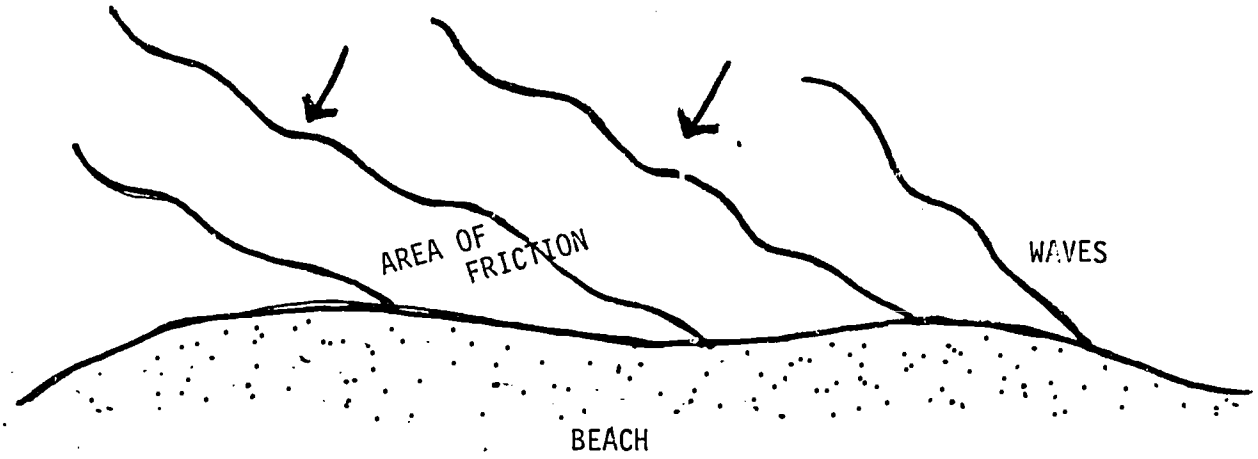
4. During your visit to the Environmental Center you will:

   a. see films about longshore current
   b. work with a wave table to help you further understand longshore current mechanics
   c. locate and measure a longshore current at one of the Stuart beaches.

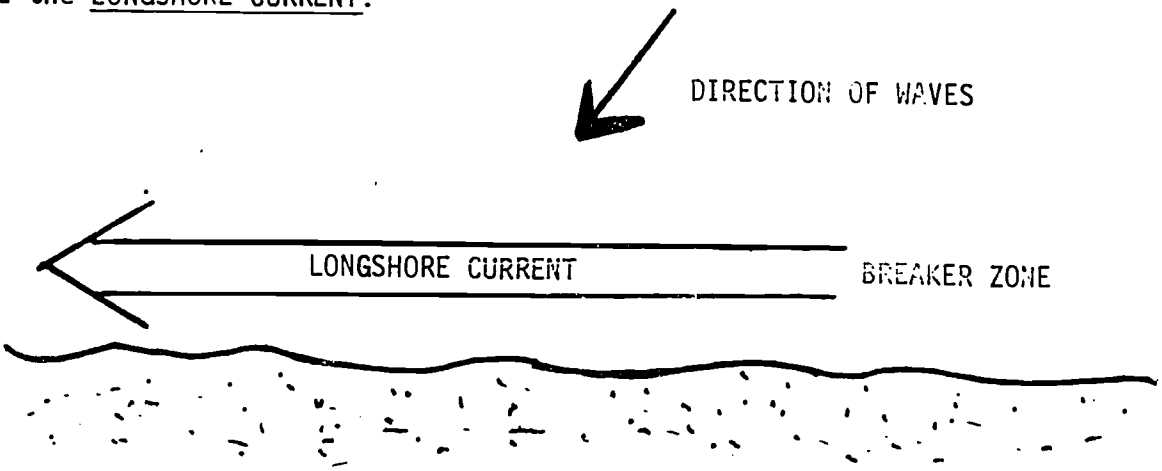
WHAT IS A LONGSHORE CURRENT?
(Underlined words are explained in GLOSSARY, page 6)

As you know, wind energy is picked up by the water as waves. When these waves eventually hit a beach, the energy is released.

Now look out toward the ocean and notice the waves. Waves appear to hit the beach head-on, but they seldom hit exactly PARALLEL. When the waves hit the shore at an angle, the part closest to the beach "feels" bottom first. This part is then slowed down by friction from the bottom. This allows the rest of the wave to "catch up".



Breakers are waves that carry water and are called TRANSLATION WAVES. Many breakers hitting the beach at the same angle can transfer large amounts of water along the beach. This movement of water along the breaker zone is called the LONGSHORE CURRENT.



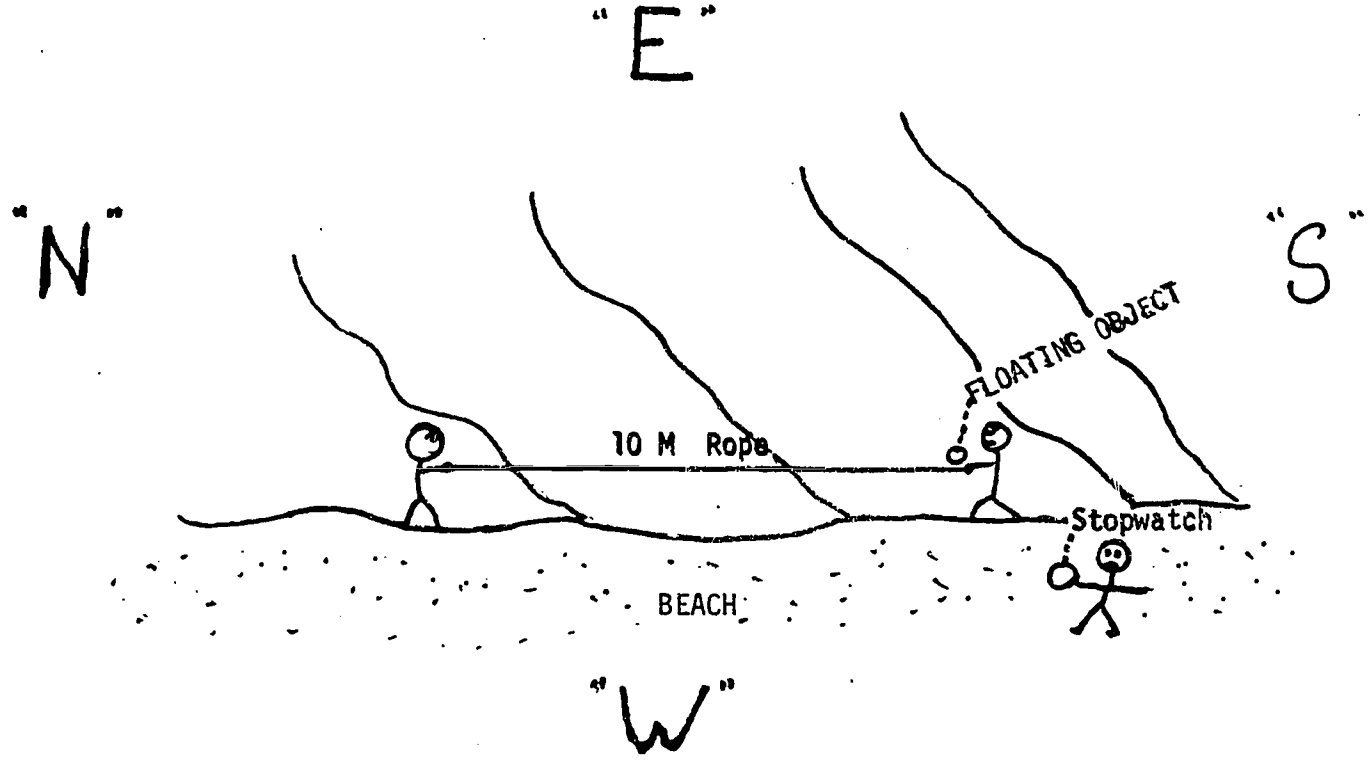
WHAT DOES THE LONGSHORE CURRENT DO?

The longshore current is responsible for many of the natural changes on the beach. Sand is kicked up by incoming breakers and is moved along by the longshore current. Movement of sand along a beach is called LITTORAL DRIFT.

HOW DO YOU MEASURE VELOCITY OF A LONGSHORE CURRENT?

Can you think of a way to find and then measure the velocity of the longshore current? On your field trip you will be given a 10 m length of rope, floating object, and a stopwatch.

LOOK AT DIAGRAM BELOW



ANSWER THESE:

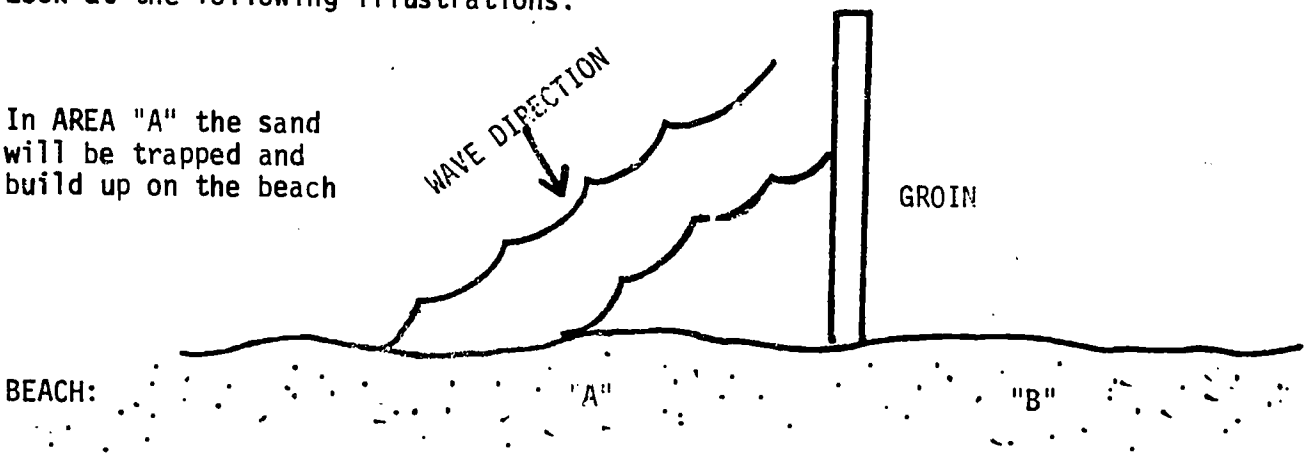
1. From what direction do you think the wind is blowing?
2. An object carried by the longshore current is moving north at the rate of 10 meters per minute. Assuming no PHYSICAL CHANGES in the beach, how far would the object move in 60 minutes?

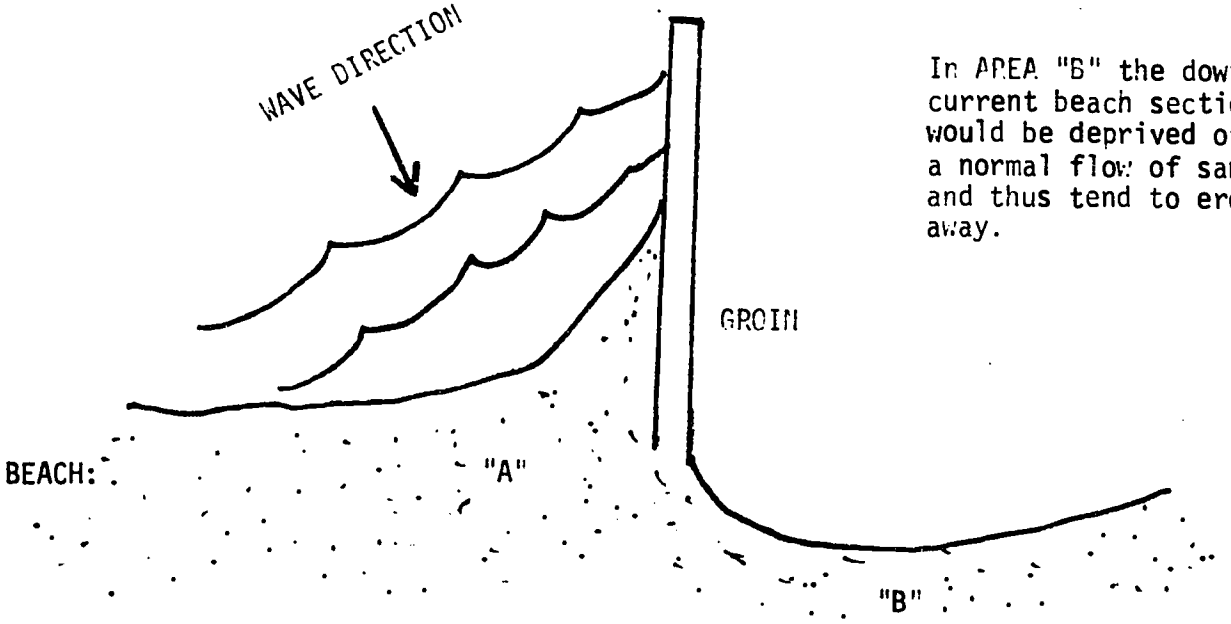
WHAT IS A JETTY?

Obstructions in the water such as GROINS and JETTIES run perpendicular to the shore. The purpose of a groin is generally to break the waves, stop or slow down the longshore current and stabilize <u>parts</u> of a beach. Generally, jetties are used at inlets to break wave action, making boating safer, and to prevent sand from obstructing the inlet.

Look at the following illustrations:

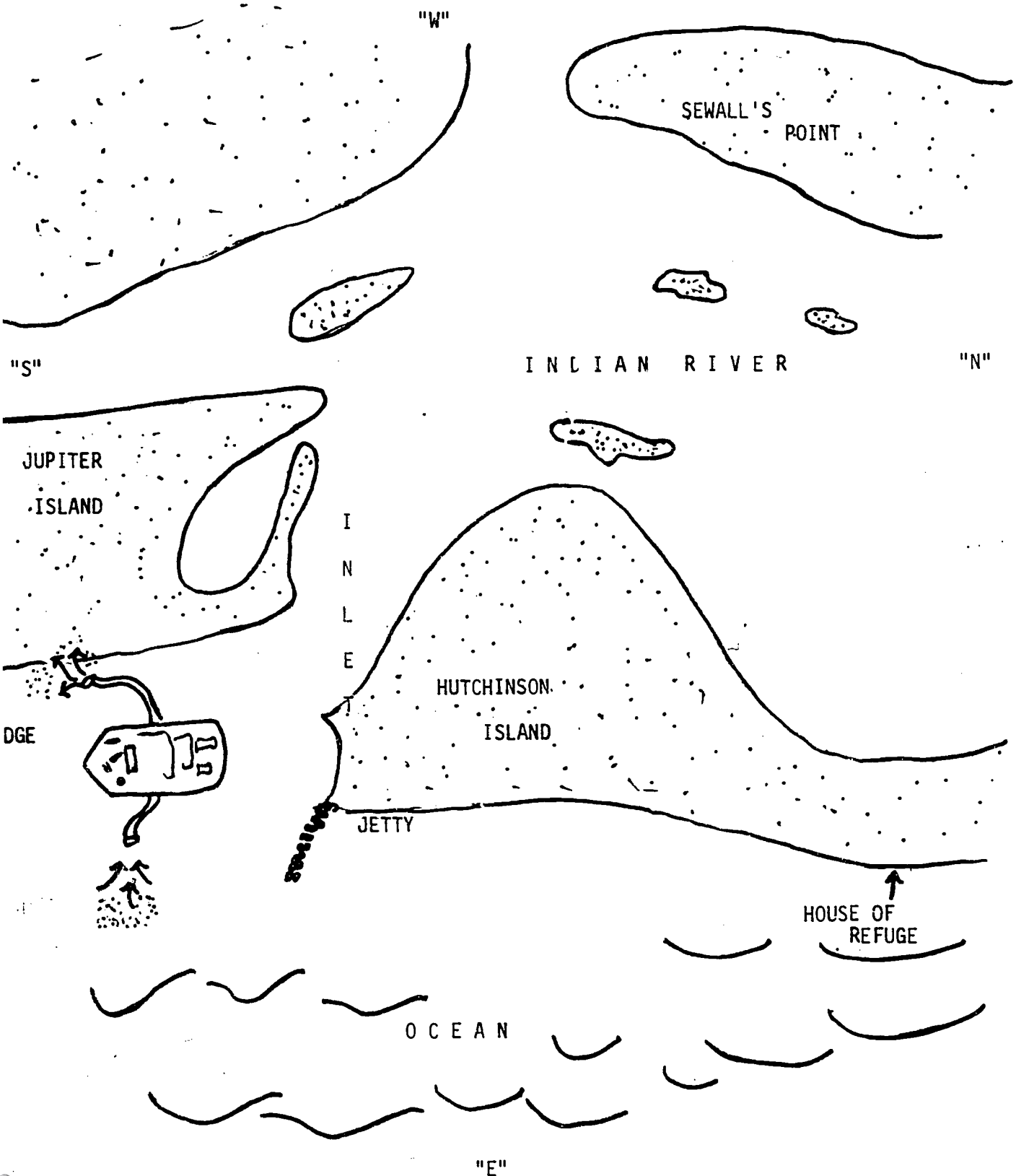
In AREA "A" the sand will be trapped and build up on the beach





In AREA "B" the down current beach section would be deprived of a normal flow of sand and thus tend to erode away.

Look at the diagram below. Why is the dredge putting the sand on Jupiter Island south of the St. Lucie Inlet?



GLOSSARY

BREAKER	-a wave that crests or breaks into foam, especially along the shoreline
CURRENT	-any steady and smooth onward movement of water
GROIN	-a dam-like structure, a few feet high, 100 feet long, constructed perpendicular to the shoreline
JETTY	-usually a pair of structures which extend into the ocean at river entrances or bay mouths
LITTORAL DRIFT	-the movement of sand along the shoreline by the longshore current.
LONGSHORE CURRENT	-a current of water that runs along parallel to the shoreline. This results from waves that strike the beach at an angle. The direction of this current depends on the angle of the wave to the beach.
PARALLEL	-two lines that are the same distance apart at every point
PERPENDICULAR	-a line that forms a right angle with the base from which it is made
PHYSICAL CHANGE	-a change in the structure of something that does not involve rearranging its molecules
TRANSLATION WAVE	-a wave that actually moves the water particles; differing from an oscillatory wave which does not
VELOCITY	-distance traveled in certain amount of time
WAVES	-ridges or swellings moving along the surface of a large body of water. They are generated by the wind and/or the action of gravity
DENSITY	-the weight of something per unit volume - e.g. grams per milliliter

Martin County Schools'
Environmental Studies Center
2900 N.E. Indian River Drive
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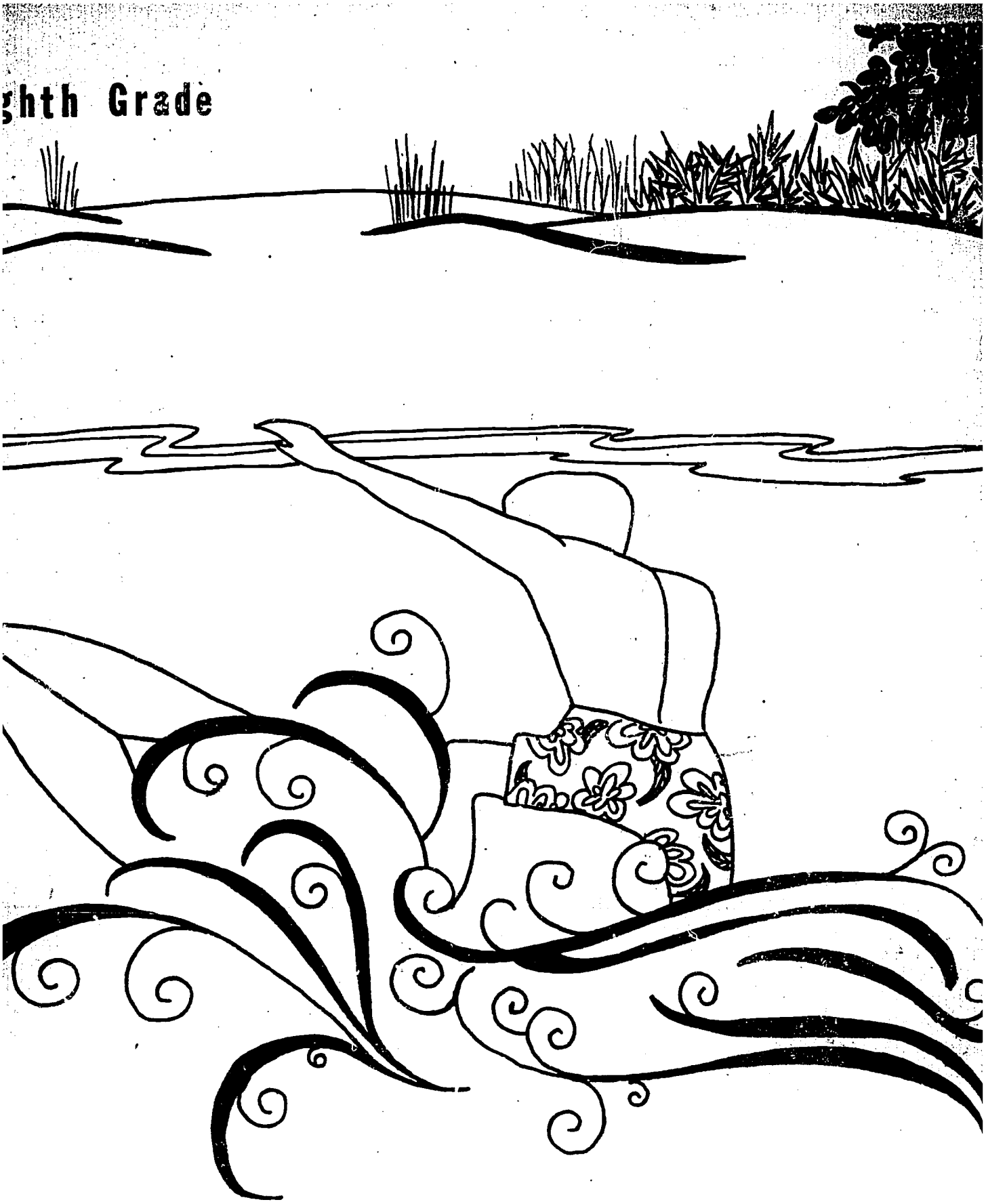
ghth Grade



BEACHES AND WAVES

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INTRODUCTION

This unit will help prepare you for one of your day's visits to the beach. Study and discuss each section thoroughly.

As part of your activities at the Center, your class will be bused to the beach. There you will be divided into three (3) working groups. Each group will work on longshore current, beach and wave measurements, and organism identification and adaption.

Wear comfortable clothes, sneakers, and bring a suntan lotion.

BEACHES:

Sand in Florida's beaches is a mixture of fine quartz grains and broken shells. Generally the beaches in the northern part of the state are of quartz composition gradually increasing to almost 90% shell fragments in the southern part of the state. The sand which makes up Martin County beaches is a mixture of old eroded shell materials and recent shell sources.

As you learned in the "Longshore Current" LAP this sand is transported south by the current, especially in the winter months. Once this sand is deposited and a beach is built up, there are forces that will alter the life that tries to develop there. These non-living forces are called physical factors.

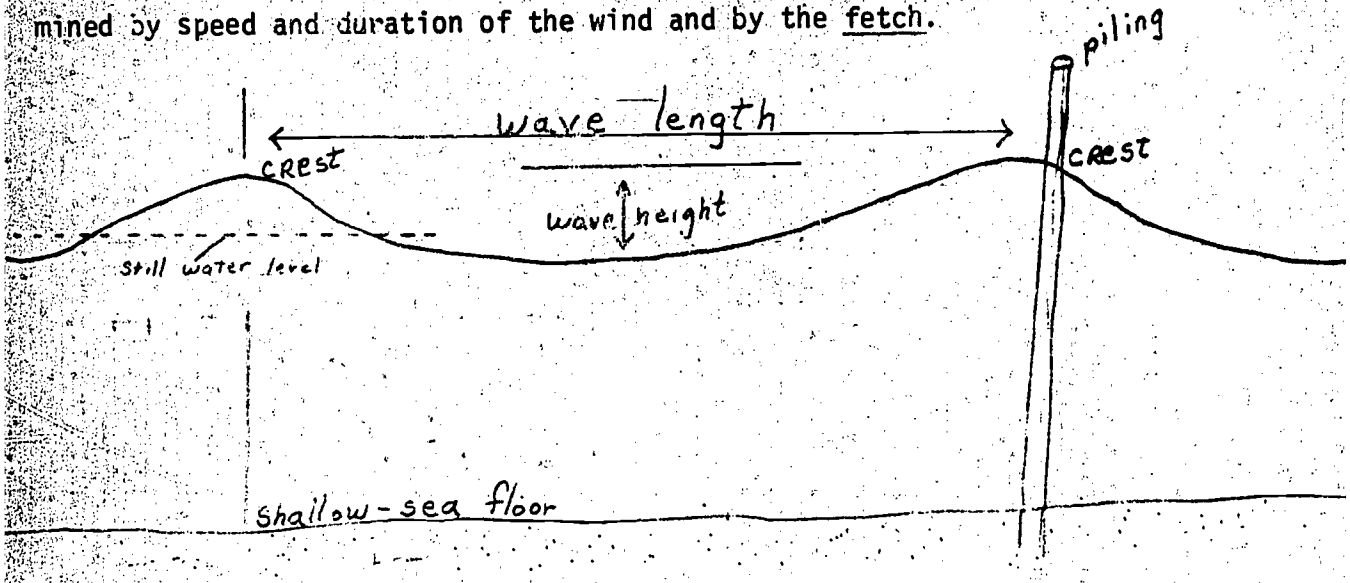
For example: You will measure temperatures of the sand and air at the beach, and find the wind direction and speed. Do you think the wind speed would help determine the type of plant you find on the beach? Would the soil temperature have an influence on the type of animal that lives in the beach zone?

WAVES:

At the Center we lack certain sophisticated equipment needed to accurately measure waves. Therefore, we will estimate all or part of our measurements.

First, let us be sure we understand the terms involved in wave dynamics. Be sure to check the underlined words for meaning and study the diagram below.

Generally waves occur everywhere in the oceans. Surface waves are caused by winds. If the wind blows with sufficient force over a long enough distance, waves are formed. The waves <u>height</u>, <u>period</u> and <u>length</u> are determined by speed and duration of the wind and by the <u>fetch</u>.



GLOSSARY:

<u>crest</u> - the high point of a wave

<u>trough</u> - the low point of a wave

<u>wave height</u> - vertical distance from crest to trough

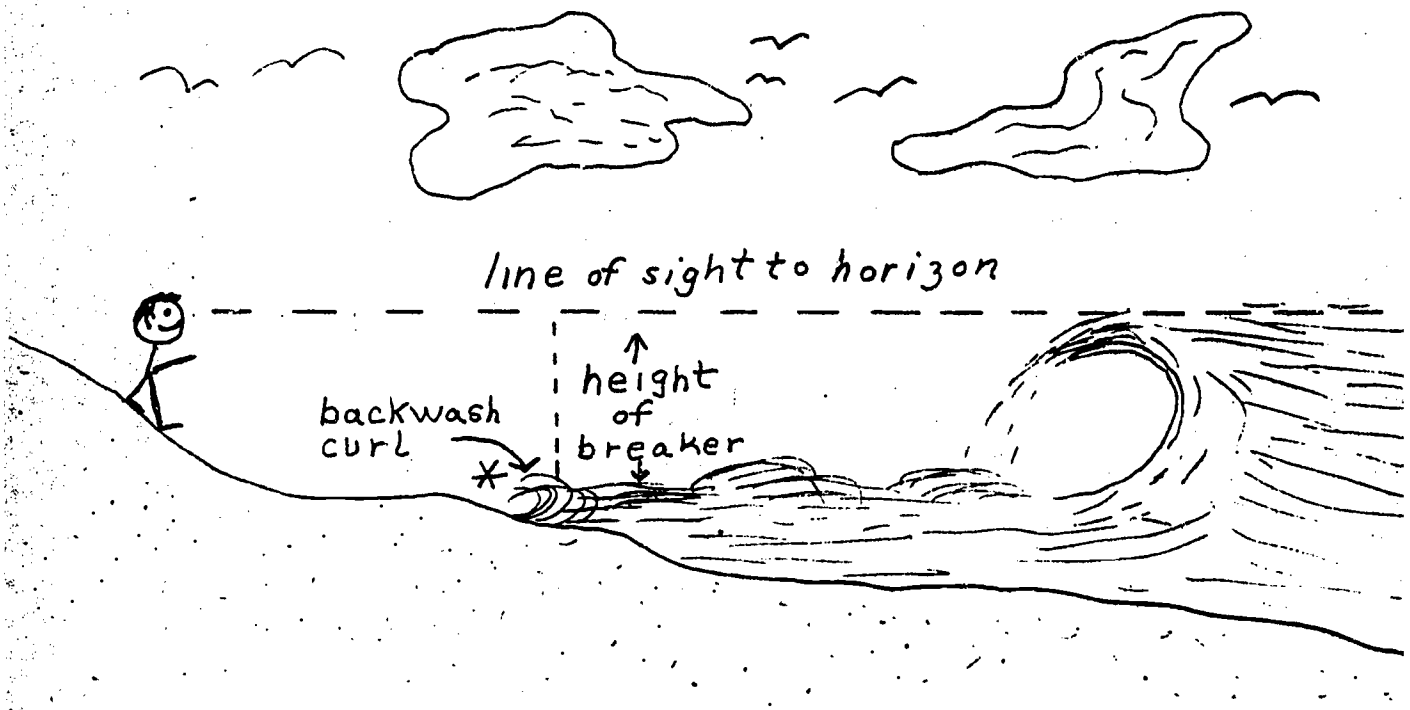
<u>period</u> - time in seconds for a wave crest to travel a distance equal to one wave length

<u>wave length</u> - the horizontal distance between adjacent crests

<u>fetch</u> - the extent of the open water across which the wind blows

HOW HIGH ARE THE WAVES?

To estimate the height of a breaker, stand on the beach at a point where your eye is in line with the top of the breaker and the horizon.



The vertical distance from your eye to the "backwash curl" is the same as the height of the breaker. (The backwash curl is that point where the retreating wave meets the water's edge and "curls" backward.)

How could you get a more accurate estimate of breaker height if your group were given a rope and a meter stick?

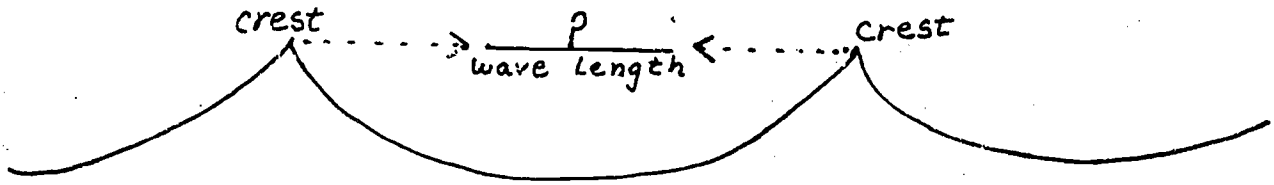
Make three (3) measurements, average and record wave height in cm. on the proper data sheet.

Reference:

Bascomb, Waves and Beaches, p 173

MEASURING WAVE LENGTH:

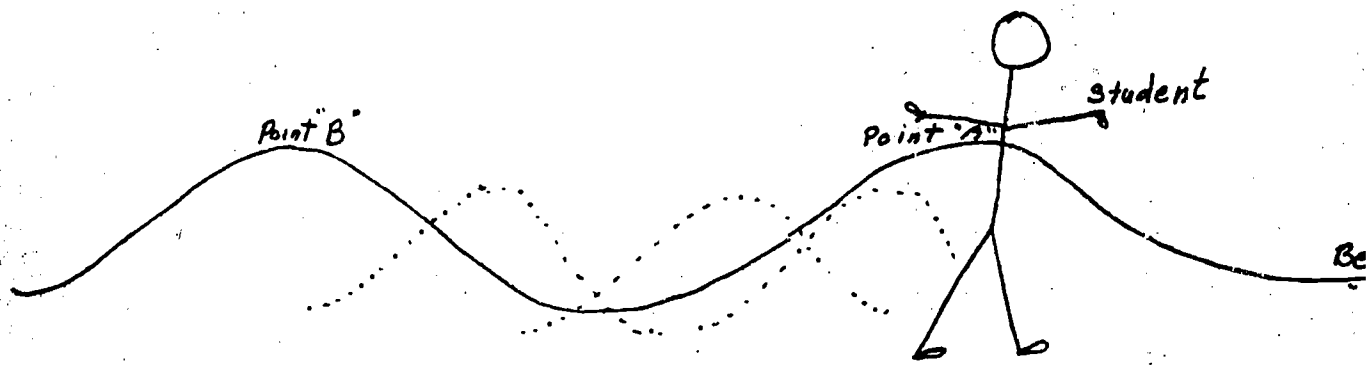
Somehow you must estimate the length between two crests.



Look out at the waves and estimate the distance in meters between crests. Get three estimates, average and record on the data sheet.

MEASURING PERIOD:

Finding the period of the wave will depend somewhat on weather conditions for that day you are at the beach. If it is relatively calm and a low tide, you could station a student at one crest of a wave, Point "A", and time with the stopwatch the number of seconds it takes for the crest of an approaching wave, Point "B", to pass point "A".



If the seas are too rough, try to find a stationary object in the water such as a pier post and time water movement passing this fixed point.

Do three estimates, average and record.

SPEED OF WAVES:

To find the speed of the waves, use the simple formula: $V = \frac{D}{T}$

V = velocity (or speed)

D = wave length (or distance)

T = period (or time)

Suppose while at the beach your group estimates the wave length as 30 meters and the period as 10 seconds.

$$V = \frac{30}{10} = 3 \text{ M/ sec}$$

ORGANISMS OF THE BEACH:

This is one of the last activities you will do at the beach. Up to now, you have been investigating and measuring physical factors on a beach. Physical factors are non-living forces.

You will now investigate briefly the life that exists in this environment. Why do you find only certain plants and animals here? Is it because these organisms like living on the beach? Why?

What were the physical factors that caused the ghost crab to locate in a particular zone of the beach? Can you think of three?

Is the ghost crab adapted to his environment? Be sure you understand that when an organism adapts, it does not change characteristics to fit the environment.

It does mean that the organism, because a structure or color was beneficial to that organism, now fits well into an environment.

The ghost crab is sand colored and runs swiftly sidewise on the tips of its toes. How does this show the ghost crab is adapted to his environment?

Think of where the ghost crab lives. He lives on sandy beaches. The ghost crab must be able to run swiftly when he is on the surface of the sand. By running on the tips of his toes, he can lift his body off the sand and run faster. Since his body is sand colored, when he stops he seems to disappear.

ORGANISMS OF THE BEACH (cont'd)

Sea Oats are one of the first plants on the dune. These plants are subjected to strong winds, salt spray and poor soil. Yet they seem to thrive on the dunes. What adaptations help these plants? Be sure to feel the leaves and note the root system of these plants.

Of course, you will find more organisms on the beach, but this will give you an idea on how to go about it.

TRY TO ADAPT -- USE YOUR SENSES

CONCEPTS WE WANT YOU TO REMEMBER

a. physical factors determine the kind of organisms found in an area.

b. these organisms are adapted to their physical environment

Do these concepts relate to people?

How?

Why?

LP AIDS:

BOOKS:

a. Ecology by J. Nicklesburg - Chapt 3 - 6

b. Deep Sea World by C. Coombs - Chapt 3

c. Face of North America by P. Farb - Chapt. 3 and 17

FILM LOOP:

a. Marine Predators

FILMSTRIP:

a. Ecological Imbalance

b. Seashore - Despoliation and Imbalance

EQUIPMENT LIST:

Student thermometer

Water thermometer

Wind guage

Hydrometer

Meter Sticks

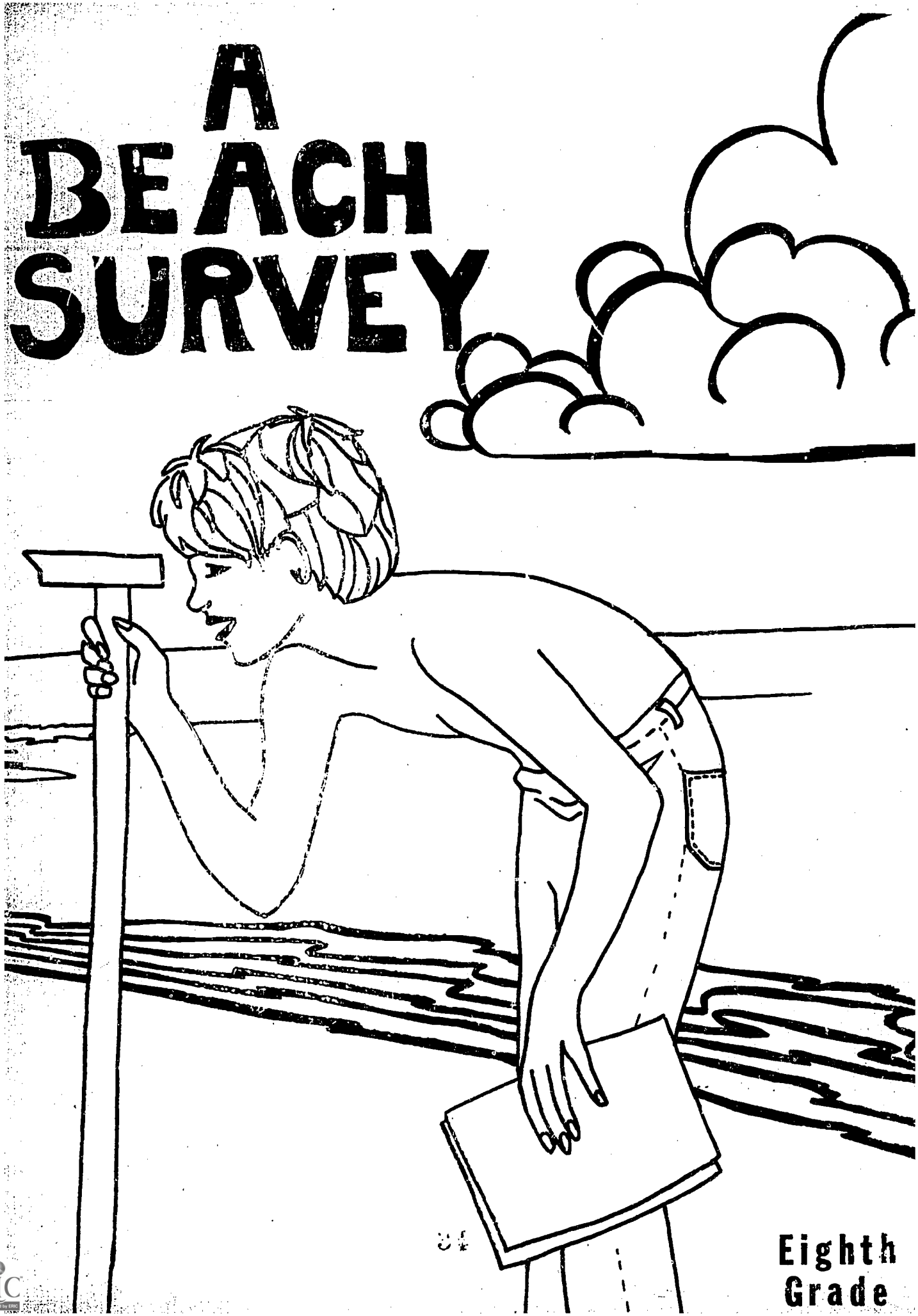
Clipboards

Stopwatch

Line

Martin County School's
Environmental Studies Center
2900 N.E. Indian River Drive
Jensen Beach, Florida 33457

A BEACH SURVEY



Eighth Grade

TABLE OF CONTENTS

INTRODUCTION

Please be sure to study this booklet carefully. It explains what a beach survey is and how to do one.

We have included an explanation of how to use the necessary equipment.

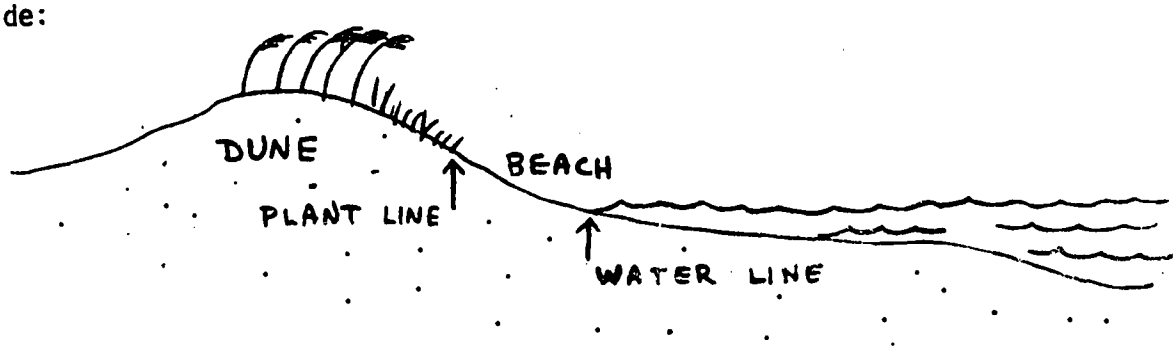
Also, you will find a Glossary on page 7. Be sure to use this as it will help you understand the materials.

Your classroom for the day will be a beautiful sand beach here in Martin County. In small groups you will do the survey as outlined in the LAP.

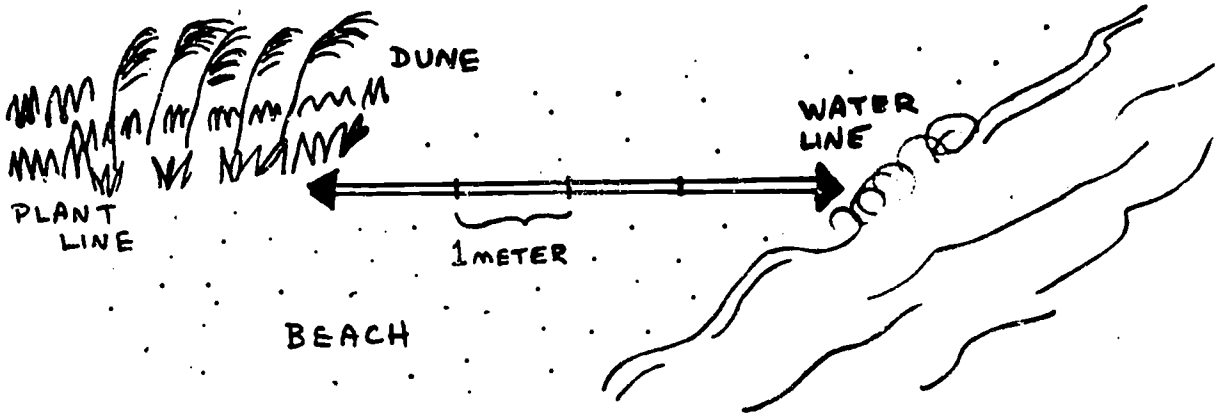
In part of your activities you will learn how to utilize your data by constructing a profile of the beach area worked. If time allows, you will find the % of grain size for each sand sieve.

A BEACH PROFILE

A profile of an area of beach is actually a view of what that area of beach looks like if you could cut down into it and look at it from the side:



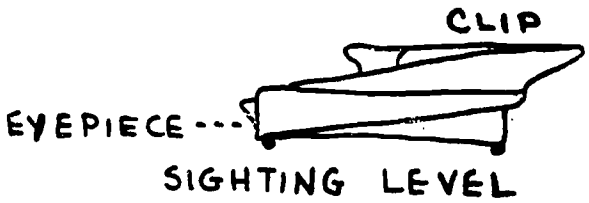
To do this you have to measure the SLOPE of the land at different points or INTERVALS. A possible line to measure is from the water line up the slope to the plant line. The measurement of height or elevation of the beach is done at regular intervals; for example every METER along the line to be measured:



Also, along this same line of measurement of beach slope other PHYSICAL CONDITIONS can be determined. These include: (1) sand type, (2) depth to the WATER TABLE, (3) temperature of water at water table, (4) SALINITY of water at water table.

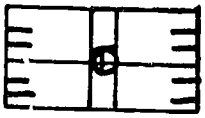
SIGHTING THE INCLINE:

The measurement of the slope of the beach is done with a SIGHTING LEVEL.



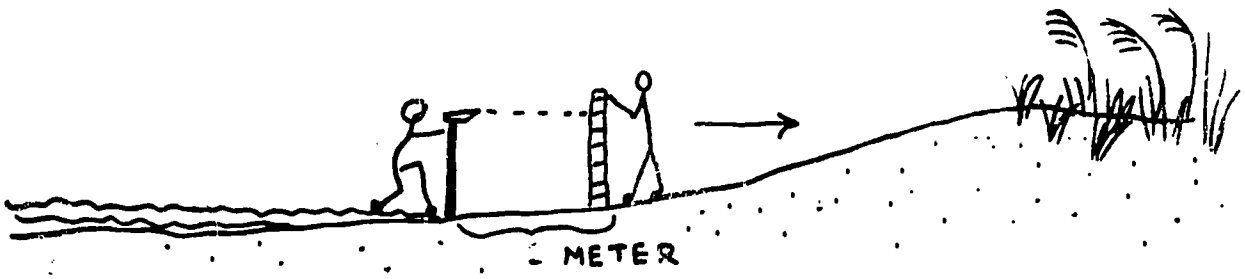
This is mounted on a stick, one (1) meter in length.

One person looks through the level at the eye piece. He locates the bubble and moves the level until the bubble is in the middle.



THE "LEVEL" IS LEVEL.

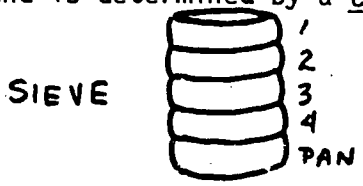
One meter away, another person is standing holding a meter stick. A meter stick is divided into 100 units called centimeters. Make sure the "100" is on the bottom or ground, and the "0" on top. The person using the level, sights on the meter stick. When the bubble is in the middle, the location of the bubble on the meter stick is the amount of increase in beach height for that meter. Record this amount of increase.



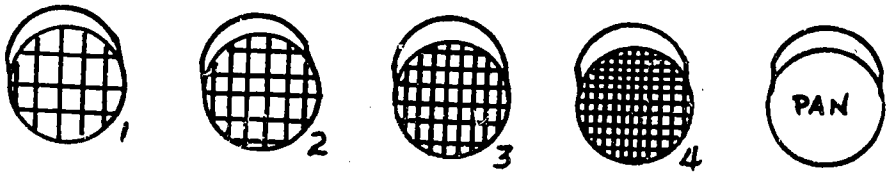
This same procedure is repeated at meter intervals right up to the plant line, and readings recorded.

SAND TYPE:

The type of sand is determined by a CALIBRATED sieve with 4 sections:



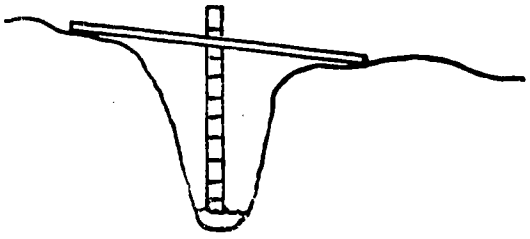
The top section (#1) has the largest mesh to hold only the coarse or largest sand particles. The fourth section has a mesh fine enough to hold the smallest.

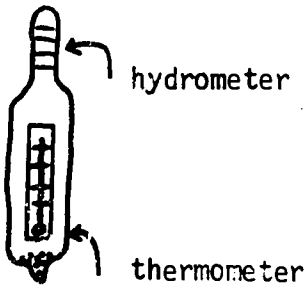


A 400 ml BEAKER of sand is placed in the top section and worked through. It can be washed through if the SAMPLE of sand is wet or shaken through if the sample sand is dry. The sand that remains in each section of the sieve is placed in a separate plastic baggie and marked with section number and group name. The percentage (%) of each particle size will be determined back at the Center.

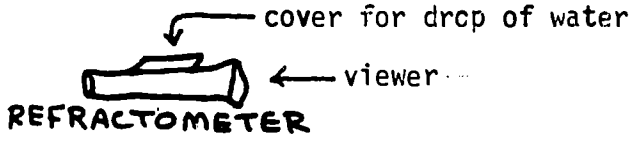
WATER TABLE: DEPTH AND SALINITY:

The depth to the water table is determined by digging to it. When the water fills the bottom of the hole, the distance from the surface of the hole to the table is measured and recorded. At the same time, the water temperature is taken and recorded.





The salinity of the water is determined by using a HYDROMETER or a REFRACTOMETER.



The refractometer is an instrument which provides a quick and accurate determination of water salinity, the amount of salt in a 1000 parts of water.

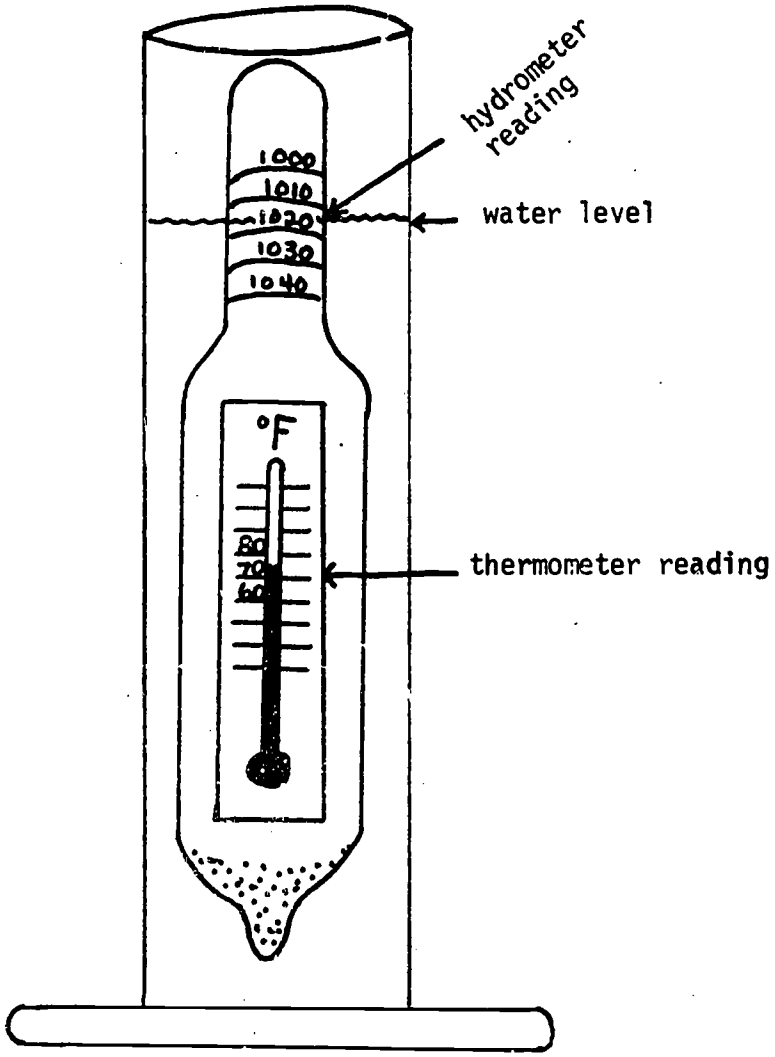
OCEAN SALINITY USING A HYDROMETER:

In order to find water salinity with a hydrometer you will need to know the temperature of the water and how far the hydrometer sinks into the water. (The hydrometer reading is actually a measurement of the density of the water). To find these readings you float the hydrometer/thermometer in the water (see illustration).

Read the hydrometer at the water level and record it.

Read the thermometer and record it.

The salinity is now found by using the "salinity chart" which comes with the hydrometer.



On the top of the salinity chart, find the temperature you recorded for the water. Now on the side of the chart find the number you recorded for the water level on the floating hydrometer/thermometer. Using these two readings, read down from the temperature and across from the hydrometer number and you will have the approximate salinity. This number means amount of salt in a 1000 parts of water.

Hydrometer reading	TEMPERATURE OF WATER								Hydrometer reading
	55°	60°	65°	70°	75°	80°	85°	90°	
1.020	26.8	27.2	28.0	28.9	29.8	30.8	32.1	32.9	1.020
1.021	28.1	28.5	29.3	30.2	31.1	32.3	33.4	34.2	1.021
1.022	29.4	29.8	30.6	31.5	32.5	33.6	34.7	35.6	1.022
1.023	30.7	31.1	31.9	32.8	33.8	34.9	36.0	37.0	1.023
1.024	32.0	32.4	33.2	34.1	35.1	36.2	37.5	38.2	1.024
1.025	33.2	33.7	34.5	35.4	36.4	37.6	38.8	39.7	1.025
1.026	34.5	35.0	35.8	36.7	37.7	38.9	40.1	41.0	1.026
1.027	35.8	36.3	37.1	38.1	39.2	40.2	41.5	42.3	1.027
1.028	37.1	37.6	38.4	39.4	40.4	41.5	42.8		1.028
1.029	38.4	38.9	39.7	40.7	41.8	42.9			1.029
1.030	39.7	40.2	41.0	42.0					1.030

For example your hydrometer reading is 1.025. The water temperature is 74°F (read to the nearest which is 75°). Find 75°F on the top of the chart, and the hydrometer reading of 1.025 on the side. Read down the chart from the 75° and across from the 1.025 hydrometer reading. The salinity is the number where the two readings meet.

GLOSSARY

BEAKER	- a wide mouth glass or cup, usually with a lip
CALIBRATED	- a series or set of marks as found on thermometers, rulers, and measuring cups, which should agree with an established (set) standard
CENTIMETER	- 1/100 of a meter; a unit of length measurement in metric system
DENSITY	- the amount or mass of anything in a certain area or volume
HYDROMETER	- an instrument that may be used to measure how much room salt particles take up in a certain amount of water
INTERVAL	- the space or gap between two things
METER	- a unit of length measurement in the metric system equal to 39.7"
PHYSICAL CONDITIONS	- the characteristics' properties or nature of non-living matter
PROFILE	- a side view of something
REFRACTOMETER	- an instrument which may be used to determine the number of salt particles in 1000 parts of water by measuring the bending of light as it passes through the water.
SALINITY	- the amount of salt found in a certain amount of water
SAMPLE	- a selection or a part of something which then represents it
SIGHTING LEVEL	- an instrument used to locate an object and determine if it is flat or horizontal
SLOPE	- the slant or incline of something or any deviation from a horizontal position
SURVEY	- detailed investigation
WATER TABLE	- the top, surface, or level of the water in the ground

EQUIPMENT

Sighting levels

Meter sticks

Water thermometer

Refractometer

or

Hydrometer

Clipboard - data sheets

Shovels

Sand sieve

Martin County Schools'
Environmental Studies Center
2900 N. E. Indian River Drive
Jensen Beach, Florida 33457

Eighth Grade

The Sifting Sand

INTRODUCTION

This LAP will help you understand how to figure the percentage (%) of the grain sizes found on our beach in Martin County.

Read the unit first. When you are sure you understand how to do the problems, take the self evaluation test. The test is on page 4.

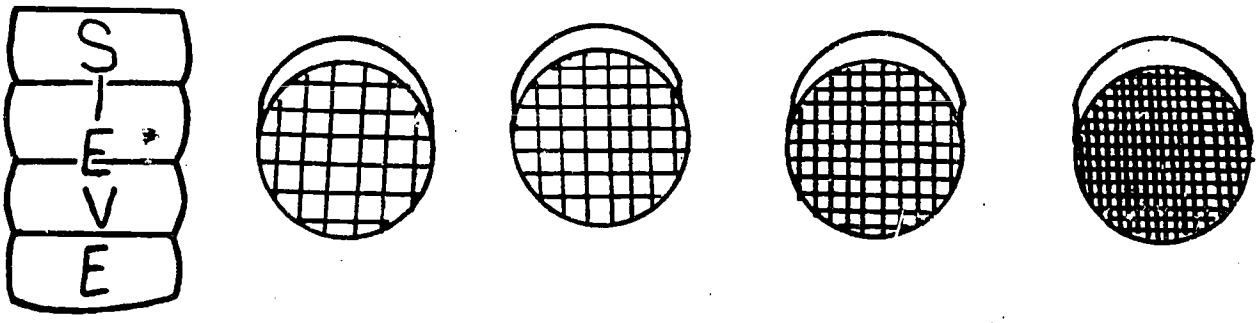
Do NOT write on the test - PLEASE.

A score of 100% is SATISFACTORY!

THE SIFTING SAND

The sand sieve is used to separate sand grains into various groups depending on the size of the grains.

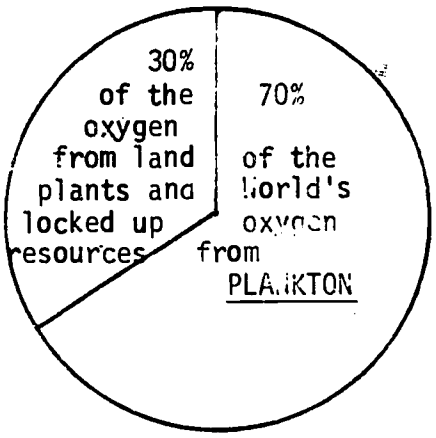
Remember in the Beach Survey LAP you were told you would put 400 ml of sand into the top sieve of the set. Each sieve grades down in size. The bottom sieve being the finest.



You of course will remember to put the sand from each sieve section into a plastic bag marked to match that section of the sieve along with your name.

We want you to find the percentage (%) of each grain size. A % is a part of the whole. The whole of anything is equal to all of it or 100%.

EXAMPLE -- LOOK AT THE PICTURE



PROCEDURE:

1. Back at the Center each sand sample is weighed separately and the weight recorded.

(Top) ... Weight of sample #1 .... 115 grams
" " " #2 .... 120 g
" " " #3 .... 100 g
(Bottom) " " " #4 .... 75 g

2. Add the weights together.

115 g.
120 g.
100 g.
75 g.

410 g.

Total weight of all sand = 410 g. or 100%

3. Divide the weight of each sample by the total weight. You can express it several ways.

a. 75 g. ÷ 410 g. = _____

b. sample #4 ----- 75 g.. =
total weight -- 410 g. ____

c. 410/ 75 = _____

4. Let's try long division.

```
      .182
410/ 75.000
     410
     3400
     3280
      1200
       820
```

5. Round off your answer to two (2) places.

.18

6. To change the answer to % simply move the decimal point two (2) places to the right and add the % sign.

.18 = 18%
····>

If you prefer, multiply the decimal by 100 the long way.

```
  100
  .18
  800
100
```

18.00%

7. Answer the following questions on a separate sheet of paper. Ask your teacher for the answer key.

SELF EVALUATION TEST

Do NOT write on the test.

Refer back to the LAP to answer questions. Using the figures given in the example on page 2, answer the following questions.

1. Which sieve of sand weighed the least?

   a. 1 c. 3

   b. 2 d. 4

2. Which weight is 100% of the sand?

   a. 75 g. c. 120 g.

   b. 100 g. d. 410 g.

3. The second sieve had sand that weighed the most. What does this mean about its percent (%) of all sand?

   a. 100% c. higher than other sieve section

   b. greater than 100% d. lower than any other sieve section

4. What is the % of the total weight of sample #3?

5. What is the % of the total weight for sample #2?

ANSWER KEY FOR SELF EVALUATION TEST

1. d

2. d

c. c

4. 24%

5. 29%

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Eighth Grade

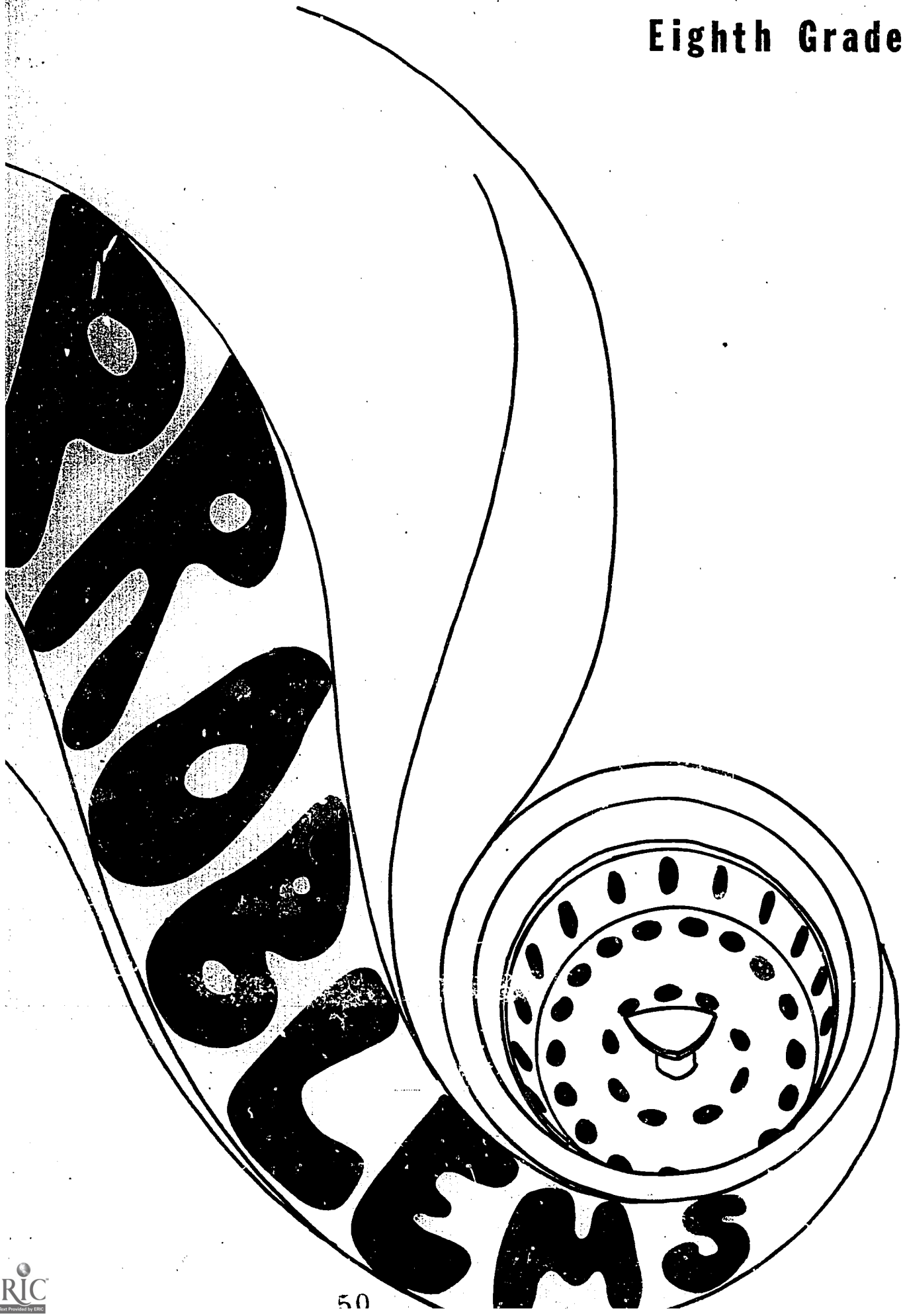


TABLE OF CONTENTS

INTRODUCTION

We hope after you have read, discussed, and answered questions in this unit that you are more aware of our environment and that you note an environmental problem for one group isn't necessarily a problem for other groups.

The fact that you can go to a beach, or even get onto the beach, swim in clean water, breathe fresh, clean air, go fishing and eat your catch didn't just happen in Martin County in 1976. Someone had to care. Someone had to work for these privileges and rights that we all enjoy.

Our city and county commissioners are continually faced with choices in regard to development of our community.

Will we try to limit growth?

Should we allow more trailer parks?

Can construction of schools, fire station, roads and bridges keep up with development?

What happens to taxes?

Do you think our problems can be solved and sent down the drain?

Do you have any solution?

ENERGY CRISIS

We have all been exposed recently to what has been termed the "energy crisis". This "crisis" was the result of a decrease in availability of certain types of fuels. These fuels are of course, fossil fuels. They are the result of aging process of decayed and now extinct forms of plants and animals that existed millions of years ago.

Man, especially in the United States, depends almost totally on this source of energy. Our electricity is generated by plants from fossil fuels. Our machinery is powered and operated by oil and gasoline, more fossil fuel.

To maintain civilization as established, man must find new sources of energy.

Nuclear energy is one means of providing the demanded electrical power. Florida Power and Light is constructing a twin nuclear power plant on the Indian River in south St. Lucie County. Work is also beginning on a much larger fossil fuel complex in western Martin County.

In some areas machines are being modified to operate more efficiently on lesser amounts of the same type of fuel. Some machines are being redesigned to operate on coal, a different type of fossil fuel.

Scientists and engineers try to harness the energy of the tides and sun. Architects are learning to redesign buildings and cities which will take advantage of natural slopes, locations, breezes, and open spaces. They will be designed to use less energy.

All of these methods will help alleviate the energy shortage at least for a time.

Should man learn ways to cut the demand on these resources to equal their supply?

Ours is a society of waste. Many things are designed to be used a few times then disposed of for a new model. Let's look briefly at a plastic cup.

How much energy is consumed for the production and use of this cup? It all begins with fossil fuel. First -- locate, drill, refine, process, and transport the fossil fuel to construct factories, which manufacture the cups -- then -- package, store, market, use, dispose, collect and burn as waste. ALL FOR ONE SIP OF WATER??

ENERGY CRISIS -- Help Aids

GLOSSARY:

extinct - no longer existing in living form

fossil - remnant or trace of an organism of a past geological age

MAGAZINES:

1. "Decisions - Decisions" by Hal Scott - Florida Naturalist - Aug. 74
2. "Tapping the Sun's Energy" by David Lee - Nat'l Wildlife - Aug-Sept.74 pp 18-20
3. "Energy" by Robert Bishop - Florida Naturalist - Aug. 74 pp 6-7

BOOKS & PAMPHLETS:

1. Atomic Energy and Your World by Glasstone and Thomas pp 2-9; 10-15; 23-26; 49-52
2. Nuclear Power Plants by Lyerly and Mitchell -- pp 15-23
3. Worlds Within Worlds by Isaac Asimov - Chapt. "Energy of the Sun" pp 55-62

FILM - 16mm:

1. "Controlling Atomic Energy" #105 - available from Instructional Center

OTHER:

1. 8 x 10 aerial picture of Hutchinson Island nuclear plant
2. One Earth - Audubon 7/74 - Lamination
3. Energy Conservation in U.S. Is a Must - Miami Herald - 4/74 - Lamination
4. Speaker from Environmental Center available

INTRACOASTAL WATERWAY

The Intracoastal waterway is a series of connected bodies of water that run from Massachusetts to the Florida Keys. The Indian River is a natural part of the waterway running about one-hundred miles along Florida's east coast.

The waterway in most areas is protected from the open seas by natural land barriers. Here in our county, Hutchinson Island is the natural barrier.

Originally the Indian River was a shallow, brackish, slow moving body of water. Many parts of it still are.

However, an increased population, industrial development, more tourists and larger boats have brought about changes in our waterway.

To satisfy the demands of citizens, the Army Corp of Engineers has dredged a channel. This dredged channel which in most areas is 3 - 5 meters deep provides a passage for shipping and larger watercraft.

Fill from the dredging is piled in mounds, forming spoil islands scattered throughout the river.

The area south of the St. Lucie Inlet is one area of the intracoastal where natural passage was practically non-existent. Heavy dredging through mangroves occured here.

Passage from the waterway to the open sea is accomplished through natural inlets or dredged inlets such as the one in Martin County.

Dredging does intervene into established ecosystems of the river. Grassflats are altered or destroyed. An increased salt water flow through dredged inlets from the ocean into the intracoastal waterway changes river salinity to some extent. How much environmental damage is done is a debatable point.

a. If you were a tourist with a large yacht and wanted to come to south Florida the safest way -- how would you feel?

b. If you manufactured moon rockets and wanted to get them to Cape Canaveral via water -- how would you feel?

c. If your livelihood depended on carrying large amounts of freight by boat -- how would you feel?

d. If you were a fisherman and the nursery provided by grassflats for gamefish were gone -- how would you feel?

e. If you were a pelican and nested in the mangroves -- would it matter to anyone?

INTRACOASTAL WATERWAY - Help Aids

GLOSSARY:

brackish - water containing some salt, but less than the ocean

ecosystem - an ecological community together with its physical environment

meter - a unit of length in the metric system of measurement

spoil island - islands formed in the river by dredging of the intracoastal waterway.

BOOKS & PAMPHLETS:

1. "America's Inland Waterway" - Chapt. 1 (excellent pictures throughout -- by National Geographic

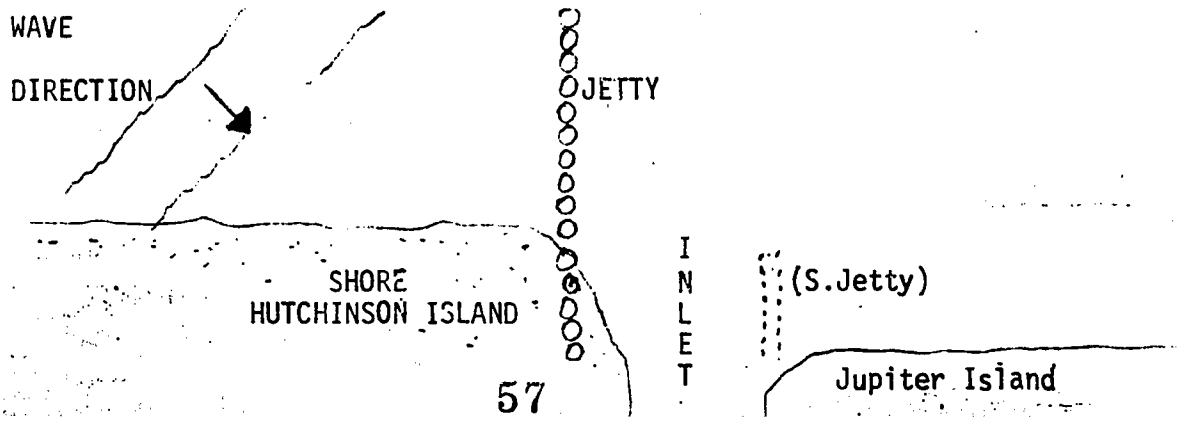
ST. LUCIE INLET AND ARTIFICIAL STRUCTURES

Much of this area's development is related to the digging of the St. Lucie Inlet. The inlet was originally dug by local residents in 1892. The inlet established a higher salinity level in the St. Lucie and Indian Rivers and also provided access to the ocean. This, of course, was a commercial boon to the area. A few years later a jetty was added to prevent shoaling of the inlet by sand. The single jetty has caused the beach to build up north of the jetty. The inlet is now maintained by periodic dredging of the channel by the Army Corps of Engineers.

The longshore current usually flows in a southerly direction along our coast. This current is supposed to deposit sand and build up beaches as it moves. However, when it comes to an obstruction such as the north jetty at the St. Lucie Inlet, the flow of sand stops. Here the beach is built up. At the same time Jupiter Island beaches south of the inlet are disappearing. Little sand is available to nourish the beach.

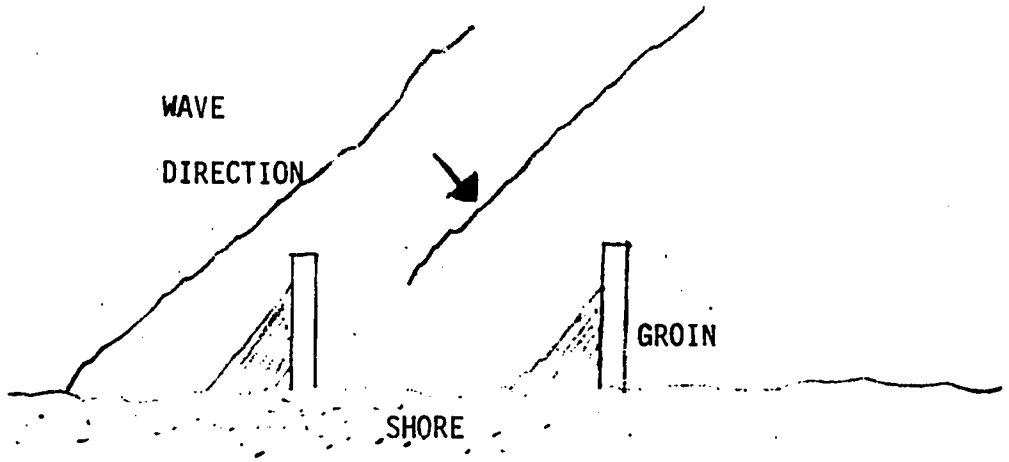
Associated with the beach problem is sand filling the inlet. Periodic dredging is needed to clear a safe passage for large fishing boats. The dredged sand is spewed southward onto the beaches of Jupiter Island.

Engineers plan to construct a new south jetty. This jetty will take advantage of sand flowing north at the times the longshore current flows north. It will also help prevent sand filling in the inlet.

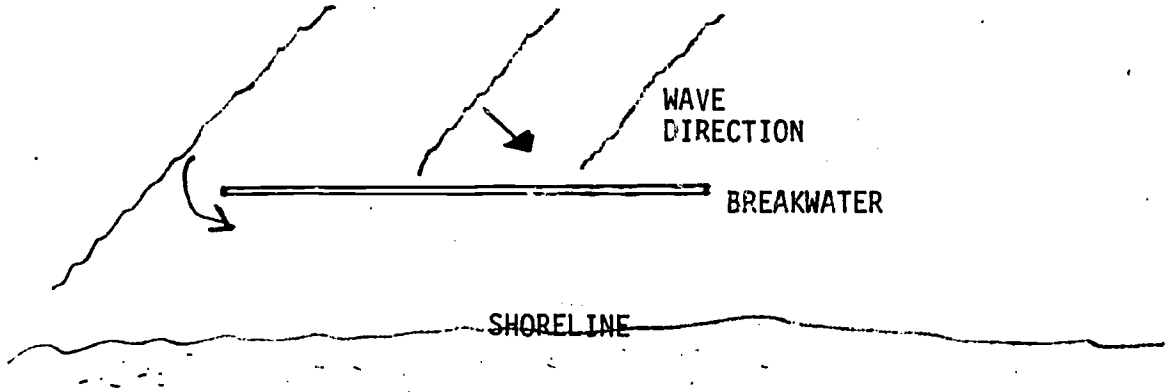


ST. LUCIE INLET AND ARTIFICIAL STRUCTURES (cont'd)

Small structures such as groins have been built for the same reason. They deter the erosion of beach front, not always satisfactorily, in commercial areas where motels and hotels have been constructed.



Another type of structure built to alter the effect of constant wave pounding, is a breakwater. This structure is built out in the water but in the same line with the shore -- parallel.



Remember these structures are built for the benefit of man. The natural shoreline is in constant change as a result of a changing earth. Continual waves and tides work in harmony with the aging of the planet.

Why are these artificial structures constructed? Do they permanently alter the progress of continual shoreline change? What environmental problems can result from their construction?

ST. LUCIE INLET AND ARTIFICIAL STRUCTURES - Help Aids

GLOSSARY:

breakwater - a barrier that protects a harbor or shore from the full impact of waves

groin - a damlike structure, usually a few feet high and about 100 feet long, constructed perpendicular to the shoreline

inlet - a channel leading inland, as from the ocean

jetty - structure projecting into the water from the shore to influence currents or protect a harbor or shoreline

longshore current - a current of water that runs parallel to the shoreline

spew - eject, expel, thrust, discharge or throw out

BOOKS & PAMPHLETS:

1. The Ocean World - by Vladimer & Kovalik - Chapt 4 - 5
2. Waves - by Herbert Zim
3. Waves, Tides, Currents by E. Clemons - Chapt. 7
4. Deep Sea World by C. Combs - Chapt. 3
5. Waves and Beaches by W. Bascomb - pp 232-256

FILM: 16 mm:

1. "Waves" - Available from Instructional Center - 16 min.

FILM LOOPS:

1. The Beach IV
2. Coastline Formation - Part IV

A BIG BAD MOTHER (Nature)

The dictionary defines disaster as an occurence inflicting widespread destruction and distress. However, remember it is man that defines destruction and distress.

Hurricanes, tornadoes and northeasters inflict severe damage to man's boats, houses, hotels, livestock and himself. These disasters cost millions of dollars in property damage and loss of life annually.

Bad as it seems there are reasons for Mother Nature's methods.

Hurricanes for example are usually accompanied by heavy rains. These rains replenish the fresh water table. The heavy winds of a storm churn up the waters and nutrients of bays, estuaries, and ocean alike.

These nutrients then become an important link in the energy webs. Storms are nature's way of clearing and cleaning dead and weakened trees from an area, sort of a natural selection process.

When man builds his cities in storm prone areas, he asks for disaster to strike.

If man is truly to live within his environment, should he adjust his ways to nature and not vice versa?

A BIG BAD MOTHER (Nature) - Help Aids

GLOSSARY:

estuary - an arm of the sea that extends inland to meet the mouth of a river

energy web - a pattern of transfer of energy within a community, an interlinking of food chains

northeaster - a storm or gale from the northeast

nutrients - something that nourishes - aids growth or development

water table - the top level of the water in the ground

MAGAZINES:

1. "Our Changing Atlantic Coastline" - Nat'l Geographic - Dec. 62 pp 860 - 887
2. "Alaska Earthquake" - Nat'l Geographic - July 64
3. "Avalanche" - Nat'l Geographic - June 62
4. "Forest Fire" - Nat'l Geographic - July 68
5. "Volcano Overwhelms an Iceland Village" - Nat'l Geographic - July 73
6. "This Changing Earth" - Nat'l Geographic - Jan. 73

BOOKS & PAMPHLETS:

1. Hurricanes, Storms, Tornadoes - Putnam Science Survey
2. Weather - How and Why Wonder Book
3. Weather - Life and Science Library
4. Storms and Man by Ross Lothrop
5. Weather - Golden Science Guide
6. Waves and Beaches - by W. Bascomb - Chapt. 11

FILM LOOPS:

1. Story of a Storm
2. Coastal Waters - Stormy Weather

THE FRAGILE DUNE

Most of you are aware that a dune is a hill of wind-blown sand. The size or type of dune is determined by the wind speed, the sand supply and vegetation.

Those of you who live on Skyline Drive in Jensen Beach are living on an old dune. Obviously the shoreline has receded in the eons of time since then. The dunes you will observe in this study unit are of course relatively new and located on the beach.

You will find a natural succession of plants proceding from the front face of the dune back from the shoreline.

All of these beach plants have certain adaptive features. For example, they have a thick outer covering on the leaves to help prevent water loss, deep roots to get fresh water, sprawling structure or very flexible stem to withstand the wind. These plants, because of their adaptations, hold the sand and hence the dune.

The pioneer or first plants in this harsh environment are the sea oats, railroad vine and sandspurs. Living on top of the dune are trees like the australian pine and sea grapes. Other plants associated with our dunes are the yucca and saw palmetto. Th r similar roots spread thick stems underground which hold water and them in their position.

Beach sunflower and sea lavender will be found moving toward the back of the dune. In this area a member of the bean family is a gangly shrub, the necklace pod.

Spurge nettle or finger rot and stickleaf are two annoying plants to man along the dune.

Other inhabitants of the sand dunes are ghost crabs, raccoons, spiders, yucca moths, butterflies, dragonflies, birds and snakes.

All these creatures are here because they can find food, water, and shelter and have some specific role to play. For example: the yucca moth has an important role in the dune system. Find out what it is.

Do you see why beach buggies are prevented from using the beach?

Do you see why ramps have been built at the beach access points?

THE FRAGILE DUNES - Help Aids

GLOSSARY:

adaptation - anything that is changed or changes so as to become suitable for a new use or situation

eon - longest division of geologic time, containing two or more eras

succession - living things that follow other living things as the conditions of the environment change

MAGAZINES:

1. Our Changing Atlantic Coastline - Nat'l Geographic - Dec. 62

BOOKS & PAMPHLETS:

1. Geology - Golden Science Guide - pp 76 - 77
2. Seashores - Golden Nature
3. Brittanica Encyclopedia - your media center
4. The Wild Young Desert by Atwood
5. Audubon Nature Encyclopedia - Vol. 3
6. Ecology by J. Nicklesburg - Chapt. 8

FILM - 16mm:

1. "Dunes" - no sound - available at Instructional Center

FILM LOOPS:

FILMSTRIPS:

SLIDES:

Slides from Center

OTHER:

Field trip from Center

Martin County Schools'
Environmental Studies Center
2900 N.E. Indian River Drive
Jensen Beach, Florida 33457

8th Grade Slide Presentation

'Problems"

TEACHER - Turn on projector to "Focus" slide. Turn on tape player. Advance the slide at the audible tone (or, if you are reading this narration, where indicated by the asterisk (*). The narration is in CAPTIAL letters.

1. "Focus" *

2. "Credits" slide *

3. "An Environmental Study Unit on Beach Investigations" *

4. "Problems" *

5. WHAT ONE GROUP CONSIDERS A PROBLEM ANOTHER GROUP MAY NOT. ENVIRONMENTAL PROBLEMS ARE THOSE CONCERNING THE ENVIRONMENT. DOES INCREASED BUILDING REALLY AFFECT THE NATURAL HABITATS OF THE PELICAN, SNOOK, AND MANGROVE? CAN BOTH EXIST AT THE SAME TIME? DOES DESTROYING THE DUNES AFFECT ONLY THE WILD ANIMALS AND PLANTS THAT LIVE THERE? THESE ARE EXAMPLES OF ENVIRONMENTAL PROBLEMS. *

6. WE WILL DISCUSS WITH YOU FIVE ENVIRONMENTAL PROBLEM TOPICS THAT ARE RELATED TO YOUR BEACH SURVEY. THEY ARE: (1) ENERGY CRISIS; (2) INTRACOASTAL WATERWAY: (3) INLETS AND ARTIFICIAL STRUCTURES: (4) BIG BAD MOTHER NATURE AND (5) THE FRAGILE DUNE. *

7. THE ENERGY CRISIS DURING THE WINTER OF 1974 WAS MAINLY THE RESULT OF THE SHORTAGE OF FOSSIL FUELS. *

8. WE IN THE UNITED STATES DEPEND ALMOST COMPLETELY ON FOSSIL FUELS, FOSSIL FUELS ARE A PRODUCT OF THE AGING AND DECAY PROCESS OF EXTINCT PLANTS AND ANIMALS. *

9. NUCLEAR POWER PLANTS PROVIDE A PARTIAL SOLUTION TO OUR PRODUCTION OF ELECTRICAL ENERGY. THE FUEL SOURCE IS THE ATOM. TWIN NUCLEAR POWER PLANTS WILL BE CONSTRUCTED ON HUTCHINSON ISLAND TO SUPPLY THE INCREASED DEMAND FOR ELECTRICAL POWER IN EAST CENTRAL FLORIDA. *

10. MOST OF OUR POWER PLANTS IN FLORIDA USE FOSSIL FUEL AS A POWER SOURCE. AT THE PRESENT TIME A LARGE FOSSIL FUEL COMPLEX IS BEING BUILT IN WESTERN MARTIN COUNTY. *

11. TO MAINTAIN CIVILIZATION AS IT IS, WE MUST FIND NEW SOURCES OF ENERGY OR BE MORE CONSERVATIVE IN OUR USE OF THE PRESENT SOURCES. *

12. MAN MUST TRY TO HARNESS (MORE EFFICIENTLY) THE ENERGY FROM THE TIDES. *

13. THE SUN *

14. THE WIND *

15. THE WATER *

16. WE MUST DESIGN BUILDINGS TO TAKE ADVANTAGE OF BREEZES, SUNLIGHT, AND NATURAL FOLIAGE. BY UTILIZING NATURAL FORCES WE CAN CUT DOWN THE WASTE OF OUR NATURAL RESOURCES. *

17. MUCH YET HAS TO BE DONE. WE ARE A 'THROW AWAY' SOCIETY. *

18. MOST OF OUR MAN-MADE PRODUCTS ARE DESIGNED TO BE THROWN AWAY. HOW MUCH ENERGY COULD BE SAVED IF MORE EMPHASIS WERE PLACED ON A PRODUCT'S RECYCLABILITY? *

19. HOW MANY TREES DOES THIS PILE OF NEWSPAPERS REPRESENT? *

20. CAN YOU SEE A WASTE OF ENERGY (LONG PAUSE - 5 to 10 seconds) *

21. INTRACOASTAL WATERWAYS ARE CHANNELS MAINTAINED IN PART BY DREDGING. *

22. THE INTRACOASTAL WATERWAY IS A CONNECTED SERIES OF PROTECTED WATERWAYS RUNNING FROM MASSACHUSETTS TO THE FLORIDA KEYS. *

23. A CHANNEL, 3-5 METERS DEEP, MUST BE MAINTAINED TO PROVIDE FOR COMMERCIAL TRAFFIC. *

24. AND PLEASURE *

25. THE DREDGED MATERIAL FROM THE CHANNEL IS OFTEN USED TO BUILD SPOIL ISLANDS. THESE ARE SCATTERED ALONG THE WATERWAY. AT THE SAME TIME DREDGING CAN INTERFERE WITH THE GRASSFLATS WHICH PROVIDE HABITAT FOR FISH, SHRIMP, CRABS, AND BIRDS. NOTE THE GRASSFLAT AT THE BOTTOM OF THE SLIDE. *

26. THE ST. LUCIE INLET WAS DUG IN THE 1890'S BY LOCAL CITIZENS TO PROVIDE ACCESS TO THE SEA. *

27. THIS OPENING RAISED THE SALINITY OF BOTH THE ST. LUCIE AND INDIAN RIVERS. THE INCREASED SALINITY IN TURN CHANGED THE SPECIES OF PLANTS AND ANIMALS FOUND THERE. TO HELP KEEP THE INLET OPEN A GRANITE ROCK JETTY WAS BUILT ON THE NORTH SHORE. YOU CAN SEE THE JETTY EXTENDING FROM THE BEACH TOWARD THE LOWER RIGHT CORNER OF THIS PICTURE. *

28. IN THIS AREA THE LONGSHORE CURRENT NORMALLY TRANSPORTS SAND FROM NORTH TO SOUTH. THIS RIVER OF SAND IS PARTIALLY BLOCKED BY THE JETTY. AS A RESULT THE SAND BEACH IS BUILT UP ON THE NORTH SIDE OF THE JETTY AS SHOWN IN THE RIGHT HAND SIDE OF THE PICTURE. SOME OF THE SAND IS ALSO DEPOSITED IN THE INLET, REQUIRING PERIODIC DREDGING TO MAINTAIN THE CHANNEL FOR LARGE BOATS. *

29. AT THE SAME TIME THE BEACH SOUTH OF THE INLET DOES NOT RECEIVE ITS SHARE OF THE TRANSPORTED SAND AND IS RAPIDLY ERODING. TO HELP PREVENT THIS EROSION OF JUPITER ISLAND, A SECOND JETTY WILL BE CONSTRUCTED ON THE SOUTH SIDE OF THE INLET. *

30. BREAKWATERS AND GROINS (THE LATTER SEEN IN THIS PICTURE) ARE ARTIFICIAL STRUCTURES DESIGNED TO CONTROL OR ALTER THE FLOW OF SAND BY THE LONGSHORE CURRENT. THEY ARE BUILT PERPENDICULAR TO THE SHORELINE. *

31. A DISASTER IS SOMETHING THAT INFLICTS WIDESPREAD DESTRUCTION. *

32. MUCH DAMAGE TO MAN'S STRUCTURES OCCURS EACH YEAR AS A RESULT OF NATURAL FORCES. THE CONCRETE WALLS OF THIS BUILDING WERE BLOWN DOWN DURING HURRICANE DONNA IN SEPTEMBER OF 1960. *

33. THIS IS HOW IT LOOKED DURING THE HURRICANE IN EVERGLADES NATIONAL PARK. *

34. WATER SPOUTS TOUCH DOWN THROUGHOUT THE YEAR IN FLORIDA. TORNADOS CAUSE WIDESPREAD DESTRUCTION ON LAND. *

35. STORMS OFTEN CAUSE HIGH TIDES THAT FLOOD CRITICAL AREAS AND CAUSE PROBLEMS FOR MAN AND WILDLIFE. *

36. DISASTERS PLAY AN IMPORTANT PART IN NATURAL SELECTION - THE WEEDING OUT OF WEAK OR SICK PLANTS AND ANIMALS. THE WEAKER MAHOGANY TREE IN THE FOREGROUND WAS BLOWN DOWN IN HURRICANE DONNA WHILE THE STRONGER TREE IN THE BACKGROUND RECOVERED. *

37. WEAK OR SICK ANIMALS SUCH AS THIS DOLPHIN CANNOT SURVIVE THE HARSH CONDITIONS. *

38. OFTEN MAN INSISTS ON REBUILDING IN THE SAME AREA AS BEFORE. ISN'T THERE A WAY IN WHICH WE CAN LEARN TO LIVE AND ADJUST WITHIN THE LAWS OF NATURE? *

39. ALONG THE BEACH ARE HILLS OF WIND BLOWN SAND. THESE ARE SAND DUNES. THEIR LOCATION AND SHAPES SHIFT AS A RESULT OF WIND, RAIN, QUANTITY OF SAND AVAILABLE AND THE PLANT LIFE. *

40. THIS DUNE WAS ERODED DURING A STORM BECAUSE PEOPLE DESTROYED THE VEGETATION BY WALKING TO AND FROM THE BEACH. *

41. SKYLINE DRIVE IN JENSEN BEACH IS AN OLD DUNE LINE. *

42. THERE IS A NATURAL SUCCESSION OF PLANTS FROM THE SHORELINE TO THE DUNES. NOTE THE RAILROAD VINES IN FOREGROUND AND SEA OATS. *

43. ALL OF THESE PLANTS HAVE CERTAIN ADAPTIVE FEATURES THAT ENABLE THEM TO EXIST IN THIS HARSH ENVIRONMENT. SOME OF THESE FEATURES ARE DEEP ROOTS. NOTE THE EXTENSIVE ROOT SYSTEM OF THE SEAGRAPE IN THIS PICTURE. *

44. THE THICK WAXY OUTER COAT ON THE LEAVES OF THESE SEAGRAPES PREVENT WATER LOSS.

45. OTHER PLANTS ALONG THE DUNE ARE THE YUCCA WITH ITS SHARP POINTED THICK LEAVES.

46. SANDSPURS *

47. AND THE SAW PALMETTO. THESE PLANTS AND OTHERS TOO, BECAUSE OF VARIOUS ADAPTATIONS, HOLD THE SAND AND HELP FORM THE DUNE. *

48. THE AUSTRALIAN PINE, AN IMPORTED PLANT, MOVES INTO THE HABITAT OF THE NATIVE PLANTS AND EVENTUALLY TAKES OVER THE AREA. AS THE AUSTRALIAN PINE IS NOT A GOOD SOIL HOLDER THIS PRESENTS ANOTHER ENVIRONMENTAL PROBLEM CAUSED BY MAN.

49. A FEW OF THE ANIMALS ASSOCIATED WITH THE DUNES ARE THE GHOST CRAB, *

50. RACOONS *

51. SPIDERS *

52. AND SNAKES. THIS RIBBON SNAKE FINDS HIS HOME IN THE PALMETTO. *

53. The End

TEACHER - Please rewind tape for next use. Thanks

JUMBLES

BEACH

THE

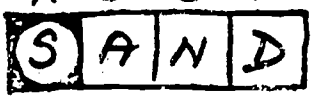
CROSSWORD

FIND

JUMBLES

#1

A D S N



A E T H

M S A C L

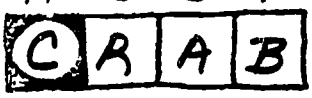
L T S A Y

CLUE: STUART BEACH IS MADE OF THIS MATERIAL

SURPRISE ANSWER HERE:

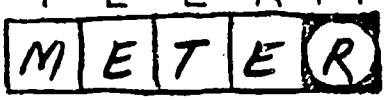
#2

A C B R

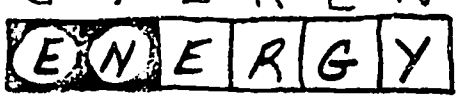


V R E U C

T E E R M



G Y E R E N



O H T F R

CLUE: A STEADY FLOW OF WATER

SURPRISE ANSWER HERE:

BEACH SURVEY

BREAK THE CODE

DIRECTIONS: Each of the following statements is in CODE. Each code is different. At the beginning of each new statement two coded letters have been broken. The decoded letters have been filled in the correct position. You figure out the rest. Each statement will be related to the BEACH.

#1 ... X = W P = A

W	A	V	E	S		W	A	S	H		S	A	N	D		A	W	A	Y
X	P	O	B	F		X	P	F	J		F	P	Q	K		P	X	P	C

#2... O = S M = E

T	H	E		S	A	N	D		I	S		S	I	F	T	E	D		F	R	O	M
L	P	M		O	R	J	F		X	O		O	X	G	L	M	F		G	N	K	A

T	H	E		S	H	E	L	L	S		I	N		T	H	E		S	I	E	V	E
L	P	M		O	P	M	C	C	O		W	B		L	P	M		O	X	M	T	M

#3 ... R = T P = E C = R

T	H	E		C	U	R	R	E	N	T		C	A	R	R	I	E	S		S	A	N	D
R	O	P		M	A	C	C	P	L	R		M	J	C	C	N	P	B		B	J	L	X

#4 ... W = A R = D

W	I	N	D		A	N	D		T	I	D	E		M	A	K	E		W	A	V	E	S
X	P	V	R		W	V	R		I	P	R	Q		A	W	L	Q		X	W	T	Q	O

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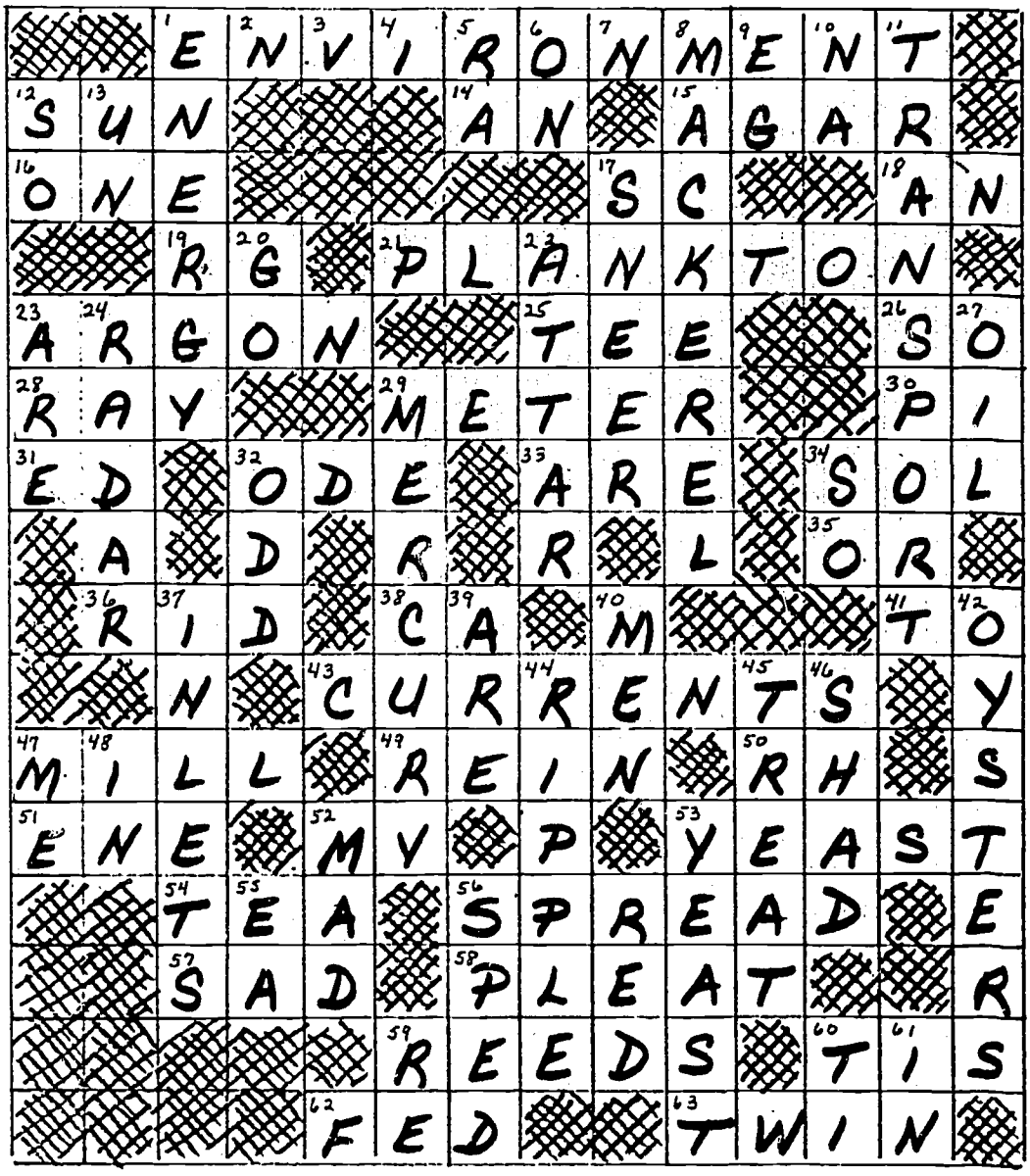

1 E 2 N 3 V 4 I 5 R 6 O 7 N 8 M 9 E 10 N 11 T
12 S 13 U N 14 A N 15 A G A R
16 O N E 17 S C 18 A N
19 R 20 G 21 P L 22 A N K T O N
23 A 24 R G O N 25 T E E 26 S 27 O
28 R A Y 29 M E T E R 30 P I
31 E D 32 O D E 33 A R E 34 S O L
A D R R L 35 O R
36 R 37 I D 38 C 39 A 40 M 41 T 42 O
N 43 C U R 44 R E N T 45 46 S Y
47 M 48 I L L 49 R E I N 50 R H S
51 E N E 52 M V P 53 Y E A S T
54 T 55 E A 56 S P R E A D E
57 S A D 58 P L E A T R
59 R E E D S 60 T 61 I S
62 F E D 63 T W I N

SANDY BEACH CROSSWORD

ACROSS

1. surroundings
12. star
14. indefinite article
15. base for culture media
16. single unit
17. abbreviation for university in South
18. indefinite article
19. abbreviation for football position
21. aquatic floating organisms
23. colorless gas
25. golf term
26. conjunction
28. manta or sting___ ___ ___
29. unit of measure
30. math constant π
31. diminutive of Edward
32. poem
33. part of verb"to be"
34. the sun
35. conjunction
36. to free
38. chemical symbol for calcium
41. preposition
43. steady movements of water
47. building to grind corn
49. narrow strap for a harness
50. a blood factor
51. wind direction
52. possessive word
53. one celled fungi
54. dried leaves used in making a drink
55. abbreviation for each
56. lay out
57. not happy
58. a fold in cloth
59. part of the mouthpieces of certain musical instruments
60. contraction for "it is"
62. past tense of feed
63. forming one of a pair

DOWN

1. power, force, energy expended
5. Egyptian sun god
6. preposition
8. food fish
9. abbreviation for example
10. chemical symbol for sodium
11. to carry
12. conjunction
13. abbreviation for United Nations
17. look scornfully
20. to proceed
22. oil from rose petals
23. part of "to be"
24. detecting objects by measuring radio wave lengths
27. grease
29. metallic element
32. queer
34. same as 12 down
37. openings to the ocean
39. I am, you ___ ___ ___
40. plural of man
42. shellfish
44. little wave
45. to deal with another person or animal
46. a fish
47. personal pronoun
48. preposition
52. insane
53. one celled fungi
55. abbreviation for each
56. past tense of speed
59. in regard to
60. musical note
61. preposition

????? ???????

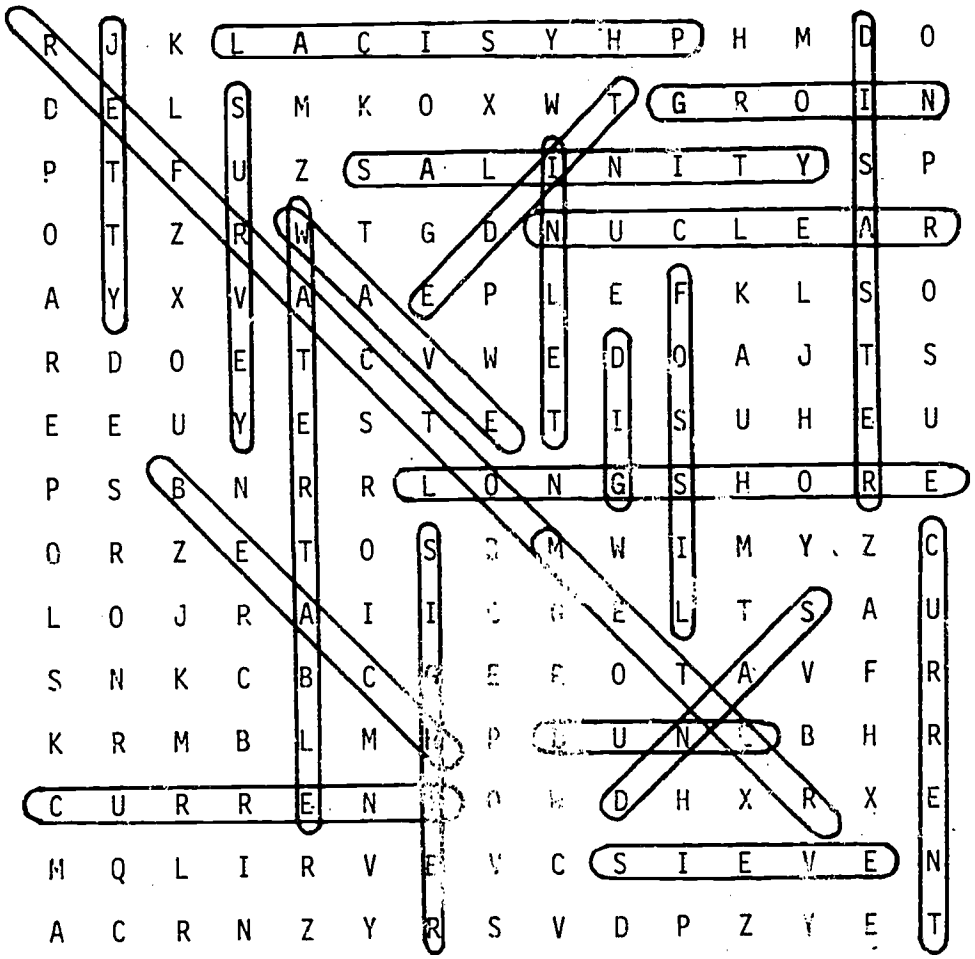
1. Fish with many sharp teeth
2. It comes from the sun
3. Basic building block of matter
4. Rock made of shells
5. Wading birds with long necks, legs, and bills
6. Diving birds
7. Measures salinity
8. A cereal grain that resembles a dune plant
9. Vertebrate with both eyes located on top of head
10. Opening to the sea
11. Term that explains transport of sand at beach
12. Fish that spawns in the Sargassum Sea

Write the one word meaning of the phrases above in the spaces provided below. The first letter in each word will spell out an activity you will do in the eighth grade program.

1. BARRACUDA
2. ENERGY
3. ATOM
4. COQUINA
5. HERONS
6. PELICAN
7. REFRACTOMETER
8. OAT
9. FLOUNDER
10. INLET
11. LONGSHORECURRENT
12. EEL

BEACH SURVEY

Directions: Find the listed words in the diagram. They run in all directions - forward, backward, up, down, diagonally.



water table
salinity
sighter
inlet
tide
longshore
current
jetty
beach
survey
dune
wave
groin
fossil
nuclear
current
sand
sieve
refractometer
disaster
physical
dig
meter

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DATA SHEET

LONG-SHORE CURRENT MEASUREMENTS

SCHOOL _____ GRADE _____ DATE _____

LOCATION _____ GROUP _____

Wind direction _____ Wave direction _____

Direction of current _____ Distance from shore to long-shore current _____

Time for object to move 10 m 1 _____

2 _____

3 _____

Total _____

Average _____(estimated speed of long-shore current)

OCEAN BEACH MEASUREMENT

DATE _____ LOCATION _____ GROUP _____

Temperature - Top Soil _____

Temperature - Air _____

Wind direction _____

Wind speed: 1 _____

2 _____

3 _____

Total _____

Average _____

Tide status _____

Temperature - Ocean _____

Ocean Salinity _____

DATA SHEET

ORGANISMS OF THE BEACH

DATE _____ LOCATION _____ GROUP _____

I - BIRDS ADAPTATIONS

II - OTHER ANIMALS

A. In WATER ADAPTATIONS

B. On the BEACH ADAPTATIONS

III - PLANTS of the OCEAN & BEACH ADAPTATIONS

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8th Grade

DATA SHEET

OCEAN WAVE MEASUREMENTS

SCHOOL _____ GRADE _____ DATE _____

LOCATION _____ GROUP _____

Estimated height of waves
1 _____
2 _____
3 _____
Total _____
Average _____

Period of waves (How often)
1 _____
2 _____
3 _____
Total _____
Average _____

Estimated wave length
1 _____
2 _____
3 _____
Total _____
Average _____

Estimated speed of waves
1 _____
2 _____
3 _____
Total _____
Average _____

V = velocity or speed

D = distance or wave length

T = time or period

Formula to find speed of waves:

$$V = \frac{D}{T}$$

GROUP _____ LOCATION _____ DATE _____

OCEAN SALINITY _____

		DEPTH - WATER TABLE	TEMPERATURE - WATER TABLE	SALINITY - WATER TABLE
STATION # _____ Distance from ocean _____		_____	_____	_____

LEVEL SIGHTING STATIONS

1 m ____ 11 m ____

2 m ____ 12 m ____

3 m ____ 13 m ____

STATION # _____ Distance from Station 1 _____		_____	_____	_____

4 m ____ 14 m ____

5 m ____ 15 m ____

6 m ____ 16 m ____

7 m ____ 17 m ____

Station # _____ Distance from Station 2 _____		_____	_____	_____

8 m ____ 18 m ____

9 m ____ 19 m ____

10 m ____ 20 m ____

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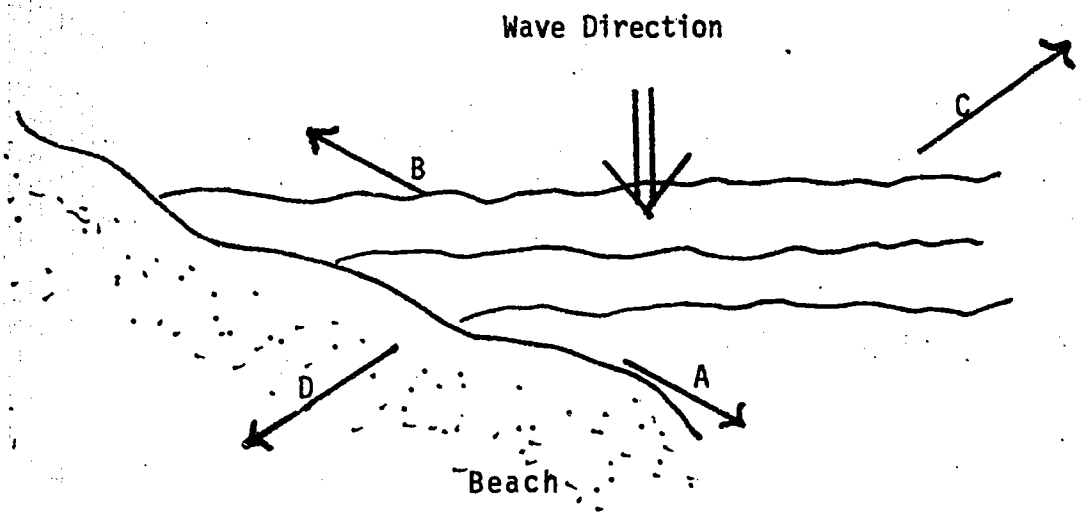
Jensen Beach, Florida 33457

OVERALL TEST

1. What determines the direction of a longshore current?

(a) angle of breaking wave to beach
(b) slope of the beach
(c) wave speed
(d) pollution

Look at diagram below -



2. Using the above diagram - in what direction will longshore current flow?

(a) A
(b) B
(c) C
(d) D

3. Using the above diagram - in what direction will the littoral drift move?

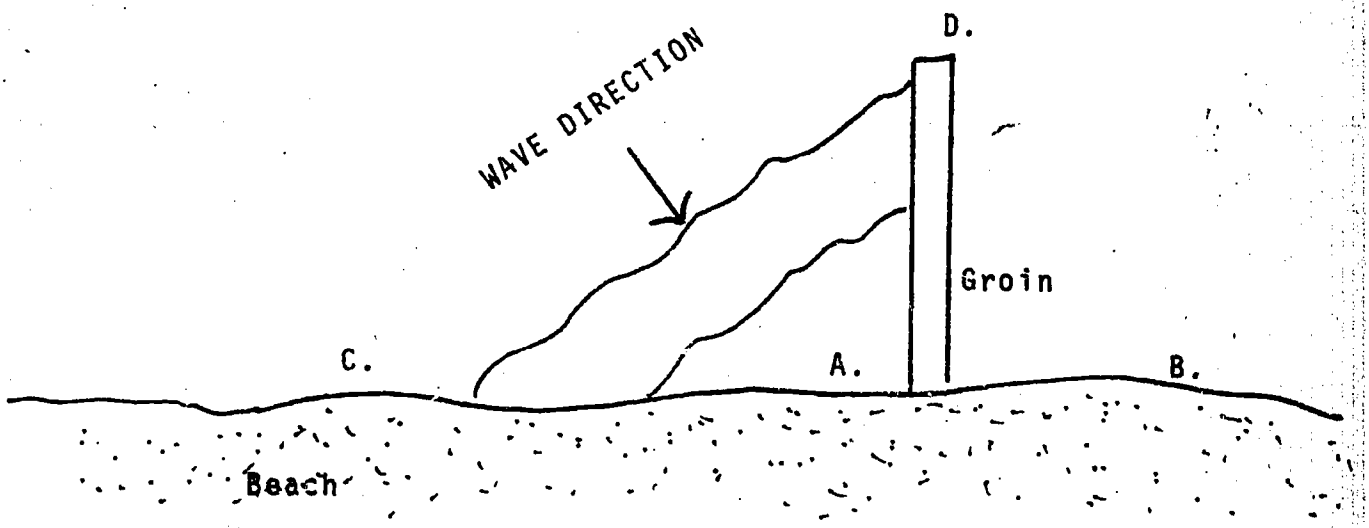
(a) A
(b) B
(c) C
(d) D

4. What causes littoral drifts along the shoreline?

(a) sand pipers
(b) undertow
(c) longshore current
(d) jetties

5. Where does the longshore current occur?

(a) around the jetties
(b) high tide zone
(c) around the reef
(d) breaker zone



USE THE ABOVE DIAGRAM FOR THE FOLLOWING QUESTIONS:

6. In what area will the littoral drift build sand the most?

(a) A
(b) B
(c) C
(d) D

7. In what area will sand erode?

(a) A
(b) B
(c) C
(d) D

8. What two physical conditions do you have to know to find the velocity of the longshore current?

(a) distance the current moves and temperature of the water
(b) distance the current moves in a certain amount of time
(c) distance the current moves and the salinity of the water
(d) temperature and salinity of the water

READ CAREFULLY, THEN ANSWER THE FOLLOWING QUESTIONS:

A ball used to find the speed of longshore current traveled 10 meters in 5 minutes.

9. What was the distance the ball traveled in one hour?

(a) 5 meters
(b) 20 meters
(c) 25 meters
(d) 120 meters

10. What is the speed of the ball?

(a) 100 meters per minute
(b) 10 meters per minute
(c) 240 meters per minute
(d) 2 meters per minute

A 400 ml (milliliter) beaker was filled with sand from the beach. The sand was then sifted through the 4 different meshed sieve sections.

Each sand sample was weighed separately and recorded -

Weight of sand - top section (1) = 115 grams
Weight of sand - 2nd section (2) = 120 grams
Weight of sand - 3rd section (3) = 100 grams
Weight of sand - 4th section (4) = 75 grams

Total = _____

11. What is the total weight of the sand?

(a) 401 g.
(b) 300 g.
(c) 410 g.
(d) 400 g.

12. Which weight is 100% of the sand?

(a) 75 g.
(b) 100 g.
(c) 120 g.
(d) 410 g.

13. The third (3rd) sieve had sand that weighed 100 grams. What does this mean about its per cent (%) of all the sand?

(a) greater than 100%
(b) less than 100%
(c) lower % than sieve #4
(d) higher % than sieve #1

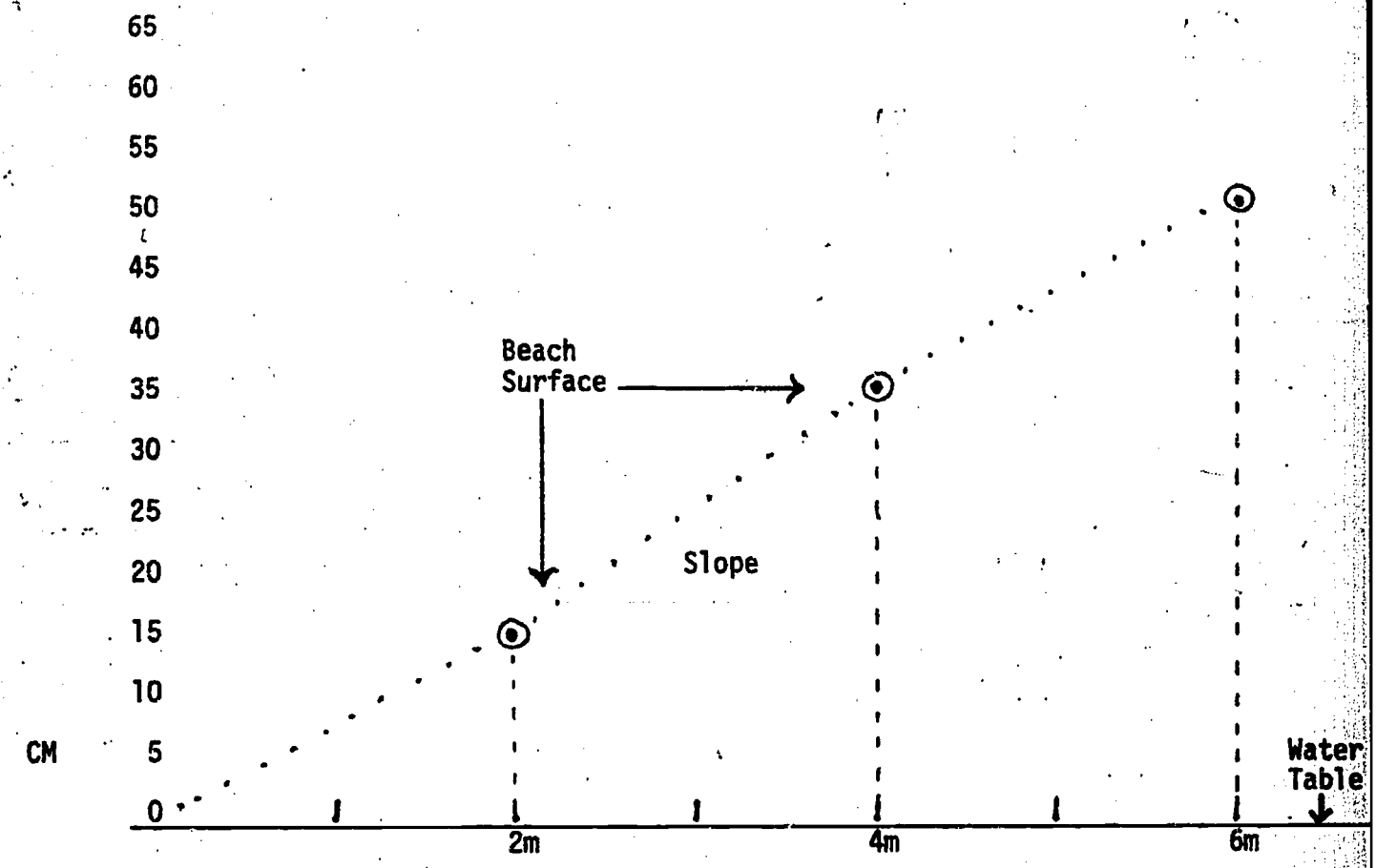
14. What is the per cent (%) of the total weight of sieve section #4?

(a) 8%
(b) 18%
(c) 15%
(d) 28%

15. The total per cent (%) for all the sand sieves is:

(a) 50%
(b) 40%
(c) 100%
(d) 400%

CHART OF BEACH SURVEY



KEY:

0 = Water's Edge

... = Beach Surface

___ = Water Table Level

--- = Distance between beach surface and water table

* NaCl = Salinity in grams of salt in 1000 grams of water (ppt)

T° = Temperature (water)

M = Meter or 100 cm

Cm = Centimeter

Use the preceding chart to answer the following questions, making sure to read both the chart and the key.

16. What is the temperature of the water table at site "A"?

(a) the same as at site "B"
(b) the same as at site "C"
(c) higher than either sites "B" and "C"
(d) lower than either sites "B" or "C"

17. At what site is the salinity the lowest?

(a) ocean's edge
(b) site "A"
(c) site "B"
(d) site "C"

18. What happens to the salinity of the water table as you move up the beach away from the ocean?

(a) increases
(b) decreases
(c) gets saltier
(d) no change

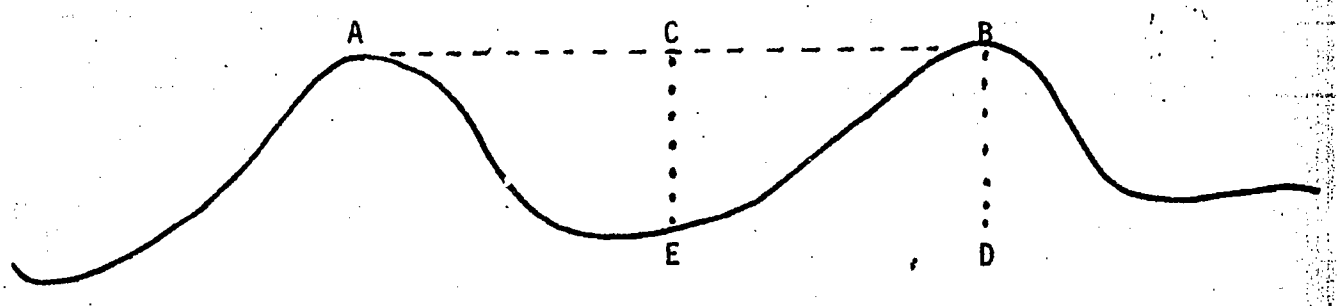
19. How much did the water temperature change between "A" and "C"?

(a) 13^0 F
(b) 11^0 F
(c) 67^0 F
(d) no change

20. What is the "water table" to the beach slope?

(a) the beach surface
(b) the base line
(c) the slope itself
(d) the sand depth

LOOK AT THE DIAGRAM BELOW: and use to answer questions #21 thru #23.



21. Wave length is the distance from:

(a) A - C
(b) A - B
(c) C - B
(d) B - D

22. Period or frequency would be measured for a wave by timing how long it takes for:

(a) A to pass B
(b) A to pass C
(c) C to pass B
(d) E to pass D

23. The height of a wave is the distance:

(a) A to C
(b) C to B
(c) E to B
(d) E to C

24. Velocity of a wave can be measured if you know:

(a) wave length and distance
(b) wave length and period
(c) wave length and height
(d) period and height

25. The backwash curl is a help in predicting:

(a) wave length
(b) wave height
(c) wave period
(d) wave velocity

26. The crest of a wave is:

(a) distance the wave travels
(b) height of the wave
(c) low point of a wave
(d) high point of a wave

USE THE FOLLOWING DATA a student collected while at the beach to answer question #27.

Wave length - 10 M

Wave height - 3 M

Wave frequency or period - 10 sec.

The formula for velocity or speed is: $V = \frac{D}{T}$

27. What was the velocity or speed of the wave in M/ sec.?

(a) 10 M/ sec
(b) 30 M/ sec
(c) 1 M/ sec
(d) 3 M/ sec

28. The chief cause of surface waves is:

(a) wind and tides
(b) wind
(c) wind and gravity
(d) time and tides

29. Wind speed and wave action on an ocean beach help determine:

(a) the type of plant and animal life found there
(b) water temperature
(c) salinity
(d) pelican population

30. The sand composition of our beach is mainly:

(a) quartz crystals
(b) broken shells
(c) detritus
(d) crushed gravel

31. The jetty north of the St. Lucie Inlet has caused:

(a) decrease in fish population
(b) sand erosion south on Jupiter Island
(c) build-up of sand south of the inlet
(d) no harm

32. Removal of sand dunes from the ocean beach:

(a) helps stabilize the beach
(b) provides additional homes for animals
(c) causes the beach to erode
(d) changes the salinity of the H_2O

33. Severe beach erosion occurs occasionally due to:

(a) hot summers
(b) too many people using the beach
(c) seasonal changes
(d) natural disasters

34. Sand filling the St. Lucie Inlet could be caused by:

(a) north jetty
(b) prevailing winds
(c) heavy rains
(d) more boats

35. The energy crisis was brought about in part by:

(a) resources not equalling demand
(b) resources equalling demand
(c) under development of fossil fuels
(d) coal miners striking

36. Killing off all small gamefish in the estuary and Indian River could be due to:

(a) too high tides
(b) over-fishing
(c) too many birds
(d) destroying grassflats

37. A natural disaster such as a hurricane could:

(a) lower the fresh water table
(b) raise the fresh water table
(c) change the salinity of the Indian River over a long period of time
(d) change the salinity of the ocean over a long period of time

38. Pollution of the ocean could be caused by:

(a) too many fish and birds
(b) dead plants and animals
(c) people living in harmony with their environment
(d) man not being aware of his environment

39. The entire intracoastal waterway is:

(a) a natural waterway
(b) man-made waterway only
(c) man-made and natural waterway
(d) a river

40. A structure projecting into the water from the shore to influence and protect an inlet is called a:

(a) breakwater
(b) groin
(c) jetty
(d) riprap

41. An inland part of the sea which meets the mouth of a river is:

(a) a canal
(b) a bay
(c) a current
(d) an estuary

42. The top layer of underground water is:

(a) water line
(b) wave table
(a) water table
(d) littoral drift

43. The amount of salt in water may be measured by:

(a) density and depth
(b) temperature and current
(c) temperature and depth
(d) temperature and density

44. Which of these instruments determines if something is horizontal or flat?

(a) refractometer
(b) sighting level
(c) hydrometer
(d) sighting compass

45. Brackish water is water that has:

(a) salt
(b) sand
(c) no salt
(d) no sand

46. The kind of organisms found on the beach is determined by:

(a) physical factors
(b) number of pelicans
(c) types of grasses
(d) animals and plants

47. Littoral drift moves:

(a) water and fish
(b) water and salt
(c) water and sand
(d) water and tide

48. When an organism is adapted to its environment it means the organism:

(a) is not helped by environmental changes
(b) does not like its environment
(c) does not change
(d) fits well into an environment

49. An example of a physical factor is:

(a) bird population
(b) amount of salt in the water
(c) red mangrove root
(d) turtle grass

50. The high point of a wave is the:

(a) trough
(b) fetch
(c) crest
(d) wave length

TEST ANSWER KEY

1.	a	26.	d
2.	a	27.	c
3.	a	28.	b
4.	c	29.	a
5.	d	30.	b
6.	a	31.	b
7.	b	32.	c
8.	b	33.	d
9.	d	34.	a
10.	d	35.	a
11.	c	36.	d
12.	d	37.	b
13.	b	38.	d
14.	b	39.	c
15.	c	40.	c
16.	c	41.	d
17.	d	42.	c
18.	b	43.	d
19.	b	44.	b
20.	b	45.	a
21.	b	46.	a
22.	a	47.	c
23.	d	48.	d
24.	b	49.	b
25.	b	50.	c