*Virginia Cooperative Extension Service*

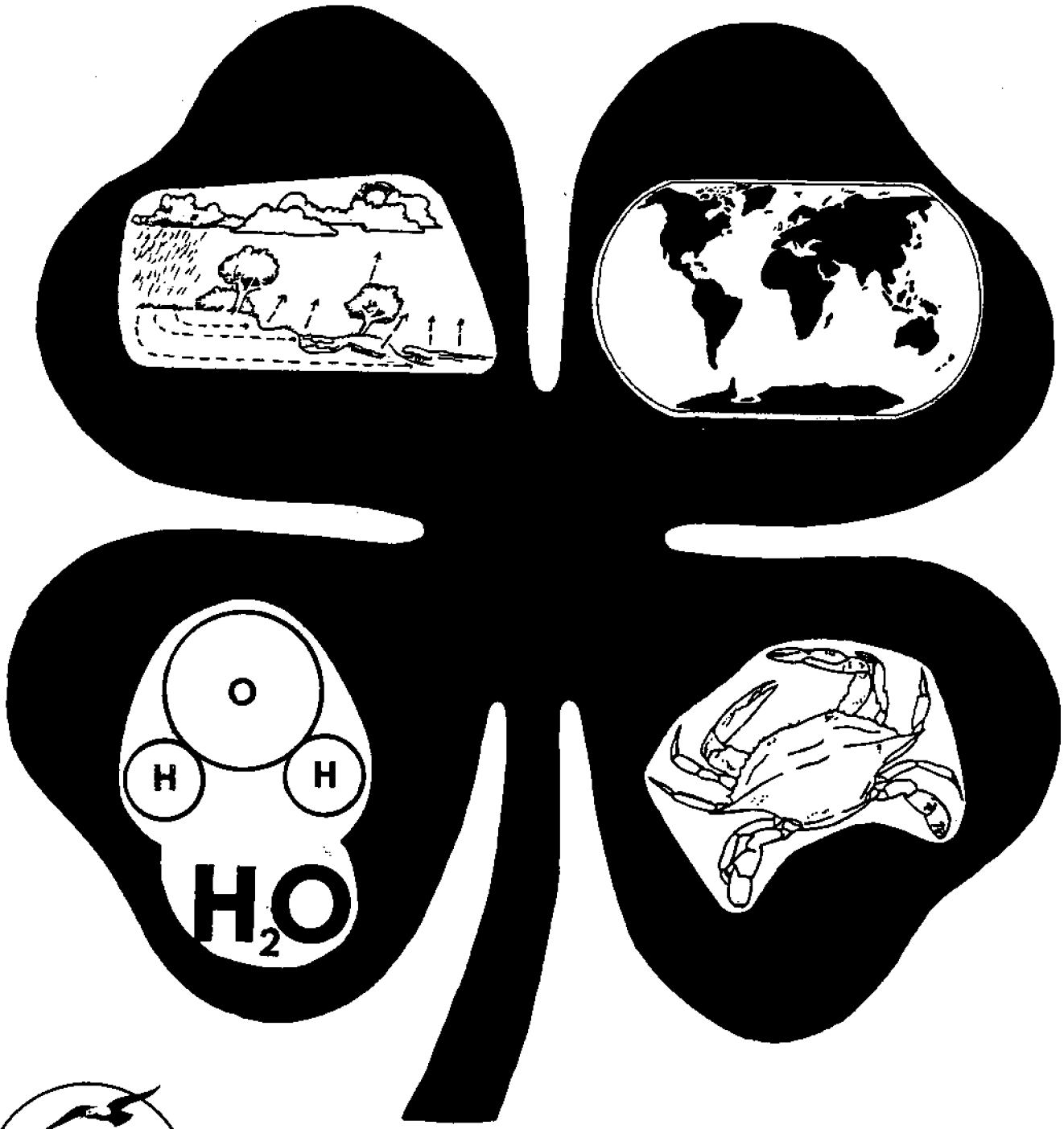
VIRGINIA TECH AND VIRGINIA STATE • VIRGINIA'S LAND GRANT UNIVERSITIES

# 4-H MARINE PROJECT LEADER GUIDE UNITS ONE-FOUR

390-050

SEPTEMBER 1985






Virginia Sea Grant College Program

## WHAT IS WATER ?
## A STREAM BECOMES AN OCEAN
## WHAT IS AN OCEAN ?
## MARINE RESOURCES

# 4-H MARINE PROJECT

## LEADER GUIDE

## UNITS ONE - FOUR

BY

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4-H Marine Education

Acknowledgements: A special note of thanks is extended to all those individuals who assisted in reviewing and field testing this project: Will McElfresh, Dr. Betsy Schenck, Rudolph Powell, Dr. Peter Bromley, Dr. Louis Helfrich (Extension Specialists), Michael Clifford, Frances Morris, Douglas Harris, John Tiggle, Randy Shank, Mary-Jane Bell-Grizzard, Mary Osborn, Michael Geisinger, Richard Pullium, Clifton Davis, Bill Ruff, Marilyn Morris (Extension Agents), Mary Sparrow, Lee Lawrence, Sue Gammisch (Virginia Sea Grant Marine Advisory Service, Virginia Institute of Marine Science), Kathryn Sevebeck (Water Resources Research Center, VPI&SU). Sincere appreciation is extended to Richard Booker for the initiation of this project and to Charlie Elliott for his helpful comments. Special thanks is given to Ernestine Fields for manuscript preparation.

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# INTRODUCTION

## Objectives of the 4-H Marine Project are to:

1) introduce youth to a variety of topics and activities in marine education,
2) help youth understand the importance of and learn to appreciate our coastal resources,
3) assist youth to gain knowledge, skills, and attitudes that will help them make sound decisions concerning coastal resource management.

## Audience

This project is designed for youth in grades 4-6 and can be used in school, community, club, and special project club situations.

## Unit Titles

Unit One - What is Water?
Unit Two - A Stream Becomes an Ocean
Unit Three - What is an Ocean?
Unit Four - Marine Resources
(Units five through nine are presented in the second leader's guide, publication No. 390-060.)

## Unit Format

The material presented in the member guides is divided into subtopics and accompanied by graphics that make it interesting and easy to understand. Wherever possible, simple or common terminology is used. Definitions are provided where necessary and important terms and concepts are emphasized with word puzzles and other activities.

Suggested reading and study topics are given in the units. Activities include both individual and group involvement. In addition, English, science, math, and social studies skills are involved in the unit activities.

The units may be presented in sequence or in any order desired. Use of all of the units (one-nine) provides a broad overview of marine education topics. Youth who complete nine units will receive a certificate of recognition. The certificates may be requested from your local Extension 4-H Agent after the 4-H Marine Project Record (Publication No. 390-061) has been completed.

## Leader's Guide

The leader's guide is written to assist in the presentation of the 4-H Marine projects. The information for each unit is organized in the following manner:

1) objectives
2) key concepts
3) vocabulary
4) introduction and background information
5) activity descriptions and answers to questions
6) puzzle solutions
7) references

The last section of this guide provides a series of questions that may be used in a marine bowl (question and answer contest), a movie list, and additional references.

## Conclusion

There is a great need to involve youth in 4-H Marine Education. Most of our marine resources are renewable; however, many are facing serious problems because of abuse, poor management, pollution, and other factors. It is important that youth gain the knowledge and proper attitudes necessary to enable them to make sound decisions concerning coastal resource management, as well as become concerned, involved adults.

After you have used these projects, we hope that you will respond and let us know how effective they are. Please feel free to offer suggestions for improvement and additional topics for future units. Send your responses to:

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Unit One - WHAT IS WATER?

Objectives - From the activities in this unit students will learn to:

1. define the vocabulary terms listed below,
2. describe the structure of a water molecule,
3. describe the attractive force between water molecules (Hydrogen Bond),
4. demonstrate and explain surface tension,
5. explain why water is called the universal solvent,
6. demonstrate the solubility of several household solutes,
7. demonstrate and describe the effect of temperature on solubility,
8. list two factors that affect the heat holding capacity of water,
9. describe the expansion property of water and its beneficial and harmful effects.

Key Concepts -

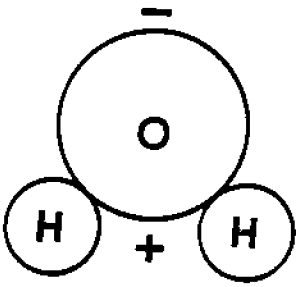
1. Water is a tasteless, odorless, colorless compound.
2. Water exists as small particles called molecules.
3. A water molecule is composed of two atoms of the element hydrogen and one atom of the element oxygen.
4. The structure of the water molecule gives it its unique chemical and physical properties.
5. Water molecules have a (+) and (-) charge at opposite ends resulting in a strong attraction between molecules.
6. The bond formed between water molecules is called the hydrogen bond.
7. The extent of bonding between water molecules depends on the state of matter (solid, liquid, gas).
8. Water possesses a strong surface tension.
9. Water is called the universal solvent because it dissolves many types of substances.
10. Water temperature and the nature of the substance being dissolved affect the dissolving power of water.
11. The volume of water and the amount of surface area exposed to air affect the heat holding capacity of water.
12. The effects of ice expansion can be both beneficial and damaging.

Vocabulary -

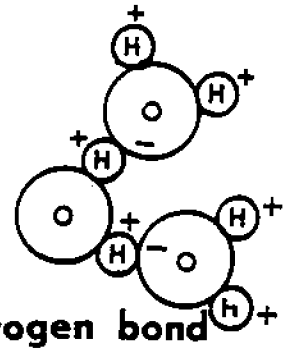
1. atom - smallest particle of an element
2. element - matter composed of one type of atom (gold, silver, lead, oxygen, sodium, hydrogen, etc.)
3. molecule - particle composed of two or more atoms (water, sugar, oil, alum, baking soda, etc.)
4. compound - molecule composed of atoms of two or more elements (see #3)
5. surface tension - surface film formed on water due to the strong attraction between water molecules

6. universal solvent - name given to water because of its strong dissolving properties
7. hydrogen bond - bonding between water molecules due to charge differences
8. heat capacity - heat storing ability

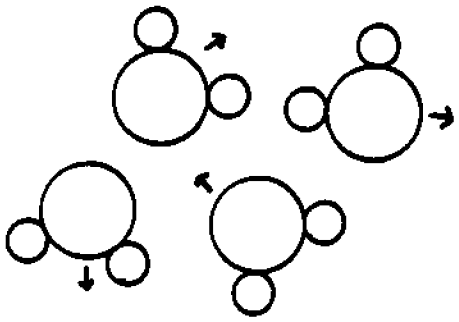
## Introduction




Water is a unique substance due to its molecular structure. Once formed by the reaction between oxygen and hydrogen, water molecules are extremely stable and strongly bonded together. The strong attraction between water molecules is due to the hydrogen bond. The molecules have opposite charges at each end, producing a strong electrical attraction between adjacent molecules. This unique structure and bonding in water gives it properties not found in any other substance. It has a strong surface tension and the ability to store large amounts of heat, dissolve a majority of substances, and expand when frozen.



**Hydrogen bond**

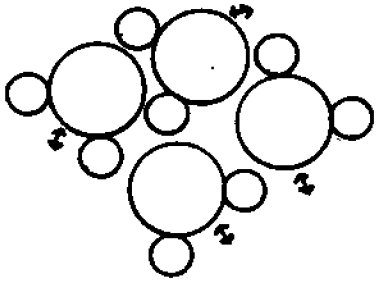


**Water Vapor**

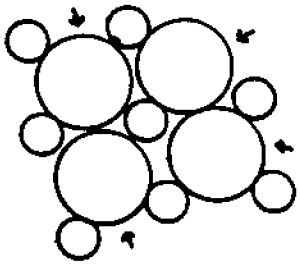
The state of water is determined by the extent of bonding between molecules. As a gas (water vapor), the molecules are highly energized and few bonds form between them. As a liquid, more bonds form keeping the molecules close together but constantly moving. As the temperature approaches freezing all of the hydrogen bonds form and the molecules become arranged in rigid, crystaline patterns.

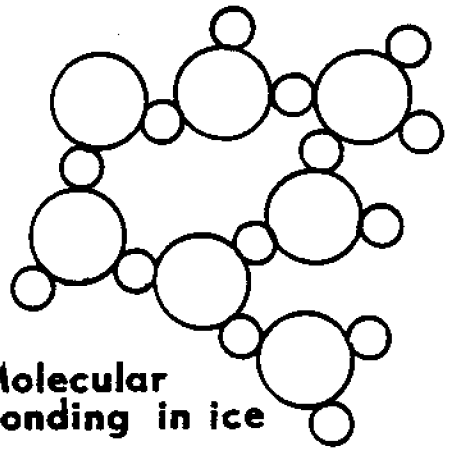
As water approaches 39°F (4°C), it continues to contract as other liquids do, and the molecules cluster tighter together. However, below this temperature, the molecules begin expanding as they form hydrogen bonds with surrounding molecules. The result is solid ice which is less dense than liquid water. This property of expansion is beneficial to the natural world, assisting erosion and insulating bodies of water with a layer of ice; however, it may cause damage to roads, buildings, and other structures.

**Water above 4°C**

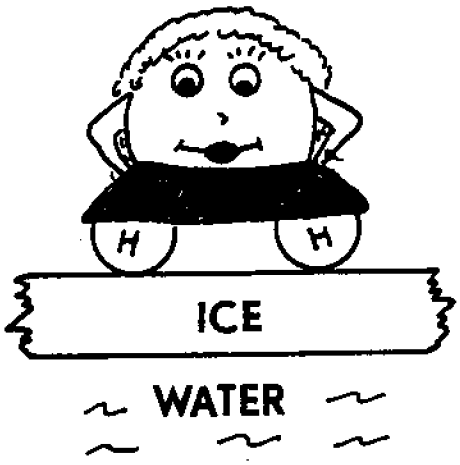


**Water at 4°C**

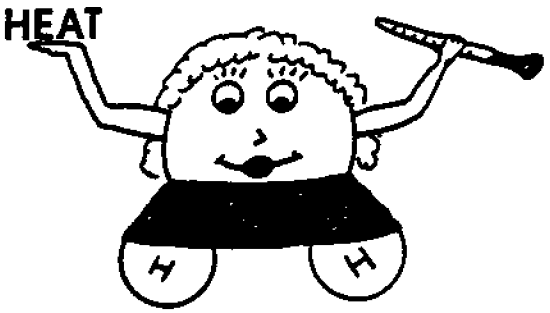




Molecular bonding in ice



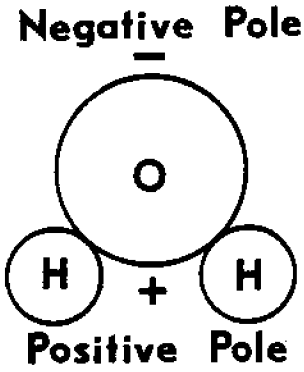

A great deal of energy is required to break the hydrogen bond between water molecules. The result is a large heat storing capacity. It takes as much heat to melt a gallon of ice as it does to heat the same amount of water from room temperature to boiling. A tremendous amount of heat is also required in evaporation. The heat needed to evaporate a gallon of boiling water would heat more than seven gallons from room temperature to boiling. The amount of heat energy stored in the world's oceans is a major influence on world weather patterns. The rate of heat loss in water is affected by the amount of water, its surface area, wind, air temperature and other factors.



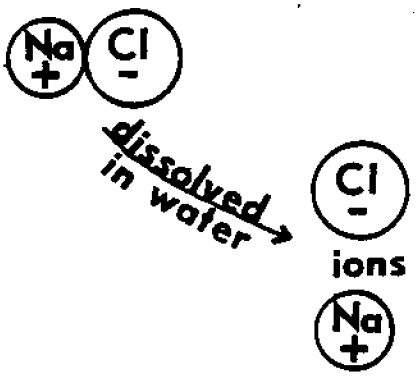

The hydrogen bond also produces what is called surface tension. Surface water molecules have a strong attraction for each other and form a film-like boundary between the air and water. Examples of the strength of the surface tension film can be seen in the flexibility of water drops and its ability to support small insects.

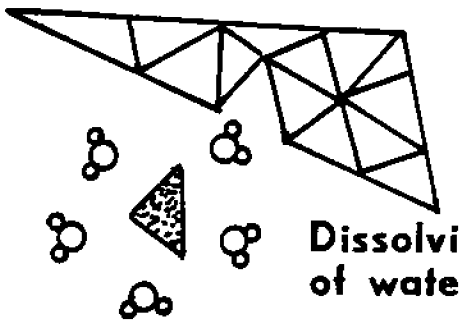
Water molecules are also attracted to molecules and atoms of other substances. The result is its almost universal dissolving ability. More than seventy elements and thousands of compounds dissolve in water, making it ideal as a life supporting medium.

The dissolving power of water is determined by the nature of the substance being dissolved and the temperature of the water. The molecular structure of a substance effects its solubility in water. Water molecules are polar; that is, they have positive and negative poles. Substances with polar molecules will readily dissolve in water (i.e., sugar, baking soda). Substances with non-polar molecules, lacking positive and negative poles, will not readily dissolve, and in many cases, will actually repel water (i.e., oil). Most salts will dissolve in water, breaking down to form ions (charged particles). Table salt (sodium chloride) breaks down in water to form sodium and chlorine ions. Not all substances dissolve readily. Gelatin, for instance, has large, strongly bonded molecules, requiring some stirring and heating in order to dissolve in water.



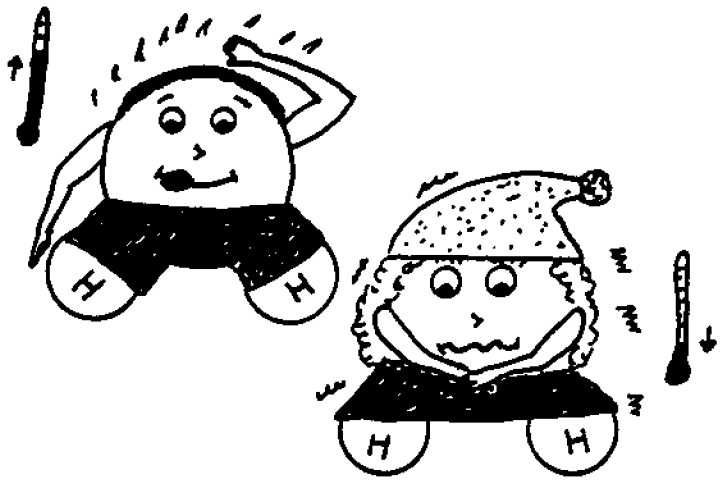

**Sodium chloride (NaCl)**



**Dissolving action of water molecules**

The temperature of the water directly affects the dissolving process. This process requires energy and hot water has more energy than cold water. During the dissolving process, water molecules act like "cowboys cutting cattle from a herd," separating and surrounding the molecules of the dissolved substance. The more energy the water molecules possess, the greater their dissolving capabilities.



Before starting the activities described on pages 3-10 of the member guide, provide sufficient materials for each person. If working with a small group, set up separate stations for each activity with the necessary materials. If you are working with a large class, divide the class into small groups and provide each group with sufficient materials for all of the activities.

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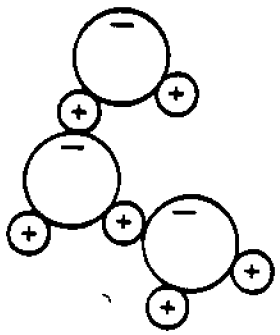
Activities (Page 3)

(Materials - two different size round objects such as jar lids, pencil, scissors, construction paper, tape or glue.)

The model water molecules will help students visualize the molecular structure of water. Be sure that children attach the hydrogen atoms to one side of the oxygen atom as shown in the illustration. Ask the children to identify the positive and negative sides of the molecule models. Explain that the hydrogen bonding between molecules is due to the attraction between positive and negative charges on different molecules. The use of a couple of bar magnets will help students understand this bonding principle. Allow the students to form hydrogen bonds between their molecules as described, sketch them, and label the atoms and bonds.

Activities (Page 4)

Use at least six water molecule models to demonstrate the various forms of water. Emphasize that the state of water depends on the amount of heat energy within the molecules. The energy of the molecules determines the extent of their hydrogen bonding. Water vapor has the least amount of bonding, while ice has the greatest degree of bonding.



Activities (Page 5)

(Materials - water, eye dropper, wax paper, tooth pick, liquid detergent, test tube or small glass, needle, tissue paper, shallow dish.)

1. This activity demonstrates the surface tension property of water. The water drop is repelled by the wax paper and forms a rounded bead. The surface film, produced by the attraction between water molecules, is flexible and the water drop readily changes shape.

2. The water drop stretches and can be broken apart then recombined. Point out to students how two smaller drops, placed side by side, actually rush together to form a

larger drop.

3. When detergent is added to the water, the water drop loses its form. The detergent interferes with the hydrogen bonding between surface molecules and the surface tension is lost.

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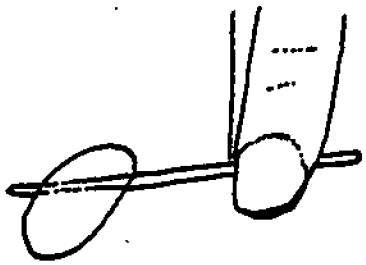
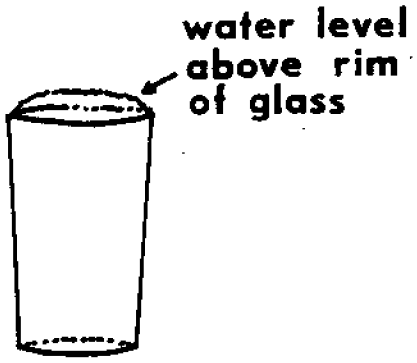
The glass can be filled above the rim since surface tension holds the water in place. A few too many drops, however, and gravity takes over as the water tumbles over the rim.



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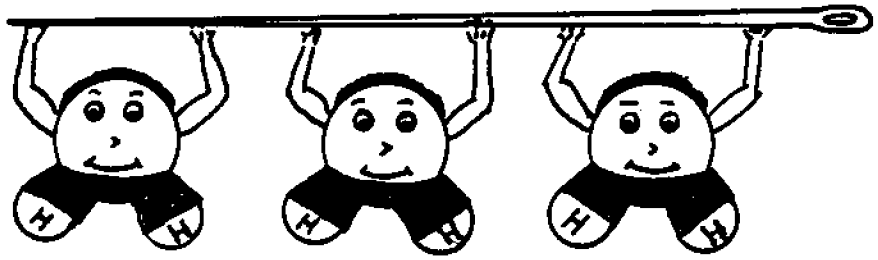
1. The needle "floats" on the surface of the water.

   The surface tension of the water is strong enough to support the weight of the needle. The hydrogen bonding between surface molecules forms a film between the air and water. This film supports the needle.




2. The detergent interferes with the surface tension film and the needle sinks.

   DO NOT ALLOW STUDENTS TO PLAY WITH THE NEEDLES. IF SAFETY IS A CONCERN, SET UP A DEMONSTRATION TABLE FOR THIS ACTIVITY AND ASSIST THE STUDENTS IN SMALL GROUPS.

Activities (Page 6)

The ten most abundant elements found in seawater are: oxygen, hydrogen, chlorine, sodium, magnesium, sulphur, calcium, potassium, bromine, and carbon.

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The dissolving property of water is important because it:

1) allows water to support an abundance of life,
2) allows minerals to be carried by flowing water,
3) aids in cooking and washing
4) is involved in a number of chemical and manufacturing processes,
5) and is indispensible to many of the earth's natural processes.
(Students may list additional reasons)

Activity (Page 7)

(Materials - sugar, salt, baking soda, jello mix, vegetable oil, teaspoon, small glass or beakers, warm water).

All of the substances readily dissolve in water except the jello mix and the vegetable oil. The jello mix requires some stirring and dissolves slowly. Oil molecules actually repel water molecules and no noticeable dissolving occurs.

Activities (Page 8-9)

(Materials - sugar, hot and ice water, small jar or beaker, teaspoon.)

Hot water has more energy than cold water. Since the dissolving process requires energy, more sugar dissolves in hot water than in cold water.

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(Materials - two different sized but similar shaped containers, made of the same material - 8 and 16 ounce styrofoam cups, hot water, two thermometers.)

The water in the larger container will cool at a slower rate than the water in the smaller container. The larger volume of water holds its heat energy longer than the smaller volume of water.

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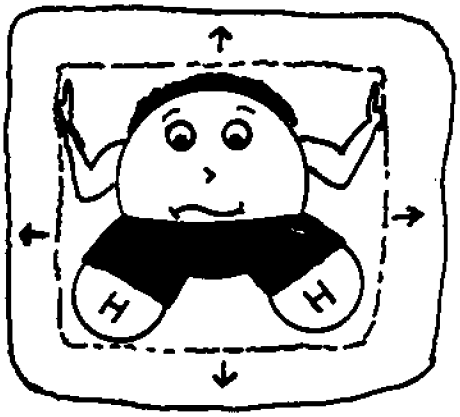
(Materials - two different shaped containers of the same size and material - styrofoam cup and bowl, hot water, two thermometers.)

The water in the container with the greater exposed surface area will cool faster than the water in the container with less exposed surface area.

Activity (Page 10)

(Materials - small, disposable container (do not use glass), water, freezing compartment.)

As it freezes, water expands. The container may bulge outward or even burst due to the force exerted by the ice.

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Some benefits of ice expansion:

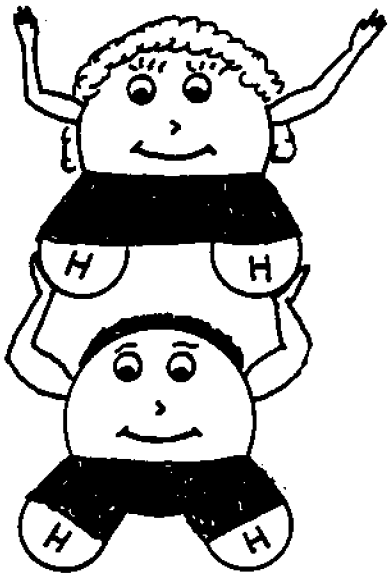
1) facilitates erosion by breaking rock & soil
2) covers bodies of water with an insulating layer of ice
3) ice is less dense than water and floats

Damaging effects of ice expansion:

1) cracks pavement, sidewalks, and other structures
2) exerts tremendous force inside closed places (engine blocks, radiators, etc.).
3) damage poorly designed or maintained structures.

Water Facts (Page 11)

1. Hydrogen, oxygen
2. Molecule
3. Water molecule has positive and negative poles which attract the opposite charges of other molecules
4. Hydrogen bond
5. Liquid
6. The hydrogen bonding between surface water molecules.
7. It dissolves a majority of substances
8. a) Nature of the substance being dissolved
   b) Temperature of the water.
9. Water can absorb and store a tremendous amount of heat energy. During long summer days, water absorbs more heat than it loses at night. The daily water temperature remains relatively constant. During fall and winter, water gradually cools as the days shorten.



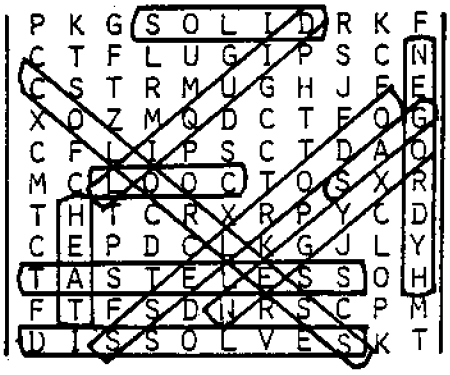
Crossword and Searchword Puzzles (Page 13)

Across

1. compound
2. surface tension
3. atom
4. vapor

Down

1. molecules
2. universal solvent
3. element
4. heat capacity



References


Engel, Leonard. 1963. The Sea. Time Incorporated, New York.

Leopold, Luna B. and Kenneth S. Davis. 1966. Water. Time Incorporated, New York.

Mauldin, Lundie and Dirk Frankenberg. 1978. North Carolina Marine Education Manual, Unit Two, Seawater. UNC Sea Grant Publication UNC-SG-78-14-B.

Sienko, Michell and Robert A. Plane. 1966. Chemistry. McGraw-Hill Book Company, New York.

Unit Two - A Stream Becomes an Ocean

Objectives - From the activities in this unit students will be able to:

1. define the vocabulary terms listed below,
2. describe the water cycle,
3. demonstrate that the amounts of water evaporating from the earth's surface and falling to the earth's surface are equal,
4. describe how oxygen and minerals are added to water flowing in streams,
5. list three reasons for damming rivers,
6. describe the effect of beaver activity on streams,
7. list two reasons why marshes and estuaries are important habitats,
8. list two reasons why the Chesapeake Bay is important to Virginia's economy,
9. list two problems facing the Chesapeake Bay.

Key Concepts

1. The water cycle replenishes the earth's freshwater supply.
2. Nearly 95,000 cubic miles of water are recycled through the earth's atmosphere each year.
3. The processes of oxygenation and mineralization of water occur in fast flowing streams.
4. Different animals play the role of predator, prey, and scavenger in the different freshwater and marine habitats.
5. Beaver activity greatly affects stream ecology.
6. Rivers are dammed to produce electricity, for recreational purposes, and for municipal water supplies.
7. Marshes and estuaries serve as breeding grounds and nurseries for many aquatic organisms.
8. The estuary is a mixing zone between rivers and the sea.
9. The Chesapeake Bay is the largest estuary in North America and is very important to Virginia's economy.
10. Pollution, heavy fishing pressure, and beach erosion are some of the problems facing the Chesapeake Bay today.

Vocabulary

1. Bay - an inlet of the sea
2. Estuary - a mixing area of saltwater and freshwater
3. Evaporation - converting a liquid to a gas
4. Habitat - the natural home of an animal or plant
5. Hydrologic (water) Cycle - the constant circulation of water on the earth's surface through evaporation and precipitation
6. Marsh - grassy wetlands

7. Nymph - immature stage of certain insects
8. Precipitation - moisture in various forms falling from the atmosphere
9. Predator - an animal that feeds on other animals
10. Prey - the food of a predator
11. Rapid - rocky, fast-flowing section of a river
12. Riffle - rocky, shallow-section of a stream
13. Scavenger - an animal that feeds on the remains of other animals
14. Spawn - the process of egg laying in fish and other aquatic animals

Introduction

From deep ocean currents to flowing rivers, the earth's waters are in constant motion. The driving force behind this movement is the hydrologic cycle powered by solar energy. Because of the constant movement, there is a uniform exchange of water between the land, ocean, and the atmosphere; thus the volumes of water in these reservoirs are relatively constant. The activities in the member guide (pages 1-3) help to emphasize this fact.

The story of "A Stream Becomes An Ocean" follows some of the changes that occur as water flows from inland to coastal areas. During this journey, gradual changes in physical, chemical, and biological characteristics occur. These changes produce the various habitats associated with water: stream, river, pond, lake, swamp, marsh, bog, bay, sea, and ocean.

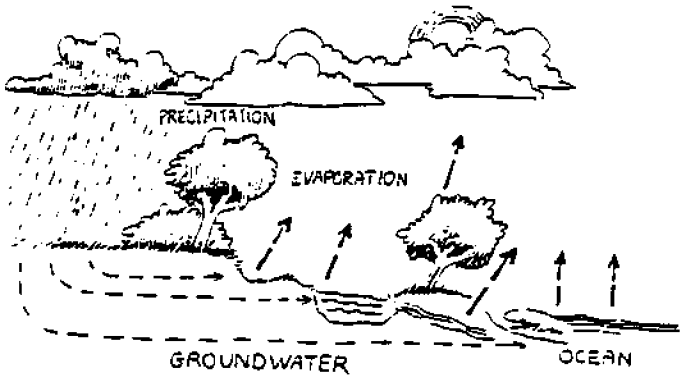
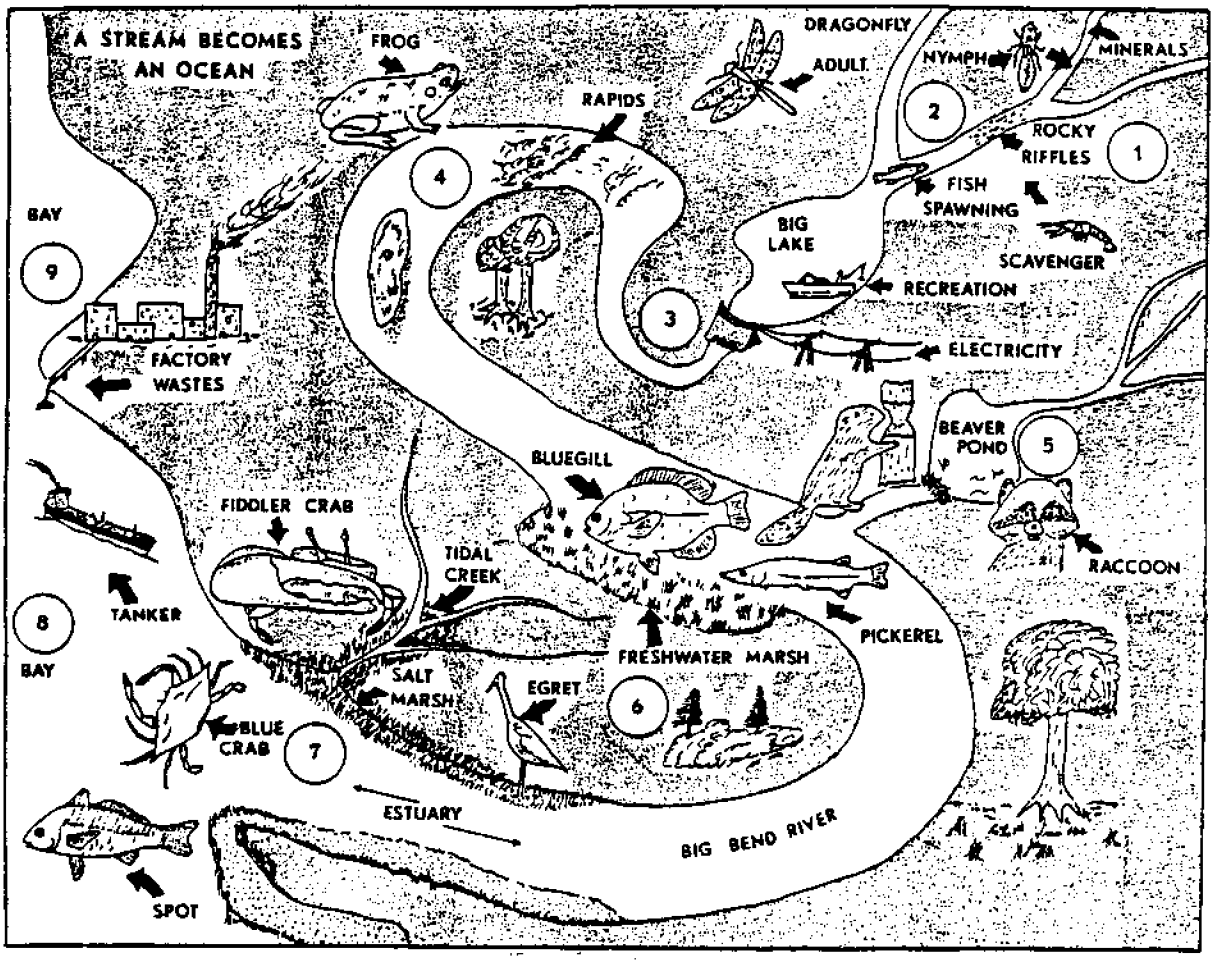



Illustration courtesy of VA Water Resources Research Center, VPI&SU

Physical characteristics of flowing water include depth, width, current, slope of the bottom, and others. Chemical characteristics include amounts and kinds of dissolved solids, and gases, organic matter, pH, and related factors. The variety of plant and animal communities determine the biological characteristics of the water. All of these characteristics are interrelated; changes in one will invariably produce changes in others. What happens upstream affects the downstream environment and vice versa. These relationships are complex and this unit can only touch on the most basic concepts of freshwater and marine ecology.

The following paragraphs, relating to each numbered paragraph in the member guide (pages 6-11), will provide back-

ground information to help you discuss the story with your 4-H'ers.




1. In general, less than one-third of the water that falls as precipitation finds its way into rivers or streams. Direct evaporation, plant absorption, ground seepage, and water retention by forests account for the remaining two-thirds. As abundant as streams and rivers are, they account for only .0001% of the earth's water supply. Despite this small amount, they have a tremendous effect on the water sheds and drainage basins they serve.

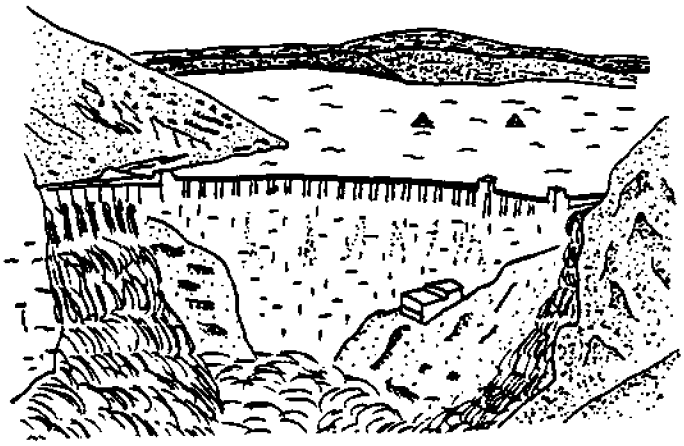
The shallow riffles of upland streams churn the flowing water, adding oxygen and minerals. They provide excellent habitat for a variety of aquatic insects, including mayfly, stonefly and dragonfly nymphs, fly and beetle larvae, and many adult forms adapted to living in fast-flowing water. Trout, minnows, darters, and sculpins are fish common to highland streams. These species require cold, fresh, oxygen-rich water. Amphibians, small snakes, and many types of invertebrates are also common to small streams.

In swift water, animals need to cling to rocks, logs, and other objects. Many insects have specialized hooks, claws, and flattened bodies to keep from being swept downstream. Fish found in these waters are strong swimmers and usually have enlarged fins, allowing them to swim in a strong current.

2. As streams unite, the volume of water increases, usually reducing the flow rate and increasing the temperature. As a result, smallmouth bass, minnows, madtom catfish, suckers, and certain types of sunfish may be abundant. The insect and invertebrate populations also change as the reduced current allows more types of organisms to live on the bottom than found in swifter streams. Due to the slower current, more organic matter settles to the bottom, providing food for scavengers such as crayfish and certain insect species. Deep water pools may be abundant, providing shelter from the stream current for many aquatic animals. The reduction in current also allows a variety of aquatic plants to take root in the stream banks and bottom.

   In general, the farther downstream you move, the greater the variety of plants and animals you will encounter.

3. Damming rivers has become a presupposed "cure-all" for water and energy needs. The resulting lakes do provide much needed water and are a source of efficient hydro-electric power. Sport fishing, boating, and other forms of recreation have also benefited from these lakes. Flood control, irrigation projects, and other water related programs have seen the birth of many damming programs.

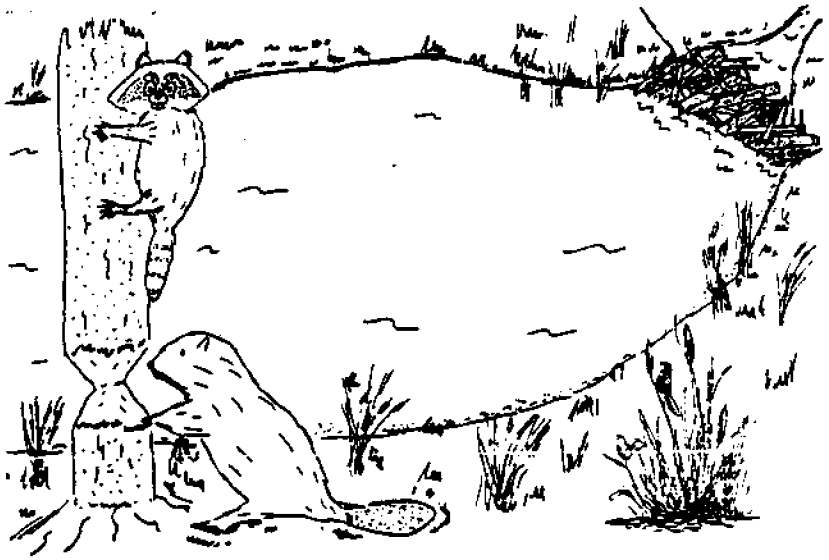


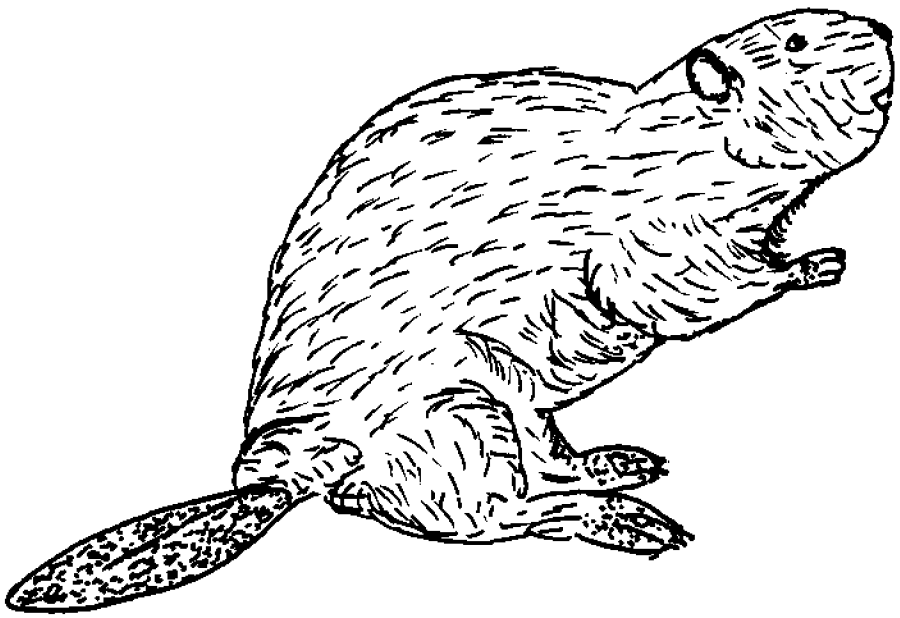
In spite of their advantages, dams can create a number of serious environmental problems. Some of these include: erosion control problems, interference with natural flooding cycles, changes in water table levels, changes in animal and plant populations, and even changes in the coastal ecology due to the reduced water flow in rivers. It is important that a thorough study of the possible effects of a dam be conducted before it is constructed.

4. Rivers offer a variety of habitats for aquatic organisms. Bass, brim, pike, catfish, carp, and perch are the more common freshwater species. Some saltwater fish, such as shad, salmon, and striped bass, migrate up freshwater rivers to spawn. A variety of birds, mammals, amphibians, and reptiles also inhabit freshwater rivers.

   Rivers vary a great deal in size, flowrate, silt load, and other characteristics; however, they generally support a greater variety of life than streams.

5. Beavers, once highly prized for their fur, were a major reason for the exploration and settlement of North America. The Hudson Bay Trading Company was formed in 1670 and dealt heavily in the fur trade. Between 1853 and 1877, nearly 3 million beaver pelts were exported from North America. As a result, beaver nearly became extinct before conservation efforts were taken to protect them from over trapping.





Beavers are social animals, living in family groups of up to 12. They mate for life and young stay with the parents for two years. They feed on the bark of aspen, willow, birch, and other trees in addition to water plants and algae.

The beaver dam is a marvel of natural engineering; so strong that it may withstand several dynamite charges. A series of dams are usually constructed along a waterway, including a primary dam and one or more secondary dams built up and down stream of the primary dam. The dams require and get constant attention. The resulting imponded water is important in flood control, raising water tables, and providing habitat for other animals.

6-7. Shallow land depressions and river or lake shores often produce marsh habitats. Marshes are dominated by grasses and other non-woody plants. Acting as a natural sponge, marshes hold and slowly filter large amounts of water. They also provide feeding, breeding, and nursery grounds for many aquatic animals. In addition to their high productivity, marshes add to the scenic quality of a river or shoreline.

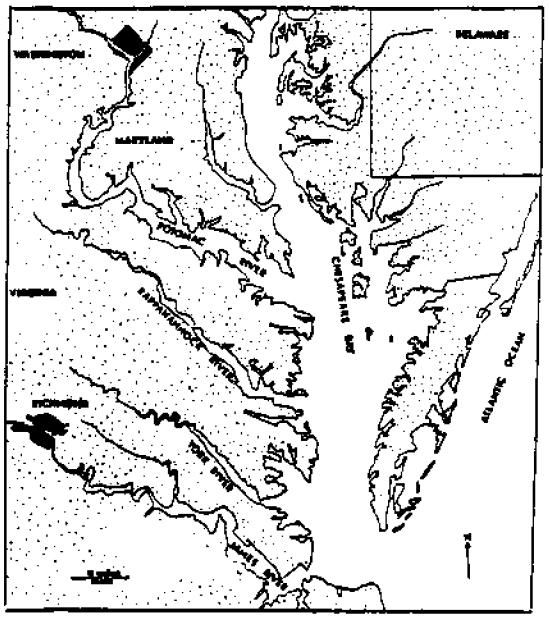
Freshwater marshes support a variety of plant life while salt marshes are dominated by only a few species of salt-tolerant plants. Despite this, productivity within a salt marsh may be ten times greater than an equal amount of cropland.

As rivers near the coast, seawater mixes with the fresh river water producing brackish (partly salty) water. This mixing zone is called an estuary. Estuaries are vitally important. They serve as spawning and nursery grounds for a majority of coastal marine organisms. They are highly productive and

serve as natural refuges for marine life and water fowl. They also serve as a buffer zone between the ocean and land, absorbing much of the wave energy and smoothing the transition between fresh and saltwater zones.

Thousands of different animals and plants inhabit the estuary. Many "freshwater" fish and invertebrates are found in the upper, brackish areas of the estuary along with their marine counterparts. It is not uncommon to catch largemouth bass, bluegill, spot, and flounder in the same area in brackish water.

8-9. The Chesapeake Bay, the largest estuary in North America, was named by the Algonquin Indians. They called it "chesepiooc", meaning "great shellfish bay." The name is more than appropriate. The Chesapeake Bay provides 25% of the nation's oyster harvest and 50% of its blue crab and soft-shelled clam catch. Nearly $100,000,000 worth of fish are harvested commercially and $28,000,000 worth of sport fish are caught each year. In spite of these impressive numbers, seafood production in the Bay has suffered declines during this century. While some species have increased in number (blue crab, menhaden), a majority have become less abundant.




THE CHESAPEAKE BAY

The Chesapeake Bay is one of the finest natural harbors in the world. The port of Hampton Roads includes marine terminals at Norfolk, Portsmouth, Newport News, and Chesapeake. Hampton Roads handles more than 7% of the nation's foreign shipping, involving nearly 60 million tons of cargo each year.

It leads all other U.S. ports in export tonnage, including 50% of the nation's coal export. More than 80 steamship lines connect Hampton Roads with almost 400 ports in 133 countries.

The heavy utilization of the Bay and the dramatic population growth have affected the Bay in many ways. The total population of the Bay basin has increased from 8 million in 1950 to 12 million in 1980. By the year 2000, there may be nearly 15 million people living around the Bay. The increased demands on the Bay for recreational, industrial, and seafood resources may damage the Bay's ecology. Already there are signs of danger: loss of plant life, silting, chemical and sewage pollution, and others. Programs, such as the Chesapeake Bay Program, have begun to study these problems and find solutions for them.

Activity (Pages 2-3)

Complete the "Water on the Move" activity by allowing students to work as a class, in small groups, or individually.

The answers to questions 1-6 are:

| | | |
|---|---|---|
| 1) 80,000 | 2) 15,000 | 3) 71,000 |
| 4) 24,000 | 5) 15,000 | 6) 9,000 |

By adding and comparing the different combinations of answers as instructed on pages 2 and 3 of the member guide, students will note that:

1) the amounts of water that evaporate from and fall on the earth are equal,
2) the amounts of water that evaporate from and fall on the ocean are equal, and
3) the amounts of water that enter and evaporate from the land are equal,
4) the total amount of water in the atmosphere remains constant because there is a continuous exchange of water between the atmosphere and the earth's surface.

Activity (Pages 4-11)

If available, show the slide/cassette program "A Stream Becomes an Ocean" and instruct the students to follow the program with the "A Stream Becomes an Ocean" map on pages 4 & 5 of the member guide.

Following the program, instruct students to complete the "A Stream Becomes an Ocean" story (pages 6-11) by filling in the blanks with the words provided for each paragraph. The paragraph numbers correspond to the numbers on the map. Use the map as a guide for completing the paragraphs. The paragraphs may be completed by:

1) asking individual students for the answers,

2) assigning the paragraphs to groups of students,
3) having a contest to see which student or group can correctly complete the story,

The correct answers are given below:

1. a) oxygen b) nymphs c) riffles d) minerals e) seawater

2. a) habitats b) spawn c) scavengers

3. a) river b) electricity c) recreation d) water supply

4. a) rapids b) bluegill c) predator d) pickerel e) prey

5. a) beaver b) pond c) raccoon d) tree bark e) meadow

6. a) marshes b) breeding ground c) nursery

7. a) estuary b) marshes c) bays d) marine environment e) fiddler f) creeks g) crabs h) egret i) spot

8. a) Chesapeake Bay b) Tankers c) seafood

9. a) pollution b) resources c) Atlantic d) evaporates e) water cycle

Activity (Page 11) - The answers to the questions are as follows:

1. Mountain stream - minnow, crayfish, trout, insects,
river - frogs, pickerel, bluegill, beaver
bay - spot, blue crabs, fiddler crabs, egret

2. Beaver dams stop water flow creating ponds, marshes, or swamps. Once their food supply has been exhausted, the beavers move to another area. The dam deteriorates and the wetlands drain. The result is an open,woodland meadow where trees once stood.

3. Marshes and estuaries serve as breeding grounds and nurseries for many animals.

4. The Chesapeake Bay provides a number of resources, both commercial and industrial, and serves as a major shipping center for the east coast.

5. The water cycle (evaporation, condensation, precipitation) converts saltwater into freshwater.

Activity (Page 12) - If time allows, students may play an ECO-BINGO game which uses the terms given in the "A Stream Becomes an Ocean" story. There are four different bingo cards in the member guide on page 12.

1. Divide the students into no more than four groups and assign each group a different card.

2. The play follows regular bingo rules. All of the answers are on the bingo cards. The spaces on the cards may be X'ed out with a pencil or covered with pieces of paper.

3. Read the first question on the question list (page 20 of the Leaders Guide) and ask a member of the first team to answer it. If the answer is correct, then everyone on that team can mark the answer on their card. Players on the opposing team(s) do not mark the answer. If the answer is incorrect, then an opposing team is given a chance to answer the question.

4. Each team has one chance to correctly answer the question. If no team gives the correct answer, the question can be repeated later. Continue asking questions until Bingo is called. This may require repeating some previously answered questions.

5. The team to get bingo first wins. (horizontally, vertically, diagonally). Students may want to repeat the game.

# ECO-BINGO QUESTIONS & ANSWERS

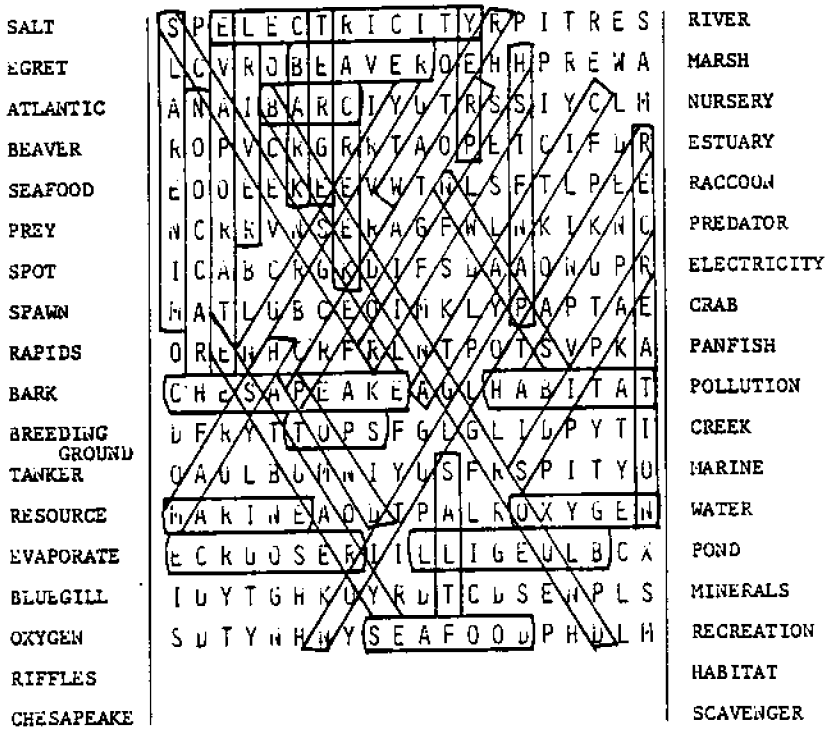
| Question | Answer |
|---|---|
| 1) What important gas mixes with water as it tumbles over rocks in a stream? | oxygen |
| 2) Dissolved minerals in stream water eventually become part of _____. | seawater |
| 3) The process of egg laying in fish is called _____. | spawning |
| 4) What are shallow rocky places in a stream called? | riffle |
| 5) An animal that eats dead animals is called a _____. | scavenger |
| 6) A young, immature dragonfly is called a _____. | nymph |
| 7) A stream will eventually become a _____. | river |
| 8) What animal can change the structure of streams? | beaver |
| 9) The place where animals and plants live is called a _____. | habitat |
| 10) What is a major use of lakes and reservoirs? | recreation |
| 11) What are small rocky waterfalls called? | rapids |
| 12) What is the food of a predator called? | prey |
| 13) A common freshwater panfish is the _____. | bluegill |
| 14) The pickerel and bass eat other fish; they are called_____. | predators |
| 15) What type of habitat serves as a nursery and breeding ground for many marine animals? | salt marsh |
| 16) Name a bird that is a common visitor of the marsh. | American egret |
| 17) What is the area called where a river meets the sea? | estuary |
| 18) What is a coastal creek that is affected by the tides called? | tidal creek |
| 19) Name a crab that is an important seafood in Virginia. | bluecrab |
| 20) Name an abundant, saltwater gamefish found in Virginia's coastal waters. | spot |
| 21) What is a serious problem facing the Chesapeake Bay? | pollution |
| 22) What term includes all types of saltwater habitats such as bays, estuaries and oceans? | marine environment |
| 23) What process renews the earth's freshwater supply. | water cycle |
| 24) What is the largest estuary in North America? | Chesapeake Bay |

## Activity (Page 13)

The answers to the crossword puzzle are as follows:

| Across | Down |
|---|---|
| 1. scavenger | 1. beaver |
| 2. marine environment | 2. riffles |
| 3. marsh | 3. american egret |
| 4. blue | 4. rapids |
| 5. estuary | 5. nymph |
| 6. pollution | 6. tidal creek |
| | 7. river |

## Word Puzzle




## References

Barbour, M. G.; Craig, R. B.: Drysdale, F. R. and Chiselin, M. T. 1973. Coastal Ecology-Bodega Head. Berkeley, Los Angeles. University of California Press.

Hynes, H. B. N., 1970. The Ecology of Running Waters. University of Toronto Press.

Louise, Mary; Shelly Grossman and John Hamlet. 1969. Our Vanishing Wilderness. Madison Square Press, New York.

Niering, W. A. 1967. The Life of the Marsh. New York, McGraw Hill.

Olson, T. A. and Burgess, F. J. 1967. Pollution and Marine Ecology. New York, Interscience.

Reid, G. K. 1961. Ecology of Inland Waters and Estuaries. New York, Reinhold.

Virginia - Facts and Figures. 1982. Commonwealth of Virginia, Governor's Office, Division of Industrial Development.

Unit Three - What is an Ocean?

Objectives - From the activities of this unit, students will learn to:

1. define the vocabulary terms listed below,
2. name and locate on a map the five major ocean systems,
3. describe one theory of ocean formation,
4. describe how the oceans became salty,
5. illustrate and describe major topographical features of the ocean floor,
6. describe the theory of Continental Drift,
7. describe the use of the echo-sounder in mapping the ocean floor,
8. describe what causes tides and how the major tidal cycles are produced by the sun and moon,
9. describe how to read a tide chart.

Key Concepts -

1. There are five major ocean systems.
2. The filling of the ocean basins and the resulting increase in salinity were due to runoff and surfacing of underground water.
3. Ocean salinity originated from erosion of land and from the sea floor.
4. The major ocean features include the continental shelves and slopes, abyssal plains, and oceanic ridges and trenches.
5. Continental Drift involves seafloor spreading from the ocean ridges and crustal sinking at the ocean trenches.
6. Tides are caused by the gravitational pull of the sun and moon.
7. Centrifugal force caused by the rotation of the earth increases tidal bulges.
8. Daily tidal changes are 50 minutes later each day due to the moon's movement in its orbit.
9. The sun and moon produce monthly tidal cycles known as spring and neap tides.

Vocabulary

Indian, Pacific, Atlantic, Arctic, Antarctic Oceans - the five major ocean systems.

1. water cycle - the processes of evaporation, condensation, and precipitation by which water is recycled on the earth
2. continental shelf - shallow coastal ocean floor
3. continental slope - ocean floor leading to the abyssal plain
4. abyssal plain - deep ocean floor
5. oceanic trench - deep opening in the ocean floor
6. oceanic ridge - undersea mountain chain
7. continental drift - seafloor spreading
8. echo-sounder - sonar device used to map the ocean floor
9. tide - daily change in coastal water level

10. centrifugal force - the tendancy of objects, moving in a circular path, to move outward from the center
11. gravity - attraction between bodies due to their mass
12. tidal range - the difference between high and low tide
13. ebb tide - the outgoing tide
14. flow tide - the incoming tide
15. spring tide - new and full moon tides that have a greater than average tidal range
16. neap tide - quarter noon tides that have a less than average tidal range
17. Mean low tide - average low tide water lever
18. Parts per thousand - any part of 1000; also means millimeters per liter
19. salinity - salt content of water

Introduction

The idea of a world wide ocean system was unknown to Europeans until the 14th and 15th centuries. Although the ancient Egyptians and Babylonians had known that the earth was round, this knowledge was lost following the fall of the Roman Empire. The Middle Ages of Europe ( 5th through the 16th centuries) produced little new scientific knowledge, and the Atlantic Ocean was thought to be a river bordering the edge of a flat world. Even Columbus' discovery of the New World (1492) and Magellan's voyage around the world (1519-1522) did not make Europeans realize the immensity of the oceans. It was not until the voyages of the Dutch navigator Abel Tasman and the English explorer James Cook (1700's), that the vastness of the oceans was first realized. Tasman and Cook proved that a ship could conceivably sail around the world in the southern oceans and never sight land.

If little was known about the shape and size of the oceans, even less was known about what lay beneath the surface. The science of Oceanography developed just during this century. More has been discovered about the oceans since 1950 than during all the rest of history. The echo sounder, SCUBA, deep diving submersibles, oceanic research vessels, and other 20th century inventions have opened the seas to human exploration. The discovery of vast undersea mountain range and trench systems, evidence of continental drift, and tremendous advances in the fields of marine biology and chemistry have totally changed our concept of the oceans.

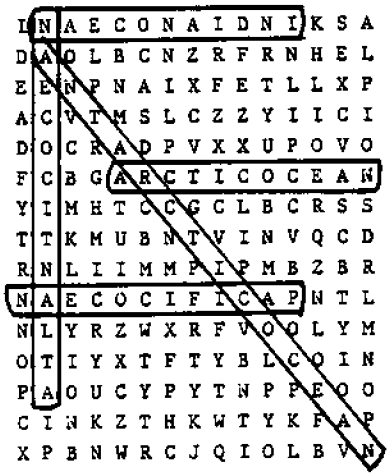
This unit presents basic information about major ocean features and processes. It introduces the reader to concepts of major ocean systems, salinity, ocean floor geography, ocean floor mapping, and ocean tidal processes. Encourage youth to further read and study about these and other fascinating ocean topics.

What is an Ocean? (Pages 1-2)

Some authors mention only four oceans and disregard the

Antarctic as a separate ocean.

The Pacific is a relatively peaceful ocean while the Atlantic is more restless. North and South America, Asia, and Australia border the Pacific Ocean. North and South America, Eupope, and Africa border the Atlantic Ocean. Africa, Asia, and Australia border the Indian Ocean. The Antarctic Ocean surrounds the Continent of Antarctica.

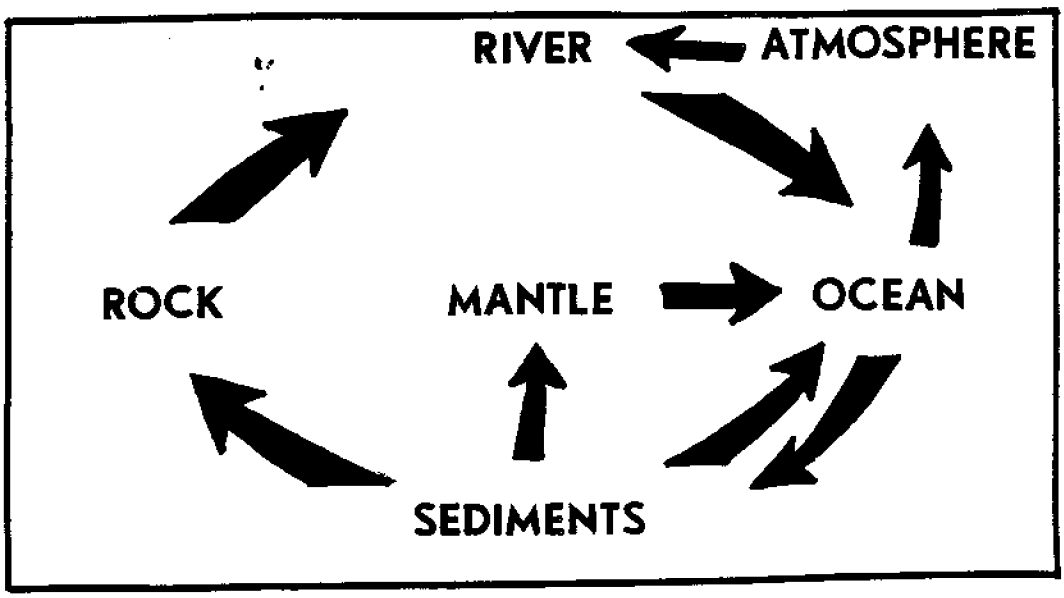


It took hundreds of millions of years to fill the oceans to their present level. As the young earth cooled, water was released from the hardening rock, escaping into the atmosphere. This vapor condensed to form clouds that started the unending water cycle. Underground and rockbound water added to the filling process.

How Did the Oceans Get Salty (pages 3-4)

Ocean salinity (salt content) is the result of a complex process involving release of minerals from the seafloor, run off from land, and reactions within seawater itself. More than 70 elements occur in seawater, in addition to thousands of compounds. Major ocean elements include hydrogen, oxygen, chlorine, sodium, magnesium, sulphur, calcium, potassium, carbon, and bromine. Of these, only chlorine, sodium, magnesium, and bromine are recovered commercially (see Unit 4 - Marine Resources). Many of the elements in seawater occur in very small amounts. Called trace elements, they are a small but important part of seawater, necessary for many of the life functions of living organisms.

The chemical makeup of fresh river water is very different from ocean water. Since tremendous amounts of freshwater enter the oceans each day, why does seawater remain chemically stable? The answer is the complex interrelationship between the atmosphere, ocean, seafloor, the earth's mantle, rivers, atmosphere, and the formation of rock. The earth constantly, but very slowly, recycles its minerals by a process that is comparable with the water cycle. Minerals removed from one part of the cycle are replaced by minerals from another part (see the illustration on page 26 .The result is an ocean system that remains chemically stable in spite of the constant exchange of minerals.




How the Earth Recycles its Minerals

Activity (page 3)

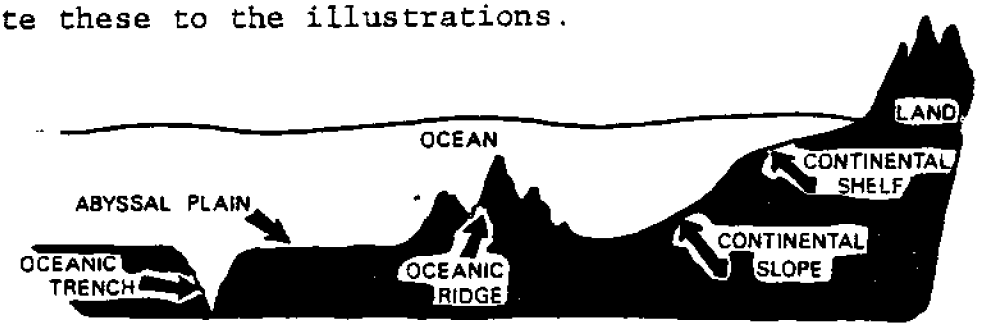
(Materials - half cup of salt, two cups of sand, cup of warm water, shallow tray, piece of glass, plastic,or metal)

1. The sand and salt represent the continental land masses.
2. The water erodes the pile, washing it into the basin. Rain and wind have eroded entire mountain ranges over millions of years.
3. The water from the basin, which represents seawater, contains more salt than the tap water, and leaves more residue on the slide.

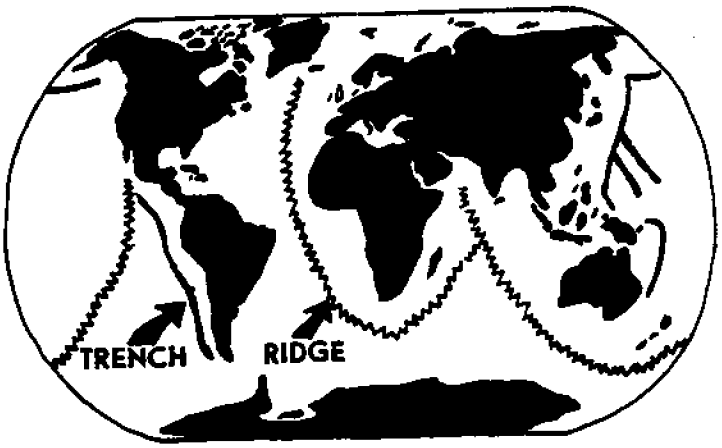
   The large inland body of water, called Lake Bonneville, covered over 19,000 square miles. With no continuous supply of incoming freshwater or an outlet to the ocean, it began drying up and is still doing so today.

What is the Ocean Floor Like? (pages 4-5)

Review this section of the member guide with the 4-H'ers. Emphasize the underlined terms (see the vocabulary list) and relate these to the illustrations.




FEATURES OF THE OCEAN FLOOR




Ocean Trenches and Ridges

For additional activities, have youth draw and label an illustration showing ocean floor features or create a relief map using paper mache', plaster of paris, or a salt-flour mixture. Recipes and instructions for these materials are given below:

Paper Mache' - shred newspaper and mix with two parts flour and one part water to form a thick paste. Add household disinfectant to retard spoilage. Cut a piece of screen at least 12"x6" and fold and crumble it to resemble a section of the ocean floor. Place the screen in a box lid and apply the mache' over the screen. Several layers may be needed to build up mountains and land masses. Allow the mache' to dry between layers. After drying, paint with water colors: ocean-blue, land-brown, etc.

Plaster of Paris - mix two parts plaster with one part water to form a thick paste. Pour it into a cardboard box top, and working quickly, scoop, cut, and smooth it to resemble a section of the ocean floor. Food coloring may be added to the wet plaster for detail.

Salt-flour Mixture - mix equal parts of flour and salt with enough water to make a thick paste. Spread the mixture in a box lid and shape it to resemble a section of the ocean floor. Drip food coloring over the paste for detail.

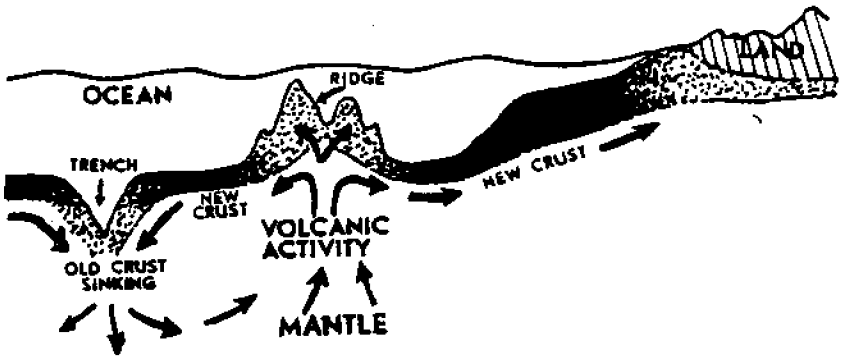
If relief maps of the ocean floor are made, these can be used to visualize the process of continental drift. Two ocean features play key roles in continental drift: ocean trenches and ridges. The mid-ocean ridges, which extend some 40,000 miles along the Pacific, Indian, and Atlantic Ocean floors, were created by volcanic activity, and are sites of new crust formation on the ocean floor. Continuous earthquake and volcanic activity forces crustal material upward from the earth's mantle and outward along the ridges. As a result, the seafloor slowly spreads

out from the ridges.

As this spreading occurs, the continents, which lie embedded in the earth's crust, are pulled apart. It is believed that the continents were once part of a single, ancient land mass. Due to stress within the earth's mantle, the land mass slowly fractured and broke apart. A quick look at a world map shows that Europe and Africa can be moved to fit neatly into North and South America. Studies of fossils, rock strata, and even magnetic fields have supported the theory of continental drift (see National Geographic, "This Changing Earth," January, 1973).

The process of continental drift is extremely slow, and although movement of land masses is measured in only inches per year, it has been going on for nearly 200 million years. Consider, if the movement were only one inch per year, one million inches would equal nearly 16 miles per million years. Since Europe and America are about 5000 miles apart, this distance could have been easily created during the 200 million year period.

The second feature important in continental drift is the system of deep ocean trenches. These trenches occur mostly in a narrow belt of the Pacific Ocean running along the coasts of Asia and the Americas. All of the trenches are V-shaped, around 30,000 feet deep, and are sites of frequent earthquake activity. Ocean trenches are areas where old ocean floor material sinks and is recycled into the earth's mantle. The rate of sinking generally equals the rate of ocean floor spreading.




CONTINENTAL DRIFT : OCEAN TRENCHES & RIDGES

Word Scramble:

SBYASLA NPALI - ABYSSAL PLAIN
NTNENOCILAT PESOL - CONTINENTAL SLOPE
NTENNLOCITA FSHLE - CONTINENTAL SHELF

NCEAOCI NCHRET - OCEANIC TRENCH
EACNCIO DGERI - OCEANIC RIDGE

Seafloor spreading is called continental drift.

How is the Ocean Floor Mapped? (pages 6-7)

The echo-sounder provided the first reliable and efficient means of mapping the ocean floor. A modified type of sonar, a signal is sent from the vessel to the ocean floor. It bounces back and is picked up by a receiving unit on the vessel. The time it takes the signal to travel from the ship, to the bottom and back is measured by a recorder which plots a contour of the ocean floor. Much of the ocean floor has been charted and numerous maps are available revealing the ocean coutours. An excellent map is the "World Ocean Floor" from National Geographic magazine, December, 1981.

Activity (page 6)

The two mountains are each approximately 1000 feet tall.

The depth of the lowest point is about 2000 feet.

The two mountain peaks are approximately 2000 feet apart.

Activity - (materials - 20-foot heavy extension cord or rope, stop watch or watch with a second hand)

The shorter the cord, the less time required for the wave to travel out from, then back to, the transmitter. If the cord were extremely long, the wave would probably not be strong enough to travel the entire distance. In very deep ocean zones the signal of the echo-sounder is often boosted with dynamite charges.

What Causes the Tides? (pages 7-9)

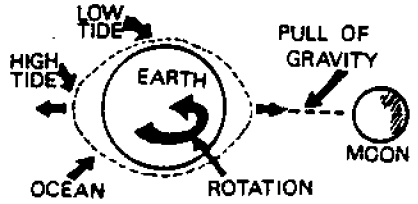
The tides are the result of the gravitational pull of the sun and moon on the earth's surface. Gravity is the attraction between bodies due to their mass (the amount of matter they contain). All objects exert a gravitational pull which is directly proportional to the mass of the object. The greater the mass, the greater the gravitational pull. Gravitational pull is also related to the inverse square of the distance between the objects. For instance, if the distance between two objects is doubled, the gravitational attraction between them would be the inverse square of 2, or $(1/2)^2$, which equals 1/4 of the original gravitational pull. This shows that distance has a much greater effect on gravity than mass. Think of how massive the sun is, yet the moon has a much greater gravitational effect on the earth's tides. This is because the moon is much closer to the earth than the sun.

Activity (page 7-8)

1. The closer the moon is to the earth, the greater its effect on the tides. High tides will be higher than average and low tides will be lower than average.
2. The sun should have the greater gravitational effect on the tides; however, as explained in the member guide, its great distance from the earth causes it to affect the tides less than the moon.

The moon's and sun's gravitational pull causes bulges on the oceans' surfaces. The bulges stay in line with the sun and moon. The earth rotates on its axis under these bulges, causing them to travel over the earth and produce the daily tidal cycles.

High tides occur on the earth's surface directly under and opposite the moon. The water under the moon is pulled away from the earth while the earth is pulled from the water on the opposite side. Low tides occur on the earth's surfaces that are at right angles to the moon. Since the earth rotates once every 24 hours, there are generally two low and two high tides each day. However, due to the irregularity of the land masses and the ocean floor, many areas of the earth have non-uniform tides. There may be fewer than four tides each day or the tidal levels may be extreme or show little change.




GRAVITY, CENTRIFUGAL FORCE AND TIDES

The rotation of the earth on its axis also affects the tides through centrifugal force. The spinning motion of the earth has a tendency to cause the tidal bulges to move slightly outward from the earth's surface, increasing their height.

Activity (page 8-9)

(Materials - heavy grade balloon, small bucket with handle, water)

1. The ballon flattens from pole to pole as it spins. Centrifugal force forces the sides outward.
2. Centrifugal force holds the water in the bucket.

Activity (page 9)

1. Areas with extreme tides have strong tidal currents. People should be aware of these when boating or swimming. The large tidal range can interfere with boat docking as well as swimming and fishing.

2. The outgoing tide removes sediments, wastes, and accumulated nutrients from the shoreline, while the incoming tide brings in fresh food supplies and seawater. Since many marine organisms cannot move around to find food (oysters, mussels, corals, etc.), the incoming tidal currents are very important to them. Many fish species also key their feeding patterns with the tides.
3. Strong tidal currents can not only be a nuisance but also a hazard. Small boat owners should be thoroughly familiar with local tidal currents when leaving shore. Running against a strong tide consumes a lot of fuel, and running out of fuel may be possible. Never leave the boat in areas where tidal currents are strong. There is a danger of being swept away from the boat. Swimmers should also be cautious of strong tidal currents along the shoreline. Strong rip tides and long shore currents can be very dangerous.

What are the Tidal Cycles? (pages 9-12)

*Tides occur about 50 minutes later each day.
*There are generally two high and two low tides daily.
*Twice each month, the tides go through a cycle of above and below average tidal ranges, called spring and neap tides.

These changes in the tides are due to the interrelationships between the sun, moon, and earth. Review the member guide for a description of these tidal changes.

Activity (page 10-11)

1. AM 12:43 6 hr. 9 min. AM 6:52 6 hr. 8 min.
   AM 6:52 PM 1:00

   PM 1:00 6 hr. 15 min.
   PM 7:15

   Four tides occur each day.

2. 12:43 47 min. 1:30 46 min.
   1:30 2:16

   The moon is revolving around the earth as the earth rotates on its axis. This causes a lag in the tides.
3. 0.0 2.4 2.4 2.5 -0.1 2.8
   2.4 -0.1 2.7

   The interaction between the sun, moon, and tides causes the daily tidal levels to change.
4. The low tides are getting lower and the high tides are

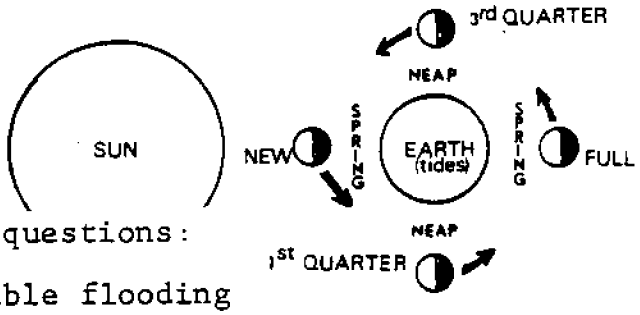
getting higher.

Activity (page 12)

1. Spring and neap tides follow the phases of the moon, spring tides occuring during full and new moons and neap tides occuring at quarter moons. If you look at a tide chart you will notice a lag between the times when the moon phases actually appear and when the spring and neap tides occur. This again is caused by the complex nature of the tidal cycles.

   The full and new moon dates will correspond to the spring tides (approximately) and the quarter moon dates to the neap tides.

2. SPRING HIGH TIDE
   AVERAGE HIGH TIDE
   NEAP HIGH TIDE
   NEAP LOW TIDE
   AVERAGE LOW TIDE
   SPRING LOW TIDE




3. Answers to tide condition questions:
   1. very high water, possible flooding
   2. high water
   3. lower than usual water level
   4. higher tides
   5. lower tides

Activity (page 13)

Refer to pages 1, 4 and 5 of the member guide to correctly label the illustrations.

Crossword Puzzle

Across

1. salinity
2. ebbing
3. echo sounder
4. PPT
5. Atlantic
6. Continental Drift
7. Oceanic Ridge
8. Mean Low Tide

Down

1. spring
2. flowing
3. tide
4. basin
5. neap
6. Arctic
7. ocean
8. continental drift
9. centrifugal
10. pacific
11. oceanic tench
12. gravity
13. tidal

References

Bhatt, J. J. 1978. Oceanography: Exploring the Planet's Ocean. D. Van Nostrand Co., New York, 322 pp.

Carson, Rachel. 1963. The Sea Around Us. Signet Books, New York, 221 pp.

Coker, R. E. 1947. This Great and Wide Sea. The University of North Carolina Press, Chapel Hill, 325 pp.

Engel, Leonard. 1963. The Sea. Time Incorporated, New York, 190 pp.

Idyll, C. P. (editor). 1969. Exploring the Ocean World. Thomas W. Crowell Company, New York, 280 pp.

MacIntyre, Ferren. 1970. Why the Sea is Salt. Scientific American. November 104-115.

Osis, Vicki. 4-H Marine Science Member's Book. Extension Service, Oregon State University, Corvallis, 27 pp.

A number of excellent articles concerning the ocean are available in National Geographic magazine. Below is a list of some of them. Use an index to locate other articles. I recommend using these articles with youth because of their quality and excellent photographs.

| | |
|---|---|
| "This Changing Earth" | January, 1973 |
| "Australia's Great Barrier Reef" | June, 1973 |
| "Strange World of the Red Sea Reefs" | September, 1975 |
| "Oasis of Life in the Cold Abyss" | October, 1977 |
| "Undersea Wanders of the Galapagos" | September, 1978 |
| "Incredible World of the Deep-sea Oasis" | November, 1979 |
| "Australia's Coral Kingdom" | May, 1981 |
| "The Ocean" | December, 1981 |

# UNIT FOUR - MARINE RESOURCES

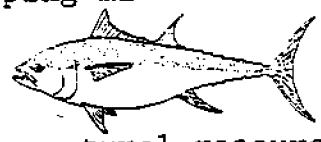
Objectives - From the activities in this unit students will learn to:

1. define the vocabulary terms listed below,
2. list at least five major marine resources,
3. give at least five examples of land - marine resource or industrial counterparts,
4. give an example of a finfish, shellfish, and trashfish,
5. list at least five examples of both "usual" and "unusual" seafoods,
6. list at least four ways seafoods are harvested,
7. list 4 important minerals found in seawater,
8. describe two ways minerals are removed from the oceans,
9. discuss some of the benefits and dangers of offshore oil wells,
10. discuss the importance of the ocean as a recreational resource,
11. list four agencies involved in marine resource management,
12. describe how scientists and lawmakers work together to manage marine resources,
13. describe problems involving at least two marine resources and offer solutions for the problems.

Key Concepts

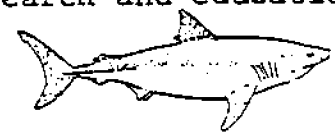
1. Marine resources include oil, minerals, water, seafood, recreational areas, and other natural resources of the ocean.
2. For almost every marine - related industry or resource there is a land - related counterpart.
3. Two major types of seafood include finfish and shellfish.
4. Shellfish include molluscs and arthropods.
5. Many types of seafood, once considered trashfish, are now used by Americans.
6. Seafoods are harvested using trawls, gill nets, pound nets, oyster tongs, dredges, and other types of fishing equipment
7. The process of desalination removes salts and minerals from seawater.
8. Seawater is a major source of the world's supply of magnesium, bromine, and salt.
9. Minerals, such as manganese, nickel, and iron, are mined from the ocean floor.
10. The increase in the number of offshore drilling operations poses some serious environmental questions.
11. The tremendous population growth along our coasts has greatly stressed our coastal resources.

12. The Virginia Marine Resources Commission, the Chesapeake Bay Foundation, the Virginia Institute of Marine Science, and the State Water Control Board are all involved in marine resource management.
13. Research scientists provide the information for law makers in developing marine resource management policies.



Vocabulary

1. marine resource - natural resource of the ocean
2. finfish - true fish such as spot and flounder
3. shellfish - marine animals including molluscs (clams, oysters, etc) and arthropods (crabs, shrimp, etc).
4. trashfish - underutilized or discarded edible marine animals
5. trawler - large fishing vessel that can tow different types of fishing nets
6. gill net - a net that catches fish by entangling the gills and head
7. pound net - a large fishing net that traps fish in a corral called the pound
8. oyster tong - a long double handled rake used to harvest shellfish from the ocean floor
9. dredge - a type of basket pulled along the ocean floor to harvest shellfish
10. desalination - process of removing salts and minerals from seawater
11. offshore oil rig - ocean, oil drilling platform
12. Barrier Islands - series of islands along the Atlantic Coast of the U.S.
13. Chesapeake Bay Foundation - a public, non-profit organization that works for proper conservation practices and improvement of the Chesapeake Bay
14. VIMS - abbreviation for the Virginia Institute of Marine Science at Gloucester Point, Virginia
15. National Sea Grant Office - a U.S. Government sponsored program which funds research and educational programs for coastal states.



Introduction

With a world population of nearly 4 billion people, the demands on our natural resources are steadily increasing. World food production has not been able to meet the demands, and as the world population may double within 35 years, the situation will become critical for many countries with respect to food and natural resources. New sources are needed for food, minerals, and water. We have turned to the sea in an effort to help relieve the critical resource problem.

The 70 million tons of seafood harvested each year, 90% of which is finfish, comprises only 2% of the total world food production. The shrimp harvest, comprising only 1/12 of the

total catch by weight, is estimated to be 1/4 the value of the total seafood harvest. In order to maintain and improve seafood harvests, fishery programs are used to restrict harvests, find better use of harvested stocks, and make harvesting more efficient.

The oceans have an abundant supply of minerals both in the water and beneath the ocean floor. Minerals such as salts, magnesium, and bromine can be extracted from seawater through desalination (salt removal). One cubic mile of seawater contains 165 million tons of different types of salts and minerals. Dissolved salts are removed through evaporation and the salts concentrated, then separated. The resulting water is usable for human consumption. Copper, nickle, tin, manganese, sand, and gravel are mined from the ocean floor. Oil and natural gas are collected by undersea drilling operations. Of the 20 billion barrels of oil used each year, 1/5 comes from the oceans. The increase in offshore drilling and mining has produced significant problems - pollution, habitat destruction, loss of wildlife, and many others.

Drugs are extracted from various marine creatures: a nerve toxin from sea cucumbers, cementing materials from barnacles, heart medications from the Portugese Man of War.

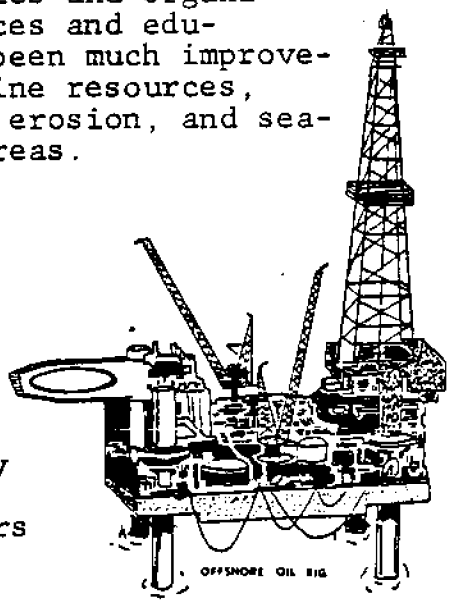
The oceans are a giant highway for thousands of cargo and passenger ships and tankers. Coal ships, container cargo vessels, oil tankers, natural gas and gasoline tankers, ore ships, and many other types ply the seas. There are over 300 collisions and ship-related accidents each year resulting in large oil spills, other forms of pollution, and loss of life.

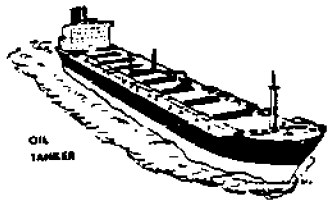
As a recreational resource, few parts of the U.S. can rival the coastal resort areas. However, due to their popularity, many coastal areas suffer from over use, poor management, and pollution stress.

A number of public and governmental agencies and organizations are at work managing our marine resources and educating people about them. Although there has been much improvement in the regulation and conservation of marine resources, serious problems, such as pollution, shoreline erosion, and seafood over-harvesting, still face our coastal areas.

Activity - Land-Marine Counterparts (answers)
(Page 1)

Crop farming . . . . seafood farming
Oil wells . . . . . offshore oil wells
Mineral mining . . . seafloor mining
Reservoirs & wells . desalination
Automobile industry . . . . . ship and boat industry
Railroads & trucking . . . . . cargo ships and tankers

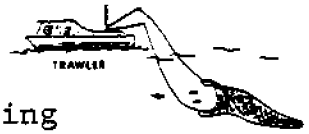




Amusement & theme parks . . . . beach resorts
Hunting & trapping . . fishing and whaling

Additional land - marine counterparts

Electronics (radio, radar, etc.) . . . . . marine electronics (radio, sonar, etc.)



Upholstery, auto & home . . . . . upholstery, boats
Inland weather forecasting . . . marine weather forecasting
Parking lots . . . . marinas, harbors
Auto repair . . . . . boat and engine repair
Highway maintenance . . . . . ship channel maintenance

Activity (page 3) - Children should check the seafoods they have tried (often, sometimes, never) and then check if they liked it or not. They should also list additional seafoods they have eaten that are not listed. Each seafood should have one or two columns checked.

Activity (page 5) - Children should check each seafood in the appropriate column. Each seafood should have one or two columns checked. (THIS WOULD BE A GOOD OPPORTUNITY TO ENCOURAGE ADDITIONAL READING ABOUT SEAFOODS.)

Minerals and Water (page 6)

The minerals listed below have the following uses:

iron - a high strength, structural material, used mostly in the production of steel. Compounds of iron are used in making fabrics, medicines, inks, dyes, pigments, and disinfectants.

Magnesium - the lightest structural material known. It is used in airplanes, electronics, portable tools, missiles, and sporting goods. Compounds of magnesium are used in antacids, laxatives, insulation materials, pigments, epsom salts, and other products.

Manganese - alloys are used in steel, propeller blades, and standard resistance boxes. Compounds of manganese are used in dyes, varnishes, paints, pigments, batteries, glazes, fertilizers, disinfectants, and other products.

Bromine - additives are used in gasoline to neutralize lead deposits in engine cylinders and are used in photo-

graphic emulsions and in sedatives.

Nickel - alloys are used in stainless steel, corrosion resistant coverings, coins, high temperature and electrical wiring, utensils, and other materials.

Oil and Natural Gas (page 7)

Children in favor of or opposed to increasing the number of offshore oil wells may support their answers with some of the danger/benefit statements listed below.

Dangers of offshore oil wells

1. oil spills
2. pollution damaging the environment and killing wildlife
3. loss of equipment and workers due to accidents and storms
4. danger to shipping, possible collisions

Benefits of offshore oil wells

1. increase oil supply
2. decrease dependence on foreign oil
3. reduce the cost of gasoline and fuel oil
4. rigs provide an attractive habitat for marine life.

Other Resources of the Sea (page 7)

Benefits of coastal development

1. improves the economy
2. attracts more people
3. makes coastal resources available to everyone
4. provide excellent vacation and recreation areas

Problems of coastal development

1. abuse and destruction of coastal resources
2. over population
3. property destruction by storms
4. increased shoreline erosion and disturbance of natural coastal processes

How do we manage our marine resources (page 8)

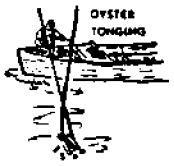
Answers to the (government control) question may be based on some of the following statements.

Federal control

1. It has greater resources (people, money, etc.).

2. It can set up national programs.
3. It can help the states work together.
4. It can bring in international assistance.
5. Programs should be for the good of the whole country.

State Control




1. The states know what is best for themselves.
2. The federal government has too much control over the states now.
3. The people can work more closely with their own state government.
4. Each state has the right to control its own resources.

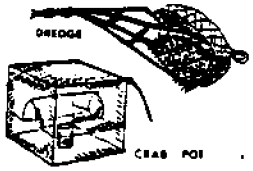
Seafood harvesting limits are set to prevent over harvesting, insure future stocks of seafood, make sure enough animals are left to reproduce, and to protect the livelihood of those who fish for a living.

In order to properly regulate our marine resources, legislators need to stay informed of current research in resource management. If laws are based on sound research, their effect will be to better conserve our marine resources.

The offshore fishing limits are set to protect the stocks of marine life from overharvesting, to insure a nation's seafood harvest is taken by its own people and to protect the security of the country.

Children may list some of the following actions they can take to assist in marine resource management (page 9)

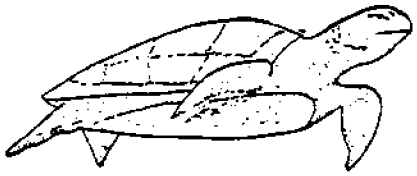
Seafood



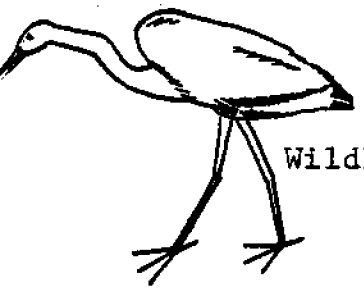

Don't waste seafood. Keep only those that you will eat. Do not keep undersized animals. Return small animals to the water so they can grow Respect the fishing laws. Do not fish or harvest seafood in restricted areas.

Shipping - Go to a department store and look for different types of foreign made goods. Stay informed about the influence of international trade on the economy of the U.S. Be aware of the importance of the import-export business to you as a consumer.

Seawater - Learn about the different sources of marine pollution and how they affect the quality of seawater. Do your part not to pollute the water. Learn how to control pollution and conserve drinking water. Educate others about the importance of clean water.



| | |
|---|---|
| Minerals & Oil | Do your part to conserve gas, oil, and fuel oil. Learn how to recycle minerals and used motor oil. Learn about alternative sources of energy. |
| Recreation | Respect the coastal environment. Get involved in developing, improving, or cleaning up a coastal recreation area with a 4-H project. Learn about planting beach and dune grasses to protect the beaches. |



| | |
|---|---|
| Wildlife | Complete a 4-H Wildlife Project for coastal wildlife. Educate others about the importance of the marine environment and its wildlife. Visit and learn about your local, state, and national coastal wildlife refuges and parks. |

Resourcefulness (Page 10-11)

This game will introduce 4-H'ers to some of the major problems facing our marine resources and possible solutions for these problems. There are ten (10) marine resource management problems presented with three (3) possible solutions for each problem. Of course, there are more solutions than those listed. Following the game, encourage students to think of additional problems and their possible solutions.

Lower level students may participate in a matching game while class discussion may be incorporated for upper level students as described below:

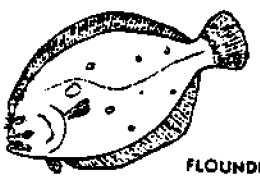
Definitions

Resourceful - an ability to meet and handle a situation

Conservation - the wise use of natural resources

Materials: one(1) solutions sheet for each team or student. Each solutions sheet contains 30 solutions for 10 problems. (3 solutions/problem).
10 marine resource problem cards.

Instructions: Remove or photocopy the Marine Resource Problem sheet from the leader guide (page 44 ). Cut along the solid lines to make 10 problem cards.



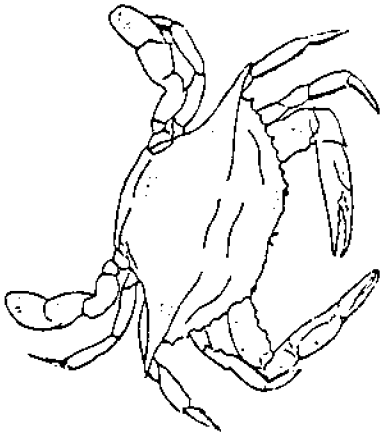
FLOUNDER

2. Remove or photocopy the Solutions sheets from the leader guide (pages 45A-45E ). Provide one copy per student or one copy per group if photocopying is not available.

3. Divide the class into no more than five teams. Have each team select a team leader.

4. Pass out one Solutions sheet to each team member or each team. Ask the students to quickly read the solutions to become familiar with them and answer any questions they may have.

5. Pass out one (1) Marine Resource Management Problem card to each team. Allow the students 3-5 minutes to select three(3) possible solutions for the problem from the Solutions sheet. Use problems 1-5 first.



6. Call on each group one at a time. Have the team leader read the management problem and the other members present three(3) solutions for the problem. Encourage everyone in the group to participate. The rest of the class will indicate whether the solutions are valid or not with the help of the leader (teacher). The correct solutions for each problem are listed on pages 42-43.

7. Each team gets one(1) point for each correct solution. Assign someone to be score keeper or the leader may keep score.

8. Pass out the second Marine Resource Problem card to each group and repeat steps 6 and 7.

9. Total the scores to see who wins. Then review the correct answers with the students.

Discussion Instructions:

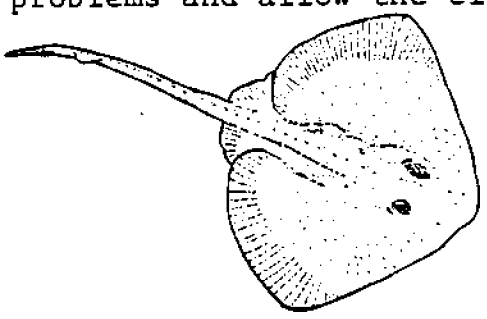
1. Follow steps 1-5 above.

2. Have each group present the problem and possible solutions. Direct the class in a discussion of the validity of the solutions and which solution may possibly be the best.

3. Encourage the class to ask the defending team questions.

   A. How does this solution work?
   B. Why did you pick this solution?
   C. How will this solution affect those people directly involved?
   D. Why does the problem need solving in the first place?

4. Encourage each group to present additional solutions to their problems and allow the class to interact with them.



## MARINE RESOURCE MANAGEMENT PROBLEMS AND SOLUTIONS

1. Many shellfish & fin fish are killed by disease and pollution.

   a. try to find the causes of the diseases of seafoods and sources of pollution
   b. grow seafoods that get fewer disease
   c. treat seafoods with medicines to cure the diseases

2. We need sources of energy other than coal, oil, and natural gas.

   a. solar energy comes from the sun - it is free for the taking
   b. wind can be used as an energy source
   c. the tides may provide us with energy

3. Coastal recreation areas are damaged by too many people using them.

   a. limit the number of people who can visit coastal vacation areas
   b. close off parts of beaches during certain times of the tourist season
   c. educate people about the need for respect for the coastal environment and how to enjoy it

4. Offshore oil drilling operations are a possible source of pollution.

   a. ban or restrict offshore drilling operations
   b. insure safe, accident free operation of offshore oil rigs
   c. have the means of controlling oil spills from offshore oil rigs in case of an accident

5. Fishing boats catch and throw away a large number of unwanted seafood (trash fish).

   a. educate people in the use of unusual seafoods
   b. find and develop markets for unusual seafoods overseas and at home
   c. develop fishing methods that reduce the number of unwanted seafoods that are harvested

6. Many collisions and accidents involving ocean going ships occur each year.

   a. ships should be frequently inspected to make sure they are seaworthy
   b. ships should be operated safely and by a dependable crew to help prevent accidents
   c. ships should be outfitted with reliable warning systems to prevent collisions

7. Some marshes and other coastal wetlands have become trash and waste dump sites.

   a. educate people about importance of not polluting our coastal wetlands
   b. enact and enforce strict laws that prohibit dumping trash and wastes on coastal wetlands
   c. clean up coastal wetlands that have become dumping sites

8. How can we harvest more fish from the ocean without endangering them?

   a. limit the size of the harvested fish
   b. limit how and when the fish are harvested
   c. limit the number of harvested fish

9. Certain seafoods are found to contain high levels of poisonous chemicals.

   a. control ocean pollution so that marine life will not be poisoned
   b. seafoods should be checked for dangerous chemicals
   c. educate people about where and how to harvest seafoods that are safe to eat

10. Many species of coastal wildlife have been endangered by human activity.

    a. educate people about the importance and necessity of coastal wildlife populations
    b. enact and enforce strict laws that protect coastal wildlife
    c. set aside wildlife refuges where human activity is limited

MARINE RESOURCE MANAGEMENT PROBLEMS

| | |
|---|---|
| 1. Many shellfish and finfish are killed by disease and pollution. | 2. We need sources of energy other than coal, oil, and natural gas. |
| 3. Coastal recreation areas are damaged by too many people using them. | 4. Offshore oil drilling operations are a possible source of pollution. |
| 5. Fishing boats catch and throw away a large number of unwanted seafood (trashfish). | 6. Many collisions and accidents involving ocean-going ships occur each year. |
| 7. Some marshes and other coastal wetlands have become trash and waste dump sites. | 8. How can we harvest more fish from the ocean without endangering them? |
| 9. Certain seafoods are found to contain high levels of poisonous chemicals. | 10. Many species of coastal wildlife have been endangered by human activity. |

## MARINE RESOURCE MANAGEMENT SOLUTIONS

Answers to Questions 1-5

- develop fishing methods that reduce the number of unwanted seafoods that are harvested
- solar energy comes from the sun - it is free for the taking
- have the means of controlling oil spills from offshore oil rigs in case of an accident
- ban or restrict offshore drilling operations
- wind can be used as an energy source
- educate people in the use of unusual seafoods
- close off parts of beaches during certain times of the tourist season
- find and develop markets for unusual seafoods overseas and at home
- limit the number of people who can visit coastal vacation areas
- educate people about the need for respect for the coastal environment and how to enjoy it
- insure safe, accident free operation of offshore oil rigs
- treat seafoods with medicines to cure the diseases
- the tides may provide us with energy
- grow seafoods that get fewer disease
- try to find the causes of the diseases of seafoods and sources of pollution

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Answers to Questions 6-10

- educate people about the importance and necessity of coastal wildlife populations
- clean up coastal wetlands that have become dumping sites
- limit the size of the harvested fish
- enact and enforce strict laws that prohibit dumping trash and wastes on coastal wetlands
- control ocean pollution so that marine life will not be poisoned
- limit the number of harvested fish
- seafoods should be checked for dangerous chemicals
- set aside wildlife refuges where human activity is limited
- educate people about where and how to harvest seafoods that are safe to eat
- educate people about importance of not polluting our coastal wetlands
- enact and enforce strict laws that protect coastal wildlife
- ships should be frequently inspected to make sure they are seaworthy
- ships should be outfitted with reliable warning systems to prevent collisions
- ships should be operated safely and by a dependable crew to help prevent accidents
- limit how and when the fish are harvested

Cut along solid line.

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Answers to Questions 1-5

- develop fishing methods that reduce the number of unwanted seafoods that are harvested
- solar energy comes from the sun - it is free for the taking
- have the means of controlling oil spills from offshore oil rigs in case of an accident
- ban or restrict offshore drilling operations
- wind can be used as an energy source
- educate people in the use of unusual seafoods
- close off parts of beaches during certain times of the tourist season
- find and develop markets for unusual seafoods overseas and at home
- limit the number of people who can visit coastal vacation areas
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Crossword Puzzle

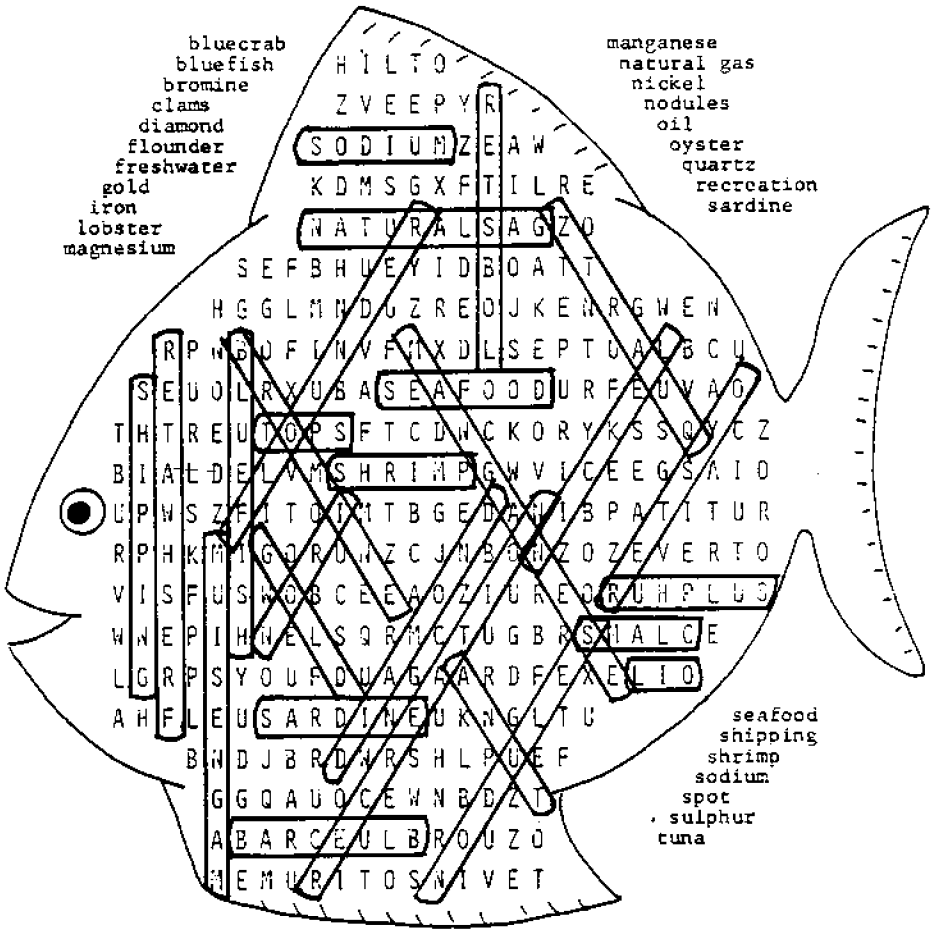
Across

1. dredge
2. Chesapeake Bay
3. recreation
4. pound net
5. trawler
6. magnesium
7. shell
8. fin
9. VIMS
10. marine resources
11. trash

Down

1. crab pot
2. octopus
3. desalination
4. Barrier Islands
5. tong
6. anthropod
7. gill net
8. offshore
9. mollusc
10. gold
11. Sea Grant

Searchword Puzzle



References

Biller, W. 1972. Tools for Coastal Zone Management. Washington, D. C., Marine Technology Society.

Dasemann, R. F. 1959 Environmental Conservation. N. Y., Wiley & Sons.

Coker, R. E. 1949. This Great and Wide Sea. Chapel Hill, North Carolina, UNC.

Firth, F. E. 1969. The Encyclopedia of Marine Resources, N. Y. Van Nostrand Reinhold.

Turnbull, J. 1958. An Introduction to the Geology and Mineral Resources of the Continental Shelves of the Americas. U. S. Geological Survey Bulletin #1067. Washington, D. C., U. S. Government Printing Office.

Idyll, C. P. 1972. Exploring the Ocean World. Thomas Y. Crowell Co., N. Y.

An excellent series of articles concerning the present status of the Chesapeake Bay appeared in the Richmond Times Dispatch March 4-7, 1984.

# MARINE BOWL-QUESTIONS AND ANSWERS

Below is a list of questions and answers concerning the information presented in the 4-H Marine Project Units, One-four. Suggestions for use include:

1. General class review - randomly ask students questions, a good time to encourage further discussion.

2. Assign questions as an additional activity that can be presented as a report or a demonstration. Students may be assigned to work individually or in small groups.

3. Divide the class into two or more teams and have a contest (marine bowl). The winning team can be given certificates of recognition. Make your own rules for the contest, select judges, and even challenge other 4-H clubs or classes.

## What Is Water?

1. List four places on the earth where water is found. (in air, on and under the ground, in living things, in rocks)
2. How much of the earth is covered by water? (three-fourths)
3. Are there any liquids that have properties like those of water? (No)
4. List two unique properties of water. (surface tension, dissolving power, heat capacity, expansion)
5. Describe the odor, taste, and color of water. (it has none)
6. What is an atom? (smallest particle of an element)
7. What is a molecule? (particle composed of two or more atoms)
8. What is the smallest particle of water called? (molecule)
9. Why is water called a compound? (it is composed of different elements (atoms)
10. What is the chemical symbol for water? ($H_2O$)
11. What bond holds water molecules together (hydrogen bond)
12. How does the hydrogen bond work? (the positive and negative ends of different molecules are attracted to each other).
13. What is water in the gaseous form called? (water vapor)
14. In what state of matter are water molecules closest together-liquid, gas, solid? (liquid)
15. At what temperature is water densest? ($4^oC$, $39^oF$)
16. Why does ice expand? (all of the molecules form hydrogen bonds causing them to spread apart)
17. What is surface tension? (surface water molecules form a film-like boundary on the water's surface)
18. What causes surface tension? (hydrogen bonding between molecules)

19. Why does a needle "float" on water? (surface tension supports it)
20. Because it dissolves so many things, water is called the _____ _____. (universal solvent)
21. How does water dissolve something? (water molecules separate and surround individual particles).
22. Why doesn't oil dissolve in water? (oil molecules repel water molecules).
23. Why does hot water dissolve things better than cold water? (it has more energy).
24. Water has a large heat capacity; what does this mean? (it can store a large amount of heat).
25. The more surface area of water exposed to the air, the A) greater, B) less... the rate of cooling.
26. Ice is (less, more) dense than liquid water.
27. What would happen to the earth if the lakes and oceans froze from the bottom up? (it would become barren wasteland)
28. Why does an iced drink get cold? (the melting ice draws heat from the liquid, making it colder)

A Stream Becomes An Ocean?

1. Describe the water cycle. (evaporation, precipitation)
2. How often is the atmospheric water recycled? (every 12 days)
3. Why don't the oceans dry up due to evaporation? (precipitation and runoff replace the evaporated water)
4. The amounts of water in the atmosphere, land, and oceans are (constant, changing).
5. Where does the water come from that is found in mountain streams? (rain, melting snow, underground - any two answers)
6. What important gas in the air mixes with water in a stream as it tumbles over rocks? (oxygen)
7. Trout require water that is (warm, oxygen poor) (cold, oxygen rich).
8. The immature forms of many aquatic insects are called _____. (nymphs)
9. A shallow, rocky area of a stream is called a _____. (riffle)
10. Minerals, dissolved from rocks by flowing water, will eventually become part of _____. (seawater)
11. As changes occur in the stream, the animal and plant populations also change. (true, false)
12. An animal that feeds on the remains of other animals is called a _____. (scavenger)
13. Name two major uses of lakes and reservoirs. (recreation, water supply, electricity)
14. Name three types of freshwater fish. (minnow, sunfish, bass, sucker, etc.)
15. A prey eats a predator. (true, false)
16. Why are marshes important to aquatic animals? (they provide breeding and nursery grounds).
17. What is an estuary (area where fresh and saltwater mix).

18. What is the largest estuary in North America? (Chesapeake Bay)
19. Name four kinds of animals found in the Chesapeake Bay. (fiddler crab, blue crab, spot, trout, shark, egret, jelly-fish, etc.)
20. Name two important resources of the Chesapeake Bay. (sea-food, shipping, industry)

What Is An Ocean?

1. Name three major oceans. (Atlantic, Pacific, Arctic, Antarctic, Indian).
2. Where is the Atlantic Ocean found? (it lies between the Americas and Europe-Africa)
3. The oceans are three to four billion years old (true, false)
4. What is salinity? (salt content of seawater)
5. What does a salinity of 35 parts per thousand mean? (a thousand buckets of seawater contain enough salt to fill 35 of them with salt.)
6. How many elements are found in seawater? (more than 70)
7. What is an ocean basin? (the depression in the earth's surface that contains the ocean).
8. What is the shallow, coastal part of the seafloor called? (continental shelf)
9. The deep ocean floor is called the _____ ____. (abyssal plain)
10. Undersea mountain ranges are called _____.(ridges)
11. Openings in the ocean floor are called _____. (trenches)
12. What is the process of seafloor spreading called? (continental drift)
13. According to the theory of continental drift, what occurs at the ocean ridges? (volcanic activity produces new ocean floor material that spreads out from the ridges)
14. According to the theory of continental drift, what occurs at the ocean trenches? (old, ocean crust sinks into the trenches)
15. What instrument is used to map the ocean floor? (echo sounder).
16. Describe how the echo sounder works. (signals sent from a ship-board instrument bounce off the seafloor, return to the ship, and are recorded on a graph)
17. What causes tides? (gravitational pull of the sun and moon on the earth's surface)
18. Which has the greater effect on gravity - mass or distance?
19. High tides are found on the earth (A)at right angles to, B) directly under the moon.
20. How does the earth's rotation affect the tides? (it increases the tidal bulges through centrifugal force)
21. What actually is high tide? (the crest of a hugh wave)
22. The difference between high and low tide is the ____ ____. (tidal range)
23. Spring tides occur: A) in the spring, B) only during warm weather, C) during full and new moons.

24. During neap tides the tidal range is: A) greater than average, B) less than average.
25. Why does the moon have a greater effect on the tides than the earth? (it is closer to the earth than the sun)

Marine Resources

1. Name two land-marine resource counterparts. (see page 36)
2. Name two main categories of seafood. (finfish, shellfish)
3. Why were sharks once considered trashfish? (they were thought to be of little value)
4. Name three types of unusual seafoods. (see member guide, page 5)
5. What are oyster tongs? (long, double handled rakes used to harvest oysters)
6. What is desalination? (process of removing salt from seawater)
7. Name two ocean minerals and a use for each. (see page 37)
8. How much of the world's oil supply comes from the ocean floor? (20%)
9. Describe one danger and one benefit of offshore oil rigs. (see page 38)
10. Name two additional marine resources (other than seafood and minerals). (recreation, medicine, transportation, energy)
11. Why are there limits set on the number and size of finfish and shellfish taken from the Chesapeake Bay? (see page 39)
12. Why should law makers stay informed about marine resource management issues? (see page 39)
13. List two ways that you can help manage and conserve marine resources. (see page 39)
14. Name two marine resources and a problem facing each one. (see page 42)

# SUGGESTED READING


## What is Water?

Anderson, Norman. 1978. Investigating Science in the Swimming Pool and Ocean. McGraw-Hill, N. Y.

Kuenen, P. H. 1963. Realms of Water. John Wiley & Sons.

Leopold, Luna and W. B. Longbein. 1960. A Primer on Water. U. S. Government Printing Office.

Water, Yearbook of Agriculture. 1955. U. S. Department of Agriculture, U. S. Government Printing Office.

## A Stream Becomes an Ocean

Eifert, Virginia. 1959. River World. Dodd, Mead and Co., N. Y.

Hynes, H. B. 1970. The Ecology of Running Waters. University of Toronto Press.

Russel, Franklin. 1961. Watchers of the Pond. Alfred Knopf. NY.

Teal, John and Mildred. 1969. Life and Death of the Salt Marsh. Brown and Co., N. Y.

Zottoli, R. 1973. Introduction to Marine Environments. C. U. Marsh Co., St. Louis

## What is an Ocean?

Cousteau, Jacques Ives. 1974. Challenges of the Sea. World Publishers, N. Y.

Cousteau, Jacques Ives. 1979. The Ocean World. H. N. Abrams, N. Y.

Darwin, G. H. 1962. The Tides. Freeman, Cooper & Co., San Francisco.

Gross, M. G. 1972. Oceanography - A View of the Earth. Prentice Hall Inc. N. J.

Penzias, Walter. 1973. Man Beneath the Sea. Wiley, Interscience, N. Y.

## Marine Resource

Brin, Andre'. 1981. Energy and the Oceans. Ann Arbor Science.

Cousteau, Jacques Ives. 1974. Riches of the Sea. World Publishers, N. Y.

Cousteau, Jacques Ives. 1979. Marine Sources of Energy. Pergamon Press, N. Y.

Firth, T. E. 1969. The Encyclopedia of Marine Resources. Van Nostrand-Reinhold, N.Y.

Hagen, Arthur. 1975. Thermal Energy from the Sea. Noyes Data Corp. N. Y.

Iversen, Edwin. 1968. Farming the Edge of the Sea. Fishing News LTD, London.

Mero, John. 1965. The Mineral Resources of the Sea. Elsevier, N. Y.

Pearson, John S. 1975. Ocean Floor Mining. Noyes Data Corp., N. J.

MOVIES - most of the movies listed below can be loaned free of charge, but require return postage and insurance. Contact each of the following offices for further information.

Virginia Institute of Marine Science
Marine Education Center
Gloucester Point
Gloucester, VA 23062

1) Chesapeake Blue (blue crab) (10 min.)
2) Commercial Fishing in the Chesapeake Bay (30 min.)
3) Estuarine Heritage (28 min.)
4) Learning About Liquids, Solids and Gases (11 min.)
5) Restless Sea (30 min.)

Mariner's Museum, Newport News, VA 23606

1) Story of Menhaden PZ-36 (30 min.)
2) Sea Images PZ-45 (19 min.)
3) The Rise and Fall of the Great Lakes PZ-49 (16 min.)
4) Salt Marshes PZ-59 (20 min.)
5) Challenge of the Ocean PZ-68 (30 min.)
6) The River PZ-78 (32 min.)
7) Billy Moore, Chesapeake Boatbuilder PZ-90 (30 min.)

Virginia Commission of Game and Inland Fisheries, 4010 W. Broad St., Richmond, VA 23230

1) Not by a Dam Site (14 min.)
2) Birds of the Shore and Marsh (14 min.)
3) Headwater (28 min.)
4) Life Along the Waterways (11 min.)
5) Marshland not Wasteland (14 min.)
6) Still Waters (14 min.)
7) Dammed Forever (20 min.)
8) Americas Wetlands (30 min.)

NOAA, Motion Picture Service
PAMP/RM 039 N BOC1
11420 Rockville Pike,
Rockville, Maryland 20852

1) It's Your Coast (28 min.)
2) The Biologist and the Boy (14 min.)
3) Watermen of Chesapeake (28 min.)
4) Estuary (28 min.)
5) Ocean World (29 min.)

The Virginia Institute of Marine Science, Marine Education Center, offers a computerized bibliography system organized by topics. Called the Marine Education Materials system, it contains an up-to-date listing of marine education material currently available. For more information write: Sue Gammisch, VIMS-Sea Grant Program, Gloucester Point, VA 23062.

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