Investigating the Marine Environment and Its Resources

Part II

by Violetta Lien

Sea Grant College Program • Texas A&M University
TAMU-SG-79-401

INVESTIGATING THE MARINE ENVIRONMENT

AND ITS RESOURCES

PART II

by

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Changes in a Larger Environment/Activity
It's Natural to Change/Reading
Once There Was One, Now There Are Two!/Reading
Sequential Changes in Matagorda Delta/Drawings
10,000 B.C./Reading
4,000 B.C. to 1,000 A.D./Reading
1520 A.D. to 1800 A.D./Reading
1800 to 1900/Reading
Future/Reading
Changes in Man's Activities on the Coast/Drawings

Major Objectives for the Topic:

After completing the activities the student will be able to:

1.1 define change;
1.1 cite examples of changes that occur;
2.2 evaluate changes in the environment
2.2 examine marine environment of the past and present and analyze changes;
2.2 conclude that the environment of any locality will change with the passage of time;
2.2 compare and contrast marine environments of the past and present
2.3 point out environmental problems that have existed in the past and that exist today;
3.1 analyze changes in marine environment to determine factors causing them;
3.1 examine marine environments of today and formulate possible future changes;
3.1 hypothesize about the consequences of man's manipulation of the environment in the past, present and projected future.

Teaching Suggestions:

The purpose of this lesson is to have the students identify ways in which the marine environment naturally changes and changes in man's activities in the coastal zone in relation to the marine environment.

1. The students will complete the readings and use the sketches to identify and analyze natural and man-made changes in the marine environment. (The materials may be distributed on the previous day.) The class can discuss the readings and activities in small groups and/or as a whole.

2. You may have the students work on the dioramas as a group. Each group is assigned to research a time period and build a diorama representing that time period

Reference from Texas Parks and Wildlife Magazine, Our Changing Coastline, Vol. 34, No. 6 (June 1976) pp. 2-5.

TOPIC TEN--CHANGES

CHANGE IS NATURAL

Complete--

Introduction to change activity.

Read--

It's Natural to Change
Once There Was One, Now There Are Two!

Look at--

Drawings of Sequential Changes in Matagorda Delta.

List--

Natural changes that occur in the coastal zone.

Sketch--

In your projection of the future Matagorda area in No. 7.

Answer--

The questions.

INTRODUCTION TO CHANGE

WHAT THINGS CHANGE?	WHAT THINGS DO NOT CHANGE?
WHAT CHANGES OCCUR IN OUR SCHOOL ENVIRONMENT?	WHAT CHANGES IN OUR HOME ENVIRONMENT?

WHAT CHANGES OCCUR IN YOUR MOODS?

Let's look at changes in a larger environment-- our society and the earth.

OVER CROWDING?

WATER POLLUTION

FLOODS

AIR POLLUTION?

DISEASE

HURRICANES

HOW DO THESE MAJOR CHANGES AFFECT PEOPLE AND SOCIETY AS A WHOLE?

HOW DO THESE CHANGES AFFECT THE BEHAVIOR OF PLANTS, ANIMALS & MAN?

YOU

YOU

IT'S NATURAL TO CHANGE

Natural processes are constantly changing and shaping the coastal region. These processes include: stream runoff; sediments being deposited; wave erosion of the shoreline; storm surge; flooding; ground sinking; faulting and sand dune movement. The processes are the result of natural interactions of climate, soil and water systems.

These processes are the agents of change. They make sure that the coastal region continually changes. These changes occur not only in shorelines but also in bays, marshlands and river courses. These changes are vital to the survival of the ecosystems. Floods flush the bays, and although this may seem to have bad effects on the organisms, it is followed by an increase in productivity. Marsh changes ensure the continuous cycling of nutrients needed for the marine organisms.

However, some of the changes conflict with our use of the land. The conflicts usually occur where we have gotten in the way of natural processes or unknowingly upset balances.

We need to know about these changes so we will not upset balances.

To learn more about these changes, the Matagorda Bay area was selected as a model for developing ways of watching and recording shoreline changes. This area was selected because this part of the coast has been the least affected by man's activities. Therefore, the changes that occur are due to natural processes.

From this study, we have already learned that 60 percent of the Texas Gulf shoreline is erosional. The erosion of the shoreline in the Matagorda area has been approximately 1,300 feet over the last 100-year-period. That is an average rate of 13 feet of shoreline that is lost each year. The principle cause is natural. Certain of our activities have helped to speed up the erosion. Therefore, it is important that we understand the changes so that our development of the area can be sound and balanced with the effects of natural changes.

ONCE THERE WAS ONE, NOW THERE ARE TWO !

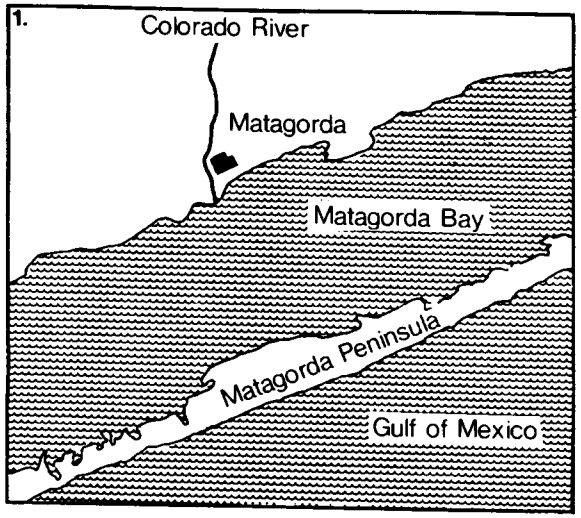
Now let's take a look at how nature changes the shape of the coastal region. If we go back in time we find that in 1856 Matagorda Bay was one bay. Drawing 2 shows the effect of a log jam at the mouth of the Colorado river in 1929.

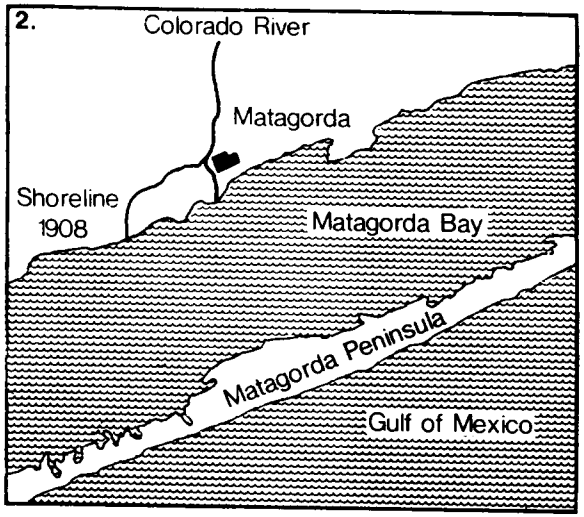
Drawings 3, 4, and 5 show what happened after the log jam was removed. Three principle streams empty into the bay. The largest is the Colorado river, and we see that it has constructed a delta dividing the bay into two parts.

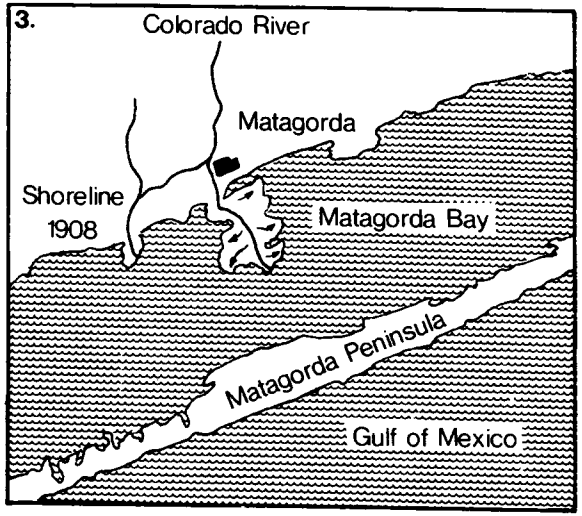
Drawing 6 shows the Colorado river mouth at the present time. Water from the river enters the western bay and the Gulf of Mexico. Marshes now occupy the low-lying areas along the shore of the mainland and the bayside of the barrier islands and peninsulas. These marsh areas of the mainland are directly related to the river.

Grassflats now occur in many areas, but are best on the western side of the delta. Here, the water is a few inches to about four feet deep and the bottom is sand and muddy sand. Oyster reefs once flourished in several areas of this bay. However, some reefs have been overrun by the delta, covered by spoil from dredging, or removed by shell dredgers. There are also numerous oyster clumps in shallow water; most are dead. Therefore, nature changes not only the shape but life in the coastal zone as well.

Some of man's activities affect the natural processes of change or have the potential of doing so. These are: (1) land and water usage (2) river diversion (3) shell dredging (4) dredging of canals (5) dune destruction (6) mining of beach and barrier sand and (7) construction of jetties and bulkheads. Knowledge of the natural processes and man's activities is essential in order to insure the coastal zone will be managed wisely.

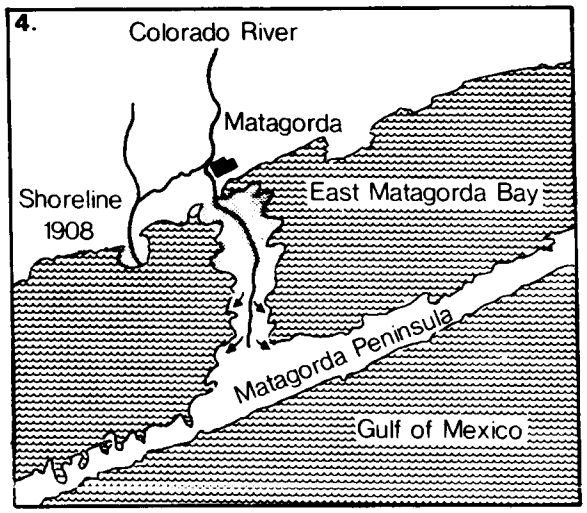


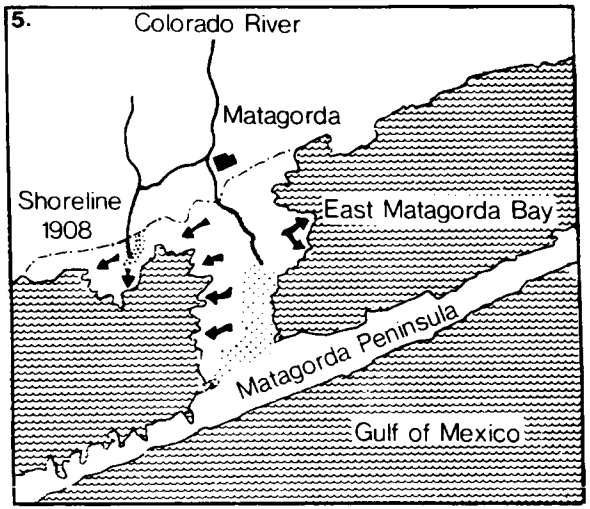


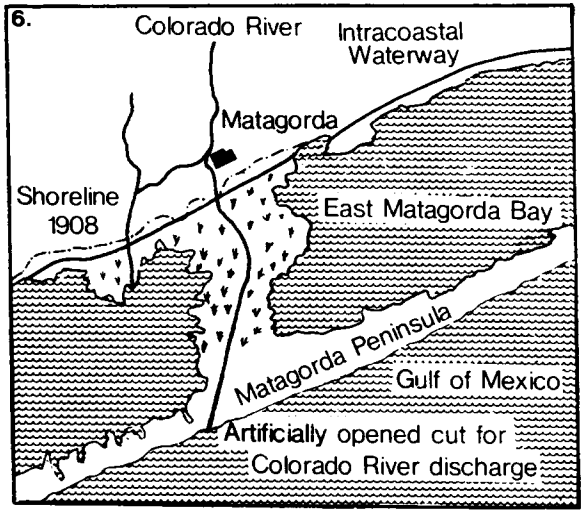


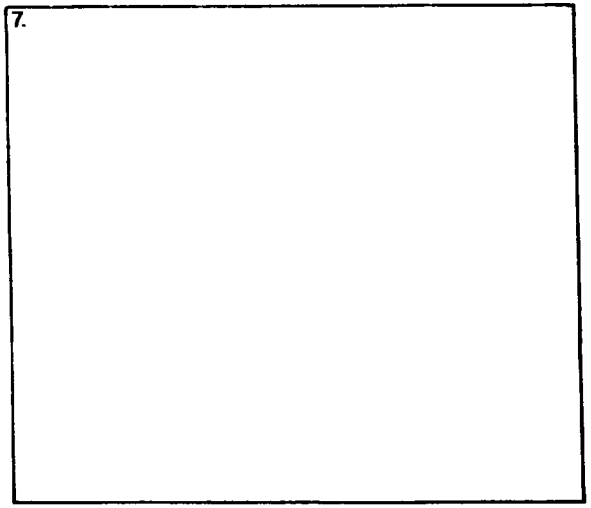
SEQUENTIAL CHANGES IN MATAGORDA DELTA

1. Colorado River 1856
2. Colorado River mouth (in Matagorda Bay) in 1929, before log jam was removed.
3. Colorado Delta 1930
4. Colorado Delta 1936
5. Colorado Delta 1941
6. Schematic presentation of Colorado River mouth as it presently empties into the Gulf of Mexico.
7. Future


4.
Colorado River
Matagorda
Shoreline
1908
East Matagorda Bay
Matagorda Peninsula
Gulf of Mexico


5.
Colorado River
Matagorda
Shoreline
1908
East Matagorda Bay
Matagorda Peninsula
Gulf of Mexico


6.
Colorado River
Intracoastal
Waterway
Matagorda
Shoreline
1908
East Matagorda Bay
Matagorda Peninsula
Gulf of Mexico
Artificially opened cut for
Colorado River discharge


7.

QUESTIONS

1. How did the Matagorda area naturally change?

2. How would this natural change affect the marine environment?

3. How would these natural changes affect the marine organisms?

4. What effect does man have on the natural processes?

5. How would man's changes affect the marine environment and the organisms living there?

6. What natural changes do you think will occur in the Matagorda area in the future?

TOPIC TEN--CHANGES

CHANGES IN MAN'S ACTIVITIES AND THE COASTAL ZONE

Read--

10,000 B.C.
4,000 B.C. to 1,000 A.D.
1520 A.D. to 1800 A.D.
1800 to 1900
20th Century-Modern Period
The Future.

Look at--

Pictures of the Texas Coast and Man's Activities Through Time.

Prepare--

A diorama of each of the above time periods.

or

Draw--

Pictures of each time period showing man's activities in the coastal zone.

Draw--

Your idea of the Texas coast in the future.

Write--

A scenario of the Texas coast in the future.

Share--

Your scenario with your classmates.

Divide--

A sheet of paper into five columns. Label them:

Time Period
Natural Changes
Man-Made Changes
Impact on Environment by Man
Resources Used

Fill in each column.

Answer--

The questions.

10,000 B.C.-- PALEO-AMERICAN PERIOD

This is Captain Seaborne. We are going back in time to look at the Texas coast. Archaeological evidence has revealed that man first came to the Texas coastal region about 12,000 years ago. This was during the time when the glaciers of the last ice age were beginning to melt. The sea level was several hundred feet lower than it is today. Therefore, the Gulf shoreline was miles further out than it is today. What today are bays were actually river valleys 12,000 years ago. Also, what we call beaches were part of the inland prairies during this period.

People of that time were nomadic hunters who killed all the game in one region and then moved on to a new area to hunt. They lived along rivers for water and transportation. Rivers also gave them a strategic location for hunting, since the animals were attracted to the water. These early inhabitants may have had an impact on their environment. It is thought that they used fire to stampede and kill mammoths, bisons, and other animals. As they moved about the land, they left scattered artifacts and a few kill sites that tell us of their presence. However, many of their remains are under the bay waters and in the Gulf in areas which were once dry land.

4,000 B.C. to 1,000 A.D.--NEO-AMERICAN PERIOD

By 4,000 to 5,000 B.C. the melting of the glaciers was causing the Gulf waters to rise to their present level. Bays, as we know them today, were in the process of being formed. Into this area moved a primitive tribe of Indians who soon adapted to the environment.

These Indians were hunters and gatherers. That is, they depended on the coastal resources in a different way than the earlier big game hunters. They began to develop social systems that are shown in their artifacts, shell middens, and burial grounds. They probably did very little to change the environment. They had fire but no horses and no wheels. Their impact was limited to their dwelling sites. After they left an area, the land changed back to its natural state. Therefore, their impact was not lasting.

1520 A.D. to 1800 A.D.--COLONIAL PERIOD

A few changes occurred in the life of the coastal Indians. Ceramics and the bow and arrow had been introduced. Agricultural practices were probably learned from neighboring groups. At the time Cabeza de Vaca landed on the Texas coast in the 1520's most of the coastal tribes were still gatherers and hunters.

The Spanish colonial period had little impact on the coastal region, except for the territorial conflicts with the French that resulted in building Spanish missions and forts at points where the French had entered. The Spaniards occupied only a few scattered permanent settlements, mainly in and around San Antonio, Goliad and Nacogdoches. A major Spanish legacy in the coastal zone lies under water off the coast of Padre Island and beneath certain shallow bays. This legacy is the sunken ships filled with gold, silver, and artifacts of the Aztec period.

1800 to 1900--NINETEENTH CENTURY

Mexico's independence from Spain opened up Texas to settlers. These settlers then won their independence from Mexico and established the Republic of Texas. With the forming of the Republic and later its becoming part of the United States, the coastal region became a major highway of transportation and commerce. It has remained so ever since.

Once the coastal region opened to settlement, increasing changes occurred. Ports were established. Ships brought immigrants and supplies into Texas from other areas of the United States and Europe. Some of the supplies brought in were lumber, shingles, bricks, flour, sugar, lime, coffee, railroad iron, fruits, clothing and material. The products shipped out varied from port to port. In the late 1800's, these included cotton, grain, beef, hides and tallow. The ships also carried passengers, not only between Texas ports but also to other parts of the United States.

The first step taken to improve these ports and harbors was to dredge them. This made the waterways wider and deeper than before. Also jetties and groins were built to make the channels more permanent with fewer hazards. Railroads were being built from these ports to the interior. Both goods and people were freely transported to and from the ports.

In 1873, the first survey was taken to find a suitable route for an intracoastal waterway. This led to the dredging

operation that eventually created a channel which joined together all the existing inland waterways along the coast. This gave vessels not requiring deep water a sheltered and uninterrupted passageway through Texas from the Rio Grande on the border of Mexico to Florida.

20th CENTURY--MODERN PERIOD

Development and expansion of the port and harbor facilities, jetties, channels and intracoastal waterway system continued. However, with the discovery of major oil fields in the 1890's and early 1900's, a new era dawned.

Today, all the major Texas ports have petroleum refineries, bulk terminals, petrochemical plants and petroleum-related industries. This has caused the Texas Gulf Coast region to become the world's largest petrochemical complex in terms of output and investment.

A fishing industry also developed on the Gulf of Mexico. Many ports on the lower coast are home ports for the commercial fishing vessels. The majority of these vessels are shrimpers, since 90 percent of the total fishing is for shrimp. Consequently, these ports also have ship building and maintenance facilities.

Another development that occurred in the 1920's was to play an important part in the shaping of the Gulf coastal area. The number of automobiles in the United States was rapidly increasing as the car became a mode of transportation. Motorists cast wistful gazes at the beaches of Galveston, Mustang and Padre Island. The beaches provided a highway along the Gulf for miles as well as an area for fishing, swimming, sightseeing, and pleasure driving. This led to the construction of causeways and development of ferry services to carry the automobile to these recreational areas.

This has led to the development of coastal marine recreation which includes swimming, fishing, hunting, camping, boating, sailing, surfing, golf, tennis, and bird watching. It has also led to vacation home development and hotels, marinas, restuarants, shops, etc. to serve the visitor.

In addition to petroleum, petroleum products, chemicals, minerals, sulfur, iron, steel, motor vehicles, machinery,

fertilizer, etc., agricultural products also move through the ports. Agribusiness, the combined phases of food, fiber and forest production, processing, transporting and marketing, is Texas's leading industry. Agribusiness products are shipped from the coastal ports. These include corn, cotton, rice, grain sorghums, soybeans, wheat, wheat flour, animal fat, and vegetable oils.

The coastal zone continues to grow and develop. The development of offshore oil and gas production and mining and their related industries have contributed to this growth. The population of the coastal zone increased 20 percent between 1960 and 1970. What will the future be like?

THE FUTURE

What will the Texas coast and man's activities be like in the future? There are many possibilities. Since we have no way of really knowing, we can only project possible events.

Some possibilities include:

1. running out of oil and gas
2. decrease in the petrochemical and related industries and ghost towns developing
3. fewer automobiles and boats
4. fewer people traveling to the coast for recreation
5. decrease in agricultural products due to less oil and gas and fertilizer available.
6. return to less technology
7. more mass transportation
8. greater use of solar and wind energy
9. return to sailing type ships

Some alternative possibilities include:

1. more oil and gas discoveries offshore
2. petrochemical chemical complex increases
3. a superport or two offshore for supertankers

4. offshore man-made islands with refineries and chemical plants

5. entire cities built out in the Gulf

6. mariculture farms for growing algae, shrimp, oysters and fish for food

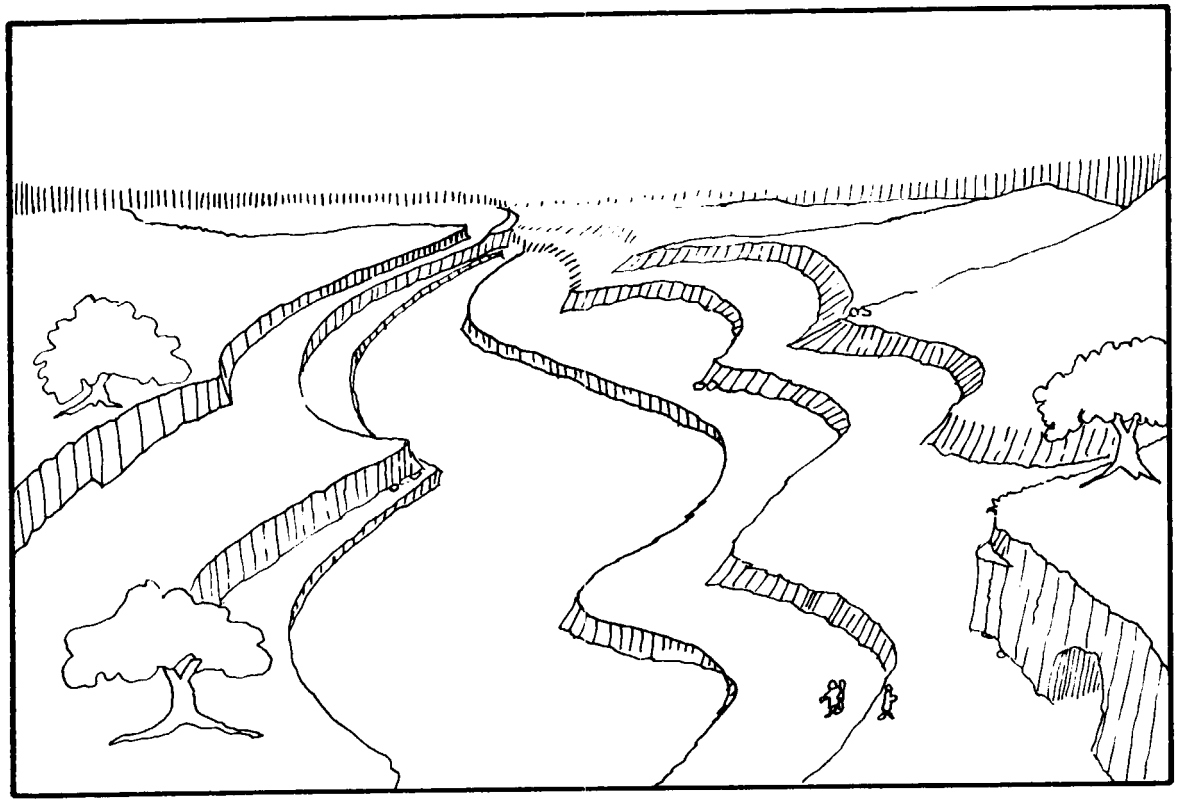
7. hydrofoil ships for transportation along rivers into the interior of Texas

8. the sun, wind and water as energy sources

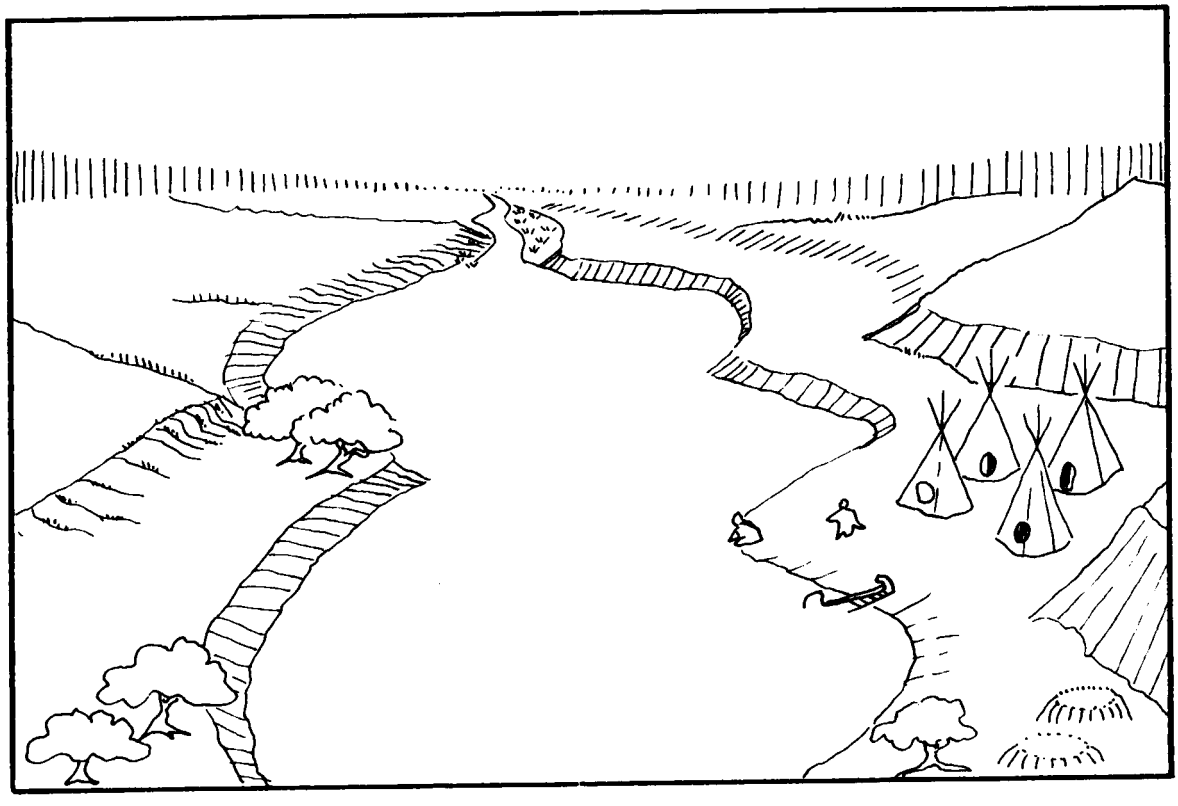
9. underwater habitats for living and working on the floor of the Gulf

The death of the coastal life zone is a possibility. The causes include dredging, coastal zone mining and drilling, tidelands real estate development, beach erosion, and water pollution. The three major water pollutants include: domestic sewage, industrial sewage (mainly chemicals), and thermal pollution. Destruction of the Gulf by pollution is a real threat since two-thirds of the natural sediments and industrial pollutants of the United States end up in the Gulf of Mexico.

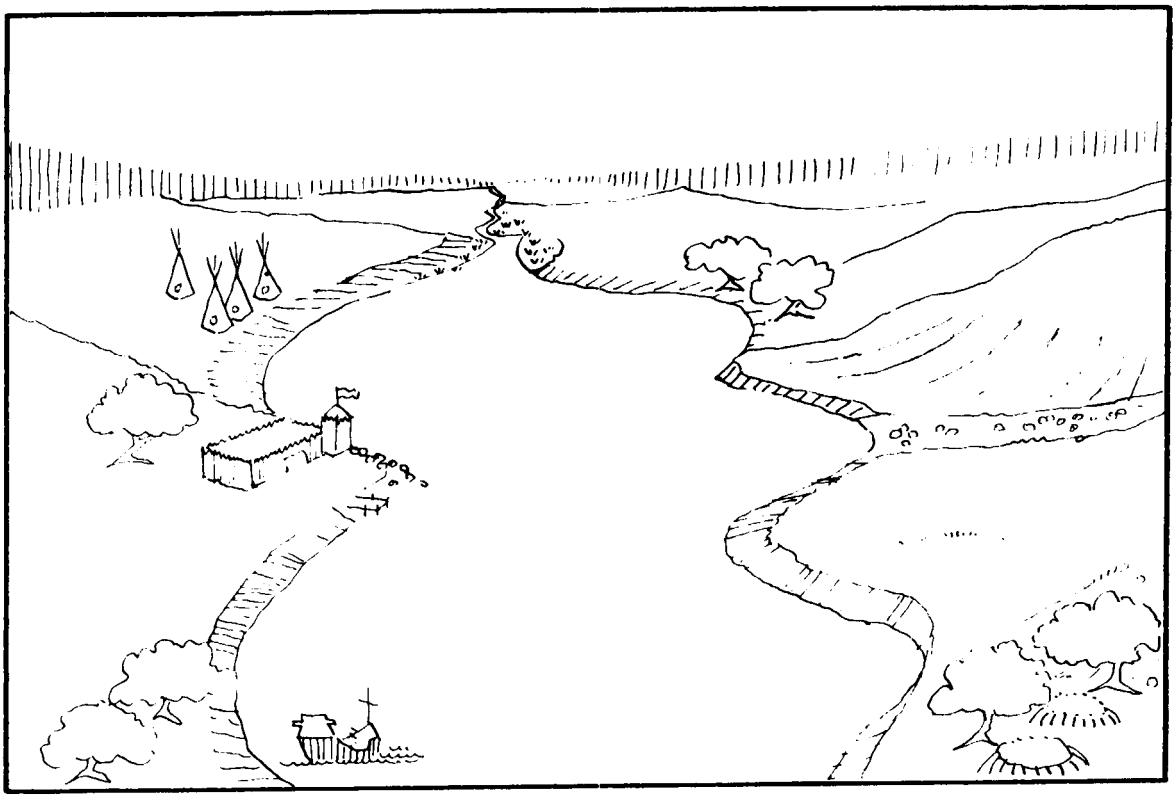
What will the future of the Gulf coastal area be like? You can and will help to decide.



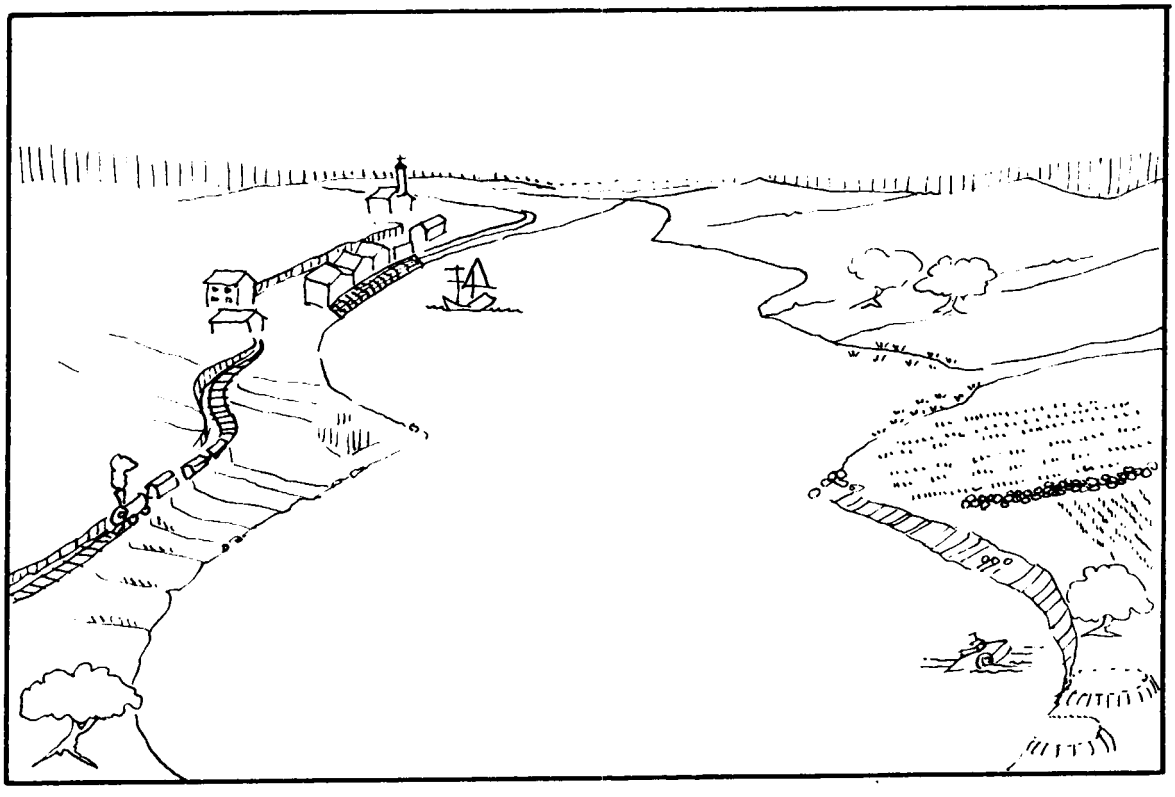
PALEO—AMERICAN PERIOD c. 10,000 B.C.



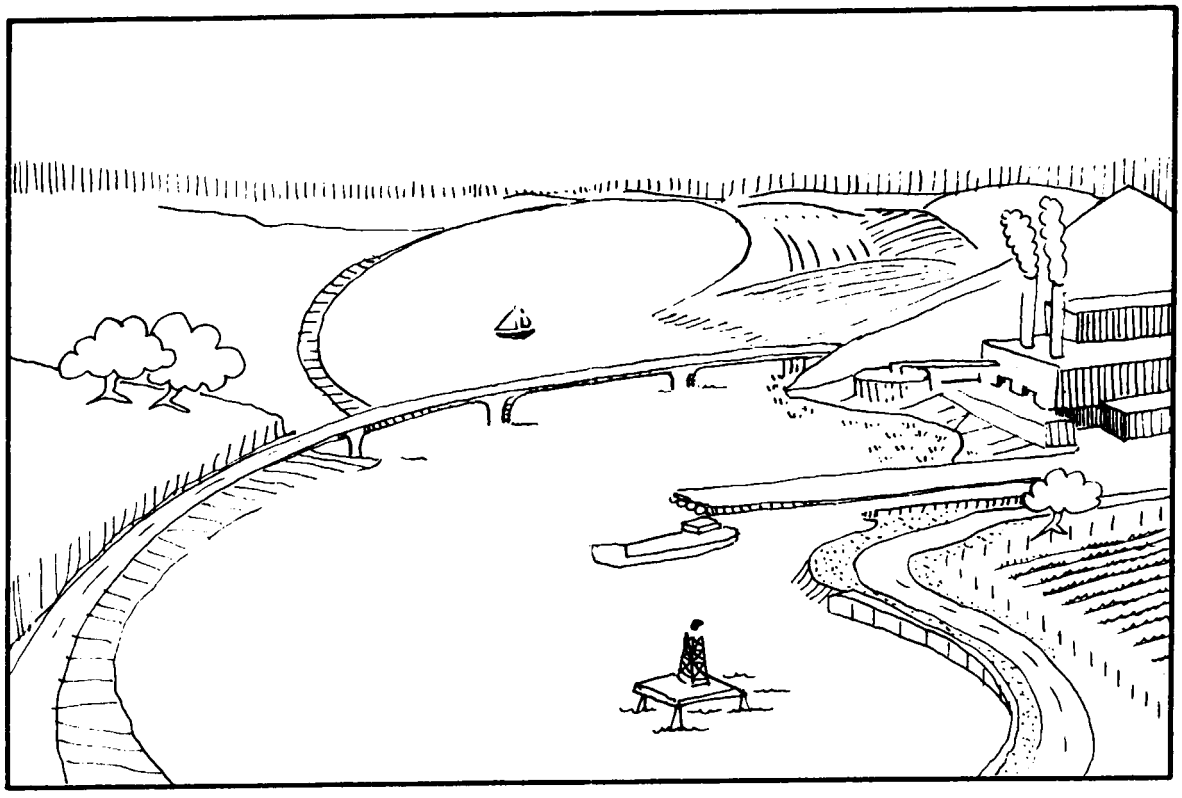
NEO—AMERICAN PERIOD c. A.D. 1,000



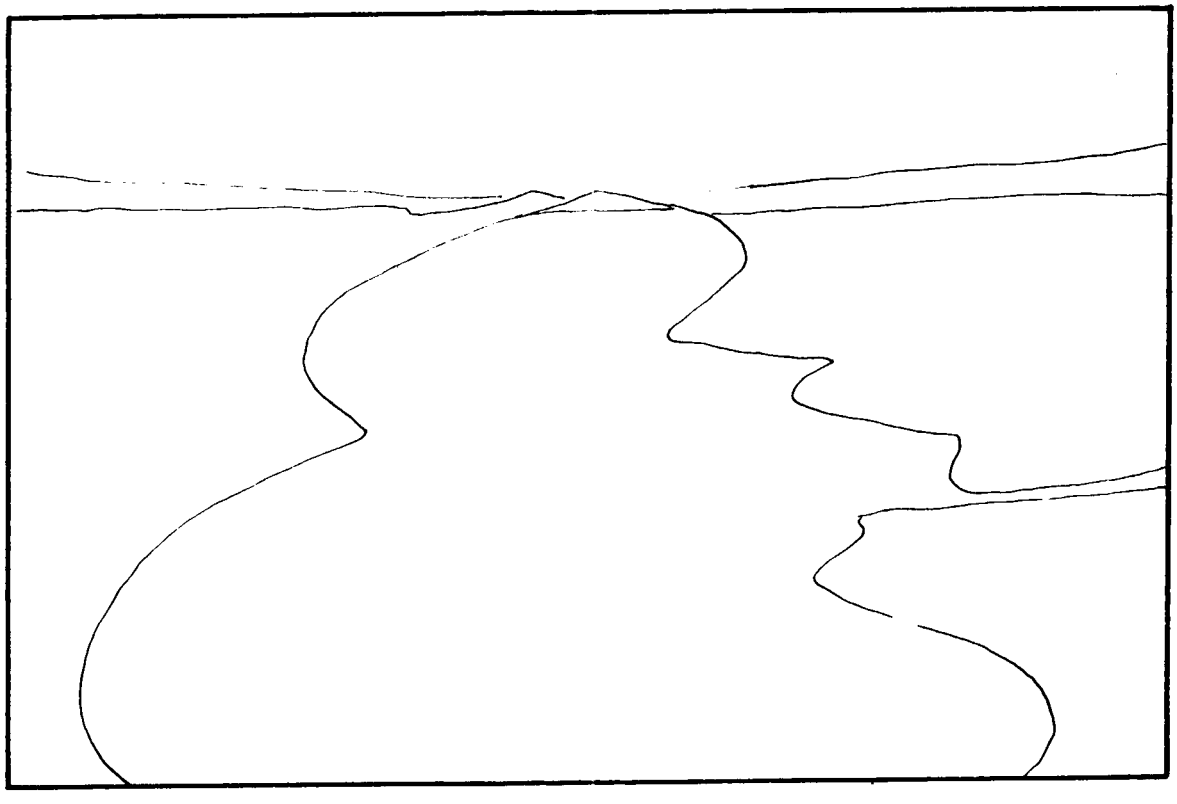
COLONIAL PERIOD c.1720



NINETEENTH CENTURY c.1870



MODERN PERIOD



FUTURE

QUESTIONS

1. Compare man's interaction with the coastal environment in the 1500's to man's present day interaction. How is it similar?

   How is it different?

2. Why has man's interaction with the coastal environment changed?

3. Compare man's use of resources in the past, present, and future.

   Why or what has changed man's use of resources through time?

TOPIC ELEVEN
WANTS OR NEEDS?

ACTIVITY ONE--Wishes, Wants and/or Needs?
ACTIVITY TWO--Past, Present and Future Needs
ACTIVITY THREE--Culture and Wants or Needs

Materials for Classroom Use:

A Dozen Wishes-Wants or Needs?/Activity
Hierachy of Human Needs/Diagram
Show and Tell/Activity
Advertising-Wants and Needs/Activity
Karankawa-The Past/Reading
Early Texas Seaport/Reading
The Year 2000/Activity
My World/Activity
Characteristics of Culture/Activity
Comparison of Cultures-Past, Present/Activity
My Imaginary Culture of the Future/Activity

Major Objectives for the Topic:

After completing the activities the student will be able to:

1.1 describe a culture;
1.1 list needs and wants in a given environment;
2.4 identify the needs of various organisms in a given marine environment;
2.4 analyze needs and wants in a given situation (past, present, and future);
2.4 if given a situation, predict future changes in needs and wants;
2.4 if given a situation, generate factors that caused changes in needs and wants;
2.4 categorize man's needs into a hierachy of human needs;
2.4 analyze the changes in needs in different situations and through time;
2.6 identify the common characteristics of cultures;
2.6 relate the common characteristics of a culture to his own culture;
2.6 analyze the common characteristics of culture and know that people live differently depending on their cultural characteristics;
4.3 evaluate wants and needs in terms of their relationship to the marine environment.

Teaching Suggestions:

The purpose of this lesson is to have the students identify past, present

and future needs and the relationship of culture to wants and needs. It will also help the student to analyze the factors which determine wants and needs.

1. The students will complete the readings and respond to the questions and/or activities. (The materials may be distributed on previous days.) In many cases there are no right and wrong answers.

2. The continuum (Advertising-Wants and Needs, My World, and My Position activities) might force people to choose the middle position. Defining a "ridiculous middle" can help steer participants off that position. You might define the ridiculous middle as the position chosen by a person who believes in one extreme from noon to midnight and the other extreme from midnight to noon. To share responses in the class, label opposite walls in a room with the extremes and ask participants to physically stand where their beliefs are. Or, draw the continuum on a chalk board and ask participants to initial the spots that represent their beliefs.

3. These activities are designed to help students understand and identify their wants and needs, to see how they change through time and the effect of one's culture on wants and needs. In Topic Twelve wants and needs will be related to one's use of resources. Do not forget to discuss the needs of marine organisms.

4. Discuss the readings and activities in small groups and/or as a whole class. Encourage the students to generate related questions and then strive to answer them.

TOPIC ELEVEN--WANTS OR NEEDS?

WISHES, WANTS AND/OR NEEDS?

Complete--
A Dozen Wishes--Wants or Needs.

Share and discuss--
Your list of wishes with your classmates.

Look at--
Hierarchy of Human Needs (Maslow's Pyramid).

Describe and present--
Your charade (show and tell) about wants and needs.

Use--
Newspapers and magazines to find ads which illustrate needs.

Cut out--
Appropriate pictures, mount them on butcher paper, label them "wants" or "needs".

Complete--
Advertising--Wants and Needs activity.

Answer--

1. What is the role of advertising in creating wants? How do television programs turn "wants" into "needs"?

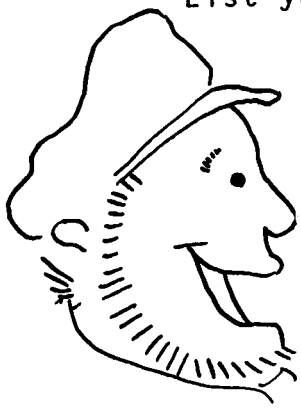
2. What are the needs of man today--the present?

List--
The needs of a marine organism. One student will name an organism and its habitat. The rest of the students will list needs of the organism and how environment meets those needs. Students will take turns naming the marine organism (plant or animal).

A DOZEN WISHES

This is Captain Seaborne. I want to tell you that this is your lucky day. You have just been granted a dozen wishes. There are no restrictions on your wishes.

What are the things you would like to have?
List your wishes in order beginning with what you want first.



Compare your list of wishes with your classmates' lists. Are they the same or different? Explain why they differ.

What makes a thing a want or need? Write your definition for wants and needs.

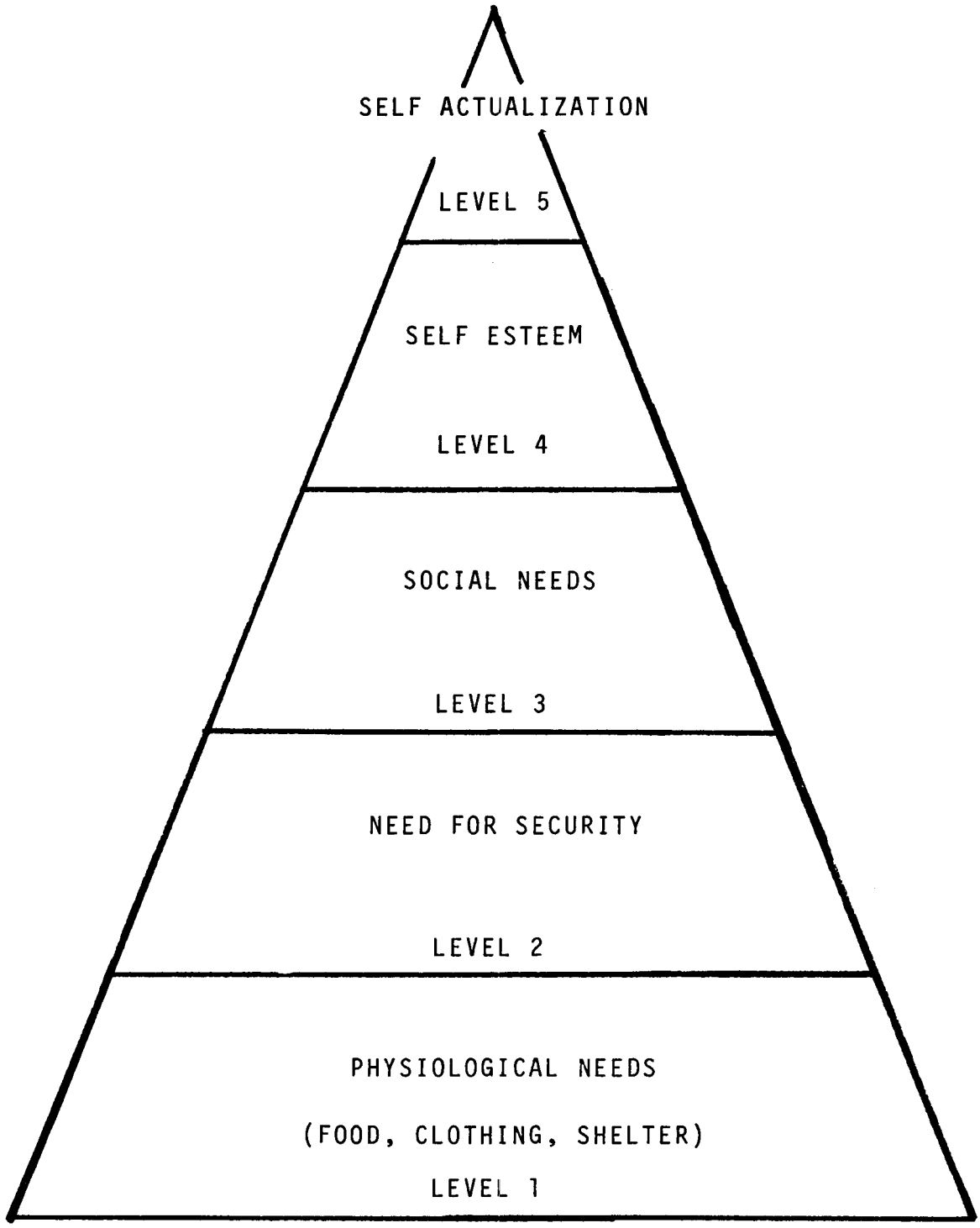
Which of your wishes are wants and which are needs? Divide your wishes into two groups, wants and needs, by placing a W by those which are wants and a N by those which are needs.

What are some needs that you would want to add to your list after looking at Maslow's Hierarchy of Human Needs. List the additional needs.

How does the environment meet your needs and wants?

HIERARCHY OF HUMAN NEEDS

(MASLOW'S PYRAMID)



SHOW AND TELL

Present a charade about wants or needs. (Use titles of songs, movies, T.V. shows, stories etc.)

Describe your charade.

Your classmates will try to guess the title and the particular want or need that is being illustrated by the charade.

ADVERTISING--WANTS AND NEEDS

How much do you think advertising affects what you want and need? Put an X on the continum that indicates your position.

I always buy advertised goods and services.

I never buy advertised goods and services.

Can you think of a time that you bought something or asked for something primarily because of an ad you saw or heard?

What are some things that you need or your family needs that aren't advertised?

Why aren't they advertised?

TOPIC ELEVEN--WANTS OR NEEDS?

PAST, PRESENT AND FUTURE NEEDS

Look at--

Sketch of Karankawa Indians.

Read--

Karankawa--The Past.

Look at--

Sketch of early Texas seaport.

Read--

Early Texas Seaport.

List--

Some differences between the needs of Indians and the early Texas settlers.

Complete--

The year 2000 chart.

Answer--

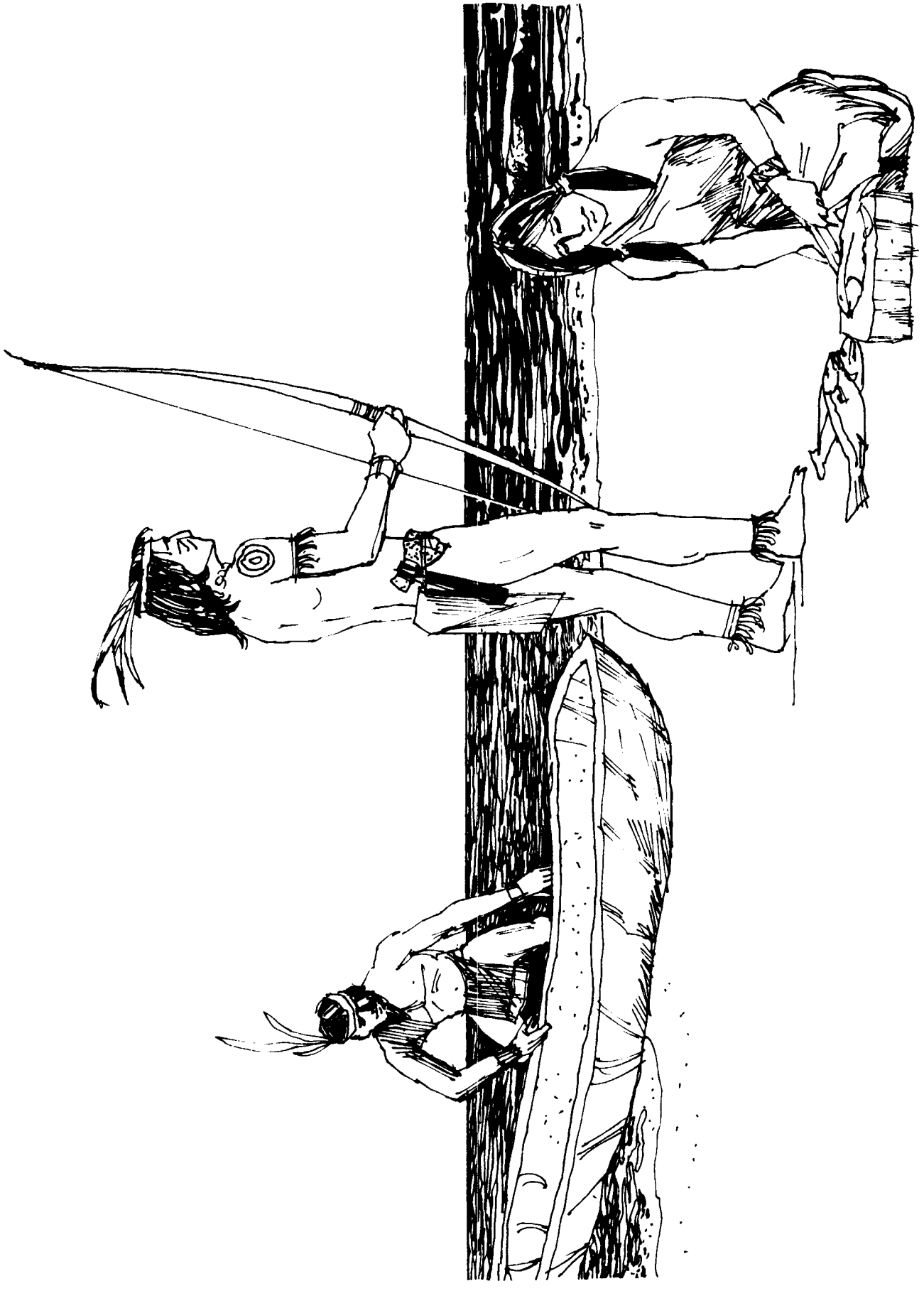
The questions.

Make--

A diorama depicting life on the Texas coast in the past, present and projected future.

Complete--

The My World activity.



KARANKAWA--THE PAST

I want to take you back in time to meet the coastal people of Texas before the Spanish and French arrived in the 1500's. They were never a large group, all five tribes never had over 500 warriors. They are the Karankawa Indians.

The Karankawa lived along the quiet lagoons. In the summers and in dry years, they would have to stay near the large waterways and move inland in search of drinking water.

They were such excellent hunters and fishermen that a neighboring tribe called them "men that walk on water." The bottoms of the lagoons were mostly smooth, and the water was shallow so they would wade out into the pools to catch a variety of fish. Fish were their most dependable food supply. At times oysters were in season as well as mussels, turtles, and porpoises. They also had ducks, geese and other birds, spiced with varieties of marine plants. Alligator meat, however, was one of their favorites.

The Karankawa did well in their hunting on the nearby prairies. Deer were the common target, but they hunted javelina, buffalo and the smaller mammals too. They also ate berries and other plants. They took only what they needed.

To protect themselves against the mosquitoes, they would smear themselves with alligator grease or shark oil. This gave them an offensive odor. Their appearance was also frightening. The warriors were over six feet tall and wore only a breech cloth. They had wild tattoos over their face. They inserted bone or cane cuttings through holes in their breasts and noses for ornamentation. The men wore small shells, disks of tin, brass or other metal strapped to their throats. Their hair was coarse and dark with a reddish hue from the constant exposure to the sun.

Their main weapon was a six foot bow made of cedar and arrows. They also had hatchets, knives, and tomahawks. They did not ride horses, but traveled on foot. The Karankawa were not only strong physically, but had endurance. They could stalk miles through the marshes and still be fresh for the chase or battle.

To add to their mobility on water, they used crude canoes or dugouts made from large tree trunks. Most of the time they did not use paddles, but propelled themselves by hand or erected a crude sort of sail out of animal skin. These could be used in the bays, but were not reliable in the Gulf, so they did not go out into the Gulf.

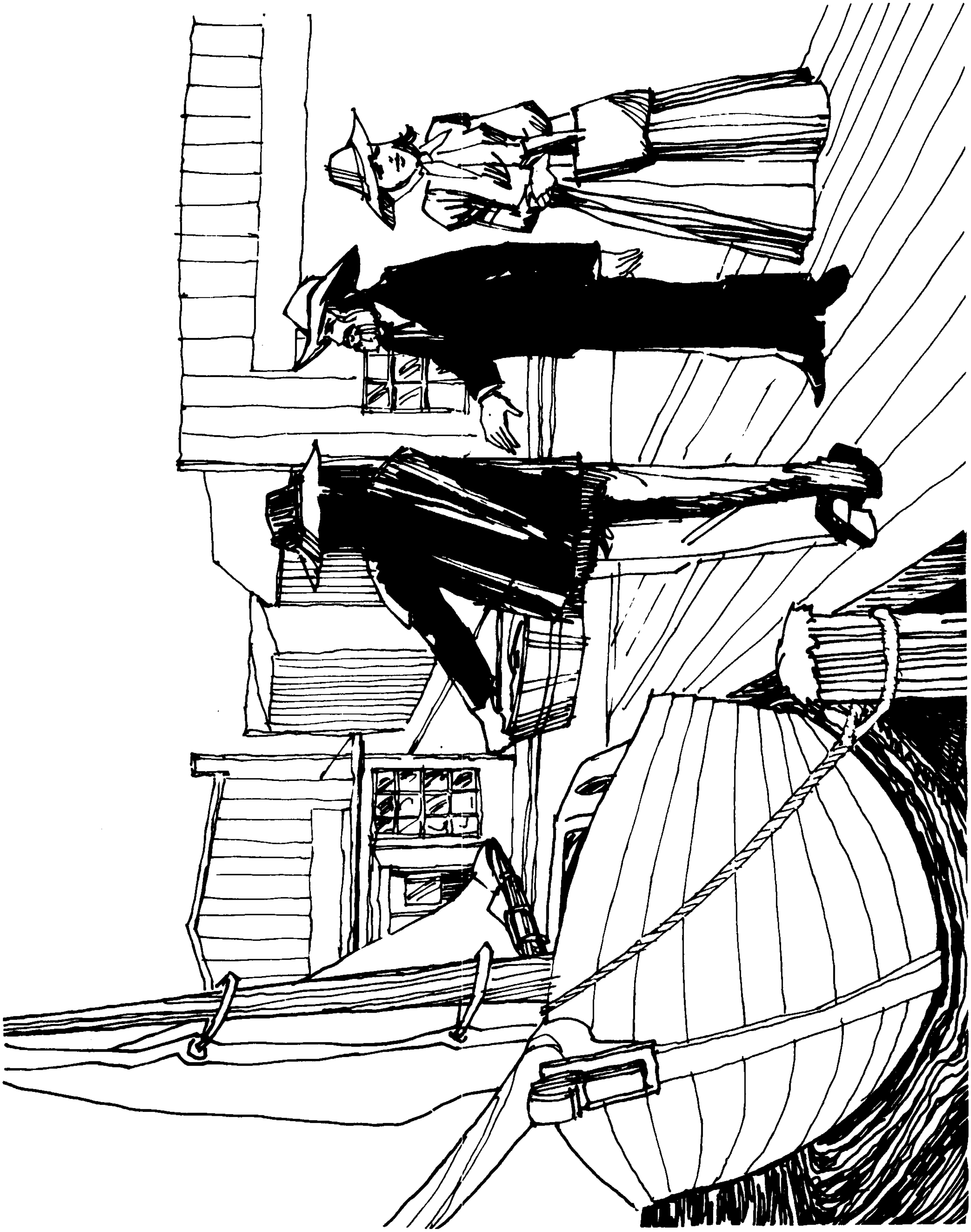
Their homes were round tent-like huts supported by slender willow poles. These could be set up or torn down by the women in an hour. Each held 7 or 8 people with no seats except for skins. There was a hole in the center of the top to let out smoke from the fire built in the center.

The women wore knee length skirts with deerskin bracelets on the left wrist. The children were naked and the men only wore breech cloths. When it was cold, they used animal skins for covering.

Little is known of their religion. They had a festival each full moon and after a successful hunting or fishing trip. Then there was chanting to music or a gourd filled with stones. A fluted piece of wood over which a string was drawn to produce a droning sound was also used.

They had to know the territory to know when the best berries were ready to be picked and where the oysters were. They did not waste food. To live as they did, the Karankawa had to understand the environment. They adjusted to its changes and its seasons. Waste was not a part of their lives.

They were thought by some to be cannibalistic. Some evidence indicates they were not cannibalistic until they saw the Spaniards of the ill-fated Narvaez expedition eating their dead in an extended fit of hunger. Their cannibalism was only a religious rite done to prevent the individual from having another life, or for revenge to get an enemy's powers.



EARLY TEXAS SEAPORT

When sailing into the early Texas port city, the buildings along the low shoreline stood out sharply. There were no trees, only scrub oaks. The wooden wharves, which were constantly crowded, extended hundreds of feet out into the Gulf. There was a railroad leading up to wharves.

The warehouses, built of cypress lumber, were the largest structures in town. They were located between main street and the shoreline. In these warehouses, merchandise taken from ships or to be loaded onto ships was stored temporarily. The unpainted cypress warehouses, small sheds and fences were weathered beautifully, giving them a coloring of silvery gray.

The early homes were cottages, but by the 1850's fine, two-story board homes had appeared. Usually they were painted a glossy white. Shutters were used on homes and commercial buildings for coolness. The shutters also helped to reduce the glare produced by sunlight reflected off the white shell and sand on which the town was built.

It was a resort area for fishing, crabbing and bathing. The "moneyed class" from upstate was attracted by the fresh sea breezes. The hotels had constructed short piers for the exclusive use of their patrons. The boundless variety of seafood was a gourmet's delight.

The children collected sea shells, coral fragments, live conches and bits of driftwood. The ladies would sit in the shade of the hotel galleries to exchange gossip.

The port city was supplied with ice harvested on New England ponds in mid-winter and shipped south in refrigerated ships. Once it arrived in the port city, it was packed in an ice house which had thick wooden walls insulated with sawdust. Thus, natural ice was available for home use, hotels, restaurants, bars, drugstores and confectionaries where ice cream and chilled drinks were sold.

It cost next to nothing to live in the early coastal port. Fish, crabs and oysters were abundant. All kinds of wild game (ducks, geese, deer, etc.) were available. The people were welcome to all the fresh beef they could carry from the slaughterhouses. There were nearby concerns in the wholesale slaughter of cattle. The cattle were driven into chutes and killed and skinned. The butchers had no use for the carcasses after the hides and tallow were removed. Therefore, town people could have all the fresh meat they wanted. The carcasses

were then hauled outside the town limits. They were left there for hogs, birds and beasts of prey to eat. The hides and tallow were shipped to the eastern United States.

It was not unusual to see herds of cattle driven through town to the slaughterhouses or to the wharves. At the wharves, the cattle were loaded onboard ships. They were shipped to New Orleans, Cuba and the eastern U.S.

There also was a turtle factory. The large sea turtles were caught in nets and brought to the factory to be canned. Once canned, they were shipped to all parts of the world.

These seaports served as ports for nearly all the country west of the Colorado River to the Rio Grande in Texas. Three ships a week arrived from Galveston and two from New Orleans. They were all sailing ships until the advent of side-wheel steamers in 1859-1860. They brought necessities and luxuries for the inhabitants of western Texas, New Mexico and a large part of the southwest. Immigrants from Germany, Switzerland, France and the southern and eastern U.S. arrived on the ships. Thousands of bales of cotton were shipped from the port along with the cattle, tallow and hides. Wool and pecans also were shipped out.

Large wagons called Prairie Schooners drawn by 10 to 12 oxen and two-wheeled Mexican carts drawn by a yoke of oxen or 6 mules came and went by long trains. Wells Fargo Express Company wagons, drawn by 16 mules, brought silver bullion from Mexico to be shipped to the mint at New Orleans. These wagons were heavily guarded. A stagecoach left for California twice a week. Early Texas ports were definitely busy and an important commercial link.

1. What were the needs of the Karankawa? List their needs.

2. List the needs of the early settlers.

3. What do you think were the wants of the Karankawas?

4. What do you think were the wants of the Early Settlers?

5. How did the environment meet their (Indians and Early Settlers) needs and wants?

6. How did the Karankawa interact or affect the marine environment?

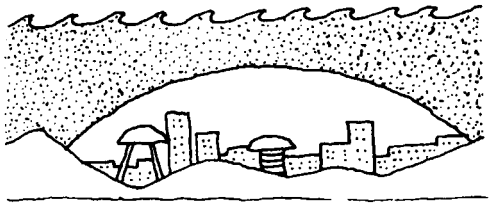
7. How did the early settlers affect the marine environment?

8. What resources did the Karankawa use? How did they use them?

9. What do you think are some things that are important to them? How is this different from your life?

10. Was there a difference in the wants and needs of the Karankawa as compared to the early Texans?

11. What were the reasons for the differences between the needs of the Indians and the early Texas settlers?



THE YEAR 2000

The year 2000 or the 21st century is part of your future. How old will you be then? _____ Most of us dream about the future once in a while. In this activity you will create your dream life in the year 2000. It can include whatever you want. What do you think it will be like?

In the chart below describe how you see each of the following in your future in the year 2000. Fill in the things you want and need.

	Description	Wants	Needs
your family status			
location of home			
description of your home, building, rooms			
your job			
location of job			
transportation you will use			
food you will eat			
forms of recreation			
clothing			
how you will spend your leisure time			
other			

1. What will be your needs in the year 2000?

2. What will be your wants in the future you described?

3. How will the environment meet your needs and wants in the future?

4. How will your needs and wants affect the marine environment in the future?

5. What are the differences between your present needs and wants and those of the year 2000?

   Why are there differences?

6. Why do wants and needs change through time?

MY WORLD

Where would you like your world to be on this continuum? Mark the spot with an X. Where is your personal world? Put a Y on that spot. Ask some people you know to put their initials on the line where they would like their world to be.

Karankawa Indians — Early Settlers — Today — 2000 A.D. Fully Automated

Think about the following questions: Do most of the world's people live in the right half or in the left half of the continuum? Why?

People in what parts of the world might live in the left half of the continuum?

Might some people choose to move from the right half to the left half of the continuum?

What are some advantages and disadvantages of the right half?

What are some advantages and disadvantages of the left half?

TOPIC ELEVEN--WANTS OR NEEDS

CULTURE AND WANTS OR NEEDS

Complete--

Characteristics of Culture
Comparison of Cultures--Past, Present.

Dream up and answer--

An imaginary culture of the future.

Develop--

You imaginary culture of the future.

CHARACTERISTICS OF CULTURE

What is meant by the word culture?

To help decide, let's look at some common characteristics of culture . . . .

1. Food
2. Shelter
3. Clothing
4. Tools
5. Music and Dance
6. Arts and Crafts
7. Beliefs
8. Behaviors

If you know some of these things about a group of people, you know about their culture.

Think about your culture or some of the characteristics listed above that you know about in your life.

Write a poem or a group of sentences describing your culture.

Now that you have some ideas on paper, draw a picture that you think shows some things about your culture.

COMPARISON OF CULTURES--PAST, PRESENT

Think about the culture or some of the characteristics of the culture of the Karankawa Indians or the early Texas settlers. You may want to refer back to Activity Two as a reference. Now that you have some idea about their culture, write a short story or produce a skit describing a day in the life of a Karankawa Indian or an early Texas settler who is your age.

Answer

1. How do the cultures of the Karankawa, early Texas and today differ?

2. What resources did the Karankawa Indians or early Texas settlers use?

3. How did they use the resources?

4. What are some things they each seem to value or are important to them?

5. How is this different from your life?

6. Why is it different from your life?

MY IMAGINARY CULTURE OF THE FUTURE

Develop an imaginary group in your mind that (A) lives in, on, or near a marine environment (B) in the future--25 years from now.

List the group's cultural characteristics based on common characteristics of culture.

Decide how these people will survive and what will they need for a "successful life" in an imaginary marine environment you describe.

Draw pictures showing resources used by your imaginary group.

Share imaginary cultures with your classmates.

TOPIC TWELVE
INTRODUCTION TO MARINE RESOURCES

ACTIVITY ONE--What is a Resource?
ACTIVITY TWO--Marine Resources-Introduction
ACTIVITY THREE--How Do They Rate?

Materials for Classroom Use:

What is a Resource?/Activity
Marine Resources-Introduction/Activity
Let's Brainstorm--Marine Resources
Filmstrip and Cassette Tape--"Marine Resources"
What Do You Think?/Activity

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 define resource;
1.1 point out resources of the marine environment;
1.1 classify marine resources as renewable or nonrenewable;
1.1 categorize marine resources as to their value-monetary, ecological, cultural, aesthetic, recreational or historical;
1.1 discuss people as a resource.

Teaching Suggestions:

The purpose of this lesson is to have the students identify marine resources and to group them as renewable or nonrenewable. The students will also determine the value of the resources and that resources are used to satisfy their wants and needs.

1. What is a Resource? is designed to help the students understand that resources are needed to satisfy their wants and needs and that resources are renewable or nonrenewable.

2. The filmstrip and cassette tape "Marine Resources" is designed to be an introduction to some of the variety of the marine resources.

3. In How Do They Rate? the students are asked to rate the resources as to the value they feel should be placed on it. Each resource can have more than one value. Also, different students will rate the same resources differently. Discuss the questions as a class. The What Do You Think? activity is for the students to express their own personal opinions.

4. You may have the students select a marine resource and do research on its past, present and future usage and become an "authority" for the class on that resource. You may have the student(s) help you present information when his particular resource is presented in the following lessons.

TOPIC TWELVE
INTRODUCTION TO MARINE RESOURCES

WHAT IS A RESOURCE?

Determine--

The resources required for wants and needs.

Classify--

The resources as renewable or nonrenewable.

Answer--

The questions.

WHAT IS A RESOURCE ?

Divide a sheet of paper into 3 columns. (You may use the back of this page.) Label them: Needs & Wants, Resource, Nonrenewable or Renewable Resources.

List your wants and needs from the previous activity (Lesson Ten-Activity one) in the first column.

In the second column list the resources needed to supply the wants and needs. Now we will go through the list and decide the resources needed for the wants and needs. We will define resources as the materials needed for the satisfaction of wants and needs.

Determine if a resource is renewable or nonrenewable. Use the definitions below to decide.

> Nonrenewable Resource--if to the best of your knowledge there is only a fixed amount of the resource in or on planet Earth, or if it is a mineral, then it should be classified nonrenewable.
>
> Renewable Resource--if to the best of your knowledge the resource can be grown or in some manner replenished from year to year or is a plant or animal, then the material should be classified as renewable.

When the definitions are clear, go through your list of resources and write R for renewable or N for nonrenewable in column three. If you are in doubt about any resource, take your best guess and put a question mark (?) beside it.

Answer the questions:

1. Do you need more renewable or nonrenewable resources?

2. Do you want more renewable or nonrenewable resources?

3. Look at your list of needs and wants in the future. Will you be using more or less resources in the future?

4. Will you need more renewable or nonrenewable resources?

TOPIC TWELVE
INTRODUCTION TO MARINE RESOURCES

MARINE RESOURCES

Write--
A definition for marine resources.

Brainstorm and list--
All marine resources.

Share--
Your lists with your classmates.

Look at and listen to--
Filmstrip and cassette tape "Marine Resources".

Classify--
The marine resources as renewable or nonrenewable.

Check--
The marine resources you use.

Share--
The marine resources you use with your classmates.

Answer--
The questions.

Select--
A marine resource to research. You will be the class expert on that resource. Determine its past, present and future importance.

Present--
The information on the resource you select to the class.

MARINE RESOURCES--INTRODUCTION

What is a marine resource? Write your definition for marine resource below.

Let's Brainstorm (See Topic One for instructions for Brainstorming)

Purpose: To make a list of a large number of marine resources.

Compare and share your lists.

Look at filmstrip and listen to cassette tape on "Marine Resources".

Add those marine resources which you had not thought about before viewing the filmstrip and tape to your list.

Group your list of marine resources as renewable or nonrenewable resources, placing a R by those which are renewable and a N by those which are nonrenewable. If you are in doubt about any resource then take your best guess and put a question mark (?) beside it. Determine which marine resources you use. Place a check mark next to the ones you use.

Compare your use of marine resources with your classmates' uses.

Answer:

1. Do you use more renewable or nonrenewable resources?

2. Which marine resources that you have not used do you think you might use in the future?

3. Does everyone in your class use the same marine resources? Why or why not?

MARINE RESOURCES

Slide 1:

Background music.

Slide 2:

Background music.

Slide 3:

Background music.

Slide 4:

I'm Captain Seaborne. Thank you for inviting me to speak to you again. This time I want to talk about another very important topic--Marine Resources.

Slide 5:

When I speak of resources I am referring to those things which satisfy our wants and needs.

Slide 6:

In many ways, both large and small, the resources of the sea affect our lives. If we could look into a clouded crystal ball and predict the future, we would see a great many ways in which the sea will influence our tomorrows.

Slide 7:

The sea provides us with much of our food. For example, we Americans consume an average of over eleven pounds of seafood annually, per person. With the realization that fish and shellfish contain no saturated fats, but are a source of high-grade protein and other essential minerals, there has been an increase in the consumption of these food stuffs. Actually, we use about five times as much seafood for fishmeal in poultry feed and food for land animals than is used for human consumption.

Slide 8:

The sea contains millions of species of plants and animals. There are more than twenty thousand species of fish alone. A great many marine organisms have been used for food, but few of them are eaten in large quantities. For example most of us would not eat sea urchins.

Slide 9:

While it is certain that the food resources of the sea are not totally used, no one knows exactly how large these resource really are. We do know, however, that overfishing has taken its toll. At least twenty of the more popular species are close to, or have been over fished.

Slide 10:

The overwhelming proportion of food from the sea (approaching ninety percent) consists of fish. Plants from the sea provide less than one percent of man's food--compared to the figure of eighty percent of land plants in some parts of the world.

Slide 11:

The role of plants in the marine environment is enormous. The abundance of marine animals is determined by the ability of the region to grow plants. Although we do not eat many sea vegetables, it is very difficult for us to get through a day without coming in contact with products made with the help of a seaweed colloid or gelling compounds. Uses range from bakery items, dairy products, meats and soft drinks to industrial applications like the tires on our cars.

Slide 12:

In future years, it is likely that we may see rows of man-made ponds along the coast. These ponds will contain marine organisms like salmon, perch, mullet, shrimp, crab, lobster, algae and others. These will be mariculture ponds for raising marine organisms. Or, there may be farms out in the ocean itself. Mariculture could increase our food supply tremendously, thus creating a blue revolution.

Slide 13:

In the future, a large portion of our energy production will also be oceanic. We do not know the size of the oil reserves, particularly those which are in the deeper parts of the ocean. The end of our oil age will actually take place when the reserves in the deep parts of the ocean are exhausted.

Slide 14:

The use of energy from the ocean has taken many forms and will take many more forms in the future. Such energy sources include wind, waves, tides, thermal and nuclear fusion.

Slide 15:

Initially the ocean was primarily used for transportation. The seas permitted large quantities of materials, abundant in one place, to be moved with little use of energy to places where they were scarce. Today, the sea still has an important role in transportation. For example, tankers and supertankers carry hundreds of thousands of tons of oil from the oil-soaked Middle East to the oil-starved United States.

Slide 16:

Located in these coastal regions of the United States are channels, harbors, docks and other facilities associated with water transportation and shipping.

Slide 17:

One great phenomena of our time is the increase in marine recreation. This has taken place gradually and is most noticeable by the congested highways and waterways on weekends and at vacation times.

Slide 18:

The attraction of the water has led to crowded beaches . . .

Slide 19:

With scarcely a square yard of sand unoccupied and the salt smell of the seashore completely lost in the haze of sun-tan lotion.

Slide 20:

Recreational activities range from pleasure driving along the coastal highways which parallel the shoreline and the bays and channels. . .

Slide 21:

To lounging, sunbathing, girl-watching. . .

Slide 22:

Beachcombing, and building sand castles on the beach.

Slide 23:

There are also the water sports of surfing and swimming.

Slide 24:

Recreation is a highly visible and obvious example of the socia

values of the marine environment. There are economic values, too; second to offshore petroleum and gas in its economic impact is recreation.

Slide 25:

While we travel to our favorite recreation area, we enjoy motoring along the coastal highways. Once we arrive at our destination, we may either settle in at a motel for the night . . .

Slide 26:

Or camp out.

Slide 27:

During the day and evening hours, we patronize restaurants, service stations, bait shops, marinas and other businesses that cater to our recreational needs.

Slide 28:

Within the sea itself, we find many minerals useful to man. For example, gold, silver, and diamonds are mined from the ocean depths. Clam and oyster shells are mined as a source of lime and building materials.

Slide 29:

The ocean has generated and is generating deposits of manganese copper, cobalt, nickel, and titanium in unique potato-like rocks called manganese nodules. Actually all of the minerals found on land appear in the oceans in concentrated quantities which are generally larger than their land counterparts. Therefore, an increasing percentage of the world's minerals will be obtained from the sea. The question that must be answered is: who owns the resources of the oceans and, how will those resources be managed and distributed?

Slide 30:

The sea is also a source of medicine. There are hundreds of poisonous marine organisms having toxins that have potential use as a drug. For example, the toxins from jellyfish, hydroids sea cucumbers and sea anemones that cause paralysis have the greatest potential use in becoming drugs for heart and muscle diseases and even a possible cure for cancer. However, if we are not careful, we will destroy this medical gold mine with pollution.

Slide 31:

We have always been attracted to shells and fascinated by their beauty. Shell collecting has led to hundreds of shell shops around the world. However in some areas, shell animals are extinct because so many have been collected.

Slide 32:

Red coral has always been valued for its beauty. As coral becomes more scarce, the value of this resource increases. Red coral is almost as expensive as gold. Today, dredges are used to remove coral. If this continues coral will soon be a souvenir of the past.

Slide 33:

The coastal zone is the nesting, resting and feeding site for many species of water fowl. Every year, many days are spent hunting for ducks, geese and other waterfowl in this area.

Slide 34:

The endangered whooping crane winters in a Texas estuarine zone; the muskrat, mink, swamp rabbit, white-tail deer and other game and fur bearing animals use it as well.

Slide 35:

Gulls, pelicans, roseate spoonbill and other migratory as well as resident species of birds use the area and are a source of enjoyment for bird lovers and photographers.

Slide 36:

The sea is a rich source of knowledge and we still have much to learn. It is helping us decipher the origin of the earth and the geological events which followed. Marine organisms are providing us with some vital research tools. The knowledge the sea can provide us is limited only by our own abilities.

Slide 37:

The surface of the coastal zone is the site of beach cottages and housing developments. Many are built on landfills in the estuarine zone.

Slide 38:

The coastal zone is also a favorite site for industries and chemical plants since abundant water is available for the manufacturing processes and the disposal of wastes.

Slide 39:

The surface of the sea itself is a natural resource for a space-starved land. Using the ocean surface away from the land for power plants, airports, industrial complexes, resorts and even cities, the threat of destroying our coastal estuaries is greatly reduced. In the future we will even utilize the underwater area for research, farming, recreation, work and living.

Slide 40:

Among the resources of the sea, the most priceless is the water itself, and in the future, it may well be the most important resource recovered from the sea. Over much of the world, water shortage is a grave and growing problem. The time may be approaching when a drop of water will cost more than a drop of oil.

Slide 41:

Our coastal zone with its bays, tideflats, bayous, lagoons or marshlands is one of our most valuable natural resources. They are more productive than our richest cornfields. An estimated ninety-five percent of all fish and shellfish landed by sport and commercial fisherman along the Gulf coast depend upon the estuarine zone during some period of their life cycle.

Slide 42:

Miles of sandy beaches and their organisms also draw countless numbers of people.

Slide 43:

Jetties and groins were made to control the movement of sand along the shore and are the rocky shore of the Gulf coast. They provide an environment where marine organisms that attach to rocks can grow and live. They also provide an arena for pleasure. The activities range from fishing, crabbing and sun-bathing to just enjoying a walk.

Slide 44:

Crabs, barnacles, jellyfish, sand dollars, seaweeds, sea oats, and many other creatures are part of the marine environment. These all add interest, beauty and aesthetic appeal and attract millions of people.

Slide 45:

The greatest joys are those of the heart and the sea is a tremendous resource for aesthetic joy. It can nourish not only the physical being but the spiritual being as well. We need this chance in our lifestyle.

Slide 46:

Each use of the marine environment satisfies someone's need or desire. Uses and alterations of the sea that jeopardize the marine resources must be controlled to insure the benefits of these resources for future generations. The marine resource are the common heritage of all mankind. The destiny of all mankind is inevitably dependent on the responsible development, both environmental and economic, of the marine environment and its resources.

Slide 47:

Well mates, I have really enjoyed visiting with you. And, I'm looking forward to sharing some more about the marine resources with you in the activities that follow. Are there any questions?

Slide 48:

The end.

TOPIC TWELVE
INTRODUCTION TO MARINE RESOURCES

HOW DO THEY RATE?

Determine--

The value of marine resources in "How Do They Rate?"

Share--

Your ratings with your classmates.

Answer and discuss--

The questions about the ratings.

Complete--

The "What Do You Think?" activity.

HOW DO THEY RATE?

Determine the value of the marine resources. We will define value as something that is important in man's existence. Use the right hand side of your marine resource list to code the marine resources as to their value in the following way:

A dollar sign ($) to be placed beside any item which is of economic or monetary value.

The letter E to be placed beside any resource which is of ecological value.

Which resources are of cultural value? Code them with the letter C.

Mark with an A any resource which is of aesthetic (beauty) value.

Put the letter R next to any resource which is of recreational value.

Next to the resources that are of historical value write the letter H.

Which resources are needed for survival? Mark them with the letter S.

Resources may be coded with more than one letter.

Answer the Questions:

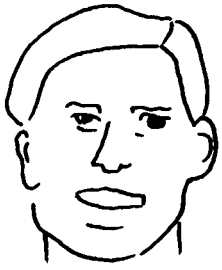
1. Did everyone rate the resources in the same way?

2. Why are resources rated differently by different people?

3. Which value do you feel is most important and should be used as a basis for deciding how a resource is to be used?

WHAT DO YOU THINK?

Do you think that we are likely to have enough energy, food and other resources for our needs in about 25 years?



Your reasons:

Your answer:

YO

What is your forecast for the future?

YOU

TOPIC THIRTEEN
LIVING MARINE RESOURCES

ACTIVITY ONE--A Sea Food Connoisseur?
ACTIVITY TWO--Food From the Sea
ACTIVITY THREE--Where would we be without the Algae?
ACTIVITY FOUR--Fishing
ACTIVITY FIVE--The Future

Materials for Classroom Use:

Are You a Seafood Connoisseur?/activity
A Diner's Delight??/reading & questions
Seafood Fair Taster Report/activity
It's Good For You!/reading
Have you Eaten Algae This Week?/activity
Nutrition of Fish and Shellfish/reading
Fish Hot Dogs, Fish Bologna and Fish Jerky, Anyone?/reading
FPC/reading
Fish as Animal Food/reading
Sea Food Surveys
Supermarket Survey
Restaurant Survey
Health Food or Oriental Food Store Survey
Those All Important Seaweeds!!!/reading
Read the Labels/activity
Fishing in the Past/reading
Fishing--Today/reading
Texas Fisheries/reading
Where Have All the Fish Gone?/reading
Fishing Laws and Regulations/activity
Housing Shortage/reading
A Blue Revolution?/reading
The Future--Scenario A/reading
The Future--Scenario B/reading
Buttons/activity
Newspapers, Magazines
Scissors, glue
Coloring & writing materials
*Sea Foods
*Sea Vegetables
*More information in teaching suggestions

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 cite examples of living marine resources;
2.3 evaluate a living marine resource problem man has solved, the changes that resulted and the new problems that arose;

2.5 if given a living marine resource, to reconstruct its relationships in the marine environment;
2.5 generate a list of living marine resources that will be important in the future;
2.5 identify the living marine resources which are utilized to produce consumer products and services;
2.5 identify the consumer products produced from living marine resources;
2.6 explain and categorize ways in which living marine resources were used in the past and are being used;
2.6 analyze the use of a living marine resource through time in relation to the values involved and availability;
2.6 describe how the changing use of living marine resources has changed lifestyles;
2.6 compare and contrast the use of living marine resources in different cultures;
2.6 identify and clarify his own value position in relation to living marine resources;
2.6 analyze value positions in relation to living marine resources to determine similiarities, differences and possible conflicts;
2.7 formulate possible future uses of living marine resources:
3.1 evaluate marine environments on the basis of man's capacity to manage them;
3.1 discuss the interplay of the many facets (sociological, economic, governmental, psychological and moral) in man's management of the living marine resources;
3.2 describe and identify situations where technology has caused a change in the use of a living marine resource through time;
3.3 if given examples of living marine resources acquisition, to evaluate what considerations are important;
3.3 analyze which factors were most important in decision making and how circumstances may change in light of altered circumstances;
3.3 identify a situation in which short term economic gains may produce long term environmental losses;
3.4 make projections about the future consequences of man's manipulations of the marine environment;
4.1 identify false expectations about living marine resources;
4.1 appraise their attitudes toward familiar and unfamiliar living marine resources;
4.1 understand that values influence people's use of living marine resources.

Teaching Suggestions:

The purpose of this lesson is to introduce the student to the living marine resources and their products in past, present and projected future. He should also learn about acquisition and use of the resources. He should begin to form ideas relative to how man can analyze the actions that he takes in terms of how those actions will affect the marine environment and how,in turn,the change will affect man.

Readings, activities and higher order and value clarifying questions and/or activities are used.

1. These activities can be used in biology or life science classes to introduce algae and marine invertebrates.

2. Have the students complete the Are you a Sea Food Connoisseur? activity and discuss it. By the defining a "ridiculous middle" it will help steer students away from that position. Complete the A Diner's Delight?' activity and discuss the questions as a group or class.

3. The "Seafood Fair Taster" activity is designed to give the students the opportunity to taste foods from the sea. Many people, however, have a psychological barrier against eating many kinds of seafoods, even if they have never tried them. For example, algae flavors are not salty or fishy as might be expected; some might be described as beanlike, nutlike or even remind one of celery, parsley or grapes. In this activity, the students will have the opportunity to taste various seafoods in an attempt to counter such attitudes. Identify the foods only by number and do not tell the students what they tasted until they have selected their top three and the class results have been compiled. (In the field testing of this activity one teacher's students nominated the seafood as their favorite which was later identified as octopus. Had they known it was octopus beforehand, they probably would not have tasted it. Also, many people who have eaten shark like it better than many fish.)

Sources of food items:
sea vegetables or seaweeds, already prepared items made of algae--available at Oriental Food Stores or health food stores

seafood--canned (Some of your students may never have tasted salmon, mackeral, sardines, oysters or etc.) and frozen--supermarkets, seafood restaurants, and fish markets

FPC--fish protein concentrate--samples available from: Population Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711.

The majority of the health food stores carry dried sea vegetables. Some of these are kanten, Nori, Hijiki, wakame, kombu, laver, and agar. They may also have teas made of algae, Irish Moss, Bladderwrack and dulse leaf tea and crackers and chips made of seaweed or be able to obtain them for you.

Instead of or in addition to tasting individual seafoods you may want to have students taste the dishes in which the sea foods are used as ingredients You may even do this jointly with the home economics department, the cafeteria, parents, or a Community Young Homemakers organization. High school students may make the dishes and bring them to school. (Check out school policies) Local seafood restaurants may even help. Check it out, they can only say yes or no. Those involved in preparing the dishes should keep the ingredients of their dishes secret. Identify the foods only by number until after the tasting. Do not discuss the ingredients before the tasting.

For free 3X5 seafood recipe cards and Shark as Seafood (contains shark recipes) utilizing Texas species write:

Seafood Consumer Specialist
442 Kleberg Center
Texas A&M University
College Station, Texas 77843

The following brochures are available from:

Marine Information Service
Sea Grant College Program
Texas A&M University
College Station, Texas 77843

single copies free, order by number

Stay Slim with Seafood, TAMU-SG-78-110
Now That You've Caught That Fish...What Are You Going To Do with It? TAMU-SG-76-501
Freezing Fish and Shellfish TAMU-SG-77-503

There will probably be other pamphlets and brochures available in the future.

The following are also sources of recipes:

The Seavegetable Book by Judith Cooper, Clarkson N. Potter, Inc./Publishers. Distributed by Crown Publishers, Inc. New York.
(Very thorough description of algae (seavegetables) including description, habitat, foraging, preparation,use, nutrients, taste, source and recipes. Recipes for snacks, soups, salads, main dishes, side dishes,desserts, beverages, etc.)

The Edible Sea by Paul and Mavis Hill, A.S. Barnes and Co., Inc., Cranbury, New Jersey 08512 (Information includes: where it is found, how to identify it, how to catch or gather it, and how to prepare it for the table; and simple and gourmet recipes for crustaceans, mollusks, fish reptiles, mammals, echinderns and seaweeds.)

The Cooking of Japan by R. Steinberg, Time-Life Books, New York, 1969.

The Beach Comber's Handbook of Seafood Cookery by H. Zachary, John F. Blair, Winston-Salem, North Carolina, 1972.

The following are also sources of recipes:
Texas Parks & Wildlife Magazines
Smoking Fish, Vol. 31, No. 5 (May 1973) p. 19
Lining Up a Dinner (Crab) Vol. 31, No. 7 (July 1973) pp. 26-29.
Midnight Madness (Shark), Vol. 31, No. 7 (July 1973) pp. 12-16
Freezing Seafood, Vol. 33, No. 4 (April 1975) pp. 24-26
Let Seafood Solve Your Mealtime Problems, Vol. 34, No. 7 (July 1976) p. 16-19.
Young Naturalist: Coquinas (Coquinas Chowder Recipe) Vol. 34, No. 8 (Aug. 1976) pp. 28-31.
Consumers Try Shark Meat Vol. 34, No. 9 (Sept. 1976) pp. 12-14

The following FPC-wheat flour mixture can be made at home and used in recipes:

4 1/2 pounds (or 18 cups) of all-purpose flour
1/2 pound (or 2 cups) of FPC

Mix the all-purpose flour and the FPC, sift several times and store in an air-tight container. This supplemented wheat flour mixture can then be used in the recipes that are given below or in other recipes that require wheat flour.

FPC-CINNAMON COOKIES

1/2 cup vegetable shortening
1/2 cup butter or margarine
1-3/4 cups sugar
2 eggs
2-3/4 cups sifted FPC-flour
2 teaspoons cream of tartar
1 teaspoon soda
3/4 teaspoon salt
2 teaspoons cinnamon

Mix shortening, butter, 1 1/2 cups sugar and eggs thoroughly. Combine and sift flour mixture, cream of tartar, soda and salt. Sift dry ingredient into shortening-sugar mixture. Chill 1 hour. While dough is chilling, mix remaining 1/2 cup sugar and cinnamon. Shape rounded tablespoonfuls of dough into balls. Roll balls in cinnamon sugar. Place 2 inches apart on ungreased baking sheets. Bake in moderate oven, 350°F. about 10 minutes or until done and lightly browned. Cookies will puff up then flatten. Remove from baking sheet and cool on racks. Makes about 40 2-1/2 to 3-inch cookies.

FPC-CHOCOLATE CHIP COOKIES

2 3/4 cups sifted FPC-flour
1 teaspoon soda
1 teaspoon salt
1 cup butter or margarine
3/4 cup brown sugar
3/4 cup granulated sugar
2 eggs
1 1/2 teaspoons vanilla
2 packages (6 ounce) chocolate chips
1/2 cup chopped pecans, if desired

Combine and sift first 3 ingredients; reserve. Cream butter or margarine, sugars, eggs and vanilla until smooth and fluffy. Stir dry ingredients into creamed mixture. Add chocolate chips and nuts; mix well. Drop level tablespoons of dough 2 inches apart on ungreased baking sheet. Bake in moderate oven, 375°F., about 10 minutes or until done and a golden brown. Remove cookies from baking sheet and cool on racks. Makes about 72 2-inch cookies

FPC can be used in soups. In the following recipe FPC is used to make light, fluffy dumplings.

HEARTY SOUP

1 tablespoon butter
1/2 cup flour/FPC mixture
(8 parts flour to 1 part FPC)
1/4 teaspoon baking powder
1 egg
1 tablespoon parmesan cheese
6 cups of chicken broth
1/3 cup of tomato sauce

Melt butter. Add flour and baking powder. Mix well. Add egg. Beat well after each addition. Blend in cheese. Heat broth and tomato sauce to boiling. Drop mixture into the hot broth by 1/2 teaspoon at a time. Cover lightly. Cook for 10 minutes.

4. The following pamphlets have information on nutrition and seafood:

Discover Seafood-Your Guide to Nutrition from the Sea 1978-754-011
Seafoods and Health GPO 822-042
From: Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

5. The purpose of the living marine resource survey is to determine the living marine resources available in the community and to become aware of them.

(1) Have the students survey supermarkets, import stores, health food stores, restaurants, and others which you may determine. Have students check with manager, or whoever is in charge, before they begin their survey. He might provide additional help. Also, you may want to divide the supermarket survey into into frozen foods, canned and packaged goods.

(2) Or visit a large supermarket, a health food store and then eat at a seafood restaurant as part of a field trip. The manager could provide the group with information and then answer their questions.

6. In the Read the Labels? activity the students will find that many products have incomplete labels and instead of listing the substances they only list stabilizers, etc. You may want to have the students check labels in the stores and compile a master list which the students can use as a guide.

7. If you live in a coastal area, you may have the students tape interviews with local fishermen (oyster, shrimp, tuna, game, deep sea, and other) and others involved in the seafood industry. You might want to work with a social studies teacher to develop an oral history collection including the past and the present. The topic possibilities are unlimited. The English or speech teachers can help provide information on interview techniques. Have the students plan the questions they want to ask and possible people to interview, etc.

8. Fishing Laws and Regulations is a simulation activity in which the students determine how different fishing regulations affect the size of the fish population. The answers for simulations 1, 2 and 3 after one year are given below:

#1 Millions of fish	#2 Millions of fish
20 (Population size at start)	20 (Population size at start)
-0 (No fishing)	-5 (25% removed by fishing)
20	15.0
+10 (50% reproduction rate)	+7.5 (50% reproduction rate)
30 (Population size after one year)	22.5 (Population size after one year)

#3 Millions of fish
20 (Population size at start)
-10 (50% removed by fishing)
10
+10 (50% reproduction rate)
20 (Population size after one year)

Encourage the students to design their own regulations and test them; generate related questions and answer them; and to do additional reading and research.

9. The Future activities are designed to have the students think about the possible alternatives for the future of the living marine resources. There are no definite answers.

10. Additional articles on living marine resources:

Texas Parks and Wildlife Magazine

Fish and Fishing
Sail! Vol. 30, No. 7 (July 1972) p. 2-5.
Deep-sea Snappers, Vol. 30, No. 11 (Nov. 1972) pp. 6-9.
Fishing the Jetties, Vol. 31. No. 5 (May 1973) pp. 2-5.
Under the Lights (Party Boat) Vol. 31, No. 6 (June 1973) pp. 2-5
Midnight Madness (Sharkfishing), Vol. 31, No. 7 (July 1973) pp. 12-16
Drag Up a Drum, Vol. 32, No. 2 (Feb. 1974) pp. 2-5.
Tug-of-War with a Jewfish, Vol. 32, No. 12 (Dec. 1974) pp. 18-20.
Above the Surf, Vol. 34, No. 2 (Feb. 1976) pp. 2-5.
Pier Fishing at the Tip of Texas, Vol. 34, No. 4 (April 1976) pp. 22-25.
Learn about Redfish, Vol. 34, No. 6 (June 1976) pp. 24-26.
Don't Over Look the Sand Sea Trout, Vol. 34, No. 8 (August 1976) pp. 10-11
Black Drum, Vol. 35, No. 2 (Feb. 1977) pp. 19-21.
A Favorite with Coastal Fishermen Vol. 35, No. 3 (March 1977) pp. 20-22.
Fish Follow the Shrimpers, Vol. 35, No. 6 (June 1977) pp. 2-3.
Fishing the Underwater Cities, Vol. 35, No. 7 (July 1977) pp. 10-11.
Hide-and-Seek Fish, Vol. 35, No. 8 (August 1977) pp. 13-15.
Winter Fishing, Vol. 36, No. 1 (Jan. 1978) pp. 14-15.
Fishing Sea Rim, Vol. 36, No. 2 (Feb. 1978) pp. 6-9.

Management, Research, Problems and etc.
Biological Overfishing, Vol. 31, No. 6 (June 1973) pp. 16-18.
Fish Graveyard, Vol. 31, No. 7 (July 1973) pp. 16-17.
Hatchery Redfish, Vol. 31, No. 9 (Sept. 1975) pp. 24-26.
Coastal Creel Survey, Vol. 33, No. 6 (June 1975) pp. 22-23.
Mariculture, Vol. 33, No. 9 (Sept. 1974) pp. 12-14.
Gulf Shrimp Patrol (pp. 14-15) and A Coastal Mystery (pp. 18-20)
Vol. 34, No. 10 (Oct. 1976).
Tracking Shrimp, Vol. 36, No. 7 (July 1978) pp. 22-23.

National Geographic Magazine

Giant Kelp, Sequoias of the Sea, Vol. 142, No. 2 (Aug. 1972) pp. 251-269.
Life Springs From Death in Truk Lagoon (pp. 578-603) and From Graveyard to Garden (pp. 604-613), Vol. 149, No. 5 (May 1976)
Where Would We Be Without Algae?, Vol. 145, No. 3 (March 1974) pp. 361-377.

TOPIC THIRTEEN--LIVING MARINE RESOURCES
A SEAFOOD CONNOISEUR?

Complete--

Are you a Seafood Connoisseur? activity.

Share--

Ratings with your classmates.

Conduct--

A survey to determine how others in your community feel about seafood by using Are You a Seafood Connoisseur? form.

Read--

A Diner's Delight??

Answer--

The questions.

Taste--

The seafoods in the Seafood Fair.

Select--

Your choice for the top three seafoods based on your tastes.

Complete--

The Seafood Fair Taster Report.

Share--

Your report with your classmates.

ARE YOU A SEAFOOD CONNOISSEUR ?

Place your initials on the line that represents your position

	Would Never Eat It				Would Eat it
	1	2	3	4	5
Algae					
Barnacles					
Clams & Quahogs					
Crabs					
Conch					
Eels					
Fish					
Jellyfish					
Kelp					
Limpets & Chitons					
Octopus					
Ocean Perch					
Oysters					
Perwinke					
Sea Anemones					
Sea Cucumber					
Sea Urchin					
Scallop					
Shark					
Shrimp					
Skates & Rays					
Squid					
Turtle					
Whale					

For how many marine organisms did you put your initials in the far right column or #5? _____

If you said sixteen or more, you are on your way to becoming a seafood connoisseur. Congratulations!

How many of the marine organisms have you actually eaten?

_____

If you said between 6 and 9, then you are just average on the world standards.

For how many marine organisms did you put your initials in the far left column (#1) -- you would never eat? _____

Why would you never eat some marine organisms? _____

_____

Would you consider tasting them? _____Why or why not?

_____

A DINER'S DELIGHT ??

THE MENU

Appetizer
Fried sweet kelp chips
Porphyra chips
Toasted Kim
Ham and Laminaria rolls

Soups
Chiton soup
Irish moss soup
Dulse mi so soup
Pacific sea vegetable soup

Salads
Kantan salad
Sea lettuce salad
Sea Grape salad
Irish Moss tomato aspic

Entrees
5 varieties of fish
sea squirts
sea urchins
sea cucumbers
squid cacciatore
limpets
octopus
eel
perwinkles
oysters
clams
mussels
abalone
lambi
shrimp
crab
lobster
shark-terikyaki

Side Dishes
Hyiki and dried squid
Wakame in sweet and sour sauce
Sea vegetables Tai Wan
Stir-fried Irish Moss

Desserts
European apricot candy
Irish moss mousse
Lime agar dessert

Beverages
Hot dulse lemonade
Bladderwarack tea
Sea Moss Cocktail
Korean spiced tea
Yogurt drink

This menu would delight diners in Japan, China, the Carribean, the Mediterranean and even France and Mexico. The Japanese, for example, eat nine sea mammals, sixty-three species of fish, eight varieties of shellfish, three kinds of clams, and two of shrimp. Each home also has seafood each day so there is no such thing as a Japanese seafood restaurant.

Even though great numbers of these marine organisms live off the coasts of the United States, they are not eaten. There may be more to eating seaweeds and sea urchins than a dietary treat. There is a relationship between the fish diet and low heart disease. So maybe we overweight Americans who favor meat and potatoes over fish may improve our health as well as adding variety to our life by eating foods from the sea.

Answer the questions on the back of the page.

1. How would you explain the differences between the way you think of marine organisms and the way the Japanese and others use marine organisms as food?

2. Why is food from the sea a part of every meal for some people like the Japanese?

3. Could you live in Japan with a family and eat their meals? Would you do it?

4. What effect do you think advertising would have encouraging people to eat a greater variety of marine organisms like the Japanese?

SEAFOOD FAIR TASTER REPORT

Put an X on the point on the line that represents your feelings about a food item.

Try to guess the main ingredients (sea foods) in each of the foods that you have just eaten. List them in the column on the right.

Number of the Food Item	Disliked the Taste 1 2	Not Sure 3 4	Liked the Taste 5	Ingredients

1. How many items did you like?

2. How many items did you dislike?

3. For how many dishes did you get the ingredients correct?

4. Did any of the ingredients surprise you? If so which ones?

5. What changes in your ideas about food from the sea have taken place as a result of the seafood fair?

6. Which dishes or ingredients do you think could become an important part of food production and nutrition in the future? Why?

TOPIC THIRTEEN--LIVING MARINE RESOURCES
FOOD FROM THE SEA

Read and Discuss--

It's Good For You!

Complete--

Have You Eaten Algae This Week?

Read and Discuss--

Nutrition of Fish and Shellfish.
Fish Hot Dogs, Fish Bologna and Fish Jerky, Anyone?
FPC.
Fish as Animal Food.

Answer--

The questions.

List--

Several steps you would suggest taking to increase the use of marine algae and organisms like the sea urchin in the United States.

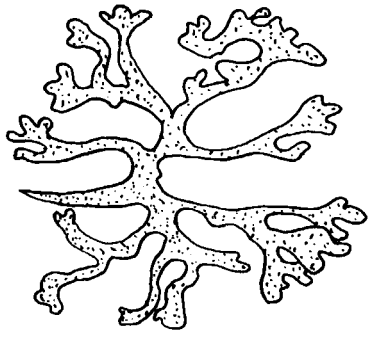
Conduct--

One of the seafood surveys to determine the living marine resources available in your community. Remember seafood includes both plants and animals.

Share--

The results of your survey with your class.

IT'S GOOD FOR YOU !



MEMORANDUM

TO: Captain Seaborne

FROM: Sally Seaweed, Nutritionist

SUBJECT: Response to your request on nutritional value of sea vegetables (not seaweeds)

Today as we learn more about nutrition, we know that sea vegetables are excellent foods and often better than food from land. Nutrients in seawater are constantly renewed by nature. The plants themselves can concentrate particular elements present from the surrounding waters several times greater than the amount found in the seawater. They are rich in vitamins A, B, B_{12}, C, D, E, Niacin and others. Liver which is the richest animal source of vitamin B_{12} contains less than do some green algae. Some sea vegetables have more vitamin C than lemons and more vitamin A than chicken eggs. The oils from sea vegetables contain a thousand times more vitamins A and D than cod liver oil.

The sea vegetables contain highly digestible proteins. Some algae contain more protein than equal amounts of rice or soybeans. They also contain very little cholesterol and are low in calories. The sea vegetables are rich in both minerals and trace elements. Some contain antibiotic compounds which slow the growth of bacteria.

They vary in taste just as land vegetables do. Some taste like beans nuts, or celery. Many have a delicate taste when they are fresh. Their taste changes when they are dried.

Most everyone eats algae either directly or indirectly every day. Extracts of marine algae are found in practically every type of prepared food item from ice cream, puddings, salad dressings, breads, diet foods, cheeses, sauces, fruit juices, dehydrated mixes to toppings to name a few. Most of these foods contain thickners or stabilizers derived from marine algae extracts. Knowing this, perhaps, it is not such a big leap to think of eating the whole plant. Marine algae have been eaten since the beginning of history by people who relished the different tastes and textures. They appreciated these sea vegetables the same way we have appreciated land vegetables. In many parts of the world the edible seaweeds are appreciated for what they truly are, <u>sea vegetables</u>. Seaweed is not an appropriate term.

Capatain Seaborne, I feel that sea vegetables are an excellent food resource and they are good for us. So the farming of sea vegetables can help provide food for the world.

HAVE YOU EATEN ALGAE THIS WEEK?

Place a check by each item below which you have eaten this past week.

Dairy
Ice cream
Milk shake
Sherberts
Ice pops
Chocolate milk
Puddings
Cottage cheese
Cream cheese
Yogurt
Packageable milk

Beverages
Soft drinks
Fruit juices
Beer foam stabilizer
Beer clarification
Fining wines
Aging of Spirits

Candy
Candy gels
Caramels
Marshmallows

Bakery
Bread doughs
Cake batters
Doughnuts
Pie fillings
Fruit fillings
Doughnut glaze
Meringues
Cookies
Cake fillings/toppings
Frozen pie fillings

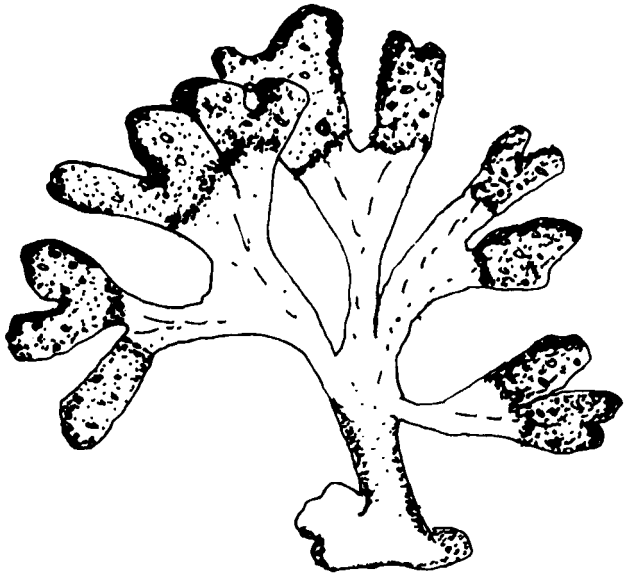
Dietetic foods
Starch free desserts
Salad/French dressings
Jellies, jams
Puddings
Sauces
Candies
Vegetable & health foods

Dressings, Sauces
French dressing
Salad Dressing
Syrups, toppings
White sauces
Mustard
Catsup

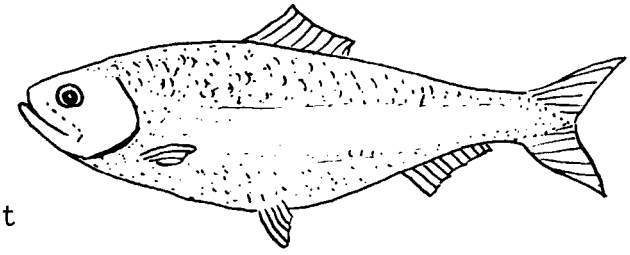
Meat, Fish
Canned fish, meat
Sausage ingredient

Miscellaneous
Jams, preserves
Prepared cereals
Processed baby food
Soups
Frozen foods
Synthetic potato chip
Fountain toppings
Artificial cheeries

How many items did you check? _____
The items listed are some which contain at least one of the four extracts from marine algae. These are algin, furcellaran, carragenan and agar. Since you already eat extracts from algae would you consider eating the whole plant? Why or Why not?



NUTRITION OF FISH AND SHELLFISH



MEMORANDUM

TO: Captain Seaborne

FROM: Shelly Fish, Nutritionist

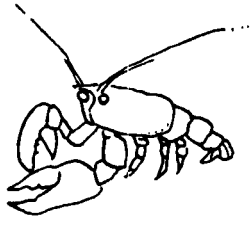
SUBJECT: Nutrition of fish and shellfish

Throughout the time of man's existence fish has played an important role in his diet. Until recent years little attention had been given to the nutritional and dietary value of seafood. Nutrition is a key to good health. Fish and shellfish are a storehouse for most of the nutrients that are required by the body. Seafoods contain generous amounts of these nutrients. They are delicious and satisfying to the appetite and taste when they are properly prepared.

Seafoods have proteins of excellent quality and they are easily digested. Therefore fish is included in many special diets for young children, elderly people and people with digestive disorders. An average serving of most seafoods furnishes more than enough protein to meet the daily needs of the body.

The fat content of seafood is very low. This makes seafood a dieter's delight since it is low in calories compared to meat. A 3 1/2 ounce serving of finfish has 101 calories; crab, 81; shrimp, 158; pork chops, 298; and beef, 303. The small amount of fat in seafood is unsaturated, low in cholesterol, easily digested and is easily used by the body tissues. The fats are soft and mostly polyunsaturated. If eaten several times a week, seafood will neutralize the harmful effects of saturated fats from other foods in the diet. It will actually reduce the cholesterol level. This has led heart specialists to recommend that their patients eat more fish in place of meet. Fish is also a good source of vitamins A, D and some of the B's. They are good sources of minerals such as magnesium, phosphorous, iron and copper and low in sodium and chloride. Fish and shellfish can be used in low sodium diets. Many shellfish have more minerals than milk.

Doctors have found that the juices and meat of oysters, abalone, clams and other mollusks contain a rich source of a substance that destroys disease germs. They have also shown that the substance protects against influenza viruses and the cold sore virus. More findings are sure to come. Captain Seaborne, I am convinced that fish and shellfish are good for us.



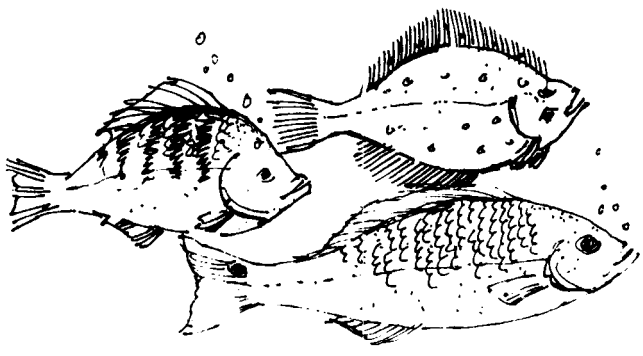
FISH HOT DOGS, FISH BOLOGNA AND FISH JERKY ANYONE ?

Chefs from restuarants and hotels sampled the newly developed seafood chowders, fish broth and fried fish crispies -- all made from white sucker. The verdict was good. These products will soon be produced and marketed commercially.

Work is underway on developing other products such as fish hot-dogs, fish bologna, fish luncheon loaf, fish jerky, fish sticks, sweet and sour fish, Swedish fish balls, fish balls in tomato sauce, fish cakes, sloppy joes, fish sausage, fish chili and fish chips. They are all made from underutilized species of fish. According to seafood researchers, this is how fish which are presently "underused" could be used. These underused fish such as sucker, croaker, spot, mullet, Spanish mackeral, grey trout and others could be used to provide a low cost, low fat, and high protein food. It would also create a market for resources currently left in the sea.

Nearly every time a fisherman pulls in his nets many fish are caught in which he is not particularly interested because they are too small or because there is no market for them. The fisherman either throws them back or packs them on ice as he does with the rest of the catch. For example, one estimate is that along the Gulf coast nearly 19 pounds of fish are thrown overboard for every pound of shrimp caught. This means approximately 750 million pounds of fish are thrown away each year.

Do these fish have to be wasted? The discarded fish are a resource that can become dollars by converting them into products like fish bologna, etc. There is probably no fish today that can't be sold. It is just a matter of promotion. Fish bologna would contain nearly 50 percent more protein and less than one-third the calories of the same amount of meat bologna. So how about a fish hot dog?



F P C

Fish protein concentrate (FPC) is an excellent source of high quality, low cost animal protein. It is made by processing the whole bodies of "trash fish". These fish such as hake, sea robins, skates and others are not accepted as food by man. This is either because of traditional preferences or because of their small size which makes processing expensive.

FPC is odorless and can be stored indefinitely. It does not change the taste or character of food. It can be used in foods to improve the quality and increase the quantity of protein and minerals without increasing fat content. A mixture of nine parts of wheat flour and one part of FPC is three or four times more nutritious than just wheat flour alone. This flour can be used to prepare foods such as bread, cakes and cookies.

FPC can be used to fortify many of the cereal products, like bread, pasta (macaroni products), crackers, cookies and sauces. This could help increase the world's available protein. At the same time it makes very efficient use of a catch of fish by using all parts.

FISH AS ANIMAL FEED

Currently in the United States, each person eats an average of 11 to 12 pounds of fish per year. The largest portion eaten is frozen breaded fish. However, the largest volume of fish is eaten indirectly. More than 55% of the fish caught by U.S. fishermen becomes poultry and livestock feed.

Since fish meal is high in nutritional value, it is part of the diet for young chickens and turkeys. As a result, chickens and turkeys use about 85% of the fish meal available in the United States. Five to ten percent of the fish meals is used for pigs.

Fishery products are the essential raw materials for the pet industry. Canned cat foods contain from 25%-100% fish. Pet birds are also fed fish-based feeds. These are usually made from crab and shrimp wastes.

Since fish have high protein and low fat levels, they are the main ingredient in feeding fur-bearing animals, especially mink. Fish make up 40-70% of the food for these animals. Yes, over half our fish catch goes to feed other animals.

QUESTIONS

1. If you are trying to lose weight why would food from the sea be good to eat?

2. Why may eating sea vegetables and marine organisms be better for you nutritionally than land vegetables and organisms?

3. Discuss the statement "Food from the sea is the world's insurance against starvation."

4. Why do you think that we aren't eating or gathering sea vegetables to sell in our grocery stores along with the other vegetables?

5. How do you think we should go about getting more people to eat sea vegetables and the edible marine organisms which are not eaten by many Americans?

SUPERMARKET SEAFOOD SURVEY

You will be looking at several sections of the grocery store for products from the sea. Divide your paper into 3 columns. In the first column list the item. In the second column list the marine organism(s) which is/are the ingredients. In the third column list the weight and the price of the item. In your survey check the fresh foods, frozen foods, canned goods, imported or speciality foods.

Check with the manager and see if you can learn:

1. Which seafood items were the most popular

2. How do they obtain their sea food?

3. What determines whether an item is added or removed from the store's stock?

4. What is the price per pound of fish, shrimp, steak, roast, chicken, and pork chops?

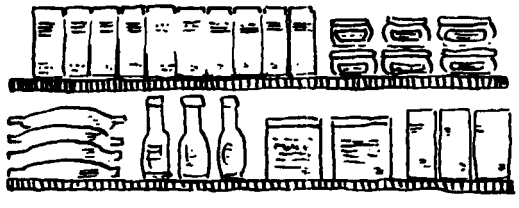
   Which is cheapest? Which is the most expensive?

5. What were the most unusual seafood items you found?

6. In which section did you find more food from the sea: fresh, frozen, canned goods, etc.?

   How many items did you find in each section?

   Was the number of items more or less than you expected?



RESTAURANT SEAFOOD SURVEY

Divide your paper into 4 columns. In the first column list the items on the menu which contain seafoods. In the second column list the marine organism(s) which is/are the ingredients. (If the menu only states that it is broiled fish, see if you can learn what kind of fish is used.) In the third column list the price of the item. Since the price will depend on amount, preparation time and ingredients in column four rate the marine organisms as to cost. 1--most expensive, etc. The manager may or may not be able to tell you this.

Questions:

1. Which seafood items were the most popular? Why was this most popular?

2. How does the restaurant obtain its seafood?

3. What determines whether an item is added to or removed from the menu?

4. How does the seafood compare in price to non-seafood items?

HEALTH FOOD OR ORIENTAL FOOD STORE
SEAFOOD SURVEY

Divide your paper into 4 columns. In the first column list the item. In the second column list the marine organism(s) which is/are the main ingredients. In the third column list the amount and cost of the item. In the fourth colum list some uses of the item.

Ask someone to help you if possible, since you may not know if the item is from the sea or not by its name.

Questions:

1. Which seafood items are the most popular? Why is it the most popular?

2. From where and how do they obtain the items?

3. What determines whether an item is added or removed from the store stock?

4. What were the most unusual seafood items you found?

5. Who are the people that buy the seafoods here? What will they be using them for?

TOPIC THIRTEEN--LIVING MARINE RESOURCES
WHERE WOULD WE BE WITHOUT THE ALGAE?

Read--

Those All Important Seaweeds!!

Determine--

Which products in your home contain algae gels--Read the Labels activity.

Answer--

The questions.

THOSE ALL IMPORTANT SEAWEEDS !!

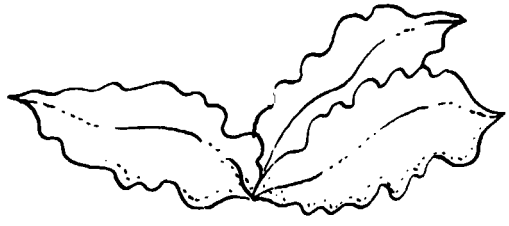
The marine algae or sea vegetables are not just a source of food for man and animals. In fact I'll bet that you cannot get through a day without coming in contact with something made from a seaweed colloid or gelling compound.

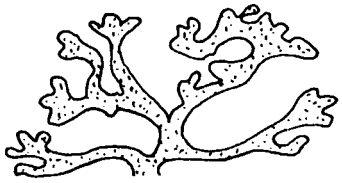
Sea vegetable gels (algin, alginate, carrageenin, agar and gelation) are found in our kitchens. We eat these algae gels, completely unaware that they are in our prepared foods. Some of these are yogurt, chocolate milk, ice cream, marshmallows, candies, bread, coatings for canned meats and fish and even more.

Historical records show that the use of seaweeds in agriculture is very old and widespread wherever there are rich supplies. They are used not only for food but also as a fertilizer for the soil. Cattle, poultry and pig feeds are produced from dried seaweeds by grinding them into a meal. This is mixed with ordinary food to give a balanced diet since the seaweeds contain minerals and trace elements.

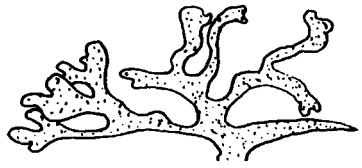
In recent years a liquid extract of seaweeds that is high in nitrogen and potash but low in phosphorous has appeared. This seems to increase resistance of the crop to abnormal temperatures, aphids attacks and fungus diseases. It even helps plants take nutrients from the soil. There is some indication that cows fed on grass fertilized by seaweed fertilizer are healthier.

Seaweeds are also important in industry. Some of these uses are in the brewing of alcoholic beverages, cosmetics and shampoos. Also in the making of linoleum, artificial leathers and silks. insulation, water-base paints and ceramics. They are important in paper products for packaging milk, butter and frozen foods, and the adhesives in paper bags, gummed tape and decals. In medicine they are used in blood anticoagulants and as a culture media. Another potential use of the algae is in the maintenance of life in space crafts. These are a few examples. To list them all would take several pages. It seems the uses are only limited for lack of the right seaweed, or our knowledge. But even more important, perhaps as much as 90 percent of all photosynthesis is accomplished by algae. And in the sea, as the vegetable part of plankton, they are the food upon which all life depends.





READ THE LABELS



Let's see how many products in our home have sea vegetable (algae) gels in them. Read the labels to determine the ingredients in a product. If the product lists: algin, alginate, carrageenin, agar or gelatin as an ingredient then it contains an algae gel.

Divide your paper into three columns. In the first column list the item which contained the algae gel. In the second column, list in what room of your house the item was located and in column three place a check mark if you have used the item.

A Reminder--Check all labeled products--pharmeceutical, all dairy products, beverages, bakery, candies, dressings, sauces, dietetic foods, meat and fish products (sausages and canned products), soups, baby food, jams, cosmetics and paints. One problem you will face is that many labels do not give complete information.

1. How many products in your home contain algae gels? How many of these do you use?

2. What effect could thermal pollution and toxic chemicals from industry have on the algae and products that use algae gels?

3. Along the east coast and the west coast the algae are numerous. However, as we round the Gulf shore from Florida toward Louisiana we find the Mississippi river and other rivers have had a stunting effect. Algae are found mainly on the wharfs, pilings and jetties. Can you explain this?

4. What would be the advantage of using gelatin made from algae instead of animal gels made from hoofs and cartilage of animals?

TOPIC THIRTEEN--LIVING MARINE RESOURCES
FISHING

Read and Discuss--
Fishing in the Past.
Fishing--Today.
The Texas Fisheries.
Where Have All the Fish Gone?

Optional
Plan and Conduct--
Your interview of individuals involved in the fishing industry, past and present.

Report--
On your interview results to the class.

Set up--
Model fish populations in the Fishing Laws and Regulations activity to determine how different fishing regulations affect the size of fish populations.

Answer--
The questions.

Read--
Article in Texas Parks & Wildlife on fishing or fish.

Report--
On the article you read to your classmates.

Write--
A short story on a day in the life of a fisherman.
Select one of the following fishermen:
Oyster
Shrimp
Tuna
Game
Deep Sea
Factory Ship
Lobster
And others

Share--
Your story with the class.

FISHING AND THE PAST

Early man began to fish about 10,000 years ago. He fished like other land animals. He would grab his prey out of the water with his hands. Clams and oysters were probably the first seafood man ate. Then hooks and nets and other simple tools were invented.

The Karankawa Indians of the Texas Gulf coast collected oysters, clams and other shellfish with their hands. They also used the bow and arrow and boats. The early Texas settlers used hooks, lines, nets and boats. With these simple methods, man did not wipe out his food supply by overfishing.

Early man had a knowledge of marine life-cycles and marine behaviors. None of the tools he used are of any value without an understanding of where and when the fish will be.

These early fishermen could not have seriously overfished an area. Yet, they knew that overfishing could affect their food supply and had to be avoided. They discovered the first laws of ecology. They wove these into their religious beliefs. To disobey these laws was to risk the anger of the sea gods. Fish were not taken during spawning season, a number of young had to be tossed back, and no more fish could be taken than could be eaten.

However, with the advance of technology, beginning with the harpoon gun, this began to change. Modern fishing equipment and ways have led to the loss of the old ways and traditions which respected the creatures of the sea.

FISHING--TODAY

Today the living animal resources of the oceans are being hunted by a variety of vessels. They vary in size and complexity. They range from a South Sea island dugout to a Russian factory ship over 700 feet long. The design of the fishing vessel is determined by the species of fish it will catch.

In the past, locating fish was difficult and an experienced captain was probably the best asset a boat could have. Today electronics and space technology are used to find fish. Echo-sounding is used to locate schools of fish. Sensitive cameras on high-flying planes and satellites are used to record the disturbance of bioluminescent plankton caused by schooling fish. Ultrasensitive microphones are used to pick up the locations of fish.

The Russian fishing fleet operates like a naval operation. Administrators direct fishing activities in each of the major seas like commanders moving their forces in battles. As many as 300 ships will travel in a group accompanied by factory ships and transport vessels.

The factory ship begins processing the catch as soon as it is taken on board from other vessels. One such factory ship, which is 540 feet long, is able to salt 200 tons of herring; process 150 tons of fish into meal; filet and freeze 100 tons of bottom fish and manufacture 5 tons of fish oil, 20 tons of ice and 100 tons of distilled water all in one day. The Russian government pays for the fleet which puts other fishing nations and the fish at a disadvantage.

THE TEXAS FISHERIES

The Texas coastline has a total estuarine and coastal lagoon area of 2100 square miles. This area is the major spawning ground and nursery for 70 percent of the fish population of the Gulf of Mexico. Shrimp also live in these large fertile areas during their early life until they are large enough to enter the Gulf of Mexico.

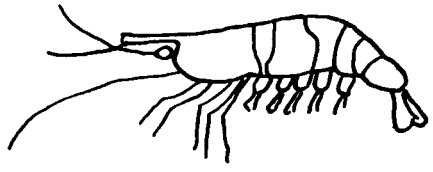
Fishermen from many states and several countries earn their living shrimping the productive Texas bays and nearby Gulf. Shrimp is the most valuable fish product in the United States, with Texas and Louisiana being the top two shrimp producing states.

Shrimp, oysters, fish and crabs are part of the Texas fish catch. Shrimp, however, make up about 90 percent of the state's commercial catch. Shellfish (shrimp, oysters, crabs and squid) totaled over 83 million pounds with a value of over $113 million in 1975-76. Fish taken commercially totaled over 8 million pounds with a value of $2.8 million. The commercial fish production on the Texas coast could be increased several times above the present level without seriously affecting the supply.

Although Texas has one of the largest fishing industries of any state in the United States, it is still small compared to other industries. The seafood industry is very important to the coastal economy. It produces millions of dollars in income and employs over 15,000 people.

Problems do exist. The production of shrimp and the Gulf fish depends on the conditions of the bays and estuaries. Therefore, both pollution and changes in the estuarine environment such as dredging and filling can have bad effects on production.

Every year the Texas shrimping industry catches an estimated 500 million pounds of fish. Many of these fish are small and presently worthless. The development of fish protein concentrate, fish meal, and possibly fish sausages may be ways to use these fish. Research and development for use of these waste fish is needed. Much can be done to improve the Texas fisheries.



WHERE HAVE THE FISH GONE ?

Early man began to fish almost 10,000 years ago, but the technological and attitude changes now threaten the survival of some of the living resources of the sea. In the 100 years from 1850 to 1950 the world fish catch increased 10 times or 25% every 10 years. However, in the 10 years from 1950 to 1960, it doubled. It doubled again from 1960 to 1970.

There has been no great increase since 1970. Over-fishing has taken its toll. At least twenty species of fish are close to being or have been overfished. These include tuna, herring, cod, ocean perch, haddock, anchovy and others. In fact, by the 1980's there may be no healthy fish supplies left.

An example of what is happening occurred in 1965. The large Russian fleets moved into the northeast coast of the United States and took tremendous amounts of haddock, a fish valued by American and Canadian fishermen. The International Commission for Northwest Atlantic Fisheries attempted to regulate the haddock catch, but the Russians disregarded this. By the end of 1967, the Russians had almost wiped the fish out. It is estimated that the 1963 catch of haddock alone could have supported the U.S. and Canadians for 10 years.

It has been charged that the Japanese have been seriously irresponsible and have shown little interest in conservation. Their research seems to lie only in developing and expanding the catches.

In North America and Europe, conservationists are asking: "Can the oceans support massive fish takes? What is the morality that urges us to take as many fish as we can--- because if we don't the Russians or Japanese will?" Only quick and close cooperation between all nations can prevent the destruction of the fishery resources of the world.

FISHING LAWS AND REGULATIONS

Fishing laws and regulations are designed to maintain healthy fish populations while giving everyone an equal chance to enjoy the sport of fishing or to work as a commercial fisherman. Let's determine how different fishing regulations affect the size of fish populations.

Set up a model fish population. Use beans or other small objects to represent fish. Each object will represent 1 million fish. The model will have 20 million fish and we will change the regulations to see what happens to the populations. Each population will have the same yearly natural reproductive rate. The number of young born will be 50% of the number of fish in the population. We will simulate fishing by removing fish (beans) from the population. We will add fish (beans) to the population to simulate natural reproduction. (Note: In this model, we will not consider the effects of starvation, disease, etc. You may want to add a percentage for death and disease each year.) Carry out each simulation below for four years.

1. The regulations allow no fishing.

2. The regulations will permit 25% of the fish to be removed by fishing each year.

3. The regulations permit 50% of the fish to be removed each year.

4. Design your own regulations and test them to determine the results.

QUESTIONS:

1. Did any of the populations increase in size?
   Decrease in size?
   Remain about the same?

2. If you were a fishery biologist, which set of regulations would be best to:
   A. Keep the size of a fish population about the same.

   B. Decrease the size of a fish population.

   C. Increase the size of a fish population.

   D. Allow the optimum catch over a long period of years?

3. If you were a fishery biologist and wanted to increase the size of a fish population but also wanted to allow people to enjoy fishing, which set of regulations would you use? Why?

4. What would happen if regulations did not allow any fishing and the fish population size increased beyond the limits of the fishes' habitat?

5. What would happen to a fish population if fishing were not regulated; that is, if people could catch fish by any method (netting, trapping, etc.) and could catch as many as they wanted?

6. Discuss laws and regulations as important management

7. What effects do politics, emotions, and other factors have on fishing?

TOPIC THIRTEEN--LIVING MARINE RESOURCES
THE FUTURE

Read--

Housing Shortage.
A Blue Revolution?
The Future-Scenario A.
The Future-Scenario B.

Answer--

Questions.

Find--

Articles and pictures in magazines and newspapers which portray some of the issues concerning living marine resources.

Make--

A collage illustrating some of the issues with pictures, words, slogans and etc. Draw your own or cut them out of a magazine or newspaper.

Write--

A short scenario of what you think or hope the future of living marine resources will be.

List--

Some of the steps which must be taken to make your future scenario become reality.

Make--

Buttons to express your views on living marine resources (seafood, algae, fish, fishing, etc.)

HOUSING SHORTAGE

The largest part of the ocean is covered by mud which creates a housing shortage in the ocean. A large number of marine organisms need a solid surface for attachment (the more surface area, the more organisms can attach) and many marine organisms need areas in which to hide from their predators.

A fish in the open ocean has no place to hide. It must depend on its coloration to become less visible, on its senses to be aware of the approach of predators and on its swiftness to escape them. This lack of hiding places may be why fish commonly collect beneath floating objects at sea.

Divers have often noticed that fish collect around wrecked ships and the offshore drilling platforms. This had led to artificial reefbuilding in the Texas coastal area to increase fishing. These reefs are composed either of oyster shells placed in bays to form oyster reefs or of old car bodies, concrete blocks, pipes or other structures including old ships. The 300 or more oil platforms built off Louisiana and Texas coast provide a similar artificial reef. Well-organized artificial reefs have become and could become a simple way to farm the thinly populated areas of the oceans.

While some oyster reefs were created in Galveston Bay before 1958, offshore reefs constructed of old automobile bodies were constructed for the first time. In 1962 and 1963 reefs were built of clay and various sized concrete pipes off Galveston and Port Aransas. Many reefs have been built since.

On February 1, 1972, a stroke of fate created an artificial reef offshore between Galveston and Freeport. The V.A. Fogg a 572 foot tanker exploded and sank. Explosives were used to change those parts of the ship which were hazardous to navigation into additional pieces of reef. The location was favorable. It was out of the shipping lanes, but also close to the ports. Therefore it was easily accessible to charter fishing and diving boats from Galveston and Freeport. In good fishing weather, as many as 20 small boats may be over the Fogg reef.

Sport fishing is by far the major reason for the accelerated interest in artificial reefs which have been placed in many areas to increase the fish population. In recent years scuba diving has become a real attraction, partly due to the additional underwater exploration sites--artificial reefs.

A BLUE REVOLUTION ?

There are more than two million acres of under-used lowlands along the Gulf coast. They rent for as little as $3 per acre or sell for $300. Someday they may be covered with neat rows of rectangular man-made ponds. They will be fed by water pumped from the bays and filled with shrimp. A dream? No, a possibility. In 1969 a team of researchers began a shrimp mariculture program at Flour Bluff near Corpus Christi. This program will answer the questions of shrimp culture. It will develop the procedures and technology for shrimp mariculture.

Mariculture is the raising of marine organisms under controlled conditions. The Chinese grew oysters and fish 2,500 years ago. It was the first recorded mariculture operation. Freshwater fish have been raised in hatcheries for 2,000 years, but not saltwater fish. The problems are greater for saltwater fish since proper saltwater balances and temperatures must be maintained. Also, we do not know all the answers to questions about diseases, parasites and reproductive cycles. Today the following organisms are part of the mariculture programs: the finfish--salmon, perch, yellowtail pompano, top minnow and mullet; shrimp, crabs, lobsters, oysters, clams, mussels and algae.

The potential is tremendous. If the technological changes are properly used, a Blue Revolution can result. This would be the development of a new food supply to help stop world hunger. At present, the government backs the research for lobsters, shrimp and other luxury sea foods instead of the fish that are easier to raise and not as popular.
The luxury seafoods of lobster and shrimp have less protein than the fish. However, sea farming will probably never replace fishing in the way that land farming has replaced hunting. Even if we solved all the problems, the ocean, like the land, can only feed a yet unknown but limited number of people.

THE FUTURE---SCENARIO A

The sewage from a secondary treatment plant of a coastal city is used to grow plankton algae. These plankton algae remove nutrients from the sewage. Oysters then remove the algae from the water. Some of the nutrients are returned to the water in the form of wastes from the oysters. These nutrients are used by seaweeds especially sea lettuce. The seaweeds are then fed to abalone (mollusks). The oysters' solid wastes which drop to the bottom of the tank are eaten by sandworms. The sandworms are put in another tank to serve as food for the flounder.

The products of this mariculture system are oysters, seaweeds, worms, flounder and abalone. The sea farm also becomes a sewage treatment plant, with clean water being returned to the sea.

In the open Gulf, there is an inexpensive raft, or mesh, 40 to 80 feet down from the surface with growing seaweeds attached. Pump intake pipes extend down into the cool, nutrient-rich, water. The nutrient-rich water is brought to the surface by wave or wind powered generators. Harvesting of the seaweed is accomplished by special vessels which move over the frames and cut off the upper part of the seaweeds. These ships remove the water from the seaweeds and then carry them to processing plants on shore.

In the open spaces left in the seaweed fields, nets are lowered and fish from the seaweed fields are lured into them. In other seaweed fields part of the harvest is fed to fish, abalone, snails, and other invertebrates in separate mariculture operations.

The seaweed is also processed by a digestion fermentation process into methane, plus other products such as fertilizers, ethanol, lubricants, waxes, plastics and the complete group of useful petrochemical products. Some seaweed is harvested as food for man and animals.

THE FUTURE---SCENARIO B

It was a fine morning with a smooth sea, sunny warm weather, and the companionship of friends. The older member of our group began to comment, "The pollution has killed everything." He goes on: "You could look down with a mask from the surface and see the wrecks on the bottom." He always complained that "there are no ducks, no fish, nothing. There's nothing out here. They're all dead and those that are alive, I'm afraid to eat."

It wasn't that we doubted his word, but he remembers another time. Most people don't. We take the pollution, turbid water, silt and lack of marine life for granted. We have been brought up with it.

Twenty miles out at an old ship wreck where the surface water was fairly turbid, we decided to dive down and take a look. We passed through layers of yellow brown matter. At 100 feet down there was no light. On the wreck, it was completely dark. Fish were lying on the bottom belly up, dead. No diver observed any live fish. Anemone, starfish and mussels were also dead. A black substance covered the sand everywhere.

Commercial fishermen run miles and miles from port to find any fish at all, and they have been pulling up dead fish in their nets. The price of fish is so high that only the wealthy can afford them. Mass starvation and food riots are beginning to occur. Food is more precious than gold.

1. What kind of energy is needed to produce seaweeds?

2. What beneficial side effects does mariculture have on the environment?

3. Why would it be good to feed seaweeds to animals which are grazing on mineral deficient pasture land?

4. How would food shortages affect life in the United States?

5. Why is fishing to feed the world as naive as trying to feed billions by hunting wildlife?

6. Why will mariculture only postpone diaster if man does not keep a stable population level in the future?

7. What problem limits the growth of sea farming?

8. What environmental and legal/political problems can the farming of algae or marine organisms produce?

9. Do you think sea farming will become an important source of food in the future? Why or why not?

10. What evidence in today's world suggests that this forecast in The Future-Scenario B could come true? Can you see any evidence that it would probably not come true?

BUTTONS

People often use buttons to show who they support in elections or where they stand on issues. Let's say that you have decided to tell the world your views on living marine resources (seafood, algae, fish, etc.) by making a whole bunch of buttons. What would they say in words or pictures? Use the space below to sketch your button designs.

1. Number the buttons according to how important they are to you. (1-most important, etc.)
2. Would you wear them everywhere?
3. Is there anywhere you wouldn't want to wear some of them? Why?
4. Are there any you wouldn't wear at all?

TOPIC FOURTEEN
TRANSPORTATION

ACTIVITY ONE--Transportation-Early Resource
ACTIVITY TWO--Sea Chanteys and the Sailing Ships
ACTIVITY THREE--Shipping Today
ACTIVITY FOUR--Texas Ports - Past and Present
ACTIVITY FIVE--Superports and the Future

Materials for Classroom Use:

Your Answer/activity
Transportation as a Resource/reading
Bible--Old Testament
Sailing Ship/drawing
Audio tape of Sea Chanteys
Sea Chanteys and Sailing Ships/script
Supertanker/drawing
The Superships/reading
Waterways of the United States/drawing
Tugs, Barges and the Gulf's Waterway/reading
Trends in Barge and Tow sizes/chart
My Opinion/activity
Indianola/reading
Galveston - 1900/reading
Houston - 1900/reading
Distribution of Goods Shipped from the Texas Coastal Zone
Texas Ports Today/series of readings
- The Sabine and Neches Ports
- Brownsville
- Corpus Christi
- Galveston
- Houston
- Other Texas Ports

Locate and Answer/activity
Prospect for a Superport/reading
Future Ports/drawings
The Future/reading
Texas' Future Water Highways/activity
Texas Highway Map (which shows rivers)
Texas Almanac

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 cite examples of transportation as a resource in the past, present and projected future;
2.3 evaluate a transportation problem man has solved and the changes that resulted and the new problems that arose;
2.6 analyze the use of transportation in the past, present and projected future in view of the needs of the time and the values involved;

2.6 describe how the changing use of marine transportation has change lifestyles;
2.6 analyze value positions to determine similarities, differences and possible conflicts;
2.7 formulate possible future uses of marine transportation;
2.7 discuss marine transportation's influence on the cultures of many societies;
3.1 discuss the interplay of the many factors (economic, governmental, moral, etc.) in man's utilization of marine transportation;
3.2 describe and identify situations where technology has caused a change in the use of marine transportation;
3.3 analyze which factors are most important in decision making concerning marine transportation;
3.3 identify a situation in which short term economic gains may produce long term environmental losses;
4.1 appraise the influence of peoples' values on the use of marine transportation.

Teaching suggestions:

The purpose of this lesson is to introduce the student to marine transportation as a major marine resource in the past, present and in the projected future. He should also begin to form ideas relative to how man is utilizing this resource and its impact on the marine environment.

1. Ezekiel 27:1-25 is an excellent description of transportation and the trade carried by ships in the past.

2. Sea chanteys--Your students may think it funny for sailors to sing while they worked. You might ask them how many of them never have a radio or stereo on while they do things. You might also help the students recognize that it was critical for the sailors pull together in order to raise the sails or lower them. A good Chanteyman was probably as important as the captain of the ship. During a storm the chanteyman was critical in keeping the ship afloat for his chants would keep the sailors working together. This was true especially for raising or lowering sails and the anchor. In the past other workers also sang or chanted while they worked. Relate the chanteys to the counting or chants of drill teams or the military.

The Sea Shanties are from the album Foc'sle Songs and Shanties (Fa 2429(by Paul Clayton and the Foc'sle Singers. Another album of sea shanties is Colonial & Revolutionary War Sea Songs & Chanteys (FH 5275) sung at Seaport '76 by Cliff Hadam and John Millar. Both are available from Folkways Records & Service Corp., 43 W. 61st St., N.Y., N.Y. 10023. American Sea Songs and Chanteys by Frank Shay, W.W. Norton & Co. Inc. N.Y. 1948 (Book)

3. An excellent reference on the superships is: National Geographic Giants That Move the World's Oil-Superships, Vol. 154, No. 1 (July 1978) pp. 102-123.

4. Use the drawing, Waterways of the United States, as a basis for discussing what portion (area and population) of the United States can be reached by water. Also, 50% of our population lives within an hour'sdrive of the coast. Most goods (over 90%) that come to us from other countries come by water and water transportation brought the settlers and immigrants. Also inland states transport goods over land to ports for overseas shipment and also receive goods the same way. (Iowa grain to Houston to India)

5. An excellent reference on the Gulf Intracoastal Waterway is: National Geographic Magazine, The Gulf's Working Waterway, Vol. 153, No. 2 (Feb. 1978) pp. 200-224.

6. Use the readings on Indianola, Galveston and Houston to discuss the settlement of Texas by water and the importance of the early ports to Texas growth and development. Discuss the living conditions and lifestyles. Note the relation and interdependence of the port to its neighboring area. Have the students visit with individuals (family, neighbors, etc.) whose parents, grandparents, etc. came to Texas in the past to determine how, when and where they entered Texas if possible. Discuss the students' findings. Your students might want to determine where the settlers came from that settled in particular towns or areas.

7. Use the readings on Texas Ports - Today to discuss the role of the ports in state and nation today; relate this to agriculture, petrochemical industry, minerals, manufacturing, etc. (The Texas Almanac data is 2 to 3 years old - e.g. 1978 almanac has 1975 shipping data.)

8. Your students may want to determine what the latest information is concerning Texas building an offshore superport.

9. Use Texas' Future Highways to determine how much of the state could be served by hydrofoil craft or SES traveling up the rivers of the state. The increase in oil and gas costs combined with cheaper energy costs of water transportation makes this a possibility worth investigating.

TOPIC FOURTEEN--TRANSPORTATION
TRANSPORTATION--EARLY RESOURCE

Complete--

Your Answer activity.

Share--

Your answers with your classmates.

Read--

Transportation as a Resource.

Read--

The description of the nature and value of transportation as a resource of the past. The description is in the Old Testament of the Bible in Ezekiel 27:1-25.

List--

The items which were carried for trade by ships and list the countries involved.

Complete--

The Transportation in the Past activity

YOUR ANSWER

Has anyone, all of a sudden, asked you a question you weren't expecting?

Below are some situations like that. Fill in your response.

HOW DID ALL THE SETTLERS AND SUPPLIES GET TO TEXAS?

YOU

HOW DOES MIDDLE EAST OIL GET TO US?

YOU

THE OCEANS AND THE GULF OF MEXICO ARE A MEDIUM OF TRANSPORTATION. IS THIS A RESOURCE?

YOU

WHY

YOU

TRANSPORTATION AS A RESOURCE

One of the major marine resources is that of transportation of men and goods. Ocean transportation allows large quantities of materials to be moved from one place to another. The materials are moved from a place where they are plentiful to places where they are lacking.

Movement across the water requires little energy in comparison to other means. A ship moving through water carries 2000 to 9000 pounds for each horsepower. For each horsepower a plane moving through the air carries only 15 pounds; a truck carries 100 to 200 pounds; and a railroad car carries 600 to 1500 pounds. This characteristic so valuable in the past is still valuable today. An example is the supertankers which carry oil from the oil rich Middle East to the oil starved United States. In fact about 98% of the movement of materials between continents is by water.

Past

We do not know when man first used the oceans to get from one place to another. The first people recorded as having used the ocean for transportation were the Phoenicians. Beginning in 1022 B.C., they had boats rigged with sails that they used to travel from the eastern Mediterranean to England and the north coast of Africa.

An excellent description of this nature and value of transportation is given in the Old Testament account of Ezekiel (Ezekiel 27: 1-25.) Around 1000 A.D. Lief Erickson traveled from Norway to the eastern coast of the United States. By the 15th century, Spanish, Portugese and Dutch ships were exploring the Atlantic.

In the early 16th century, the Spanish ships began exploring the Gulf of Mexico and the coast of Texas. From the 17th to the 19th century, ships from Spain brought soldiers and supplies to Mexico and Texas. The ships would then take back precious raw materials from Mexico. By the mid 19th century ships began to bring settlers and supplies to Texas. This was the beginning of the development of the Gulf as a resource for transportation.

TRANSPORTATION IN THE PAST

Read the description of the nature and value of transportation as a resource in the past. The description is in the Old Testament of the Bible in Ezekiel 27: 1-25. (Verses 4-9 list the materials used to make the ship and the origin of the materials or workers. Verses 12-25 list the countries and the goods they traded.) List below the materials used to make the ship and the countries from where these materials came. Also below list the items which were carried for trade by early ships and which countries were involved.

TOPIC FOURTEEN--TRANSPORTATION
SEA CHANTEYS AND THE SAILING SHIPS

Look at--

Drawing of Sailing Ship.

Imagine--

You are on a 19th century sailing ship.

Sing--

Along with the audio tape of sea chanteys and act out each activity.

Imagine--

What it would be like to work on the deck with the sails during a storm.

Write--

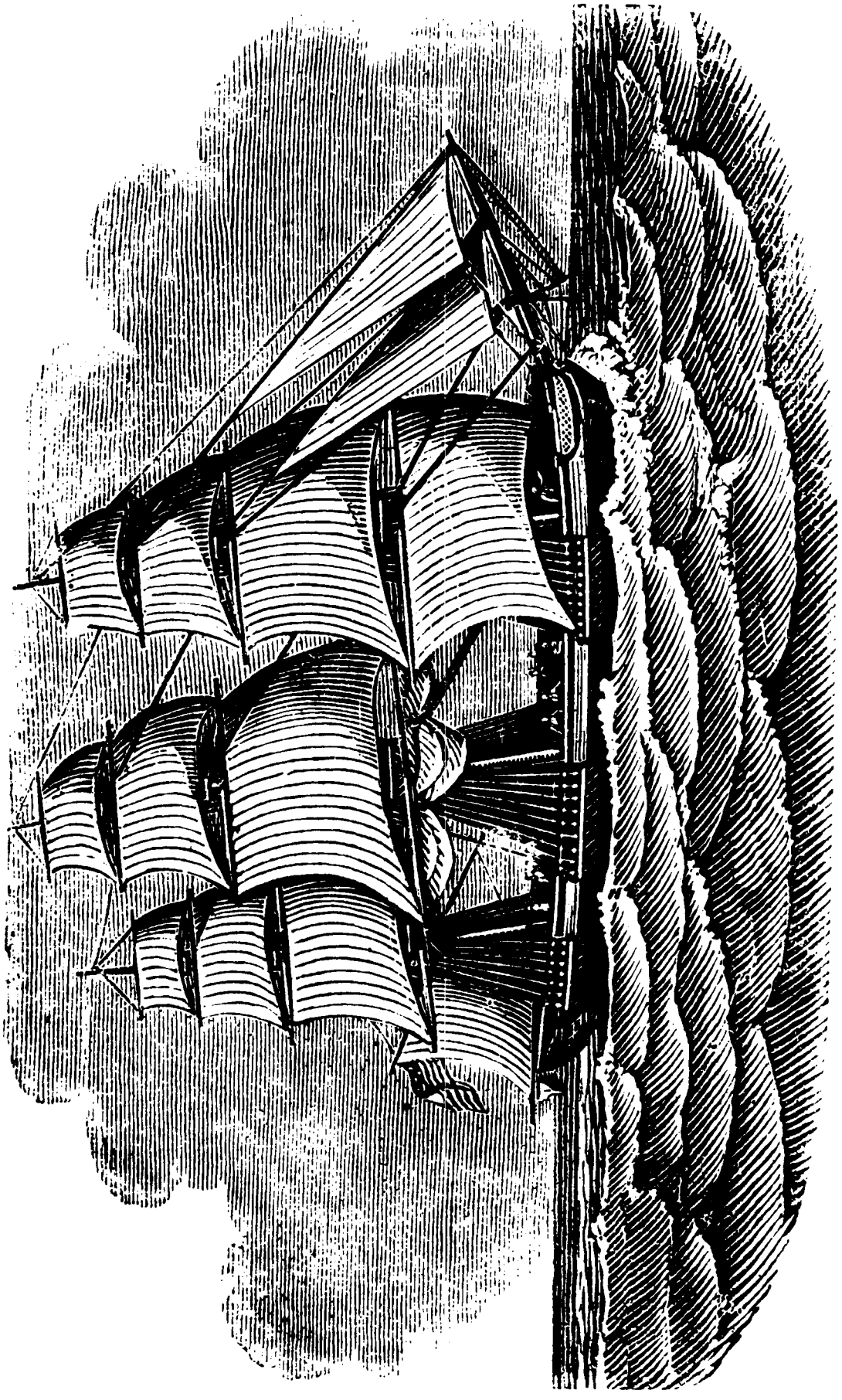
A short story or song describing the scene.

Answer--

The questions.

Write--

A song that would be sung on or about a vessel today. Some vessels that you might want to write a song about are: tug-boat, supertanker, cargo ship, ferryboat, tankers and cruise ship.



SEA CHANTEYS AND THE SAILING SHIPS

Imagine you are on a sailing ship in the 19th century. Today is sailing day! Sailing day for a famous ship is always a gala affair. All great ships had their fans who followed their careers, cheered their speedy passages, and often welcomed them home. Sailing day attracted the largest crowds. The sailors want to make the most of the moment.

As the tide prepares to ebb, the order is passed forward and the chief officer goes into action and snaps out his order to raise the anchor. The Chanteyman begins the Chantey and you sing the chorus as you pull up the anchor to the chant.

Pretend you are pulling up an anchor by performing the actual motions. The final word in the chorus is the signal to pull back on the rope.

Chief Officer: "Now, men and sogers both, heave away at the windlass. You, chanteyman, give us 'Rye-O!' and raise the decks, aye, raise the very dead. Heave and a-way!"

Chanteyman: Oh, say were you ever in the Rio Grande,
Crew: Oh you Rio,
Chanteyman: It's there that the river runs down the golden sand,
Crew: And we're bound for the Rio Grande.
Chorus: So away love away,
Oh you Rio,
Sing fare well, my pretty young girl,
And we're bound for the Rio Grande.
Chanteyman: Now New York town is no place for me,
Crew: Oh you Rio,
Chanteyman: I'll pack up my trunk and I'll go off to sea,
Crew: And we're bound for the Rio Grande.
Chanteyman: Now all you beachcombers we'll have you to know,
Crew: Oh you Rio,
Chanteyman: We're bound for the Southard and glad for to go,
Crew: And we're bound for the Rio Grande.
Chanteyman: So it's put down your bag and get it unpacked,
Crew: Oh you Rio,
Chanteyman: The sooner we leave, the quicker we're back,
Crew: And we're bound for the Rio Grande.
Chanteyman: The anchor is weighed and the gear all made fast,
Crew: Oh you Rio,
Chanteyman: And the boys give a cheer when the harbor is passed,
Crew: And we're bound for the Rio Grande.

This favorite capstan chantey was used mainly in raising the anchor on outbound trips. It does not refer to the Rio Grande River but to the Brazilian port of the same name. Whether bound for that port or not, a chanteyman would strike up this rollicking song on leaving port, as much to entertain the girls and men on the crowded docks as to facilitate heaving up the anchor.

Once the anchor is raised, the chief mate turns to the quarter-deck, and receiving his orders from the captain, cries out.

Chief mate: "Lay aloft there, ye walkin' corpses, and loose all sails!"

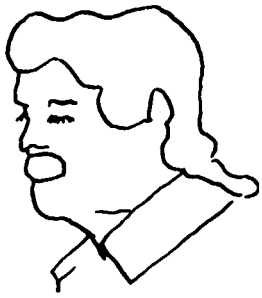
The second and third mates, the bosun and bosun's mate rush to their stations, repeating orders and checking the progress of the work. The foremost sail is the first to break out white, followed quickly and in order by the main and mizzen masts. Other chanteys break out. From the shore comes another great cheer that puts even more heart and brawn into the crew. The ship moves and a new voyage has begun.

Roll the Cotton Down

(This chantey probably originated from one of the southern cotton ports and was used in hoisting the main sails.)

Pretend you are pulling up the main sail by performing the actual motions.

Chanteyman: Away down south where I was born,
Crew: And roll the cotton down,
Chanteyman: I used to work from night till morn,
Crew: And roll the cotton down.
Chanteyman: I thought I'd go and climb the lines,
Crew: And roll the cotton down,
Chanteyman: And for the sailors sun shall shine,
Crew: And roll the cotton down,
Chanteyman: A dime a day is the black man's pay,
Crew: And roll the cotton down,
Chanteyman: A white man's pay is a dollar a day,
Crew: And roll the cotton down.
Chanteyman: I served my time in the Black Ball line,
Crew: And roll the cotton down,
Chanteyman: It was the there I wasted all my prime,
Crew: And roll the cotton down.
Chanteyman: On the Black Ball line is for me the line,
Crew: And roll the cotton down,



Chanteyman: That's when you'll fly the number nine,
Crew: And roll the cotton down.
Chanteyman: And to Henry Clay I went one day,
Crew: And roll the cotton down,
Chanteyman: And for Liverpool town we sailed away,
Crew: And roll the cotton down.

Imagine you have a few free moments to reflect on your life as a sailor. You would probably sing a non-work song or foc'sle song. It is named for the area of the ship where it was usually sung.

The three elements found most frequently in sea songs, complaints about the hard life at sea as compared to an easier life on shore; a description of actual work onboard ship; and some mention of the girl left behind, are found in this song.

Haul Boys Haul

Chorus:
Haul, Boys, Haul, haul, boys haul,
Heave away the capstan, lads, and let's get up the trawl,
When the wind is gently blowing and the ship is gently rolling,
When the wind is gently blowing and the ship is gently rolling,
My Hannah, my Hannah, won't you be true to me.

Oh, once I was a schoolboy and I lived at home in ease,
But now I am a traveling lad to plow the raging seas;
I thought I'd like seafaring life, 'twas all right till I found
"Twas a damn sight worse than slavery when you got on the ground.

For every night in winter, as regular as the clock,
You put on your sou'wester and likewise your oilskin frock,
And go up to the capstan, lads, and ever heave away,
For that's the cry in the middle of the night as well as in the day.

All your sailing days are not pleasant. Imagine what it would be like to work on the deck with the sails during a severe storm. Write a short story describing the scene or write a song about it.

1. Why were chanteys an important part of sailing the square rigged sailing ships?

2. Why do the chanteys differ in length and rhythm?

3. Why don't the work chanteys have a very fast tempo?

4. What feeling do the chanteys give?

5. Do you sing or listen to songs? When do you do this?

6. Why do you sing or listen to songs?

7. Why aren't chanteys a part of ship life today?

8. How have the ships and the life of the sailor changed? What caused this change?

9. What would a chantey written today on a supership say?

TOPIC FOURTEEN--TRANSPORTATION
SHIPPING TODAY

Look at--

Sketch of the Supership

Read--

The Superships

Answer--

The questions

Look at--

Waterways of the United States

Discuss--

What portion (area and population) of the United States can be reached by water.

Determine--

How products from inland states would reach a port to be shipped overseas.

Read--

Tugs, Barges and the Gulf's Waterway

Look at--

Trend in Barge and Tow Sizes Chart

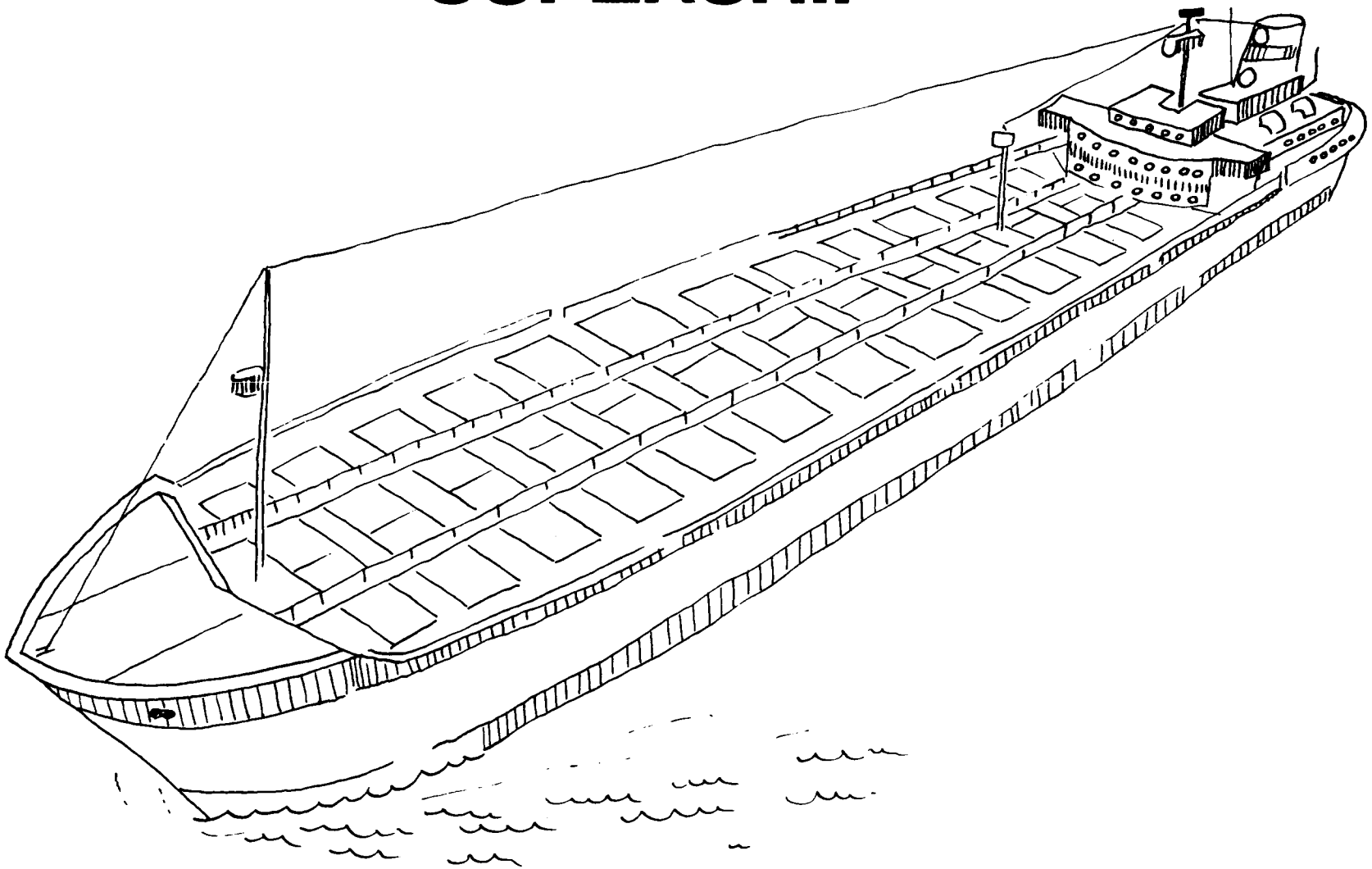
Answer--

The questions

Complete--

The My Opinion Activity

SUPERSHIP



THE SUPERSHIPS

Meet Capt. Petro, he is the captain of a supertanker. He will tell you about his supership.

Today supertankers like mine which have a deadweight of 500,000 tons are common. This was not always true. The first ocean-going oil tanker, the Gluckauf, was built 100 years ago. The first full cargo of oil was transported from Philadelphia to London. That ship could hardly be called a "tanker." However, it started the transportation of oil which today dominates modern commerce due to both the size and importance of tankers.

During World War II, the largest tanker had a deadweight of 18,000 DWT (deadweight tons). Superships are almost a quarter of a mile long with bridges 100 feet above the surface of the water. Today there are hundreds; by the turn of the century there will be thousands.

My supertanker requires more than three miles to stop; therefore, new navigation equipment and skills are needed. Our tankers account for half of all tonnage afloat. One million DWT tankers are being planned.

Sailors don't look at these depersonalized vessels as ships. They are called VLCC's or Very Large Crude Carriers. Our supertankers are too expensive to remain still so we spend less than 10 percent of the time in port.

Ports are another problem. Few ports can handle our superships. Today the United States is only planning a superport, so we have to unload our cargo onto smaller vessels to carry it into port. Foreign countries, however, have ports that can handle our superships. Where natural harbor and channel depths are not available at these foreign ports, they have constructed transfer channels in deep water miles offshore. These foreign countries believe that the port which can handle these ships will get the bulk cargo business of the future. Numerous foreign nations dealing in the iron ore, coal and crude oil have readied or are developing ports to receive our ships. The United States ports severely limit tanker size to under 100,000 DWT.

Transport savings of large tankers and bulk carriers have been long since proven. Many people are opposed to the supertankers because of their large size or because they also represent a tremendous threat to the environment.

In a detailed study of the recent ship accidents that involved pollution almost all were due to poor seamanship and

human error. A very large number of these mistakes are made by ships flying one of the flags of convenience. These are ships owned by United States interests, flying a foreign flag and manned by a foreign crew.

According to the law, American flag ships must be built in the United States and three-fourths of the crew must be Americans. American shipbuilding costs and seamen's wages are still higher than others, so American users of the flags of convenience argue that they use them because it is cheaper.

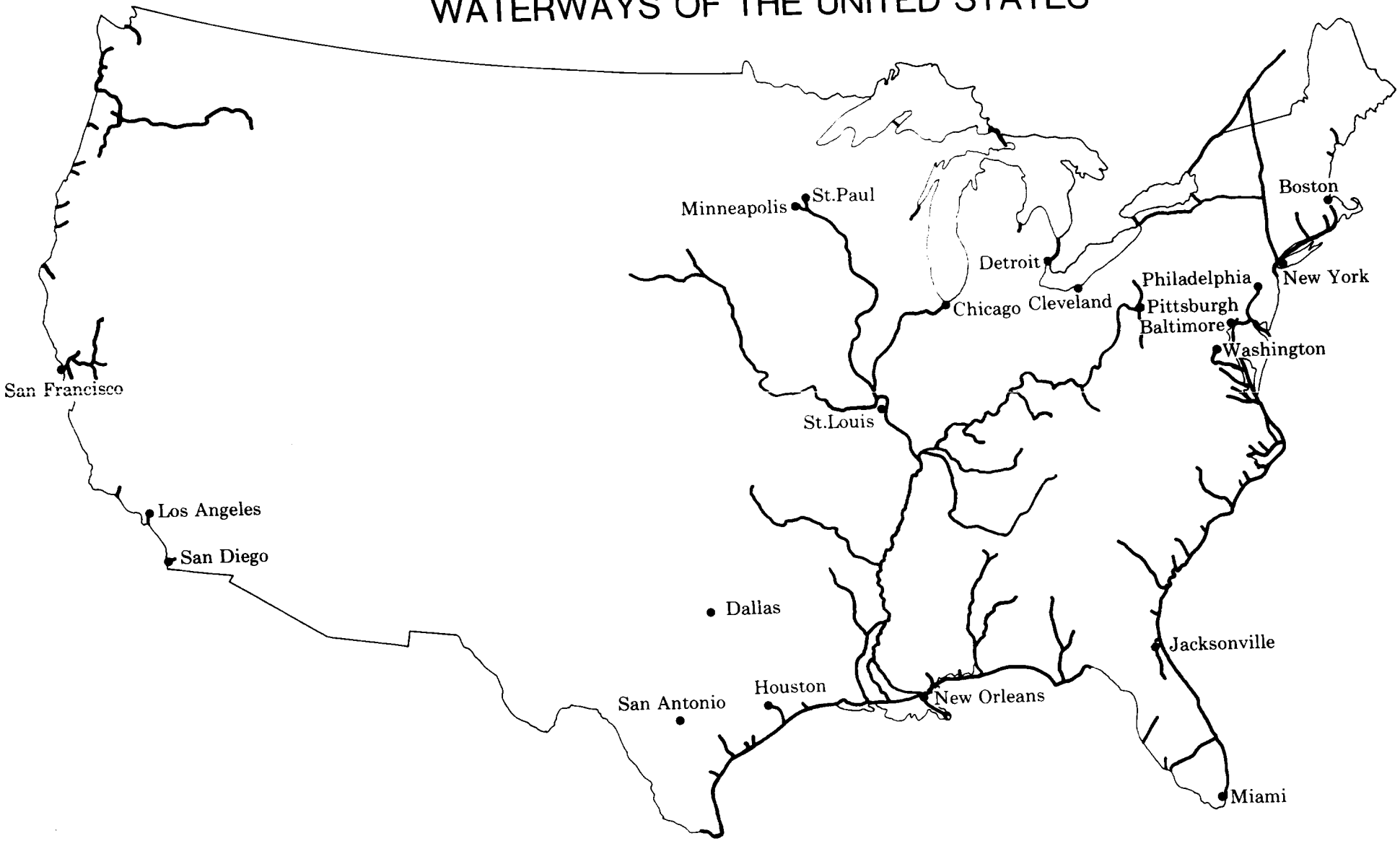
These new supertankers under the flags of convenience have the newest equipment. Too often its crew does not know how to use the equipment or repair it, however. Superships are not built to last. As they get older, they begin to break down and become too expensive to repair. We need to have some international sea standards to protect us and the environment.

1. Under the present construction prices, it would take over $20 million to build a tanker of 50,000 DWT and over $71 million to build a tanker of 400,000 DWT. The larger the tanker, the more expensive it is to build. Why build a supertanker?

2. How many 50,000 DWT (deadweight tons) class ships do you need to transport a cargo of 400,000 tons?

3. What will have to be done to Texas ports before supertankers can use them?

WATERWAYS OF THE UNITED STATES



TUGS, BARGES AND THE GULF'S WATERWAY

Meet Capt. Tug, he is the Captain of a tugboat on the Gulf Intracoastal Waterway. He will tell you about transportation on his waterway.

My waterway is a work route. It stretches almost 1,200 miles from the Florida panhandle to the Mexican border. It extends 426 miles along the entire coast of Texas. Actually the waterway is a string of bays, natural channels and man-made canals. The waterway provides our barges, tugs and other small craft a protected passageway. The channel is at least 12 feet deep and 125 feet wide.

When the project really got started in the early 1900's, they hoped the traffic would grow to 5 million tons a year. They were wrong. Today it is more like 100 million tons and still growing. In fact, each year the Gulf Intracoastal Waterway more than pays for its total construction and maintenance through its transportation saving If the shipper had to use a more expensive form of transportation, he would have to charge his customers more. Railroads say that barg are unfair competition. They are leading a fight to have us pay a "user fee." The use of waterways has always been free.

Petroleum and petroleum products account for most of the traffic. A fourth of the cargo is crude oil pumped from the fields on the Texas and Louisiana coasts and from offshore wells. This makes the passage from New Orleans to Houston the busiest section. Pleasure boaters and fishermen also used the waterway for shelter and easy access to the Gulf.

A tugboat is small but powerful. It can push or pull any big ship into a dock. Tugboats not only work in the harbors but many like mine push long strings of barges along the waterway. This method is very economical since individual barges can be disconnected and dropped off at various ports. Tugs and barges have a very shallow draft, making them suitable for the waterway and many areas that larger ships can't enter.

The new LASH (standing for "lighter aboard ship") and Seabee will improve cargo handling tremendously. They are special barges that are carried on board ship. They will permit loading 12 times as muc per hour with less than half the people. Cargo damage and theft als will be reduced with the sealed barges.

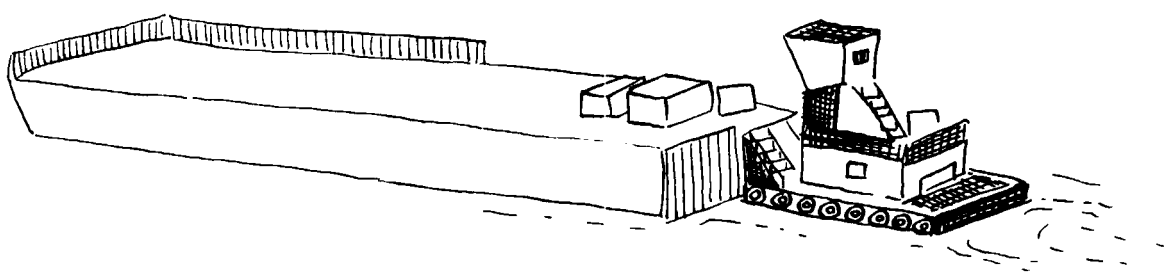
Here is how it works. You have 25,000 tons of Texas soybeans that must be moved to Cologne, West Germany. The

soybeans are loaded onto LASH barges at Corpus Christi. A tugboat moves the barges along the waterway to Houston or New Orleans. They are lifted on the mother ship, which goes to Rotterdam. There the LASH barges are unloaded. A tug then moves them up the Rhine River to Cologne where the soybeans are scooped out.

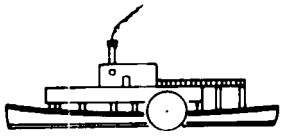
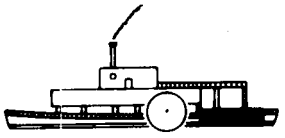
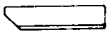
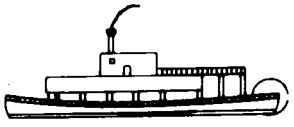
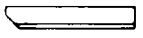
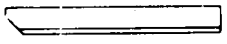
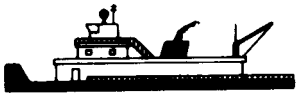
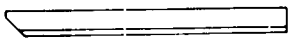
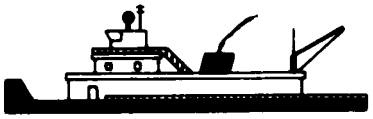
Life on our 50-foot tug is self-contained. We work in two shifts. While one is working, the other sleeps in the small cabins below the deck. Our lives seldom touch the land which is only several feet away.

We see lots of water fowl, deer, muskrats, nutrias, otters, alligators, and snakes. You have to watch where you walk since sometimes a water moccasin comes on board. The waterway cuts through the marshes of the Aransas National Wildlife Refuge. The magnificent whooping cranes are not bothered by the traffic. However, a bad spill from an oil or chemical barge could kill their food as well as that of other birds. In the past, the waterway ran outside the refuge.

Since the waterway is an economic success, it plays a vital role in industrial activities and the creation of jobs. Industry wants to make it more successful. In 1962 Congress approved enlarging the waterway between New Orleans and Houston, but nothing has happened. There are many groups to be satisfied - industry, counties, landowners, hunting and fishing clubs, environmentalists and others. Industry wants it enlarged. Landowners don't want to give up their land. Counties don't want to use tax money to move the pipelines under it since they don't get any benefits from barges moving by. Environmentalists are against enlarging it since dredging destroys the wetlands. Deepening the channel causes increased salt water, and it may also stir up harmful pollutants in the sediments. Who will win. . . the honking of geese or the growl of the tugs?



Trend in Barge and Tow Sizes

	CAPACITY (TONS)	POWER (HP)
1807 STEAMBOAT	 400 – 600	<1,000
1832 STEAMBOAT with BARGE (BOX)	 400 – 600	1,000
1910 STEEL BARGE (STREAM LINE RAKES)	 600 – 800	 1,400
1945 STANDARD HOPPER BARGE	 900	 1,800
1950 JUMBO HOPPER BARGE	 1400 – 1500	 3,200
TODAY BARGES	 > 2000	 > 7,000

1. Why are barges an efficient way to transport goods?

2. Is the use of the waterway really free?

3. Can more barges move along the waterway and leave it unspoiled?

4. How do the values of the different groups affect the waterway's future?

5. What do you think should be done about the Intracoastal waterway?

6. How has technology caused a change in the use of marine resource transportation?

7. Why is there a decrease in the use of passenger ships for transportation?

MY OPINION

A number of governmental agencies are discussing the supertankers, superports and the enlarging of the Gulf Intracoastal Waterway. Pretend you're writing to one of them with your own ideas of what should be done.

Dear People,
I've been thinking about _____,
and I think

Thank you for considering my opinion,

Sincerely,

TOPIC FOURTEEN--TRANSPORTATION
TEXAS PORTS--PAST AND PRESENT

Read and Discuss--

Indianola
Galveston--1900
Houston--1900

Interview--

People (family, neighbors, etc.) in your community to see if they came to Texas through a port and which one.

Report--

To the class on your findings.

Read and Discuss--

Texas Ports Today
- The Sabine and Neches Ports
- Brownsville
- Corpus Christi
- Galveston
- Houston
- Other Texas Ports

Look at--

Distribution of Goods Shipped from the Texas Coastal Zone

Use--

A Texas Highway Map and Texas Almanac to complete the Locate and Answer activity.

INDIANOLA

Prince Karl zu Solms--Braunfels was named the commissioner general for a projected colony of German settlers in 1844. In July 1844, he landed in Galveston but could find no land on which to place them. He went in search of a more desirable place for receiving the future shiploads of settlers. He decided that Indian Point (later named Indianola) had water deep enough to permit sailing vessels to anchor. So in December 1844, the first wave of German settlers bound for New Braunfels arrived. Some Germans despaired of ever reaching New Braunfels and bought land and settled there. Indianola was born from a tent camp of immigrants.

Indianola grew from an immigrant camp to a cosmopolitan port city. It was second only to Galveston in size, and it was a threat to Galveston's commercial and maritime supremacy. Indianola wielded a vast influence on the development of all Texas land west of the Colorado River. It was the port for trade with the Chihuahuan area of Mexico and for the shortest overland route to California. Tens of thousands of immigrants from Germany, Switzerland, France, other parts of Europe and from the scuthern and eastern United States landed there before heading to the new lands of the west. Through Indianola's wharves moved the recessities and luxuries for life for the inhabitants of Western Texas as well as guns, ammunition and other supplies for the chain of forts that protected Texas from Indian tribes. Scores of towns in western Texas were born from immigrants landing in Indianola and supplies from her continued to nourish them. Indianola was the mother of western Texas.

Streets in the lower part of town were crowded with wagons and carts waiting their turn at the warehouses and wharves. Wagon trains brought in raw materials from northern Mexico and western Texas for export and left with finished lumber, foodstuffs and manufactured goods. Cattle for export came in by train.

Dry goods, grocery, hardware and jewelry stores carried enormous stocks from which selection could be made on a wholesale as well as a retail basis. There were wholesale and retail dealers in liquors, wines, beers and brandies for supplying saloons and liquor merchants in western Texas. One could purchase washing machines, sewing machines, Steinway and Chickering pianos, custom made clothes, boots, shoes, etc. All stores had free delivery for local purchases,even ice.

Theatrical companies landed here to begin their tours in western Texas. Each hotel had its own dining room for guests and residents of the city. There were several photographic studios. There was a saloon for ice cream lovers and iced "soda water" in several flavors, and hard candies were made in the local factory. There

were billiard rooms, a gymnasium, several theaters and local baseball teams which traveled to play teams in Corpus Christi, Victoria, etc.

In its quarter century existence Indianola saw the arrival of steam propelled ships, railroads from the interior, gas lighting, packing of fresh meat in tins, mechanical refrigeration and the telegraph. The death of Indianola--the mother of western Texas--was due to two "once-in-a-century" type hurricanes in eleven years (1875 and 1886). The entire region sank into a paralyzed economic state and recovery did not occur for more than 50 years.

GALVESTON
1900

Galveston was the largest port in Texas and the third largest in the United States in exporting grain. It exported nearly 25 million tons of wheat and corn annually for Liverpool and other European ports. Great coal-burning cargo ships, square-rigged sailing ships, and coastal schooners kept the miles of wharves filled. An average of 1200 ships entered the port. They exported nearly 70 percent of the nation's cotton and grain, flour, breadstuffs, zinc, ore, sawed lumber, cottonseed oil, beef, hogs, and dairy products brought in by railroads, etc. The ships brought in cane beet sugar, jutt butts, sisal, cement, coffee and chemicals.

There were three large storage elevators filled with almost four million bushels of grain by the docks. The sheds along the waterfront were packed with thousands of bales of new cotton. Smoke poured from the tall chimneys of the city's manufacturing plants: there was a five-story brewery, cotton mill, rope and twine factory, the Texas Star Flour and Rice Mills, cottonseed oil processing plant, baggage and cordage works and Clarkel Courts, one of the largest printing and stationery firms. The Galveston City Cotton Mill manufactured more textiles than any plant in Texas. There were sixty other industries of varying sizes. These ranged from cotton compresses to a hat and shoe factory.

Galveston was neatly laid out with geometric precision. Great mansions lined Broadway with oleander, oak and palm trees. The city offered six public squares, two parks, crushed-shell paved streets, three concert halls, an opera house, twenty hotels and electric streetcars. The economy was good with more than thirty stock companies backed with large capital. Crime was rare in Galveston. At night people would walk down the promenades to take advantage of the Gulf's cooling breezes. Galveston was a beautiful city. Most of the 37,789 people who lived in Galveston claimed they lived in the finest city in the state and even the entire Gulf coast.

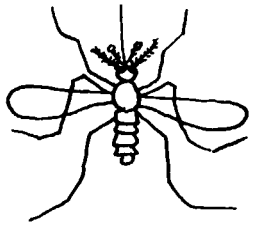
HOUSTON
1900

Houston, fifty miles inland from Galveston, was a brawling, hard-luck town sited between swampy bayous and an unpromising prairie to the north. Houston was unplanned and ugly. Also no sensible person wandered out on Houston's humid streets after dark; its reputation for violence was unmatched anywhere in Texas. There were very few days when a brawl in some saloon did not end in gunfire and death.

Houston was founded in 1836 by two brothers from New York who lured immigrants from the East with extravagant newspaper ads. The immigrants came to Houston by wagon train, oxcart, on horse-back and aboard flat-bottomed canoe like boats. After traveling through the mosquito-infested, root-tangled bayous, they found themselves in an oppressive climate where constant warfare was waged with mud, yellow fever and alligators. Many moved on, but others stayed, seeing promise that Houston could one day become d, a thriving port since Buffalo Bayou led into the bay and then the Gulf of Mexico.

Promoters envisioned Houston as the state's future "great interior commercial emporium." The main street was to run to the head of the navigable Buffalo Bayou but only shallow-draft paddle-wheelers and barges were able to take advantage of pickup and delivery of goods in the heart of town. Attempts to dredge a channel to the sea were a failure. Deep-draft, seagoing ships could not approach Houston directly. Galveston was getting the bulk of the ocean commerce that Houston somehow believed was rightfully hers.

Interior trade depended upon seven-teamed oxen struggling with heavy wagons up dirt roads. These roads turned into bogs when it rained which was frequently. The merchandise was stranded, perishables were ruined and schedules were not kept. Railroads were needed and came, but only after a series of financial disasters. Houston also had recurring floods that swamped the town. Casualties were high from a whole series of epidemics, mainly yellow fever carried by the millions of mosquitos swarming in the bayous. Houston as "Port of Houston" became a statewide joke.



TEXAS PORTS TODAY

Today there are fourteen deep water ports located along the Texas coastline: Beaumont, Brownsville, Corpus Christi, Port Isabel, Port Mansfield, Sabine Pass, Texas City and Port Lavaca-Point Comfort. The Port of Houston is the largest inland port in the nation and the third largest port in the United States. The Port of Corpus Christi is the ninth largest in the nation. Another Gulf port, New Orleans, is the second largest in the nation. Over 250 million tons of cargo pass through the Texas ports and over 65 million tons are transported on the Gulf Intracoastal Waterway. These figures will probably continue to increase with economic growth since water transportation is cheaper than other forms.

Every major Texas port is the location point for petroleum refineries, bulk terminals and petrochemical plants. Most of the major Texas ports are characterized by substantial private investments in port facilities located near those owned and operated by port authorities or navigation districts of the local communities. This relatively independent structure sets Texas apart from other Gulf coast areas where state governments own and operate port facilities.

THE SABINE AND NECHES PORTS
BEAUMONT, ORANGE, PORT ARTHUR, SABINE PASS

The Port of Beaumont on the Neches River was established in 1916. The port struggled through years of slow, intermittent growth and passive development. Today it is third in Texas ports in overall tonnage. In 1975 it shipped 30.5 million tons of cargo. Port Arthur was fourth, shipping 26.5 million tons, while Sabine Pass had a tonnage of 513,000. The Port of Orange, located on the Sabine River 42 miles from the Gulf, was constructed in 1918. In 1975, its tonnage was over 912,000 tons.

BROWNSVILLE

The Port of Brownsville (1936) like all other Texas ports is man-made to some degree. It is located three miles north of the Rio Grande River and the Mexican border. The port is connected with the Gulf of Mexico by a seventeen-mile long ship channel with an entrance to the Gulf of Mexico at Brazos-Santiago Pass. It is the southern end of the Gulf Intracoastal Waterway. Its location makes it unique. Its area extends across south Texas, New Mexico, and other western states. More importantly, it reaches deep into Mexico. It is actually closer to Monterrey and Saltillo, the

industrial and agricultural centers of northern Mexico, than are the Mexican ports. As a result, Port Brownsville has not only benefited South Texas but northern Mexico. It has been an important cotton handling port and has ranked first in shrimp in the United States. This is largely due to the large fishing fleet in Brownsville and Port Isabel and the frozen shrimp from Mexico.

CORPUS CHRISTI

Corpus Christi, the second largest Texas port (41.2 million tons in 1975) and the ninth largest in the nation, opened as a deep-water port in 1926. The Port of Corpus Christi is located on Corpus Christi Bay, 21 miles inland from the Gulf. Its location is ideal since it is flanked by one of Texas' most productive agricultural regions for grain sorghum, cotton and livestock. Over 260 oil fields are found within 100 miles, so it is also a center for petroleum and petrochemical production and manufacturing. Its mild climate attracts many visitors, making it a major resort area for fishing and water sports as well as the gateway to Padre Island National Seashore.

GALVESTON

The earliest movement of traffic through the Port of Galveston was in 1832. The island had lost its position as the greatest seaport of Texas partly because of shortsighted leaders who had followed a policy of profit-taking and conservative expansion in the face of a growing trade in the past. Also being an island, its expansion was limited. In 1975, it handled almost 6 million tons including wheat, dry sulphur, sorghum, grains, cotton, rice, and petroleum. In keeping with the new concept of containerization and unitization of cargo for shipping Galveston has the facilities to handle containers. The port will also handle barges in much the same way containers are handled. The barges are usually 62 feet in length, 33 feet in width and will hold up to 450 tons of cargo. These require the use of 500-ton cranes for loading.

HOUSTON

The port of Houston is the third largest United States seaport and ranks second in tonnage and value of foreign trade. It was opened to deep-sea traffic in 1915 after the dredging of Galveston Bay and the bayou. In 1974 it shipped 89.1 million tons of cargo. More than 100 steamship lines offer regular services between the Port of Houston and some 250 ports of the world. Every year more then 4,000 ships call at Houston and there are more than

100 wharves in operation, including private terminals of the large industrial complex that lines both sides of the channel for some 20 miles. It is also the center of multicounty petrochemical developments that are the world's largest. It exports wheat, corn, sorghum grains, rice, basic chemicals, fertilizers, machinery, petrochemical products, etc. The early planners were correct in envisioning Houston as the state's future "great interior commercial emporium." It is no longer a joke or a wound to civic pride but rather is the pride of the United States.

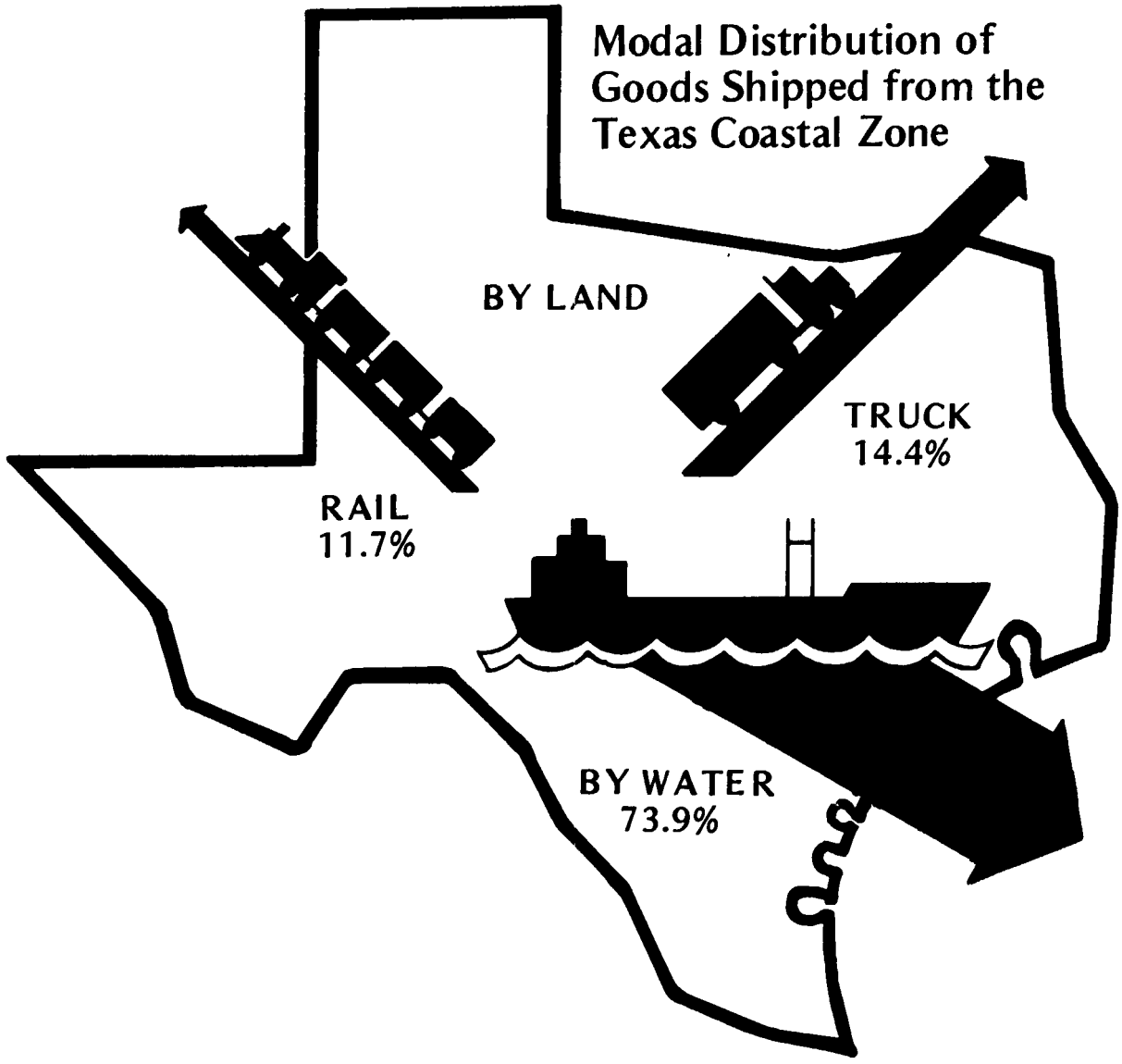
OTHER TEXAS PORTS

Texas City in Galveston Bay handled a tonnage of 23.9 million tons in 1975, making it the fifth largest Texas port. Its shipping is related to the petrochemical industry

Freeport, with a tonnage of 8.2 million, is part of a community of nine cities which have the world's largest basic chemical complex. Its exports include basic chemicals and rice. It is also the location of shrimp and other commercial fishing.

There are additional ports along the Gulf Intracoastal Waterway, and associated ship building and repair activities. These include the construction of tugs, towboats, barges, tankers, regular cargo ships, oceanographic research vessels, mobile oil drilling units, shrimp trawlers, and various types of pleasure crafts.

Although hurricanes have hit the ports at one time or another, they generally have been rebuilt on a larger scale. Even today the ports continue to grow and expand. In the future there may even be a superport.



Few Texans realize the importance of water transportation to the Coastal Zone and to Texas. Over 120 million tons of goods are shipped by water from Texas ports each year. This represents almost 75% of all goods shipped from the State as a whole.

LOCATE AND ANSWER

Use a Texas map (Texas Highway Department maps are excellent) and the Texas Almanac to complete the following.

1. Find Indianola. On what bay is it located and near what present day cities.

2. The first German settlers who landed at Indianola traveled to New Braunfels to settle. Locate New Braunfels. How far was New Braunfels from Indianola?

3. Use the Texas Almanac, Index of the map and a Texas history book to list the forts located in western Texas which Indianola served. Also locate these forts on the map.

4. Indianola was the port closest to Mexico in the past. Which present day Texas ports are closer to Mexico than Indianola was?

5. Locate Houston and Galveston on the map. Use the Houston-Galveston area inset to determine the path of a ship to reach downtown Houston.

6. Why was Galveston the leading Texas port in the past?

7. Divide a sheet of paper into 5 columns. The columns will be as follows:

   Name of major deep-water port
   Location (on river, top of bay, on the Gulf, etc.)
   Neighboring inland area it serves
   Major items shipped (use the Texas Almanac to help answer)
   Rank of port (based on total tonnage)

8. Where are the four larger ports today located? How does this compare to the large ports of the past?

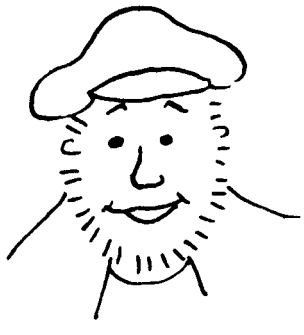
9. Name and locate some of the other Texas ports (other than

the fourteen major ones). Use the map and the Texas Almanac.

10. Locate the Gulf Intracoastal Waterway. Follow it from Port Arthur to Brownsville.

11. Where is much of the crude oil which this nation imports shipped to be refined? Why?

12. What areas could become ports of the future? Explain.



TOPIC FOURTEEN--TRANSPORTATION
SUPERPORTS AND THE FUTURE

Read--

Prospect for a Superport.

Look at--

Sketches of possible future ports.

List--

The advantages and disadvantages of a superport facility offshore in the Gulf of Mexico.

Read--

The Future.

Obtain--

A Texas Highway Map.

Use--

Map to complete Texas' Future Water Highways.

Answer--

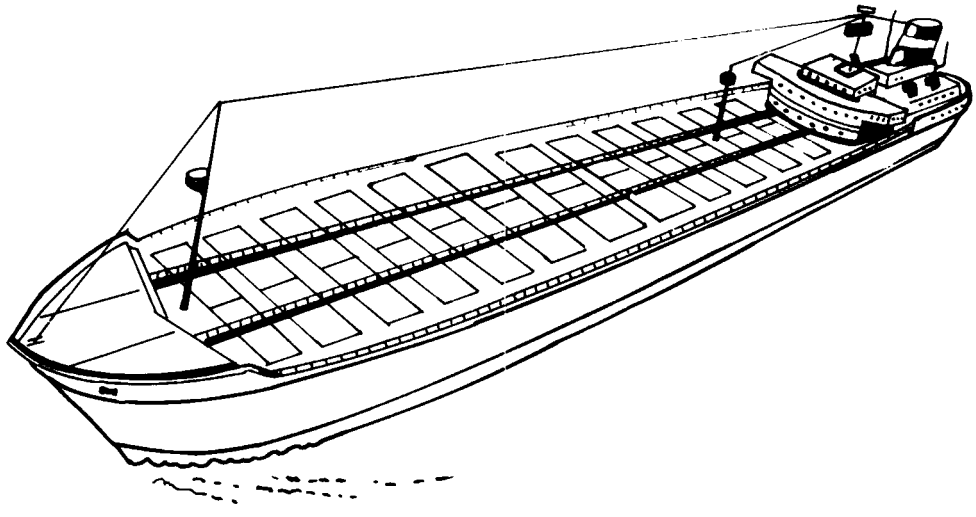
The questions.

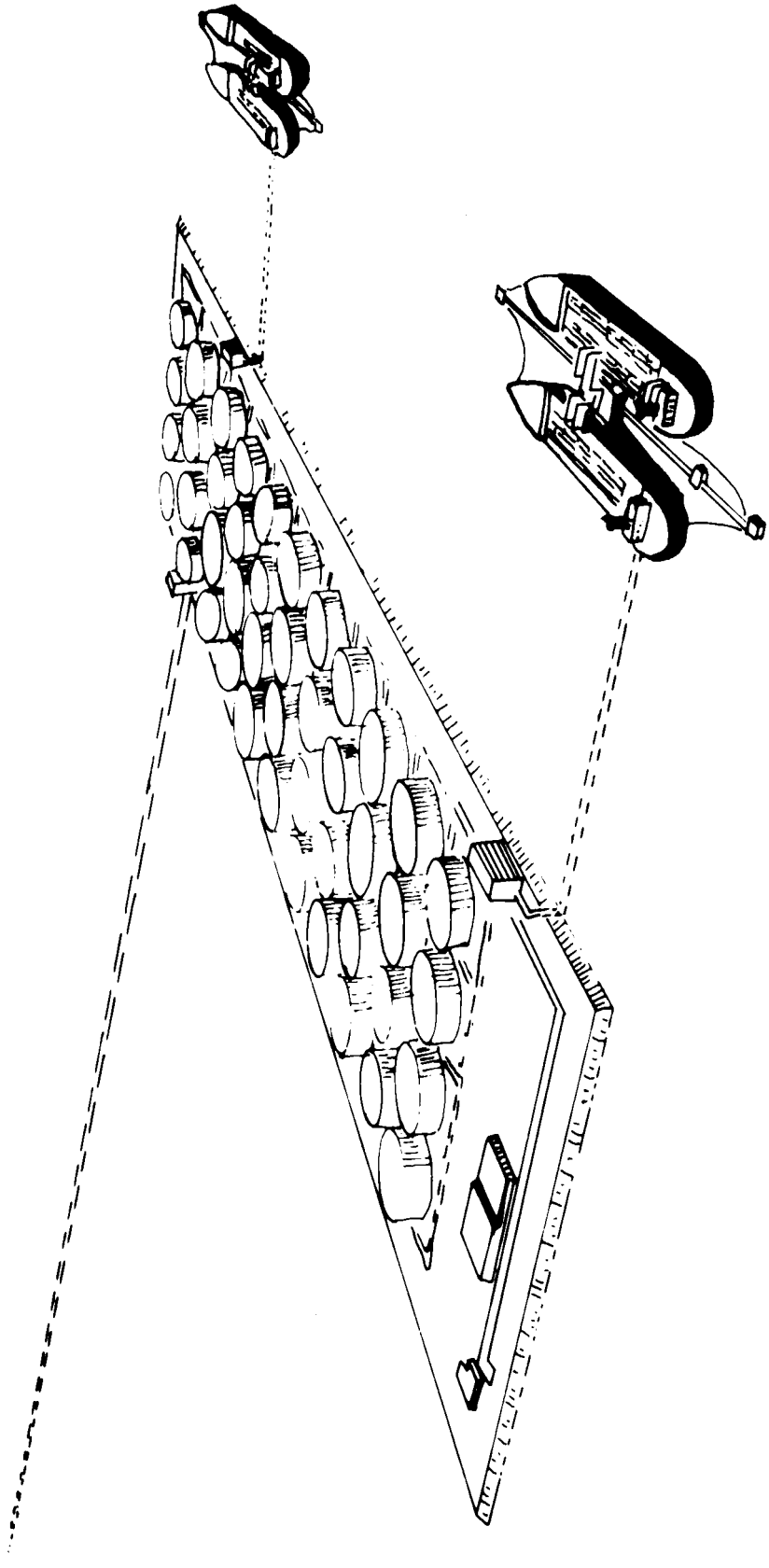
PROSPECT FOR A SUPERPORT

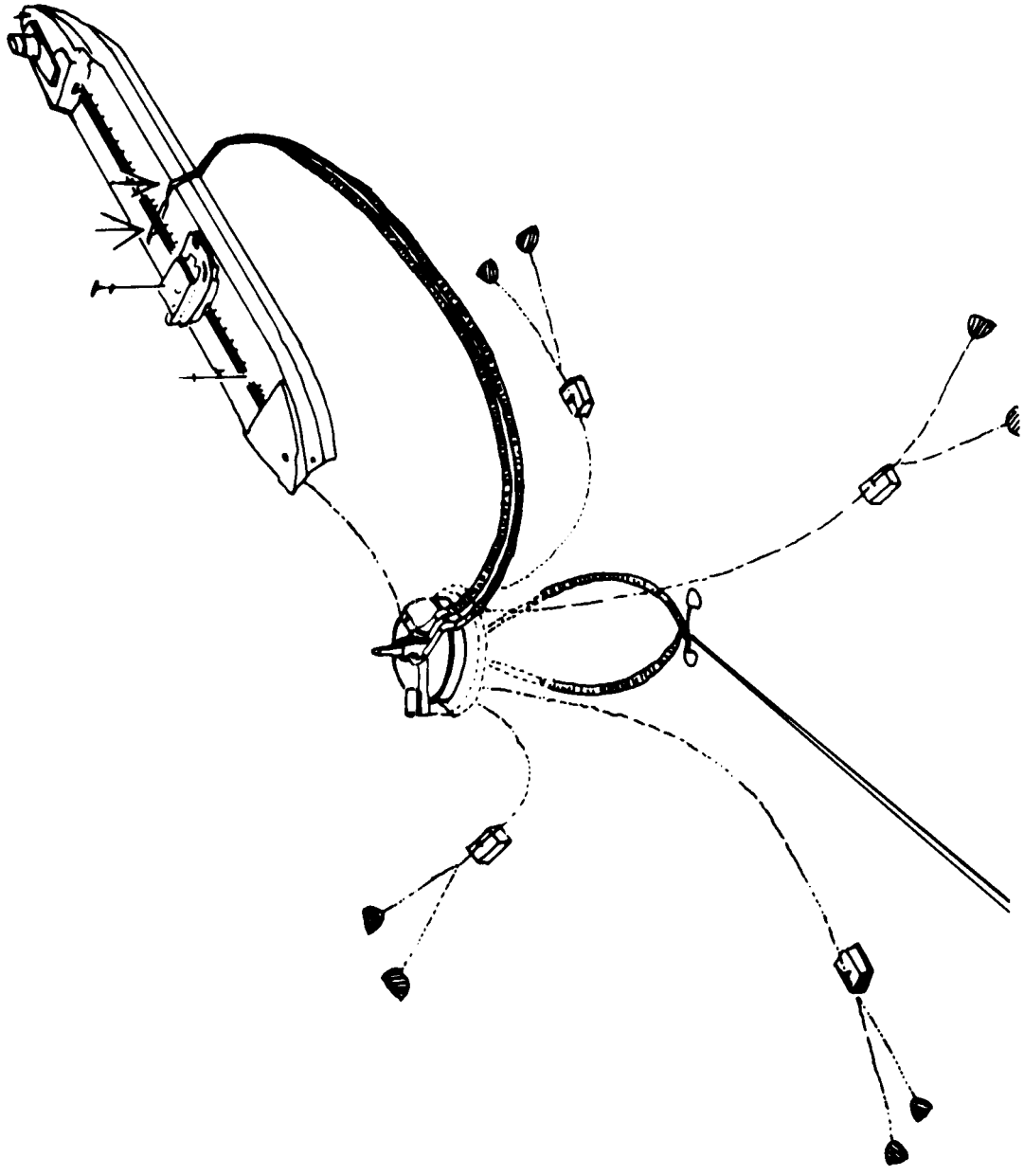
There is considerable discussion and agitation over the prospect of a superport off the Texas coast. With the need for increasing supplies of petroleum and petroleum products, we will have to import vast amounts of foreign oil. To supply these needs for oil, we will need the supertankers which require ports with depths up to 100 feet.

There are many questions to be answered. Can channels for supertankers be safely dredged? How will the channel affect the marine life? How will it affect the lives of the people in the area? What will be the economic, social, environmental and international implications of a superport?

There are alternatives to developing a port. Offshore ports can be constructed so there will be no need to dredge channels. A buoy-mooring facility is one possibility. See the drawing. The supertanker attaches to hoses of a mooring buoy, and underwater pipelines from the buoy would carry the oil to storage tanks on shore. This buoy would be located several miles out into the Gulf where the depth is great enough for the superships. Another possibility is to build an artificial island with oil storage tanks at a point in the Gulf deep enough for supertankers. This oil is then piped to the refineries on shore as it is needed.







THE FUTURE

Vessels

Hydrofoil crafts travel the bays, lagoons, major rivers and streams and the Gulf, skimming the surface of the water and requiring a depth of only 3 feet. They can travel up to speeds of 50-75 miles an hour and carry passengers and cargo up and down the major streams. With the decrease in petroleum and the high cost of gas and oil, trucks, buses and cars have become too expensive. Waterways again have become a resource for transportation.

Also in the bays, lagoons and in the Gulf are SES (Surface effect ships) ships. These several hundred ton vessels reach speeds of up to 100 miles per hour as they skim on a bubble of air trapped between their hulls and the flexible "skirts" at each end. They ride smoothly over 2-4 foot waves. Long-range SES ships are being developed to carry high grade cargo on trans-ocean routes.

There are large submerged or semisubmerged vessels, particularly tankers. A ship operating below the surface of the sea does not produce surface waves; therefore, it can be propelled at high speeds with less power than a surface ship and it is not affected by the weather conditions.

Advanced Technology

Most cargos are shipped in a container system which reduces cargo handling by 60 to 80 percent. The developments in remote control and in monitoring equipment have led to machinery plants on ships which need only a crew for maintenance and minor adjustments. This development of unmanned power plants and sophisticated navigation equipment has led to ships which travel between ports almost without a crew. They have only a small emergency crew. Others board the ship on arrival to take it into port.

We all realize that wind power was the major energy for ocean transportation until the invention of the steam engine. If energy costs continue to rise, nuclear energy may be used for the superships. A hybrid form of sail and fossil fuel may once again be the most economic form of ocean transportation.

TEXAS' FUTURE WATER HIGHWAYS

Obtain a Texas Highway map.

Trace all the rivers with a blue magic marker. Underline each city of a population of over 20,000 that is on a river or bay, lagoon or intracoastal waterway with a red magic marker. Or use the Texas Almanac listing of the populations of over 20,000 on the map and underline with a red pen those which are located on a bay, lagoon, river or waterway or within a couple of miles of one.

1. What proportion of the state would hydrofoil craft or SES be able to reach? Could this be a feasible means of future transportation?

2. What problems would have to be overcome for this type of transportation to develop?

3. Would people be willing to give up travel by automobile for travel by hydrofoil vessels? Explain.

4. What is the social impact of technological change in transportation? How can we solve the problem of how to cope with the social impact of technology?

5. In the 19th and 20th centuries, the ocean was and is used as a domain for military power. Two world wars have been fought on it. Some do not regard military use as a resource. What do you think?

TOPIC FIFTEEN
MARINE ENERGY RESOURCES

ACTIVITY ONE--Oil!
ACTIVITY TWO--Pollution Free Energy

Materials for Classroom Use:

- My Energy Position/Activity
- Here and Now With Energy/Activity
- Oil Production/Reading
- Exploration Rigs/Drawing
- Offshore Platform/Drawing
- The Search for Oil/Readings
  - Test Drilling for Oil
  - Drilling for Oil Production
  - Getting the Oil Ashore
  - Undersea Platform
- Letter From an Offshore Platform/Reading
- Environmental Impact of Offshore Drilling/Reading
- Oil Spill Simulation/Activity
- Pre-oil Social and Environmental Impact/Reading
- Questions
- Point/Counterpoint
- Pollution Free Energy/Readings
  - Harvest of the Wind
  - Sea Thermal Power
  - Tidal Power
  - Wave Energy
  - Windmills in the Water
  - Hydrogen to Burn
  - Energy from Earth's Depths
  - Energy of the Future--Nuclear Fusion
  - The Ocean as a Coolant
- Question
- Future Energy Headlines/Activity

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 cite examples of marine energy resources;
2.3 evaluate a marine energy resource problem man has solved and the changes that resulted and the new problems that arose.
2.5 generate a list of marine energy resources which will be important in the future;
2.6 analyze the use of marine energy resources in the past, present and projected future in view of the needs through time and in relation to the values involved;

2.6 describe how the use of the energy resources has changed and will change lifestyles;
2.6 analyze value positions in relation to marine energy resources to determine similiarities, differences and possible conflicts;
2.7 discuss the idea that marine energy resources represent "a common heritage" and belong to the entire international community;
3.1 discuss the interplay of the many facets (sociological, economic, governmental, psychological and moral) in the management and utilization of the energy sources;
3.2 describe and identify situations where technology has caused a change in the use of marine energy sources from the past to the present and projected future;
3.3 analyze which considerations are important in the utilization of marine energy sources;
3.3 identify a situation in which short term economic gains may produce long term environmental losses;
3.4 make projections about the consequences of man's use of marine energy resources;
4.1 appraise attitudes about marine energy sources;
4.2 advocate the use of less energy.

Teaching Suggestions:

The purpose of this lesson is to present the student information on the marine energy resources of the past, present and future. He should also begin to form ideas in terms of how man's actions will affect the environment and how in turn the change will affect man.

1. Have the students complete the readings and respond to the questions and/or activities. (The materials may be handed out the previous day.)

2. In the My Energy Position activity, define a "ridiculous middle" to help steer participants from that position. To share the responses in the total group, label opposite walls in a room with the extremes and ask participants to physically stand where their beliefs are. Or, draw the continuum on a chalkboard and ask participants to initial the spots that represent their beliefs. There are no correct answers for that person at that time! The students may have other students initial their place on the continuum as well as faculty members and the administration, family and neighbors.

3. The readings: Oil Production and The Search for Oil series, Letter From an Offshore Platform will give the students a general understanding of what is involved in offshore oil production. If you live in an area where there is oil production or refineries, your students can interview individuals to learn about their jobs, the problems, frustrations. humor, concerns and hopes. You might work with English and social studies

teachers to collect oral histories of the oil industry and keep them for future studies as well as using them in this topic.

4. The oil spill simulation will help give the students an idea of the difficulty of controlling it. Encourage the students to design their own simulation (with different conditions--calm sea to storm) and test different materials other than those listed.

5. Read and discuss the Pre-oil Social and Environmental Impact statement. If you live in areas with oil and gas production or refineries discuss the effect of the industry coming in and what would happen to the community if the industry closed down today. If you do not live in an area where there is oil and gas production, you might have the students look up information on such an area and project the effects.

6. In the Point/Counterpoint activity have the students draw for their position and opponent. Or you may not want to tell their opponent until it is time for their debate. Some students will draw a position to defend which they will personally not favor. If this is the case encourage them to play the devil's advocate. There are more students than positions so you will have more than one presentation on the same issue. If this is the case, the drawing for positions may be set up as follows:

Superport A/No Superport A
Superport B/No Superport B
Offshore Drilling A/No More Offshore Drilling A
Offshore Drilling B/No More Offshore Drilling B
and etc.

Some of the positions could be:

Offshore Drilling/No More Offshore Drilling
Superports/No More Superports
Supertankers/No Supertankers
Money for More Oil Exploration/Money for Other Sources of Energy
Money for Conservation Measures/Money for Exploration
Used Crankcase Oil Pollution/Offshore Platforms or Tanker Oil Pollution
Nuclear Energy/Oil and Gas Energy

You may add and/or substitute additional topics based on the current energy problems. Also give the students time to prepare their presentations (either in class or out). You will act as the timer. This is patterned after the C.B.S. 60 Minutes Point/Counterpoint. The following information may be helpful in discussing this topic. The common sources of oil pollution are:

sources of oil pollution	millions/ton
non-industrial wastes (mechanics, crankcase, etc.)	2.1
tankers	1.4
industrial (non-refinery)	1.1
natural seeps	0.6

atmospheric fallout	0.4
refineries	0.2
offshore oil platforms	0.1
	5.9 total

Oils differ in harmfulness

type of oil	ranking (100 is worst)
used crankcase oil	100
new lube oil	98
#2 fuel oil (home heating)	80
Venezuelan oil	47
diesel	41
Kuwail oil	35
Alaskan crude	33
Louisiana crude	10

7. The Pollution Free Energy readings can serve as a basis of information and discussion. The students may use them as a reference for planning a model or display of devices or ways to obtain energy from the sea. They can make models or displays of existing devices or create their own designs and even test them. This can be done individually or in groups. Each should explain the principle of the model or design to the class.

8. The Future Energy Headlines will allow the students to visualize the energy future as they see it.

9. Have the students discuss the readings, questions and activities in small groups and/or as a whole class. Encourage students to generate related questions and then strive to answer them cooperatively.

10. Additional references from:
National Geographic Magazine
Pollution, Threat to Man's Only Home, Vol. 138, No. 6 (Dec. 1970) pp. 738-781
Barehanded Battle to Clean the Bay, Vol. 139, No. 6 (June 1971) pp. 866-881
The Search For Tomorrow's Power, Vol. 142, No. 5 (Nov. 1972) pp. 650-681
Oil: The Dwindling Treasure, Vol. 145, No. 6 (June 1974) pp. 792-825
Geothermal Energy--The Power of Letting Off Steam, Vol. 152, No. 4 (Oct. 1977) pp. 556-576
Man's New Frontier--The Continental Shelf, Vol. 153, No. 4 (April 1978) pp. 495-531
Sailing with the Supertankers (pp. 102-123) and World's Worst Spill (pp. 124-135), Vol. 154, No. 1 (July 1978)
Natural Gas: The Search Goes On, Vol. 154, No. 5 (Nov. 1978) pp. 632-65
The Promise and Peril of Nuclear Energy, Vol. 155, No. 4 (April 1979) pp. 458-493)

TOPIC FIFTEEN--MARINE ENERGY RESOURCES
OIL!

Complete--
My Energy Position activity.

Share--
Your position with your class mates.

Complete--
Here and Now with Energy Activity.

Discuss--
The results with your classmates.

Look at--
Drawing of Exploration Rigs and Offshore Platform
Map of Gulf Coast Oil and Gas Fields.

Read and Discuss--
Oil Production
The Search for Oil Series
- Test Drilling for Oil
- Drilling for Oil Production
- Getting the Oil Ashore
- Undersea Platform

Letter From an Offshore Platform

Interview--
Individuals associated with offshore oil and gas industry. Have them discuss their jobs, their working conditions, frustrations, concerns and hope for the future.

Report--
On the interview to your classmates.

Read--
Environmental Impact of Offshore Drilling.

Complete--
Oil Spill Simulation Activity

Read and Discuss--
Pre-oil Social and Environmental Impact

Answer--
The questions.

Prepare--

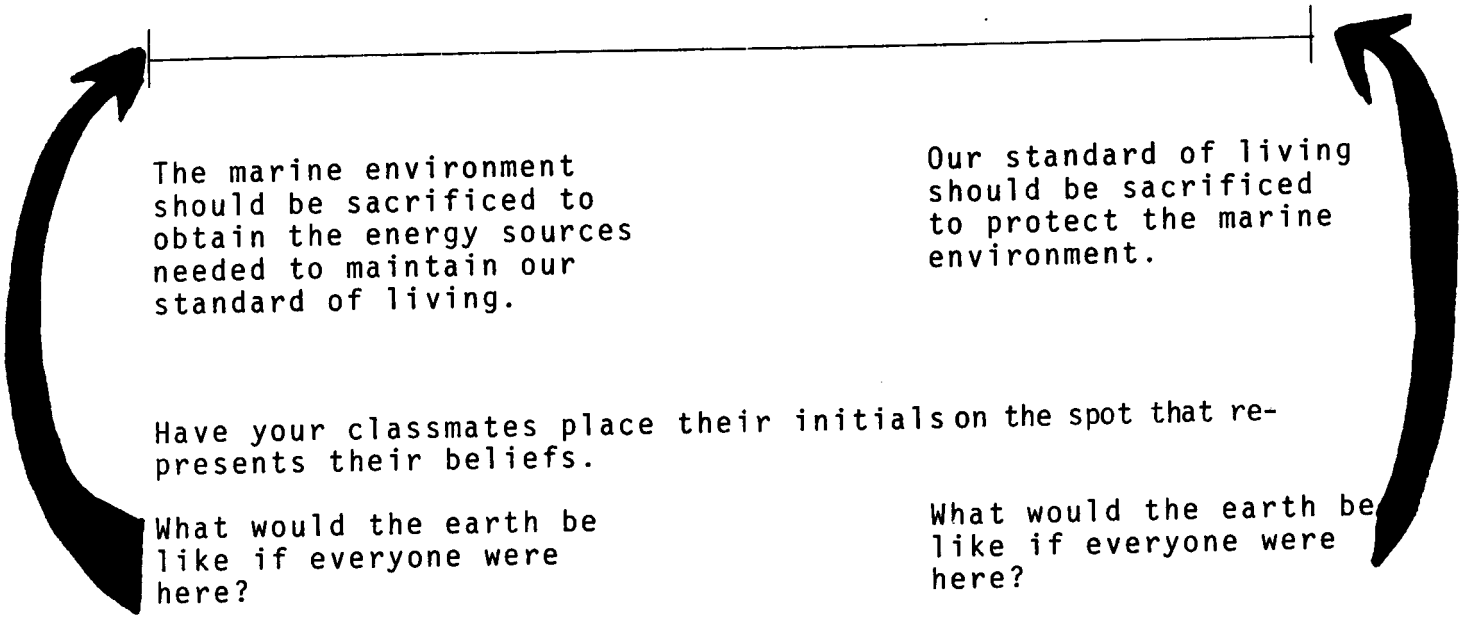
A one minute Point/Counterpoint presentation.
You will draw one of the following positions:
- Offshore drilling/No more offshore drilling (refer to Topic Fourteen)
- Superport/No superports (refer to Topic Fourteen)
- Supertanker/No supertankers (refer to Topic Fourteen)
- Money for more oil exploration/Money for other sources of energy
- Money for conservation/Money for exploration

Present--

Your one minute presentation in front of the class with a classmate representing the opposing view.

MY ENERGY POSITION

Put your initials at a point on the line that represents your position.



The marine environment should be sacrificed to obtain the energy sources needed to maintain our standard of living.

Our standard of living should be sacrificed to protect the marine environment.

Have your classmates place their initials on the spot that represents their beliefs.

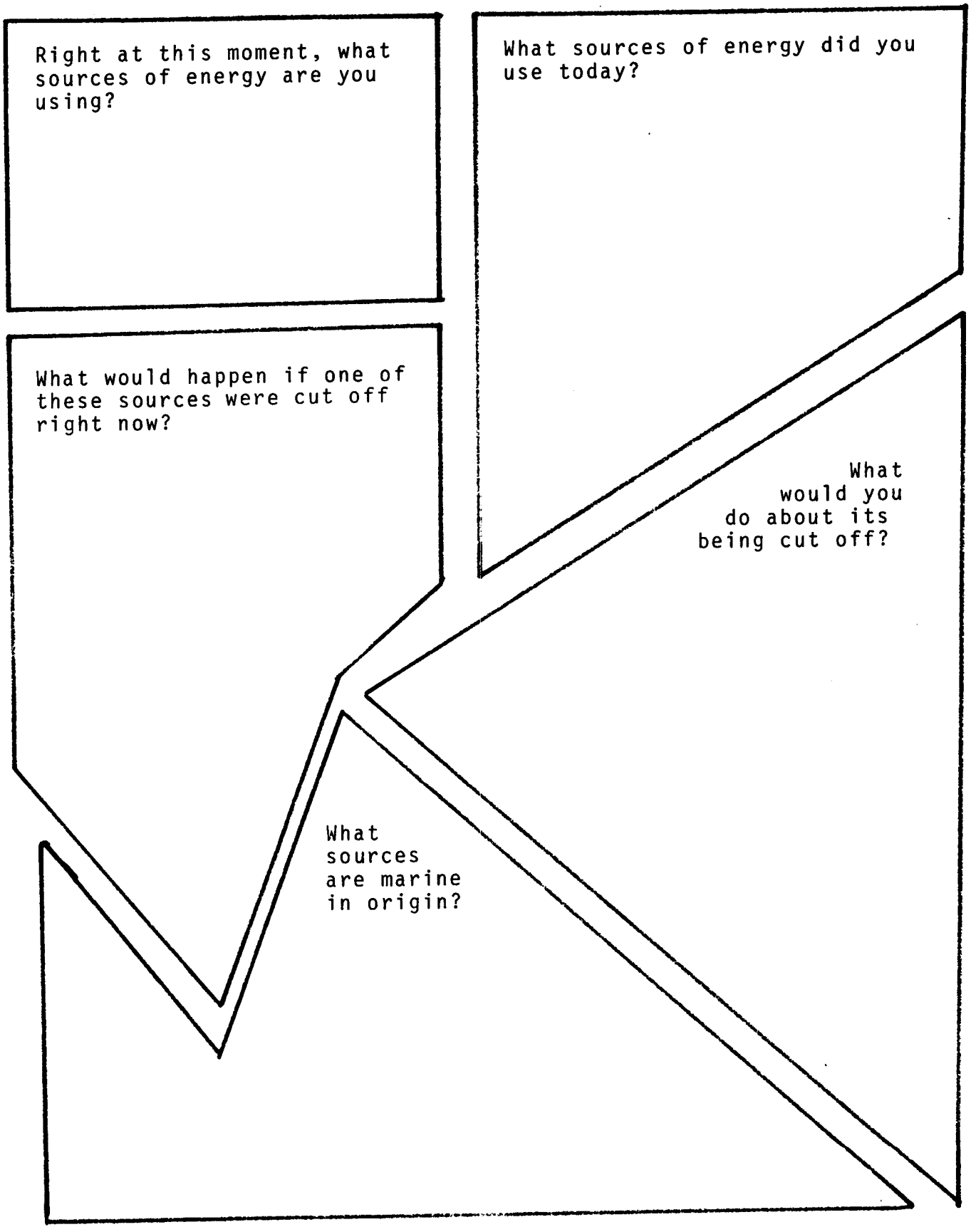
What would the earth be like if everyone were here?

What would the earth be like if everyone were here?

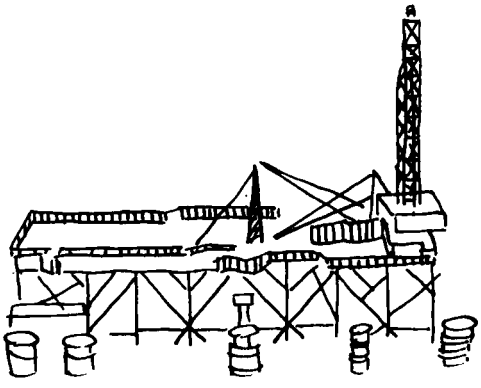
Were more initials on the left or the right side of center?

Why did you select the position you did?

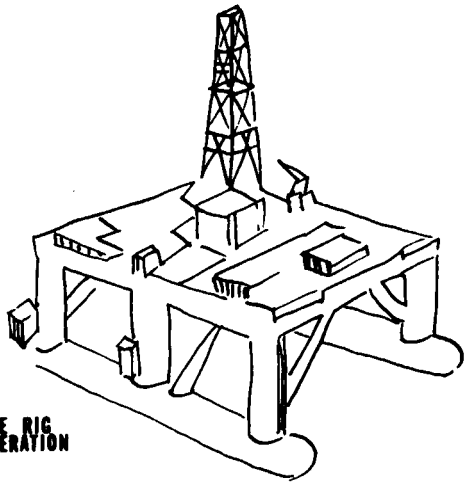
HERE AND NOW WITH ENERGY



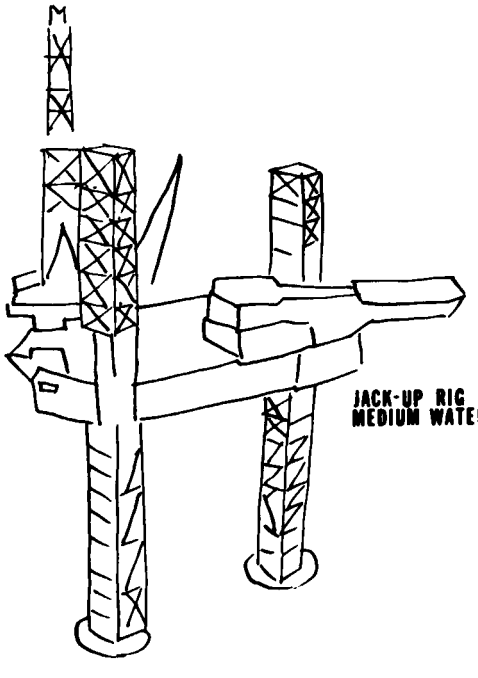
EXPLORATION RIGS



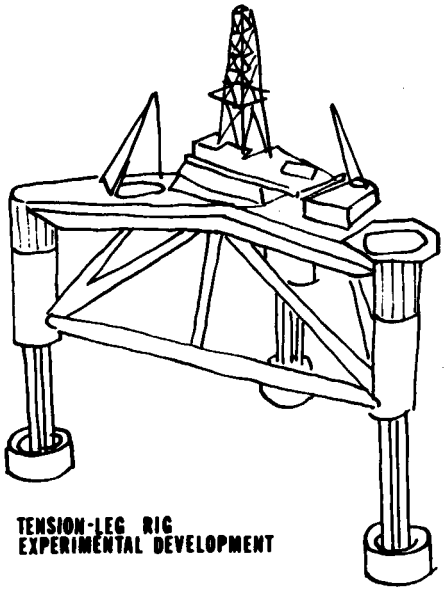
TEMPLATE RIG
SHALLOW / MEDIUM WATER



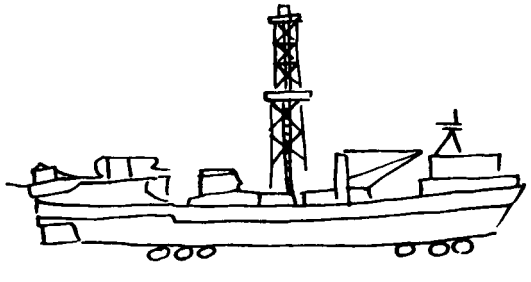
SEMISUBMERSIBLE RIG
DEEP-WATER OPERATION



JACK-UP RIG
MEDIUM WATER OPERATION

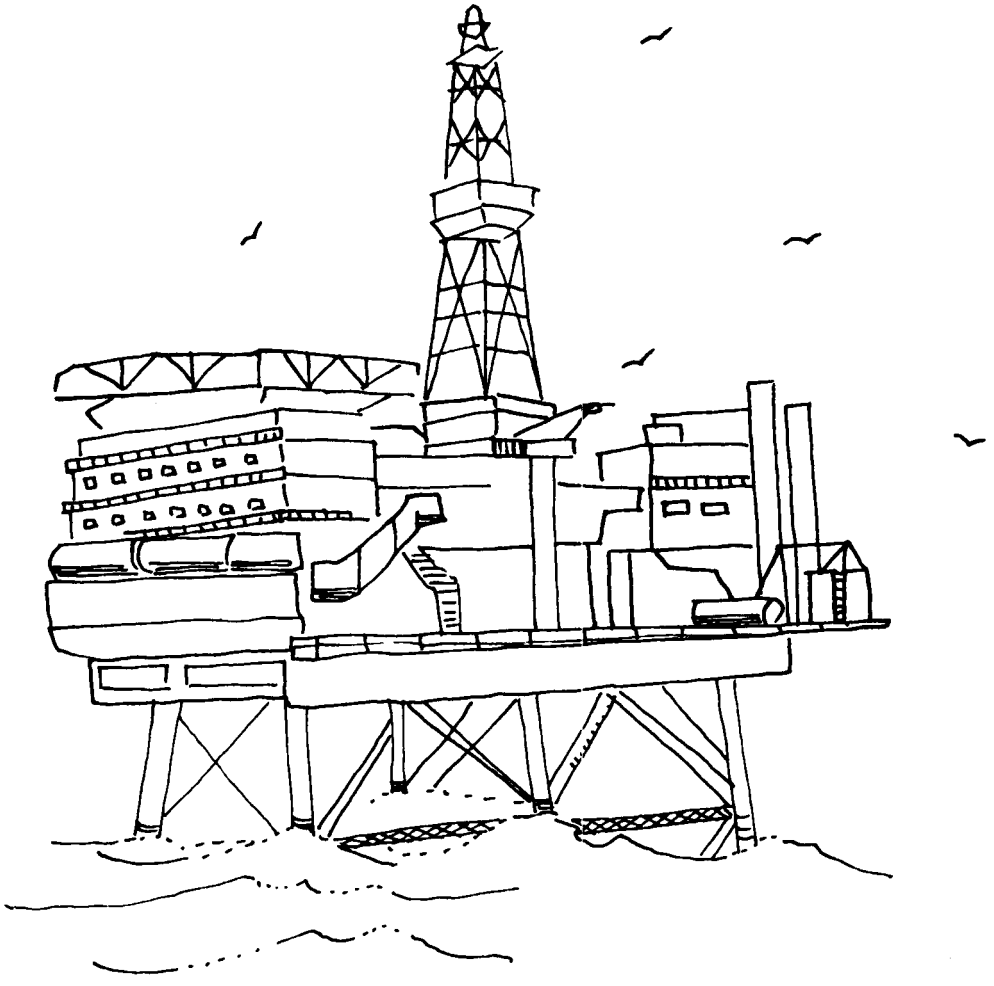


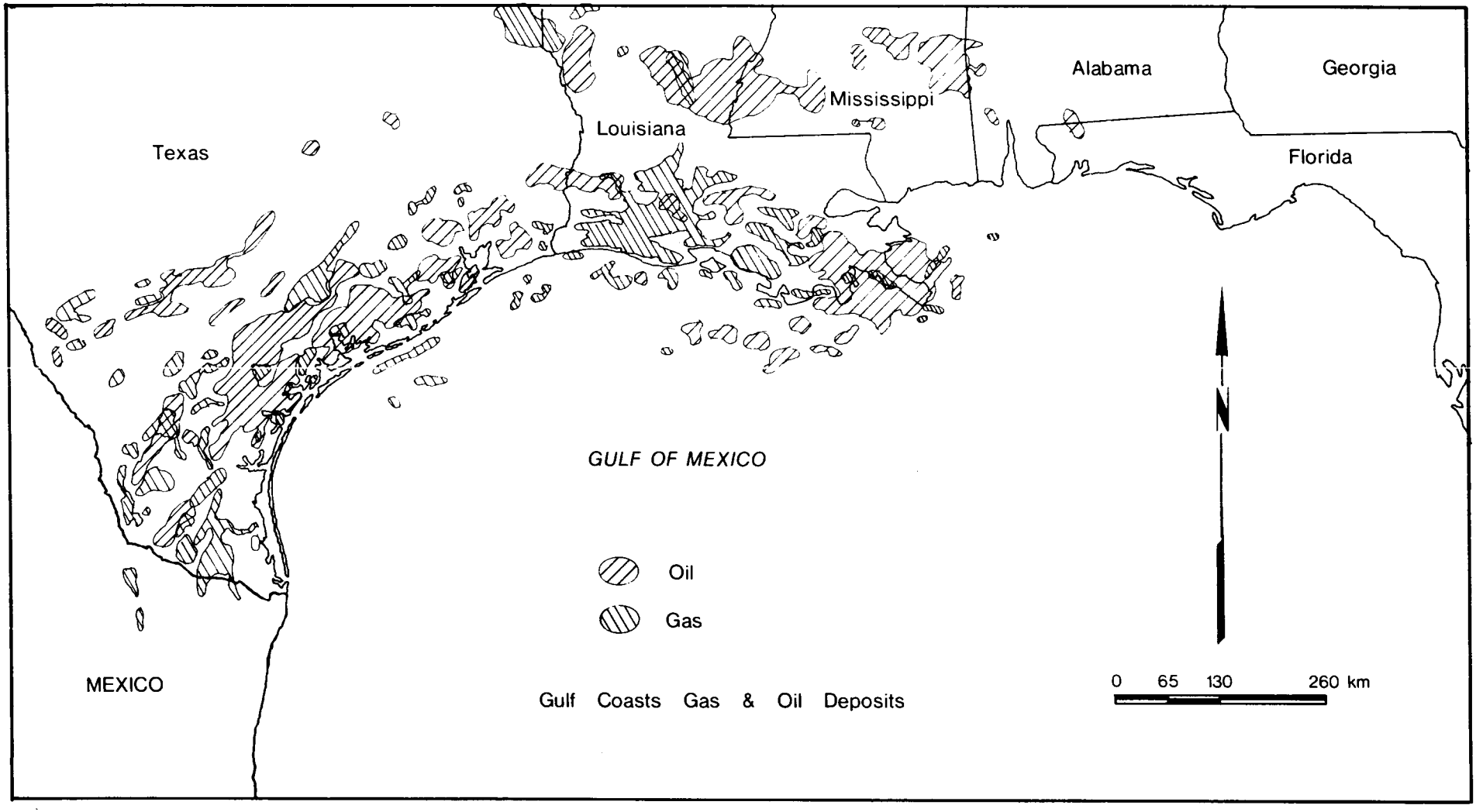
TENSION-LEG RIG
EXPERIMENTAL DEVELOPMENT



DRILLING SHIP
GENERAL SURVEY

OFFSHORE PLATFORM




Texas
Louisiana
Mississippi
Alabama
Georgia
Florida
GULF OF MEXICO
Oil
Gas
MEXICO
0 65 130 260 km
Gulf Coasts Gas & Oil Deposits

OIL PRODUCTION

For thousands of years, people have thought of the harvest of the sea in terms of food resources. Recently, attention has been turned to the harvest of the mineral resources that lie beneath the sea. An estimated 26 percent of the world's known oil reserves are submerged beneath the seas. Some experts think exploration will greatly raise that percentage. An increasing amount of the world's oil of the future will be drawn from beneath the ocean. The end of the oil age will occur when the oil in the deeper parts of the ocean is exhausted.

Oil in the Texas coastal zone was found seeping from the soil long before the first Europeans arrived. They told explorers that the fluid had medicinal values. This first record of Europeans using crude oil was in the calking of boats, in 1543, by survivors of the De Soto expedition near Sabine Pass. In 1866, the first well was drilled to produce oil. The basic principle of rotary drilling was used and it has been used ever since, although with much improvement.

The development of offshore oil exploration had its beginning in the Gulf of Mexico during the summer and fall of 1947. The first subsea well was completed from a mobile platform in the Gulf of Mexico. No longer was offshore oil production limited to the rigid platforms that had to be built in place.

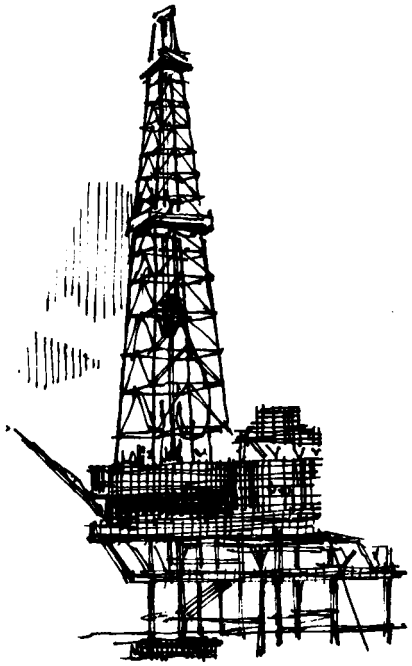
Exploration for petroleum is taking place on all continental shelves except the Antarctic. The continental shelf in the Gulf of Mexico has had the greatest concentration of exploration and drilling. It also has the largest number of producing wells of any offshore area in the world. Over a million dollars is spent each day to develop offshore oil wells in the Gulf. A recent count showed that around 7,000 platforms are located in the Gulf of Mexico. More than 40 percent of the nation's natural gas reserves are located on the Texas Gulf Coast.

Even in the Gulf of Mexico, with all its wells, a large area remains to be explored. There are more than 330 million submerged acres beneath the Gulf in water less than 60 feet deep. Of these only about 35 million acres have been explored. There are also billions of acres at deeper depths that are unexplored.

With the increasing demand for oil, it is important to know the success in finding new fields, the time involved in the discovery, and the development of the field for production.

These are important in predicting the role of offshore oil on future energy supplies. In the Gulf, the time from discovery to development is 3 to 4 years. In the North Sea it is at least 10 years, due to the sea's conditions. Of course, the major problem still is that we do not know where oil is located. Therefore, many wells that are drilled find no oil, and it costs millions of dollars just to learn there was no oil there.

To tap more underwater oil deposits, there will have to be drilling in deeper water. It now costs seven times more to drill for oil offshore than on land. As drilling begins in deeper water, the costs rise even more. Even if there are large submerged oil deposits, they will be expensive to develop.



THE SEARCH FOR OIL

Although oil and natural gas are found under rocks on land as well as under the sea, it was formed millions of years ago in the sea. So wherever there is oil, there was once deep water over a continental margin. It is also certain that wherever there is oil, the environment was probably tropical in the distant past. All the world's major oil fields on what is now land have probably been found and are being worked. It is the oil that lies underwater that interests us.

Both on and offshore, explorers for oil and gas are looking for the same types of rocks and structures. What they look for is: a source rock rich in the organic remains from which oil and gas are generated; a reservior rock into which the oil and gas can migrate (sandstone or limestone); an impermeable seal or cap-rock for the reservior (shale or salt) to trap it in the reservior.

They use seismic reflection to determine the structure of the rocks beneath the seafloor. In this method, they set off a controlled explosion on the surface. The sound waves from the explosion move down through the seabed rocks and are partially reflected by each layer. The reflected waves are picked up and recorded by a series of hydrophones. The variations in the reflections show the structure of the rocks beneath the sea.

DRILLING FOR OIL

The experts study the results of the seismic survey to try to decide if there is oil. If the chances look good for finding oil, then a deep hole is dug since this is the only way to determine if there is really oil there. To get oil from the sea, special rigs are needed. Before 1953 the offshore drilling rigs were confined to shallow waters. However with the development of the jack-up rig, they were able to go out into deeper water up to 300 feet. The legs of the jack-up rig sit on the bottom of the sea and workers can make its legs taller or shorter.

In 1962 there was a breakthrough with the semisubmersible rig. It has special legs (pontoons filled with air) so it can be floated out to the drilling site. There it is held in place with anchors floating but partly submerged. In 1971 the first drill-ship was used. It has a derrick (drilling tower) built on its deck and the drilling bit and the drill string go through a hole in the bottom of the ship. Drill-ships had been in use for nearly 20 years, but this advanced type is able to stay over a well in deep water by using directional propellers. These mobile drilling rigs have increased in number and are sent all over the world.

The majority of the holes drilled contain only water or uneconomic amounts of oil. A drilling bit is used to cut through the rock with a pipe called the drill string joined to it. Engines drive the drilling bit into the earth and pipes are added to the drill string as it goes down. As the drilling bit goes deeper and the rock is hard, the bit will wear out and have to be changed. Mud and rock come up the drill string. If the drillers find oil, it rushes up the drill string. However, complex systems of pressure-control devices makes sure that oil will not gush uncontrollably up the pipe. Just discovering oil proves nothing. What counts is the amount and accessibility. From a range of tests, engineers can tell whether a field is worth commercial exploration. If it looks promising more wells will be drilled to determine the size and shape of the field. Then if oil-company experts decide to develop the field, they must make preparations for several years of costly drilling from a fixed platform and to bring the oil ashore to refineries.

DRILLING FOR PRODUCTION

Drilling for production is even more expensive because a production platform must be built to support multiwell drilling equipment and oil and gas processing equipment for about 30 years. The earliest platforms were wooden tressel. The type of platform will depend on the location of the field. The base of the platform is built on land. It is pulled out to the area on its side by barges, turned over and set in the sea. Next the production platform is built. Cranes on barges put the decks in place and lift the blocks of buildings, drilling derrick, equipment to process the oil before transporting, etc., onto the platform.

The production platform is like a factory with everything that is needed to get oil up from the well and ashore. When the platform is ready, the wells can be drilled. The biggest modern platforms may have two derricks drilling simultaneously, with double crews working round the clock. There may be living quarters for as many as 140. As many as 60 wells may be drilled outward at an angle from each platform. A fleet of work boats and helicopters will bring in pipe, casing, cement, mud, men, fuel and food.

When all the wells have been drilled, the production equipment is put in place. This includes a complex group of control valves (the Christmas tree) which shut off automatically if there is any damage to the well. Now the operation is mostly automatic. On the deck of the platform the various parts of the crude-oil or gas mixture are separated and the oil and gas are transferred to a tanker or pumped through a pipeline to the shore. Once all the equipment is working, the complete platform can be automated and controlled from a computer onshore. Production platform installation takes 6 to 8 years.

GETTING THE OIL ASHORE

Many wells have been drilled and the oil and gas are flowing to the platforms. Transporting the crude oil and natural gas from the offshore wells to coastal areas presents a challenge all its own. This calls in part for pipelines under the sea. Within a field pipes are usually laid from all the platforms to a central point. From the central point the oil may be taken to shore by tanker if the field does not justify the installation of a pipeline. If oil is pumped away from the platform to a mooring a short distance away, these moorings are anchored to the sea bed and a hose carries the oil from the sea bed through the mooring buoy to the tanker via a floating hose. The drawback is bad weather.

If a pipeline is feasible, it is carefully planned and designed and every possible route is studied. The shortest route between the platform and shore is most desirable but underwater topography, geology, marine activity, underwater objects, winds, waves, currents and the shore environment must be considered.

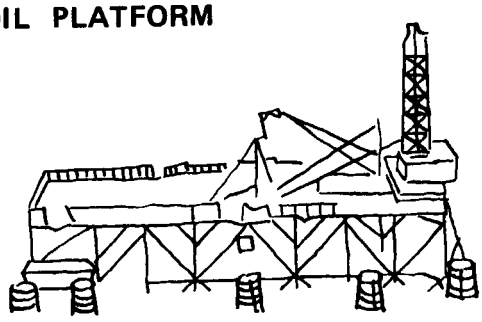
Once a site is selected the pipelaying operation begins with a well-equiped and coordinated "work spread." This includes pipe supply vessels, tugboats, a pipe-laying barge and a trenching barge. Daily rental fees for the spread in 1978 could be $40,000 a day in the Gulf of Mexico and $300,000 a day in the North Sea. When the pipeline reaches shore, the lay barge can no longer operate. Tractors, bulldozers and trucks now do the work.

Before the actual pipeline can operate the line must be tested. If a pipeline passes all tests, it is ready for operation. Today's pipelines are under constant automatic monitoring to control and detect problems. The United States built its first offshore pipeline over 30 years ago; now more than 7,000 miles of submarine pipelines are found beneath U.S. waters. It costs 15 cents to send a one-ounce letter from Houston to New York; a gallon of gasoline travels the same distance by pipeline for less than 1½ cents and sometimes in less time. Today the United States has more than a half million pipelines (land and sea lines), enough to circle the earth 22 times. A major portion of all the energy used in the United States moves through the pipeline network.

UNDERSEA PLATFORM

An alternative to platforms is undersea production, in which all the equipment is mounted on the sea floor. The sea-bell wellheads are covered by a chamber in which there is a one atmosphere environment. A small diving bell brings the workers from the surface ship and mates with the sea chamber. In the sea chamber, the men can work in dry, warm, sea-level pressure conditions. A series of these over an oil field will feed into a central seabed gathering station from where crude oil will be pumped to a platform in shallower water or to tankers. Systems like this represent the best answer for oil production in water depths greater than 600 meters

LETTER FROM AN OFFSHORE OIL PLATFORM



Capt. Al G. Seaborne
Coastal Port
Texas

Dear Captain Seaborne,

I am working as a roughneck at sea on an offshore oil drilling platform in the Gulf of Mexico.

A helicopter takes us to work 95 miles out in the Gulf. We land on the helicopter pad of our drilling rig. There are fifty of us, men and women, working and living here. We work twelve hour shifts for seven days. Then we helicopter back to shore for our seven days off.

The platform and its operations look like those on T.V. commercials. It is spotless. We are not allowed to throw even a cup over the side. Even rain water falling on the platform is filtered before it reaches the surface of the Gulf.

Our platform is 200 feet wide and 290 feet long. It is 160 feet above the Gulf. The platform has the helicopter landing pad, derrick, pumps and machinery, monitoring equipment, repair shops, offices and living quarters. We are in water that is 300 feet deep and may drill to a depth of 10,000 feet. Our platform can move under its own power. Our drilling platform may be drilling as many as nine wells. The living conditions are good and so is the food. Only when you look at the water do you know that you are not on land.

If you look through the five stories of grill work, you can see scores of fish darting about the platform's steel legs. The fish are neither attracted nor repelled by oil for the simple reason, there is none. The fish are attracted by the platform itself, which acts like a reef. It attracts a food chain that starts with phytoplankton and barnacles and works to larger marine creatures like the shark. Our platform actually attracts more marine organisms into the area than were here before.

The job is outdoors and offers adventure and excitement. This drilling platform works on the same principle as the earlier ones. The operation is different today. It is larger and there are more technological innovations. Today we even use T.V. cameras and computers in our work. It is more difficult now, so more education is needed. Once only grade school was needed, now one needs a high school education or more.

It is time for my shift to go to work.

Sincerely yours,

C. Diver

C. Diver

ENVIRONMENTAL IMPACT OF OFFSHORE DRILLING

Capt. Al G. Seaborne
Coastal Port
Texas

Dear Captain Seaborne,

This is in answer to your letter asking me to assess the environmental impact of offshore drilling.

After the oil shortage of 1973, one of the provisions to decrease our dependence on oil imports was to lease some 10 million acres of the Outer Continental Shelf for offshore oil development. The plan aroused a storm of opposition from environmentalists, legislators and businessmen as well as nature lovers.

There is an uproar in spite of economic pressures and the talk of energy shortages. People who care little about protecting the environment at a distance really get concerned about protecting it close to home. The uproar is understandable, but not for their reason--the fear of oil spills.

Oil companies have greatly improved their offshore oil production. The reasons for this improvement were: drastic fines for damage from oil spills; the financial loss due to wasting oil; and public opinion. Now there are automatic storm chokes which react instantly to changes in heat, pressure and rates of flow. There are also thicker pipes, electric monitoring, and blowout preventers designed to cut off and contain oil in emergency cases.

Even if the new safety systems fail, there are improved booms and skimmers to contain the spill before it reaches a shore. Pipes are used to carry the oil to shore in the Gulf. The environmental danger is much greater if ships are used. The chance of a large oil spill from the offshore platforms is fairly remote.

Among the sources of oceanic pollution, spills from offshore drilling rank far down the list. Tankers and even normal shipping are far greater offenders--19 times greater. River deposits and sewer drain-offs, including crankcase oil from the thousands of gas stations, cause the most pollution. Even the natural seepage emitted from time to time from the oil seabeds is greater. It is this natural seepage that forms the tar on Gulf coastal beaches.

There is visual pollution by the wells and rigs in the Gulf. They do give the seascape an industrial look. However, they don't have to be unattractive. Off Long Beach, California, they are made to look like apartments on an offshore artificial island. Off the Atlantic coast

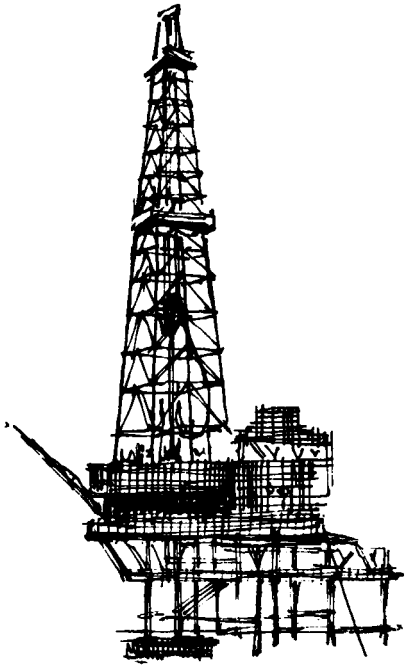
the rigs are 25 to 75 miles offshore and on a clear day only the uppermost tips would be seen from shore.

It is the shore itself--what drilling can do to it... that is the real issue. It is not the oil itself since pipes carrying the offshore fuel are heavily protected against corrosion and rupturing. They can be brought in underground to the refineries and storage tanks which can be inland away from the fragile coastal area. The real problem, social as well as environmental comes before any oil is produced. I have attached a report on that problem.

Sincerely yours,

Charles Crude

Charles Crude, Executive
World Wide Oil
Exploration Inc.



OIL SPILL SIMULATION

Create your own ocean by filling an aluminum pie pan, plastic bowl or other container with water. Create your own oil spill by placing 15 to 20 drops of salad oil or regular oil on the water in the dish.

Your task is to clean up your oil spill. You may use any or each of the following (keep the piece of each material you use the same size):

a) cotton balls
b) a spoon
c) eye dropper
d) piece of nylon net
e) piece of styrofoam
f) piece of nylon hose
g) piece of cardboard
h) piece of string
i) other materials

Select the method you think will work best. Time yourself. You may want to repeat the simulation by generating waves in your container to determine the effect of waves on the cleaning up of your oil spill.

1. How long did it take to clean up your oil slick using each of the alternatives?

2. Which method do you think is the most effective in calm water? in rough seas?

3. How many methods can you think of which might work more efficiently than the methods listed?

4. What problems are created by the gigantic oil spills which occur regularly now in our oceans?

5. What factors affect the cleaning up of the oil spills in the oceans?

6. Who should be responsible for cleaning up the spills?

7. Can you or your group design possible solutions to this major problem. Brainstorm as many possibilities as you can. Accept all ideas as possibilities. Narrow down your list later by applying your own criteria (testing the idea etc.)

8. What would you consider to be the three best alternatives to clean up oil spills in the ocean?

PRE–OIL SOCIAL AND ENVIRONMENTAL IMPACT

The real problem of offshore oil development is social as well as environmental and occurs before any oil is produced. The building and the setting up of the offshore platforms requires a large onshore task force. The offshore work force is small compared to the people employed onshore. People are needed to assemble the platforms, operate the needed fleet of boats and barges and to supply the daily needs of the crew. This working force of thousands, along with their families moving into a small coastal community, creates large problems--both social and environmental, both immediate and long range.

The platform construction workers bring other builders needed to put up housing for the workers and their families. Next come more schools, stores, restaurants, professional offices and entertainment establishments, with roads and sewers needed for all of them. (In other words it becomes a boomtown with labor shortages, inflated land prices, and higher wages.) There are also the social strains between natives and outsiders.

Another problem exists. The small shore community is probably scenic with recreation activities that are easily affected by sudden growth in industry and construction. The fragile nature or the coastal environment allows it to be easily damaged from the heavy equipment that the building and hauling of oil rigs and heavy supplies require.

The boom may abruptly end. The field's potential may not be what was expected. Only actual drilling answers that question, and the odds are only one in seven that a well will yield any oil or gas. Or the time comes when the oil is gone. No more platforms are built; no more pipe laid; workers move away; stores close; schools disappear; houses are empty. A boomtown becomes a ghost town. Worse is that it will never recover its pre-boom resort quality. All energy taken from the earth requires a price in environmental damage.

Another problem is that no one knows how much, or is any, oil or gas is available under the outer Continental Shelf. If there is oil there, it will be 8-10 years at least before any large scale production will occur. In the meantime, we continue to increase our use of petroleum. By the end of 1975 we were importing close to 40 percent, a long way from independence.

1. Do you think we should continue and increase offshore oil exploration? Why or why not?

2. What are the alternatives if we choose not to explore for offshore oil?

3. At present, most U.S. offshore oil production is in the Gulf of Mexico and off the coast of California while the Atlantic coastal states are saying no to offshore oil development. How do you feel about this?

   What should be done?

4. How would you solve the problem of small coastal communities becoming boom towns?

5. Oil gushes up from the sea bed--black gold, the greatest source of wealth from the sea, with the highest potential to destroy. State your feelings and explanation about the above statement.

POINT / COUNTERPOINT

This activity is patterned after the CBS program 60 Minutes - Point/Counterpoint. You have drawn to determine which position you will represent. The position you have drawn may not be the position you actually support in real life. However you are to support the position you drew as though you have always favored and supported it. Your presentation will be one minute in length. Time will be called after one minute. You will probably want to make an outline of what you want to say so you won't leave out your key points. Your outline may differ from the one given below. You may have more or less points. Remember to be concise in your presentation.

Position - _____

by _____

I. _____

A.

B.

C.

II. _____

A.

B.

C.

III. _____

A.

B.

C.

TOPIC FIFTEEN--MARINE ENERGY RESOURCES
POLLUTION FREE ENERGY

Read and Discuss--

Pollution Free Energy.
- Harvest of the Wind
- Sea Thermal Power
- Tidal Power
- Wave Energy
- Windmills in the Water
- Hydrogen to Burn
- Energy from the Earth's Depths
- Energy of the Future
- Ocean as a Coolant

Design--

A model or complete a display of your own device or way of getting Energy From the Sea.

Display and Explain--

Your device to the class.

Divide--

A sheet of paper into three columns. Label the columns:
Past
Present
Future

List the marine energy resources in the column in which they belong. Include oil and gas. Some may be more than one column.

Answer--

The questions.

Complete--

Future Energy Headlines activity.

Share--

Your Headlines with your classmates.

POLLUTION FREE ENERGY

The sea produces many miracles--one is the potential for pollution free energy. All the energy the world needs is concentrated in the ocean's physical systems. If we used this source of free energy, we would not be dependent on other countries for our energy. This would free us from the possibility of blackmail by other countries which control the oil and gas supplies. Ever since the need for new sources of energy arose, scientists and engineers have looked toward the endlessly moving waters of the oceans: the fury of the storm, the pounding of the surf, the rise and fall of the tides and the movement of the wind and waves. All suggest that the seas hold an awesome amount of potential power. The question has been how to harness that power for use in a way that is economical and will not interfere with the marine ecosystem.

Harvest of the Wind

The heating of the earth's atmosphere by the sun, and the rotation of the earth, results in wind patterns. For many centuries and with varying degrees of success, man has used motions of the wind to propel his machines. Wind power was the major energy for ocean transportation until the invention of the steam engine. If energy costs (environmental and financial) continue to rise, a combination of wind and oil may once again be the most economical form of ocean transportation. Windmills have been the other use of wind power. In the future, we may see large windmills on floating platforms offshore.

Winds are regional, variable and has its own characteristics. However in studying the wind in an area, it is repeatable. So a wind generator could be designed to work in a particular wind region. The most energetic winds move over the ocean. However the energy from the wind can be used to form hydrogen gas which is a storable and low-cost energy transmission agent. In other words, the wind energy could be stored and shipped in the hydrogen gas until it is needed.

There are many ocean areas near enough to the shore and in shallow enough water so the hydrogen gas could be piped to shore. It would also be possible to extract energy from the wind over the oceans in the most favorable wind areas. The wind generator platform could be a self-propelled ship equipped to convert the wind energy to hydrogen gas and store it. Later it could be transported to storage areas on land.

In the oceanic winds, we have a huge energy source that we can harness to serve our needs as we want it. It could be put to use in the near future, economically with no pollution of any kind.

Sea Thermal Power

The most promising form of oceanic energy is the use of energy from the difference in temperature between the surface water and the water of the ocean depths. It is the ocean's greatest renewable source, since it is replenished each day by solar radiation. The ocean accounts for 90 percent of the earth's surface between the Tropic of Cancer and the Tropic of Capricorn. This area is where the most intense solar radiation reaches the earth. The heat capacity of water is greater than that of any other liquid. The sun's energy does not penetrate very deeply into the oceans so even under the hottest tropical seas there is cold water. The energy potential of oceanic thermal differences can be tapped. It is also economically feasible.

Projections are that it would be possible for large numbers of sea thermal power plants to be located in a rather large area. This area would be 15 miles east-to-west and 550 miles south to north along the western portion of the Gulf Stream. They could produce electricity or convert it to hydrogen gas. This could be sent to any part of the United States and sold at a competitive price.

The principle of the sea thermal power plant is the opposite of a mechanical refrigeration plant or refrigerator. The warm surface water would give up heat to the working fluid (Freon, ammonia or propane) in tubes. The heat would change the fluid into a vapor under pressure. The cold bottom water is used to chill the condenser tubes under the turbine. This creates a region of low pressure where the vaporized fluid can expand. When it expands, it can do useful work, turning the turbine to produce electricity.

A sea thermal plant could operate 24 hours a day, year round. It has been estimated that the temperature differences of the Gulf stream could generate 82 trillion kilowatt hours. The projected need for the United States by 1980 is 2.8 trillion kilowatt hours. One team of researchers has estimated that this ocean-wide power source is capable of continuously providing 200 times the earth's total power needs in the year 2000.

In the winds over the oceans and in the thermal differences which the sun creates, we have plentiful resources of pollution free energy. Using the free energy of the ocean could place us in harmony with the biosphere. We would only be using renewable energy sources.

The one side effect which may exist is that it could change the ocean temperature. This could affect marine life and weather conditions. Weather changes can be caused by a small change in the heat balance of the ocean. We do not know the long range effects. At the same time the burning of oil, gas, coal, etc., also produces heat which could affect marine life and weather

conditions. The ecological consequences of sea thermal power need to be studied. We need to determine the upper limit on using ocean thermal energy.

Tidal Power

Records indicate that by the eleventh century tide mills were used along the Atlantic coast of Europe mainly in Great Britain, France and Spain. Even as late as the mid-nineteenth century, tidal energy was used widely in coastal areas. Twenty-foot water-wheels installed under London Bridge in 1580 pumped part of the city's water supply for some two and one half centuries later. The first tidal mill in the United States was built in 1635 in Salem, Massachusetts. Some of these were impressive in size. One in Rhode Island, built in the 1700's, used 20-ton wheels, 11 feet in diameter and 26 feet wide. The early mills used waterwheels and were low in energy production. These 30 to 100 kilowatts were used at the site.

Today on the Rance River in France there is a 240 megawatt plant which has successfully harnessed the tides. There are only about 90 places where tidal heights and volumes are great enough for the operation of tidal electric power plants. These include estuaries and bays of northeastern North America and the Gulf of Alaska among others.

With new construction techniques and large better-adapted generating units, it is technically possible to use the tides. It is conservatively estimated that they could produce 13,000 megawatts. The total power produced from this resource would be small in terms of the world's total energy needs. However it could fill the energy needs of the local area. Tidal energy converted to electric energy is not harmful to the air, water or land.

There are some problems in the construction of tidal power plants. These include the cost of construction and blockage of the waterway to commercial and pleasure craft. There is also the scenic pollution of dams and turbines on the waterways. The life cycles of the marine organisms may be affected by changes in salinity, temperature and nutrients.

Wave Energy

There is a tremendous amount of energy in the form of waves. Scientists have estimated that a four foot wave has 5.45 horsepower per wave; or 28,000 horsepower per mile. (Small riding lawn mowers have a 5 horsepower engine.) If the power in one 10 foot wave were harnessed for 4 miles it would produce an amount of energy equal to the daily production of a typical nuclear power plant.

In 1909 an invention called "The Reynolds Wave Motor" was produced. It transformed the energy of the surf into electricity. It did produce electricity to light a string of light bulbs but not much more. The theory was sound and with today's technology, it could become the basis of an efficient energy system. However, large-scale production of energy from waves needs more research.

Windmills in the Water or Current From the Current

In the past, before electricity, windmills dotted the farms and ranches of Texas. The power of a breeze would turn the blades and pumps would be driven to pull the water from underground wells. Today, windmills are beginning to make a comeback on land. The principle of the windmill may be used to capture the power of the sea in the future also.

The water of the Gulf stream flows rapidly past the Florida Keys. The force of the water is like a breeze. The current's speed changes, but it is more reliable than wind. Scientists have proposed a system of underwater windmills in the Florida current portion of the Gulf Stream. The water is strong enough to drive rotor-type motors 350 miles from the U. S. A proposed row of twelve turbines over the 350 mile area could produce 100,000 megawatts of pollution free energy. It has been calculated that if as little as 4 percent of the flow were trapped, between 1000 and 2000 megawatts of energy could be produced. There is a large resource of energy equal to that produced by twenty-five 1000 megawatt power plants available in the Florida current. Other streams in the oceans could be harnessed for additional energy.

Hydrogen to Burn

What is needed is a fuel which can be easily manufactured from a renewable source and easily transported and stored (a liquid or gas), is clean-burning and gives off maximum energy from a minimum amount. It also must be safe to handle and non-toxic.

No such fuel exists, but hydrogen comes close. It is the cleanest-burning fuel, giving off only water vapor and heat when burned in oxygen. In air, it gives off water vapor and heat. If the fire is hot enough, it gives off small amounts of oxides. Hydrogen can be bottled, stored, piped, pumped, burned, exploded, liquified. It was used to take man to the moon. It can be safely substituted for petroleum and coal in many industrial processes. It can be easily converted to other fuel forms.

Internal combustion engines can efficiently run on it as can gas turbines. Fuel cells, which are flameless, can produce electricity with little waste.

Free hydrogen is not plentiful in the earth's atmosphere. There is plenty of it stored combined with oxygen to form water. Hydrogen can be produced by the electrolysis of seawater using electricity from ocean currents and sea thermal plants. Ocean tankers could collect and deliver it to where it is needed. Hydrogen may be the key to our using the energy from the sea.

Energy from the Earth's Depths

Throughout the world there is a common heat source in abundance--the natural heat from the earth's rocks. This is geothermal energy. It offers a source of potential power that can be tapped. A government survey estimates that the known geothermal resources in the United States, both land and ocean, could produce 140,000 megawatts over a period of 30 years. This is equal to the amount of energy of 140 nuclear power plants. A thousand megawatts is about the energy needed for a city of a million persons.

The geothermal energy will not solve the energy shortage--no single source can do that. There are still some technological problems and ecomonic problems. However, in a few years it may be more available.

In several countries such as Iceland, France, Hungary and New Zealand, they are heating homes with the earth's hot water and using the heat for industrial purposes as well. Actually geothermal heating in the United States is not new. Over 350 homes in Klamath Falls, Oregon, are using energy from hot water wells. Also in Boise, Idaho, homes along Warm Springs Avenue have used the hot water for nearly a century. At present in the United States at The Geysers in California there is a geothermal plant. This plant produces about half of San Francisco's energy needs. Also the Imperial Valley of California seems to offer rich prospects for geothermal development.

One of the richest future sources of geothermal energy lies beneath the Texas - Louisiana coastal region. There are large hot-water reserviors both on shore and off. The hot water containing methane (the chief ingredient of natural gas) is trapped under abnormally high pressure under the thick sediments. Drilling for it is difficult and costly. However, as the prices for other energy rise, it will become profitable to drill for it. Estimates are that there is as much as 115,000 megawatts of energy for 30 years. The methane in the water would have an equal energy value. (The total United States power capacity in 1976 was about 550,000 megawatts.) So the coastal zone of Texas - Louisiana is not only a source of oil and gas but geothermal energy.

Like all energy sources, geothermal energy has both advantages and disadvantages. It is relatively clean, there is no fuel to buy and the reserves are thought to be long lasting. However, there is the question of subsidence. Will the earth sink in the area where the water is removed? This can be avoided by returning the water from which the heat has been removed back into the wells. There is the problem of hydrogen sulfide gas (odor of rotten eggs), poisonous arsenic and boron in geothermal waters. However if the water is pumped back into the wells this problem can be avoided. All things considered mining for geothermal energy may be desirable.

Energy of the Future--Nuclear Fusion

In the future, it is expected that power from nuclear fusion will be feasible and the cost will be reasonable. The fuel for these power plants will be heavy water (Water whose hydrogen atom contains an extra neutron.). A small but important percentage of sea water is heavy water so when this form of energy is developed, the ocean will be the source for the fuel.

The Ocean as a Coolant

The ocean can serve as an effective and inexhaustible source of cold water for cooling. For any kind of thermal power plant, whether it is solar, nuclear or fossil fuel that is used as an energy, a supply of cooling water is as important as the heat source. Land-based plants require expensive, unsightly cooling towers. Also, nobody wants a power plant in his backyard, especially a nuclear one.

An alternative is to build these power plants offshore. The New Jersey Public Service Electric and Gas Company, with the combined efforts of Tenneco and Westinghouse, plans to construct the first floating nuclear power plant 2.8 miles off the coast of New Jersey. The developers believe that in the open sea the warm water will disperse better. Therefore there will be less damage than occurs when the heated water is discharged into coastal areas. Mariculturists feel that the warm water could be used to set up areas where fish and algae could be farmed.

The problem of radioactive materials will have to be kept at very low levels. Some feel that the ocean dilutes radioactivity more easily than does the land. This theory is not logical since the radioactive substances will be used by marine organisms. So the radioactive chemicals will be returned to us in our food fish.

If nuclear plants are built offshore, there will be less danger to people in case of an accident where radiation is released. The ocean would provide protection. Also there are more offshore sites available for plants than on land.

In the future, whether it is oil, coal, ocean thermal, wind, wave, tide nuclear fission or nuclear fusion, a large part of the world's production of energy may be from the oceans.

Questions

1. Why should pollution costs be included when comparing one energy source with another?

2. What are the problems in the use of fossil fuels for energy?

3. How does energy from fossil fuel compare with energy from waves, currents, tides and water temperature differences?

4. Why must we find non-polluting sources of energy?

5. Why do we need more energy than was needed in the past?

6. Why is the ocean considered the source of most of our future energy?

7. What are the advantages and disadvantages of energy from the ocean as compared to the fossil fuels (oil, gas, coal)?

8. Discuss the political and economic advantages of not being dependent on another country for our energy supply.

FUTURE ENERGY HEADLINES

Newspaper headlines seem to fluctuate between good news and bad news about the marine environment and energy. As you look into the future, what do you see newspaper headlines saying? Write your worst fears and your best hopes for the marine environment and energy in the form of headlines.

Worse Fears	Best Hopes

Which of these headlines do you think is more likely to happen? Put an X by it.

Put a star by those fears that one person could do something about.

Circle those things that would require a lot of people to prevent from becoming true.

TOPIC SIXTEEN
RICHES OF DAVY JONES' LOCKER

ACTIVITY ONE--Marine Mineral Resources

Materials for Classroom Use:

Table of Concentration of 57 elements in Seawater
Riches of Davy Jones' Locker/series of readings
Water-The Most Priceless Resource/Reading
A Solar Still/Activity
More of the Riches of Davy Jones' Locker/Reading
Who is the Owner?/Reading
Questions of Ownership?/Activity
What I Think Should Be Done About The Ocean's Mineral Resources/Activity

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 list some marine mineral resources;
2.3 evaluate a marine mineral resource problem man has solved and the changes that resulted and the new problems that arose;
2.5 generate a list of marine mineral resources that will be important in the future;
2.5 identify the consumer products produced from marine mineral resources;
2.6 explain and categorize ways in which marine mineral resources were used in the past and are being used;
2.6 analyze the use of a marine mineral resource through time in relation to the values involved;
2.6 describe how the changing use of marine mineral resources has changed lifestyles;
2.6 identify and clarify his own value position in relation to marine mineral resources;
2.6 analyze value position in relation to marine mineral resources to determine similiarities, differences and possible conflicts;
2.7 discuss the idea that marine mineral resources represent "a common heritage" and belongs to the entire international community;
3.2 describe and identify situations where technology has caused a change in the use of a marine mineral resource through time;
3.3 evaluate what considerations are important if given examples of marine mineral resource acquisition;
3.3 identify a situation in which short term economic gains may produce long term environmental losses;

3.4 make projections about the future consequences of man's exploitation of the marine mineral resources;
4.2 advocate a position in relation to marine mineral resources.

Teaching Suggestions:

The purpose of this lesson is to present the student information on the marine mineral resources. He should also begin to form ideas in terms of ownership and how various actions will affect the environment and in turn affect man.

1. Have the students complete the readings and respond to the questions and/or activities. (The readings may be handed out the previous day so they can be read before class.)

2. You may do the solar still activity to illustrate this principle as a means of obtaining fresh water and removing the minerals from the water.

3. In the "Question of Ownership" continuum, steer students away from the middle position. There is no correct answer on the continuum, every individual's answer is the right answer for that person at that time.

4. After dealing with each reading or at the end of the entire set have a class discussion on the questions and/or activities.

5. In the speech on "What I think should be done about the ocean's mineral resources" you may have them share their outlines in small groups and then the small group compiles an outline to present to the class. If you have each student present a speech to the class, be sure to time the presentation.

Additional reference.
6. National Geographic Magazine, Man's New Frontier--The Continental Shelf, Vol. 153, No. 4 (April 1978) pp. 495-531.
"Hawaii's Deep Sea Jewels" Vol. 155, No. 5 (May 1979) pp. 718-732.
The Ocean World of Jacques Cousteau, Vol. 17, Riches of the Sea, Danbury Press.

TOPIC SIXTEEN--RICHES OF DAVY JONES' LOCKER
MARINE MINERAL RESOURCES

Look at--
Table of Concentration of 57 Elements in Seawater.

Read--
Riches of Davy Jones' Locker
Water--The Most Priceless Resource

Optional
Make--
A solar still and distill saltwater.

Read--
More of the Riches of Davy Jones' Locker.

Optional
Select--
A marine mineral resource and report on all its uses.

Read--
Who is the Owner?

Complete--
Question of Ownership activity.

Share and Discuss--
The Results of the Question of Ownership Activity.

Prepare--
Outline for five minute speech for "What I Think should be done about the ocean's mineral resources" activity.

Present--
Speech to the class.

TABLE OF CONCENTRATION OF 57 ELEMENTS IN SEAWATER

ELEMENT	TONS PER CUBIC MILE	ELEMENT	TONS PER CUBIC MILE
Chlorine	89,500,000	Nickel	9
Sodium	49,500,000	Vanadium	9
Magnesium	6,400,000	Manganese	9
Sulfur	4,200,000	Titanium	5
Calcium	1,900,000	Antimony	2
Potassium	1,800,000	Cobalt	2
Bromine	306,000	Cesium	2
Carbon	132,000	Cerium	2
Strontium	38,000	Yttrium	1
Boron	23,000	Silver	1
Silicon	14,000	Lanthanum	1
Fluorine	6,100	Krypton	1
Argon	2,800	Neon	.5
Nitrogen	2,400	Cadmium	.5
Lithium	800	Tungsten	.5
Rubidium	570	Xenon	.5
Phosphorus	330	Germanium	.3
Iodine	280	Chromium	.2
Barium	140	Thorium	.2
Indium	94	Scandium	.2
Zinc	47	Lead	.1
Iron	47	Mercury	.1
Aluminum	47	Gallium	.1
Molybdenum	47	Bismuth	.1
Selenium	19	Niobium	.05
Tin	14	Thallium	.05
Copper	14	Helium	.03
Arsenic	14	Gold	.02
Uranium	14		

Seawater contains an average of 35,000 parts per million of dissolved solids. In one cubic mile of seawater, weighing 4.7 billion tons, there is about 165 million tons of dissolved matter, mostly chlorine and sodium. The volume of the ocean is about 350 million cubic miles, giving a theoretical mineral reserve of about 60 quadrillion tons.

RICHES OF DAVY JONES' LOCKER

The world's oceans are a storehouse of a great variety of mineral materials. They vary greatly in characteristics and occurrence. The minerals include those dissolved in the sea water, those accumulated on the ocean floor, and those locked in rocks beneath the ocean floor. If the minerals of the sea could somehow be extracted from the water and spread evenly over a smooth sphere the size of the earth, the resulting mineral layer would be 150 feet thick. It has been estimated that within the oceans there are some 50 quadrillion (metric) tons of minerals, including:

2 quadrillion tons of magnesium

100 trillion tons of bromine

7 trillion tons of boron

20 billion tons of uranium

10 billion tons of gold

(See the chart of the elements in sea water.)
At present, only common salt, magnesium, bromine and fresh water are being recovered from sea water. The gross value per cubic mile of sea water of the 17 common industrial elements is around $600,000.00.

Most of these elements are in short supply in the United States. In fact the United States is importing most of the resources which it needs to survive. So we have become dependent on other countries for our supply of needed resources. With this dependence on other countries for resources, we have put ourselves in a position where we may face economic blackmail with these resources. This is presently occurring with our dependence upon the OPEC countries for our oil. Mining the resources from the sea would help the United States become more resource independent.

The major economic problem in removing the elements of low concentration from sea water is the huge amount of water that needs to be pumped and processed. A plant handling this much water would have to process 2.1 million gallons per minute, every minute for an entire year. Progress has been made in economically recovering a few of the elements of higher concentration. These minerals are bromine, iodine, and magnesium. The removal of these from the sea water is the same in cost as removing them from land sources.

WATER--THE MOST PRICELESS RESOURCE

Among the resources of the ocean the most priceless is the water itself, and in the future it may well be the most important resource recovered from sea water. Interest in desalination (obtaining usable water by removing salt from saltwater) goes back several thousand years to Aristotle. He described a method of evaporating seawater to produce drinking water. Greek sailors of that time-period drank fresh water that had been desalted in small quantities onboard their vessels.

Even though water is central to the history of man, 97 percent of the world's supply is salt water unfit for consumption. The fresh water in lakes and rivers, so important to life, is really water in transition as it flows toward the sea.

A practical approach to solving the domestic, agricultural and industrial water problems is the application of desalination on a large scale. The processes used in pilot plants include: distillation, semi-permeable membranes, (reverse osmosis and electrodialysis), freezing and crystallization.

Distillation processes are the most widely used today. All of the world's larger desalination installations use this method. This includes the 1,000,000 gallon per day plant at Freeport, Texas and the 905,000 gallon per day plant at Chocolate Bayou, Texas.

The cost of pure water from conventional sources is steadily rising. The cost of water from desalination is decreasing, especially in the large plants. Soon the cost of desalting in large size plants may decrease as technology advances and low-cost heat sources are developed.

Long-range estimates indicate that by the year 2000, world desalting production should be more than 30 billion gallons per day, compared to about 0.10 billion gallons per day in 1970. This 30 billion gallons per day is about 8 percent of U.S. domestic use today.

We must renew our understanding of the importance of water. Our personal and national lives depend on the quality and supply of fresh water and the careful use of the resources from the sea.

A SOLAR STILL

Make a solar still and distill salt water into fresh water by using energy from sunlight.

1. Obtain a plastic tray with cover. (Plastic shoe box)
2. Cover the tray with black paper (construction paper) (side and bottom).
3. Cut a piece of aluminum foil a little shorter than the length of the tray. Attach it to the sides of the tray by making a small fold.
4. Fold the foil to make a V shape.
5. Pour a salt solution (10 grams of salt in 100 ml of water) into the tray to a depth of 1/2 inch.
6. Put the cover on the tray.
7. Set it in direct sunlight.
8. Let it remain undisturbed until drops collect on the underside of the cover.
9. When a large number of drops have collected, tap the cover to make the drops roll into the foil "V" trough.
10. Pour the sample into a cup and taste it.

Answer:

1. Where did the drops that formed on the cover come from?

2. Are these drops "fresh" or "salt" water?

3. Some people have said that the future of a country depends on her water supply. Do you think this is true? Why or why not?

The demonstration you set up is a simple process that distills a liquid with the energy of sunlight (solar energy). It works well on a small scale. However, it costs too much to build the solar stills and pump sea water into them and fresh water out. We can't irrigate a field with high cost water and expect to grow low cost crops.

4. What do you think will happen in the future?

MORE OF THE RICHES OF DAVY JONES' LOCKER
NUMBER THREE--MAGNESIUM METAL

Magnesium is the third most abundant element found in sea water. Ninety percent of magnesium metal produced in the U.S. is obtained from seawater. Some 65 percent of the world's production comes from only two plants that process seawater: Dow Chemical Company at Freeport, Texas and Norsk Hydro-Elektrisk, Norway. Magnesium is used where weight is important, since it is the lightest of structural metals.

The first magnesium metal from seawater was produced in 1949 from the Gulf of Mexico by Dow Chemical of Freeport, Texas. It is estimated that a cubic mile of seawater contains roughly six million tons of magnesium. This is approximately one-sixth of an ounce per gallon and is worth less than 10 cents. The Dow plant pumps approximately 1 1/2 million gallons per minute or almost 2 billion gallons per day. This includes the water for cooling.

Magnesium hydroxide is also removed from the water at the Freeport plant and sent elsewhere. Bromine was extracted from seawater from 1941 to 1970 at Dow Chemical. This operation is no longer occuring, so the only plants are in France, Italy, England and Japan.

OIL -- BLACK GOLD

Oil is found under rocks on land. It is also found under rocks under the sea. Oil deposits extend into the continental shelves as do the deposits of many other minerals. Oil is the principal mineral of economic value that is obtained from the continental shelf. At present the most productive offshore fields around North America are in the Gulf of Mexico.

The future of the world's oil industry lies underwater. There will not be another Middle East oil field on land. There may be as much as four billion barrels of oil under the continental shelf of the U.S. Atlantic Coast. There is oil under the Gulf of Mexico, the west coast and Alaska's broad shelf may hold a further wealth of oil. In the end, only actual drilling will determine how much oil there is under the shelf. The continetal slopes, from about 200 meters down to 3,000 meters, may hold further stores of petroleum, but it will be hard to get at them because of the great depths as well as the sea floor configuration. As for the deep ocean floors, they are geologically young and largely composed of basalt. This is not the kind of rock beneath which oil is likely to be trapped.

NATURAL GAS

Just as there is oil under the continental shelves there is natural gas. There may be as much as 14 trillion cubic feet under the shelf of the U.S. Atlantic coast. However, interest is focused on the geopressure zones of the Gulf coast region. These areas could lead to more gas than we have dreamed of, enough for centuries. The geopressure systems are 150,00 square miles of porous shale and sandstone. These are saturated with hot brine at abnormally high pressure. So far there is good scientific evidence that this brine could contain as much as 50,000 trillion cubic feet of gas. That is 2,500 times our present yearly production.

Another possible marine source of gas is from methane hydrates. At certain pressures and temperatures, methane and water form an icelike substance beneath the permafrost and in deep-ocean bottoms. They were not noticed until the mid-1960's. The hydrates may have captured enormous quantities of gas.

How much is there? Only by drilling, by developing solid engineering data and lab reseach are we going to be able to answer the questions. How much gas is there? How much can we produce and at what cost?

OCEAN COAL MINES ?

Coal is one of the minerals which has deposits extending into the continental shelf. Coal is abundant througout the world on the continental shelves. If coal develops as the main raw material for energy, we may see oceanic coal become important. However, the land coal reserves are so great that they will be the main source of coal. The oceanic coal will not be mined until its extraction costs equal that of land coal.

THE ECONOMIC INDICATOR

Sulfur is so important to modern industry that it is considered to be an indicator of the nation's economic activity. Most of the United States sulfur is mined from salt dome deposits in the Gulf coastal region. As the sulfer deposits on land are being depleted, more sulfur is being recovered from the offshore salt domes in the Gulf of Mexico. It is not known how many salt domes in the Gulf contain sulfur since it was discovered during oil explorations.

Sulfur is used to make sulfuric acid. Sulfuric acid is needed by the fertilizer, chemical, paint and pigment, iron and steel, rayon, film, paper, petroleum and many other industries.

"THAR'S GOLD IN THEM WATERS"

There is gold in those waves and there is gold under the waves. Gold may be found underwater in areas where streams that contained large amounts of gold empty into the ocean.

When gold was discovered in California in the nineteenth century, a gold rush took place causing towns to spring up overnight. The discovery of gold under the water has not caused the same excitement. On land only a pick and shovel was needed. Mining the ocean raises much greater problems.

The removal of gold from beneath the sea is complicated and expensive. Methods must be discovered that will interfere with bottom-dwelling organisms only for a short time period. It must not seriously affect the marine environment.

A WOMAN'S BEST FRIEND

Off the coast of Africa, millions of dollars worth of diamonds lie on the seabed. A Texan, Sal Collins, was the first to remove diamonds from the seabed on a commercial scale. He used barges to dredge the offshore area. Although his success was limited, he opened the way for underwater mining.

Today, mining barges with over a hundred men use suction hoses to pump gravel and diamonds on board. The diamonds are removed and sorted by hand. The remaining material is returned to the sea. Support and sampling vessels prospect for diamonds. When an area is rich, large-scale dredging is taken over by the large mining barge. This severely disrupts the life of organisms that live in the dredging area on the continental shelf.

JEWELS FROM THE SEA

Man has always been attached to shells and fascinated by their beauty. Primitive man actually used shells as money. Even today, shells are of value. For example a great spotted cowrie shell, of which only 18 are known to exist in the world, was offered for sale in 1973 for $1,750.

Shell collecting has led to hundreds of shell shops around the world. Most are located in tourist and resort areas near the sea. Many of the valuable shells in the shops are

collected by divers. They collect the marine life for their shells only. In some areas the shell animals no longer exist because of this collection.

Red coral has always been valued for its beauty. It was also used as a medium of exchange. Eventually wars were even fought over the right to take coral from the Mediterranean. Today instead of divers depleting the coral reefs, dredges are used. In a few years all coral will be a souvenir of the past. Dredging takes coral which took thousands of years to form, in a short period of time. The dredging also kills the living coral and other inhabitants of the reef.

As coral becomes more scarce, the price increases. The price of coral is almost as expensive as the price of gold. Also a coral diver can earn in a few months more than a business executive does in a year. That is, as long as there is coral.

THE DULLEST RESOURCES--SAND AND GRAVEL

When compared with oil, diamonds and gold, sand and gravel seem very dull. However, sand and gravel are a valuable resource for making cement for construction. In the U.S., sand and gravel is a billion dollar a year industry. Sand and gravel are second in economic importance behind oil and gas. Projections indicate that by the year 2,000 the demand will increase four times.

Presently in the United States, there is little mining of offshore sand and gravel. In Great Britain the land sources of gravel are close to being depleted. It is projected that by 1990 England will get all its sand and gravel from the sea. The ocean in its beach erosion processes produces and sorts gravel and sand into different sizes. Sand and gravel from land sources often must be crushed which requires energy and increased cost.

Dredging the continental slope can turn entire marine environments into wastelands. Plant life, attached organisms, shellfish and crustaceans die from silt churned up by dredging. Eggs and larvae of many species will be destroyed. Sand and gravel are an important resource for the continued growth, but their mining is also a destroyer of the marine environment.

THE MYSTERIOUS MANAGANESE COBBLESTONES

The most glamorous and maybe the most mysterious marine resource is the billions of tons of metals contained in the maganese nodules scattered on the ocean floor. In some areas the sea floor looks like a cobblestone street due to the large number of the nodules. It is estimated that in some areas the nodules concentration reaches 180,000 tons to the square mile.

The nodules also contain iron, nickel, copper, cobalt and traces of two dozen other elements. The elements found in the nodules will vary from one location to another.

Besides the economic value of the nodules for the metals they contain, they have another vaulable quality. The nodules are a renewable resource. They are continually forming; however, they grow very slowly. The process by which the nodules are formed is not clear. Once this is learned, it might be possible to "raise" the nodules on a mineral farm.

Recovering the nodules poses new problems in technology and of international law. The two most reasonable mining ones are the use of deep-sea hydraulic systems or of a cable bucket system. The hydraulic system depends on a dredge to collect and sort the nodules on the ocean floor. The cable-bucket system is a series of collecting containers attached to a cable that moves them down and across the ocean floor.

Mining the nodules will not be easy. There are difficulties in controlling a long length of pipe or cable from a ship in a rough sea. It will also be costly.

Although the nodules are found in areas that are almost biological deserts, it does not mean that mining will have no effect on the marine environment. The potential problems include: disruption of the sea floor ecosystem; redistribution of sediments; alteration of chemical balances; and sediments may bury organisms that live on the sea floor. A greater environmental problem may come from the plants on land that will process the modules. They will have to dispose of millions of tons of residues which will contain toxic metals.

There is also the uncertainty about the legal aspects of deep-sea mining. Who will control the mining? Who owns the nodules? These questions must still be answered. Successful exploitation of the minerals of the sea depends

on three factors: (1) more geological knowledge to determine the location of resources (2) technological advances for pollution-free extraction and mining (3) definition of international law regarding marine mineral rights. Number three is interrelated with the other two because national governments and private industry want legal protection for their investment.

SHELLS AND SAND

In addition, many specialized mineral sands are found on the shelves. Glaniconite is mined as a fertilizer. Almost all the oil drilling muds come from offshore deposits in Alaska.

As much as 20 million tons of oyster shell have been produced from the shelf. Most of this came from Texas and other Gulf Coast states. It is estimated that a minimum of 100 million tons of shells may lie on the continental shelf off the Gulf Coast. The oyster and clam shells are used in concrete and road material, manufactureof cement and lime, poultry grit and fertilizer additives.

Investigations have shown high concentrations of zircon, titanium and iron in the Gulf. Zircon is used in resistant types of materials like chemically resistant ware, electrical insulators, glazes, porcelains, enamels and pigments. Other deposits in the Gulf include potash-rich layers, phosphatic rock, iron ore, bauxite and possibly other metallic veins. Much remains to be learned about the mineral treasures of the continental shelf.

TO SUM IT UP!

What can we say in summary on the mineral wealth of the oceans? We can say that all of the minerals of the land appear in the oceans and in concentrations that may be larger than those on land. Finding the deposits of the minerals in the ocean is more difficult than finding them on land. In the water the minerals are spread out over the oceans while on land they are concentrated into particular areas. We can predict that an increasing percentage of the world's minerals will be obtained from the sea. Also someday the ocean may be the major storehouse of the world's mineral wealth.

WHO IS THE OWNER?

Who owns the resources of the ocean? In the past, it was whoever could stake a claim. Today with technology, our ability to take from the sea has also changed.

This could be the picture in the year 2000. The coastal countries have extended their limits to the centers of the oceans. All vessels must pay a tax as they pass from one country's zone to another. There is constant fighting between the rich and the poor countries for the resources of the sea. There is fighting between the coastal countries and the landlocked countries for ownership of the ocean's mineral resources. The landlocked nations are demanding access to the ocean through neighboring countries as well as fishing and mineral rights in the sea. The world situation tense. Fish are rare. The fish that are found taste odd. Most of the ocean is polluted. In most coastal areas, swimming is forbidden by law. Pollution is killing most of the phytoplankton which produce the world's oxygen.

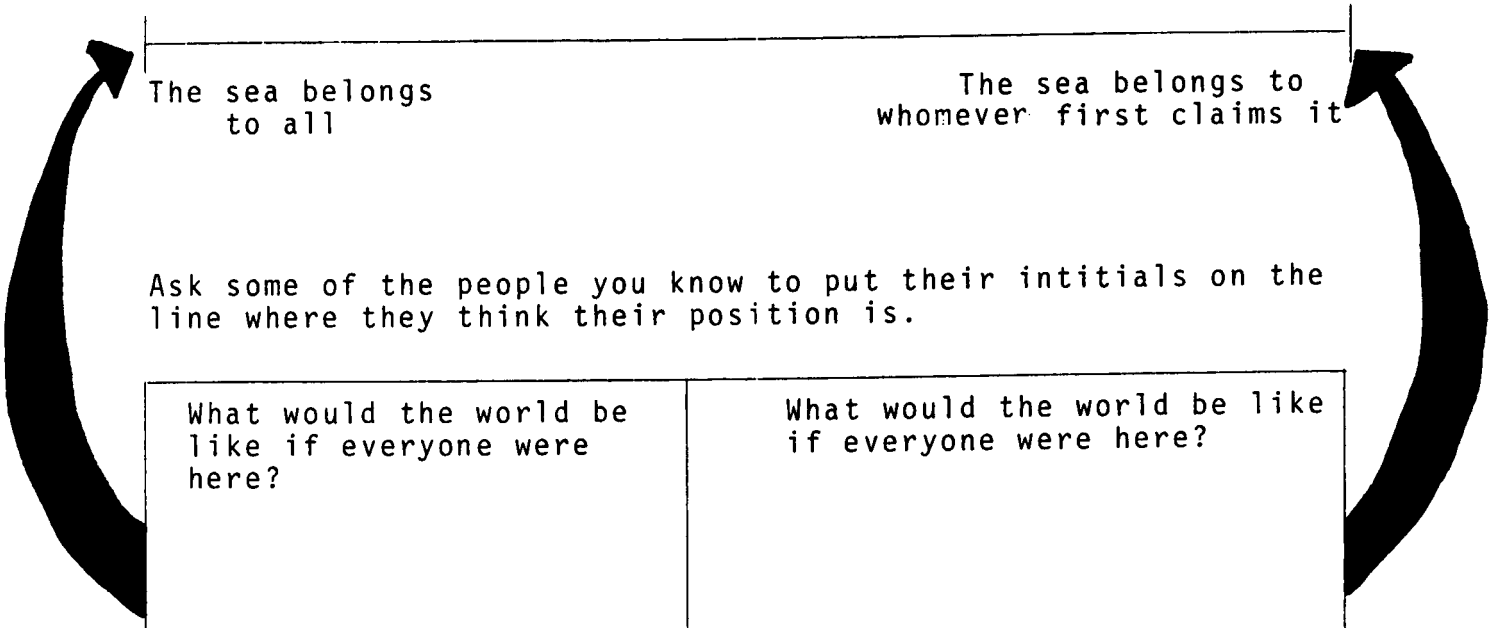
Does it sound scary? It could happen. The 1970s have seen growing tension between governments over fishing rights, rights of passage, mineral resources, control of pollution and scientific exploration.

In 1967, the United Nations created a forty-two nation study committee to study the problem. On the recommendation of the committee, the UN General Assembly adopted a resolution in 1970 stating that the oceans were "the common heritage of mankind." This became the basis for a series of international conferences to establish a new law of the sea. There have been conferences in 1973, 1974, 1975 and in 1976 with more than 1,200 negotiators from 156 nations.

One of the most important and controversial issues before the Law of the Sea Conference is the formation of an international authority to manage and distribute the resources of the sea. The crucial question is, can we find a way to create this needed organization in time?

QUESTION OF OWNERSHIP

Put your initials on the line that represents your position.



Ask some of the people you know to put their intitials on the line where they think their position is.

What would the world be like if everyone were here?	What would the world be like if everyone were here?

Where do you think we (the world) are today on the question of ownership?

What are the possible alternatives?

Why are a nation's extended boundaries what it says they are and other nations will agree to?

Do animals have a common right to the oceans just as people do? How would this affect our use of the oceans?

WHAT I THINK SHOULD BE DONE

Congratulations! You've just been invited to speak to a session of the United Nations on "What I Think Should Be Done About the Oceans' Mineral Resources." The speech is to be five minutes long. You'll probably want to make an outline so you don't leave anything out. (Your outline may differ from the one below.)

"What I Think Should Be Done About the Oceans' Mineral Resources"
by_____

I. _____

A. _____

B. _____

C. _____

II. _____

A. _____

B. _____

C. _____

D. _____

III. _____

A. _____

B. _____

C. _____

TOPIC SEVENTEEN
RECREATION

ACTIVITY ONE--Marine Recreation and You
ACTIVITY TWO--A Needed and Beneficial Resource
ACTIVITY THREE--Marine Parks?

Materials for Classroom Use:

You Are the Recreation Director/Activity
Recreational Activities/Activity
Your Uncareer/Activity
Recreation and the Economy/Activity
Problems in Recreational Development/Activity
Needed: Marine Parks/Reading
Design a Marine Park/Activity

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 identify marine recreational activities;
1.1 defend recreation as a marine resource;
2.3 evaluate a marine recreational problem;
2.6 analyze the marine recreational activities through time in relation to values and lifestyles;
2.6 compare and contrast marine recreational activities in different cultures;
2.6 identify and clarify his own value position in relation to marine recreational activities;
2.7 formulate possible future marine recreational activities;
3.1 discuss the interplay of the many facets (sociological, economic, governmental, psychological, and moral) in man's use of the marine environment for recreation;
3.2 describe and identify situations where technology has caused a change in the marine recreational activities;
3.3 analyze which factors are important in utilization of the marine environment for recreation;
3.3 identify a situation in which short term economic gains may produce long term environmental losses;
3.4 identify man's marine recreational needs and wants--past, present and future;
3.4 make projections about the future consequences of man's use of the marine environment for recreation;
3.4 plan a marine park;
4.2 express personal philosphy on marine recreational activities.

Teaching Suggestions:

The purpose of this lesson is to have the students analyze the marine

environment in relation to recreation and make decisions concerning its use.

1. The activity You Are the Recreation Director is to help recognize the economic and environmental impact of recreation on the coastal zone.

2. Your Uncareer is to have students think about future coastal recreation and the impact of more leisure on recreation. From the Recreational Activities sheet, the students have learned that a number of today's activities were unheard of when their parents were growing up. The same will be true for their (students) grandchildren. Have the students think in terms of which activities of today will also be activities of the year 2000 and what the new activities would be.

3. In Problems in Recreation, discuss an example(s) of each of the general problems with the whole class. Encourage students to generate related questions and then strive to research and answer them.

4. References:

Texas Parks and Wildlife Magazine
Young Naturalist: Beachcombing
Vol. 30, No. 7 (July 1972) pp. 6-9
Parks take Planning
Vol. 32, No. 11 (Nov. 1974) pp. 2-5
Beneath the Gulf (diving)
Vol.33, No. 4 (April 1975) pp. 16-21
Winter Diving
Vol. 34, No. 2 (Feb. 1976) pp. 6-9
Too Many People
Vol. 35, No. 12 (Dec. 1977) pp. 16-18
Master of the Wind & Water (sailing)
Vol. 36, No. 6 (june 1978) pp. 2-5
Galveston Island
Vol. No. 8 (Aug. 1978) pp. 10-13
National Geographic
Our National Wildlife Refuges: A Chance to Grow
Vol. 155, No. 3 (March 1979) pp. 342-349.

TOPIC SEVENTEEN--RECREATION
MARINE RECREATION AND YOU

Complete--

You Are the Recreation Director activity.

Share--

Your plans with your classmates.

Answer--

The questions.

Complete--

The Recreational Activities sheet.

Discuss--

The questions with your classmates.

Draw pictures
or make symbols--

For Your Uncareer activity.

YOU ARE THE RECREATION DIRECTOR

You have been hired as a recreation director in the Gulf coastal area. Your first job is to plan a weekend for twenty people. All you know about them is that they are more or less like you and that they want to have a good time.

Divide your paper into 4 columns. In the first column: What would be the schedule of activities for the weekend? In the second column list the facilities you would use for each activity. In the third column list the equipment you would need for each activity. In the fourth column place a $ sign by all of the activities which cost money.

Place an E beside all activities which use petroleum energy (gas, oil). Place a check by all the activities which can only be done in a coastal area. Place an X by all the activites that pollute the marine environment.

1. Did you list activities that you like to do or activities you thought the group would like?

2. Which activity do you think the group will enjoy the most?

   What activity would you enjoy the most?

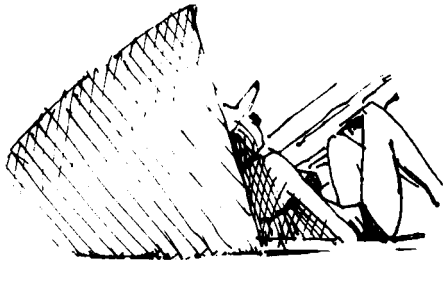
3. How many activities in your schedule can only take place in a coastal zone?

4. Which activity will have the greatest economic value to the area? Which will have the least?

5. How would your list of activities differ if this weekend had been 25 year ago?

6. What effect would the age of the group make in your plans?

7. Discuss the economic effect of recreation on the coastal area.



RECREATIONAL ACTIVITIES

Beachcombing	Hunting	Sunbathing
Bicycling	Lounging	Surfing
Bird watching	Motor boating	Swimming
Canoeing	Motorized bikes	Tennis
Camping	Oyster cookout	Visiting historical sites
Crabing	Painting	Visiting archeological sites
Cruises	Photography	Walking
Driving	Picnicking	Waterskiing
Dune buggy	Sailing	Wildlife watching
Fishing	Scuba Diving	Others _____
Fish fry	Sea shell collecting	_____
Golf	Shrimp broil	_____
Horseback riding	Sightseeing	

1. Place a X by those activities which can only take place in a marine environment.
2. Which recreational activities would your grandparents have participated in when they were your age?

3. Why didn't some of the other activities take place in the past?

4. Check each of the activities in which you have participated.
5. Place an * (asterisk) by the activities which you have never done and would like to do.
6. Which activities depend mainly on natural resources?

7. Which recreational activities require technology and development?

8. Which activities could have a bad effect on the environment?

YOUR UNCAREER

We spend time thinking about the future and our "career." But you won't be working all the time. What sorts of things do you look forward to doing in your leisure time? Use this page to draw pictures or make symbols of all the things that you can think of that you'd like to do in your future "time off." (Don't forget to include possible recreational activities of the future that may not exist today.)
You live within 50 miles of the coast.

TOPIC SEVENTEEN--RECREATION
A NEEDED AND BENEFICIAL RESOURCE

Read--

Recreation--A Needed Resource.

Answer--

The questions.

Complete--

Recreation and the Economy activity.

Compare--

Your Recreational Activity s Impact with your classmates.

Answer--

The questions.

Read--

Problems in Recreation Development.

Cite and Discuss--

An example of each of the problems in recreation development.

Select--

A problem of coastal recreation development.

Prepare--

A T.V. presentation on the problem you selected.

RECREATION---A NEEDED RESOURCE

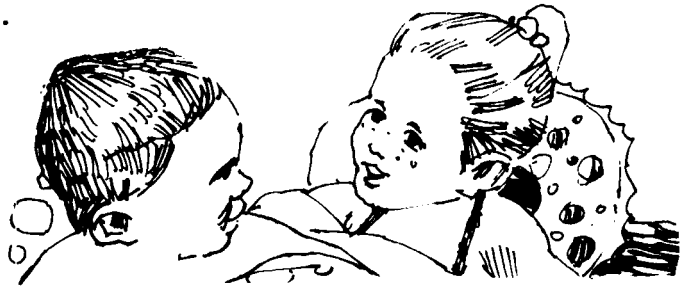
One of the greatest potential resources of the Gulf coast has little to do with oil, minerals, or even food. It is the attraction of the water itself for outdoor recreation activities. Throughout history we have found a way to mix play with work.

Pleasure and peace of mind are not small pursuits. Our ultimate goal is not production or work for the sake of working or producing. Our goal is to fill essential needs and to provide for our happiness. Today we have more free time for enjoying recreation-leisure activities in order to gain relief from the pressures of living in an overcrowded industrial society. Leisure has become an American life-style. It is more than just an occasional hobby enjoyed once a year.

A great deal of money and time is spent not only in enjoying leisure, but also in preparing for it. A conservative estimate is that the U.S. consumers will spend over 100 billion yearly on recreational activities. This will continue to increase.

Nationally, over 75 percent of the population lives in coastal areas and here the rate of growth is greatest. The recreational demand is increasing at a rate generally double that of the population growth. Texas is no exception. Nearly half of the people of Texas already live near the coast. Those choosing the coast for recreation have doubled in numbers in recent years and they spend $200 million annually for recreation uses there.

The population growth brings greater and greater pressure for recreational uses upon the same resources that are important for other uses such as for industry, agriculture, navigation and fishing. Already serious conflicts with other land uses are occuring. Can Texas protect her coast from the exploitation which has occurred on the coastal shores of other states? From Maine around to Texas and from California to Washington, development has, for the most part, monopolized the coastal zone. The development of the Texas coastal zone is beginning. It is the last major source for recreation and tourism left in the 48 contiguous states. Due to the demands of individuals for recreation and tourism it appears that the coast is a valuable resource from both the aesthetic and economic points of view.



1. Is recreation a resource? Explain your answer.

   If recreation is a resource is it a renewable or non-renewable resource?

2. Why do we need time for recreation and leisure?

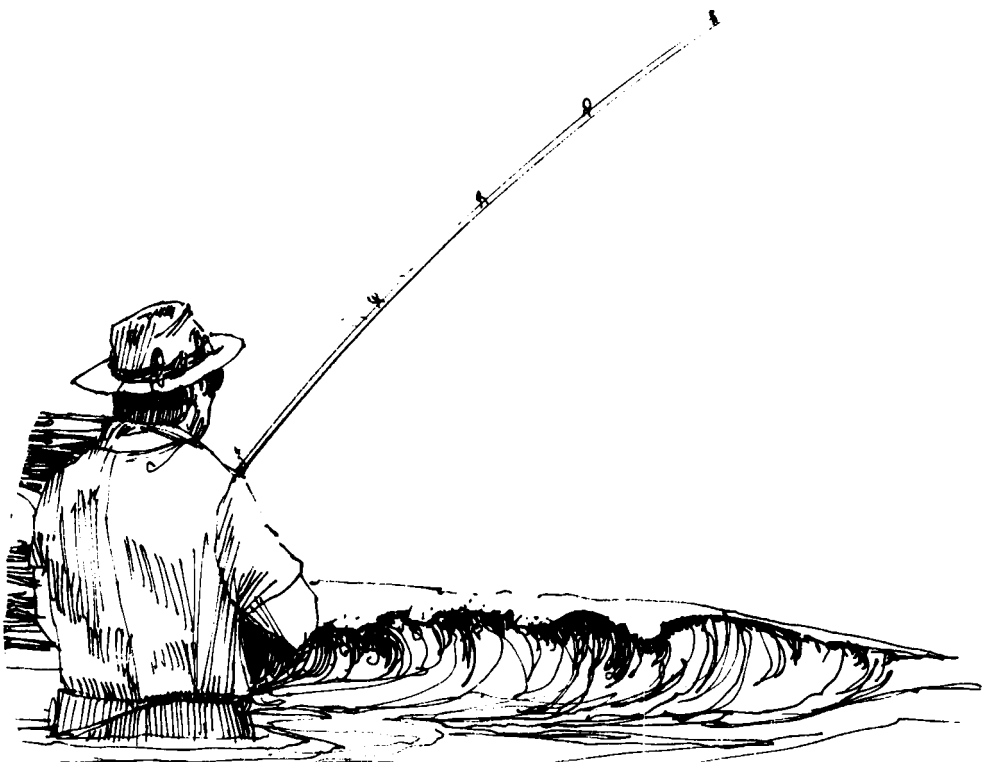
3. Why do we have more time for recreation today than we did in the past?

   Will our time for recreation in the future increase or decrease?

4. The coastal area is attracting many people for recreational activities and it will probably attract even more in the future. List the assets of the coastal zone that are important for recreation and tourism.

5. Which of the assets are natural resources?

   Which are man-made?



RECREATION AND THE ECONOMY

Select one activity from the list in the Recreational Activities lesson you have done or would like to do for a weekend. Analyze the economic impact of the activity. Write down all the items you would purchase for your weekend and include the source of the purchase. (Don't forget to include equipment, food, beverages, lodging, transporation, clothes, etc.)

1. Which activity had the least economic impact?

   The most economic impact?

2. Which activity would have the greatest environmental impact? The least environmental impact?

3. What is the relationship between economic impact and environmental impact? Is there one?

PROBLEMS IN RECREATIONAL DEVELOPMENT

Equally important as assets for development are the problems of the coastal region. The following have been identified as problems of the region for recreation-tourism development today:

Overall environmental pollution--air, water, aesthetics

Lack of centralized concern--state government and regional

Lack of planning and growth guidance

Lack of private leadership (business and citizen) in regional planning development

Lack of legal tools to guarantee good land use

Conflict with non-recreational users

Conflict among recreational users

Poor maintenance--public and private

Poor policy and management of areas

Excessive haphazard and low-quality development

Poor access to beaches

Conflict between developers and preservationists

Conflicting legal ownership and regulation of beaches

Not enough parks and recreational areas

Conflicts of social goals--parimutual betting, liquor

Lack of portable water supply

Public lack of concern towards the problems appears to be a greater obstacle than the lack of technology.

YOUR T.V. SPOT

A local T.V. station is providing time between their regular programs for public presentations on these problems. The presentation is to be 3 minutes long. You may use any medium (skit, music, charts, songs, etc.) to provide information on the problem. Select a problem from the list for your presentation. You will probably want to prepare your script so you don't leave anything out. Time your presentation so that the station will not cut you off before you finish.

TOPIC SEVENTEEN--RECREATION
MARINE PARKS?

Read--

Needed: Marine Parks.

Complete--

Design a Marine Park activity.

Share--

Your recommendations for the marine park with your classmates.

MARINE PARKS

We have attempted to preserve the beauty of land areas by the formation of National and State Parks. There are areas of real beauty in the sea as well, but the idea of preserving them is slow to develop. Yellowstone, the first U.S. National Park, was established in 1872, but it was not until 1935 that an area of the sea was included in control of the U.S. National Park Service. This was Fort Jefferson National Monument at Dry Tortugas, 65 miles west of Key West, Florida. It was not created for its marine gardens, but for the massive fortifications.

In 1971, the National Park Service only had control over the adjacent marine areas of 10 of the 47 national parks in coastal areas. Some are under study for inclusion of the marine zones and some aquatic-related areas are under consideration for addition.

One of the reasons that marine parks have developed slowly is that man has only entered the sea for recreation on a large scale in the last couple of decades. There is a feeling that there is no need for preservation since the resources of the sea are so great. This is not true for certain fishes and other marine organisms are endangered. Another attitude is that the oceans are a good dumping place for wastes. However, a can in a marine garden is as offensive as one in a land garden. Conservation must replace wanton exploitation.

A marine park does not have to be all ocean. Any park that includes part of the sea can be a marine park. Large marine parks can be divided into different areas. Recreation can be emphasized in some. Other areas could have complete protection so coral gardens can be merely observed or photographed, and fishes watched, not speared.

The advantages of marine parks are numerous. Visitors can be educated to appreciate what they see and become more aware of the need for conservation. It will be a sanctuary to maintain breeding stocks of threatened marine organisms and examples of the various marine habitats. It can serve as a research area that will not be disturbed by fisherman and others.

A major problem facing marine parks once they are established is enforcement. In marine parks it will be more difficult to enforce the park regulations. It is difficult to put fences around an area of the ocean.

Progress has been made in the development of marine parks. However, we must increase the efforts to preserve the natural areas of the sea before they are completely exploited by man.

DESIGN A MARINE PARK

The United States Park Service has asked you to locate an area to establish a marine park. You are also to make recommendations about its use.

What is the purpose of your park?

For what acitivities will the park be used?

List things that need to be considered in selecting the site for your park.

What other factors do you feel are important in establishing a marine park?

Why are park regulations more difficult to enforce in marine parks than land parks? How will you enforce the regulations?

TOPIC EIGHTEEN
WATERFOWL

ACTIVITY ONE--For the Birds . . .

Materials for Classroom Use:

Waterfowl/Reading

Major Objectivies for the Topic:

After completing the activities, the student will be able to:

1.1 explain waterfowl and wildlife as a marine resource;
2.5 reconstruct the relationship of the waterfowl in the marine environment;
2.6 identify and clarify his own value position in relation to waterfowl;
3.2 describe and identify where technology has caused a change in waterfowl in the marine environment;
3.3 analyze which factors are important in man's utilization and
3.4 make projections about the future consequences of waterfowl;
4.1 recognize that values influence man's use and management of the waterfowl.

Teaching Suggestions:

The purpose of this lesson is to have the students analyze waterfowl use and management in relation to the marine environment.

1. The student will complete the reading and respond to the questions (reading and questions may be distributed the previous day).

2. Discuss in small groups and/or a whole class the reading questions and the possible future alternative which they wrote.

3. Use the waterfowl articles listed in the teacher's section of Topic Six to help in obtaining information. Have the student present the information to the class as though the bird is speaking.

4. Additional articles:
Texas Parks and Wildlife Magazine
A New Look at Texas Vol. 33, No. 9 (Sept. 1975) pp. 6-8
A Better View of Wildlife Management Vo. 36, No. 6 (March 1978) pp. 13-15

TOPIC EIGHTEEN--WATERFOWL
FOR THE BIRDS

Read--

Waterfowl.

Answer--

The questions.

Write--

A possible alternative to the possible future reading.

Look up--

Information about a specific waterfowl.

Present--

The information about the waterfowl to the class as though the bird is speaking.

Optional
Read--

An article in Texas Parks and Wildlife Magazine on waterfowl or wildlife management in the coastal zone.

Optional
Write--

A short summary or report to the class on the article you read.

WATERFOWL

Past

Picture in your mind the thousands of acres of marshes and estuaries on the upper Texas Coast filled with millions of waterfowl. They migrated South each fall to spend the winter where plenty of food, water, and shelter was available for them. This was an area of wide-open spaces, very few people, no roads, or fences. Cattle roamed the prairies and grazed on the lush green growth in the marshes.

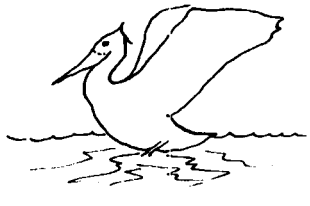
This was an area where market hunters came to slaughter ducks and geese by the thousands. They were shipped in barrels to market in the cities of the Northeastern United States. This was a thriving business in the early days. Canvasback ducks sold for $5.00 per pair; Greenhead Mallards and Pintails sold for $3.50 per pair.

Present

Now, picture the same area today, with its thousands of people living in and around these marshes. Blacktop roads leading in all directions from one area to another from one city to another. Railroads run across the area. Drainage ditches cut throughout the upper coast. Land is fenced with barb wire and the cattle are confined to certain pastures. There are large rice farms where marshes used to be, before the drainage. Large canals cut through the marshes, with tug boats pulling and pushing several sections of barges up and down the canals.

Telephone power lines run throughout the area. Airplanes fly overhead. Large cities surround the area. There are large industrial plants operating and more are being built. Oil fields are developing in and around these areas. Pipelines are laid through the marsh. There are automobiles and trucks speeding through. Insecticides and pesticides are used freely on crops and cattle. The waste and pollution from all these flow into the lowland, marshes and estuaries and bays. What a wonder, that we still have waterfowl continuing to use such an area. Will they continue?

Good sound management is necessary if we expect to keep the great number of waterfowl that migrate to the coast each fall. The marshes and estuaries on the upper Texas Coast provide wintering grounds for waterfowl.



A Possible Future

Now picture the same area in the future with good management. The management can be very complicated or simple. It can be expensive or not so expensive, depending on the location of the area and its existing conditions.

We will picture the management of a 25,000-acre ranch in this area. Due to civilization having moved in, water gates are installed on canals to control the water level. This is done to keep a certain amount of saltwater coming into the marshes and, with high tides, to maintain the water in a brackish form to preserve the marsh vegetation.

There is a large reservoir for open water for ducks and geese, which is good in the dry season. Pumps are installed to flood the rice stubble for waterfowl use. Roads have been constructed and shelled to the marsh areas for access by the hunters. Cattle walkways are built through the marsh and can be used by the hunters.

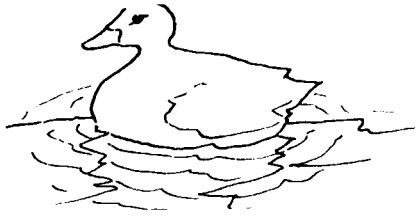
Three hundred acres are set aside as a rest area where hunting is not permitted. This provides an area where the game may rest, feed and not be bothered during hunting hours. This helps keep greater numbers of waterfowl on the ranch.

Another ranch regulation is that hunting is allowed only from sunrise to noon. This give the game afternoon and night to return from throughout the ranch to feed, rest and find shelter from hunters on neighboring ranches and marshes.

Hunters are checked in at the gate. After the hunt, the hunter returns to the checkout gate and his kill is recorded. The exact number of hunters and number of waterfowl killed is known. Hunters are given information on hunting sites and laws and a guidebook which identifies waterfowl. The ranch is open to the public and a fee is charged for hunting privileges. Between 16,000 to 20,000 ducks and 8,000 to 10,000 geese are bagged each year.

In addition to public hunting, about 3,000 acres are used for rice farming. Muskrats are trapped, and 4,000 head of cattle run on the ranch. There is fishing in the reservoir and some grain and hay is raised. There also is shrimp and crab farming.

There are problems of trespassing, careless and unknowledgeable hunters and nutria rats destroying vegetation. By good management, however, the marshes and estuaries are preserved. The can have multiple uses with economic value.



Questions

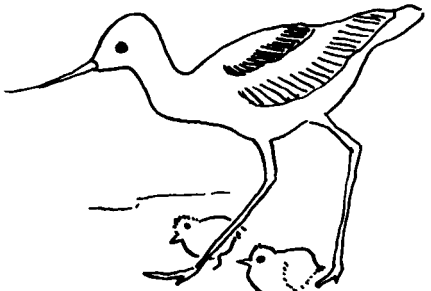
1. Why are waterfowl important and why should the marsh areas be preserved?

2. Why is good management necessary to keep a large number of waterfowl coming to the Texas Coast?

3. Why is multiple use of the area important?

4. What are some problems that must be overcome to make the future come true?

5. What do you think will actually happen to the waterfowl in the future and why?



TOPIC NINETEEN
MARINE MEDICINE CHEST

ACTIVITY ONE--Marine Medicine Chest

Materials for Classroom Use:

Marine Medicine Chest-A Lifesaving Gold Mine/Reading

Major Objectives for the Topic:

After completing the activities, the student will be able to:

1.1 cite examples of medicine and drugs from the sea;
2.5 identify the marine medicine and drugs that will be important in the future;
2.5 identify the consumer products produced from the marine organisms;
2.6 discuss ways in which marine organisms were used for medical purposes in the past and at present;
2.6 identify situations where economic values are often in conflict with aesthetic values;
3.2 describe and identify a situation where technology has caused a change in the use of marine organisms for medicine.

Teaching Suggestions:

The purpose of this activity is to introduce the student to marine medicine and drugs and problems associated with the development of their use.

1. Have the students complete the readings and respond to the questions.

2. Discuss the readings and questions as a whole class.

3. Have the students share the feelings or opinions that they expressed in their slogans and/or advertisement.

TOPIC NINETEEN--MARINE MEDICINE CHEST
MARINE MEDICINE AND DRUGS

Read--

Marine Medicine Chest--A Lifesaving Gold Mine.
Marine Biomedicine.

Answer--

The questions.

Write--

Slogans or advertisements stating your feelings and/or opinions on governments, private industry, defense, transportation, recreation, mining and other interests spending millions of dollars annually. This is spent to exploit the oceans, but marine medicine and pharmacology receive little financial support.

MARINE MEDICINE CHEST--A LIFESAVING GOLD MINE

The Pharmacology Institute
U.S.A.

Dear Capt. Seaborne,

I am unable to come and speak to your group of students due to my research schedule. However, I would like to tell you why I think that the oceans are a medicine chest. These marine resources could become a lifesaving gold mine. There are hundreds of marine organisms that are poisonous. Each one of these toxins and poisons has potential as a medicine.

Past

The earliest record of the effect of algae toxins is in the Biblical writing, Exodus 7:17-18, where it describes the waters of the Nile turning red and the fish dying. We know that dinoflagellates cause red tides and killing of fish.

The ancient Japanese ate red seaweed to cure intestinal worms. The modern cure is a substance (kainic acid) commercially prepared from the red seaweed. Cancer is not found among some of the Polynesian Islanders. The custom has been that cancer victims are given the fluid from a sea worm. Researchers are finding that substances from marine worms will stop 60% of the cancers in laboratory mice.

The natives of Guam squeezed sea cucumbers into pools where fish were. The drugged fish would float to the surface where they could be easily caught. These sea cucumber chemicals slow growth in fruit flies, prevent regeneration and stop the spread of several types of tumors in mice--a possible answer to cure cancer in man. They also stimulate the heart like digitales, a heart drug.

Present and Future

Presently, only one percent of our drugs come from the sea. Only a very small group of the marine plants and animals have been examined for potential drugs. Of the more than 2,000 organisms surveyed, mostly from the Caribbean and the Pacific, we found 250 species with confirmed anti-cancer properties and half a dozen that could be useful in the circulatory and nervous systems. Here the ancient medical records may be of help. The ancient Biblical dietary law in Leviticus 11:9-12 states: "You may eat any kind of fish that has fins and scales, but anything living in the water that does not have fins and scales must not be eaten..."

Many poisonous fish belong to the group that lacks scales and each poison is a potential drug.

The toxins from jellyfish, hydroids, sea anemones and corals that cause paralysis and death have the greatest possibility for becoming drugs for heart and muscle diseases and even epilepsy. However at present, we need to develop an anti-toxin for these toxins to protect divers.

The potential of algae is high as a source of food protein, an ingredient for dental impression substrates, treatment for ulcers, and a potential killer of bacteria. The alginic acid of kelp collects radioactive strontuim from our body and waterways, so it could be a lifesaver from the fallout of atomic explosions. Another kelp compound holds heavy particles in suspension so one will not have to shake medicines first. There is also a green algae which contains a strong antibiotic. The toxins of the dinoflagellates which cause the red tides may be used to cure bacterial diseases since they stop the growth of most types of bacteria.

A toxin from a snail causes muscles to relax-a possible drug for muscle convulsions. Another snail toxin causes muscles to contract violently so one could be the antidote for the other. A drug from it could possibly help restore damaged muscles.

Many possible drugs exist in the sea. An abalone (a mollusk) extract will protect laboratory mice from flu and polio virus. A toxin from the puffer fish acts on muscles and nerves that receive pain. It is commercially available as an antispasm treatment for epileptics and to relieve the pain of terminal cancer. The poison from the deadly stone-fish could aid in treatment of high blood pressure. The chemical from a marine worm may become an important cancer or birth control drug. A chemical from the hagfish may be able to take the place of heart pacemakers.

We have found a fungus that feeds on sewage that is the source of an antibiotic with properties similar to penicillin. An extract from the sea squirt recently cured 50% of two groups of mice with leukemia and destroyed human cancer cells in tissue culture experiments. The venom of the weever fish is undergoing investigation for a chemical that slows the heartbeat as a potential aid in surgery.

A chemical from clam liver stops cancer growth, but only if the clams are in unpolluted water. So as we pollute our waters we could also be destroying our potential cancer-

curing drugs. One of the major problems is when the chemicals in the sea change, so do the fluids in the marine organisms. Mariculture could help solve this problem.

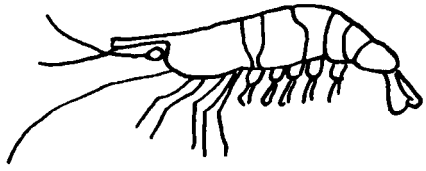
We have one group looking at the remarkable properties of chitoson-from chitin in the shells of shrimp, lobsters and crabs. It has amazing wound healing properties. Therefore it is possible that from the millions of tons of waste (skeletons and shells) we may make suture material that helps in healing.

We are just beginning our research into marine medicine and drugs and we have a long way to go. It is a long and difficult process to extract and purify chemicals. Then we must still find out what the chemical will do for a sick human.

Yes, the oceans could be a medical gold mine! Yet remember that we could very easily destroy it with pollution.

Sincerly yours

Dr. C. Pill



MARINE BIOMEDICINE

The Marine Biomedicine
Research Institute
Texas

Dear Capt. Seaborne:

Dr. C. Pill asked me to answer your questions about the ocean and the medical information it provides us. The animals of the sea that are most curious to us are those that appear to be very different from us. However, all forms of life carry on many of the same functions. Careful study of the lower forms of life can often provide clues to what can go wrong with our own physiology. In fact, almost any human organ or system in need of study will be found in a simpler, more convenient form in the sea. The ocean is providing medicine with some vital research tools.

One of the advantages of using marine organisms in our reseach is that tissues, cells, nerves, sense organs, the reproductive system, etc., are easier to get at and study. It is also less costly to use marine organisms.

Much of our modern knowledge of the nerve cell has come from the studies of the giant nerve fiber of the squid. The giant nerve cell of the squid can be removed from the animal. If the nerve cell is bathed in sea water, it will remain active for many hours in a test tube. This makes it a very useful tool in research.

Marine organisms have been used to study vision for a long time. The clam was used to learn about the loss of visual sensitivity in the light (light adaptation) and its recovery in the dark (dark adaptation). This helped us learn how our eyes adjust to the 10 billionfold range of light intensities from high noon to twilight. It was found that it was possible to dissect the eye of the horseshoe crab and record electrical activity from single nerve fibers. This contributed greatly to our understanding of how the visual message is encoded and transmitted by nerve fibers, and has helped us learn how our eyes discern forms and objects. We do not completely understand our vision and disorders of the eye. With the help of the squid, skate and other marine organisms, however, we have come a long way.

Fertilization and the beginning of development have always captured the imagination of researchers. However, it was difficult to study it in mammals since fertilization and development are internal and few eggs are produced during a reproductive cycle. However, there are certain organisms that produce many eggs to be fertilized outside the body. These can easily be studied.

The marine organisms that have proven most useful for study of fertilzation are echonoderms (especially sea urchins, sand dollars, and star fish), molluscs (particularly clams) and some marine worms. In sea urchins, for example, a female can produce between four million and four hundred million eggs in a three to four month breeding season. It is especially important that the eggs and sperms can be easily fertilized in a test tube. So fertilization and development of an organism can easily be studied. These fertilization studies of marine organisms have greatly contributed to the basic knowledge of sperm-egg interaction. In addition, this has proved beneficial to cancer (abnormal cell division) research and fertility regulation.

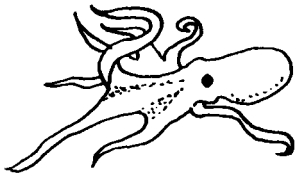
By using an oyster, researchers at the University of Texas Medical Branch at Galveston have developed a way to test for the human genetic disease, cystic fibrosis. It now can be detected when there are no symptoms present and even in individuals who are carriers.

Through studies of marine animals may come answers to such medical problems as human driving diseases, shock, sudden infant death syndrome, diabetes and stress metabolism. In addition we may learn how to do genetic engineering in many human genetic diseases resulting from the absence of a specific enzyme. By investigating the adaptations of marine mammals to water immersion, we may even learn more about ways in which man can adapt to prolonged weightlessness during space flights. The sea contains many organims which can help us in medical research.

Sincerely yours,

James C. Drift

Dr. James C. Drift



QUESTIONS:

1. List some marine organisms and how they or their chemicals might be helpful to man.

2. Why should we undertake expensive research for marine antibiotics similar to penicillin?

3. How could mariculture help in supplying marine drugs?

4. Why are poisonous marine organisms possible sources of drugs?

5. We usually see nothing wrong with killing an organism that could be dangerous to man. Why might this not be a good idea?

6. Cite some examples of why marine organisms are good medical research tools.

7. For what reasons do you think that some very small organisms have such strong toxins. The toxins are much stronger than they need to survive.

TOPIC TWENTY
THE UNSUNG HEROES

ACTIVITY ONE--Beauty
ACTIVITY TWO--Knowledge
ACTIVITY THREE--Space

Materials for Classroom Use:

Life's Extras/Activity
Jonathan Livingston Seagull/Experience
A Refreshing Refill/Reading
The Sea--A Source of Knowledge/Reading
Evidence is Being Destroyed/Reading
My Thoughts/Activity
City on the Sea/Drawing
Space--A Resource Too!/Reading
Working Under the Sea and Homo Aquaticus/Drawing
Future Undersea City/Drawing
Living and Working Under the Sea/Reading

Major Objectives for the Topic:

After completing the topic the student will be able to:

1.1 to explain why beauty, knowledge, and space are considered to be resources;
2.6 predict the future use of the marine environment as a source of beauty, knowledge, and space;
2.7 discuss the influence of the marine environment on man and nations as a source of beauty, knowledge and space;
3.1 analyze man's role in the utilization and management of the marine environment in relation to beauty, knowledge and space;
3.1 discuss the interplay of the many factors (sociological, economic, psychological, political and moral) in man's management of the marine environment for beauty, knowledge and space;
3.2 generate possible future changes in marine resources (beauty, knowledge, and space) which will be brought about by technology;
4.1 appraise attitudes towards living below or on the sea;
4.3 identify and clarify value position in relation to beauty, knowledge, and space of the marine environment.

Teaching Suggestions:

The purpose of this topic is to help the student identify beauty, knowledge, and space as marine resources.

1. Have the students complete the readings and respond to the questions and/or activities. (Readings may be distributed on the previous day.)

2. The Life's Extras activity is to help students understand the sea in terms of aesthetic value and as a source of inspiration. The students could divide into groups and use the brainstorming method in this activity and, then, discuss the results.

3. You might appoint a good reader to rehearse "A Refreshing Refill" outside of class. At the beginning of the activity have written on the board the words: aesthetic value?; resource?; physical need?; psychological need?; joy?; necessity?. Discuss with the students what these words mean, and how they are related to the word aesthetic. After a brief discussion project from a slide or filmstrip one to three beautiful sea scenes. As the students are looking at the scene have the designated student read "A Refreshing Refill." Then discuss the activity again.

4. For the Jonathan Livingston Seagull Experience have the book, Jonathan Livingston Seagull by Richard Bach, Macmillan Co. publisher, New York or Avon Books (paperback) New York, 1970, available for the students to read--or have the story taped by a good narrator (possibly an outstanding drama or speech student). The book is short. You might want to work up a question sheet to emphasize the aesthetic and symbolic meanings in the story. The class period after the story is completed could be spent listening to Neil Diamond's album "Jonathan Livingston Seagull." The music is impressive and meaningful after one has read the book. Students could be asked to close their eyes and visualize the gull's flight during "Skybird"; to "feel" the loneliness during "Lonely Looking Sky"; to "feel" the presence of the Almighty during "Be"; etc. The album jacket contains the words so these could be typed for the students to go over after first listening and experiencing. You may develop your own variation and use other music, books, poetry, etc. about the sea. Afterwards the students could develop their own activity using music, books, poetry, dance, etc. as a form of expression.

5. The Knowledge activity is designed to remind students of the knowledge of both our past history and in development of new ideas and technology.

6. Additional Reference
The Ocean World of Jacques Cousteau Volume 13--A Sea of Legends

TOPIC TWENTY--THE UNSUNG HEROES
BEAUTY

Complete--
Life's Extras activity.

Read and Discuss--
A Refreshing Refill.

Read--
Jonathan Livingston Seagull by Richard Bach.

Complete--
Jonathan Livingston Seagull experience.

Listen To--
Neil Diamond's album Jonathan Livingston Seagull and visualize the gull's flight during the different segments.

Make--
A sketch of a design for a future building based on a sea shell.

Find--
A poem, picture, painting, song, story or music that illustrates the sea as a source of inspiration to the writer or artist.

Share--
It with your classmates.

Present--
To the class art, poetry, literature, song or music which illustrate the aesthetic joy or inspiration the sea provides you. It may be your own creation or work done by a writer or artist which expresses your feelings.

Find Pictures--
Of marine organisms, especially sea shells. Use these for ideas to design future buildings.

LIFE'S EXTRAS

1. How do you refill your creative springs? In other words, when the hectic schedule of your daily activities gets to you, how do you relax, unwind and renew yourself?

2. Does nature play a role in your relaxing and renewal? If so, explain.

3. What is beauty?

   What does beauty mean to you?

4. Does beauty play a role in your relaxing and renewal? If so, explain.

5. Is beauty necessary or is it just an extra (something you could do without)?

Make two lists: one listing marine things that are necessary and the other things that are extras.

Necessary Marine Things	Extra Marine Things

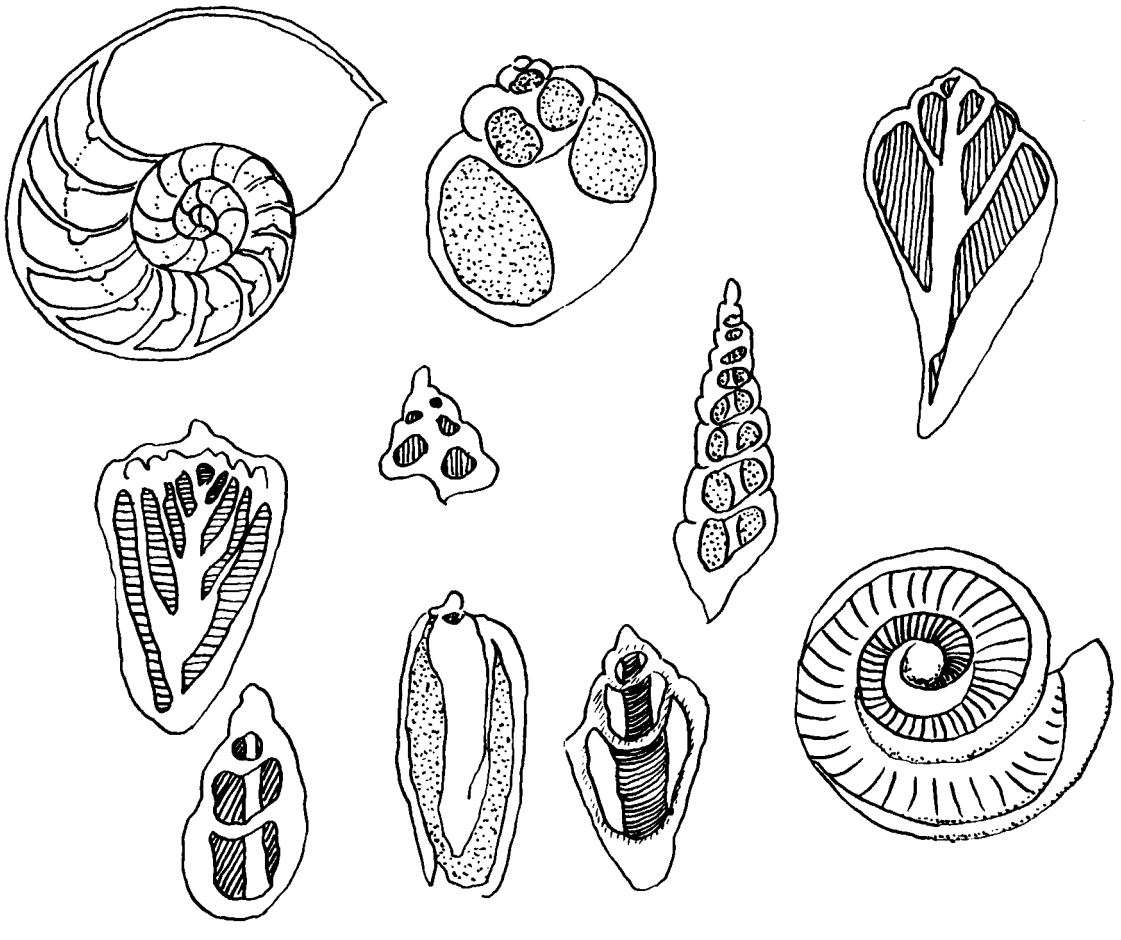
Share your lists with your classmates.

A REFRESHING REFILL

The sea's greatest treasure is not a monetary one. The greatest joys are those of the heart and the sea can flood us with an aesthetic joy. The sea exists to nourish us not only physically but spiritually. It can refill our creative springs.

Frank Lloyd Wright, the great American architect, told his students to examine the designs in nature, expecially those in sea shells. The housing of the marine organisms may seem lowly when compared to the great buildings constructed by man. However, the marine organisms have inspired form to match the complex function. Man's structures often lack inspiring form. The sea provides us with needed inspiration.

The sea provides a much needed escape and release from our hectic lifestyle. It draws us, capturing our attention and imagination. The sea is an inspiration and has been throughout the ages. This is seen in art, literature and song. As our urban areas increase, we will need the refreshing spiritual refill of the unpolluted sea even more.



JONATHAN LIVINGSTON SEAGULL EXPERIENCE

Obtain and read the book Jonathan Livingston Seagull by Richard Bach.

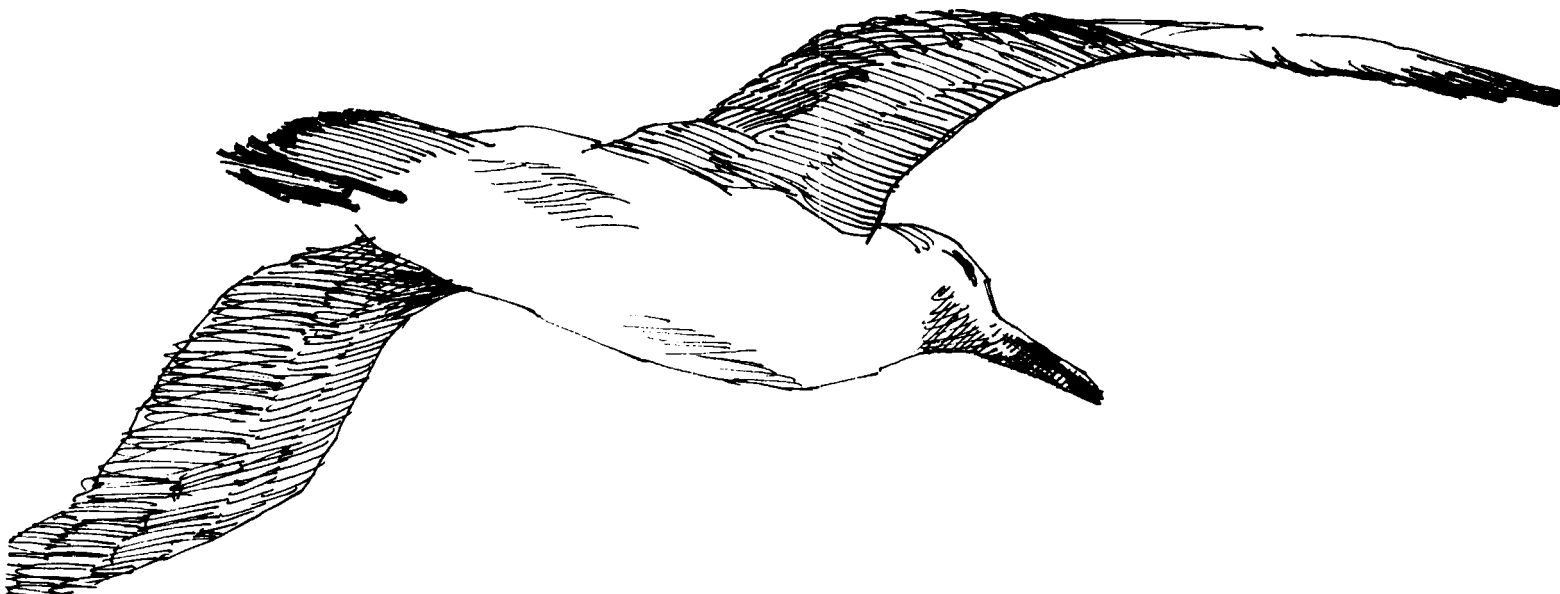
Identify the aesthetic and symbolic meanings.

What emotions and feelings does it express?

What does the book say to you individually?

Obtain a copy of Neil Diamond's album "Jonathan Livingston Seagull." Listen to the album and experience (see, feel, etc.) each segment. Visualize the flight during "Skybird"; feel the loneliness during "Lonely Looking Sky"; feel the presence of the Almighty during "Be"; etc. Select three segments which impressed you most and briefly express your personal feelings and the meaning these had for you.

Share and discuss the experience with your classmates.



TOPIC TWENTY--THE UNSUNG HEROES
KNOWLEDGE

Read and Discuss--

The Sea-A Source of Knowledge.
Evidence is Being Destroyed.

Complete--

The My Thoughts sentences.

Share--

Your sentences with your classmates.

Optional
Read--

"Glass Treasure From Aegean," National Geographic Vol. 153, No. 6 (June 1978) pp. 768-793
"The Sunken Treasure of St. Helena" Vol. 154, No. 4 (Oct. 1978) pp. 562-576

THE SEA--A SOURCE OF KNOWLEDGE

Early man could not have conceived, even approximately, of the oceans as we know them today. Even today we still have much to learn from the sea. The greatest resources of the sea are the aesthetic and intellectual joys it can flood us with.

Marine Archaeology

Marine archaelogy can give us a glimpse of the technology of a period and the life of a seaman at that time. The excavation of the Revolutionary War ship DEFENSE will give us a view of the life of a seaman and the technology during the Revolutionary War. The artifacts provide information on the story and daily life of the Colonial period not found in books.

There is an excavation of an 11th Century shipwreck which was carrying a load of Islamic glass when it sunk in 100 feet of water off the southern coast of Turkey. It has provided evidence of important changes that took place in wooden hull construction and design at that time. It may tell of the ship's port of origin, her destination, the route she took, who the people were, what they traded, with whom they traded and what life aboard an 11th Century vessel was like.

Marine Archaelogy will help to determine the location, age, construction techniques and overall design of ancient ports. It will answer many questions of man's past history and his relationshp with the sea which we can learn of in no other way. It shows us a lively world that has vanished.

Marine Geology

The sea is level but the surface of the earth beneath the sea is as varied as the more familiar surface of the land. There are rocky mountains, muddy plains, chasms, cliffs and canyons.

The rough jigsaw puzzle fit of the continents first was noticed when the New World was mapped in the 16th century. In the last two decades, scientists have found new evidence to support the theory that the continents have drifted apart. The proof of their theories came from the sea. They discovered the Mid-Oceanic Ridge, sources of earthquakes and the reversal of magnetic fields and found and measured the movement of continents. According to the theory of continental drift, the continents came into their present position by the spreading of the sea floor between the great land masses. The sea is helping to decipher the origin of the earth and the geological events that followed.

Medicine and Drugs

The animals of the sea that are most curious to us are those that appear to be very different from us. However, all forms of life carry on many of the same functions. Careful study of the lower forms of life can often provide clues to what can go wrong with our own physiology. In fact, almost any human organ or system in need of study will be found in a simpler, more convenient form in the sea. The ocean is providing medicine with some vital research tools.

Obviously, marine drug discoveries involve only a small part of the organisms known to live in the seas. Hundreds of thousands are waiting to be understood, appreciated and used. The knowledge the sea provides us in all areas is definitely one of its greatest resources.

Invisible Messages

Marine organisms have especially well developed nonvisual senses, which are able to receive "invisible messages." Many of the "invisible messages" produced by undersea creatures cannot be read or understood by man. We are only beginning to comprehend the range of "invisible messages." We are extending our senses with the help of instruments. The sea is just different enough from land to be loaded with helpful hints. Replacement senses are inspired by the sea. In Britain scientists have built acoustic goggles for the blind which transmit and receive ultrasonic sounds, very much the way dolphins do. They enable a sightless man to "see with his ears.

As we develop our capability of tuning in more and more to the oceans, we expand our intellectual horizons, our sources of inspiration, and our artistic and philosophical creativity. Yes, the sea is actually a treasure chest of unopened knowledge.

EVIDENCE IS BEING DESTROYED

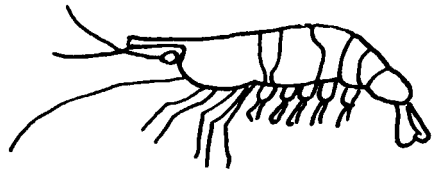
Many changes that result from cultural and technological changes affect the interactions between man and his natural environment. Indications of these interactions are records of the past. They are resources. They are important for cultural, scientific, aesthetic and psychological reasons. This evidence is continually being lost.

In spite of our modern technological protection from the natural processes, many lessons can be learned from a study of the past. Indianola might have been Texas' great port city, but it was destroyed by hurricanes in 1875 and 1886. There is a lesson there and in the Galveston hurricane of 1900. There are lessons to be learned from man's coping with the drought years of the 1870's, the 1930's and the early 1950's. There are lessons to be learned from the uncontrolled actions during the boom years of oil gushers and spills. The flaring of natural gas in the coastal oil fields during the early 1900's was common. All these show how man has an impact on the environment and how the environment exerts an impact on man.

It has been estimated that one-third to one-half of all recorded archaeological and historical sites in the coastal region have already been destroyed. Less than one percent of this area has been studied to locate evidence of the past. The submerged areas of the coastal region are almost totally unexplored. It is difficult to predict where a great new archaeological resource or a historical resource may be found on land. It is also hard to predict where evidence may exist on submerged lands.

It is in our best interest to learn from the past and to benefit from past experiences. Therefore, any sites with evidence that provide a link with other times and other people and the land are valuable.

MY THOUGHTS



Knowledge of the sea in the past was important to _____

_____ because _____

_____.

Knowledge of the sea is important to me today _____

_____

_____.

Knowledge from the sea is important to the world _____

_____

_____.

In the future, knowledge from the sea _____

_____

_____.

Therefore, I feel _____

_____

_____.

I wish _____.

I will _____.

Etc. _____

_____

_____

TOPIC TWENTY--THE UNSUNG HEROES
SPACE

Look at--

Drawing of Floating City of the Future.
Drawing of a Man-made Island.

Read--

Space-A Resource Too!

List--

Possible uses of the surface of the sea.

Make--

Sketches of your designs and ideas for the use of the sea's surface.

Look at--

Pictures of working under the sea and Homo Aquaticus.
Future Undersea City

Read and Discuss--

Living and Working Under the Sea.

Read--

An article on living and working under the sea from a magazine or book.

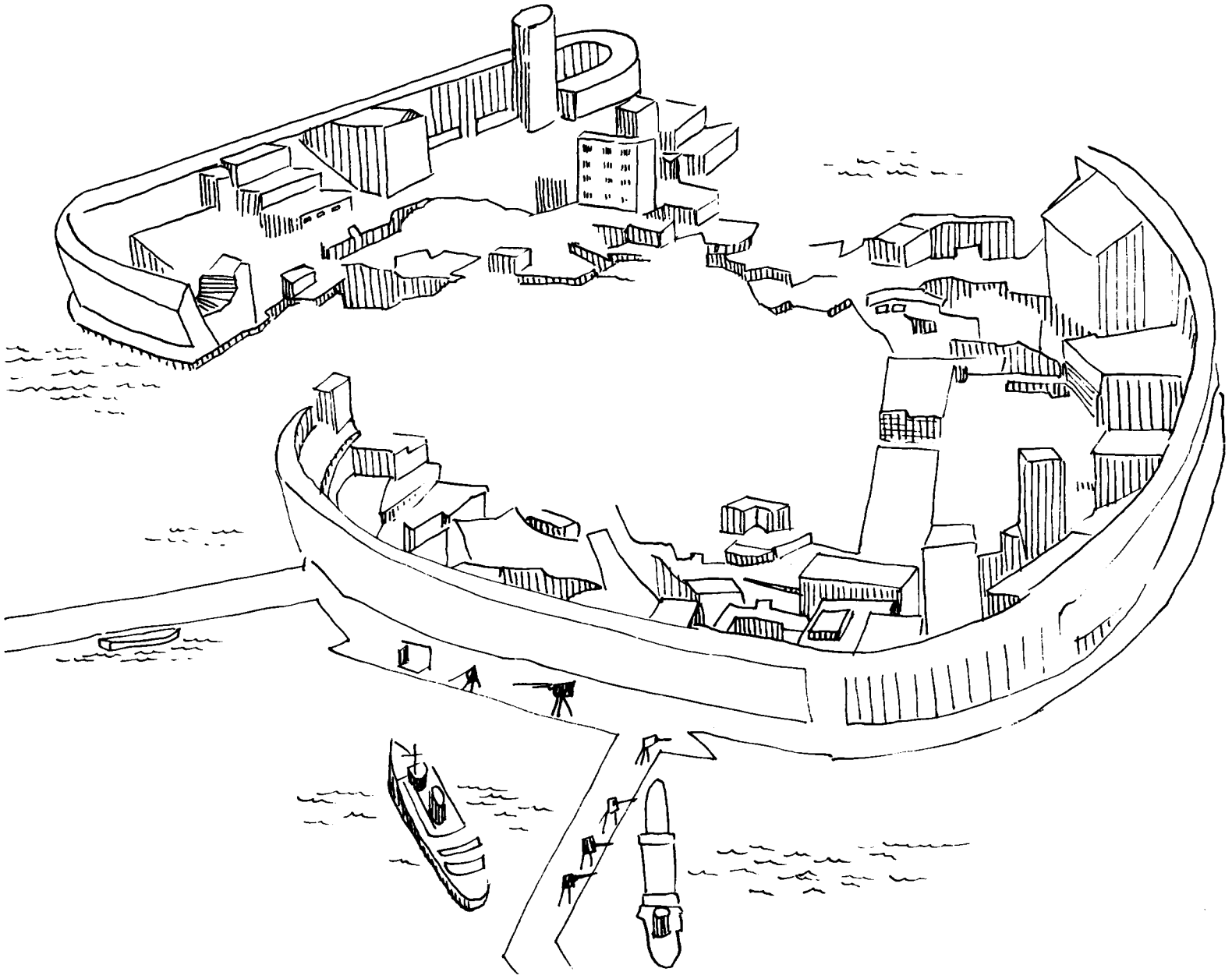
Imagine--

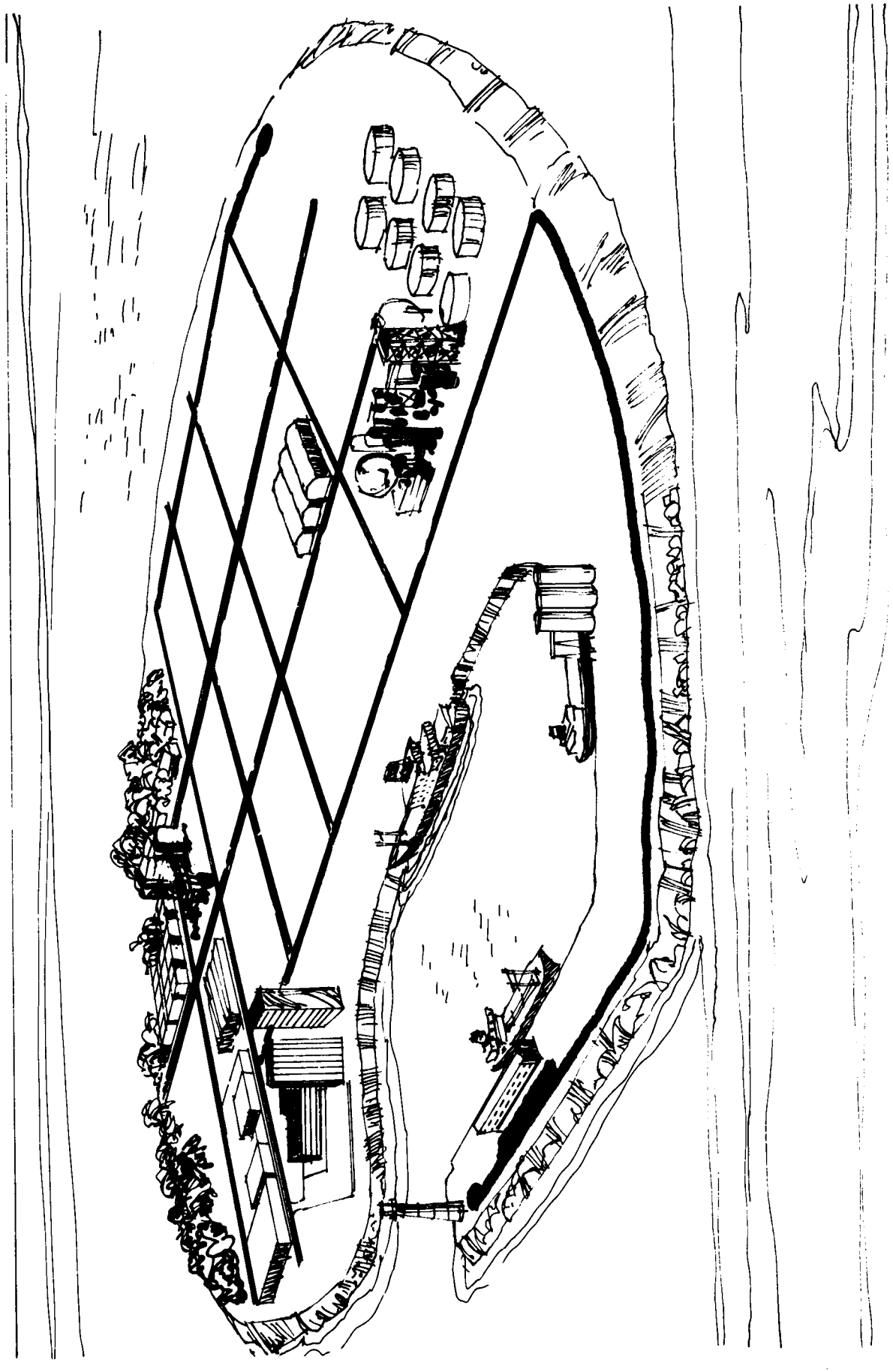
What a day in the future (2000) would be like if you lived on the sea or under the sea.

Now write--

A short story about your day. You may want to include drawings.

FLOATING CITY OF THE FUTURE





SPACE--A RESOURCE TOO !

The surface of the sea itself is a natural resource for a space-starved land. The ocean is only a space like the land. The use of the ocean surface away from land for power plants, airports, cities, industrial complexes and resorts reduces the threat of destroying coastal estuaries.

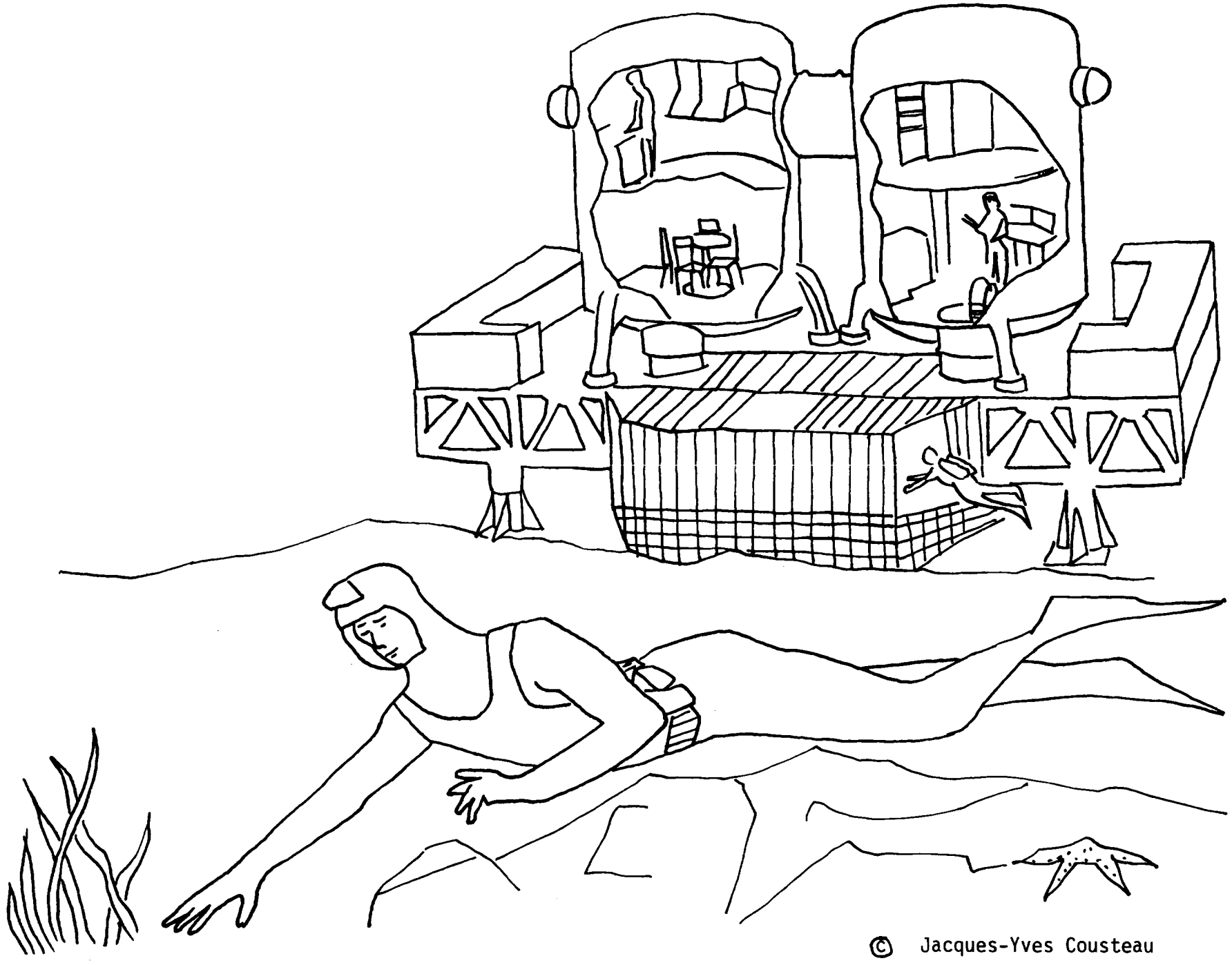
The nutrient-rich waters of the coastal area are the nurseries for a majority of the marine organisms. The filling in of these areas for building beaches, hotels and industrial sites decreases the survival chances of the salt marshes and estuaries. If these structures were built offshore, the delicate coastal ecosystems could be protected. Indications are that the energy costs of living on land are much greater than on the sea. There is no occupation that cannot be done on a water environment.

The United States was once an ocean society. The sea was a daily part of lives. It was a source of cheap transporation for goods and people. The housing was next to the port and the sea. In the future we may again become an ocean society.

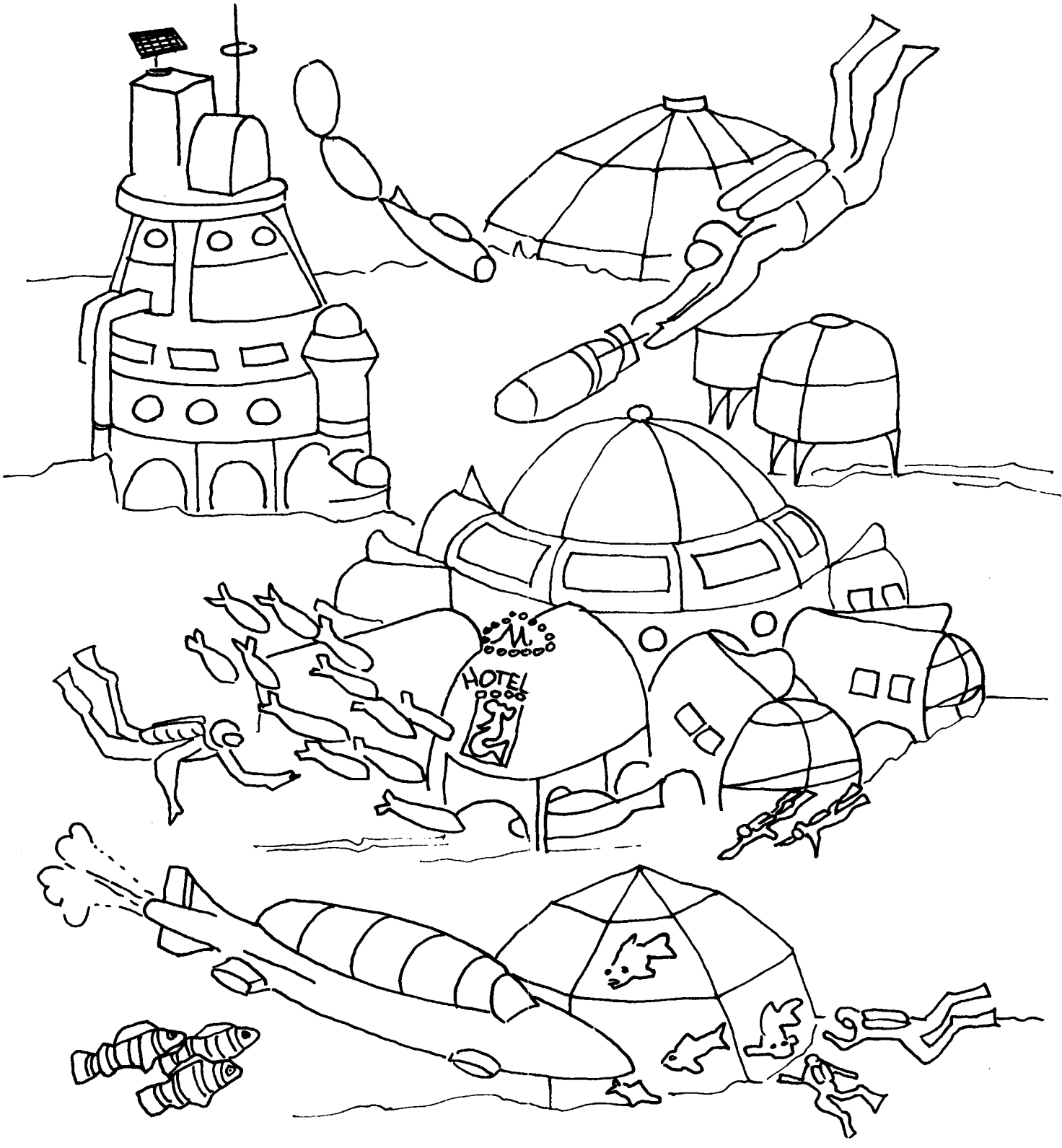
The U.S. Federal Aviation Administration is considering the design of floating terminals, and several groups are involved with floating cities. Several countries are already beginning to build artificial islands. These artificial islands will be used for power plants, airports, cities, industrial plants, ports and resorts. Along with the plans for floating cities there are plans for floating high rise structures and cities on stilts. The maripolis (marine city) is a possible future solution to our land space problems.

Think of possible uses of the surface of the sea.

Make sketches of your ideas.



FUTURE UNDERSEA CITY



LIVING AND WORKING UNDER THE SEA

We have greatly increased our ability to do things under water in the last few decades. Prior to 1940, a diver could only dive with a lungful of air and work for a few minutes at a shallow depth. The development of the aqualung by Jacques Cousteau and Emile Gagman during World War II freed divers from cumbersome diving suits and air hoses. With this diving became a sport. It opened the shallow waters to a whole new fields of science and engineering.

A breakthrough in deep diving was made by Piccard, who in 1948 developed the bathyscaph. This allowed man to go down into the deepest parts of the ocean. Since then many other types of submersibles have been developed which can work almost anywhere.

Some underwater tasks require prolonged diving, involving physiological changes that require very slow ascent to the surface. Now pressurized, self-contained living and working spaces have been built so the diver does not have to spend so much time going up and down. These devices are called Sealab, Conshelf and Tektite. Scientists have lived in and worked out of them for several months at depths of fifty feet and for weeks at a greater depths. There seems to be no reason why larger underwater habitats should not be put to use.

The underwater habitats make a difference in the kind of observations that can be made. To the underwater inhabitant, organisms become individuals whose complex relationships are the key to their survival. The next step in underwater exploration is to move our laboratories and classrooms to the marine environment. Classes in the future will be conducted underwater, where the action is.

Submarine farming, effective monitoring of the ocean, undersea mining and industrial work will increase. Man's use of diving suits, submarines, underwater habitats and innovative methods of deep scuba diving will help man work on and become more familiar with the continental shelf. A suit called Jim is used to retrieve and repair oil-rig equipment in the Gulf of Mexico. It enables one to work at depths as deep as 1,500 feet. Dry chambers or "cellars" are used to allow men to make offshore repairs on oil wells in their shirt sleeves. These cellars are less expensive than platforms and can be used in water too deep for platforms.

The sea is alive today with more things than marine organisms moving around beneath the surface. Now a new breed of adventurer is plunging deep beneath its surface in a search for knowledge of the sea and its treasures. These new explorers are pushing back a mighty frontier that has more promise for practical use than does outer space.

The sea is a hostile environment for man, the land-dweller who uses lungs to breathe air. There are men who look forward to the day when they will no longer belong to the land but will become true dwellers of the sea complete with artificial gills. Perhaps we will experiment until we have medically engineered Homo Aquaticus. He is a human being who has been medically engineered to live underwater without oxygen tanks. He has undergone a surgical operation which replaced his lungs with a unit containing a special fluid which furnishes oxygen to his circulatory system. He can travel as deep in the sea and as long as he likes. He cannot breath a gas (air) and he does not have to worry about the "bends" or other symptoms of nitrogen narcosis or decompression trama. He would be at complete liberty to live in the sea, to play, to farm, to repair undersea machinery and to supervise research.

Today's man is not waiting until the day of the gilled fishman to go exploring beneath the sea or to perform surprising tasks within its depths. While he is still a land creature, he is creating new tools, new techniques, new salvage equipment and new ways to stay below and work on the ocean floor.

He is designing houses in which to live while there. So in the future, fast undersea cargo ships will take the shortest routes to deliver goods to you from any part in the world, going under the poles, never coming to the surface between ports. Or perhaps you will become aquatic adventurers vacationing in a resort under the sea instead of beside it; or go off on a world cruise in a luxury submersible; or live and work in a city undersea.

Think of the possible uses of the undersea environment. Make sketches of your ideas.

TOPIC TWENTYONE
RAP UP!

ACTIVITY ONE--Simulation: Shoreview
ACTIVITY TWO--International Sea Exposition
ACTIVITY THREE--My Feelings About It All!

Materials for Classroom Use:

Coastal Management Reports/Reading
Coastal Problems
Coastal Management Authority
Basis for Concern
Shoreview City Council Action/Reading
Aerial View of Shoreview Area/Sketch
Instructions for Simulation
Role Cards For Simulation
Information Sheet
International Sea Exposition/Instructions
Say It With Music/Activity
Self Contract

Major Objectives for the Topic:

After completing the activities, the student will be able to:

2.3 infer that environmental problems do not have simple answers and that many factors must be considered;
3.1 explain the factors which must be considered when attempting to live in harmony with nature in selected marine environment;
3.3 identify activities of man which would have the least detrimental impacts on given marine environments;
3.4 devise a plan for living in harmony with the environment in a selected situation;
3.1-4 plan a display on the past, present, and projected future importance of marine resources and their exploitation and management;
4.2 select personal goals in the interest of preserving the marine environment and conserving marine resources.

Teaching Suggestions:

The purpose of this lesson is to have the student think about the factors that must be considered to determine how one would go about living in harmony with the marine environment and utilizing marine resources, while at the same time considering economic, political, social and other pressures which cannot be ignored. The student's values are being confronted in a very real manner and he is given the opportunity to affect other people's actions by producing a presentation which will be heard and seen by his classmates and which has the possibility of being seen and heard by the public.

1. The students should have been made aware of these two culminating activities at the beginning of the unit. The students may already have been assigned sections for the International Sea Exposition with Topic Twelve and have been gathering material for the display.

2. The class periods for activities one and two are greatly variable. You will need to decide this in relation to your objectives and schedule.

3. Have the students read and discuss the coastal management reports. Then discuss the instructions for the simulation roles. (You may vary the instructions to meet your class needs).

4. Have the students draw for their roles. (Separate the cards into male and female roles for the drawing.) Emphasize the importance of the students playing their role to the hilt. You may even want to award "Academy Award-Oscars" for the best performances. Provide an activity time schedule for the students to aid in their conducting the simulation. Remind them to apply all that they have learned in previous lessons. A background reference is "Can We Save Our Salt Marshes?" National Geographic Vol. 141, No. 6 (June 1972) pp. 729-765.

5. The questions and discussion at the end of the simulation is very critical to its success and culmination. This is an open ended simulation game; feel free to add scenarios as class interest dictates.

6. For the International Sea Exposition your students should have gathered information and planned for several weeks beginning with Topic Twelve. Being quite serious, make arrangements to have the displays set up in an area where they can be viewed by the community. This may be in a bank, local shopping center mall or other area where the public could view them in your community. Announce the dates of the display to the class before you begin this topic. Then make sure the local news media is alerted to the display.

7. You may even have the public evaluate or vote on the displays. For example-most informative, best use of music, best art work, most attractive and etc.

8. If you have more than one class of students, you will have to determine some way to develop display groups in each class to avoid duplication and neglect of some areas.

9. These activities are limited only by you. (Remember public awareness of students' learning is beneficial to education and your students can help develop a marine-literate public.)

TOPIC TWENTY-ONE--RAP UP!
SIMULATION: SHOREVIEW

Read and Discuss--

Coastal Management Reports on:
Coastal Problems
Coastal Management Authority
Basis for Concern

Optional
Read--

Article "Can We Save Our Salt Marshes?" National Geographic, Vol. 141, No. 6 (June 1972) pp. 729-765.

Look at--

Sketch of aerial view of Shoreview area.

Read and Discuss--

Shoreview City Council Action
Instruction for Simulation: Shoreview.

Draw--

Card to determine the role you will play in the simulation game.

Complete--

The description of the role you will be acting by completing the information sheet.

Play--

Your role in the activities of the Simulation: Shoreview.

Answer--

Questions.

COASTAL MANAGEMENT PROGRAM REPORT
COASTAL PROBLEMS

The Texas bays and estuaries are a great public resource. They provide habitats for fish, birds, and other wildlife. They contain important archaeological and historic sites; and they are scenic assets. The bays and estuaries also provide for many human uses.

Generally, these waters can handle heavy uses without any bad effects, but they are not all equally suited for all uses. Heavy human demands on critical natural areas such as tidal marshes and submerged grass areas cause problems.

Tidal marshes produce twice as much dry organic material per acre per year as the best farmlands. Only tropical rain forests, coral reefs, and some algal beds produce more. This high level or productivity supports extensive food chains in the marsh and adjacent bay areas.

Because of the high productivity of marsh plants, a tidal marsh can use high levels of municipal and industrial wastes to produce its organic material. Tidal marshes serve as nursery areas for estuarine organisms, a variety of fur bearing animals, game fish and waterfowl, including several "endangered species." Tidal marshes also aid in erosion control by absorbing wave energy and serve as temporary flood buffers.

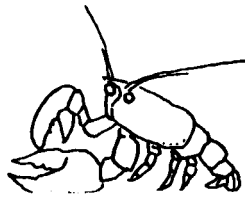
Human uses supported by the marsh system include:

- waterfowl management and hunting
- livestock grazing
- commercial and sport fishing
- waterborne transportation (channel dredging)
- recreational and aesthetic enjoyment
- mineral production
- mariculture and waterfront land development for resorts
- recreational and second homes

It is unlikely that a marsh system could handle all of these uses at the same time. However, marsh systems can provide many values at the same time, and even land developments can be designed to minimize their adverse impacts upon the total marsh system.

Because of the role the marsh plays in the production of food for the populations, both inside and outside the marsh, anything that affects the natural flow of water is harmful. These include: filling of sea grass areas, poorly planned road embankments, ditches and dredged material dumpings.

Another intensive human use is the dredging of waterways and



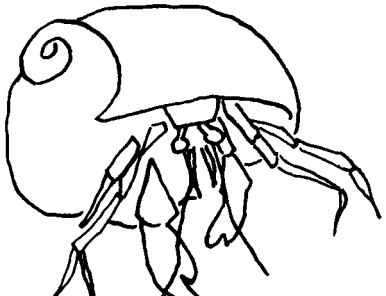
the placing of dredged materials (spoil). Texas bays are so shallow that dredging is essential so large ocean-going ships can enter. The direct effects of dredging and spoil placement are on the local environment and organisms. These activities also have indirect and long-term effects, including changes in bay circulation patterns, erosion rates, salinity levels and sediment distribution and migration of various marine organisms. Changes in salinity levels and suspended material may reduce the productivity of oyster reefs, marsh areas and open bays far from the site of dredging. Channels must be redredged. Poor placement of dredged material may unnecessarily cover biologically productive areas or increase the turbidity of water so it is harmful to marine organisms. Sometimes the dredged material contains pollutants.

There are problems in finding places to put the dredged material. However, proper placement of dredged materials can actually create new marsh areas. All these must be taken into consideration when planning the placement of dredged material. Solutions that are consistent with local environment, social, economic or political conditions should be selected.

COASTAL MANAGEMENT PROGRAM REPORT
CURRENT MANAGEMENT AUTHORITY

Most of the management decisions affecting the coastal area are made by private interests operating in a market economy. The private sector, from the individual citizen who shops in the grocery store to giant corporations, makes most of the decisions that affect coastal use. Such decisions as what use will be made of a particular tract of land, what product a plant will manufacture, or what crops will be planted are made by private decision-makers in response to market forces.

When public problems arise from private decisions concerning the use of coastal resources, it becomes necessary for government to intervene in the market economy. For example, water pollution that results from a decision made in the private sector is a problem that cannot be solved by the private sector alone. So the government steps in. Although federal and state governments have coastal regulatory authority, most governmental decisions regarding the coast are made by local governments. Some local government decisions are shaped partly by the guidelines and regulations issued by state and federal agencies.



COASTAL MANAGEMENT PROGRAM REPORT
BASIS FOR CONCERN

The abundant natural resources of the coastal region contribute to both economic development and the attractiveness of the coast as a place to live. As a result, the Gulf Coast of Texas is a major contributor to the prosperity and well-being of both the state and the nation. It houses 40 percent of the nation's petrochemical industry and over 20 percent of the nation's refining capacity. In 1972, its combined agricultural and fishery production was over $700 million, and the 2,500 miles of shoreline brought nearly 10 million visitors to the state. The petroleum, petrochemical, and agricultural sectors rely heavily upon Texas ports and waterways for transportation of their products. Three-fourths of all goods shipped from Texas to other states travel by water.

The population and economy of the Texas Gulf Coast have grown rapidly over the past decade. This growth rate is expected to continue. The natural systems of the Texas Coast are interdependent. They are closely tied to the coastal economic and social systems. Coastal issues, too, are bound together--jobs with livability, housing with agriculture and wetlands protection with water transportation.

There are three main areas for public concern in and around coastal waters. They are:

(1) the economic activities produced by the coastal waters
(2) the natural resources within and beneath coastal waters
(3) the livability(qualities that make an area a good place to live) of the coastal region

These areas for concern interact. The economic activities use natural resources. The natural resources provide the "raw materials" for a livable environment. The economic activities also produce jobs and dollar flows which increase livability. Economic activities provide tax revenues that may be used for resource conservation projects or public works.

Livability is determined by intangible values of resources, both natural and social. The coastal region can continue to be a livable place as long as economic and natural resources are used to promote human well-being. Noncoastal residents also have a stake in the future of the coastal zone, not only to visit or because the coastal waters are publicly owned, but because their uses benefit the state and nation. The coastal waters are owned by the public and their rights and interests should take priority over the rights of private individuals to profit at public expense.

SHOREVIEW CITY COUNCIL ACTION

In public meetings held by the Coastal Management Program along the Gulf Coast, coastal residents have expressed their concern about a number of problems that result from conflicts over the use of natural resources. Based on this, the three Coastal Management reports, increasing local problems, and increasing pressure from various interests the Shoreview City council has decided to take action to develop a plan for the future of the city.

The city council decided that the following procedure would be followed:

A) The city council will appoint a planning commission of five citizens.
B) The planning commission will hold hearings in which they will listen to everyone or each group who wishes to speak on the problems and make recommendations.
C) The planning commission may ask for presentations by consultants or groups to help them.
D) The planning commission will develop several proposals (2 to 5) as the master plan for the city's future growth and development.
E) The planning commission will present the proposals to the citizens at a meeting where the citizens may ask questions and state concerns.
F) The planning commission will then either amend the proposals or present the original proposals to the citizens for a vote.
G) The voters (citizens) will then select the proposal they favor. They may campaign for the proposal.
H) An election will be held to determine which proposal the citizens favor.
I) If there is no definite favorite proposal, the city council has the option to ask the planning commission to develop a new compromise proposal based on the ideas of the stronger proposals.
J) This may or may not be voted on by the citizens. This city council will decide this and how the proposals will be used.

Here are a few of the suggestions or statements that are being discussed or presented to the city council.

Channels need to be dredged deeper and wider so boats won't run into each other or run aground.

Is a beautiful part of the shore scene--marsh and dunes as essential as hills or forests?

Need to allow mining of oil, natural gas, phosphates, sand, shell and gravel.

Need to allow tidelands real estate development. This includes residential housing, industrial development, boat basins, marinas, highways, airports and recreational area.

Need to build a power generating plant in the estuaries which can provide cooling water.

Need to use it as a city land-fill so we can get it filled in free.

Is a source of salt water hay.

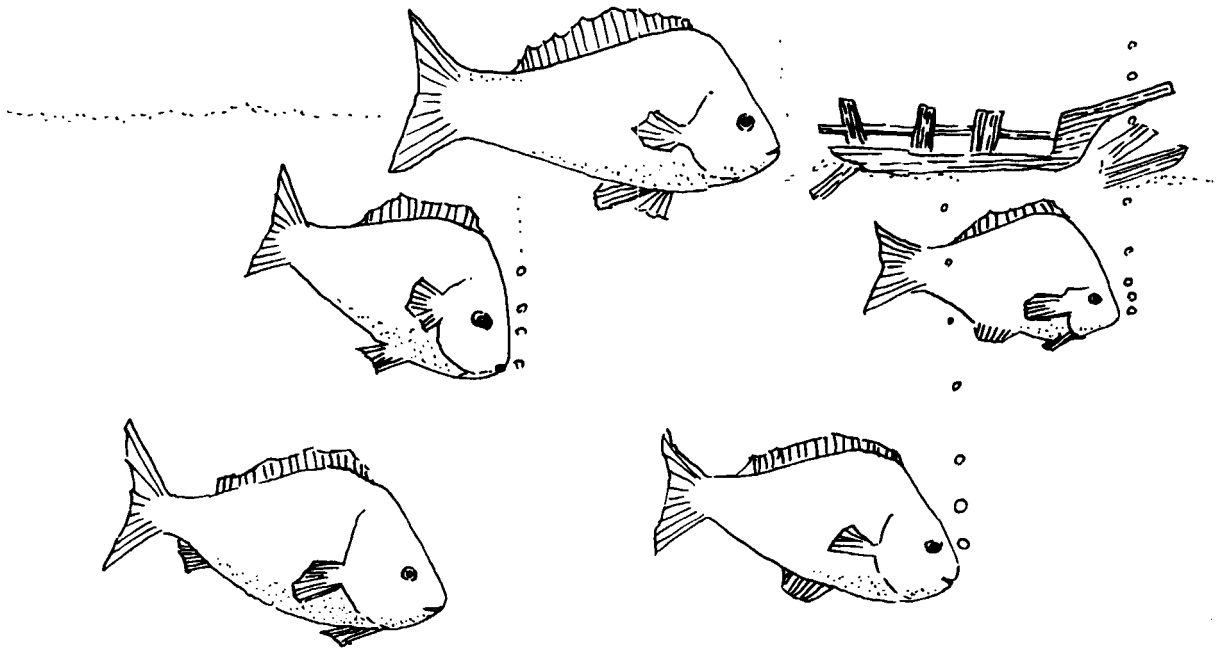
Is a mosquito breeding ground, to be drained or treated.

Do not need to change, if we change will lose our small town resort characteristics.

Need to build a superport so catch up and pass up other Texas port cities.

A superport would provide jobs and allow the chemical and oil companies to expand.

Need to protect the marshes, otherwise our fish, shrimp, oysters and wildlife will disappear.



INSTRUCTIONS FOR SIMULATION SHOREVIEW

A) Draw a card to determine the role you will play in deciding Shoreview's future. Complete the citizen information sheet.

B) Although you are provided some information about the individual, you will want to add more information to help describe the role/individual you will be.

C) If you are a city council member, you will need to meet with your fellow city council members to select the five planning commission members. The mayor will call your meeting.

D) If you are selected to be a member of the planning commission you need to meet with your fellow members. Select a chairman, decide your procedures, (rules and regulations for people or groups speaking at the hearing). Set the date for the hearing. Decide on things you will need to know to complete your assignment for the city council.

E) If you are a citizen, prepare your presentation to the planning commission. (Remember to follow their rules and regulations.) You may want to find others believing as you do (individuals you represent) and form a group. You may want to make single presentations or a group presentation. Research your position, obtain data, etc., to help present your view and interests.

F) Make your (or group) presentation to Planning Commission hearing.

G) After hearing, Planning Commission meets to develop proposals.

H) Planning Commission reports on the proposals it has developed.

I) Determine what action you (and your group) will take. Will you favor a proposal? Which one? Plan and conduct your campaign for your position.

J) The city council will set up the vote on the proposals.

K) After the election, the city council will determine the next step.

SURFSIDE GROCERY STORE MANAGER — 40 yrs. old Female 3 children, husband is Sea Breeze Yacht Service Inc. Manager, oldest son recently employed as welder at oil refinery, own 2 boats	PHARMACIST — 50 yrs. old Male No children at home, Mayor, owns Bayside Drugstore, wife just became a real estate saleswoman, own bay property and sailboat
CHEMICAL COMPANY ENGINEER — 45 yrs. old Male Chemical engineer, only one teenager at home, city council member, building a beach home	RESORT REALTY SALESPERSON — 38 yrs. old Female 3 children, husband manages Sea Wind Apartments and Surfside Motel, Resort Realty specializes in resort retails and sales, hope to buy some beachfront real estate
DRIFTWOOD GIFT AND SHELL SHOP OPERATOR — 37 yrs. old Female 2 children, husband is architect beachcombs, makes gifts to sell from materials collected on beach	BAYSIDE BUILDER AND DEVELOPER — 49 yrs. old Male 2 children, owns some beach front and marsh land which he hopes to develop, specializes in beach or bay front apartments and homes, owns deep sea fishing boat
CHARTER AND PARTY BOATS, INC. RECEPTIONIST — 31 yrs. old Female 3 children, husband is self-employed plumber, saving to build a beachfront home	SAND DUNES INSURANCE CO. SALESPERSON — 43 yrs. old Female 2 children, husband is a boat salesman, own sailboat and small motor boat
BUILDER'S SUPPLY LUMBER COMPANY OWNER — 62 yrs. old Male Widower, part-owner of two shrimp boats, one son is a builder, another one owns shrimp boat repair service	WE HAVE EVERYTHING DEPARTMENT STORE MANAGER — 52 yrs. old Female Widowed, 3 children, 23 yr old unemployed son living with her, city council member, member local Audubon Society, bird watcher

B & J BARGE CO. OFFICE MANAGER — 40 yrs. old Female 2 children in college, 1 in high school, 19 year old unemployed daughter, husband is county tax collector	SEA BREEZE MOTEL OWNER — 56 yrs. old Female No children at home, husband employed by city, own boat for deep sea fishing
BLACK GOLD OIL COMPANY EXECUTIVE — 39 yrs. old Male 2 children, owns beach home, boat, travel trailer	LAWYER — 27 yrs. old Male 1 child, wife is substitute teacher, president of Jaycee's (Junior Chamber of Commerce)
INDUSTRIAL PLANT MANAGER — 46 yrs. old Male 3 children (2 in college), wife is secretary for Vice President of Oil Refinery, own sailboat, building a bayside cabin	WAITRESS AT SANDPIPER LOUNGE — 21 yrs. old Female Part-time Jr. College student, lives at home, dating Tugbut Co. Employee, loves to surf
U.S. POSTAL SERVICE EMPLOYEE — 33 yrs. old Female Divorced, 2 children, water sports enthusiast, teaches swimming and diving to all local youth	BEACH BAIT & TACKLE EMPLOYEE — 21 yrs. old Female Single, lives in Bayside Apts., water skier and surfer
RICE FARMER — 55 yrs. old Male No children at home, son with degree in Agribusiness is helping run the farm, another son operates local rice dryer	SARGE'S SERVICE AND GARAGE OWNER — 32 yrs. old Male 2 children, city council member, hunts and fishes, owns small boat

SURF SHACK MANAGER — 30 yrs. old Female 2 children, husband works on off-shore drilling platform, spends time off beachcombing	SEA GULL RESTUARANT OWNER — 60 yrs. old Female Widow, no children at home, owns some undeveloped property along the beach
BAYSIDE MARINE EMPLOYEE — 20 yrs. old Male Lives with his parents, surfing enthusiast, father works at local industrial plant	HIGH SCHOOL COACH — 40 yrs. old Male 3 children, in summer directs a beach camp for Junior High age students, hunts, fishes, owns pickup camper
JUNIOR HIGH STUDENT — 14 yrs. old Female 2 brothers and sisters, father is telephone company manager, mother is secretary for Resort Realty, family owns boat	DOCTOR — 59 yrs. old Male No children at home, owns Bayside Clinic, beach home and yacht, has invested in local real estate, one son is practicing medicine with him, daughter is an oceanographer
HIGH SCHOOL SENIOR — 18 yrs. old Male Needs job, 4 brothers and sisters, father works for B&J Barge Company	SUPERINTENDENT OF SCHOOL DISTRICT — 45 yrs. old Male 4 children, 2 in college, wants to build beach home, owns sailboat, wife is local women's club officer
TRUCK DRIVER FOR INDUSTRIAL PLANT — 28 yrs. old Male Divorced, 1 child, owns boat and hunts	BIOLOGY TEACHER — 28 yrs. old Female 1 child, husband is counselor, takes students on field trips and camping, board member local natural history museum, member Sierra Club

STATE REPRESENTATIVE 41 yrs. old Male 2 children, a lawyer, his family owns ranch, he owns some marsh land near town, loves to hunt ducks and geese	ART TEACHER 24 yrs. old Female Single, paints and photographs nature, very successful at arts and crafts shows statewide
DREDGE-AWAY DREDGING SERVICE EMPLOYEE 48 yrs. old Female 4 children, likes to hunt and fish, hopes to buy deep sea fishing boat	FIRST STATE BANK PRESIDENT 60 yrs. old Male Married, no children at home, owns beach home and some ranch land in the county
DRIFTWOOD FLOWER SHOP AND NURSERY MANAGER 48 yrs. old Female No children at home, teaches flower arranging, collects sea shells, husband employed by chemical plant	TEXAS PARKS & WILDLIFE EMPLOYEE 35 yrs. old Male 2 children, wife paints seascapes, has degree in Marine Biology, likes to fish
BLUE CRAB CAMPGROUND AND MARINA MANAGER 42 yrs. old Female Widow, 3 children (2 in college)	GULF CONSTRUCTION COMPANY EMPLOYEE 29 yrs. old Male 2 children, likes to race motorcycles, owns dune buggy
TELEPHONE COMPANY EMPLOYEE 28 yrs. old Female 2 children, recently divorced from automobile salesman, lifelong resident of community	BEACHSIDE DRIVE-IN GROCERY MANAGER 45 yrs. old Female 2 children, husband maintenance manager for oil refinery

SURFSIDE DAIRY QUEEN MANAGER — 32 yrs. old Female 3 children, husband Maintenance Dept. Manager at nearby marine research station	DRIFTWOOD MOBILE HOME PARK OFFICE MANAGER — 60 yrs. old Female Widow, no children at home, husband was a shrimper
RETIRED FISHING BOAT CAPTAIN — 65 yrs. old Male Sometimes acts as fishing guide for Sportsman's Village Marine	BANK TELLER — 22 yrs. old Female Engaged to surveyor for construction company, likes to spend weekends on the beach
SANDPIPER REALTY OWNER — 50 yrs. old Male 4 children (only 1 at home), member of city council, part owner of Rip Tide Apartments and Condominiums, owns yacht	REPRESENTATIVE FOR SUPERPORT, INC. — 31 yrs. old Male A non-resident who is here to convince people to support building of a superport. If port is established will receive a large promotion and a 25% pay increase
CAPTAINS JUG MANAGER (LIQUOR STORE) — 30 yrs. old Male 2 children, hoping to find another job but wants to stay in area	LIBRARIAN AT PUBLIC LIBRARY — 52 yrs. old Female 2 children in college, lifelong resident, hobby cooking seafood small dishes, husband manages sea food processing plant in neighboring town
GRADUATE STUDENT — 24 yrs. old Female Single, student at state university, studying the local marsh as a part of her research in Marine Biology, lifelong resident of area, member National Wildlife Society	AMATEUR NATURE PHOTOGRAPHER — 42 yrs. old Female 3 children, mainly is a housewife, husband is editor of the local paper

INFORMATION SHEET

Name _____ Occupation_____
(You may make up a name for the individual you are representing.)

Are you a city council member? _____

Are you a planning commission member? _____

Describe yourself (family, interests, opinions, etc.) in more detail.

Describe what you think the city should do in planning for its future.

What people in town probably feel the same way you do?

What people will probably differ from you?

What will it take for you to change your position or view?

QUESTIONS

1) What are your general feelings after participating in Simulation: Shoreview?

2) What upset you the most?

3) What did you like the best?

4) Do you think that the simulation was realistic or not? Explain.

5) Do you feel that the local, state or federal government should be responsible for managing the coastal waters and wetlands? Explain.

6) What could or should be done to insure the best coastal management of the coastal area to insure its survival?

TOPIC TWENTY-ONE--RAP UP!
INTERNATIONAL SEA EXPOSITION

Brainstorm and list--

Ideas to be presented.

Discuss--

List of ideas with your classmates.

Select--

The ideas that will be presented.

Research--

The idea that you and your group are working on.

Outline--

Your group's presentation.

Design--

Your group's exhibit.

Prepare--

The exhibit.

Set up--

The exhibit.

INTERNATIONAL SEA EXPOSITION

Now that you have studied some of the resources of the Gulf of Mexico along with some of the marine resources, you and your classmates have been invited to prepare part of the exhibit for the International Sea Exposition. Your section will present the importance of the sea with emphasis on the Gulf of Mexico. The display should illustrate past and present importace of the sea. It should also place emphasis on the projected future importance of the Gulf of Mexico's resources.

The exhibit will be set up in a convention hall, so design it accordingly. Use the media (slides, tapes, pictures, murals, collages, models, drawings etc.) that will best present your ideas. Remember, it should be self-explanatory to the people viewing it.

Let's brainstorm for a few minutes to make a list of all the ideas that should be presented as part of your exhibit at the International Sea Exposition. You may brainstorm as a class or divide into groups. Select a chairperson, a recorder and a time keeper. List all ideas. Limit your brainstorming to 7 minutes.

Discuss the list of ideas and determine which ones you will present as part of the exhibit. Divide into groups with each group selecting an idea to present as an exhibit. Your first steps should be to research your idea, outline your presentation and design your exhibit. Then you are ready to begin preparing the exhibit.

Use the space below to outline your presentation and sketch the design of your exhibit.

TOPIC TWENTY-ONE--RAP UP!
MY FEELINGS ABOUT IT ALL!

Complete--

Say It With Music activity.

Complete--

Your Self Contract.

This completes your study of the marine environment and marine resources. Thank you for allowing me to introduce you to the marine environment and its resources. I hope you will enjoy, appreciate and live in harmony with it.

Your Seafaring Friend,

A. B. Seaborne

Captain Seaborne

SAY IT WITH MUSIC

It might be fun to speak about some things you know about the marine environment and its resources through songs. List below some of the things you might want to say.

Now spend some time thinking of songs for each thing. The song can be either vocal or instrumental or both. Listen to the radio or T.V. for ideas. You may want to rewrite a song or commercial or write your own song. If you can't find a song for something, describe the type of song and what you want it to say.

SELF CONTRACT

_____, hereafter know as Self, agree to the following terms:

I. In the interest of preserving the marine environment, my Self will _____

_____

_____.

2. In the interest of conserving marine resources, my Self will _____

_____

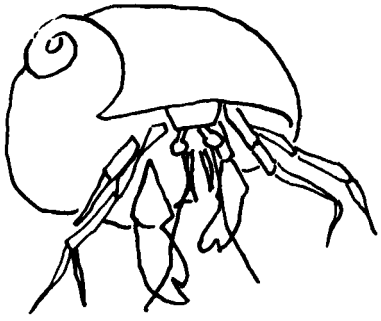
_____.

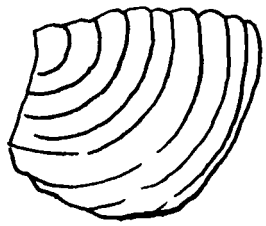
3. I will also _____

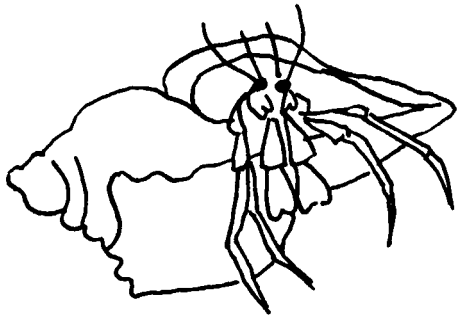
_____

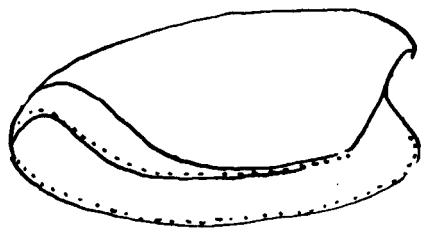
_____.

Signed: _____
(your name)









XXIII

Appendix

The purpose of this appendix is to assist the teacher in the selection of activities which are appropriate to the courses identified by an X in each column. The activities identified by an X indicates that the majority of the activities can be used in that particular subject. An asterick (*) identifies a single activity when that one is the only activity in the group appropriate for a specific subject. However since many of these activities can be adaptable to various courses, the teacher will need to become familiar with all the course objectives and their students needs.

The Life Science column includes the following subjects: Life Science, Biology, Ecology and Environmental Science. Social Studies includes the following subjects: Economics, History, Government, Free Enterprise and Sociology.

	Art	Economics	Home Arts	Language	Music	Science - Earth	Life	Physical	Social Studies
PART I									
I. UNIT OVERVIEW									
Major Goals and Objectives.....									
II. TOPIC ONE--INTRODUCTION.....									
Activity One--Earth Is a Water Planet.....				X		X	X	X	X
A Syntu About the Sea.....									
The Sea and Me.....									
Brainstorm--How Water Influences Us.....									
Slides/Cassette Tape--Earth is a Water Planet.....									
Collage of Concerns and Feelings.....									
Activity Two--Words, Poems and Books of the Sea.....				X					
Words from the Sea.....									
Sea Language Ashore.....									
Marine Words.....									
Poetry of the Sea.....									
Letters of the Sea.....									
Books of the Sea.....									
Tales of the Sea.....									
Tale of the Sea.....									
Activity Three--Signals of the Sea.....				X					X
Signal Flags.....									
Signal Flags and Communication.....									

	Art	Home Economics	Language Arts	Music	Science - Earth	Life	Physical	Social Studies	
Sea Ice Formation									130
The Frozen Seas									131
Activity Five--A Little Salt and Force					X		X		132
What is the Salinity?									133
A Little Salt									134
Why is the Ocean Salty?									136
The Force--Pressure									138
Sea Water and Pressure									141
Activity Six--Density and the Sea					X		X		142
Salinity and Density									143
Temperature and Density									144
Sea Water and Density									146
Activity Seven--It Moves!					X		X		147
Currents								*	149
Surface Currents of the Gulf of Mexico									154
How Tides are Formed									157
In and Out-The Tides									158
Waves									160
Make Waves									162
Catastrophic Waves									164
Say It with a Dance				*					165
VI. TOPIC FIVE--SEA INTERACTS WITH THE LAND									166
Activity One--Texas Coastal Climatic Zones					X	X		X	171
The Gulf of Mexico Interacts With the Texas Coast.									172
El Nino									176
Activity Two--Tropical Storms and Hurricanes					X			X	177
Hurricane!									178
Spectacular Agent of Change									180
Hazardous Sea Warnings									182
Hurricane Tracking									184
Hurricane Flooding									185
Hurricane Storm Surge									188
How Would You Prepare for a Hurricane?									189
Hurricane Safety Checklists									189
VII. TOPIC SIX--THE MARINE ENVIRONMENT AND MARINE ECOSYSTEMS									194
Activity One--Zones of the Marine Environment					X	X			199
Zones of the Marine Environment									200
Marine Zones and Abiotic Characteristics									204
Activity Two--Basic Groups of Marine Organisms					X	X			206
Nekton									207
Plankton									208
Benthos									210