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ABSTRACT

This is one of a series of 14 instructional components of a semester-long, environmental earth science course developed for undergraduate students. The course includes lectures, discussion sessions, and individual learning carrel lessons. Presented are the study guide and script for a learning carrel lesson on ocean resources and food from the sea. The slides, audio-cassette tape, and other materials necessary for this lesson are not included. (BT)

SCIENCE EDUCATION CENTER

THE [illegible] FOUNDATION

GY-9339 (EZ)

STUDY GUIDE AND SCRIPT

SECTION V: OCEANOGRAPHY

LESSON 6.14: OCEAN RESOURCES

ENVIRONMENTAL STUDIES

A Cooperative Project of The Department of Geological Sciences and the Science Education Center

The University of Texas at Austin

ENVIRONMENTAL EARTH SCIENCE

"Environmental Earth Science" is a new course developed at The University of Texas at Austin by the Department of Geological Sciences and the Science Education Center. It is offered at The University of Texas at Austin as Geology 361K and has been tried out during the spring semesters of 1972, 1973, 1974, and 1975. Revisions have been made as necessary after each tryout. The project within which the course has been developed has been supported by the National Science Foundation.

The course includes lectures, discussion sessions, and individualized Learning Carrel Lessons. Extensive use has been made of multi-media technology in the presentation of the course. Learning Carrels for individualized instruction have been especially designed for this program. The lectures introduce specific topics, suggest problems or questions, and provide background information. The discussion sessions provide the student an opportunity to ask questions and clarify ideas. The discussion sessions also provide input and feedback to the instructor.

The Learning Carrel Lessons have been written by faculty and graduate students in the geological sciences and in science education. Writers and resource contributors include Dr. Robert Boyer, Dr. Rolland Bartholomew, Dr. Keith Young, Dr. Samuel Ellison, Dr. James Underwood, Dr. David Butts, Dr. Addison E. Lee, David Keller, Melanie Lewis, Wayne Schade, Ann Lee, and William McLoda. Technicians involved in production of scripts, sound, and photography were Stan Prescott, Lee West, Charles Geffen, and William McLoda. Artists were Jesus Rivas, Alice Canestaro, Aly Knox, and Javier Flores.

Each Learning Carrel Lesson consists of a set of 2 x 2 slides, an audio cassette tape, a study guide, a script, and other materials necessary to the lesson. The study guide and script are in this booklet. Students may set their own time schedule within an announced period when slides and tapes are made available.

The student should note the list of Learning Carrel Lesson topics to place in proper content the lesson in this booklet, and then read carefully the introduction, rationale, prerequisites, and lesson objectives in the study guide. The student should follow the instructions in the study guide for the entire lesson. In some instances, these instructions are also repeated on the audio cassette tape. The slides and tapes have been synchronized to automatically advance the slides appropriate to the audiotape. However, there is a tone signal given before the change of each slide so that the lesson can be used outside of the carrel if automatic facilities are not available. When the student is ready to start the lesson, the "on" switch should be pushed. If the slides and tape are operated manually, both will need to be turned "on." The first slide is always a title slide or a blank solid colored slide. If

the slides and tape are manually operated, this title or blank slide should be on view before the tape is started. For automatic operation, the slides and tapes will be set up by the Instructor or Proctor before the lesson and between each use. It is most important to start each lesson according to these instructions in order to provide synchronization of the slides and tape. Remember that slides placed in the tray to be used with a rear view screen are reversed from those to be used with a front view screen.

The student will be instructed by the study guide and/or the tape to stop at various places to carry out certain activities. Usually the audio-tape will say, "Please stop the tape now and restart only when you have finished this exercise." Therefore, the student should wait a few seconds to finish hearing the instruction after the word "Stop." However, one should not wait long enough for the tone signal or automatic change to the next slide. This signal should be heard after you restart the tape. If the lesson is moving too rapidly, the student may stop the tape and slides at any time to consult the study guide or script, but it is NOT POSSIBLE to back up and re-examine a given slide without completing the entire cycle of the lesson.

It is particularly important for the student to carry out the instructions for activities given in the study guide. In order that a record may be maintained of these activities, each student should pick up a copy of the STUDENT RESPONSE SHEET which include questions to be answered and the other activities requiring responses. These should be completed and turned in to the instructor as required for grading, feedback for the instructor, and to provide a basis for student interaction in the discussion group.

Each Learning Carrel Lesson is independent within the context of the course. Some of them provide direct information on a given topic, but in an individualized mode requiring some activities and thought on the part of the student. Others place the student in a role-playing situation where some position must be taken on provocative questions or issues. Others deal primarily with applications of environmental information. In all the lessons, the student is expected to receive basic information that is coordinated with the lectures, the small group discussions, and the readings.

ENVIRONMENTAL EARTH SCIENCE

LEARNING CARREL LESSONS

Section I: Man's Effect on Nature

Lesson 6.1: Population
Lesson 6.2: Land Use
Lesson 6.3: Urban Crisis (Field Trip)

Section II: Energy

Lesson 6.4: Energy
Lesson 6.5: Energy Resources
Lesson 6.6: Future Projections

Section III: Processes Through Time

Lesson 6.7: Geologic Time
Lesson 6.8: Long Term Events
Lesson 6.9: Short Term Events

Section IV: Natural Resources

Lesson 6.10: Minerals
Lesson 6.11: Conflicts of Interest
Lesson 6.12: Soils
Lesson 6.13: Water

Section V: Oceanography

Lesson 6.14: Ocean Resources
Lesson 6.15: Pollution of the Oceans

STUDY GUIDE FOR LEARNING CARREL LESSON

6.14

OCEAN RESOURCES

ENVIRONMENTAL STUDIES

A Cooperative Project of the Department of Geological Sciences and the Science Education Center

TO THE STUDENT:

This booklet contains two sections: (1) the Student Study Guide for this lesson, and (2) the Script or printed copy of the discussion recorded on the audio cassette tape.

You are expected to begin with the printed instructions in the Study Guide and follow them continuously as you study the lesson. In many instances the same or similar instructions may also be heard on the audio cassette tape. Refer to the script only if you need to refresh your memory as to something that was said. The script is provided because you cannot back up the tape if you need to review something already said on the tape.

Specific instructions will be given in the Study Guide as to when to start and stop the tape. Do not restart the tape until instructed to do so in the Study Guide.

Questions requiring written answers should be completed on the STUDENT RESPONSE SHEETS provided by the Instructor.

INSTRUCTIONS:

1. Start the audio cassette tape and slides. (For manually operated slide carousels, be sure the slide on the screen is the title slide or the blank colored slide in slot number one. Otherwise, the slides and tape will not be synchronized.) Listen to the tape and view the slides until reference is made to page 1 in the Study Guide. Then STOP THE TAPE AND SLIDES.

Read the Introduction, Rationale and Objectives for this lesson that follows. If you have questions, check with the Instructor or Proctor.

INTRODUCTION:

To an observer in space, the planet earth appears as a globe largely covered by water. These oceans that cover 70% of our planet are great reservoirs of food, minerals, and water.

In the first part of this lesson, we look at food from the sea. What it is, where it is, and how we get it.

In the second part of this lesson we look at the mineral resources of the oceans. What minerals are taken from the seawater, what minerals are obtained from the ocean floor, and finally what minerals are found beneath the ocean floor are questions answered in this lesson.

After this lesson is completed, you should have a better insight about the role the oceans currently play in our lives and the very important role the oceans will play in man's future.

RATIONALE:

All indications are that we will depend more heavily on the oceans for our future food, water, and mineral needs. For this reason it is worthwhile for us to become familiar with the resources of our oceans and what efforts we must expend to obtain these resources.

OBJECTIVES OF THIS LESSON:

At the end of this lesson you should be able to:

1. list three factors that determine the location of fish populations
2. describe one or more fishing techniques that are currently being used to improve the amount of fish taken from the oceans
3. describe ways of increasing the amount of fish we can harvest from the oceans
4. explain what is meant by "overfishing"
5. list three chemical elements that are extracted from seawater
6. list four substances mined from the ocean floor
7. list three substances obtained from beneath the ocean floor

INSTRUCTIONS:

2. Complete the Pretest on the white pages at the end of your STUDENT RESPONSE SHEETS. At the end of the lesson you will be asked to take a Posttest on the green pages at the end of your STUDENT RESPONSE SHEETS. You can then compare your answers on the Pretest and the Posttest to determine some of the things that you learned during this lesson.

INSTRUCTIONS:

3. Restart the audio cassette tape and slides. Listen to the tape and view the slides until reference is made to Frame 1. Then STOP THE TAPE AND SLIDES and follow instructions on the slide.

Frame 1

You have learned that upwellings off the coast of Peru provide the conditions for an excellent fishing ground. Off the coast of California near Monterrey there used to be excellent fishing grounds caused by upwellings. Fishing is poor now and old cannery buildings are used for stores and warehouses. What do you think happened to this fishing ground? (USE STUDENT RESPONSE SHEET)

INSTRUCTIONS:

4. Check your answer before continuing. Restart the audio cassette tape. Listen to the tape and view the slides until reference is made to Frame 2. Then STOP THE TAPE AND SLIDES and follow instructions on the slide.

Frame 2

Before proceeding with this program, we would like you to make a hypothesis and an estimation. Think about the number of pounds of beef or fish that can be raised per acre. Answer the following questions on your STUDENT RESPONSE SHEET.

Can man raise more, less, or the same number of pounds of beef as fish per acre?

Next, your estimation of the ratio of number of pounds of fish to beef will be:

(a) .5 to 1
(b) 1 to 1
(c) 8 to 1
(d) 20 to 1

INSTRUCTIONS:

5. Restart the audio cassette tape and check your answers with the information on the next slide. Listen to the tape and view the slides until reference is made to Frame 3. Then STOP THE TAPE AND SLIDES and follow instructions on the slide.

Frame 3

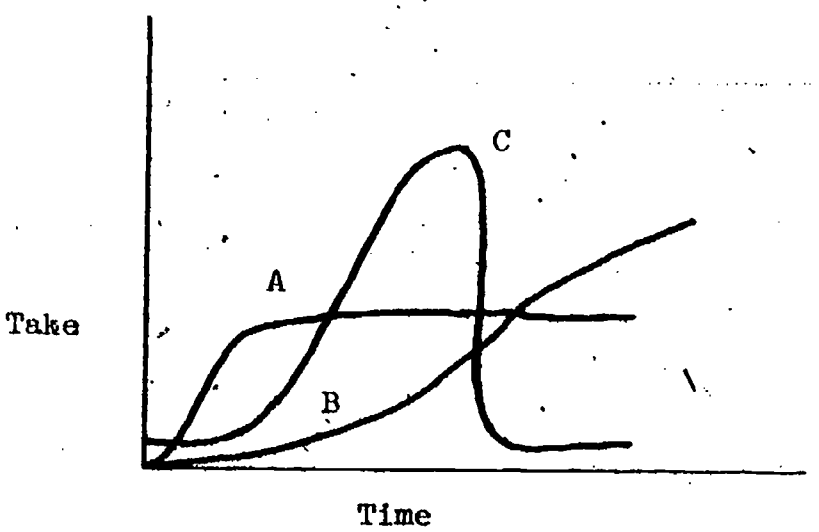
This lesson has completed an explanation of several technological techniques that will increase the fish take from the oceans. However, we all recognize that technology operates within economic and political domains. Let's study for a moment the same problem -- how to increase fish catch -- from a social point of view. Look at Figure I. If we overfish the ocean, Curve C describes what will happen. If we follow Curve B, the fish take may be large and continuous through time, but not rapid enough to prevent millions of people from starving. If we follow Curve A, the fish take would most nearly match our immediate needs and provide a continual supply.

List on your STUDENT RESPONSE SHEET two economic or political agreements that would have to be made before Curve A could be carried out.

Agreement I:

Agreement II:

FIGURE I



ANSWERS TO QUESTIONS IN STUDY GUIDE

FRAME 1 Answers

You have learned that upwellings off the coast of Peru provide the conditions for an excellent fishing ground. Off the coast of California near Monterrey there used to be excellent fishing grounds caused by upwellings. Fishing is poor now and old cannery buildings are used for stores and warehouses. What do you think happened to this fishing ground?

Your first response would most likely be overfishing. However, likely as that answer is, scientists tell us that the location of some fishing grounds change through time for as yet unexplained reasons.

FRAME 3 Answers

Before proceeding with this program, we would like you to make a hypothesis and an estimation. Think about the number of pounds of beef or fish that can be raised per acre.

Can man raise more, less, or the same number of pounds of beef as fish per acre?

Less

Next, your estimation of the ratio of number of pounds of fish to beef will be:

(a) .5 to 1
(b) 1 to 1
(c) 8 to 1
(d) 20 to 1

Answer: (c)

$$\frac{\text{pounds of fish per acre}}{\text{pounds of beef per acre}} = \frac{2,500}{300}$$

Therefore, the answer is (c) 8 to 1.

FRAME 3 Answers

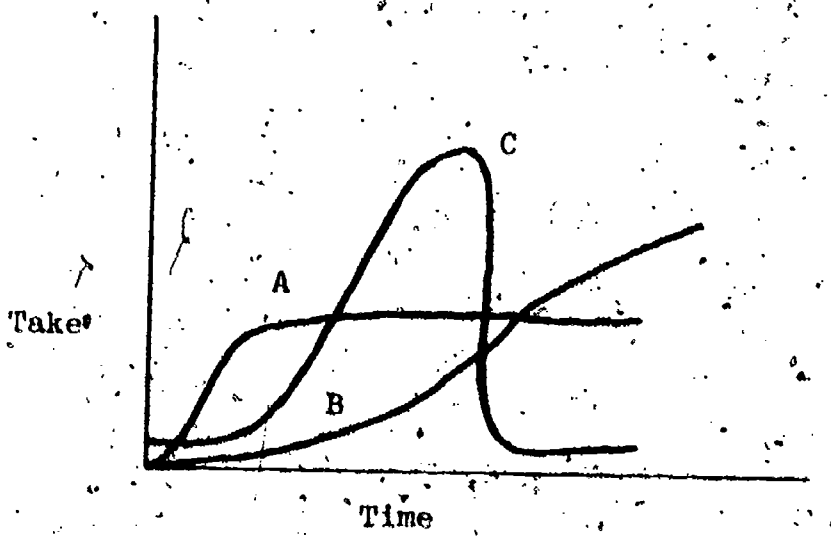
This lesson has completed an explanation of several technological techniques that will increase the fish take from the oceans. However, we all recognize that technology operates within economic and political domains. Let's study for a moment the same problem -- how to increase fish catch -- from a social point of view. Look at Figure I. If we overfish the ocean, Curve C describes what will happen. If we follow Curve B, the fish take may be large and continuous through time, but not rapid enough to prevent millions of people from starving. If we follow Curve A, the fish take would most nearly match our immediate needs and provide a continual supply.

List below two economic or political agreements that would have to be made before Curve A could be carried out.

Agreement I: All countries taking fish from the ocean would have to agree on the amount of catch that could be taken by each country each year.

Agreement II: All countries taking fish from the ocean would have to agree on the police procedures to monitor each countries' fishing industry.

FIGURE I



ANSWERS TO PRETEST

1. What three major factors determine the number of fish in any area?

amount of plant life available
oxygen content
sunlight
nutrients like phosphates and nitrates

2. Which of the following oceanic water masses contains the most oxygen?
   (a.) cold bottom waters
   b. equatorial waters
   c. island waters
   d. surface waters

3. How far down into ocean water does sunlight penetrate?

200 meters

4. At which one of the following places are nutrients for fish life most abundant?
   a. at the equator
   b. at the poles
   c. in ocean basins
   (d.) near shorelines

5. Which one of the following areas produces the least fish life?
   a. the equator
   b. the poles
   (c.) center of ocean basins
   d. shorelines

6. Which of the following techniques is (are) now used to catch fish?
   (a.) man-made reefs
   (b.) sounds
   (c.) suction tubes
   (d.) underwater lights

7. Name 2 ways of locating and/or catching fish which will probably become widespread in the future.

satellite photography, suction tubes, underwater lights, sound impulses to attract fish

8. In what parts of the world does most seafood farming now occur?

Asia and the Far East

ANSWERS TO POSTTEST

amount of plant life available
oxygen content
sunlight
nutrients like phosphates and nitrates

(a.) cold bottom waters
b. equatorial waters
c. island waters
d. surface waters

200 meters

a. at the equator
b. at the poles
c. in ocean basins
(d.) near shorelines

a. the equator
b. the poles
(c.) center of ocean basins
d. shorelines

(a.) man-made reefs
(b.) sounds
(c.) suction tubes
(d.) underwater lights

satellite photography, suction tubes, underwater lights, sound impulses to attract fish

Asia and the Far East

ANSWERS TO PRETEST (continued)

9. Do we have evidence at present to indicate that fish farming can contribute significantly to our fish catch?

Yes ✓ No ____

10. How do cattle crops compare with potential fish pond crops?

Cattle: 300 lbs./acre/year
Fish: 2,500 lbs./acre/year

11. How is fish meal used?

(a.) as chicken feed
(b.) as hog feed
c. as sawdust
d. In industrial paints

12. Of what kinds of fish is fish meal made?

a. lobster tails
(b.) fish heads and entrails
c. trout and tuna filets
(d.) untasty fish

13. Have we overfished in many areas of the oceans?

Yes ✓ No ____

14. How are fish species protected from fishing to the point of extinction?

preventing or limiting the fish catch

15. How long will it be before we are harvesting the maximum amount of fish we can without upsetting the ecological balance of the oceans?

1985

16. What are the 2 most important mineral resources we take from the oceans?

Oil Gas

17. What percent of the earth's oil reserves are estimated to lie beneath the continental shelf?

a. 10%
b. 20%
(c.) 40%
d. 80%

ANSWERS TO POSTTEST (continued)

Yes ✓ No ____

Cattle: 300 lbs./acre/year
Fish: 2,500 lbs./acre/year

(a.) as chicken feed
(b.) as hog feed
c. as sawdust
d. in industrial paints

a. lobster tails
(b.) fish heads and entrails
c. trout and tuna filets
(d.) untasty fish

Yes ✓ No ____

preventing or limiting the fish catch

1985

Oil Gas

a. 10%
b. 20%
(c.) 40%
d. 80%

ANSWERS TO POSTTEST (continued)

18. Which minerals are now being extracted directly from seawater?

magnesium, iodine, and salt

19. What is the common source of our iodine?

a. globigerina ooze
(b.) kelp
c. seawater
d. tuna

20. Can we depend on the oceans to supply our fresh water needs in the future?

Yes ✓ No ___

21. Why have we not yet extracted gold from the oceans to solve our monetary crises?

cost of extraction is more than the gold is worth

22. Name 6 mineral resources which are found on the ocean floor.

sand and gravel, phosphorite (phosphate), oyster shells, diamonds, manganese nodules, iron

23. Name 6 mineral resources which are found beneath the ocean floor.

oil, coal, gas, iron ore, sulfur, nickel-copper ore

24. List all the ways the ocean provides us with pleasure and fun.

fishing, water skiing, underwater diving, watching wave action, sailing, watching birds, watching sunsets, swimming, surfing.

ANSWERS TO POSTTEST (continued)

magnesium, iodine, and salt

a. globigerina ooze
(b.) kelp
c. seawater
d. tuna

Yes ✓ No ___

cost of extraction is more than the gold is worth

sand and gravel, phosphorite (phosphate), oyster shells, diamonds, manganese nodules, iron

oil, coal, gas, iron ore, sulfur, nickel-copper ore

fishing, water skiing, underwater diving, watching wave action, sailing, watching birds, watching sunsets, swimming, surfing

SCRIPT FOR LEARNING CARREL LESSON

6.14

OCEAN RESOURCES

ENVIRONMENTAL STUDIES

A Cooperative Project of the Department of Geological Sciences and the Science Education Center

THE UNIVERSITY OF TEXAS AT AUSTIN

1

Title Slide
"Resources of the Ocean"

This program will provide you with some answers to questions you may have had concerning the ocean and its resources.

2

Off-shore oil well | Sea-food buffet

You will learn about the food, minerals, and enjoyment we derive from the oceans. Before viewing this program, please turn to page 1 in your Study Guide and read the information you will find there.

Stop the tape now.

3

Food from the Sea

(seafood)

In Part I of this lesson we will look at food from the sea. What it is, where it is, and how we get it.

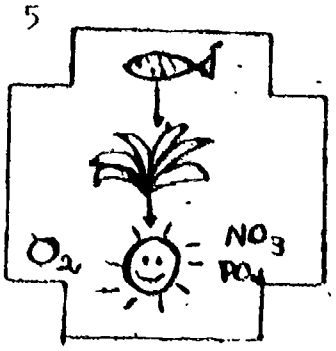
4

Where are the fish?

(fishing boats)

Where are the most productive fishing areas?

5



The amount of fish in an area is directly proportional to the amount of plant life available, which, in turn, is dependent on the abundance of three things: oxygen, sunlight, and nutrients like phosphates and nitrates.

Where do we find oxygen in the oceans?

6

Slide showing upwelling

This cold, oxygen-rich water rises to the surface along certain coastline areas. These upwellings are some of the most productive fishing areas in the world.

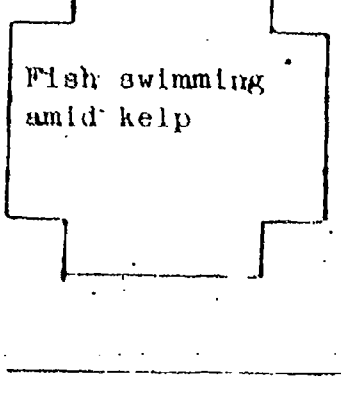
7

Peru's coastal waters are the site of upwellings and are probably more productive than any area of similar size in the world.

8

Stop the tape now and complete Frame 1

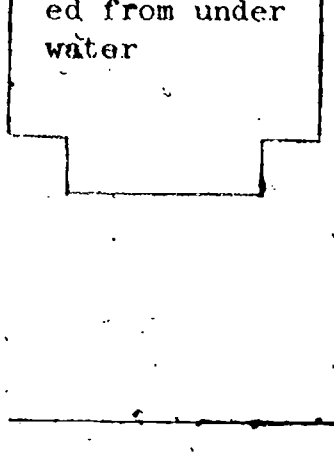
9



Fish swimming amid kelp

Why is light important? As you have learned, the abundance of plantlife in the oceans determines the number of fish. The plants which furnish food and oxygen for the fish can grow only at depths where sunlight penetrates.

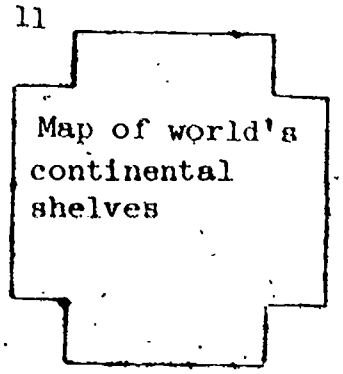
10



Sunlight viewed from under water

Light penetrates to a maximum depth of only 200 meters.

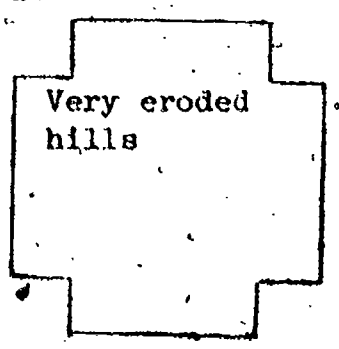
11



Map of world's continental shelves

It is therefore not surprising that most of the world's catch of fish is taken over continental shelves in water less than 200 meters deep.

12



Very eroded hills

Where are nutrients most abundant? Phosphates, nitrates, and other nutrients necessary for life are washed out of soils into rivers which empty into the sea. Therefore, as we could expect, coastline waters are richest in these life-giving nutrients.

13

Open, deep blue waters

The farther out into the ocean we travel, the less of these nutrients we find, and the less life, both plant and animal, we encounter.

The bright blue waters in the center of ocean basins are virtual deserts, due to the lack of these nutrients, and because the depth of these basins is usually much greater than 200 meters.

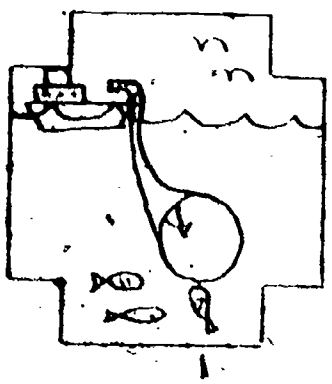
14

How to get more?

(fish)

How can we increase our fish take from the oceans?

15



New kinds of equipment can help increase our take. Russian fishermen have been catching fish called kilka which swim near the mouth of a suction tube which draws them out of the water onto the deck of the fishing vessel. Electrical impulses and sounds have been used to lure fish into the tube.

16

Underwater lights

Underwater lights have been used by Japanese fisherman who attach them to their nets and then turn them off one by one until the fish are captured deep within the nets.

17

Fish swimming near underwater wreckage

Jacques Cousteau in his early underwater dives noted that large quantities of fish congregated around sunken ships. Cousteau proposed building a multi-level concrete home to attract fish and feeding them through a system of pipes.

18

Photo of wrecked cars in the ocean near shore

This concept has been utilized somewhat by sports fishermen who have built man-made reefs of scrap metal and old cars to attract and concentrate fish in one area. This has proven to be a very successful action.

19

Satellite view of oceans (part of satellite in picture)

Satellite photography may help fishermen to locate schools of fish. Satellites can detect the presence of near-surface nutrients, fish oils, and other phenomena which are directly related to fish concentrations. This information can be relayed to land-based tracking stations. They, in turn, send this news to captains of fishing vessels in the area.

20

Fish in air bubble enclosures

Other proposals for increasing our fish take have been made which are still in the experimental stage. Scientists have found that fish shy away from air bubbles. They have laid down perforated plastic pipes or hoses into which they fed conpressed air. No fish would swim through the bubbling water. Engineers picture sea enclosures with bubbling walls covering thousands of acres of ocean waters where millions of fish could be grown.

21

Will fish farming help?

(fish ponds)

Can fish farming increase our protein supply?

22

Underwater Japanese woman diver looking for oysters

Approximately 4 million tons of fish and shellfish are cultivated annually. Most of this production comes from Asia and the Far East. Shrimp are cultivated on a large scale in Southeast Asia, and the Japanese have been farming oysters for centuries.

23

Men shoveling oysters into open water

Oyster farming in the United States has recently become a big business. Tiny oysters are nurtured under optimal conditions in a farm, and then planted in oyster beds. It takes 4 to 5 years for an oyster to grow to maturity naturally.

However, oyster farms with a capacity to create ideal environmental conditions can cut this growth time in half.

24

Fish school

The greatest fish mortality occurs between hatching and the end of the larval stage. Nurseries which rear young fish through this dangerous period can increase fish populations. In an experiment which began in 1949, some young salmon were artifically reared through the larvel stage in a hatchery,

25

Salmon underwater

and then released into a nearby pond. From there they made their way out into the ocean. Three years later some of the salmon returned to the ponds. From these, scientists selected the biggest males and females for breeding purposes. This continued over the years.

26

Salmon swimming up rapids

And now, 30 years later, salmon are returning in 3 years instead of the usual 4, and are heavier and longer than naturally bred salmon.

27

Fish ponds

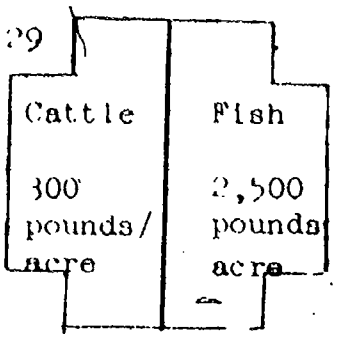
But the greatest discovery was that these fish have an ability to survive in the ocean at a rate of 10 to 30 times greater than the naturally bred salmon.

Experiments like this prove that we can do much toward improving the harvest of the oceans. In addition to hatcheries which release young fish into the oceans, fish ponds can be constructed in which fish grow from eggs to maturity and are harvested.

28

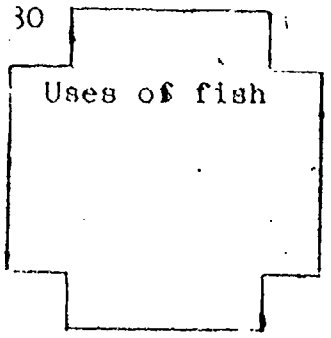
Stop the tape now and complete Frame 2

29



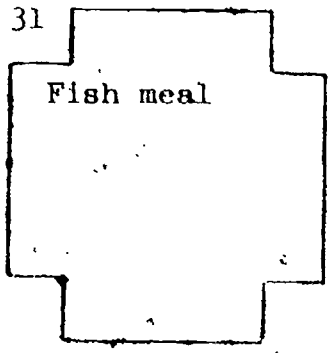
One attractive feature of fish ponds is that they can be developed on poor land unusable for agriculture. One British fishing authority estimates that 300 pounds of young cattle per acre can be produced on good pasture annually, yet 2,500 pounds of fish per acre can be produced annually in ponds located on poor tropical soil.

30



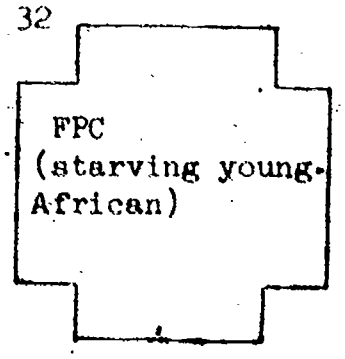
How do fish benefit man? Naturally, we all know how to use tasty fish like lobster and shrimp to good advantage.

31



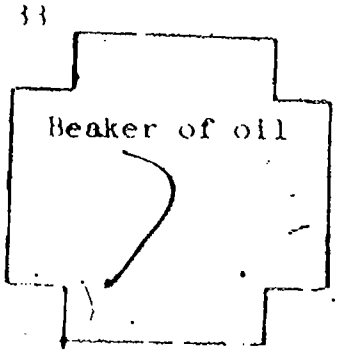
However, many fish unpalatable to human taste buds and waste parts of edible fish contain the same proteins so valuable to man. These fish are dried and then ground up to make fish meal. Both pork and chicken cost less than beef, partly because of the widespread use of fish meal for the feeding of pigs and chickens.

32



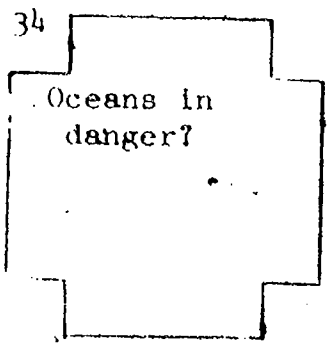
This same fish meal can also be deodorized and refined for human consumption. This food is called fish protein concentrate, better known as FPC. FPC has been used as a substitute for milk in feeding babies, and mixed with other foods to add protein to human diets.

33



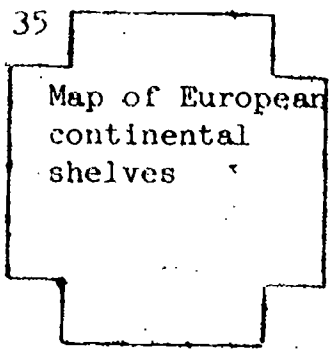
Fish oils are a by-product of the fish meal processing method. Much cheaper than vegetable oils, they are used as margarine and cooking fats, and as industrial oils. Another use of fish oils is as vitamins for chicken and cattle.

34



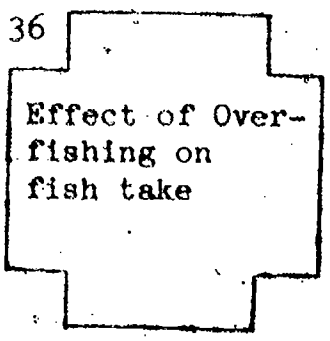
Are we in danger of overfishing the oceans?

35



Overfishing is already a problem for some species. Stocks have been depleted in heavily fished areas such as the continental shelves of Europe, particularly the North Sea.

36



When the catch of a species reaches the point where reproductive capacity is unable to compensate for the losses sustained, fisheries become uneconomical and fishing of many species to extinction is thus prevented.

37

Stop the tape now and complete Frame 3

38

Graph: Annual fish take — 1950-1985

Oceanographers estimate that the energy available in the oceans is capable of producing only 240 million tons of fish per year. Allowing for loss to other fish, sea birds, and animals, we are left with a maximum of 100 million tons for human consumption each year. At present, we are harvesting 65% of this amount annually, and we are expected to harvest the maximum 100 million tons by 1985.

39

240 million tons (fish lying on deck)

Two conclusions are obvious: (1) the sea is capable of producing only a finite amount of food,

---

40

Same graph as slide #38

and (2) man is now approaching the maximum limit he can expect to harvest without upsetting the ecological balance of the oceans.

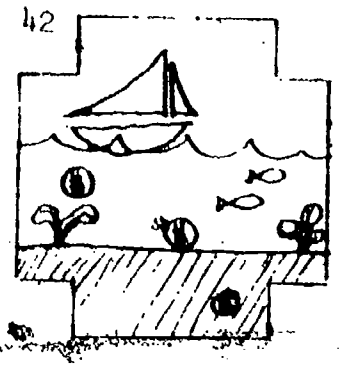
41

Minerals from the ocean

(offshore oilwell)

In Part II we will discuss minerals from the oceans.

42



Oceanic minerals are found in three different places: dissolved in seawater, lying on the seafloor, and underneath the seafloor.

43

Most important mineral?

(offshore wells)

What is the most important mineral resource we take from the ocean? Oil and gas are the most important minerals from the sea. The annual production exceeds 6 billion dollars.

44

Offshore Production of Oil

Presently, about 16% of the world's oil and 6% of our natural gas come from offshore wells. By 1980, offshore production of oil is expected to be one-third of the total world production.

45

Waves on cliff

Geologists estimate that 40% of the earth's known oil reserves lie beneath the continental shelf, but it is possible that subsea oil deposits exceed those on land.

46

Na, Pb, I, Mn, Cl, Mg, Br, S, Fe, Au (underwater scene)

What minerals are dissolved in seawater? Almost all the natural occuring elements are found in seawater. However, sea water is an extremely low-grade source for most of these elements. The most important industrial metals are valued at less than 28 cents per million liters of seawater, and the gold dissolved in each cubic kilometer of ocean water would cost far more to extract than it is worth.

47

Mineral extraction economical (beakers of minerals)

Can minerals be extracted economically from seawater?

48

80% of our bromine (industrial scene)

The answer is yes, they can be. Eighty percent of the world's bromine supply comes from seawater. The supply is supposedly inexhaustible.

49

Most U.S. magnesium (another industrial scene)

The bulk of the U.S. supply of magnesium now comes from the ocean. This is because the extraction of magnesium from seawater is cheaper than mining and refining ore.

50

Salt

And, of course, much of the world's sodium chloride salt comes from the sea.

51

Strip-mining scene

As land supplies of other important elements become depleted, extraction of these elements from seawater may also become economically feasible.

52

Iodine concentrated in kelp (diver amid kelp)

Nature does not always make it difficult for us to harvest her riches.

The seaweed kelp concentrates iodine in large amounts of seawater. The dried seaweed is burned to obtain iodine. Even the iodine mined from the salt beds of Chile comes from the remains of kelp.

53

Child in sea

The greatest treasure in the oceans may be water. All living things depend on it for life. However, our fresh water supplies are being rapidly depleted. We will soon have to turn to the oceans for at least part of our water needs.

54

Desalination plant -- West Indies

In different parts of the world, hundreds of desalinating experiments are underway. Already desalination of seawater contributes a large portion of some areas' water supplies -- like this 800,000 gallon per day unit in the West Indies,

---

55

Guantanamo Bay desalinating plant

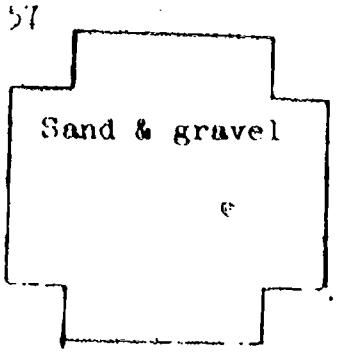
and like this plant in Guantanamo Bay, Cuba. As our water supplies become scarcer, desalination will become more economical and greater portions of our fresh water will come from the sea.

56

What minerals are on the seafloor?

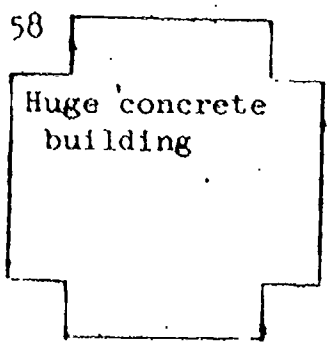
What mineral resources are found on the seafloor?

57



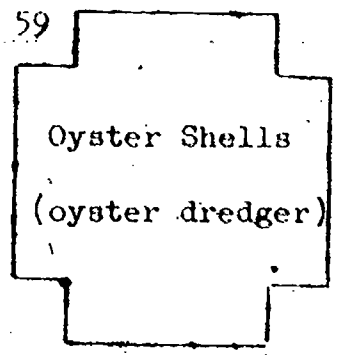
Sand and gravel are mined from shallow coastal waters in greater quantities than any other material.

58



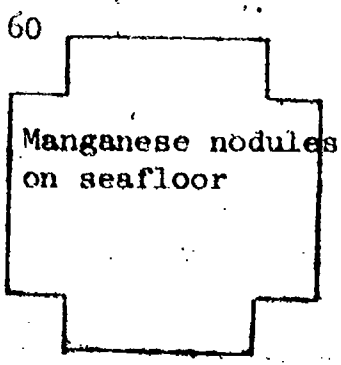
Most sand and gravel is used in concentrate and as road material. As land deposits become exhausted, the sea will become a major source of building material for construction industries, particularly in coastal areas.

59



Oyster shells are also dredged for use as building material in high purity lime.

60



Manganese nodules are black concentrations of iron manganese, and are believed to have been formed by precipitation from seawater. They form very slowly, but estimates of their abundance is high.

Some companies are now attempting to develop the technology necessary to harvest these nodules. If some economical way of gathering them could be devised, they would provide an abundant iron and manganese source for years to come.

61

Bag of phosphate fertilizer

Phosphorite is a source of phosphate fertilizer, and is deposited underwater in many areas throughout the world.

62

Outline of state of California

One rich deposit off southern California contains about 30% phosphate. However, due to a large supply of phosphate deposits on land, the marine deposits are not economic at present.

63

Diamonds on black velvet

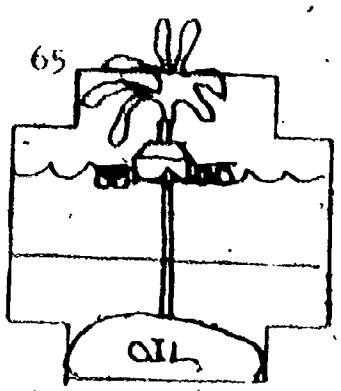
More glamorous than fertilizer, diamonds are also found on the ocean floor. Since 1952, more than half a million carats of diamonds have been dredged from the seafloor off the southwest coast of Africa.

64

What minerals are found underneath the seafloor?

What minerals are found underneath the seafloor?

65



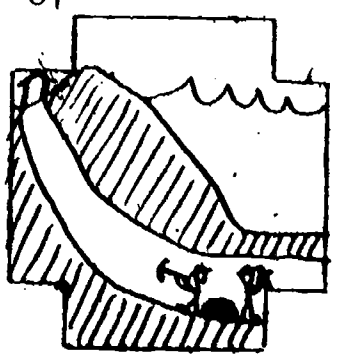
Oil and gas, at present the most important minerals, are, of course, found beneath the seafloor.

66

Aerial view of sulfur wells in Gulf

Another subseafloor mineral, sulfur, is associated with salt domes. Sulfur is recovered from beneath the sea bottom by melting it with superheated water and piping it to the surface. Two sulfur mines off the Louisiana coast account for 15% of the U.S. production of sulfur.

67



Surprisingly, a large amount of coal, iron ore, and nickel-copper ores are mined from beneath the sea. They come from mine shafts beginning on land. Coal from beneath the sea accounts for more than 30% of Japan's production, and more than 10% of Britian's.

68

In addition to food, minerals, and water, (fishing boat)

69

the oceans give us many other gifts.

(Music)

70

(sailboat)

These gifts are given freely ..

(Music)

71

(ocean sunset)

and have been ours since the beginning of time.

(Music)

72

(water skier)

It has not been necessary to slave ...

(Music)

73

(waves crashing on rocks)

or spend millions of dollars to acquire them.

(Music)

74

(fish -- bright ones)

Other resources are finite in amount.

(Music)

75

(horse & rider on beach)

However, these gifts can be inexhaustible...

(Music)

76

(sailboat in mist)

if we value them highly enough.

(Music)

77

Surf on rocks

(Music)

78

Posttest

Now turn in your Study Guide to the Posttest. Answer the test questions again, this time on the green pages. Stop the tape now.

79

Answer page in the Study Guide

You may now check your Posttest answers against the answer sheet in the back of the Study Guide. If after checking your answers, you feel you have learned all you need to know from this lesson, you may stop. However, if you did not answer most of the questions correctly, feel free to take this lesson over again. The Proctor will help you.

80

The End of this Lesson

LESSON 6.14: OCEAN RESOURCES

STUDENT RESPONSE SHEETS

Name _____

Date _____

LESSON 6.14: OCEAN RESOURCES

STUDENT RESPONSE SHEET

Frame 1

You have learned that upwellings off the coast of Peru provide the conditions for an excellent fishing ground. Off the coast of California near Monterrey there used to be excellent fishing grounds caused by upwellings. Fishing is poor now and old cannery buildings are used for stores and warehouses. What do you think happened to this fishing ground?

Frame 2

Before proceeding with this program, we would like you to make a hypothesis and an estimation. Think about the number of pounds of beef or fish that can be raised per acre. Answer the following questions:

Can man raise more, less, or the same number of pounds of beef as fish per acre?

Next, your estimation of the ratio of number of pounds of fish to beef will be:

(a) .5 to 1
(b) 1 to 1
(c) 8 to 1
(d) 20 to 1

Answer: _____

Name _____

Date _____

LESSON 6.14: OCEAN RESOURCES

STUDENT RESPONSE SHEET

Frame 3

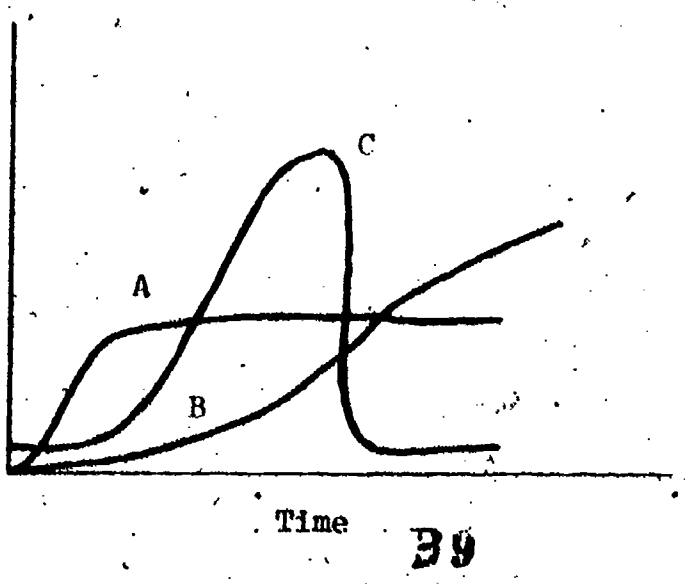
This lesson has completed an explanation of several technological techniques that will increase the fish take from the oceans. However, we all recognize that technology operates within economic and political domains. Let's study for a moment the same problem -- how to increase fish catch -- from a social point of view. Look at Figure I. If we overfish the ocean, Curve C describes what will happen. If we follow Curve B, the fish take may be large and continuous through time, but not rapid enough to prevent millions of people from starving. If we follow Curve A, the fish take would most nearly match our immediate needs and provide a continual supply.

List below two economic or political agreements that would have to be made before Curve A could be carried out.

Agreement I _____

Agreement II _____

FIGURE I



Name

Date

LESSON 6.14: OCEAN RESOURCES
STUDENT RESPONSE SHEET
PRETEST

1. What three major factors determine the number of fish in any area?

2. Which of the following oceanic water masses contain the most oxygen?
   a. cold bottom waters
   b. equatorial waters
   c. island waters
   d. surface waters

3. How far down into ocean water does sunlight penetrate?

_____ meters

4. At which one of the following places are nutrients for fish life most abundant?
   a. at the equator
   b. at the poles
   c. in ocean basins
   d. near shorelines

5. Which one of the following areas produces the least fish life?
   a. the equator
   b. the poles
   c. center of ocean basins
   d. shorelines

6. Which of the following techniques is (are) now used to catch fish?
   a. man-made reefs
   b. sounds
   c. suction tubes
   d. underwater lights

7. Name 3 ways of locating and/or catching fish which will probably become widespread in the future.

8. In what parts of the world does most seafood farming now occur?

Name

Date

LESSON 6.14: OCEAN RESOURCES
STUDENT RESPONSE SHEET
POSTTEST

a. cold bottom waters
b. equatorial waters
c. island waters
d. surface waters

_____ meters

a. at the equator
b. at the poles
c. in ocean basins
d. near shorelines

a. the equator
b. the poles
c. center of ocean basins
d. shorelines

a. man-made reefs
b. sounds
c. suction tubes
d. underwater lights

Name _____

Date _____

LESSON 6.14: OCEAN RESOURCES
STUDENT RESPONSE SHEET
PRETEST (continued)

9. Do we have evidence at present to indicate that fish farming can contribute significantly to our fish catch?
   Yes _____ No _____

10. How do cattle crops compare with potential fish pond crops?
    Cattle: _____ lbs./acre/year
    Fish: _____ lbs./acre/year

11. How is fish meal used?
    a. as chicken feed
    b. as hog feed
    c. as sawdust
    d. in industrial paints

12. Of what kinds of fish is fish meal made?
    a. lobster tails
    b. fish heads and entrails
    c. trout and tuna filets
    d. untasty fish

13. Have we overfished in many areas of the oceans?
    Yes _____ No _____

14. How are fish species protected from fishing to the point of extinction?

    _____

    _____

15. How long will it be before we are harvesting the maximum amount of fish we can without upsetting the ecological balance of the oceans?

    _____

16. What are the 2 most important mineral resources we take from the oceans?

    _____, _____

17. What percent of the earth's oil reserves are estimated to lie beneath the continental shelf?
    a. 10%
    b. 20%
    c. 40%
    d. 80%

Name _____

Date _____

LESSON 6.14: OCEAN RESOURCES
STUDENT RESPONSE SHEET
POSTTEST (continued)

Yes _____ No _____

Cattle: _____ lbs./acre/year
Fish: _____ lbs./acre/year

a. as chicken feed
b. as hog feed
c. as sawdust
d. in industrial paints

a. lobster tails
b. fish heads and entrails
c. trout and tuna filets
d. untasty fish

Yes _____ No _____

_____

_____

_____

_____

a. 10%
b. 20%
c. 40%
d. 80%

Name _____

Date _____

LESSON 6.14: OCEAN RESOURCES
STUDENT RESPONSE SHEET
PRETEST (continued)

18. Which minerals are now being extracted directly from seawater?

_____, _____

and _____

19. What is the oceanic source of our iodine?

a. globigerina ooze
b. kelp
c. seawater
d. tuna

20. Can we depend on the oceans to supply our fresh water needs in the future?

Yes _____ No _____

21. Why have we not yet extracted gold from the oceans to solve our monetary crises?

_____

_____

22. Name 6 mineral resources which are found on the ocean floor.

_____, _____,
_____, _____,
_____, _____.

23. Name 6 mineral resources which are found beneath the ocean floor.

_____, _____,
_____, _____,
_____, _____.

24. List all the ways the ocean provides us with pleasure and fun.

_____

_____

_____

_____

Name _____

Date _____

LESSON 6.14: OCEAN RESOURCES
STUDENT RESPONSE SHEET
POSTTEST (continued)

_____, _____

and _____

a. globigerina ooze
b. kelp
c. seawater
d. tuna

Yes _____ No _____

_____

_____

_____, _____,
_____, _____,
_____, _____.

_____, _____,
_____, _____,
_____, _____.

_____

_____

_____

_____