



LOAN COPY ONLY

MARINE STUDIES

IDEA BOOK

For Teachers
Grades K-6

CIRCULATING COPY



Sea Grant

WRITTEN MATERIALS AVAILABLE

The following materials were developed by the Marine Education Program, Institute for Marine and Coastal Studies Sea Grant Program of the University of Southern California

- Wet and Wild (K-6) a six-unit multidisciplinary bilingual (English-Spanish) teacher guide
- *Marine Studies Idea Book (K-6) a resource book of ideas and activities (available in English or Spanish) for the development of lesson plans by the elementary school teacher
- Marine Studies Idea Book (7-12) a resource book of ideas and activities for the development of lesson plans by the high school teacher
- Tidepool Animals, Sharks and other Sea Creatures, Fantastic Marine Animals (K-12) a series of three bilingual (English-Spanish) mini-information booklets to be used for supplementary classroom material
- Tuga the Turtle (K-6) a children's book, written in braille and large letter, on tidepool animals
- Dimensions of the Sea (K-12) a six-part slide(35mm) presentation with written narrative, for use in the classroom and for teacher workshops

*MARINE STUDIES IDEA BOOK (K-6)

Developed for the Institute for Marine & Coastal Studies Sea Grant Program of the University of Southern California

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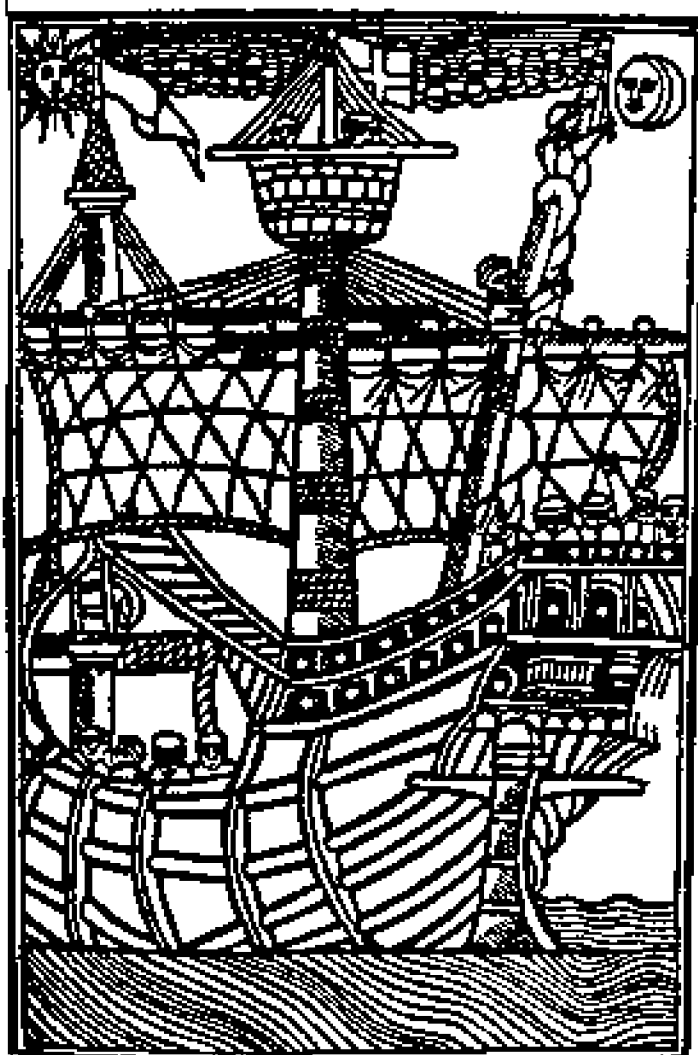
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MARINE STUDIES IDEA BOOK

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*Knowledge of the ocean is more than
a matter of curiosity. Our very survival
may hinge on it.*

JOHN F. KENNEDY

INTRODUCTION

WHAT IS THIS IDEA BOOK ABOUT?

This is a resource book of ideas to help you make marine studies more lively and, hopefully, more involving to your students. It offers theories to consider, suggestions for classroom activities and, we trust, enough of a sampling to prompt you to want to share the wonders of the ocean with your students-- even if that means having to develop your own lesson plans.

Intentionally there are no pre-developed lesson plans in this book. With a multi-disciplinary approach it not only allows the teacher to integrate new material into an existing class, or draw up a completely new class, it also encourages the instructor to embark on his/her own voyage of discovery. The themes you will find here should tug

your imagination in directions that fit the needs of your particular audience. In conjunction with this Marine Studies Idea Book, you may want to purchase the Supplementary Marine Education Curriculum Guide for grades K-6 ("Wet and Wild") also developed by the U.S.C. Sea Grant Program. The "Wet and Wild" guide, in both Spanish and English, contains more structured lesson plans complementary to the ideas and activities presented in this Idea Book.

THE BASIC CURRICULAR FRAMEWORK

Marine education is handled in an unconventional way in this book. Most marine curricula are anchored to topics such as the density of sea water (as deter-

PSYCHOLOGY

meaning/purpose
sociodynamics
expression of
self and culture

CULTURAL
ANTHROPOLOGY

artifacts
form/function
style

ART
ARCHITECTURE
GEOMETRY

interdependence
repetition/change
design

consciousness
ambivalence
communication

LITERATURE

mythology
creativity
search/striving

HISTORY
ARCHAEOLOGY

exploration
acquisition
conflict

POLITICS
LAW

cooperation/
competition
power/weakness
use/abuse

MARINE BIOLOGY
CHEMISTRY
PHYSICAL
OCEANOGRAPHY
GEOLOGY

SOCIOBIOLOGY
ECOLOGY

mined by temperature, salinity and pressure), the capacities of modern oceanographic vessels, the discovery of new fisheries resources, the effects of wind currents, and so on. These subjects may arise in your class, but starting out with such weighty matters will soon sink your students' interest.

Instead, we will approach marine sciences by the way of the humanities and social sciences, and by way of broad biological and ecological principles that are demonstrated in the sea.

The circle at the left is a model of possible links between various disciplines and the sea. You can go around the circle in either direction, or cross over to the other side at any point. Between the disciplines are listed some unifying themes.

If the model looks too much like some medieval monk's version of cosmic organization, consider the following:

Suppose you were an English major and a Melville devotee. You would probably choose to enter the circle at LITERATURE and move either clockwise or counterclockwise. As the class read selections from *Moby Dick* (or saw a film or listened to the passages recorded by Heston, Dulles, and Rose),* the students might become interested in whaling or shipbuilding as part of our nation's history. An extension into history might also come by way of reading the biblical story of Jonah or myths about the creation of the world. Suddenly the class could be talking about Atlantis and/or theories about continental drift. From there students can leap across the circle

and study anthropology (island cultures, for example) and maybe read the student's version of *Kon-Tiki*.

* Bibliographic information is provided at the end of the book. See *References*.

On the other hand, perhaps the students' interest is in the act of going to sea itself--in exploration and acquisition of new territory, which seem inevitably to lead to conflicts about ownership, including current arguments about fishing rights and who owns the middle of the ocean. By now they're well into politics, and the teacher might want to incorporate issues being debated at Law of the Sea conferences.

Even the most superficial exploration of law and the sea will lead to weighty questions about individual freedom versus group benefit and cooperation versus competition--which are the very themes talked about in, for example, Wilson's *Sociobiology*. Study about the web of life and the necessary role of each organism in nature might inspire a digression into the roles of children in families and families in society (skipping over the DESIGN area).

In another classroom, the study of sociobiology might lead to an awareness of design in nature--of form and function and its relationship to, for example, the patterns used to design houses, or maybe to a comparison of architectural styles of sea creatures and man.

By either route, the class is led to consider cultures and their styles, artifacts, and means of expressing themselves. That topic is in turn a branch of psychology,

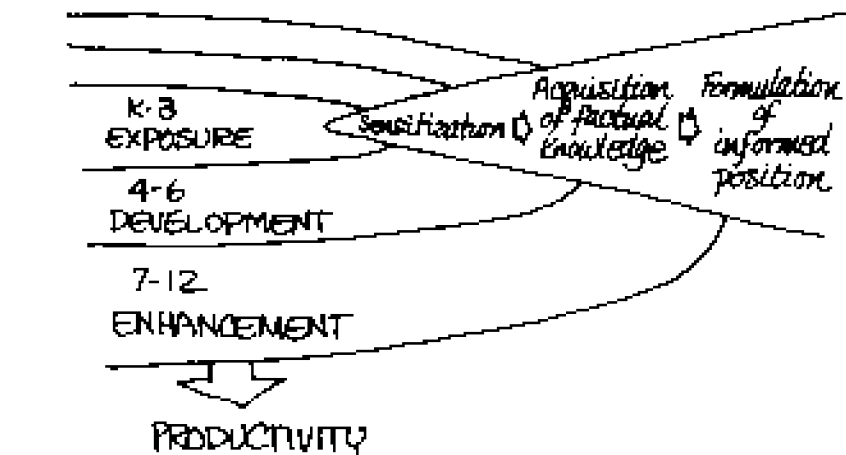
which with its themes of consciousness, ambivalence (the threatening and pacifying aspects of the sea, for example), and symbols for communication leads directly back to literature.

In the center of the curriculum are the traditional oceanographic disciplines: marine biology, chemistry, physical oceanography, and geology. The point is that they feed into all of the other areas. When thinking about form and function and the way evolutionary adaptation works, for example, marine biology comes in--not by rote memorization as is all too common, but by being an ideal source of examples that demonstrate certain principles. Geology is not a starting point, but a natural correlative to underwater archaeology and continental movement. Physical oceanography and chemistry will enter the picture quite naturally in any study of pollution or even in questioning (perhaps as a factor in seascape painting) why the sea is blue.

Should you remain confused, read on: the suggested activities are much less esoteric than this relatively formal conceptual guide.

THE LONG-TERM CURRICULUM

At some point you might be asked how the learning unfolds over time. The chart at the right summarizes the movement from basic concepts, (*What do fish look like?*) through development of more complex ideas, (*What do they do together?*) to enhancement of themes leading to action, (*How much control should there be over the harvesting of fish? Is international control feasible?*).



K-3 EXPOSURE to sea creatures, marine foods, seascapes and sounds, ships, sea stories

4-6 DEVELOPMENT of awareness of oceanic cultures, political and economic issues, myths, biological principles

7-12 ENHANCEMENT of consciousness of ocean issues and themes (social, political, economic, literary, historical, aesthetic), leading to activity: research, project preparation, conservation action

LONG TERM GOALS: voter preparedness, citizen action, ocean awareness and enjoyment, marine career preparedness

HOW TO USE THIS IDEA BOOK

The Marine Studies Idea Book is divided into four themes:

THEME 1: A WHALE OF A GOOD TIME

A study of the history, literature, politics, anthropology, economics, art and music of whaling.

THEME 2: MYTHS, MONSTERS, AND MARINERS

A series of lessons on the mythology, history, folklore, archaeology, and cultural anthropology of the sea.

THEME 3: FINS AND FINIALS

A study of nature's architectural patterns as evidenced by marine creatures, including biological adaptation and its role in evolution.

THEME 4: DIVIDING THE OCEAN PIE

A series of activities on the politics, law, and ecology of the sea.

Each of the four themes is divided into 10 activity sections, and each section is built around a topic related to the central theme. When writing lesson plans for your class, you may wish to stick to one theme and conduct the activity sections in order from one to 10, or you may incorporate topics and activities from other themes. You are encouraged to work from your past experiences, utilizing existing teaching aids whenever possible, to transmit the rainbow of ways the ocean touches us all.

And don't forget that you have the option of sticking with just one part of a theme. We're not trying to "cover the material" or "do" the ocean. As one poet pointed out, there is danger in the trivial, once-over-lightly approach: "A taste for poetry, a taste for ecology, a taste for videotape, a taste for litmus paper, added up, gives a taste for randomness and fragmentation." (Lopate, p. 374)

A WORD ABOUT FIELD TRIPS

You won't find a trip to the tide-pools or a harbor cruise among the suggested activities because, for many schools, such a visit would be nearly impossible to arrange. However, an excursion to a marine-related facility or to the beach can be a key experience for your students. Inquire in your area for marine museums, research vessels, science centers, etc., which might be of interest to your students. An example would be to visit a port facility to see how ports are run and their impact on the environment and on our lives.

WHY TEACH THIS COURSE?

*The oceans are a wonderful place
on which to focus any discipline.
It's not just a place for scientists.
It's a place for everybody. It's a
place for artists; it's a place for
writers; it's a place for musicians.*

Atholstan Spilhaus
Father of Sea Grant

As nearly every oceanographic curriculum guide points out, the earth is nearly three-fourths covered with water, so it behooves us to know more about the oceans that surround us. Most of the guides also point out that our land resources are dwindling, that America has expanded seaward 200 miles, and that we need to act quickly to protect and conserve the nation's marine resources.

Perhaps an equally good argument could be made for teaching about the ocean because it provides a natural arena for learning many of the enriching ideas people need to know about as early in life as possible. The ocean is part of our history; it provides themes and symbols for our literature. Most physical and biological principles are demonstrated in the oceans, and many sociological ones as well. We can use the ocean to study math, reading, folklore, music, and certainly political science and international relations.

Thus you have the opportunity to educate children about something you care about--the ocean--while teaching them some wider ideas and skills that will come in handy as they continue their education.

Consider, for example, the skills used by people in maritime occupations. Any lessons you can plan that would teach those skills would be helpful to the next generation. Here are a few:

1. Taking a representative sample and counting the number of organisms or measuring the pollutants found in it.
2. Mapping, including mapping by satellite.
3. Identification of fish and sea animals.
4. Boatsmanship.
5. Drawing up hypotheses and testing them; i.e., ascertaining the origin and control of harmful effluents.
6. Diplomatic handling of disputes.
7. Writing, both scientific and creative, as well as proposals for funding and reports of results.
8. Photography.
9. Public speaking.
10. Designing engineering methods for sound use of the oceans' resources.
11. Locating and excavating historic underwater ruins.
12. Predicting consequences and future patterns; advising governmental bodies of predictions.

For the teacher the benefits of teaching a marine studies class are much the same as

for their students. The course provides opportunities to learn about the ocean in an exciting, "hands-on" way unhindered by a narrow, discipline-oriented approach. Interwoven in each theme are concepts and information that will challenge your curiosity and intellect. Teachers and students are both explorers in a domain where nature rewards creative adaptability.

on ocean conservation issues.

WHAT WILL THE STUDENTS BE ABLE TO DO?

One of the necessities in modern education is articulating your behavioral goals--the things you expect the learner to be able to do after you have taught the course. As you go along, try to add objectives to the lists below.

The activities in this Idea Book are designed to help elementary students:

1. Examine and create artistic and literary works in which the ocean and its creatures are the theme.
2. Identify problems in the marine environment and originate possible solutions.
3. Conduct research into marine topics about which the students are curious.
4. Identify and describe biological adaptations that contribute to the survival of marine organisms; classify patterns by which nature designs marine organisms.
5. Relate, dramatize, or illustrate some of the oceanic tales, myths, poems, and songs which are part of our cultural history.
6. Demonstrate the ability to take action



A sea fan.

SOME GENERAL SUGGESTIONS

-- Watch television listings for shows on marine subjects. You will find everything from Cousteau specials to old Errol Flynn movies such as The Sea Hawk. You can either alert your students to the shows or possibly arrange to have videotapes of the programs shown in class.

-- Try to set up an aquarium in the classroom. Approval is sometimes difficult because an aquarium takes both space and money -- scarce items in most schools. Remember that after you've succeeded in installing the tank, your work has only begun. Marine species need care, even on holidays. Delicate tropical fish are a particularly bad choice for classroom aquarium. It does not advance student interest in marine life to bring fish into class and let them die.

-- Most libraries, and city or county school districts publish a list of films that can be borrowed. Look for marine subjects and then preview the films for relevancy.

-- Take a field trip to study the ocean firsthand. In California, whale-watching season is a fine time to acquaint students with both the sea and one of its most awesome residents. If trips offshore or to tide pools are impossible, try to visit a marine museum, an aquarium or even a fish market.

-- Watch constantly for books, films, posters, magazine articles and even advertisements about the ocean. As relatives and friends to save magazines with water-related articles.

Here is a partial list of publications to watch for:

Current	Oceanus
Discover	Science Digest
Dive	Science 80s
GEO	Sea Frontiers
International Wildlife	Sea History
National Geographic	Sea Technology
National Wildlife	Skin Diver
Natural History	Smithsonian
Ocean Industry	Technology Illustrated
Ocean World	Underwater Naturalist
Oceans	

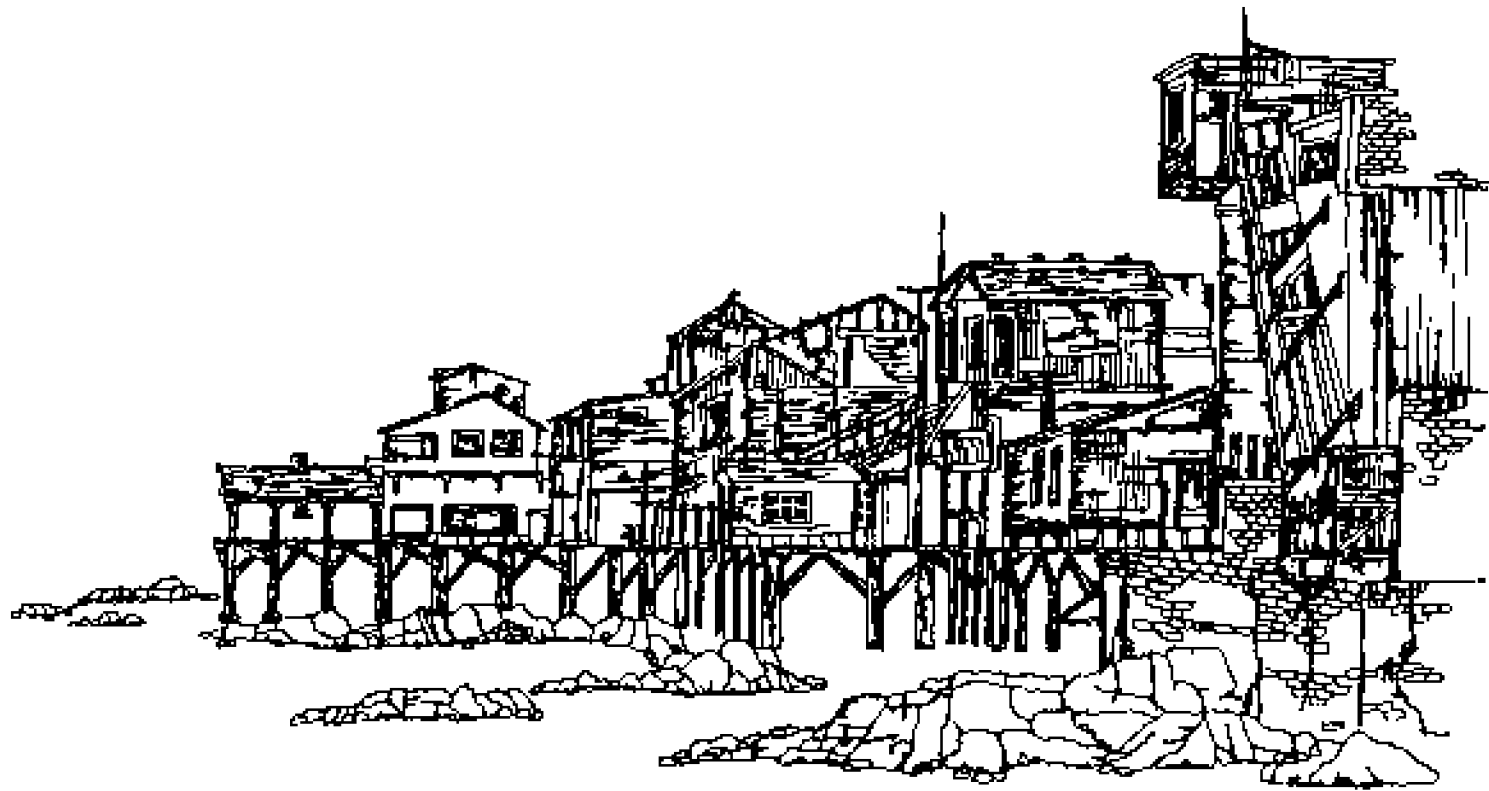
-- Start your study of the oceans by preparing journals for noting ideas or notebooks for collecting newspaper and magazine articles.

-- Your collection is important because no one textbook includes all of the information you may wish to use. If you and the students work on a notebook together, you will be adding to a marine studies legacy that can be passed to succeeding classes.

-- Bring in current newspapers and magazines. Break into small groups and look through the periodicals with one primary question in

in mind: How does the ocean affect your lives? In your journal, make a list of ideas you find and the questions that the articles raise. Many of the connections between the ocean and people aren't obvious. For instance, when you see a perfume ad you might not link it to the whaling industry; likewise with a dog food ad. It's also easy to overlook weather summaries, tide tables and lists of ship movements.

-- Consult the reference section at the back of this book. It lists books and other sources of information about the marine world.



cannery row

Illustration by Corrie Morehouse

A WHALE OF A GOOD TIME

A SERIES OF LESSONS
ON WHALES AND WHALING

Whaling is an ideal theme for organizing interdisciplinary sessions. Certainly no discussion of marine biology, literature, history, or folklore is complete without that topic. Through whaling, students can examine economics (*What products do we use? What substitutes are available?*), cultural differences (*What is the debate with Japan all about?*), ecology (*Are whales becoming extinct? What will the results of extinction be?*), Eskimo literature and culture (*How has technology changed cultural patterns?*), mathematics (*How big is a whale?*), biology (*How do whales raise their young? What are their migration patterns?*), psychology (*What do we know about the brains of cetaceans?*), and art (*How has whaling influenced folk art?*).

The topic of whales and whaling raises a strong emotional response in many people -- it is a loaded issue, and probably will become more so. One side charges that new methods of whaling, including radar, helicopters, and harpoons with an explosive charge have combined with an increase in the human population to cause a decline in the whale population. The other side argues that whales provide protein that is an important dietary component of some of the world's people.

One source of information about whales is the American Cetacean Society (ACS), whose aim is the "conservation, education and protection of all marine

life, with special concern for whales, dolphins and porpoises." A file in the Marine Resource Library (SSW 308) contains many of the Society's publications, including a "Gray Whale Teaching Kit."

Another source is the National Geographic Society, which includes excellent photographs in its magazine articles about whales. *Oceans*, a publication of the Oceanic Society, frequently carries articles about whales and devoted its entire Number 4, 1977, issue to cetaceans. (The issue, which has many photographs, is available in the MRL.)



ACS

THEME I OBJECTIVES

The students will be able to:

1. Distinguish the family of whales from other mammals and groups of fish.
2. Describe biological features of some whales, including their use of baleen or teeth, migration patterns, and commercial value to men.
3. Estimate the size of whales relative to other living and nonliving things in the environment.
4. Summarize a story about whales, drawn from either folklore or scientific literature.
5. Write letters of inquiry or opinion to whale conservation groups or legislators.
6. Write poetry that conveys their perception of whales; illustrate their work.
7. Carve "scrimshaw" in the style of whalers.

RATIONALE

Before he or she can marvel at whales or take rational action to ensure their conservation, the student has to know what a whale is--what one looks like, what it sounds like, where it lives, how it cares for its young, how it is different from the fish with which it shares the sea.

theme 1 ACTIVITY 1

K-6 (Unless you are knowledgeable yourself, ask the American Cetacean Society to send a volunteer speaker to your classroom. He or she will bring a film that introduces the viewer to whales.

Talk about how whales breathe, how their bodies are shaped to help them swim, what they eat, how they are like or unlike other mammals. Make a list of things you know and those you don't know.

Use books and periodicals from the MRL (i.e., Watson: *Whales*, the American Cetacean Society file, and the *National Geographic*, December 1976) to look up answers to the questions you have posed.

MATERIALS

Film, projector, and screen.
Relevant photographs of and books about whales.

AUXILIARY ACTIVITIES

-- To demonstrate the necessity of mammalian breathing, have the children see how long they can hold their breath. (Whales can stay down for as long as an hour, but they must return to the surface to breathe.)

-- Include wherever appropriate a discussion about evolution and whales. When did whales live on land? When and why did they return to the sea? Where do our family trees join? How are whales like humans?

-- Find a picture of baleen (the plates through which some whales strain food). Think of special features we have that enable us to eat successfully.

RATIONALE

Whale behavior will probably not "sink in" if you just read the children a list of facts. Some children's books work information about whales into an appealing tale.

MATERIALS

K-3
Hurd, *The Mother Whale*; flannel board and cutouts or photographs, *Mammals of the Ocean*.

4-6
Benchley, *Kilroy and the Gull*; McIntyre, *Mind in the Waters*; *The Sea Library*, *Mammals of the Ocean*.

theme 1 ACTIVITY 2

K-3 Read Edith Hurd's *The Mother Whale* available from the MRI. Use flannel cutouts, dramatization or photographs to enhance the discussion.

4-6 Read Nathaniel Benchley's story of *Kilroy and the Gull*. Discuss questions that arise; i.e., what kind of relationship do the killer whale and the gull develop? What other marine creatures help each other? (See Theme 3 for some descriptions of mutualistic relationships.) How does a pod of whales work together? How do whales communicate? (See articles in *Mind in the Waters*.)

For both levels, use the Sea Library's *Mammals of the Ocean* to demonstrate the distinguishing features of whales when compared with other ocean creatures.

theme 1 ACTIVITY 3

K-6 Have the students sketch the sizes of various marine creatures on the playground using chalk and a yardstick, measuring wheel, or paces. This can be done in a gymnasium using pieces of string. Show illustrations of the creatures under discussion, and whenever possible relate the sizes of the creatures to what the children know best -- themselves.



*Could a whale fit into the gym?
Could two of them play basketball?*

RATIONALE

As architect Richard Wurman has noted, we often "talk in numbers we can't comprehend and about sizes we can't visualize." Being able to judge distance and estimate size are useful skills in everyday adult life, and essential in some professions like architecture and dressmaking. Having a sense of the magnitude of some marine animals will perhaps give students a better notion of how large the ocean is.

MATERIALS

Chalk or a piece of string several hundred feet long; a measuring wheel, yardstick, or ruler (to measure children's feet); paper for calculations.

INFORMATION FOR ACTIVITY 3*

- Sperm whales sometimes are 60 feet long and weigh over 50 tons, which is bigger than a Greyhound bus. They charge at about 20 miles per hour. A blue whale(100 feet, 200 tons) can equal 33 African elephants. Some whale arteries are so large that a child could crawl through them.
- Newly hatched lobster are less than $\frac{1}{4}$ inch long (which is why so few of them grow to adult stage, because they have so many predators).
- Some starfish grow to about three feet from armtip to armtip, but most are smaller. Some have as many as fifty arms, but most have five.
- An elephant seal might get to be 16 feet long and weigh $2\frac{1}{2}$ tons.
- Most octopi are the size of a large human fist, but some grow to 12 feet with their tentacles outstretched.
- The green moray eel is reputed to grow as long as 10 feet. Electric eels can be 9 feet long.

* Many of these figures and ideas were presented by the Aquarium of Niagara Falls(N.Y.) in its *Teacher's Handbook*, and by Julian S. Huxley in "The Size of Living Things."

- A jellyfish has been found with a disc over 7 feet across and 18 inches thick, with tentacles over 20 feet long. It weighs probably half a ton, and is as bulky as a large horse.
- The largest elephant could fit inside a whale's skin with room to spare top and bottom.
- One tiny aquatic animal, the rotifer, is so small that it would take over a million to weigh as much as a bee.
- Some trees are bigger than whales. The largest whales weigh over 100 tons; a tree can weigh 1000 tons.
- Giant squids weigh 2 or 3 tons.
- Clams can weigh as much as a man.
- For comparison, if you bought an ounce of fleas, you would get over 80,000.
- This may be too unpleasant to mention, but the largest tapeworm that lives in human intestines can be 70 feet long --longer even than the whale you have drawn.
- For additional interest: you might have noticed that all organs don't grow proportionately. If they did, how big would a whale's eye be? Use your body to compare.
- Another tidbit: "Crustacea are limited (in size) by their habit of moulting. A crab as big as a cow would have to spend most of its life in retirement growing a new armour plate."(Huxley)

RATIONALE

Trying to teach other students in the school about whales and whaling will result in further learning for the "teachers."

theme 1 ACTIVITY 4

K6 Make a large paper mural about whales for the hall wall.

Possible topics:

1. Whaling ships and history.
2. Relative sizes and/or numbers of different whales.

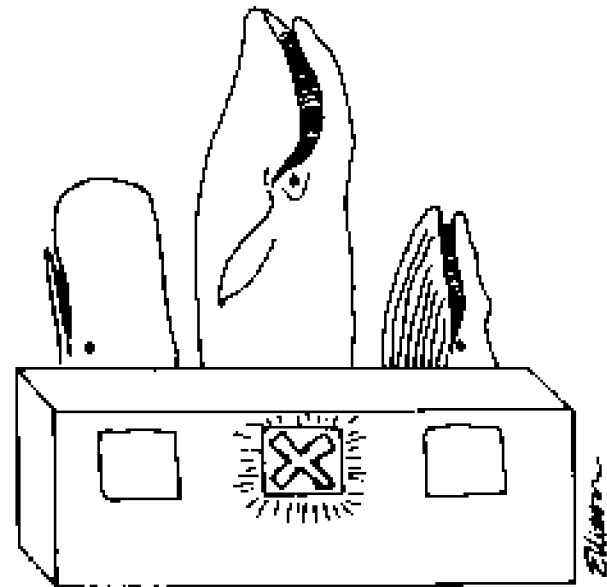
Grades K-3 could arrange cutouts in order of size.

Grades 4-6 could make a circle graph showing the numbers of whales in various categories.

3. Products we get from whales (soap, fertilizers, edible oils for margarine, ink, and food for humans and pets).
4. Decreasing numbers of whales i.e., which ones have zero-kill quotas now? Older students could calculate percentages of whales before and after current whaling methods came into use.
5. Map of migration.

MATERIALS

Paper, paints, brushes, water, clean-up rags.



Will the Right Whale please stand up.

RATIONALE

Execution of a presentation--whether television show, puppet show, or other theatrical form--requires not only informative content, but also organized and captivating structure. This activity provides practice in thoughtful planning and pleasure in successful performance.

MATERIALS

Cardboard carton.
Other materials variable.

theme 1 ACTIVITY 5

K-6 After the children have acquired some basic knowledge about whales, plan and put on a "television show" about whales and whaling. Using a large cardboard carton as the set, you can use puppet-type characters, ask questions of a panel of whalers, or design any other format you choose. If the performance goes well, invite another group of children in to watch.

NOTE: Children with limited experience in fantasy play will probably need more adult help to organize and put on their show.

theme 1 ACTIVITY 6

K-6 Write poetry about whales. While writing, listen to *Songs of the Humpback Whale*, a recording of whale sounds. You will probably have to transcribe what younger children say -- perhaps while working together to create a group poem.

If you have never experienced poetry writing, refer to the notes in the MRL entitled "On Writing Poetry with Children."

Make a book of the whale poems, and illustrate it with both original drawings and magazine clippings. Show early whale paintings, including some disastrous encounters while whaling.

Use reference materials from the MRL: *National Geographic* articles, Cousteau's *The Whale: Mighty Monarch of the Sea*, and McIntyre's *Mind in the Waters*.

RATIONALE

"One reason why poetry should have a place in the curriculum is that it is able to turn to use those mysterious, grotesque, creepy, crepuscular, iridescent experiences which the child generally feels he had better leave outside the school door, but which obsess him and rob his attention." (Lopate, page 331)

MATERIALS

Paper and pencils or pens, record or tape of whale sounds, recorder, examples of poems about whales, and pictures of whales. Crayons or charcoal, glue, and string or brass fasteners for binding poetry books.

RATIONALE

K-3

One way to learn about whales is to hear tales which have been passed down in those cultures that depend for survival upon the sea. In addition to marine education, this activity gives practice in listening to and following the sequential action of a story, which are essential language skills.

4-6

Through gaming, students can experience some of the pleasures and problems encountered on whaling vessels. They will concurrently be developing their ability to plan ahead and to solve problems creatively.

MATERIALS

K-3

Felt cutouts, felt board, book of stories.

4-6

Cardboard carton, books for information, and props if desired.

theme 1 ACTIVITY 7

K-3 Using felt cutouts, retell an old whaling story, such as a version of the Jonah myth, in which the hero is swallowed by a whale. One possibility is "Inside the Monster," a second-century story in *A Cavalcade of Sea Legends* (in the MRL).

You could also read Robert McCloskey's book *Burl Dow: Deep Water Man*, a modern day version of the Jonah myth.

4-6 Using an old refrigerator carton or arrangement of desks, recreate a whaling voyage, trying to be as authentic as possible. Assign roles: harpooner, first mate, captain, cook, and others. Solve problems that arise: what to eat and wear, how to navigate, how to kill the whale, and so on. Use props such as paper-towel-roll telescopes.

theme 1 ACTIVITY 8

K-6 Show photographs and drawings of examples of scrimshaw. Make scrimshaw using clay for K-3 and soap or plaster of paris for grades 4-6.

Here are some instructions from "Tall Ships": Mix plaster of paris and put $\frac{1}{8}$ inch in the bottom of a paper cup. After about five minutes, put a straw in the plaster to make a hole. Remove and let dry ten more minutes. Use a nail to scratch a picture into the plaster of paris disc. Hang with yarn or string if desired.

You can use the time while the plaster of paris is setting to show illustrations of scrimshaw and tell something about its uses.

While the children are carving, you might want to read them a story from *Tales from the Igloo* (MRL). There are also stories about whales and Eskimos in *Hunters of the Northern Ice*, Chapter 11.

RATIONALE

A culture's art work often tells us a great deal about its people. This is true of both the etching done by whalers (scrimshaw) and the carving done by Eskimos. The experience of making scrimshaw, either useful tools or fetishes, will perhaps give a better feel for the pace of life at sea and in an Eskimo village.

MATERIALS

Plaster of paris, clay or soap. Nails for scratching, books for stories, and illustrations of scrimshaw.

theme 1 ACTIVITY 9

K-3 To increase public awareness of whales, make an ecological mobile to hang in the school hallway or office. Use either pictures of whales cut out of magazines, or have the children color and cut out mimeographed drawings. For information on mobile making see:

Arts & Activities

June 1970, pp. 14-16

January 1971, pp. 20-21

April 1972, pp. 32-33

Teaching Exceptional Children

Spring 1972, pp. 134-41

Lynch, John, *How to Make Mobiles* (N.Y.: Viking Press)

4-6 Have the students plan a presentation that will inform a younger group of children (K-3) about issues in whaling conferences. Include the views of Alaskan Eskimos and the Japanese as well as those of whale conservation organizations.

In the blue loose-leaf folder there is an article on the efforts of Greenpeace, a group that locates whaling ships and intercedes to try to prevent whale slaughter. Discuss whether such action is beneficial or not.

Write a group letter to a politician or conservation organization stating your opinions.

Play recordings of rock songs whose theme is the fate of whales.

theme 1 ACTIVITY 10

K-6 Celebrate the end of your mini-course by having a whale of a good time. You could show a whale movie or have a ship-board party with punch and cookies and tales told all around. This might be a good time to make up a story about whales round-robin style, with each child adding a sentence or two.

RATIONALE

It is never too early to start learning that pleasurable end-results often require action, not theory and sentiment.

MATERIALS

K-3
Photographs or drawings. Card-board, crayons, scissors, string, and dowels or hangers.

4-6
Articles, books, paper and pencils, and stamp.

RATIONALE

There is a JEP tradition of devoting the last session of a mini-course to celebration, including having a party and reviewing what has been learned.



MYTHS, MONSTERS, & MARINERS 2

A SERIES ON THE MYTHOLOGY,
HISTORY, ARCHAEOLOGY, FOLKLORE,
AND ANTHROPOLOGY OF THE SEA

One of the most enjoyable facets of study about the sea is its historical and folkloric elements--the myths that grew up around it, the tales of monsters that have been said to inhabit it, the voyages of people upon it, and the influence it has had on the lives of peoples who have chosen to dwell beside it.

There are several directions you can take in teaching about those elements. You might choose to focus all of your sessions on, for example, Greek myths about the sea. If your interest is primarily in sailing, you could expand the shipbuilding sessions. What will probably happen in either case is that you will bump into areas addressed in other activities suggested here. For instance, any thorough study of

Greek mythology contains within it a study of vehicles for sea transport, motives for going to sea, tales of the monsters encountered there, and so on.

Underlying this whole theme, though not mentioned explicitly, is consideration of the sea as symbol: to some people it is dangerous and forbidding; to others, nurturing and soothing.

Included in this theme is a lesson on what sinks and floats, or the best materials and shapes to choose when building a ship. Historically, however, there is much more to learn about ships than simply the materials of which they are best constructed. You could conduct ten sessions on naval history. As Sir Walter Raleigh remarked

about the importance of the sea: "Whoever commands the trade of the world commands the riches of the world, and consequently the world itself." Many people think that is still true, as we will see in Theme 4. You might also choose to focus on people such as Sir Francis Drake, Captain Cook, Lord Nelson, and Columbus.

Maybe you should consider your lesson plans under this theme as being similar to the sea affairs about which Lord Nelson wrote in the *Victory*: "In sea affairs, nothing is impossible and nothing improbable."

Sources of Information

Since this theme is too broad to be summarized here, included below is a list of some reference works in the MRI:

- *Under Water Archaeology*, (Bass)
- *Folklore and the Sea*, (Beck)
- Audio tape of folklorist Horace Beck speaking on National Public Radio
- Tape-transcription of Richard Caldwell talking about Greek mythology and the sea.
- "Ships Through the Ages" (part of the Delaware curriculum)
- "Tall Ships" (activities for young children)
- Various books on naval history

THEME 2 OBJECTIVES

The student will be able to:

1. Tell a myth, legend, or tale about the sea.
2. Discuss and draw sea monsters, based on historical reports or imagination.
3. Locate and read information about the historical sea.
4. Perform a dramatization of a sea legend.
5. Demonstrate knowledge of the principles of shipbuilding, including stating which objects in a given assortment will sink or float, predicting the flotation potential of materials with which he or she has not experimented, and drawing the shape for a boat that will float the best and carry the most cargo.
6. Draw generalizations from second-hand observation of life on a South Seas island.

theme2 ACTIVITY 1

K-6 In your own words retell a myth or fairy tale about the sea (myths and tales available in the MRL). Talk about myths in general, and as a group make up a story to explain some ocean phenomenon (i.e., why the ocean is blue, why is it salty, or what makes waves).

For information, read the transcript (available in the MRL) of Associate Professor Richard Caldwell telling Greek myths about the sea to a group of students.

Give each student a chance to practice telling a myth about the sea to another child, who then tells it to another. That should provide a good example of how stories get distorted in a culture whose history is transmitted orally.

Consider such questions as: "What are myths? Why do people dream up strange creatures? How are mythical monsters similar to those people believe in today?"

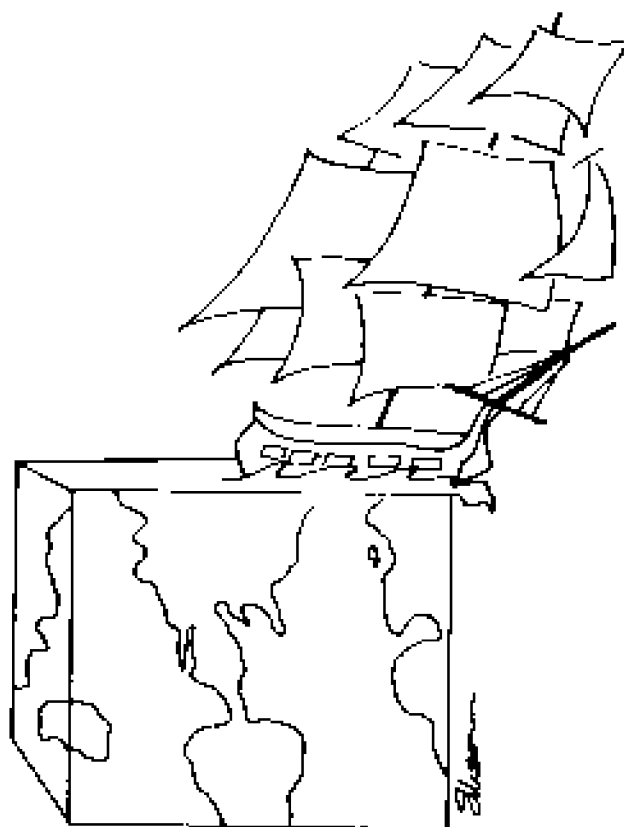
RATIONALE

As the German poet Schiller wrote, "Deeper meaning resides in the fairy tales told to me in my childhood than in the truth that is taught by life." When such tales and myths are about the sea, they contribute not only to a child's ego development, but also to his or her knowledge of the ocean.

MATERIALS

Book of myths.

4-6 Slides, tape, recorder, and projector.

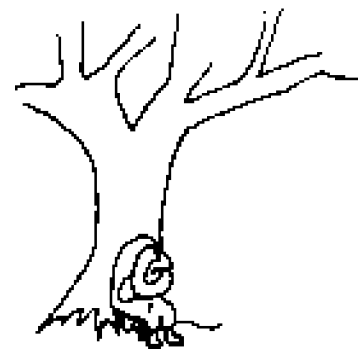


WHY THE OCEAN IS SALTY

Retold by Gail Ellison.
Based on a tale retold
by H. Beck in
Folklore and the Sea.



Once there was a farmer
whose wife had no ham
for Easter dinner.



The farmer felt bad
because he couldn't
provide, so he went



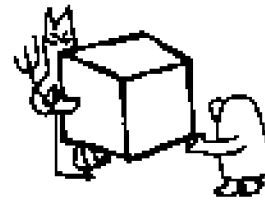
to see his friend,
who told him
what to do.



"You have to go to hell
and take a bacon
to the Devil," he said.



So the man
took a bacon
to the Devil.



And the Devil gave him
a machine that would
make anything he wanted.



"All you have to do,"
he said, "is tell it
when to stop."



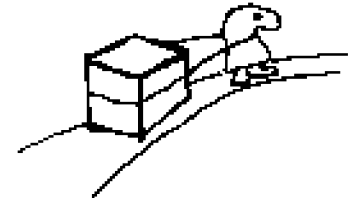
After he got home,
the man and his wife
told the machine to
make Easter ham.



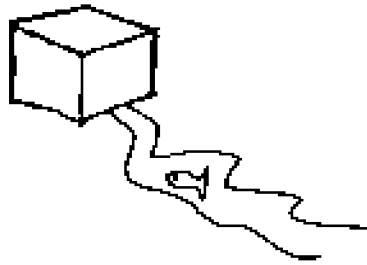
It made enough
hams for all of
the neighbors.



and then the man
told it to stop
making Easter hams.



Since by then he was
very rich, the man gave
the machine to his
brother.



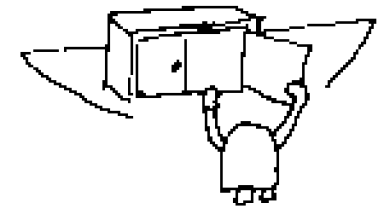
His brother took it home
and made a whole
river of soup.



A sea captain saw
what the magical
machine could do,



and he stole it
and took it on
board his ship.



Just before people
came to dinner,
the skipper realized
that he had no salt.



So he commanded
the machine to make
salt, which it did.



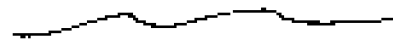
And did. And did.
You see, since the
sailor had stolen
the machine,



he didn't know
the magic words
to make it stop!



The salt eventually made
the ship sink to the
bottom of the ocean



where it still lies.
And the machine is
still making salt.

If you don't believe me,
taste some ocean water.

RATIONALE

Our cultural history includes tales about sea monsters and ghost ships. Children are fascinated with those topics, as well as with most creatures in the ocean that can sting, bite, cripple, or kill a person. If we are to believe Bruno Bettelheim, author of *The Uses of Enchantment*, children would be much healthier if we gave them more opportunities to deal with those fantasies.

MATERIALS

Books of legends and tales about sea monsters.
Drawings, paintings and other illustrations of sea monsters. *Dangerous Sea Creatures*.

theme 2 ACTIVITY 2

K-6 Prepare yourself by reading Horace Beck's *Folklore and the Sea*, pp. 264ff. (available in the MRL). Ditto and read together a tale about kraken (the Scandinavian sea monster), the Loch Ness monster, Nessie, or other sea monsters. Discuss the evidence that sea monsters exist.

With older children, discuss illusions, and how we tend to see what we expect (or fear) to see. You could take in some Rorschach ink blots.

Show illustration from *Dangerous Sea Creatures* (in the MRL) and talk about which ocean creatures really are potentially dangerous.

If you need background music, play a recording of Wagner's *Overture to the Flying Dutchman*.

theme 2 ACTIVITY 3

K-6 Paint a mural of sea monsters -- perhaps a whole tale. Some students might want to paint their own imaginary monsters. (If the mural is to be placed in the school hall, be sure to get permission, acceptable dimensions, and mounting instructions through your school coordinator.)

Look in the MRL for paintings, old woodcuts, etc.

RATIONALE

One of the best ways to condense information and convey it to others is to create a large mural for the school wall. In addition to showing pride in new knowledge, the mural can be an instructive catalyst for other children.

MATERIALS

Paint and brushes, long paper, tape or other material for mounting mural. Books with illustrations of monsters.

RATIONALE

Owing in part to the popularity of the movie *Jaws*, many people, especially children, are reacting to sharks as though they were sea monsters. There have been many reports of phobias and obsessions. This activity capitalizes on children's fascination with sharks while attempting to limit their fears to the realistic rather than the irrational.

theme2 ACTIVITY 4

K-6 NOTE: This activity requires two sessions. Build a paper-mache model of a shark, using the time while building to explore facts about sharks. Use Ann McGovern's book *Sharks* from the MRL for both information and illustrations.

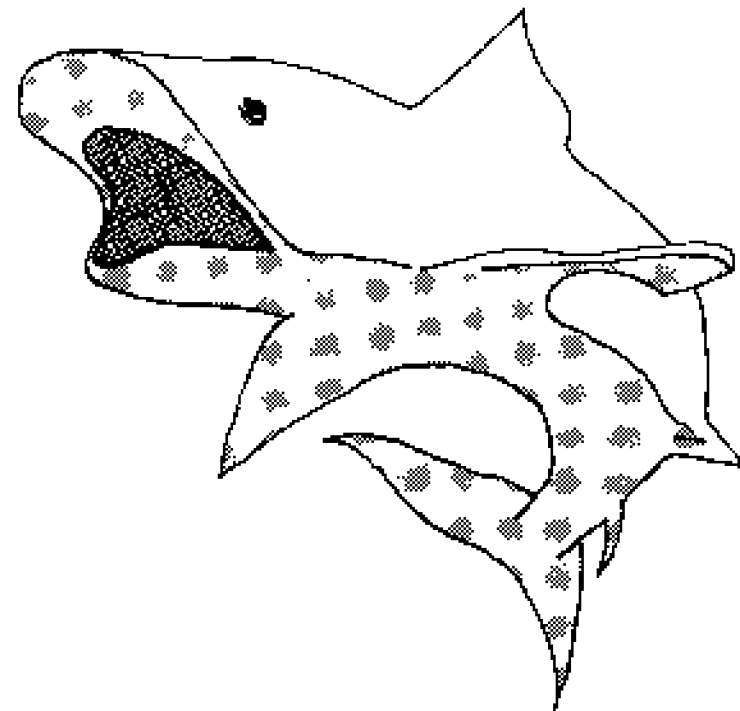
Instructions for making paper-mache:

Tear newspaper, tissue paper, and/or construction paper in strips or small pieces. Soak the paper $1\frac{1}{2}$ days in warm water until it turns to pulp. Drain and squeeze out excess water.

Mix flour and water to the consistency of heavy cream. Add library paste for extra stickiness. Stir in paper. The mixture should be the consistency of modeling clay.

theme2 ACTIVITY 5

K-6 Continue working on the paper-mache shark you started last week. Paint the model and put it on display.



RATIONALE

Jules Verne's *20,000 Leagues Under the Sea* is easy to overlook because you'd assume that children would not be interested in science fiction that was first published in 1870. Not so. As an adventure story, *20,000 Leagues Under the Sea* is first rate, and there is an abundance of scientific information worked into the tale.

MATERIALS

20,000 Leagues Under the Sea

theme2 ACTIVITY 6

K-6 *20,000 Leagues Under the Sea* was written when sea exploration was just beginning. The book describes a fictional submarine voyage--a trip that moved from fantasy to reality almost one hundred years later when a U.S. submarine completed the first underwater navigation of the world. Thus, you can approach the book from a perspective of history, literature, or marine biology--or, ideally, all three at once.

The book is too long to read the whole thing aloud, so I would suggest that you read a couple of passages and allow time for discussion. You could tell the rest of the story briefly if you know it. The illustrations in the McKay edition are fine. You may want to show them all, even though you read only a small fraction of the book.

Here are some especially interesting passages. Feel free to choose your own. (The page references are to the McKay edition.)

Three characters are on board the American steam frigate *Abraham Lincoln*: Pierre Aronnax, a professor and expert in marine zoology; Conseil, his servant, an expert at classifying marine life; and Ned Land, a courageous

Canadian harpooner.

- Pages 15-18, *Chase in the Pacific*, are about how the characters are thrown overboard and picked up by the submarine.
- Pages 23-24 give a little of the flavor of the life on board, and the men's struggle over being prisoners.
- Pages 33-36, *A Walk on the Sea Floor*, give a feeling for the underwater environment.
- Pages 64-68, *Spanish Treasure*, bring in underwater archaeology.
- A brief passage on page 70 is about the lost continent of Atlantis.
- Pages 82-85, *Trapped by Ice*, is a thrilling section in which the *Nautilus* (the sub) is stranded.
- Pages 88-92 cover the travels of the *Nautilus* through the Gulf Stream and a hurricane. If at all possible continue reading to the end of the book.

When you finish, try to answer the children's questions, then ask them questions about the story and see if they can retell it to you or to others.

NOTE: To extend this topic you could show the film *Thirty Days Beneath the Sea*, which is available from the IMCS film library, #MN 10407B (color, 14½ minutes).

theme2 ACTIVITY 7

K-6

The questions of the day are "What should a ship be built of?" and "How should it be designed?" The children's goal will be to find out which materials sink and which float, with an eye to the best design and materials for ship construction, as well as to the differences between ancient and modern vessels.

Here is an activity, adapted from Ruth Boragine's "Tall Ships":

One of the most elementary principles of oceanography is that some things sink and others float. For early shipbuilders, and future ones as well, knowledge of which materials and shapes to use for boats was crucial. In this session you can also give children the opportunity to experiment and record their findings in the manner of scientists.

1. Take a clear container of water and try to float a variety of different objects. Make a chart showing which sink and which float. Try corks, washers, various kinds of wood, stones, styrofoam, glass, plants, paper clips, sponges, shells, erasers, cotton, etc.

2. Talk about how the objects that sink are alike. What do the ones that float have in common?
3. Drop a ball of clay into the bucket. Challenge the children to make the clay float. Encourage them to say what they are doing and perhaps to record what changes in the form of the clay worked and which attempts failed.
4. Now introduce some sinkers (you can use marbles). Use a balance to compare the weight of the clay boat with the number of sinkers it will hold. Make a record. What if the clay is thinner? What happens when the sides are higher? What happens if the bottom is wider?
5. If you need an encore, give each child a 6" square of aluminum foil and ask him or her to make it float.

Ancient ships were not only very well constructed, but some were large. Until the construction of the Great Eastern in the last century, the greatest known ship was built in Egypt about 2000 B.C.

JOHN ISAKS

RATIONALE

Since in sea tales people were usually going somewhere for some reason, a close corollary to the study of the legendary part of marine history is the study of shipbuilding, including technological advances, materials acquisition, and romantic or warring destinations. In this activity, the children learn something of the physics of the ocean while they are creatively solving a problem.

MATERIALS

See-through container of water and material from list above. Clay, a balance, sinkers, and aluminum foil.

RATIONALE

There is a great deal to learn about the lore of ships. It seems to matter little where you start-- if you and the children are interested in ships, your explorations will lead you on voyages into related topics.

theme 2 ACTIVITY 8

K-6 This section should be called "Activities" because you can choose among several and originate many others:

- After you have read an adventure story like a children's version of *Kon-Tiki*, write either group or individual stories about imaginary trips. Give the children an idea to start with: i.e., you are being held hostage on a pirate ship and you see land out the window.
- Put on a play about pirates and smugglers using scarves, old earrings, eye patches, cardboard swords, skull-and-crossbones flags, pirate hats, and yarn for beards. This might be a good chance to try pantomime and improvisation.
- Make communication flags based on real ship's flags. Use them for sending messages.
- Duplicate copies of different types of ships (i.e., from *A Coloring Book of Ships* in the MRL). While the children are coloring them to display on the wall, read and talk about the differences and similarities among various ships: dug-outs or skin on wood, Viking,

Roman, ships of William the Conqueror, Spanish galleons, modern submarines, FLIP ship, and so on.

- Read the tale of the *Flying Dutchman* or other ghost ships.
- As a corollary to shipbuilding or reading a tale about sailing, children might like to learn how to tie sailor's knots (which of course might also be needed by pirates for tying people up). This is a good activity for developing hand-eye coordination and for learning to follow directions.
- If that's not enough, go to the MRL and look at "Ships Through the Ages," an entire unit of study for grades 3-6, prepared by the Marine Advisory Service of the University of Delaware. It contains many facts and theories that you'll want to look at no matter what activity you choose.
- And if you can carry a tune, teach some sailors songs. Many scores are available through the MRL.



overhand



figure eight

theme2 ACTIVITY 9

K-6 For good examples of oceanic anthropology, you could look to the Galápagos (west of Ecuador) or the South Seas Islands. If you choose to devote some time to looking at how people live on islands (What do they wear? eat? believe? How do they sound? dance? think?), you will be teaching more than marine studies. You will also be teaching some of what Margaret Mead says are the basic skills an anthropologist learns:

- Making comparisons
- Getting a sense of a whole
- Accepting something as "there" even when you don't understand it
- Working with living systems (as opposed to statistics or individual testing)
- Making and recording observations
- Using new instruments such as film, recordings, and videotape

And possibly reducing our sense of ourselves as the center of the universe.

Ideally, in this session you would go to a beach community to make and record observations, take photographs, and interview the

"natives". Since such a field trip will probably be impossible, bring an island community into the classroom in the following ways:

- Make a fish dish using an island recipe. (Recipes for seaweed dishes are available in the MRL.)
- Play a recording of island music. If possible, have an ethnomusicologist or dance student come in and lead the children in island dancing.
- Look at the *National Geographic*, *Smithsonian*, and *Natural History* articles collected in blue loose-leaf binders in the MRL. List your observations. See if the children can draw generalizations from what they see and read. Have them draw pictures to go with their observations.

theme2 ACTIVITY 10

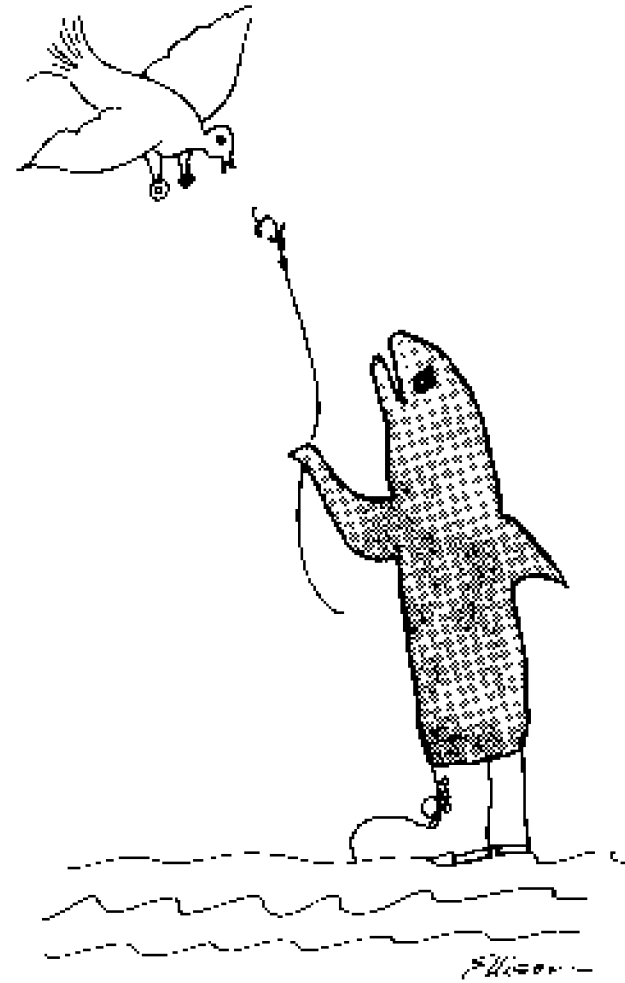
K-6 Celebrate the end of your mini-course with a party and a review of what you have learned. Plan a fun extension of the activities in this theme; for example, play a recording of selections from *H.M.S. Pinafore*.

RATIONALE

A logical extension of the study of sailing and oceanic exploration is a study of where people went and what peoples and traditions they found there. In this activity, children experience a facsimile of life in another culture and have an opportunity to expand their world view.

RATIONALE

Traditionally the end of a JEP mini-course is celebrated by having a party and reviewing the material covered.



FINS AND FINIALS 3

A SERIES OF ACTIVITIES DESIGNED TO HELP YOU TEACH
ABOUT ADAPTATION, FORM AND FUNCTION,
ANIMAL ARCHITECTURE, AND DESIGN IN NATURE

It is not by accident that birds fly and jellyfish sting--or that our mouths have teeth in them, for that matter. Throughout creation, certain adaptations have evolutionary advantage; they contribute to surviving in a certain niche of the ecosystem. If you're going to survive for long underwater, for example, you will need built-in scuba gear in the form of fins and "snorkeling equipment."

Nature has come up with such a seemingly infinite array of designs that we tend to ignore certain patterns. We don't even notice *how* animals are designed, let alone wonder *why*.

Since the importance of perceptual skill in learning to read has been widely recognized, and since observational skills are now recognized to be an essential component of all professions, it makes sense that teaching children to see should be every educator's goal.

In this section, we will be looking at marine biology from three sides:

- Biological adaptations and their functions
- Nature's broader design schemes
- Marine animal architecture

ADAPTATION*

The biologist tends to categorize creatures according to their physical design and behavior. One good place to demonstrate these categories is in the sea. Consider these examples:

Adaptation: Sea lions "fly" through the water with front flippers. See the chart that follows for other examples.

Poisoning: Lionfish have venomous spines. Cone snails have poison darts.

Feeding: Methods of feeding include
1. filtering water to strain out plankton (a method used by hydroids, sea anemones, urchins, clams, and oysters, as well as sharks and some whales),
2. using poison to capture prey (sea anemone),
3. using brute force (starfish, walrus, stingray, octopus), and
4. swimming fast to catch a meal (tuna).

Camouflage: Some fish look like rocks. Others, such as coral rays, are flat and blend in with the ocean floor. "Many of these bottom-dwelling fish have a large head which helps in catching a meal. When the unsuspecting passerby comes too close the fish opens its gaping mouth, creating a suction which pulls the victim in with one gulp." (Murphy)

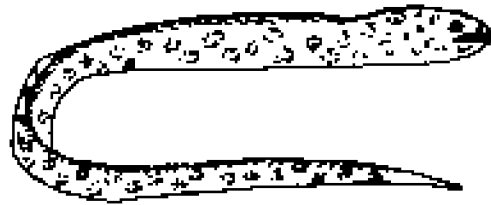
* The information in this section is from the Aquarium of Niagara Falls *Teacher's Handbook*, Sam Hinton's *Seashore Life of Southern California*, and other sources.

Symbiosis: The wrasse, butterfly fish, and some angels remove parasites from other fish, for which reason they are sometimes called "cleaner" fish (one of them is called "barber" by Mexicans). Without them many fish would get sick and die. Another example is the symbiotic relationship between the anemone and the damselfish. The venomous tentacles of the anemone provide the fish with protection. The fish in turn helps the anemone by luring predators into its tentacles, thus providing food for both. (It is believed that the fish is protected from the anemone poison by a mucous secretion.)

Community Organization: A kelp bed has lobster and abalone at the bottom, fish in the mid-region, and sea otters on top. In hydroid colonies, jobs are assigned to specialized polyps: some collect food, others breed. The whole colony has one digestive tract. Whatever is eaten by one member provides food for all the others. An individual member couldn't survive if detached. (Hinton)

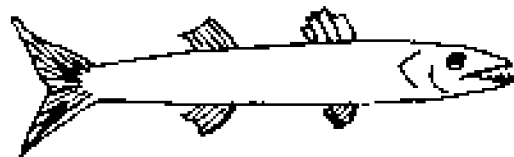
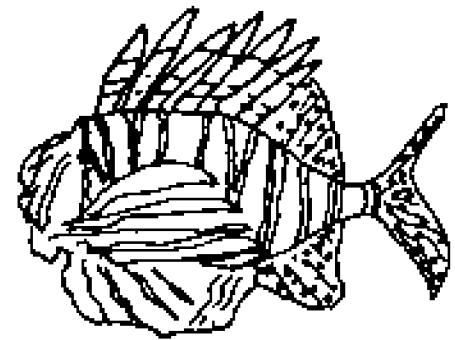
MARINE

DAPTATIONS



Moray eels are long and thin so that they can slither in and out of coral crevices.

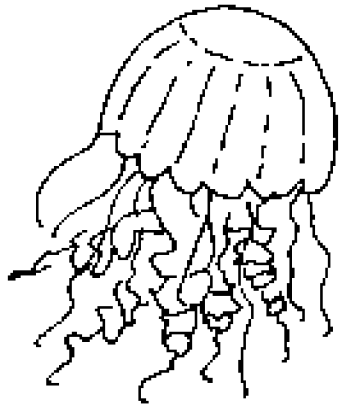
A lionfish has many spiny fins and spots to match the ocean environment. By flaring out his fins, he seems larger than he is and scares away predators.



Barracuda and tuna are streamlined to swim very fast.

Low, rounded bodies or shells provide minimum resistance to crashing waves. The flat bodies of rays allow them to bury themselves in the sand to hide.



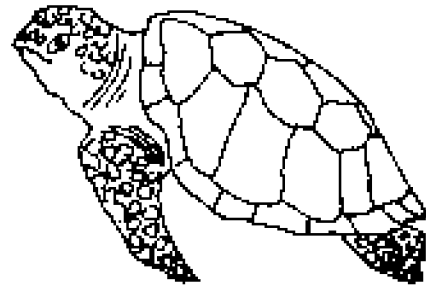


The tentacles of a jellyfish help it to get food.
Anemones use tentacles too.
With them they can sting prey.

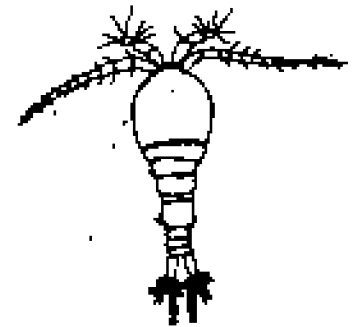


Anemones crowd together (as many as 200 per sq. ft. of rock surface) because a large mass has relatively less surface area for evaporation than would solitary anemones.

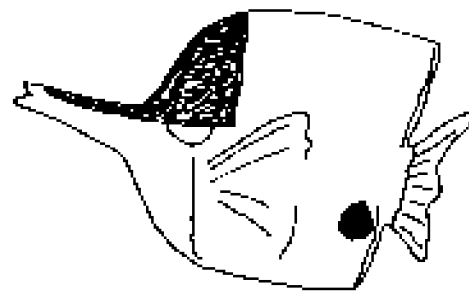
The green sea turtle has paddle-shaped legs instead of claws.
Ever try to swim with your fingers open?



Copepods have branched legs to keep themselves afloat.

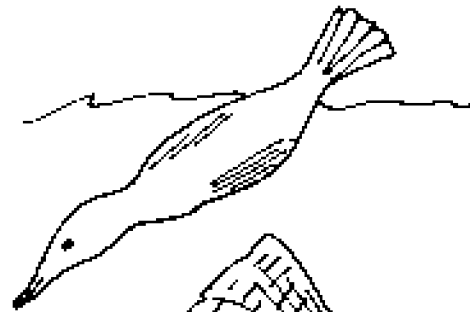


Mexican cave fish used to have sight, but now are blind because their eyesight had no function. Since they live in caves, their eyes have no pigmentation because there is no light.
(Compare to getting a tan at the beach.)

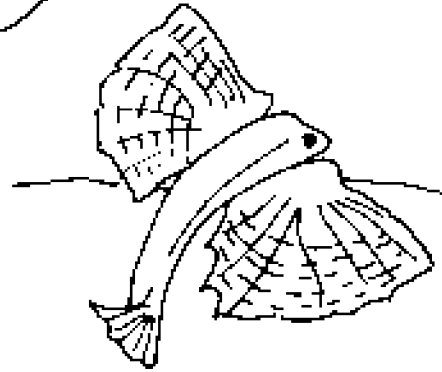


The longnose butterfly fish has developed a false eye spot near its tail and a mask to hide the actual eye, so that predators attack the wrong end.

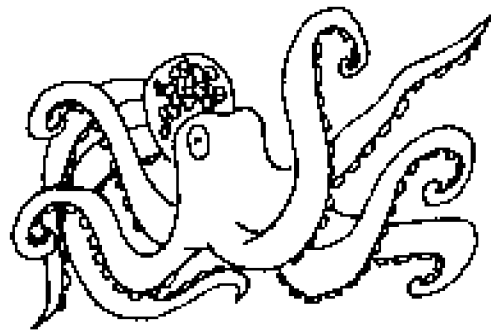
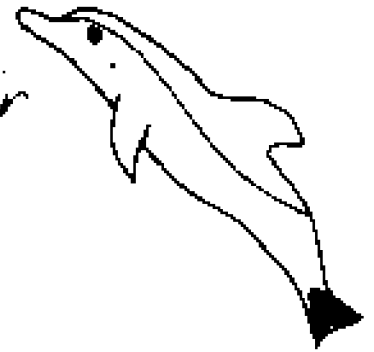
There are birds that can't fly, but are good at diving...



... and fish that have fins like wings.



Dolphins can make sounds. They use their voices like sonar to locate food and each other.

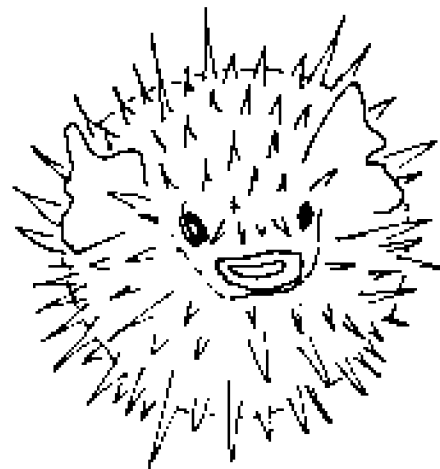


An octopus can change its color to match its surroundings. What do you think all of those suction cups are for?



Why do you suppose pelicans have that big stretchy pouch?

A porcupine fish puffs itself up when frightened, which makes it look much more scary to its potential attacker.



WHAT ARE YOUR LEGS GOOD FOR?
AND YOUR FINGERS?
FINGERNAILS?
WHAT FUNCTION DOES OUR
HAIR SERVE?
WHY DO SOME PEOPLE THINK
WE'LL GRADUALLY LOSE OUR
BABY TOES (THE ONES THAT
WERE NEEDED AT ONE TIME
FOR CLIMBING TREES)?

Here are a few other adaptations:

Ribbon worms have a nose that can be turned inside out. It is used to capture food and to scout ahead.

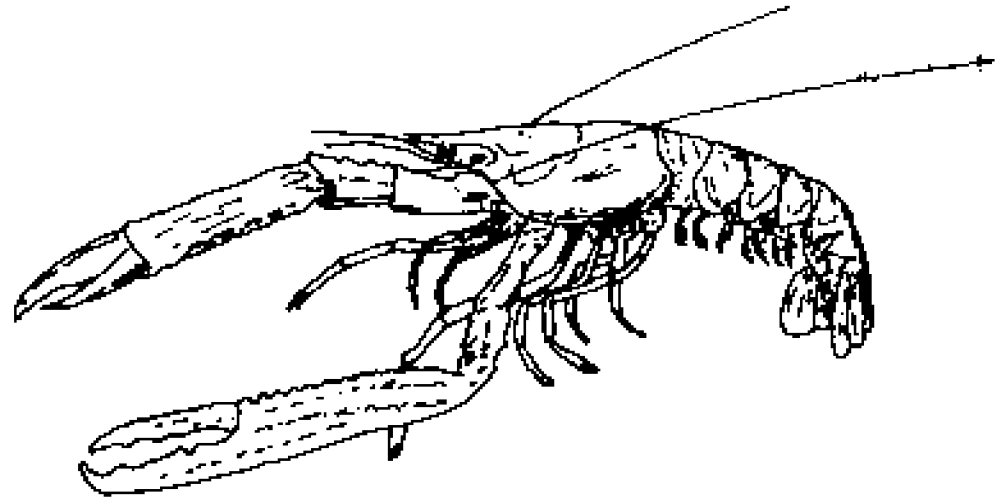
The fur of sea otters and polar bears, and the feathers of aquatic birds, trap bubbles of air that help to keep the animal or bird warm in cold water. (These creatures are especially vulnerable to oil spills because the oil destroys the insulating value of the fur or feathers, and the animal or bird dies from the chill.)

The male narwhal has a tusk which is an extreme development of its left front tooth. It grows into a spiral up to nine feet long, and may be used in ritualized combat in mating season.

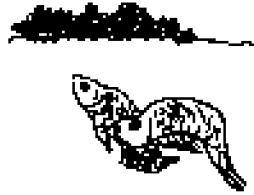
Parrot fish have developed beaks to bite off whole branches of coral to eat the polyps inside.

Penguins have many blood vessels in their feet, as well as a brooding pouch hanging down from their abdomen. The male penguin holds the egg on his feet and covers it with his pouch, thus keeping it warm for two months, even while walking about. (The father stays upright and does not eat all that time.)

NOTE: Because they have a thick layer of blubber, penguins are able to migrate to land in the Antarctic winter and withstand conditions where no predators can exist.

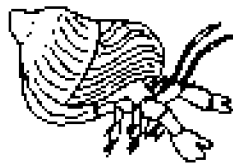


Legs of crustaceans (lobster, crayfish, shrimp) are specialized: "Those near the face are used to hold, tear, and taste food, while other legs on the head are used as jaws, toothbrushes, and feelers. The large legs or pincers, are used for catching fish and fighting. Special legs under the body are used for walking. Slow swimming legs under the tail are sometimes used for holding eggs. Legs at the end of the tail are flattened to form a fan-shaped fin which is used in swimming backward." (*Teacher's Handbook*, Aquarium of Niagara Falls.)



A water spider builds an air-filled transparent sac anchored by threads. Paradise fish build bubble nests.

Sticklebacks are much-studied nest-builders. The male builds a nest out of sea vegetation--algae, roots, and other plants. He glues the pieces together, bores two holes to make a tunnel, and pushes up the ceiling. After the eggs are laid the male watches over the nest chasing away all creatures, fanning water into the nest, and even improving on the air conditioning when necessary.



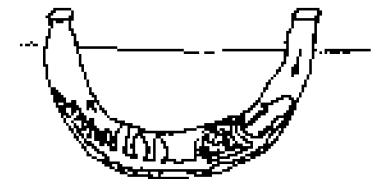
Hermit crabs have solved the housing shortage: they just move into an empty shell. Over time this practice has resulted in adaptations. Their tails have adopted the spiral form of a snail's shell, and they have lost the hard body

armor on the tail that crabs usually have.

Sam Hinton describes the innkeeper worm: "The innkeeper lives in a U-shaped burrow, the ends of which are at the surface of the mud and about 16 inches to 3 feet apart. The animal crawls forward in the permanent tunnel, and attaches a

ring of slime to its walls; this forms the beginning of a slime net, which is spun out as the animal crawls backward...The net has extremely fine openings, so that all particles larger than about 4 millionths of an inch are filtered out of the flowing water. When the net has become clogged and the pumping [to create a flow of water] difficult, the innkeeper crawls forward again, this time swallowing the net and its contents en route. It actually swallows only the smaller particles, and pushes the larger ones aside; these provide food to the numerous worms, clams, crabs, and fishes which share the innkeeper's burrow and give it its name."(Hinton, p. 62)

The parchment tube worm has developed three fans that are used to propel water through a similar burrow. In this case, "new net material is produced continually, but the net is not increased in length, for a cup-shaped organ at its small end gathers it together and rolls it into a ball which contains not only the net, but the entrapped food as well." (Hinton, p. 67)

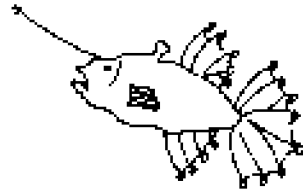


DESIGN IN NATURE*

Many fish that live at depths have light-producing organs and swim bladders (to enable them to stay at a constant depth).

Anglerfish, for example, have a luminous lure dangled over their foreheads.

The light attracts some species of fish, so the angler doesn't have to go to the surface to feed. The viperfish is even fancier: it has luminous photophores on its dorsal fin and the roof of its mouth, and above its eyes. Curious prey swim right into the corridor of light. Gulp.



Moreover, as Lewis Thomas noted, "there are inventions that seem to have been thought up on the spur of the moment, like propositions to be submitted for possible evolution...Certain Australian surf bathers, several years ago, were stung by tiny creatures that turned out to be nudibranchs armed with the stingers of Portuguese men-of-war. Having fed on jellyfish, the *Glaucus* community had edited their meal and allowed the stinging cells to make their way to the surface of their new host, thus creating, for the time, a sort of instant hybrid with, allowing for asymmetry, the essential attributes of each partner." (Thomas p. 9)

When we look around us, nature appears to use so many designs that things look random. We don't really think about them or observe carefully because we figure "that's just the way things are." In fact, however, nature designs according to some fairly rigorous principles. For example, as a rule, "things tend toward a configuration with the least energy, that is to say, with the tightest fit, the lowest altitude, or the least motion." (Stevens, p. 37) In other cases--in the evolution of active animals, for example--nature's goal is effectiveness, not efficiency.

Perhaps if we can train children to be active observers--or rather give them a chance to do what they by nature do very well, at least until they go to school--we will in the process be training future environmentalists who are reluctant to ignore the information brought to them by their senses.

The following is an extremely abbreviated summary of some ideas that you might want to include in your sessions:

*Much of the information on design in nature is from Peter Stevens, *Patterns in Nature*, and D'Arcy Thompson, *On Growth and Form*.

There are some forms in nature that are most probable ways of filling space. The four prototypical patterns are:



the spiral



the explosion



the meander



branching

Examples of each pattern:

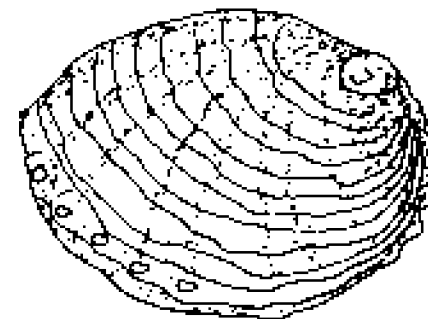
The spiral: Many seashells grow in a spiral. The whelk is a continuous rolled tube; the chambered nautilus is a partitioned tube. As the creature grows, the shell enlarges and forms a progressively larger domain. Look closely at the top of an abalone shell too. The abalone is a snail and has a spiral shell on close examination. (The holes on the sides, by the way, are used to breathe and to carry away wastes.) Other examples include the garden snail and spiral galaxies.

The meander: Brain coral meanders. In this case, the close packing arises from a competitive struggle. The living creatures pile up their excretions on ridges between the valleys. Each row pushes and gets pushed by neighboring rows. As they jockey for territory, the result is an equilibrium pattern.

The explosion: Compare a sea anemone to fireworks. Compare both to the crater Tycho on the moon and to the flower of a bottlebrush plant. You could also drop some ink into glycerin and see what happens. What nature is trying to do here is establish equilibrium between two "fluids" of slightly different density. The density decreases at increasing distances from the point of "impact". And don't forget to look at palm fronds and dandelions.

Branching: In addition to branching in hydroids, kelp, and trees, children could observe branching in their arteries, in subway system maps, and in forked columns to support a roof. The design of trees, incidentally, follows several common patterns:

- whorl pattern--pine, fir, spruce
- opposite pattern--maple, ash, dogwood
- alternate pattern--alder, oak, cottonwood



Nature is always interested in *closest packing*, or the best use of space. Consider these examples and look for others:



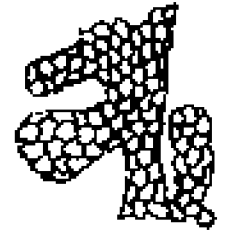
corn on the cob



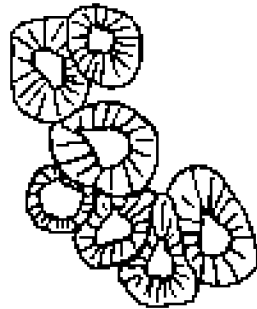
wasp's nest



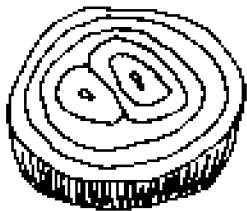
pinecone



coral



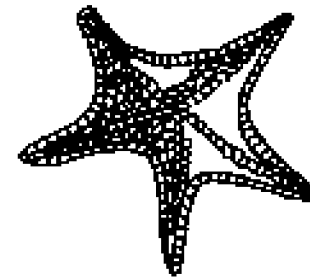
barnacles



a slice of onion



bread rolls



a starfish

ARCHITECTURE IN THE SEA*

Animals and insects, like people, need environments that fit them according to their size, the numbers living together, their breeding and infant-rearing habits, their need for defense, the available building materials (dirt, rocks, branches, twigs, etc.) and the prevailing climate (temperature, humidity, precipitation).

Sanoff, p. 9

Just as we humans build our dwellings to meet our needs--or we should--so creatures in the sea construct or select houses that meet theirs. To teach a lesson on marine architecture, you don't have to know what all of the sea houses look like or what each detail is for. All you need to do is encourage the children to look and to speculate. Even if you're dead wrong, you and the children are developing skills in the processes of observation and speculation. These are skills that will be needed later; the details will probably be forgotten anyway.

Here are a few examples of the kinds of things you could consider in your sessions:

* The information in this section is from Sam Hinton, *Seashore Life of Southern California*; Henry Sanoff, *Seeing the Environment*; and Karl von Frisch, *Animal Architecture*.

Soldier crabs bury themselves in the sand when the tide is coming in. They need to breathe, so they trap a pocket of air by piling up pellets of wet sand. They pack more on the ceiling to keep the roof from crushing in.

Coral polyps usually live in colonies, with their body walls and gut cavities connected to their neighbors. They can pull themselves inside their external skeletons and cover themselves with a wet secretion to protect themselves from drying out when they are exposed to the air for several hours.



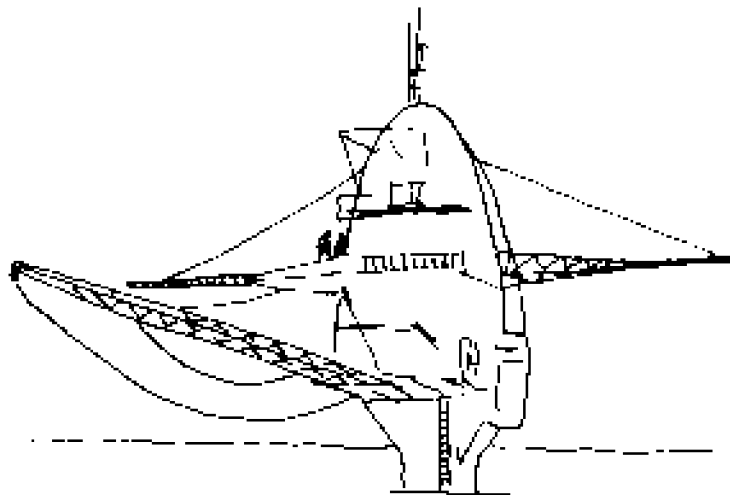
Foraminifera start with a single chamber and add many more. The dividing walls, and frequently the outer walls, are perforated. (Sometimes these organisms are very small and can be mistaken for grains of sand.) Foraminifera send out thin filaments to catch minute organisms to eat.

Jawfish live in a cavity built like a well, with pieces of shell or coral pressed into the wall.



Snail shells are built gradually as the animal grows. You can see the individual growth layers, just as you can in trees, bullock horns, and some rocks. Shells coil in many ways: some are flat, others raised in the center like a cone; some are piled high like a steeple, some have several spikes.

You will also want to include human architecture in the sea. For example, a sphere is used for underwater exploration because it is strong under hydrostatic pressure. Another good example of interesting design is the Floating Instrument Platform or FLIP ship. The ship flips its bow from horizontal to completely vertical, so that a marine lab is 30 feet in the air, and measuring instruments are 300 feet below the surface.



THEME 3 OBJECTIVES

The student will be able to:

1. Identify advantages of certain physical characteristics of fish and other sea creatures.
2. Incorporate his or her knowledge of fish forms in artistic creations.
3. Draw or build in two or three dimensions designs like those used in nature.
4. State verbally ways in which the human body demonstrates many of the same biological principles as marine animals.

RATIONALE

Talk about marine creatures will mean little to children who have never seen the ocean. It is therefore almost mandatory that you take into the classroom real and/or photographic illustrations of the biological principles you are describing.

MATERIALS

Plastic or glass container(s).
Goldfish or guppies. Paper for drawing.
Books to look up information about fish. De-chlorinated water.

Optional: plants, sand, pebbles.

theme 3 ACTIVITY 1

K-6 Using a plastic or glass container, set up an aquarium in the room. (Note: if you use tap water, let it stand for 24 hours to get rid of the chlorine.) Add goldfish or guppies. The latter require temperatures above 70 degrees (21°C). Add some plants (which furnish oxygen) and pebbles or sand (optional).

Here are some student activities adapted from Herb Strongin's book *Science on a Shoestring*:

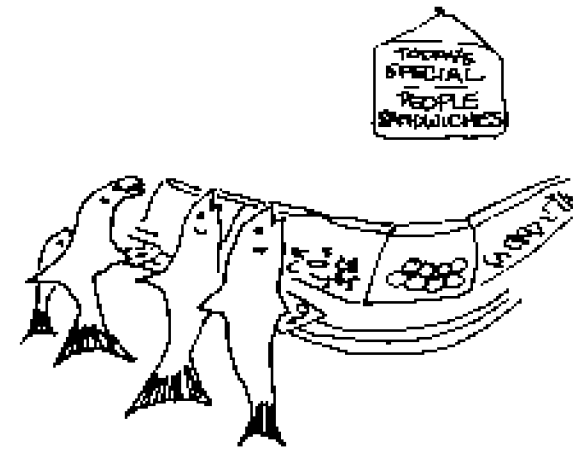
Draw the fish and their environment. Use books to identify and label parts.

Watch the fish to find answers to questions such as these:

- 1) Do the fish sleep?
- 2) How do they move?
- 3) Can they move backwards?
- 4) How do the fish respond when you feed them?
- 5) Can they tell when you are approaching the aquarium?
- 6) Can you see how fish breathe?

- 7) Do the fish play or communicate together?
- 8) Are the plants giving off gas?
- 9) Can you tell the fish apart, or do they all look alike?

L.A. County Schools has a 12-minute film called *Aquarium: Classroom Science* (#1056) that tells how to set up an aquarium in a classroom.



RATIONALE

One of nature's adaptive tricks is to provide sea creatures with means to poison, maim, or just scare their victims. Another is to provide camouflage so the creatures can hide from predators. These protective adaptations are probably best seen in photographs, since many of the marine animals would be difficult to obtain.

MATERIALS

Filmstrip and projector, tape and cassette player. *Dangerous Sea Creatures* (from MRL).

theme 3 ACTIVITY 2

K-6 Go to the Marine Resource Library and preview the filmstrip "Poison, Points and Pigments" which is part of a BFA series entitled *Silent War in the Sea*. Show the filmstrip in the classroom. If the cassette tape is too advanced for younger elementary children, just show the pictures and paraphrase the commentary.

Try to answer the children's questions. The Time/Life book *Dangerous Sea Creatures* should be extremely helpful. If you can't answer all of their questions, fear not: your next session is automatically planned. You take the children to the library (or take books if they can't leave the room), and teach them how to look up things they want to know. If you want to ask some questions, see the guide that comes with the filmstrips.

Alternative: Show the film *Venomous Animals of the Sea*, which won numerous prizes. It is available from the IMCS library, #MN-10697 (color, 28½ minutes).

theme 3 ACTIVITY 3

K-6 Go to an aquarium or market where they have fresh fish and observe:

- appendages for locomotion
- coloration
- covering, hard or soft

Draw sketches and hypothesize about the purposes of various adaptations. If you are unable to leave the classroom, show the film *Looking at Fishes* (L.A. City Schools #1542), or adapt the activity which follows.

RATIONALE

The limitations of media eventually show themselves, at which time you will probably feel the need to see (and perhaps touch) the real thing. This activity is also valuable for connecting the fish in the filmstrips with the fish we eat in a sandwich.

FISH FORM AND FUNCTION

A lesson adapted by Richard Murphy from McDonough & Korporeal, L.A. County Schools, "Form, Function, and Adaptations to the Environment in Common Marine Fish".

Objective: To familiarize the students with the basic anatomy of a fish and show how one can determine the environment in which a fish lives by its appearance.

Materials: Purchase the following fish whole and preferably not cleaned: mackerel or bonito, rockfish or rockcod, flatfish, anchovies. Anchovies can be purchased at any bait and tackle store, and the other fish can be obtained at a fish market. Make sure the fish are thawed before class.

Procedure: Give one anchovy to each pair of students. Lead the students through the following steps:

1. Inform the students that the anchovy is a fish that lives at the surface of the sea; feeds by filtering tiny plants, animals, eggs, and detritus from the water; lives in a school; and swims fast to avoid being eaten.
2. *How do we know this is true?* We can infer this from the fish's appearance.
3. *What is the color of the anchovy?* It is blue-green on its top side and whitish on its underside. One color gradually blends to the other along the side of the fish.
4. *What does the color of the fish tell us?* To help fish hide and avoid being eaten the

colors of the fish match their background. As one looks into the water of the sea from above, the background is blue-green. Thus, from above the fish matches this color. If we were under water looking up, the surface water would appear a shimmering silver. The color of the fish likewise is silver to help the fish hide, when seen from below. This color pattern is called *counter shading*.

5. *What is the shape of the fish's body?* If we cut the anchovy in cross-section the body will have an oval shape. lengthwise the body is slender.

6. *Can the body shape tell us anything about the living habits of a fish?* a) Fish that live in open water above the bottom and that swim fast to avoid being eaten are long and slender with oval body shape. The bonito and mackerel have similar characteristics. b) The large head and tapering body of the rockfish and rockcod indicate that these fish live on the bottom and do not have to swim fast.

7. *What do we learn from the fin and tail structure?* The anchovy swims by moving its tail fin back and forth. The fins are used for turning and keeping the fish stable while swimming. The fastest swimming fish have tail fins which are shaped like a new moon or are deeply forked. Anchovy tails are forked.

8. *With such a large mouth, what do you think this fish is going to eat?* (Note: Have the students open the mouth of the anchovy by grasping the lower jaw and pulling down.) Expect a variety of answers. Does the anchovy have teeth?

9. *If this fish feeds on other fish, it should have teeth.* The anchovy has very tiny, almost microscopic teeth.

10. *Could the fish filter small particles from the water?* Open up the mouth and look inside toward the gills. Break open the underside of the fish where the gill covers meet, exposing the inside of the gills. Notice the very fine hair-like filaments extending inward. These structures are called *gill rakers* and are used by the fish to filter microscopic particles from the water for food. The anchovy's large, gaping mouth enables the fish to take large gulps of water. This is helpful for both feeding and breathing.

11. *Why are the gills red and why are they so delicate?* Gills perform the same function as our lungs. They take in oxygen from the outside and get rid of carbon dioxide. But instead of air coming in and out as in our lungs, fish create a constant flow of water across the gills. Gills are red because of the rich supply of blood. They are delicate because the fish needs a very high surface area for the exchange of gases.

12. *What do you think the scales are for?* The scales protect the fish from a number of things: damage from rubbing on things, infection (as does our skin), and the loss of body fluids to the ocean medium outside.

13. *What other protective means does the anchovy have?* Anchovies swim in large schools. Living in a school has a number of advantages, among which is protection in numbers. In addition, when time comes for mating, there are a number of fish in proximity for the release of sperm and eggs and thus fertilization.

Comparison to Other Fish

You may want to cover the above list of questions for each fish. Consider the following characteristics which are important features in understanding the life style of any fish:

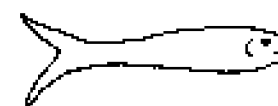
Body Shape

cross section

side view



oval



long, slender



thick,
flattened belly



large head

Tail Shape



fast swimmer



slow swimmer

Mackerel or Bonito

Color: blue-green to silvery
Environment indicated by color: surface, open sea.
Body shape: cylindrical, long, streamlined
Habitat indicated by body shape: open water
Speed of movement: fast, note body shape and tail fin
Mouth: large
Teeth: relatively large
Gill rakers: not fine and delicate
Food: these fish are predators and feed on other fast swimmers--sometimes anchovies
Protection: speed and coloration

Rockfish or Rockcod

Color: orange, red, brown
Environment indicated by color: rocky bottom. The brownish color helps the fish blend with its background; red and orange colors for these fish indicate they are from deep water where the subdued light also results in the fish being camouflaged.
Body shape: chunky, large head and slender body
Habitat indicated by body shape: bottom dwelling, not fast swimming
Speed of movement: slow(non-streamlined body, non-forked tail)
Mouth: large, strong jaws
Teeth: fairly large teeth, somewhat sharp
Feeding: the large head enables these fish to open their mouths to create a suction which pulls in smaller prey fish
Food: crabs and other crustaceans(large jaws),fish(large head)
Protection: camouflage and large spines on fish and head

Flatfish

Color: brown
Environment indicated by color and color pattern: sand or mud bottom
Body shape: flattened side to side(It may not appear that it's from side to side, but remember that these fish are lying on their sides, with the top of the fish being on either the right or left edge and the bottom on the opposite edge. These fish began life as a normal appearing fish, then the eye on one side of the head migrated to the other side, and the fish began lying on one side with the blind side down.)
Speed of movement: they are not fast long-distance swimmers, but they are capable of very quick short bursts of speed
Mouth: relatively small
Teeth: small teeth
Food: some species have teeth only on the bottom side of the mouth. They are used to snip off worms and clam siphons (necks) sticking out of the bottom. Other species like the California halibut have well developed sharp teeth for catching fish and crustaceans.
Protection: extremely good camouflage while lying on the bottom. These fish often flutter their fins to stir up the sediment which then falls back down on the fish, covering it up. A diver sometimes sees only the eyes sticking out of the sand.

Ask the students to think of a place in the sea where they might like to live and then have them decide how they would stay alive. Consider coloration, body shape, food, swimming speed, enemies, and ingenious means of protection.

RATIONALE

Fish provide us not only with symbols and food, but also with a medium for art. One way to see more clearly fish scales, fins, shape, etc. is to make an artistic print or model of one.

MATERIALS

K-3
Play dough or clay, implements for carving, wood and nails for mounting.

4-6
Materials listed in Sea Grant publication.

theme 3 ACTIVITY 4

K-3 Using play dough or clay, make a school of fish. Emphasize the parts to include: fins, eyes, gills, mouth and scales. Mount the fish as a group on a piece of wood, or individually on dead tree branches. You could display them swimming through a facsimile kelp bed.

4-6 Follow the instructions in the Sea Grant Marine Advisory Publication on gyotaku, Japanese fish printing. The illustrated publication is available in the MRL.

theme 3 ACTIVITY 5

K-3 Read and talk about the story of *Swimmy*, by Leo Lionni. The children will undoubtedly want to look closely at the illustrations. If there is time, draw and color some of the creatures *Swimmy* meets on his journey.

4-6 Preview, then show and discuss one or more of the filmstrips in the series *Moving Designs: Life in the Sea* (available in the MRL). The titles include:

- Animals with Backbones
- Animals without Backbones
- Armored and Spiny-Skinned Animals
- Plants and Simple Animals

Each of the filmstrips runs less than 10 minutes, so you might want to show more than one.

RATIONALE

Additional examples will help to reinforce design principles that have been learned in previous activities.

MATERIALS

K-3
Lionni, *Swimmy*.
Paper and crayons.

4-6
Filmstrip(s) and projector, cassette tape (s) and player.

RATIONALE

K-3
Part of the learning of young children (and adults for that matter) derives from kinesthetic experience, the absence of which is sometimes said to be responsible for reading difficulties. One way to better remember the styles and mannerisms of marine organisms is to experience their characteristic patterns of movement.

4-6
One of nature's predominant design principles is the effort to minimize surfaces. In this activity, the students are able to watch one such minimization taking place. The observation skills they acquire are those needed by scientists.

theme 3 ACTIVITY 6

K-3 After watching a short film about life in the ocean, practice moving like various ocean creatures. Use words to describe the movements: jerky, quick, heavy, slithering, diving, motionless, sluggish, and so on. If you think you will need some mood-setting accompaniment, take along the tape cassette of ocean sounds (available in the MRL).

You might want to ask questions: Who are you? Where do you live? Who lives near you? What do you do when people come near?

4-6 Experiment with soap bubbles as a demonstration of how the froth on ocean waves behaves. The bubbles try to minimize their surfaces and use the least material by clinging to each other. To design "minimum membrane structures", soak pipe cleaners in 3/4 cup of dishwashing liquid with 4 cups of warm water. Make a 3-D frame by twisting them together, with one pipe

cleaner shaped like a hook to hold for dipping. Dip the structure and see what happens. (Hold it still and give it time to transform itself.)

Using a straw, blow bubbles and observe their form. Try to draw what you see.

You can point out that a turtle shell looks very much like this bubble pattern, as do the wrinkles on a horseshoe crab shell. The wrinkles on the crab shell are from molting. The new shell is wrinkled under the old; then as it fills out and stiffens, scars remain. Compare that pattern to the markings on a giraffe.

MATERIALS

K-3
Record or tape cassette of ocean sounds for inspiration. Paper and string for labeling children according to the organisms they represent.

4-6
Pipe cleaners, dishwashing soap, bucket, water, straw.
Books with illustrations of bubble patterns in nature.

Other things you can do that day if there is time:

- Use graph paper or cut tiles to experiment with patterns. What happens with pentagons laid edge to edge? Will they cover the surface? Will triangles? hexagons? combinations? (If the school has a set of them, use parquetry blocks for this activity.)
- Take in a photograph of the Alhambra (there is one in *Accent of Man*, page 171, with discussion on tiled designs) to show what can be done with geometric design.
- Take in a copy of M.C. Escher's drawings to illustrate repeated patterns.
- Using the illustrations in the book *Art in Nature* (MRL), see what patterns you and the children can discover.
- Look at a book of snowflake patterns and examples of radiolaria. Using folded paper, cut out similar forms.
- Make textile prints using the designs you have admired.

theme 3 ACTIVITY 7

K-6 Take a walk outside and look for patterns in plants, trees, mud, buildings and so on. Look for colors, repeated patterns in leaves, and branching patterns in trees. Try to find two leaves exactly alike.

When you come back inside, use an opaque projector to enlarge pictures or specimens of ocean creatures. Count the legs, body segments, antennae, etc. Draw them, and put the drawings on the wall. Count your own appendages. In what ways are all human beings alike? How are they different?

When the idea of camouflage and protective coloration comes up, you could play a game suggested by Project Learning Tree. It is called "Bird and Worms". Scatter colored pipe cleaners on grass, soil, parking lot, and so on. The children are birds who pick up the "worms". Which colors are picked up first? Which last?

Children in grades K-3 might be stimulated by the 10-minute film, *Use Your Eyes* (L.A. City Schools #2280).

RATIONALE

Observational skill may be one that requires practice for its unfolding. There is among environmentalists some agreement that learning to see and learning from seeing are needed for our continued existence. As Karl von Frisch noted in his foreword to Animal Architecture, "If the public at large knew more about the workings of nature it would help to protect our living environment against the progressive destruction that threatens it."

MATERIALS

Paper and pencils for sketches. Opaque projector and pictures or specimens of ocean creatures.

theme 3 ACTIVITY 8

RATIONALE

The remarkable thing about nature's patterns is the way certain principles are followed whether in the sea or on the land-- or even in the kitchen or the kiln.

K-6 Look at design in nature as represented by:

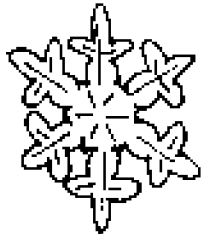
Corn on the cob, barnacles, bread rolls in a pan, onion cross-section, sea coral, a sunflower, dried-cracked mud, cracked glazes on pottery, wrinkling in the human brain, a honeycomb, a wasp's nest, soap bubbles, a pineapple, a pine cone...

Draw what you see. Use the group's favorite pattern to make a long drawing that goes all the way around the room.

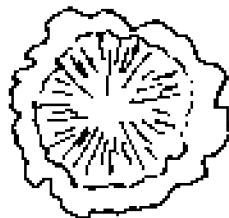
MATERIALS

Illustrations of nature's designs. Paper and crayons or markers.

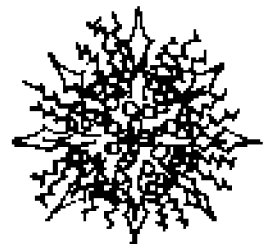
SNOWFLAKES



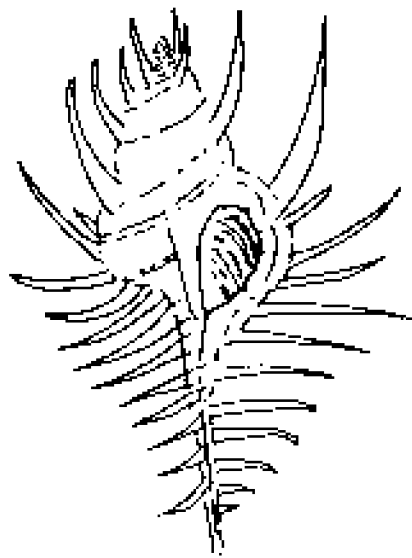
BACTERIA



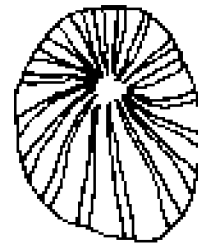
RADIOLARIA



Slison



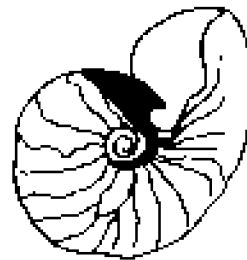
Venus comb murex



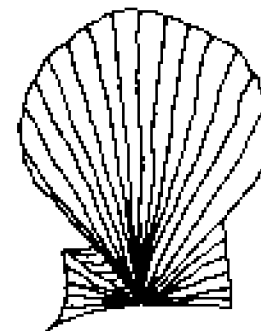
Limpet shell



Horn shell



Chambered Nautilus



Scallop shell

RATIONALE

One of the best objects the ocean offers to demonstrate principles of design is sea shells. By working with shells, students become familiar with the beauty and variety in sea shells; they also gain additional practice in improving skills in observations, categorization, and artistic creation.

MATERIALS

Sea shells, string, books on sea shells, clay.

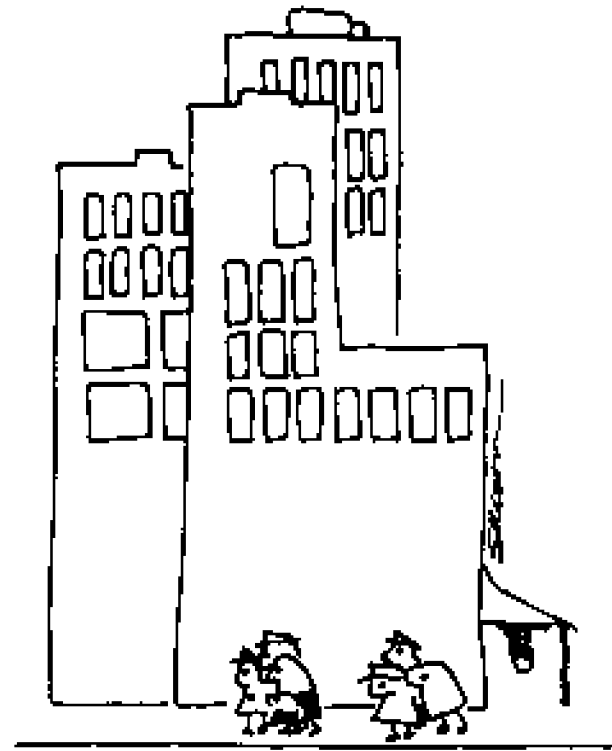
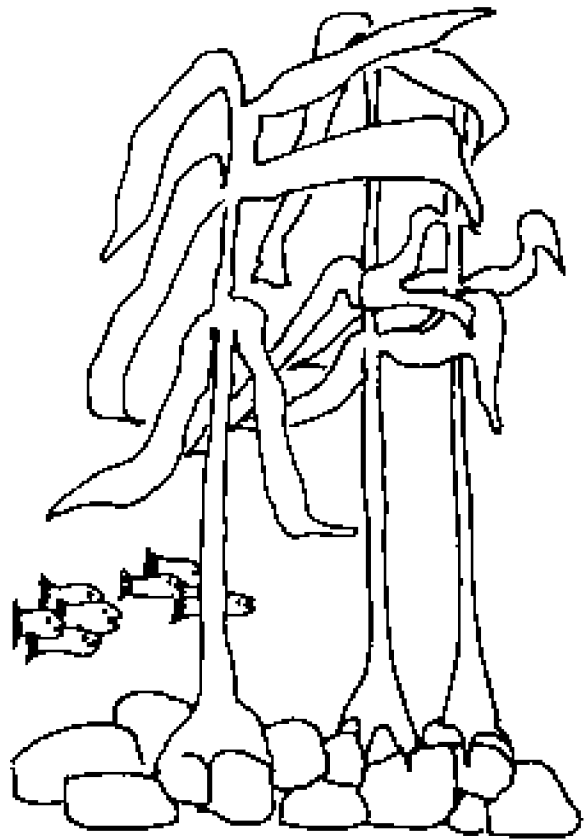
theme 3 ACTIVITY 9

K-6 Take in the collection of sea shells from the MRI. Look closely at the shells. How are they the same? How are they different? Try to categorize the patterns. Attempt to copy some in clay.

Use small shells to make jewelry. Some shells for this purpose are available in the MRI. You can collect others when you go to the beach. One common Southern California shell has a hole in it, so drilling is unnecessary. For information, consult Sandved and Abbott, *Shells in Color*, a book in the MRI.

theme 3 ACTIVITY 10

K-6 Follow the JEP tradition of celebrating your mini-course by concluding with a party in which you review what you have learned, enjoy each other's company, and say good-bye.



DIVIDING THE OCEAN PIE 4

A SERIES OF LESSONS ON POLITICS,
LAW, AND ECOLOGY OF THE SEA

For most of our history we have thought of the oceans in terms of an economic and political concept sometimes known as "freedom of the seas." Basically, according to this point of view, the oceans (and the fish and mineral resources in them) are common property--they belong to everyone. Fish are "free": when we buy them in the market, we are paying only for the fisherman's labor in catching them.

The sea-as-a-commons theory is based on certain assumptions: that the oceans are too large to turn into property, that they are infinitely pure, and that their resources are unlimited.

Now, with the exception of some people who defend the notion of freedom and resist restriction at any cost, most theorists are at least questioning the idea of freedom of the seas--if indeed they are not shouting that it is dead wrong.

Current theory has it that improved fishing technology and increased population necessitate some international regulation of marine resources. Since enforcement of boundaries is much more difficult than on land (and it has rarely been easy on land), there are many grey areas and innumerable unanswered questions.

MARINE ECOLOGY

The oceans are the part of the environment that makes planet earth habitable. They are the heat storage system of the world, the moderator of climates, the provider of rain, the source of more than three-fourths of the oxygen to sustain life.

From the proceedings of meetings
at The Oceanic Institute, 1976

While the ecology of the sea is very complex, it is also very straightforward. Put simply, as our population increases at an ever-greater rate, we use the sea as a garbage dump, pouring into it millions of tons of effluents and many gallons of oil. That action upsets the food webs, which in turn affects ever-more-needed basics of breathable air, edible food, and tolerable climate. In short, if we destroy the fauna of the sea, we will destroy all life.

That possibility should certainly provide ample justification for teaching children about those aspects of the sea. Here are a few ideas you might want to think about in conjunction with lesson-plan preparation along ecological lines:

- Part of environmental education is training to develop the senses of sight, smell, hearing, touch, and taste. But it is also important to educate for *competence*, without which awareness and concern might still lead to inaction. (See Mark Terry, *Teaching for Survival*.)

- An important theme in ecological education should be the concept of the irreversibility of certain chemical transformations. Life is a process of continual transformation and reformation, so we might be tempted to say "Well, things change." In fact, however, some combinations don't reform--they are toxic and useless. (Terry)
- Ethics in oceanography, as in other disciplines, are relative. Your point of view depends on whether you're part of the in-group or the out-group. For example, you can kill an enemy in war and get a medal, but if you kill a fellow countryman, you'll probably go to jail. The same relativity of perspective holds in coastal access questions: if you are a powerful nation with extensive and gently sloping continental shelves, for example, you are probably going to believe less in equal division of the oceanic pie than if you are a poor, land-locked nation.
- Watch your language. You will discover that it is very easy to use language to obscure reality, and oceanographers are certainly not immune from this practice. For example, as Paul Yambert has pointed out, what we call "sanitary land fill" is often an unsanitary dump, and "away" is often where we put things where they will damage the ecosystem. (Yambert in McInnis)
- Public attitudes about marine conservation issues are in a state of flux. You might want to trace the history of the conservation movement in this country. How, for example is our attitude toward oil spills influenced

by our perception of energy needs? When oil drilling rigs are placed out of sight, will public reaction be less inflamed when a spill occurs?

- Environmental education has many components. One author listed them: perceptual awareness, conceptual understanding, aesthetic discrimination, values clarification, creative abilities, humanism, organizational skills, decision-making.
- The problems of too many people and too little food and too much consumption of thermally polluting energy may have marine solutions. Aquaculture will provide some food, or as Mark Terry says he learned in school: "The Asians won't starve, as long as I eat everything on my plate and we harvest the sea." (p. 7) We can also meet some of our needs by using the ocean's many sources of energy: tidal power, ocean currents, wave power, ocean thermal differences, hydroelectric power, and solar energy (converted to vegetation). But the fact is that these solutions help only for now. We must still fashion a new lifestyle and stabilize the world's population. (Wilcox, *Journal of Marine Education*)
- It is important to develop a broad and long-term perspective. For example, a problem with the conversion of fossil fuel or nuclear energy is that the fraction lost through inefficiency is discharged into the environment as low-grade heat. That doesn't make much difference to most of us now, but in

200 years, it could amount to 100 percent of the solar energy currently reaching the surface of the earth. Some people believe that the polar icecaps would then melt, and sea level would rise to 160-200 feet, which would flood our cities and farmlands (Wilcox). Others think that glaciers might build even higher from increased evaporation and precipitation.

A SUMMARY OF ISSUES

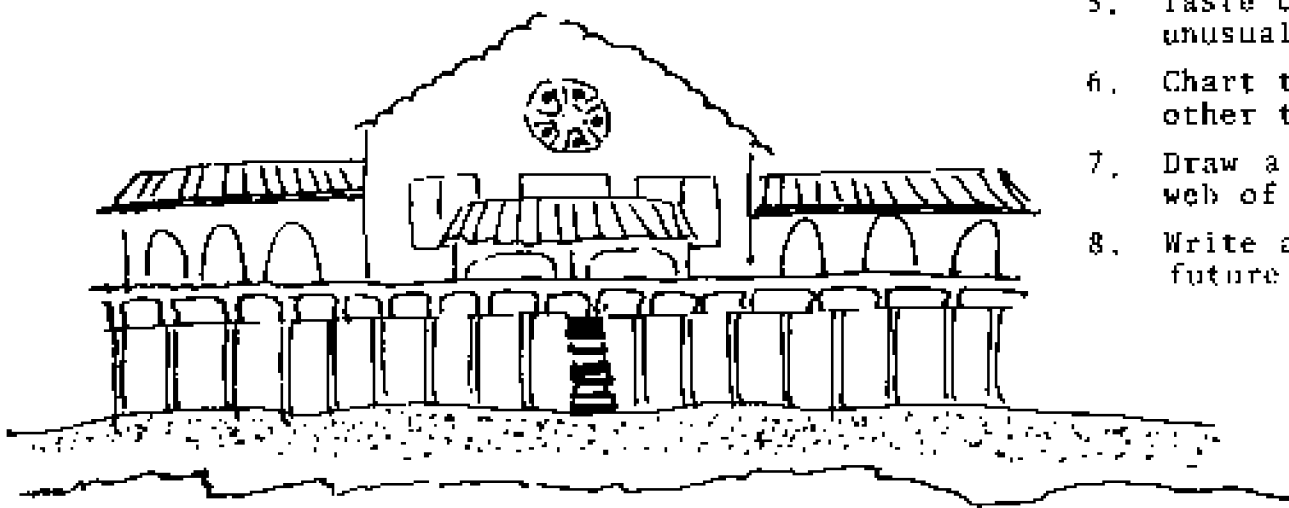
The following are some issues that are being debated (usually hotly) in marine studies:

- 1) There is legislation to prevent indiscriminate ocean dumping, but how can it be enforced? The same problem arises when we try to allocate mineral resources, to police whalers, and to protect dolphins.
- 2) How can we balance the need for the oil reserves off the U.S. coasts and on continental shelves and slopes and the need to prevent potential damage to the environment and to fisheries?
- 3) Should our ports be developed to accommodate big tankers, or should offshore facilities with pipelines to shore be developed, or should we cease importing? (Compare this issue to the debate over landing of the Concorde in our nation's airports.)

THEME 4 OBJECTIVES

The student will be able to:

1. Summarize both sides in a current oceanographic debate; i.e., private vs. public ownership of coastal property, or the tuna-porpoise controversy.
2. Identify the marine inhabitants of tide pools.
3. Originate solutions to ensure the just allocation of a limited resource.
4. Watch a slide presentation on oceanographic exploration. Discuss the slides.
5. Taste edible ocean resources, including unusual seafoods and seaweed.
6. Chart the destination of water and other things we put down our drains.
7. Draw a marine food web, or the web of life as a whole.
8. Write a science fiction story describing future uses (and/or abuses) of the oceans.



* Activity 1 owes its existence in part to discussions with law professor Arvid Pardo and political scientist Robert Friedheim.

RATIONALE

One of the major questions at the UN Law of the Sea conferences which have gone on periodically for almost fifty years is how to allocate resources for "geographically disadvantaged states," those without a sea-coast. Landlocked countries can be given rights to the sea's resources, but if their rights of access are not guaranteed, they will remain at the whim of their neighbors for transit permission, which sometimes involves high fees and tariffs.

One way for children to grasp this dilemma is to experience a model in which there is a fixed pie with an increasing number of claimants--the so-called "prisoners' dilemma." Even preschoolers are acutely aware of the potential for being gyped at juice time

theme 4 ACTIVITY 1

K-6 Take to class an insufficient number of crackers, preferably the brand shaped like small goldfish. Let the children count the number of fish crackers and the number of children who want one. Lead them in a discussion of possible solutions. Make a list of their suggestions, with the pros and cons of each.

Some of the solutions will very likely be those proposed at the Law of the Sea conferences:

- 1) The biggest person could take them all. He or she could eat them alone, or share them with friends.
- 2) The group could try to sell the crackers and buy something else.
- 3) All children absent receive none, or some are set aside for them.
- 4) The crackers could be offered as a reward, or given only to those children with a certain characteristic (e.g.,

those wearing blue that day).

- 5) All of the crackers could be cut in half (or in quarters).

When discussing the necessity of moving from freedom to regulation, you can also offer the analogy of what happens when a small town grows into a city:

When a town is just beginning, there is almost no traffic and people tend to be rather polite about letting the other person have the right-of-way at the few intersections.

When the town grows, however, there are more cars. Stop signs have to be erected, and perhaps a traffic light installed at the major intersection. Soon afterward, a few traffic lights and one police officer aren't enough. Citizens become afraid of additional expense and bureaucracy, so they vote against more lights and police officers.

That is exactly where ocean management is now, and the result is similar too: serious accidents occur at unguarded intersections.

if there is not enough food to go around. Since these children are our next generation of ocean resource managers, it is imperative that they develop a sense of the results of greed and the merits of just allocation of the world's available property.

MATERIALS

Goldfish crackers or other food to be divided.

RATIONALE

An important aspect of oceanography today is the research that is being conducted by various countries on vessels throughout the world.

theme 4 ACTIVITY 2

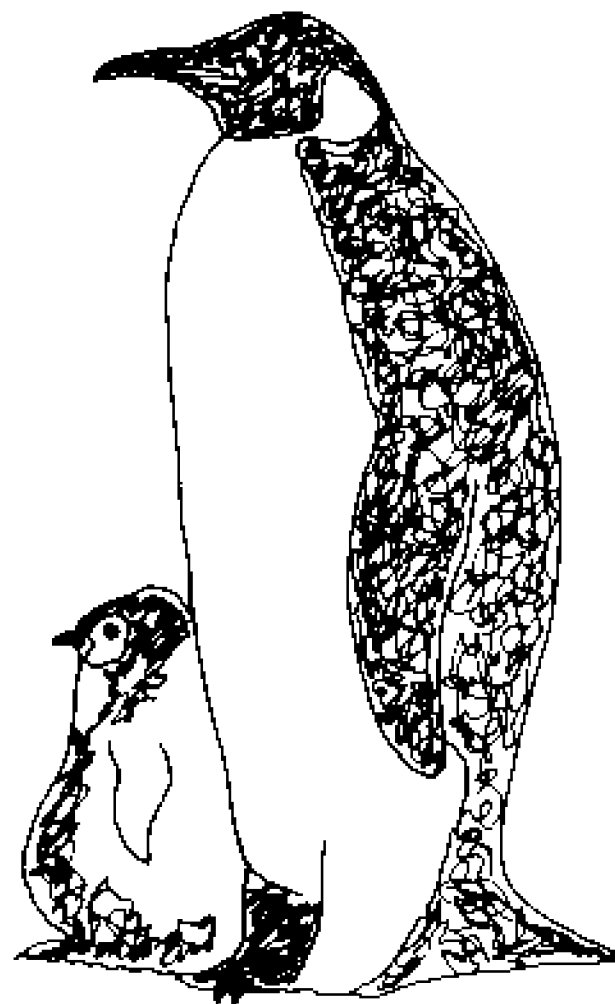
K-6 Preview and then show the slide presentation (in the MRI) on a Chilean expedition to Antarctica. The slides, courtesy of Leo and Jackie Rojas, include:

- Departure and journey past glaciers;
- living accommodations and lifestyle;
- Animal life observed, including seals and penguins.
- Scuba diving expedition with underwater photography.

There is a sound cassette narrated by Jackie Rojas. One side of the tape is in English; the other is in Spanish and English.

Take the world map from the MRI to show where the expedition went. You can also take the book *The Emperor Penguin* to have on hand if the slides spark further interest in penguins.

Note: If students liked this topic, you might want to show them the film *Oceanographer in the Polar Regions*, which is available from the IMCS film library, #MN-10301 (color, 29 minutes).



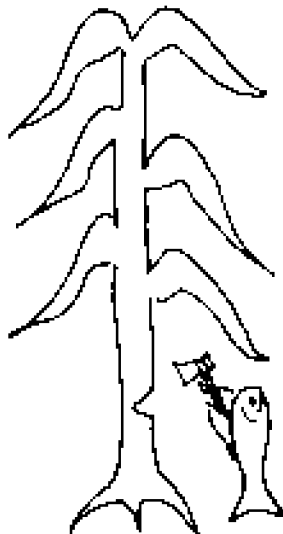
MATERIALS

Slides and carousel projector. Audio tape and cassette player. Map of the world including Antarctica.

theme 4 ACTIVITY 3

K-6 Prepare a lesson on ocean edibles. Include things students may not have realized: i.e., that most of the fish we eat is in the form of chicken and that there is a seaweed product in chocolate milk and ice cream.

In class, make and taste fish and seaweed dishes. Include small portions of less common seafood such as octopus, squid, and eel.



PICKLED SEAWEED

- 1 cup vinegar
- 1 clove garlic
- 1 stalk green onion
- 1 tomato, chopped
- ¼ cup shoyu
- 1 green pepper, chopped
- 2 tsp. sugar
- 1 tsp salt

Add ingredients to the vinegar. Place seaweed that has been in boiling water for 3-4 sec. (and drained) into a jar. Cover with vinegar mixture. Let stand for a day in refrigerator to marinate.

RATIONALE

One branch of oceanography is concerned with obtaining food from the ocean--especially with optimizing edible ocean resources. Children probably know what a tuna fish sandwich tastes like (but don't take that for granted). They probably are unaware, however, of other foodstuffs from the sea, especially those whose usage will become more common within the children's lifetime.

MATERIALS

Seafood and seaweed dishes. Charts and books on edible ocean products. Drinking water.

NATIONALE

Most of the activities so far in this book have stressed the effects of the sea on people. Now we will open up a topic that is to many oceanographers the number one issue in the field: ocean pollution--the effects of people on the sea.

MATERIALS

Paper and markers.
Books and charts.

theme 4 ACTIVITY 4

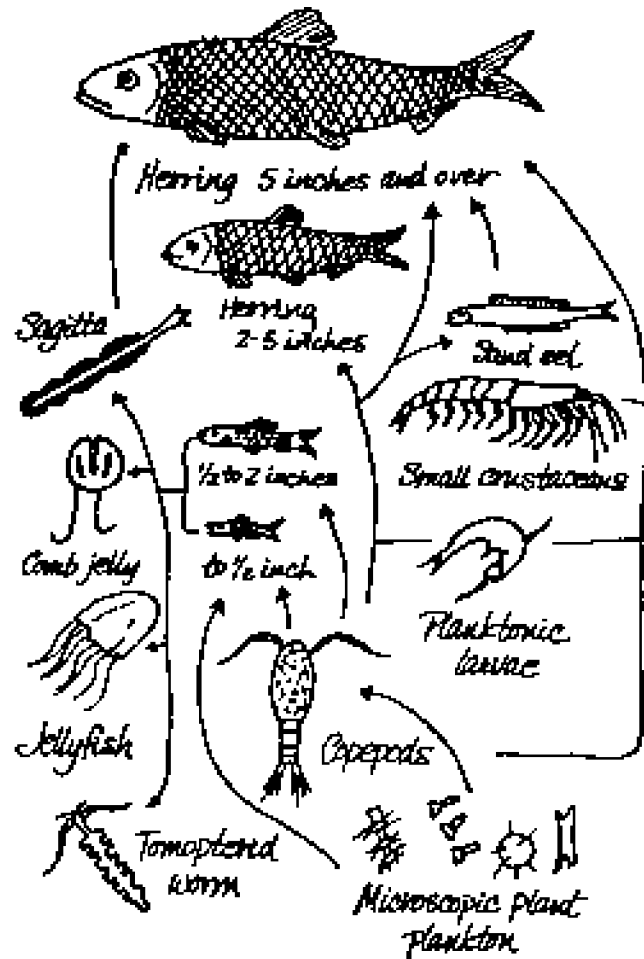
K-6 Take in the loose-leaf notebook of newspaper articles on pollution. (It's in the MRL.) Look at recent articles and try to make a list of what is being polluted by whom, and what is being done about it.

If you are not an expert yourself, invite a guest to the classroom to lead the discussion about what happens to the products we wash down the drain. Where does our water come from? Where does it go? What do homes and industries add to the water on its route? What does the school add? Make a large chart of the process. Map the path of pollution.

Talk about the web of life and ways in which we can upset food webs in the ocean. If you need to know more about this topic, look at the articles collected in the MRL.

You can play a web of life game: Connect with string children representing various marine animals and plants. When a tight web is formed, have one child drop out. What happens? What if two drop out? More?

In grades 4-6 you could also show the 9-minute film *Food Chains in the Ocean*. The film is available from L.A. City Schools (#2118).



Food web in the sea. Drawn from Schwantze & Troost, *Patterns of Life*.

theme 4 ACTIVITY 5

K-6 Play a game to demonstrate a food chain in the ocean community. While the game below admittedly over-simplifies interrelationships, it will perhaps foster the beginnings of recognition that such connectedness exists among nature's creatures.

Make chest labels to identify participants according to their roles:



Design a game like the scissors-rocks-paper game (in which scissors can cut paper, paper can wrap rocks, and rocks can smash scissors). In your new game, shrimp can eat copepods (but not vice versa), and seals eat fish, which eat shrimp, which eat diatoms, and so on. Trade roles so that everyone has a chance to be a consumer.

After you have played the game, make a poster for the room or school hall. It could show an oceanic food web, the web of life as a whole, the effects of pollution, or a subject of your choice as a group. (Don't forget to obtain permission for this activity through your School Coordinator.)

RATIONALE

Many ecological problems stem from the inability of the populace to recognize the interrelationships between members of a community. Since we often lack sufficient awareness of the web of life, we tend to be unable to predict the consequences of our actions when we interrupt a food chain. Developing such a perception would be good not only for ecological salvation, but also for expanding the "interrelationship point of view" to family psychodynamics, political systems, and theoretical constructs in economics, law, and international relations.

MATERIALS

Chest labels. Poster paper and crayons of paints. Books with diagrams and descriptions of food chains and the interrelationships between the ocean and all of life. Cloth or paper towels for cleaning up.

RATIONALE

Another issue in oceanography is private versus public ownership of the coastline. One writer observed that of the 59,197 miles of U.S. coastline, excluding Alaska and Hawaii, only two percent is owned by the public. The students may not perceive that this question has much to do with them, but if you are interested in this topic, they could--and should--be persuaded.

MATERIALS

No materials are required for the "zoning hearing" debate. Materials for preliminary activities might include recordings, photographs, books, and games.

theme4 ACTIVITY 6

K-6 Start by making younger children (and inexperienced older ones) aware of life at the seashore--the sensations and recreations that are in jeopardy. You could:

- Play and identify seashore sounds from a recording: foghorn, gulls, waves, motors, kids playing, seals barking, exhaling under water.
- Show photographs of the ocean. If you were there, what would you hear, smell, do, etc.? What colors do you see?
- Use the L.A. Harbor's coloring book. Talk about safety when swimming.
- Play drawing for pairs or concentration using a deck of cards that includes pictures of fish, names of fish, sea mammals, beach, rocks, boat, island, etc.
- Make a box with a hand hole. Identify ocean objects by feel: shells, kelp, beach rocks. Are they rough, soft, hard, smooth, jagged?

With more experienced children, have each person take a role and present his or her side in a debate in which the zoning of a stretch of beach is being determined. Roles: housing development contractor, boater, amusement park owner, private citizen who wants to build a home for his or her family, surfer, hotel owner, kennel owner, oil company representative, government representative, fisherman, a fish, a child who wants to play at the beach.

What are the costs(dollars, social, ecological, aesthetic) of each person's proposed usage? What will be both the long- and short-term effects? Who will benefit?

theme 4 ACTIVITY 7

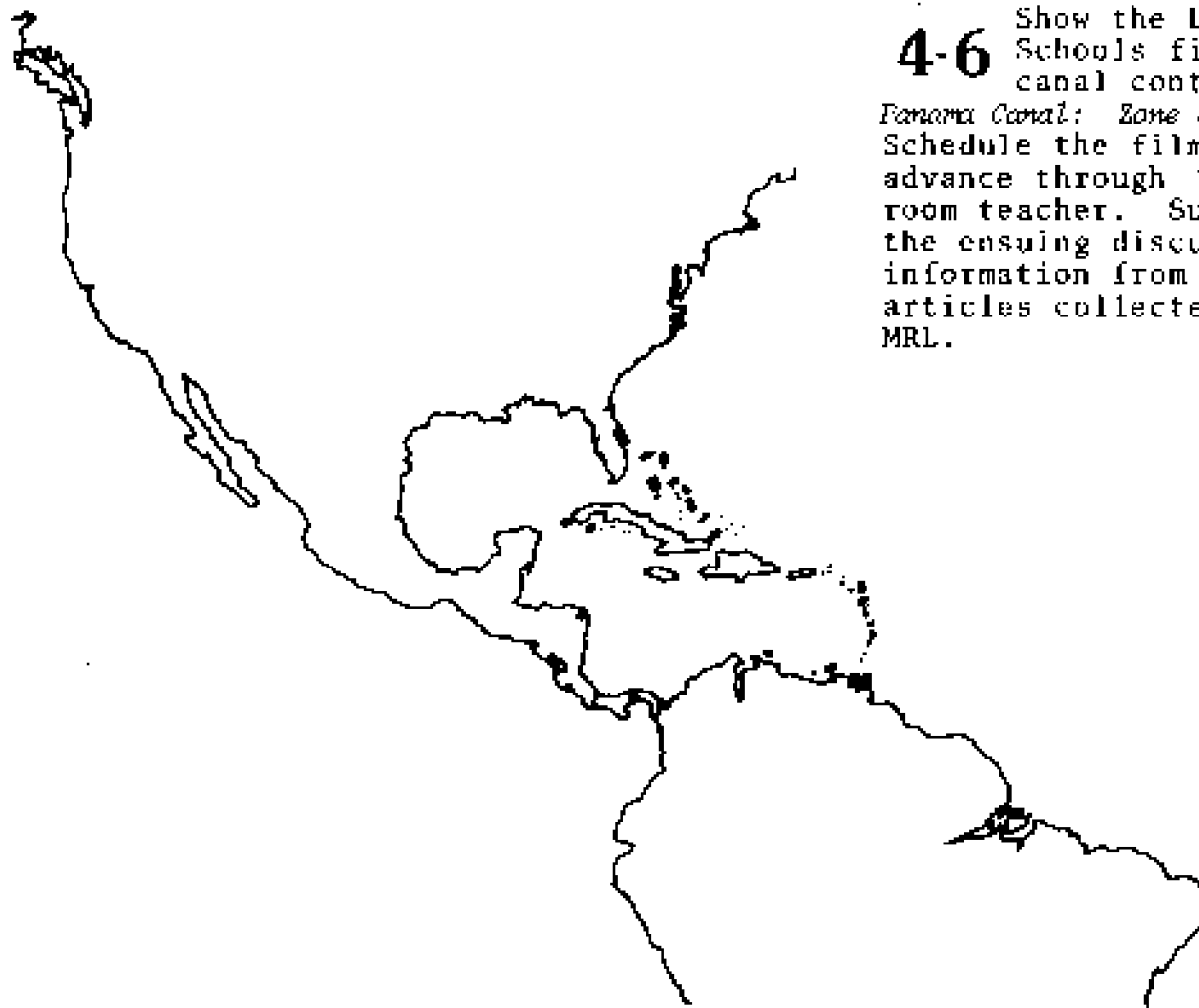
4-6 Show the L.A. City Schools film on the canal controversy: *Panama Canal: Zone of Conflict*. Schedule the film well in advance through the class room teacher. Supplement the ensuing discussion with information from newspaper articles collected in the MRL.

RATIONALE

Controversy surrounds United States control of the Panama Canal--the important linkage between oceans. In this activity, students consider varying points of view and are encouraged to arrive at their own conclusions, both of which are skills needed by responsible citizens.

MATERIALS

Film and projector.
Map. Newspaper articles.



RATIONALE

One issue that is currently very hot is the debate between the tuna fishermen and the advocates of more stringent limitations on the number of porpoise killed in the process of fishing for tuna. In addition to helping children understand the points of view in this issue, this activity will help children

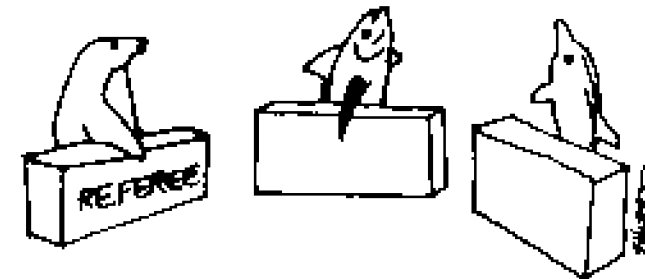
- 1) experience the frustrations of holding a view that is in conflict with the view of someone else,
- 2) experience the difficulty in working out compromise solutions
- 3) carry out activities essential to the legal profession: conduct research, organize evidence, present convincing arguments, and use persuasive skills,
- 4) practice skills needed by all students: asking questions, taking notes, outlining, public speaking, organizing information.

theme 4 ACTIVITY 8

4-6 Using the notes in the MRL on "How to Conduct a Debate," set up a debate among the following participants:

- A man with a family who has worked 20 years to be able to buy his own tuna fishing boat. He is worried that his family will starve if he tries to meet the quota on dolphins that may be killed. (Currently \$9,050 per year may be taken by the U.S. tuna fleet.)
- A person representing the Fund for Animals. He or she thinks that the tuna fishermen can avoid killing dolphins, and points out that they are not going to be prosecuted if they accidentally kill a few in the process of fishing.
- A person from the National Marine Fisheries Service who is supposed to enforce the act that sets a limit on the killing of dolphins. He or she is just trying to do his or her job.

- A representative of the cannery that gave the fisherman \$3million to buy his boat. They want him to make his payment of \$500,000.
- A fisherman from another country that doesn't have such a quota. He or she just keeps bringing in more tuna and making more money.



The tuna-porpoise debate.

RATIONALE

One of the capacities needed by policy planners is the ability to perceive long-range effects of present day decisions. This activity calls upon the children's creativity and imagination while they speculate about the ocean's future.

MATERIALS

Paper and pencils. Crayons or markers for illustrating story. Science fiction story.

RATIONALE

There is a JEP tradition of devoting the last session of a mini-course to celebrating.

theme 4 ACTIVITY 9

4-6 As a group, write and illustrate a science fiction story about the ocean 100 years from now. What creatures will live in it? Who will travel on it? how? What color will it be? What will the oil rigs, if they still exist, look like? Will there be swimming?

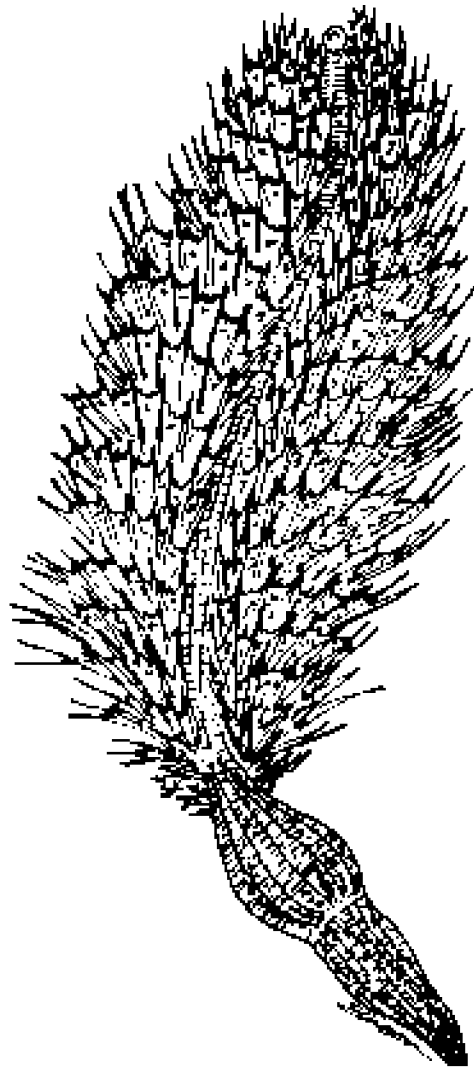
Read a brief science fiction story if the students need inspiration.

theme 4 ACTIVITY 10

K-6 Celebrate the end of the mini-course by reviewing what you have learned and having a farewell party. You could show a film, restage a debate for visitors, or dramatize your science fiction story.

ADDITIONAL SUGGESTIONS:

- Study an ocean issue on the ballot. Look at advertisements for both sides. How are issues sold? Write and draw a TV commercial advertising the group's opinion about the ocean. Can you also write one that makes undesirable something that you really think is desirable?
- To aid in understanding the dispute over the 200 mile limit, use chalk or string to draw an equal amount of space around each child's desk. What happens to the people on the edges? In the middle? How are fights settled where the "districts" overlap?
- As a group, write a letter expressing your opinion in the tuna-porpoise controversy. Send it to a legislator or conservation group of your choice.



Sea pen
(after Haeckel).

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SPANISH VOCABULARY

THEME 1

whale	<i>la ballena</i>
fish	<i>el pez, pescado</i>
environment	<i>el ambiente</i>
conservation	<i>la preservación, conservación</i>
to measure	<i>medir</i>
size	<i>la medida, el tamaño</i>
ocean	<i>el océano</i>
migration	<i>la migración</i>
to write poetry	<i>escribir poesía</i>
ecological mobile	<i>un móvil ecológico</i>

THEME 2

mythology	<i>la mitología</i>
shipbuilding	<i>la construcción de barcos</i>
tales of monsters	<i>los cuentos de monstruos</i>
folklore and the sea	<i>el folklore; cuentos, leyendas y tradiciones del mar</i>
dangerous sea creatures	<i>los animales marinos peligrosos</i>
to paint a mural	<i>pintar un mural</i>
to build a model	<i>construir un modelo</i>
submarine	<i>el submarino</i>
world exploration	<i>la exploración del mundo</i>
pirates	<i>los piratas</i>
island culture	<i>la cultura isleña (de isla)</i>

VOCABULARIO ESPAÑOL

THEME 3

adaptation	<i>la adaptación</i>
marine biology	<i>la biología marina</i>
animal architecture	<i>la arquitectura animal</i>
nature's design	<i>los diseños de la naturaleza</i>
poison	<i>el veneno</i>
camouflage	<i>el camuflaje, un disfraz(n) disfrazar(verb)</i>
tentacles	<i>los tentáculos</i>
paddle-shaped legs	<i>los patas como remos</i>
octopus	<i>el pulpo</i>
penguin	<i>el pingüino</i>
spiral	<i>espiral(adjective)</i>
snail shell	<i>la concha del caracol</i>
aquarium	<i>el acuario</i>

THEME 4

oceanography	<i>La Oceanografía</i>
law of the sea	<i>la ley del mar</i>
tuna-porpoise debate	<i>el debate del atún y el delfín</i>
seaweed	<i>el alga marina</i>
food chain	<i>cadena de comida</i>
web of life	<i>la tela de la vida</i>
oil rigs	<i>la torre del pozo de petróleo</i>
Panama Canal	<i>El Canal de Panamá</i>
beach	<i>la playa</i>



THE END.