

# MAKAHIKI KAI

festival of the sea

FILE COPY

## STUDENT WORKBOOK

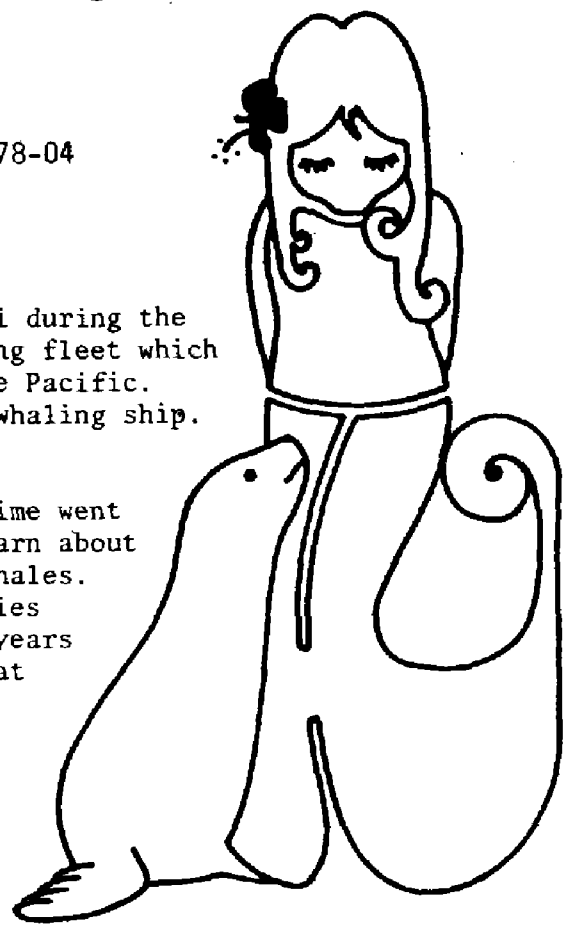
UNIHI-SEAGRANT-MR-78-04

February 1978

MAKAHIKI KAI '78 takes you to Lahaina, Maui during the days when it was the port 'o call for the whaling fleet which sailed around the Horn to hunt for whales in the Pacific. Life is not easy for the sailor who signs on a whaling ship. He is away from his family for 3 or 4 years.

What happened to the whaling industry as time went on? Why is there a problem today? You will learn about the largest living creature in the world--the whales. Can we preserve them and yet allow those countries which have been hunting whales for hundreds of years to continue to kill them? This is a problem that each of us needs to think about.

In addition to exhibits on the whales and whaling, Makahiki Kai '78 has displays on the marine environment: the beach, the reef, the deep blue waters, and the abyssal depths. What is each environment like? What lives there?



A project of the University of Hawaii Sea Grant College Program

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# Bicentennial of Cook's Arrival

On January 18, 1778, Capt. James Cook (1728-1779) sighted the islands of Kauai and Oahu and named the group of islands the Sandwich Islands after his patron the Earl of Sandwich.

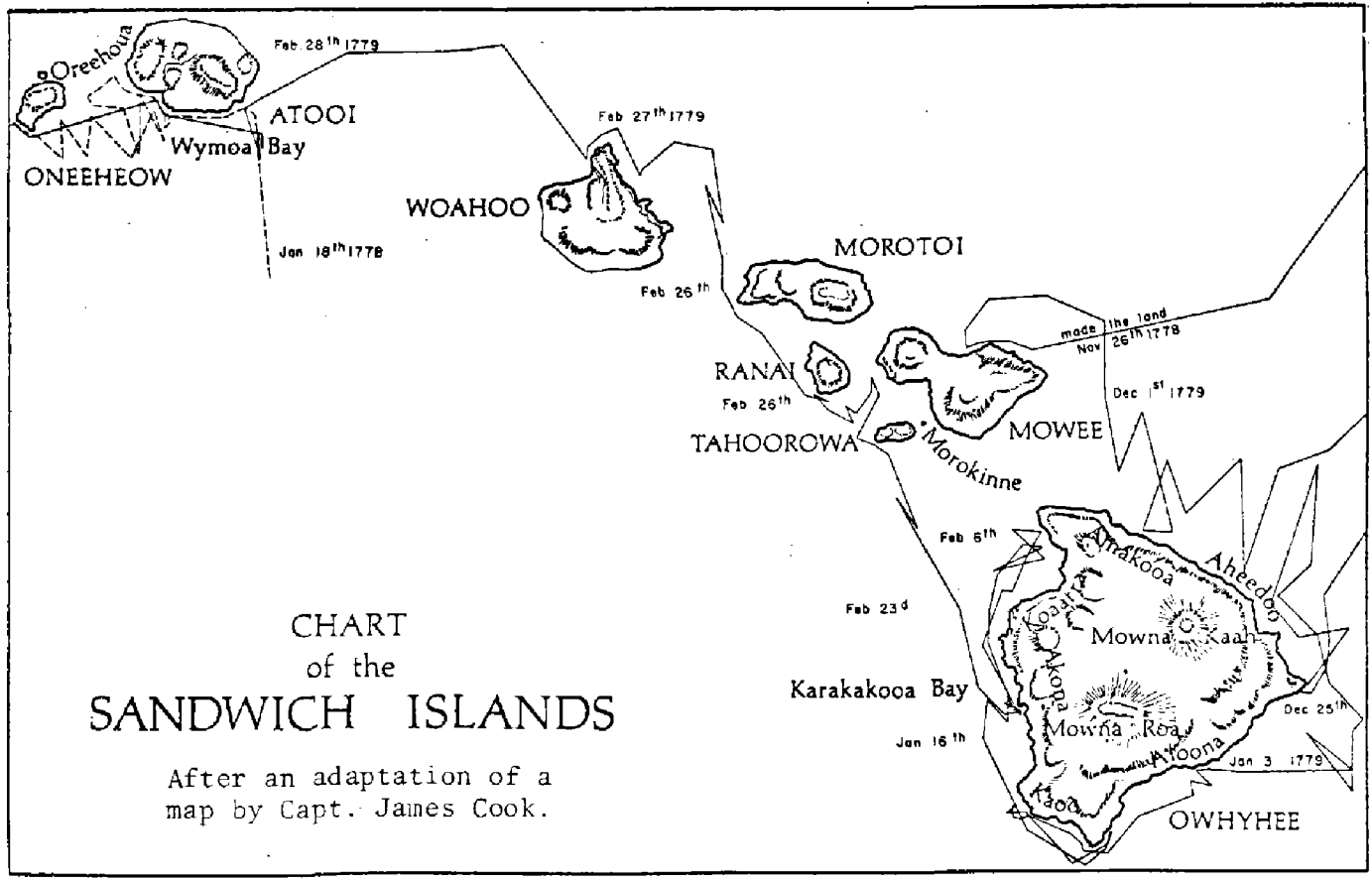
Capt. Cook was on his third exploration voyage to the Pacific. On this trip, he was in search of a Northwest Passage from the Pacific to the Atlantic Ocean.

On January 19, he led his ships, the *Resolution* and the *Discovery*, along the coast of Kauai, where he found a safe anchorage and fresh water. The Hawaiian natives thought he was their god Lono and bowed before him.

After taking on water and food, Capt. Cook continued his voyage in search of the Northwest Passage. He passed through the Bering Strait but was soon blocked by ice and was forced to turn back.

He returned to Hawaii where he was received kindly at Kealakekua Bay, Hawaii. However, due to a misunderstanding, Capt. Cook was killed on February 13, 1779.

Capt. James Cook was probably the greatest of the Pacific explorers. He made true and clear maps of places already discovered in addition to those he discovered. Although his arrival is recognized as the first European discovery of the Hawaiian Islands, some accounts credit Spanish explorer Juan Gaetano with being the first European to discover the Hawaiian Islands in 1542 on his way to the Philippines. Regardless, Capt. Cook made his discovery known to the world and his arrival marked the beginning of the coming of westerners to our island shores.



# Cook's Historic Voyage

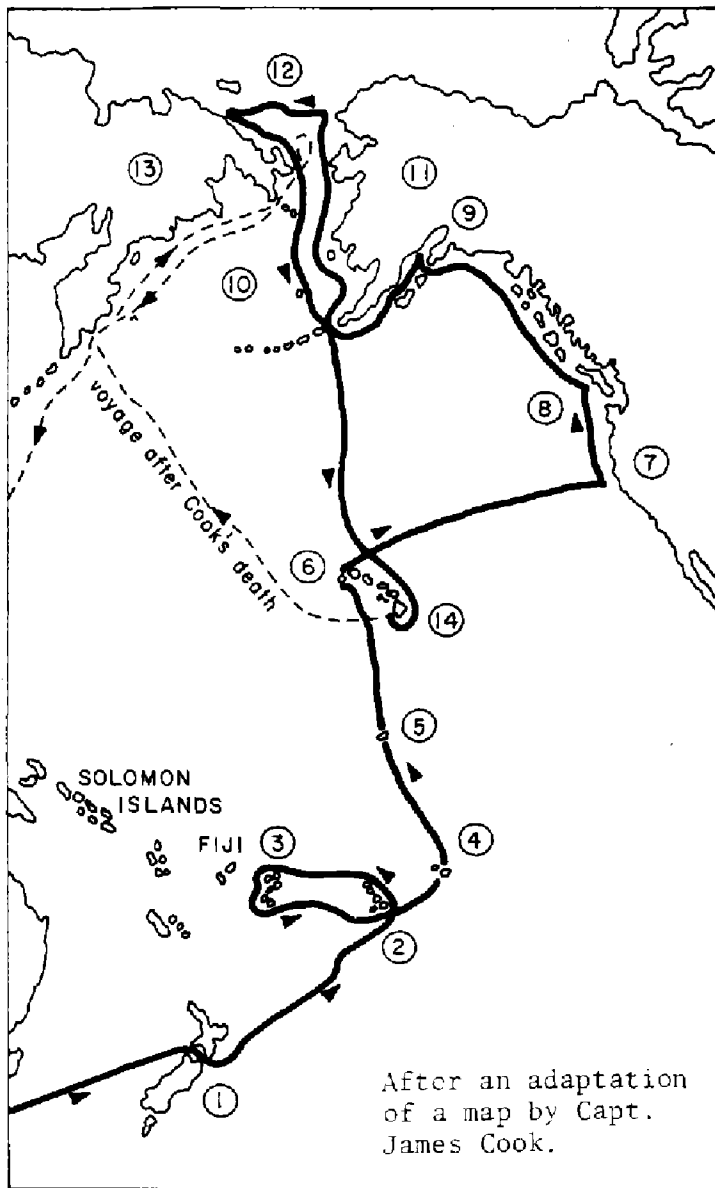
Below is a map of the Pacific Ocean and the route of Captain Cook's third voyage. It was on this voyage that he discovered Hawaii.

## LIST OF PLACES

|                  |              |
|------------------|--------------|
| Christmas Island | Kauai        |
| Tahiti           | Hawaii       |
| Vancouver Island | Alaska       |
| Siberia          | New Albion   |
| Cook Inlet       | Cook Islands |
| Friendly Islands | Bering Sea   |
| New Zealand      | Arctic Ice   |

## DIRECTIONS

Fill in the MAP KEY below. Use the names from the LIST OF PLACES (left).



## MAP KEY

- ① \_\_\_\_\_
- ② \_\_\_\_\_ Islands
- ③ \_\_\_\_\_ Islands
- ④ \_\_\_\_\_
- ⑤ C h r i s t m a s Island
- ⑥ \_\_\_\_\_
- ⑦ \_\_\_\_\_
- ⑧ \_\_\_\_\_ Island
- ⑨ \_\_\_\_\_
- ⑩ \_\_\_\_\_ Sea
- ⑪ \_\_\_\_\_
- ⑫ \_\_\_\_\_
- ⑬ \_\_\_\_\_
- ⑭ \_\_\_\_\_

# History of the Whale Fishery

Man has been hunting WHALES (20D) far back into RECORDED HISTORY (14A). The earliest period of whaling dates back to the 12th century.

EUROPE (8D). The BASQUES (11A) at first used STRANDED (5D) whales, but soon after began to go out to SEA (13A) with small boats to hunt the RIGHT (16D) whales.

In the early 17th century the DUTCH (31A) discovered the ISLAND (17A) of SPITZBERGEN (2A) and the rich whaling grounds around it. The Dutch built shore STATIONS (12D) and competed with the ENGLISH (3D) for the valuable oil and baleen of the GREENLAND (23D) right and BISCAY (11D) whales.

ASIA (35A). By the end of the 17th century, the Japanese developed a new way of hunting using NETS (4A) with empty barrels that served as FLOATERS (21A).

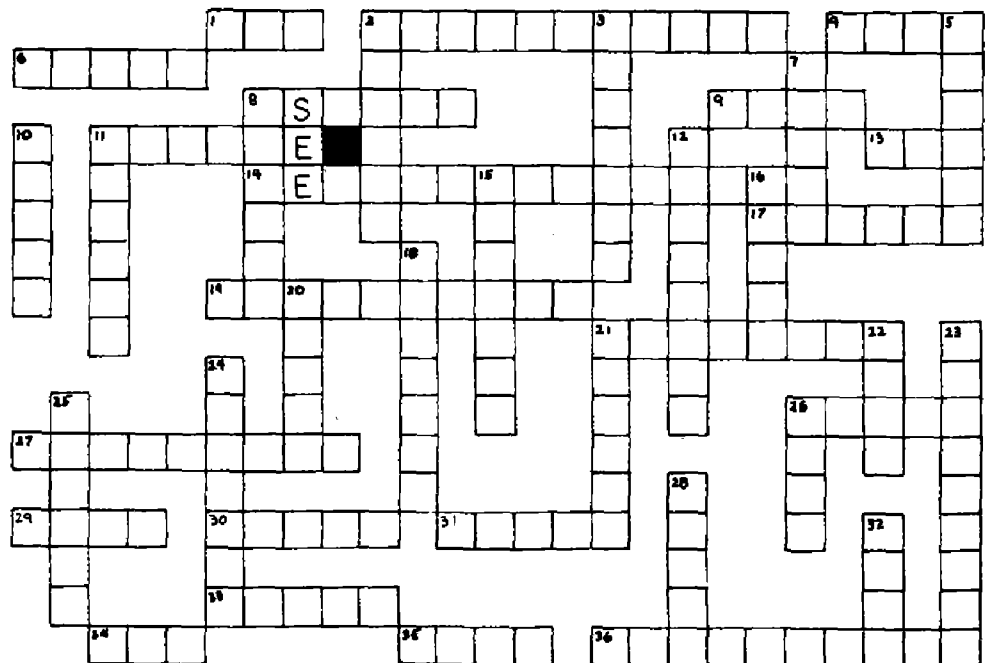
South Pacific. Below the EQUATOR (15D) the British, Americans, and FRENCH (21D) hunted whales around NEW ZEALAND (19A).

North America. The Aleutian ESKIMO (8A) started whaling about the same time as the Basques. They would use their kayaks with double-ended PADDLES (18D) to quietly sneak up on the whales.

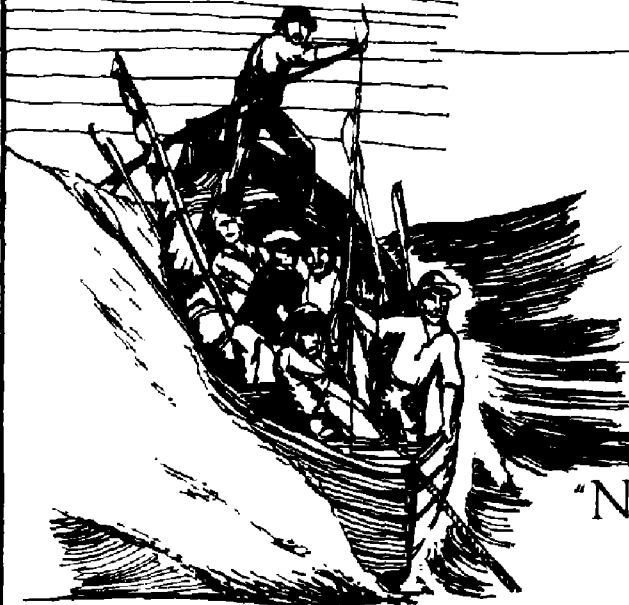
Some west coast Indian tribes in America hunted the California GREYS (7D) in the bays of BAJA (32D) California. In NEW ENGLAND (36A) Indian tribes used a fleet of BARK (29A) CANOES (33A) and bows and ARROWS (28D) to hunt. "DRIFT (6A) whales," which were dead or stranded whales, were highly prized in the Massachusetts BAY (34A) area.

In 1712, SPERM (10D) whales were found to contain valuable spermaceti. To chase these whales New England whalers began building larger vessels equipped with TRYworks (1A) to boil the blubber. SHIPs (22D) from NANTUCKET (27A) journeyed to Cape HORN (9A) and into the PACIFIC (24D) and to CHILE (26A). A FLEET (30A) of ships, each carrying a CREW (26D) of 40, transferred whale oil to cargo ships in ports like HAWAII (25D). At the height of the whaling industry 70,000 SAILORS (2D) were employed.

DIRECTIONS:  
Read the "History of the Whale Fishery" and complete the crossword puzzle.



# Seaman's Life



It was difficult to imagine that fishermen ever dared to attack whales with harpoons thrown from small wooden boats. For pure size and power, whales have no rival. But for the Yankee whalers or whalemen, the danger of hunting whales was a way of life. His life was filled with hard labor and long periods of boredom waiting to sight a whale. On the average, a whaling ship lost a third of its crew because of deaths and desertions.

## "Nantucket sleighride"

The crew lived in crowded quarters on the bow of a ship called a "forecastle," or as it was pronounced, fo'c's'le. The walls were lined with double-decked bunks. The cornhusk mattresses were called "donkey's breakfast." The room smelled of sweat, smoke, mildewed clothes, and garbage and the sailor aboard a whaling ship had as room-mates rats and insects as well as fellow whalemen.

His clothing became more colorful as the trip progressed because he mended them with colorful patches. Purchasing new clothes at the ship's store, called the "slop chest," was much too costly.

A sailor always welcomed the sight of another ship so he could visit or "gam" with the visiting sailors. It was good to see new faces, hear new stories, eat fresh food, and pick up a letter or news from home.



## fore-castle (fo'c's'le)

The favorite pasttime during those long hours and weeks of waiting for a sighting of a whale was scrimshawing. Scrimshawing of beautiful artwork was made by scratching pictures of ships, whale hunts, and loved ones on polished whale's teeth. Scrimshaws made very attractive gifts and are prized by collectors and museums today.



## scrimshaw

# "Lay" Pay

A whaling crew was paid in a different way. They were not paid by the hour or month but by a fraction of what the ship made after a 3 or 4-year voyage. How much would each of the following crewmen be paid?

1) If a captain's pay or "lay" was  $\frac{1}{8}$  of \$25,200, his share would be \_\_\_\_\_

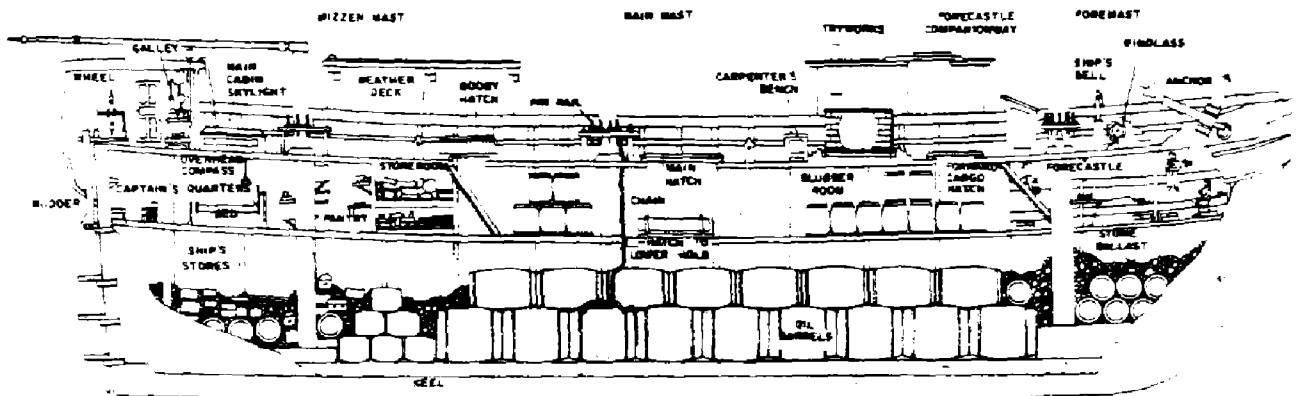
2) If a boatsteerer's "lay" was  $\frac{1}{50}$  of \$25,200, his share would be \_\_\_\_\_

3) If a cook's "lay" was  $\frac{1}{120}$  of \$25,200, his share would be \_\_\_\_\_

4) If a cabin boy's "lay" was  $\frac{1}{250}$  of \$25,200, his share would be \_\_\_\_\_

# New Bedford Whaleship

Whaleships were loaded with provisions and equipment for a long trip at sea. The average whaleship carried in its hold 40 barrels of flour, 60 barrels of salted beef, 200 bushels of potatoes, and hundreds of barrels of fresh water among other food items. The equipment included harpoons, lances, two complete sets of sails, spare rigging, tools and thousands of rivets, and nails for repair work. As the provisions were used, the space created was used to store whale oil.



M O V E R H E A D C O M P A S S E S  
 T H G I L Y K S N I B A C N I A M E  
 H C T A P E A J A C K E T W R O F R  
 R N R B L U B B E R R O O M C I D O  
 S E T U P E N I A M I E Y J N M T T  
 T B F I D G E Y E L L A G K I R S S  
 O S L H L D N H B L W K T Z Y N A Y  
 R R H I Y I E A W N E S Z W R P L A  
 E E A M A D R R O G A E O P T A L T  
 R T T H L R E I Q M N R K K N N A S  
 O N C O E L N R N M K I C H A T B E  
 O E H L A A O I A S L E R A P S E R  
 M P S H P H A S P L D M B E L T N O  
 B R W M C M T R E L T S A C E R O F  
 P A O N H S O B B O W S P R I T T L  
 Q C A P T A I N S Q U A R T E R S Y

|                |                     |
|----------------|---------------------|
| ANCHOR         | (LOWER) HOLD        |
| BED            | KEEL                |
| (SHIP'S) BELL  | MAIN (HATCH)        |
| BLUBBER ROOM   | MAIN CABIN SKYLIGHT |
| BOWSPRIT       | MAIN MAST           |
| CAPTAIN'S      | MIZZEN MAST         |
| QUARTERS       | OIL BARRELS         |
| CARPENTER'S    | OVERHEAD COMPASS    |
| BENCH          | PANTRY              |
| CHAIN          | PIN RAIL            |
| (FORECASTLE)   | RUDDER              |
| COMPANIONWAY   | STEERING WHEEL      |
| (WEATHER) DECK | STONE BALLAST       |
| FORECASTLE     | STOREROOM           |
| FORESTAYS      | (SHIP'S) STORES     |
| GALLEY         | TRYWORKS            |
| HATCH          | WHALER              |

1) \_\_\_\_\_

4) \_\_\_\_\_

2) \_\_\_\_\_

5) \_\_\_\_\_

3) \_\_\_\_\_

Find five additional words which describe a sailor's clothing and his belongings and write them in the space provided.

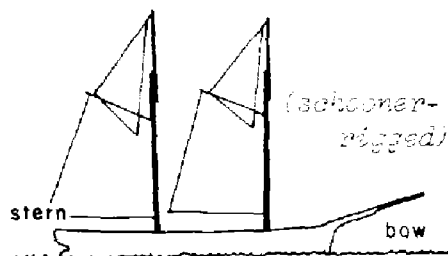


# Sailing Ships

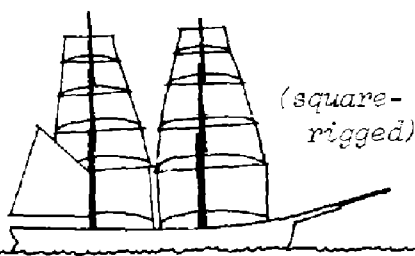
All of the major discoveries and early trading were made in sailing ships. There are generally two types of sails. (1) The *schooner-rigged* or fore-and-aft sails are set along the forward (bow) and back (stern) direction of the ship. (2) *Square-rigged* ships are called square not because of their sail shape but because they are set square or perpendicular to the fore-and-aft direction of the vessel.

Many ships have combinations of both types of sails.

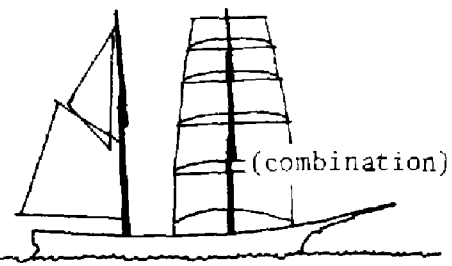
schooner



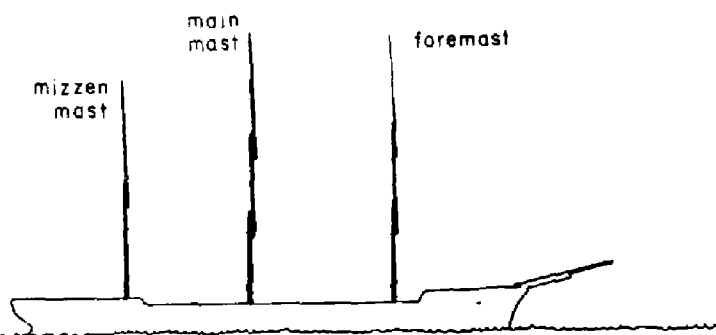
brig



brigantine



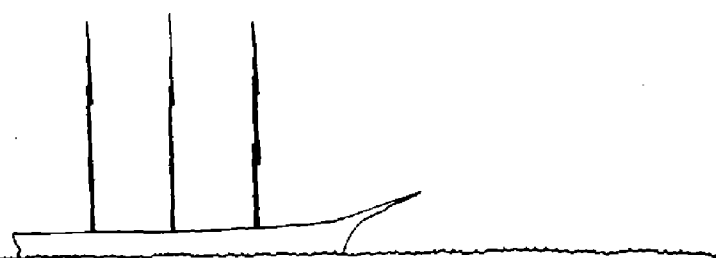
DIRECTIONS: Below are three different types of sailing ships. Draw in the proper sails after reading the ships' descriptions and looking at the drawings above.



## SHIPS DESCRIPTION

### 3-masted bark - Essex (whaler)

Most of the whalers were barks where the foremast and main mast are *square-rigged* and the mizzen mast is *schooner-rigged*.



### 3-masted barkentine - Irmgard

Barkentines have 3 to 6 masts, all of which are *schooner-rigged* except the foremast which is *square-rigged*.

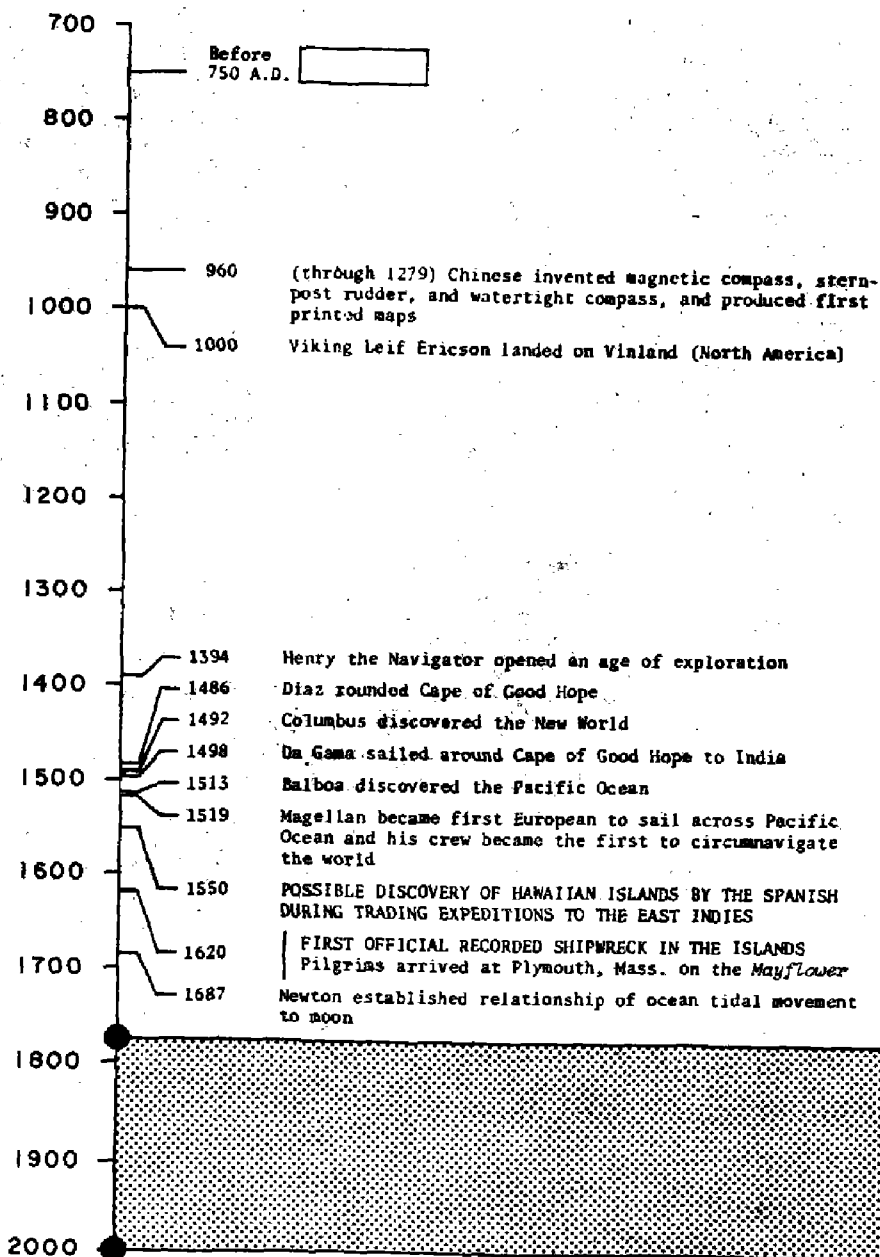


### 4-masted ship - Falls of Clyde

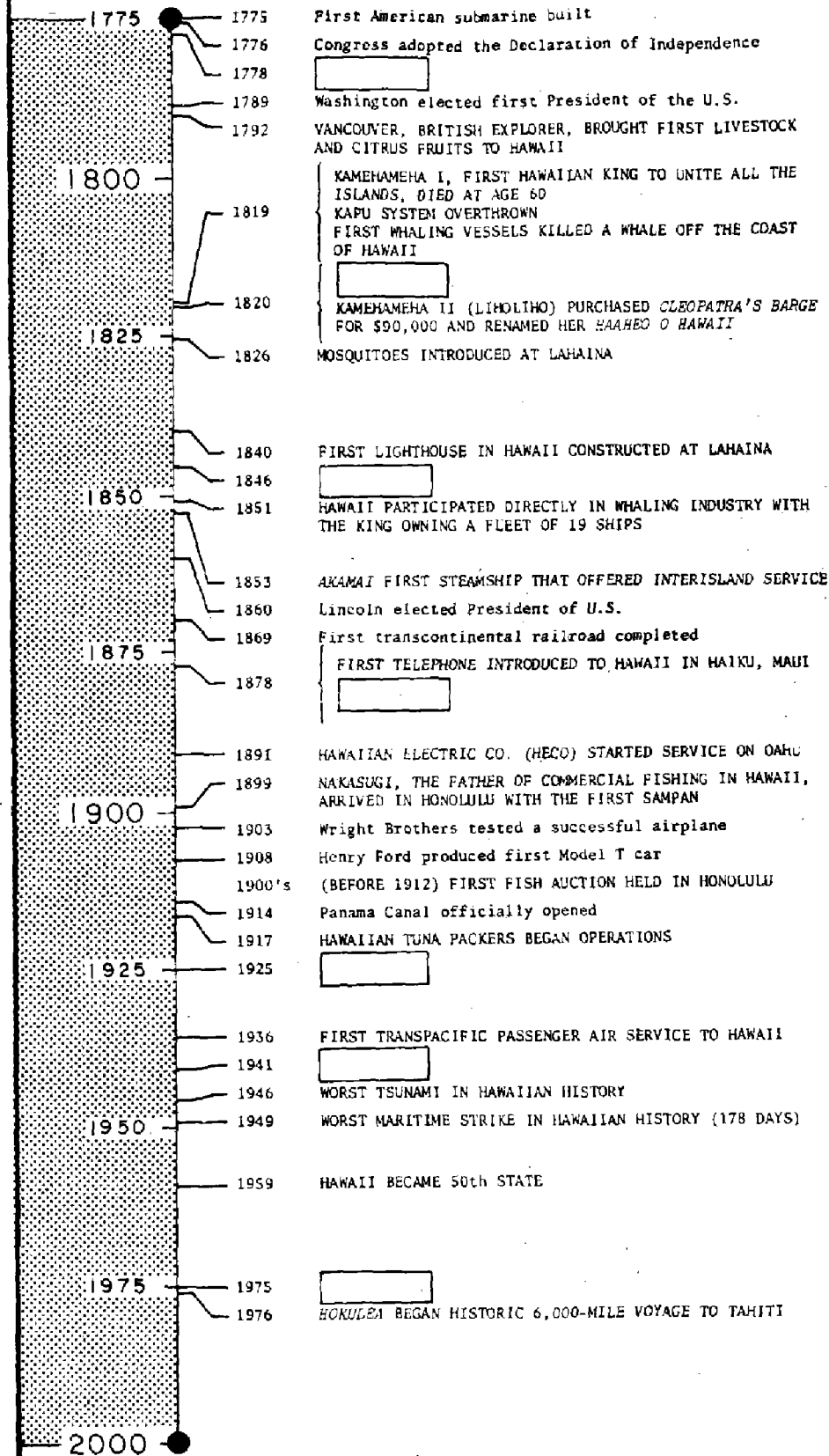
A ship or fully rigged ship has 3 to 5 masts, all of which are *square-rigged*.

# Maritime History of Hawaii

This is a short maritime history of Hawaii and the world. On page 11 the timeline is enlarged so details of events that happened between 1775 to the present can be shown.



# and the World



## DIRECTIONS

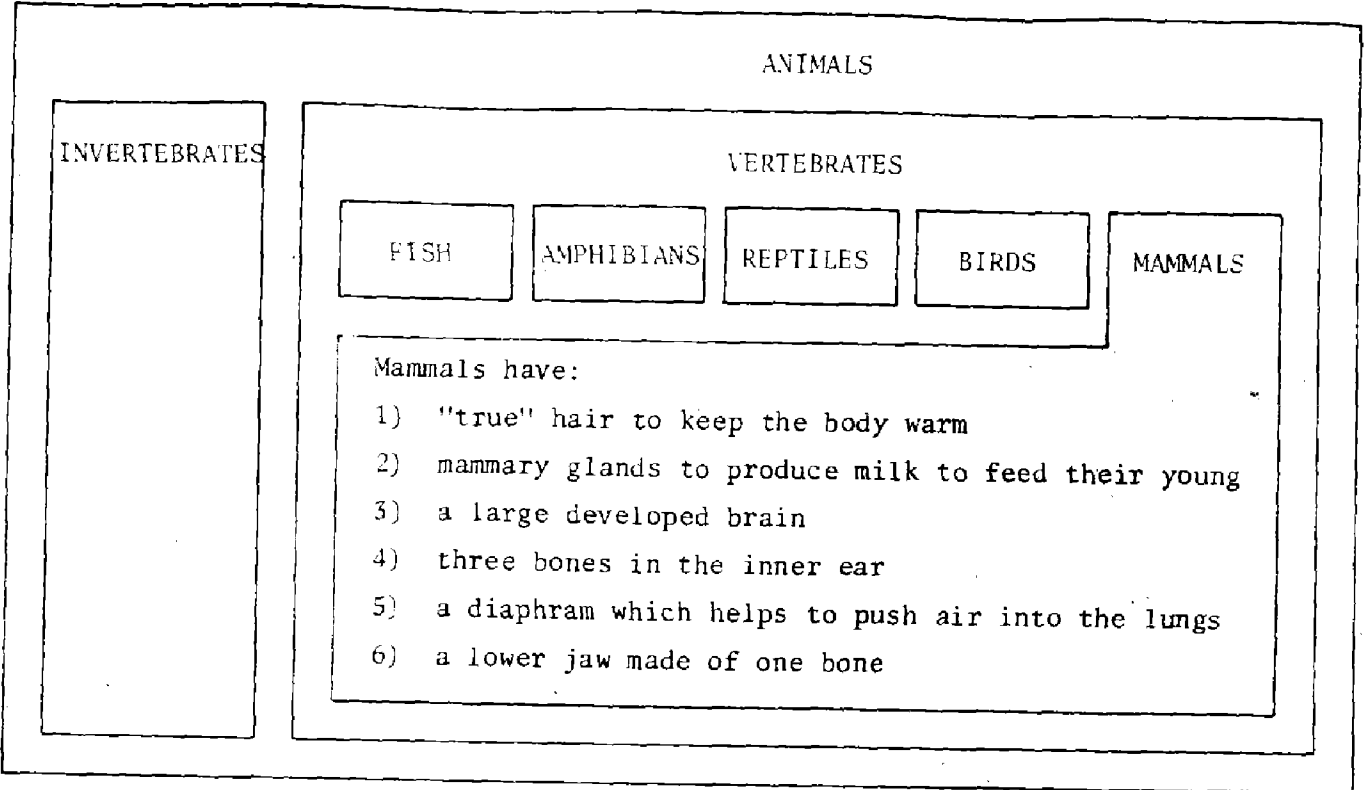
Place the missing events in the timeline where there are blocks . Use the letters in the list below.

## LIST OF EVENTS

- A. ALOHA TOWER BUILT
- B. COOK DISCOVERED THE HAWAIIAN ISLANDS
- C. INTERISLAND HYDROFOIL SERVICE BEGAN
- D. PEAK YEAR FOR HAWAII WHALING INDUSTRY WITH ARRIVAL OF 596 WHALERS IN HAWAIIAN PORTS
- E. PEARL HARBOR ATTACKED. ARIZONA EXPLODED AND SANK
- F. ARRIVAL OF FIRST MISSIONARIES
- G. EARLY POLYNESIANS SETTLED IN HAWAII
- H. FALLS OF CLYDE BUILT

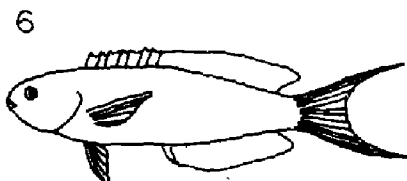
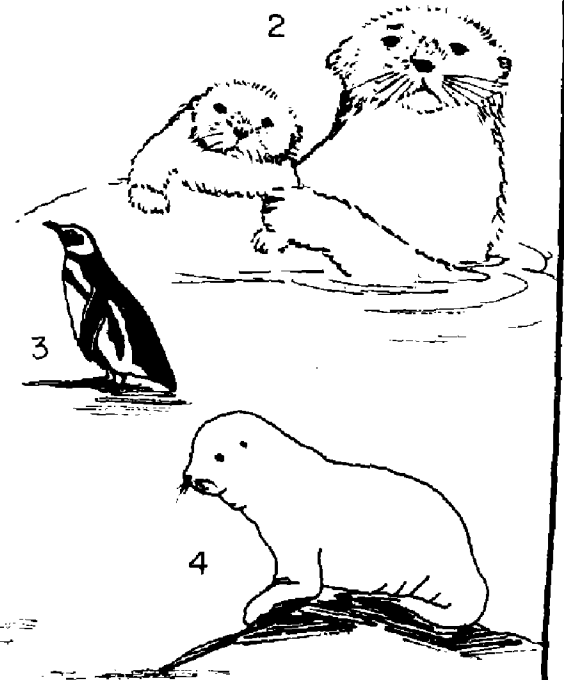
# Mammals

Animals are either INVERTEBRATES, animals without a backbone, or VERTEBRATES, animals with backbones. Mammals are VERTEBRATES. Other vertebrates are fish, amphibians, reptiles, and birds. There are 20 ORDERS, or groups, of mammals, only four of which are marine mammals.  
 How are mammals different from the other vertebrates?



DIRECTIONS

Draw a circle around all the mammals.

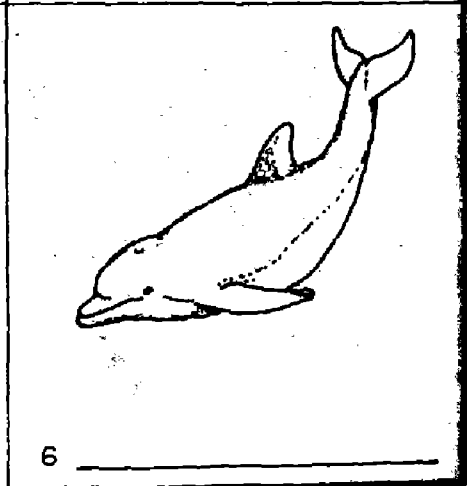
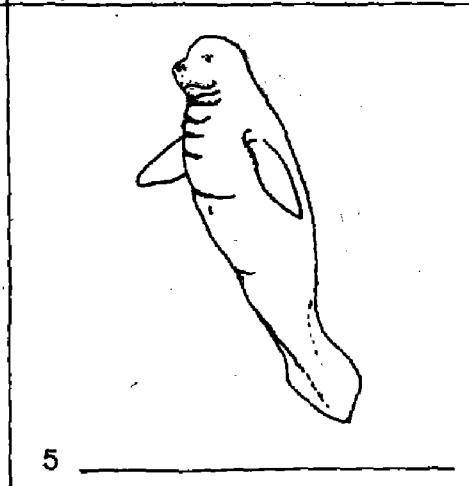
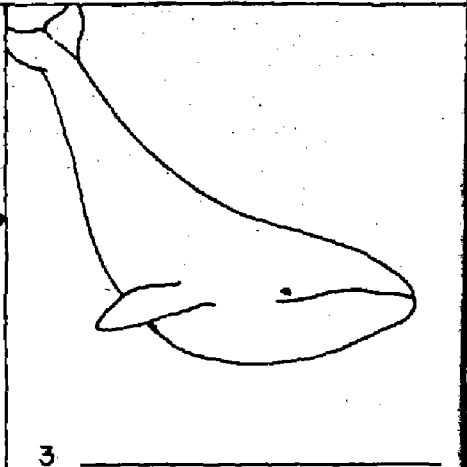
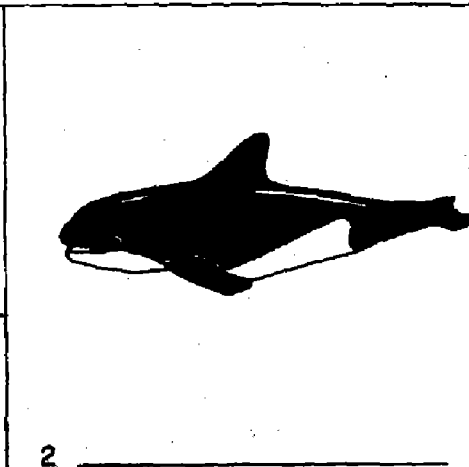
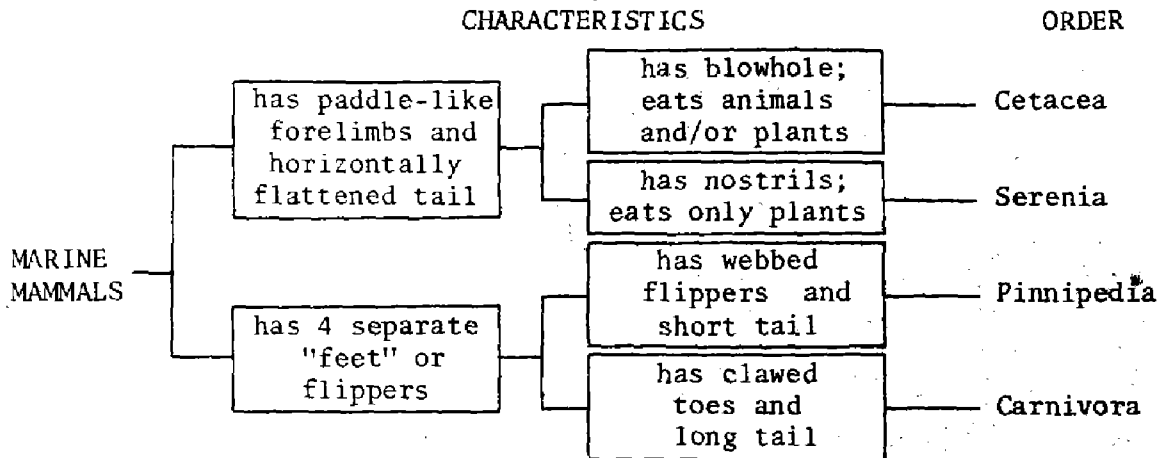


# Marine Mammals

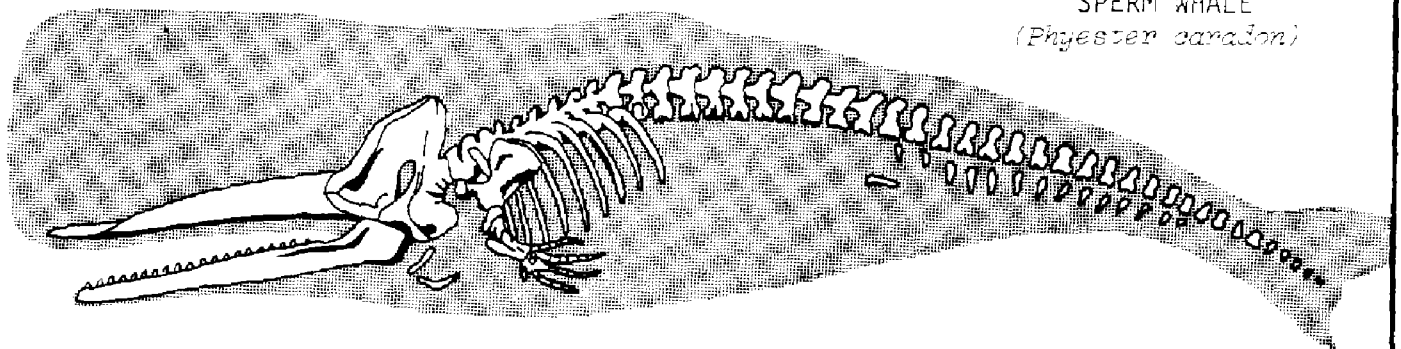
Mammals are divided into 20 different ORDERS, or groups, according to how they are alike. For example, human beings and apes belong to the PRIMATE ORDER and horses and zebras are placed in the PERISSODACTYLA ORDER.

Marine mammals are classified into four ORDERS: a) CETACEA, b) SIRENIA, c) PINNIPEDIA, and d) CARNIVORA.

DIRECTIONS: Look carefully at the drawing of the marine mammals below. Using the following chart place each into the correct ORDER and write the name of the ORDER in the blank below each animal.



# Toothed Whales



SPERM WHALE  
(*Physeter catodon*)

Most of the cetaceans are toothed whales which range in size from the 1-meter dolphins and porpoises to the 18-m sperm whales, *Physeter catodon*.

Toothed whales have 2 to over 200 teeth in either or both jaws. How big the cetacean is does not determine how many teeth it has. The 11-m bottle-nose whale, *Hyperoodon ampullatus*, has only 2 teeth while the 1.5-m La Plata river dolphin, *Steno delphis blainvillii*, has 210 to 240 teeth in two rows.

The number of teeth whales have usually determines what they eat. Cetaceans which have many teeth, such as porpoises, are able to catch slippery, active fish, while cetaceans which have just a few teeth are able to catch and hold only squid and less active fish. The sperm whale, which feeds on deepsea squid, has 18 to 24 teeth on each side of the lower jaw.

Toothed whales feed mainly on squid and fish. Killer whales, *Orcinus orca*, however, eat sea otters, seals, birds, and other whales (some of which are bigger than the killer whale itself), in addition to squid and fish.



KILLER WHALE  
(*Orcinus orca*)

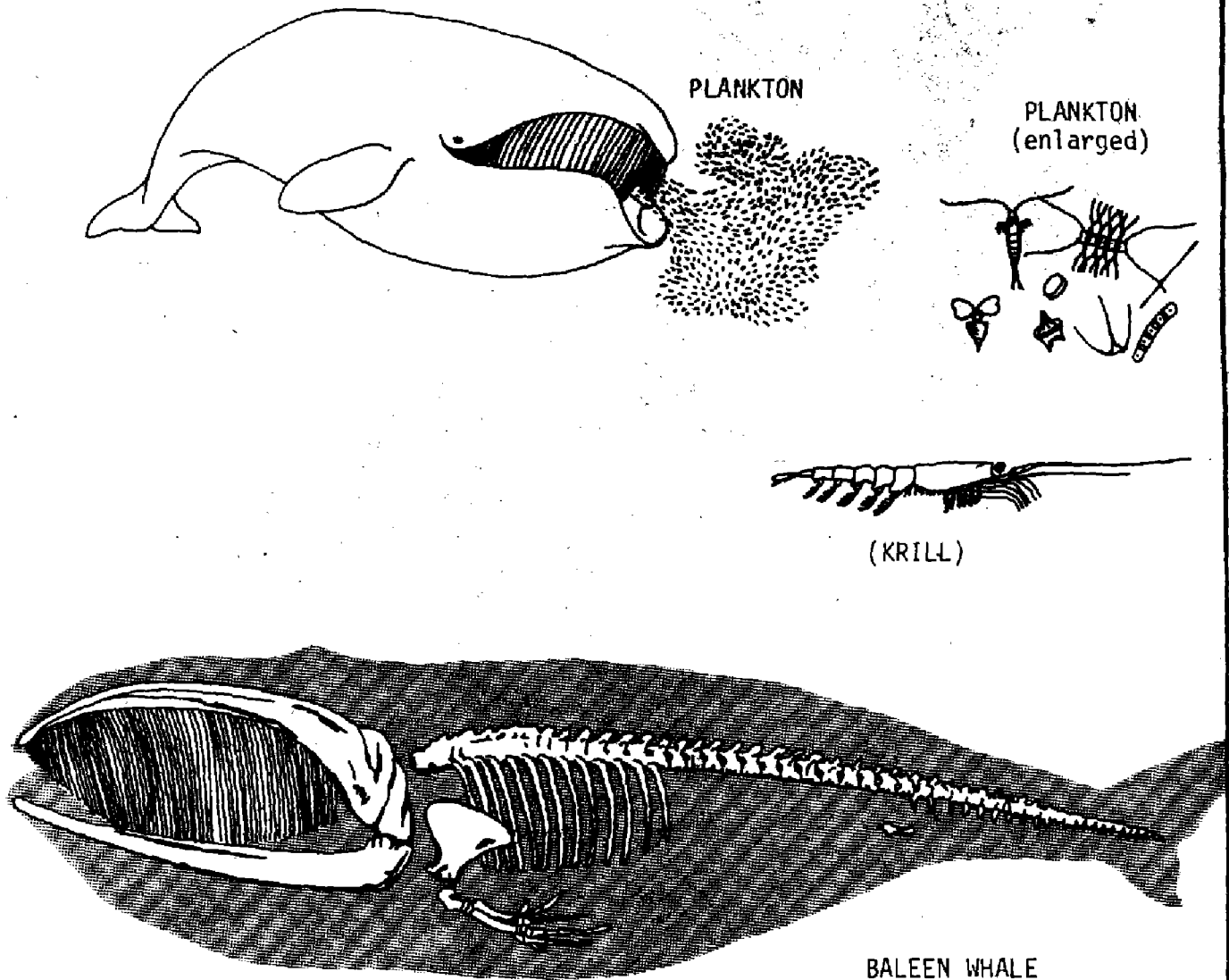
## "Toothless" Whales

Unlike most whales which have different numbers and kinds of teeth, baleen whales have no teeth. They are "toothless."

Baleen whales, therefore, do not eat fish, squid, or other seafood which require chewing. Instead, they feed on plankton, tiny marine plants and animals, which can be swallowed whole.

The baleen whale uses the hundreds of baleen plates hanging from the roof of its mouth to eat. Each baleen plate is frayed on the inside edge. When all of the plates are placed next to each other, they form a tangled mass which is used to capture food. Thus, when feeding, the baleen whale opens its mouth to take in seawater and plankton. It then closes its mouth, using the tongue to push the seawater through the baleen plates, leaving the filtered plankton to be swallowed.

The blue whale, *Balaenoptera musculus* (30 m), which is the largest mammal, and the humpback whale are examples of baleen whales.





BLUE WHALE

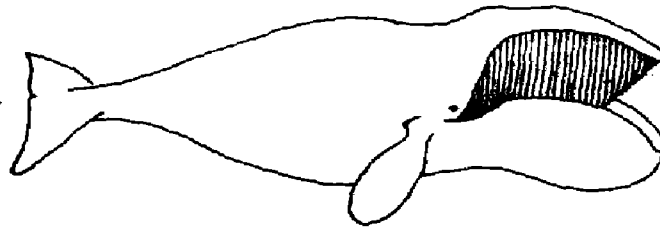
1) How many would fit in a bathtub?



FINBACK WHALE

2) How many would fit in a 11,000-gallon oil tank?

BOWHEAD or GREENLAND WHALE



HUMPBACK WHALE



3) How many would fit in a 100-ton ship's hold?

GRAY WHALE



LITTLE PIKED WHALE



PYGMY RIGHT WHALE



## BALEEN WHALES

4) If an 11,000-gallon oil tank is 5-m long, how many would fit in it?

GREAT WHITE SHARK



WHALE SHARK (Largest Fish)



PACIFIC BLUE MARLIN



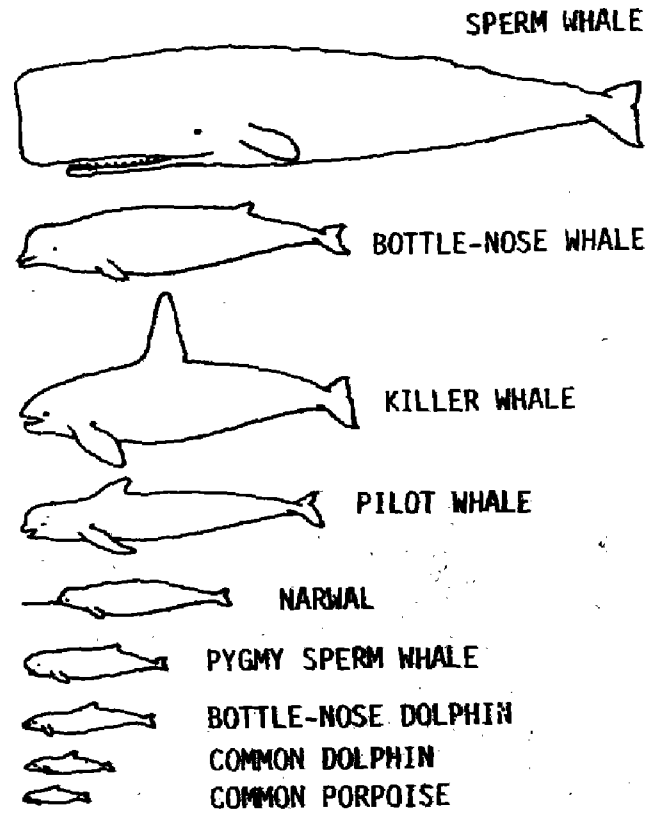


# d Problems

children, all weighing 30 kg each,  
 gh as much as a 750-kg elephant?

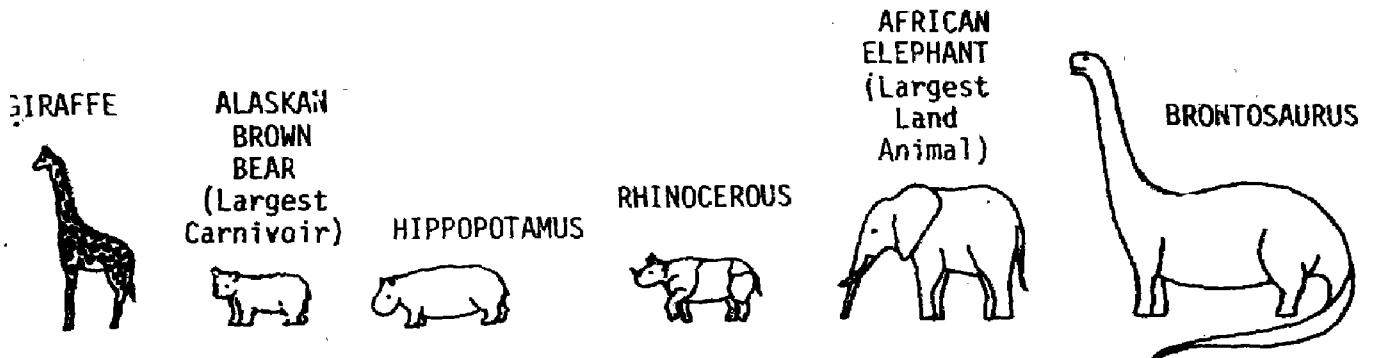
750-kg elephants would weigh as much as  
 -kg blue whale? (Round off to the near-  
 elephant.)

children, all weighing 30 kg each,  
 gh as much as an 11,310-kg blue whale?



## TOOTHED WHALES

elephant, the largest land mammal, is  
 , how many elephants would equal the  
 f a 30-m blue whale?



# Where Have All the Whales Gone?

The hunting of whales goes as far back as the 9th century. The invention of the harpoon with an explosive head in 1868 by a Norwegian named Svend Foyn and other modern techniques made the killing of whales more efficient. For this reason, many more whales have been killed during the 20th century than during the romantic period of Yankee whaling or any other time. The whalers realized, as they saw fewer and fewer whales, that there would be no whales left to hunt if they continued to hunt them at ever-increasing rates. This led to international agreements to accept controls on whaling for conservation purposes.

Webster defines conserve as, "to keep in a safe or sound condition; save." Why is it important to conserve the whales? Among the many reasons are the following:

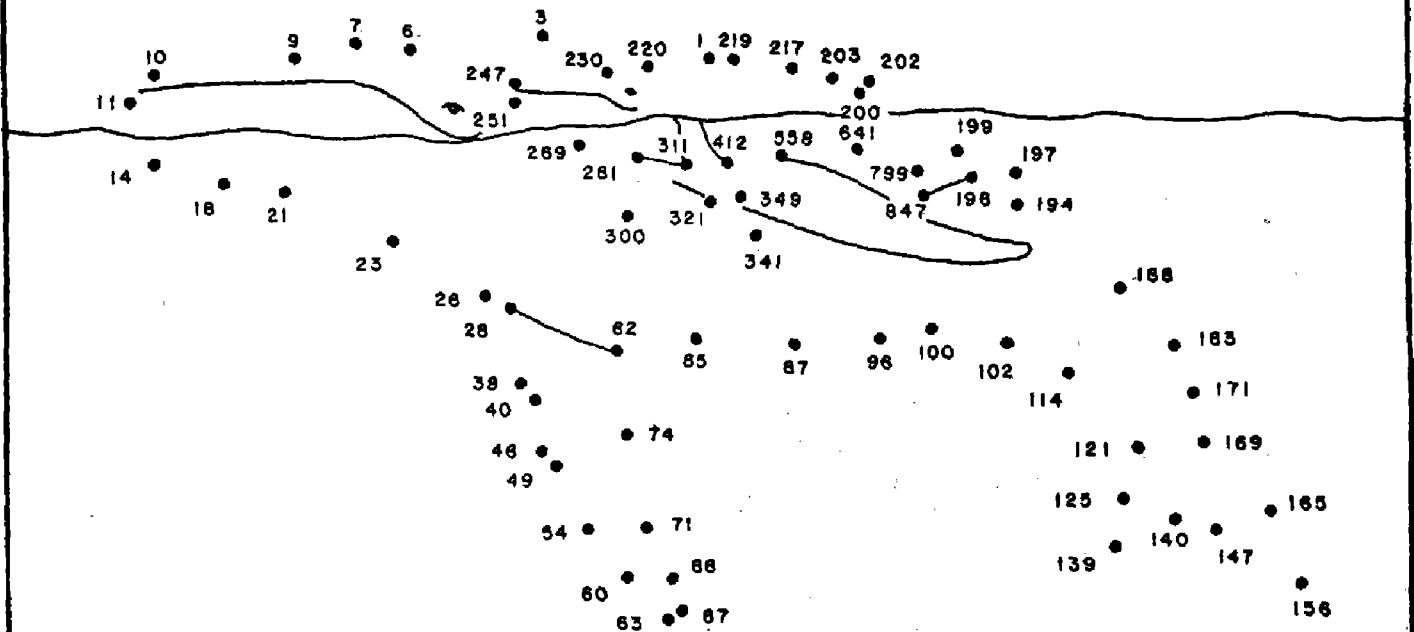
1. Aesthetics  
All life forms are unique and should be preserved for everyone to see and enjoy.
2. Science  
Whales need to be studied so that the industry will know how many whales can be taken without reducing the population. The whale's intelligence and communication abilities are of great interest to scientists.
3. Commerce  
Whales have been a source of food, oil, and other uses for many centuries.
4. Balance of Life  
Nature has designed a place for all species of animals. When an animal becomes extinct or too plentiful, the balance of life changes and may cause problems. For example, if there are no whales to eat the krill, squid, and fish that they normally feed on, there may be an overpopulation of these animals. Will there be enough food for these animals themselves to survive? Will they turn to foods normally eaten by other animals to keep themselves alive? How will all this affect the animals that survive?

There have been many efforts to conserve the whale population. The International Whaling Commission attempts to regulate the commercial whaling of its member nations. The United States has passed two laws to protect whales and other marine mammals. Penalties for breaking these laws are fines of up to \$20,000 and one year in prison.

Meanwhile there are pressures on whaling countries, especially Japan and Russia, to end their whaling activities. The Japanese claim they need to hunt whales not only for the oil but more importantly as a source of protein for their people. They argue that it will be difficult and costly for them to purchase the same amount of beef or pork. Russia and other nations also rely on the whale for food and oil. Whaling is also a means of livelihood for thousands of people, including some Eskimos. How do we solve this international problem? Do we ban whaling altogether or is it possible to hunt whales without killing all of them?

# Humpback Whale Preserve

In 1976, the humpback whale was adopted by the Hawaii State Legislature as the official marine mammal of our state. Not long ago, waters between Maui, Lanai, Molokai, and Kahoolawe were declared the first whale preserve in the US. The proclamation states that the months from December to May will be whale reserve months in the county of Maui to protect the endangered humpback whales. These whales migrate to Hawaii from the North Pacific each winter to breed. During the winter months the babies are born. It is really important not to bother the whales because this is when they teach the calves to breathe on the surface and hold their breath underwater.



DIRECTIONS: Connect the dots and find the meaning of the words below.

WORD LIST:

adopted

preserve

proclamation

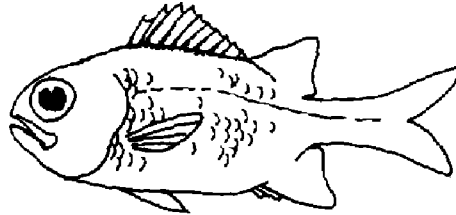
endangered

# Vertebrates and Invertebrates

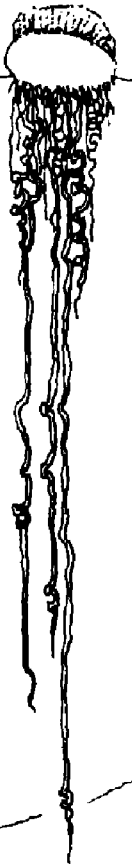
Most animals can be divided into two broad groups--the vertebrates and the invertebrates. VERTEBRATES are animals with *backbones*. Most vertebrates, like the eels and fish, have a spinal column. More primitive vertebrates like the shark have *notochords* to support their bodies. INVERTEBRATES are animals without a backbone or skeleton inside their bodies. Some invertebrates, like crabs and shells, wear their skeleton on the outside of their bodies in the form of hard outer coverings. Other invertebrates like jellyfish, nudibranchs, and sea cucumbers have no outer coverings.

DIRECTIONS: Place a check mark in the square of all the INVERTEBRATES below (1-8).

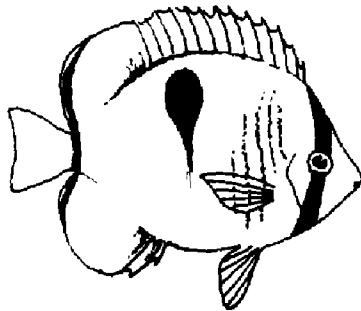
Squirrelfish



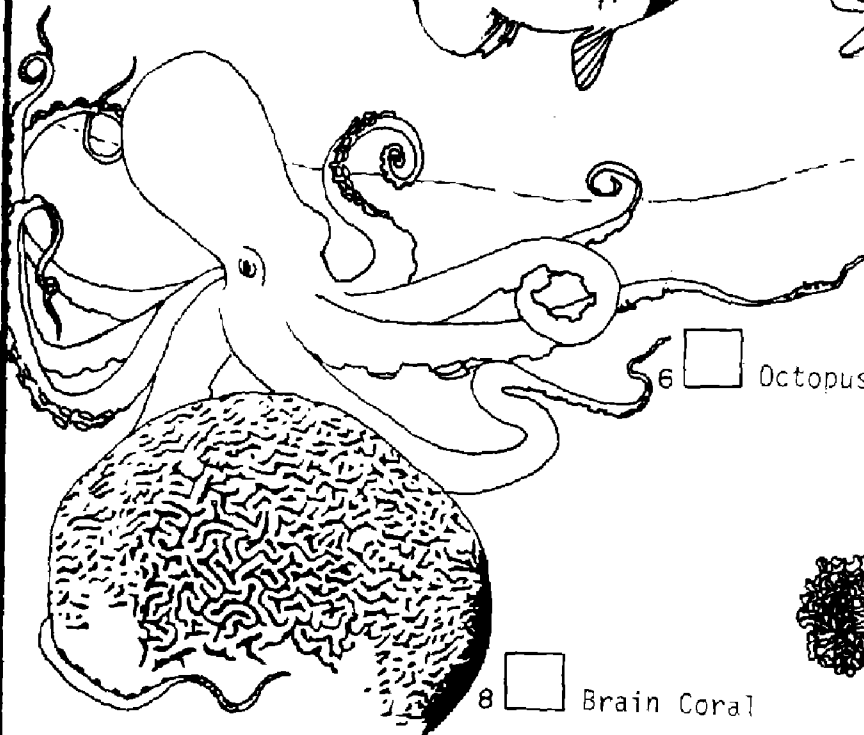
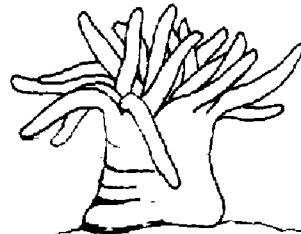
2 Portuguese Man-of-War



3 One-spot Butterflyfish

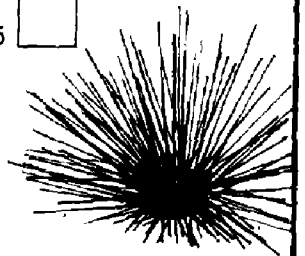


4 Sea Anemone

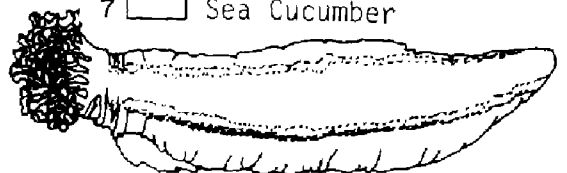


6 Octopus

5 Sea Urchin



7 Sea Cucumber



8 Brain Coral

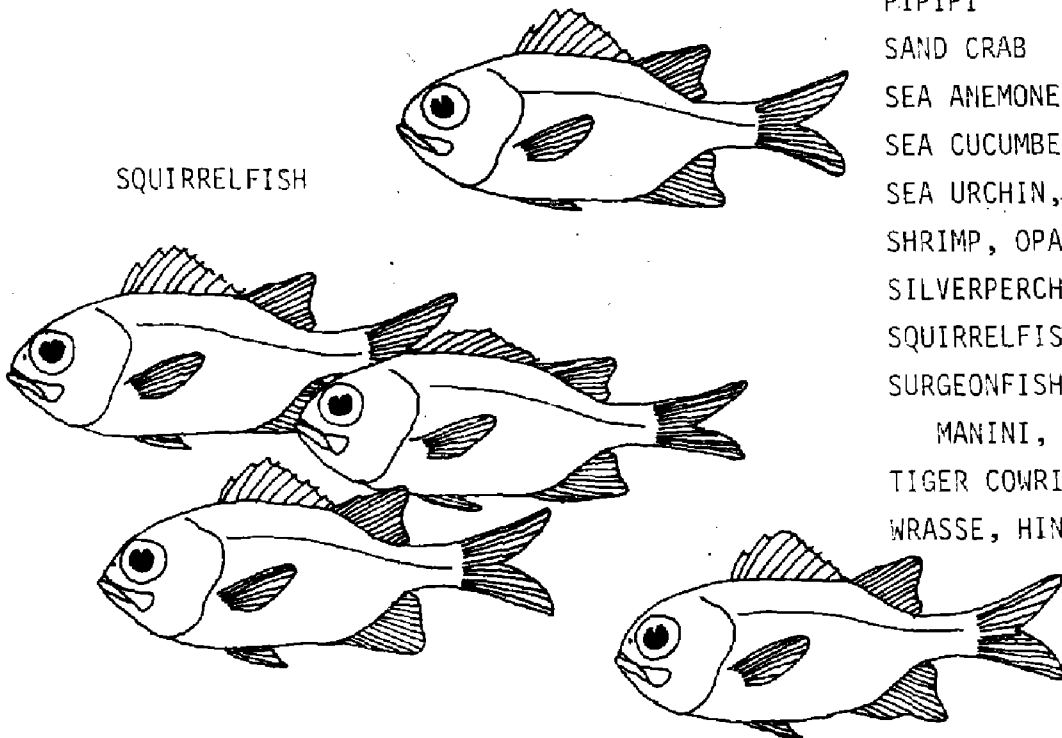


# Wordsearch

ROCKSKIPPERPMLISQUINBDO  
 ULBANDANAPRAWNPRET SBOLI  
 TIGERCOWRIENYZUQH LTSEAL  
 HZJOKDPGMUHSIFNOEGRUSES  
 VACUBNIAORPBDGDHRSFPQEE  
 CRADOYHNSUPOTCOPMVRAPNA  
 WDHAKNIAANCHOVYAITGPF OU  
 BFSMANBWJLEEDHSOTQFARMR  
 XIISTELLUMFEIATECFILTEC  
 GSFEOLKXLOLIMPETRLIUDNH  
 NHL LZBAMAAMASURNAIMSCAI  
 AYEFEYLAELANI HUPBPGJHAN  
 TBRISEACUCUMBERSOIWEKEO  
 TNRSSLINQPALANIHPSEMSL  
 CZIHACHLDNEIPOCTMIAHUYI  
 IRUMRAIJOININAMRTPBEZBV  
 VGQFWNKELOHELOHAOUOJAWX  
 NHSIFRATSELT TIRBOKKRVUK  
 OALBLACKROCKCRABARCDNAS  
 CSHQIBMHCREPREVLISNLJWA

ANCHOVY, NEHU  
 BANDANA PRAWN, OPAE KAI  
 BARNACLE  
 BLACK ROCK CRAB, A'AMA  
 BLENNY, ROCK SKIPPER  
 BRITTLE STARFISH  
 CARDINALFISH, UPAPALU  
 CRAB  
 DAMSEL FISH--KUPIPI,  
 MANO, MAOMAO  
 EEL, PUHI  
 GOBY, O'OPU  
 GOATFISH, OAMA--WEKE  
 HERMIT CRAB  
 LIMPET, OPIHI  
 LIZARDFISH, U'LAE  
 LOBSTER, ULA  
 MULLET, AMAAMA  
 OCTOPUS, HE'E, TAKO  
 OYSTER  
 PIIPII  
 SAND CRAB  
 SEA ANEMONE  
 SEA CUCUMBER, LOLI  
 SEA URCHIN, WANA  
 SHRIMP, OPAE  
 SILVERPERCH, AHOLEHOLE  
 SQUIRRELFISH, ALAHI  
 SURGEONFISH--PALANI,  
 MANINI, CONVICT TANG  
 TIGER COWRIE, LEHO  
 WRASSE, HINALEA




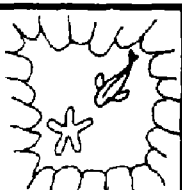

SQUIRRELFISH



# Seashore Safety

- DIRECTIONS:
- 1) Players: 2
  - 2) Markers: find 1 for each player
  - 3) Moves: 1 space = Jan (paper)  
2 spaces = Ken (stone)  
3 spaces = Po (scissors)
  - 4) To begin: Jan, Ken, Po (winner goes first)

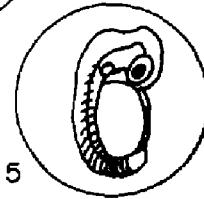
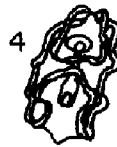
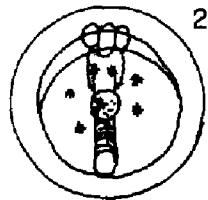
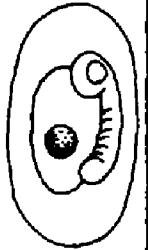
Take a friend along just in case  
START

|        |  |  |  |  |  |
|--------|--|--|--|--|--|
| 1      | DANGER 2<br>BIG WAVES<br><i>Start again</i>  | 3  | SHARP 4<br>CORAL AHEAD<br><i>Go to box 10</i>  | Wear tabis 5<br>or slippers<br><i>Advance one space</i>                              | 6  |
|        |    |  |  |  | 7  |
|        | 12   | SLIPPERY 11<br>ROCKS<br><i>Go back to box 3</i>                                    | 10   | 9  | DANGER 8<br>PORTUGUESE MAN-OF-WAR<br><i>Go to box 10</i> |
|        | DANGER 13<br>WANA<br><i>Go back one space</i>  | 14   | Keep an eye 14<br>on the waves<br><i>Advance one space</i>                           | 15   | DANGER 16<br>PUHI<br><i>Go back one space</i>            |
|        |  |  |  | DANGER 17<br>HOLES<br><i>Advance one space</i>                                       | 18   |
|        | 24   | 23   | High tide 22<br>coming in.<br>Hurry along.<br><i>Advance one space</i>               | 21   | 20   |
| FINISH |  |  |  |  | DANGER 19<br>CONE SHELLS<br><i>Go back one space</i>     |



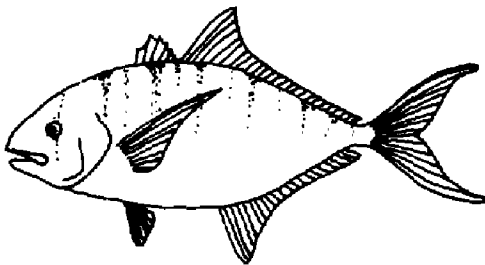
# Reef Community

DIRECTIONS: Draw a line from each of the plankton (1-6) to what they will grow up to be.

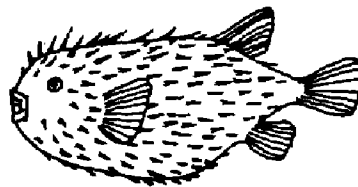


PLANKTON, or drifters, have little or no control of where the winds and currents take them. A few of the animals like the jellyfish or Portuguese man-of-war are large, but most plankton are too small to be seen without a microscope. Some of these animals spend their whole life drifting while others are the young of benthic and nektonic animals that after a while fall into deeper water or settle on the ocean floor.

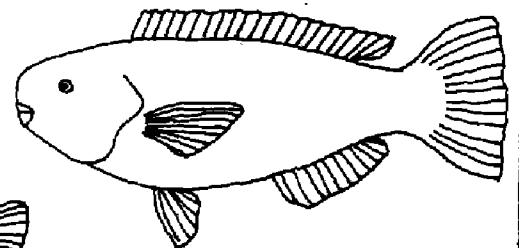
NEKTONIC animals are the swimmers of the sea. They are the animals that can move through the water on their own power. Fish and squid are examples of nektonic animals.



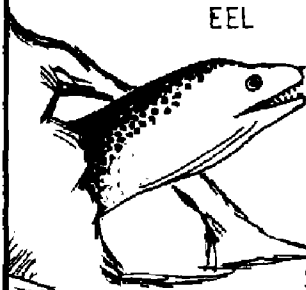
ULUA



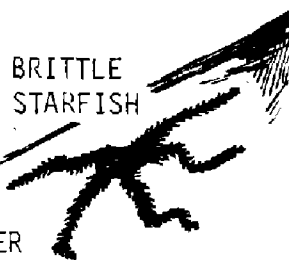
SPINY PUFFER or BALLOON FISH



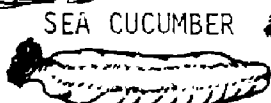
PARROTFISH or UHU



EEL



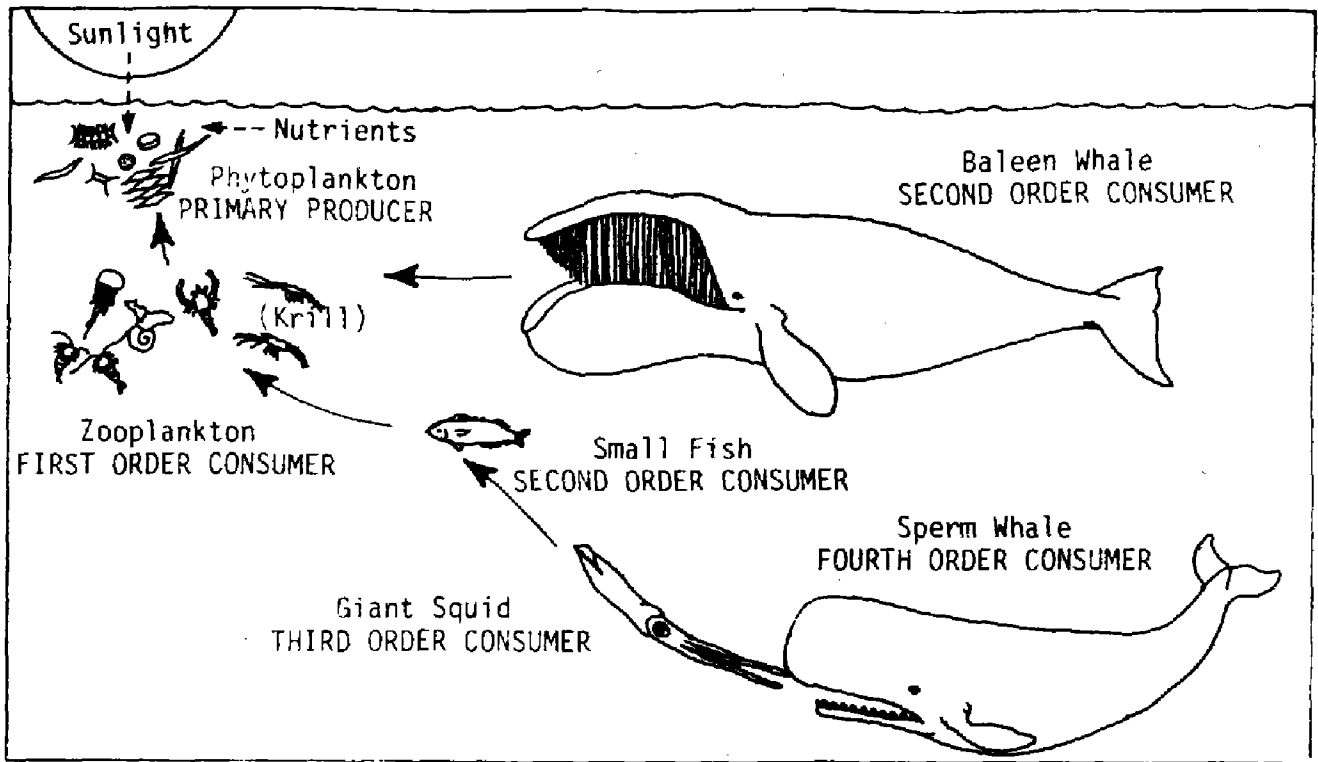
BRITTLE STARFISH



SEA CUCUMBER

Animals and plants that live on the bottom of the ocean are called BENTHIC dwellers. Some of these animals and plants begin life as plankton or drifters then settle to the bottom where they spend the rest of their lives. Corals and limu find a place that's right for them and permanently attach themselves to the bottom. Other animals that crawl, creep, or even swim close to the bottom are also part of the benthic community.

# Food Web



DIRECTIONS: Using the diagram of the FOOD WEB, complete the following sentences by filling in the blanks.

The two food chains start with (1) \_\_\_\_\_  
 or tiny plants. The phytoplankton are called (2) \_\_\_\_\_  
 \_\_\_\_\_. It is the first link in most food chains. All  
 phytoplankton need to grow are (3) \_\_\_\_\_ and  
 (4) \_\_\_\_\_.

(5) \_\_\_\_\_ eat phytoplankton. Zooplankton are  
 (6) \_\_\_\_\_. The  
 (7) \_\_\_\_\_ and (8) \_\_\_\_\_  
 are SECOND ORDER CONSUMERS. Squid are (9) \_\_\_\_\_ ORDER CONSUMERS. If  
 a sperm whale eats the squid, it becomes a (10) \_\_\_\_\_ ORDER  
 CONSUMER. What order consumer would you be if you ate the squid?  
 (11) \_\_\_\_\_ ORDER CONSUMER.

These animals are not the only animals in the ocean. When you include  
 all the animals and what they eat, this is called a FOOD WEB.



# Body Shapes

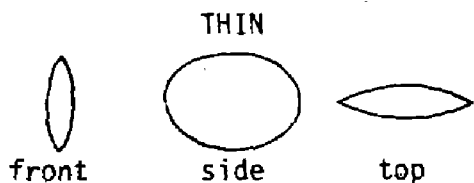
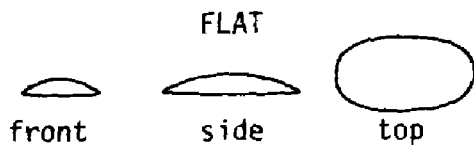
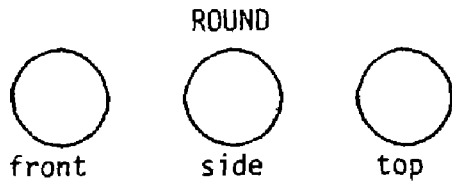
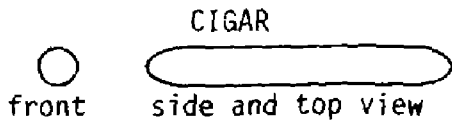
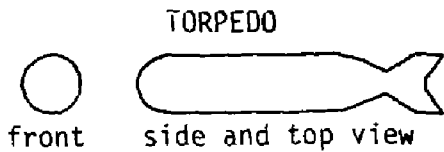
Just as man's body is adapted to walking and a tiger is adapted to running, a fish's body is adapted to moving about in water. How a fish moves about depends on the shape of its body.

Fishes come in many shapes.

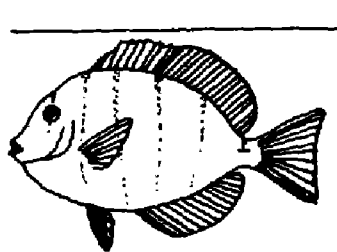
Most TORPEDO shaped fish are strong and fast swimmers that can move quickly in open water. The CIGAR-like barracuda is shaped for quick movement.

Puffers and stonefish are nearly ROUND. These fish are not streamlined and do not have to be speedy or travel far for food.

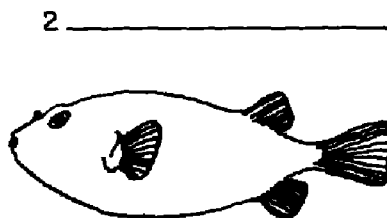
Skates and rays are examples of FLAT fish. Some fish, like the butterfly fish, are very THIN and when you look at them from the front or back there is hardly anything there.



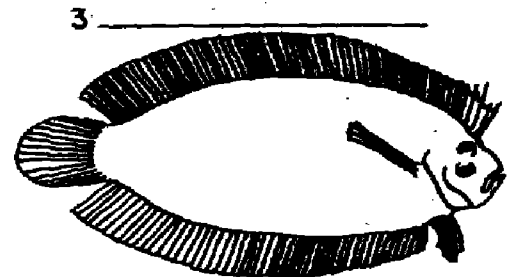
DIRECTIONS: Write in the type of shape on the line above each fish.



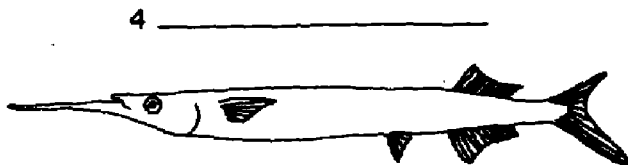
MANINI  
(*Acanthurus sandwicensis*)



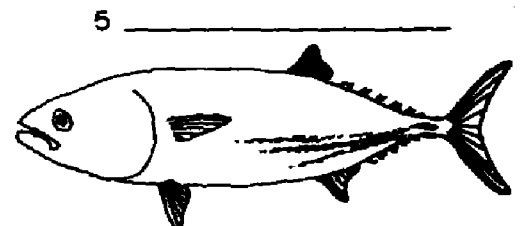
PUFFER  
(*Arothron hispidus*)



FLOUNDER (top view)  
(*Sammarsiscus corallinus*)



HALFBEAK  
(*Hyprorhamphus pacificus*)



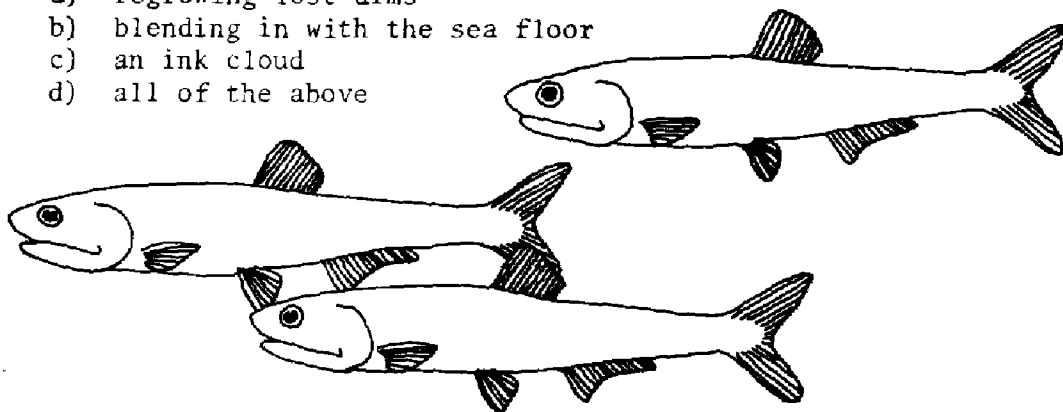
SKIPJACK or AKU  
(*Katsuwonus pelamis*)

## Methods of Protection

The coral reef is the home of many animals. There are many ways these animals protect themselves from each other and from people, too. Some of these ways of protection can be harmful to you.

**DIRECTIONS:** Circle the letter (a-d) that best completes the sentence (1-8).

- 1) A sea urchin protects itself with \_\_\_\_\_.
  - a) an ink cloud
  - b) sharp teeth
  - c) spines
  - d) all of the above
- 2) A starfish can \_\_\_\_\_.
  - a) swim away
  - b) regrow lost arms
  - c) cover itself with limu
  - d) none of the above
- 3) Squids shoot out \_\_\_\_\_ to make a get away.
  - a) spines
  - b) an ink cloud
  - c) bullets
  - d) all of the above
- 4) Nehu or anchovies \_\_\_\_\_ for protection.
  - a) are silvery colored
  - b) school
  - c) reproduce in great numbers
  - d) all the above
- 5) Sea cucumbers protect themselves by \_\_\_\_\_.
  - a) hiding in the sand
  - b) ejecting parts of its intestines
  - c) blending in with the sea floor
  - d) all of the above
- 6) Portuguese man-of-wars \_\_\_\_\_.
  - a) bite
  - b) strangle
  - c) sting
  - d) none of the above.
- 7) Crabs are protected by \_\_\_\_\_.
  - a) claws
  - b) hard shells
  - c) blending in with the sea floor.
  - d) all of the above
- 8) An octopus protects itself by \_\_\_\_\_.
  - a) regrowing lost arms
  - b) blending in with the sea floor
  - c) an ink cloud
  - d) all of the above



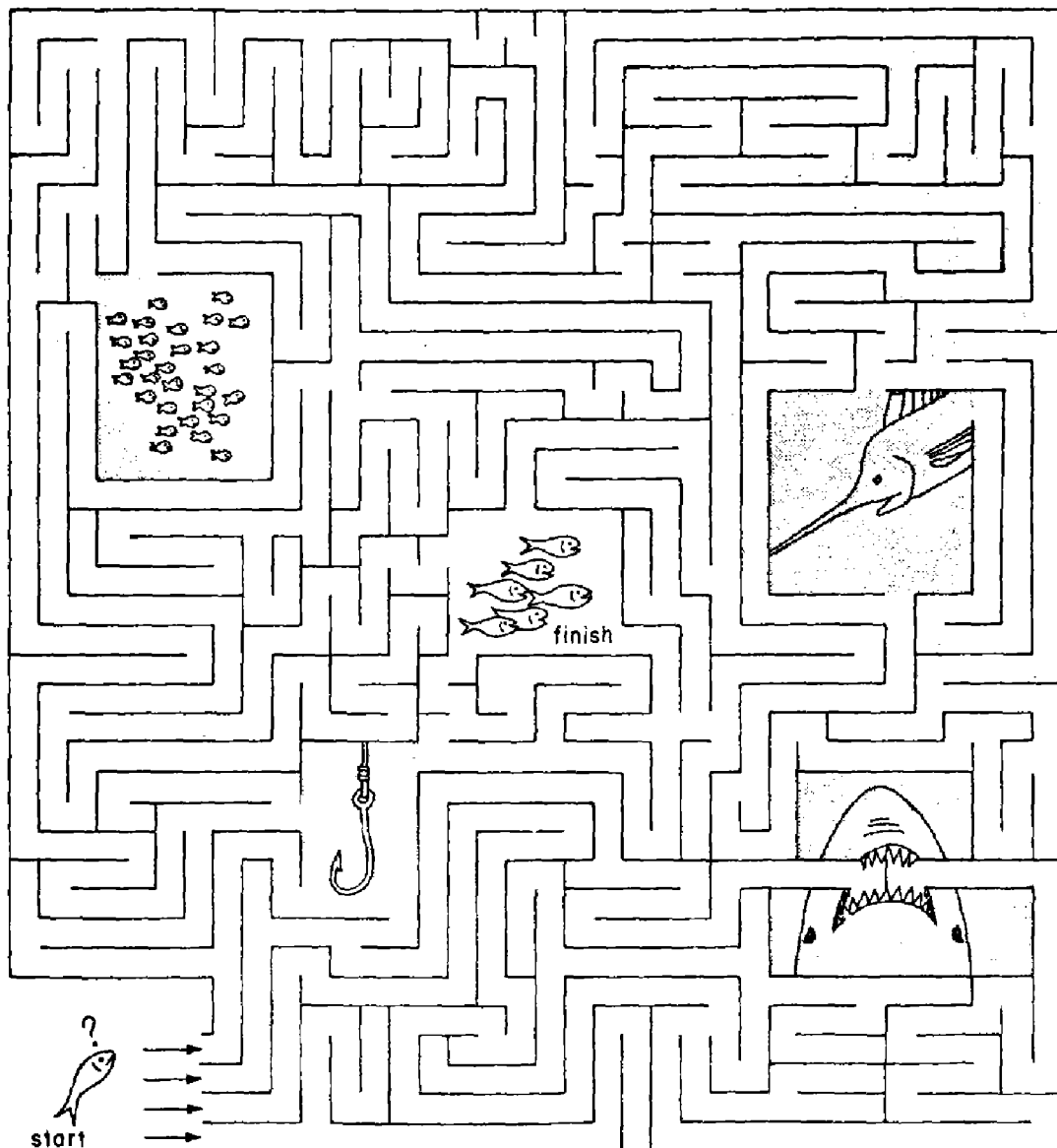
# Aku Schooling Maze

One reason certain fish like aku or skipjack tuna SCHOOL or swim together in large groups is because schooling is a means of protection. Schools are made up of fish that are the same type and size. When there are many of the same type of fish, none standing out as being extra big or little, a PREDATOR is confused as to which one to attack. There is safety in numbers.

In the deep blue waters where there is no place to hide and large, fast-moving billfish and sharks are continuously looking for a snack, a small fish swimming along would have little chance to survive. Can you help this fish find its way back to the school?

Can you name some other fish that school?

What are other names for groups of animals that stay together as a method of protection? Give examples of each.



# Formation

## DIRECTIONS

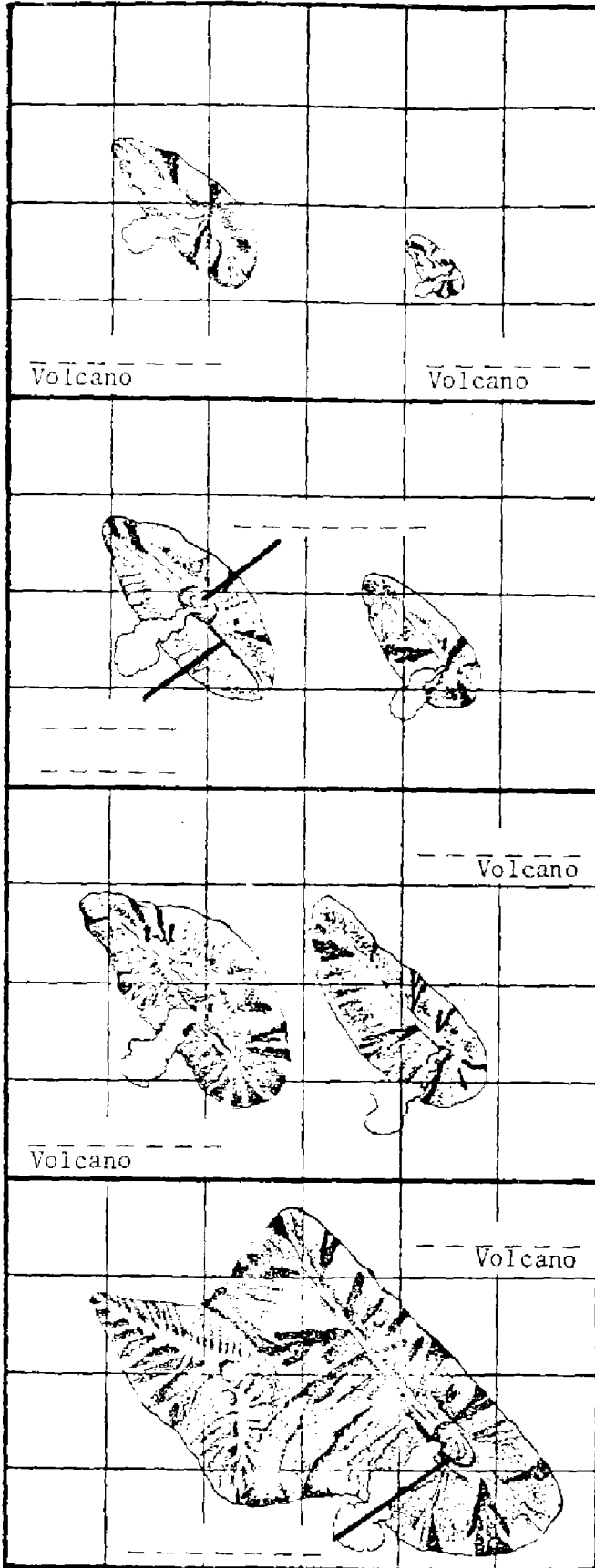
Label each diagram with the underlined words from each caption.

The first stage shows lava domes of the Waianae (left) and Koolau (right) Volcanos.

Here the top of the Waianae Volcano has collapsed to form a large caldera and a high fault cliff stops the lava from flowing down the southwest slope. The Koolau Volcano is still growing.

The caldera of the Waianae Volcano is almost full of lava and is entering the old age phase. Meanwhile the Koolau Volcano is still growing along the northwest rift.

The Koolau Volcano is now so large it has joined the Waianae Volcano to form one island. See how the Koolau Volcano has formed a caldera.



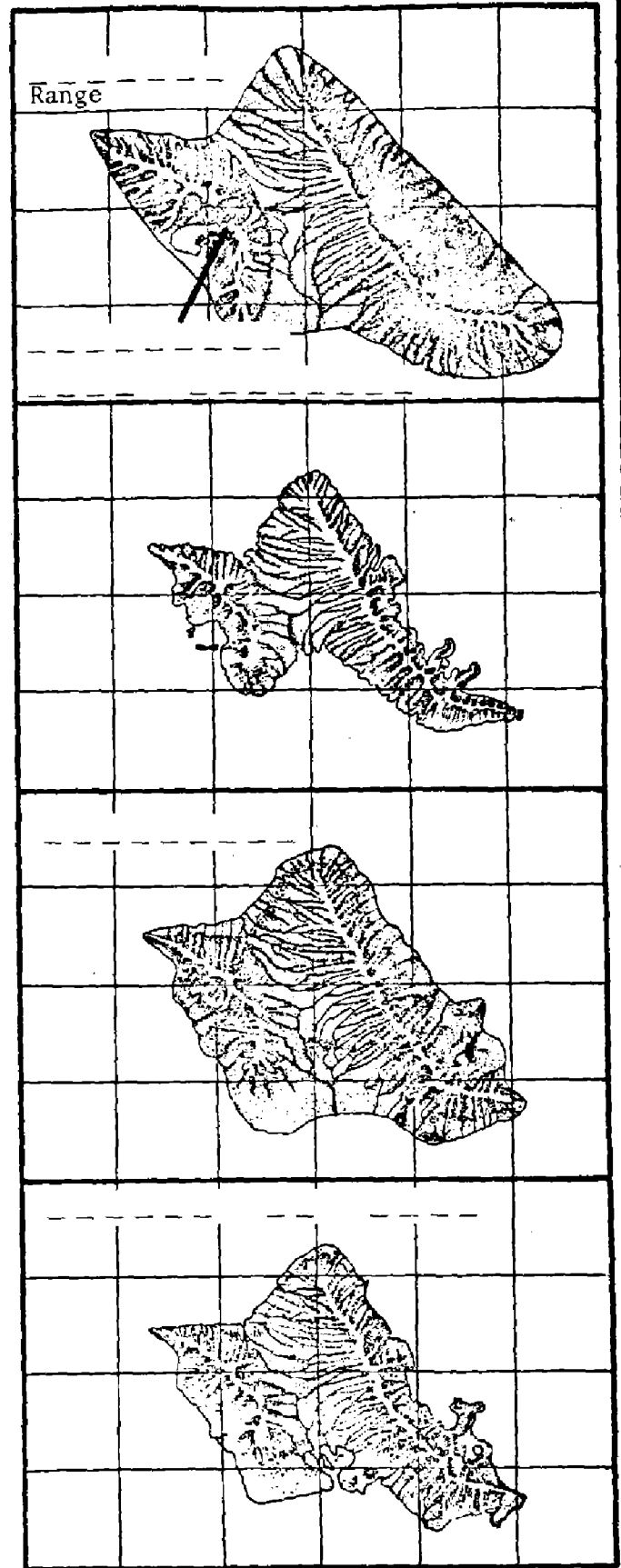
# of Oahu

Both the Waianae and Koolau Volcanos have deep valleys forming by stream erosion. A white cloud rising from the Waianae Range shows a small secondary cone eruption.

The melting of the ice at the end of the Ice Age caused the water level to be 250 feet above where it is today.

Later the shoreline dropped to 60 feet lower than what it is today.

The last diagram shows what the island of Oahu looks like today.



# The Darkest Depths

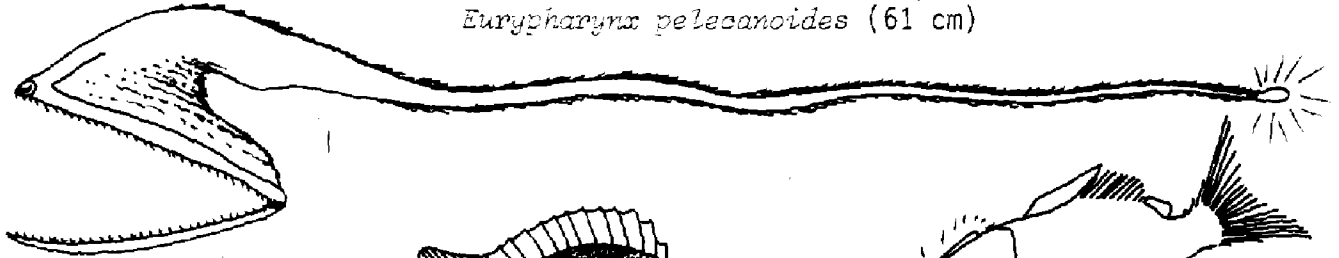
Some animals are only able to live in the deep dark abyssal depths of the ocean where it is so dim our eyes would not be able to see anything. These animals live far below the surface where it is cold all the time and where the pressure from the water above could crush even the strongest ships. Just as seashore and reef animals could not live in the great abyssal depths, abyssal animals could not live the crashing waves of the seashore or in the brightly colored coral reef.

Some abyssal animals have lights on the sides of their bodies to attract or scare away others, and large mouths to gulp down food as big as themselves.

Look at the following animals. Can you tell which animals live in the abyssal depths and which ones live in the coral reef?

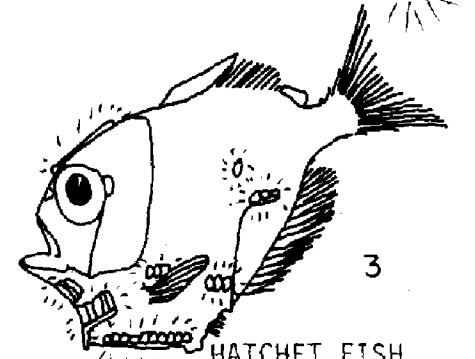
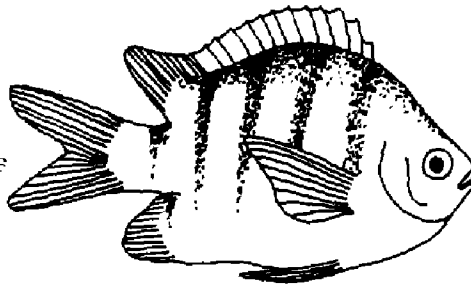
DIRECTIONS: Draw a circle around the animals that live in the darkest depths.

GULPER or PELICAN EEL  
*Eurypharynx pelicanoides* (61 cm)



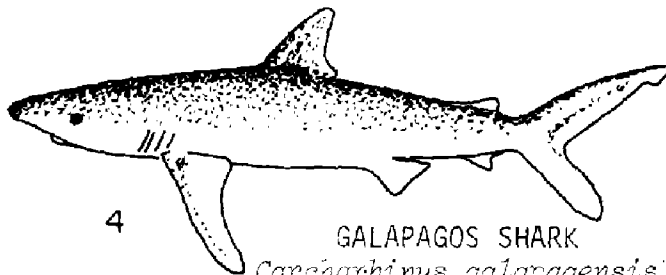
MAOMAO  
*Abudefduf abdominalis*  
(23 cm)

2



3

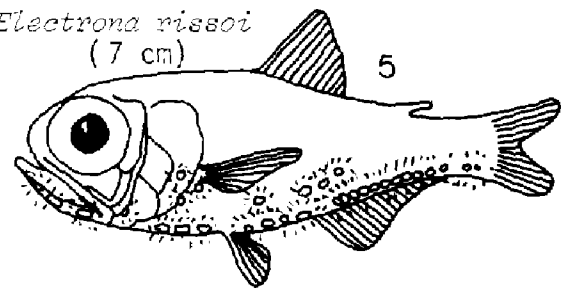
HATCHET FISH  
*Sternoptys diaphana*  
(6 cm)



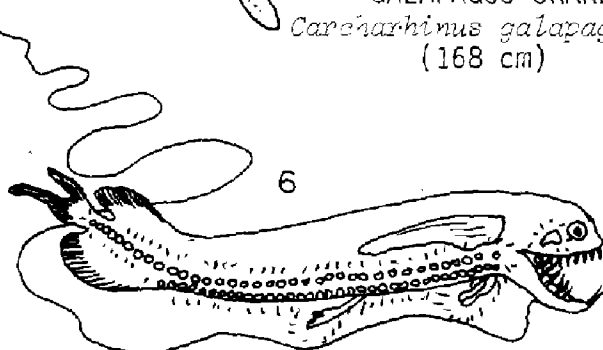
4

GALAPAGOS SHARK  
*Carcharhinus galapagensis*  
(168 cm)

LANTERN FISH  
*Electrona rissoi*  
(7 cm)



5



6

VIPERFISH (30 cm)

SKIPJACK TUNA OR AKU  
*Katsuwonus pelamis* (80 cm)

7



# Cheat Sheet

(p. 7)

1. \$3,150.00
2. \$504.00
3. \$210.00
4. \$100.80

(pp. 10-11)

- 750 = G.
- 1778 = B
- 1820 = F
- 1846 = D
- 1878 = H
- 1925 = A
- 1941 = E
- 1975 = C

(p. 13)

1. Pinnipedia
2. Cetacea
3. Cetacea
4. Carnivora
5. Sirenia
6. Cetacea

(pp. 16-17)

1. 25 children
2. 15 elephants
3. 377 children
4. 6 elephants

(p. 23)

1. Parrotfish
2. Ulua
3. Brittle Starfish
4. Sea Cucumber
5. Eel
6. Spiny Puffer

- 1925 = A
- 1941 = E
- 1975 = C

(p. 30)

1. Abyssal
2. Reef
3. Abyssal
4. Reef
5. Abyssal
6. Abyssal
7. Reef

(p. 25)

1. Thin
2. Round
3. Flat
4. Cigar
5. Torpedo

(p. 24)

1. Phytoplankton
2. Primary Producers
3. Sunlight
4. Nutrients
5. Zooplankton
6. First Order Consumers
7. Baleen Whale
8. Small Fish
9. Third
10. Fourth
11. Fourth

(p. 20)

|   |   |
|---|---|
| 1 |   |
| 2 | ✓ |
| 3 |   |
| 4 | ✓ |
| 5 | ✓ |
| 6 | ✓ |
| 7 | ✓ |
| 8 | ✓ |

(p. 8)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | O | V | E | R | H | E | A | D | C | O | M | P | A | S | S | E | S |
| T | H | G | I | L | Y | K | S | N | I | B | A | C | N | I | A | M | E |
| H | C | T | A | P | E | A | J | A | C | K | E | T | W | R | O | R |   |
| R | N | R | B | L | U | B | B | E | R | R | O | O | M | C | E | D | O |
| S | E | T | U | P | E | N | I | A | M | I | E | Y | J | M | T | T |   |
| T | B | F | I | D | G | E | Y | E | L | L | A | G | I | R | S | S |   |
| O | S | L | H | L | D | M | H | B | L | W | K | T | Z | Y | N | A | Y |
| R | R | H | I | Y | I | E | A | W | N | E | S | Z | W | R | L | A |   |
| E | E | A | M | A | D | R | R | O | G | A | E | O | P | T | A | L | T |
| R | T | H | L | R | E | I | O | M | N | R | K | K | N | A | S |   |   |
| O | N | C | O | E | L | N | R | N | M | K | I | C | H | A | I | B | E |
| O | E | H | L | A | A | O | I | A | S | L | E | R | A | P | S | E | R |
| M | P | S | H | P | H | A | S | P | L | D | M | E | L | T | N | O |   |
| B | R | W | M | C | M | T | R | E | L | T | S | A | C | E | R | O | F |
| P | A | O | N | H | S | O | B | B | O | W | S | P | R | I | T | T | L |
| Q | C | A | P | T | A | I | N | S | Q | U | A | R | T | E | R | S | Y |

(p. 12)

2, 5 and 4  
are mammals

(p. 21)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| R | O | C | K | S | K | I | P | P | E | R | P | M | L | I | S | Q | U | I | N | B | D | O |  |
| U | L | B | A | N | A | N | A | P | R | A | W | N | P | R | E | T | S | B | O | L | I |   |  |
| T | I | G | E | R | C | O | W | R | I | E | N | Y | Z | U | Q | H | L | T | S | E | A | L |  |
| H | Z | J | O | K | D | P | G | M | U | H | S | I | F | N | O | E | G | R | U | S | E | S |  |
| V | A | C | U | B | N | I | A | O | R | P | B | D | G | D | H | R | S | F | P | Q | E | E |  |
| C | R | A | D | O | Y | H | N | S | U | P | O | T | C | O | P | M | V | R | A | P | N | A |  |
| W | D | H | A | K | N | I | A | A | N | C | H | O | V | Y | A | I | T | G | P | F | O | U |  |
| B | F | S | M | A | N | B | W | J | L | E | E | D | H | S | O | T | O | F | A | R | M | R |  |
| X | I | I | S | T | E | L | L | U | M | F | E | I | A | T | E | C | F | I | L | T | E | C |  |
| G | S | F | E | O | L | K | X | L | O | L | I | M | P | E | T | R | L | I | U | D | N | H |  |
| N | H | L | L | Z | B | A | M | A | A | M | A | S | U | R | N | A | I | M | S | C | A | I |  |
| A | Y | E | F | E | Y | L | A | E | L | A | N | I | H | U | P | B | P | G | J | H | A | N |  |
| T | B | R | I | S | E | A | C | U | C | U | M | B | E | R | S | O | I | W | E | K | E | O |  |
| T | N | R | S | S | L | I | N | Q | P | A | L | A | N | I | I | H | P | S | E | M | S | L |  |
| C | Z | I | H | A | C | H | L | D | N | E | I | P | O | C | T | M | I | A | H | U | Y | I |  |
| I | R | U | M | R | A | I | J | O | I | N | I | N | A | M | R | T | P | B | E | Z | B | V |  |
| V | G | Q | F | W | N | K | E | L | O | H | E | L | O | H | A | O | U | O | J | A | W | X |  |
| N | H | S | I | F | R | A | T | S | E | L | T | T | I | R | B | O | K | K | R | V | U | K |  |
| O | A | L | B | L | A | C | K | R | O | C | K | R | A | B | A | R | C | D | N | A | S |   |  |
| C | S | H | Q | I | B | M | H | C | R | E | P | R | E | V | L | I | S | N | L | J | W | A |  |

# MAHALO

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## SEA GRANT OVERVIEW

The enactment of the Sea Grant College Program Act of 1966 envisioned the creation of a network of sea grant colleges in institutions of higher education across the country which would parallel land grant colleges.

"Sea Grant College" is a designation that is earned by a university when it proves that it has the capability of carrying on comprehensive programs on marine-related research, education, and advisory/extension programs--the three-pronged mission of the Act. The University of Hawaii became a Sea Grant College in 1972, culminating four years of program building.

In 1977-78 Sea Grant funds of \$1.3 million, matched by nearly \$.9 million in state and other local funding, have enabled university-based experts to carry on research in:

- marine resources development (projects on aquaculture of plants and animals)
- socio-economic and legal studies (projects on ocean law, marine economics)
- marine technology research and development (projects on ocean engineering)
- marine environmental research (projects on coastal pollution and monitoring)

The second Sea Grant program area, education and training, has ongoing and new projects to develop curricula and programs for lower education, undergraduate, graduate, and community college levels.

The third major mission of the Sea Grant College Act is being fulfilled by the establishment of a statewide marine advisory program to transmit information on a timely basis to all users.

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