Makahiki kai
festival of the sea '77

UNIHI-SEAGRANT-MR-77-01

STUDENT WORKBOOK

COME, JOIN Kuulei-momi-kai (precious pearl of the ocean) the little mermaid that symbolizes Makahiki Kai and explore the four different marine environments and the plants and animals that grow and live there. The theme for Makahiki Kai '77, "me and the sea," sets the tone of the exhibits which will promote a personal relationship between youth and adults and the fascinating marine world.

Kuulei-momi-kai is underwater watching a school of fish flashing by. But the Makahiki Kai '77 exhibits begin at the beach and examine the very different and exciting rocky and sandy beaches. Rich communities of fish and other life forms live near coral reefs which provide food and shelter. The blue water off shore is home for large fishes and mammals. Most of the fishes that are eaten by us live in deep blue waters. The abyssal or the darkest depths of the ocean is an eerie place. Even under the extremely severe conditions of high pressure and cold, there are living animals that call this dark harsh environment "home."

Makahiki Kai '77 "takes you there" without having to put on SCUBA gear or getting into a submarine.

SEA GRANT COLLEGE PROGRAM

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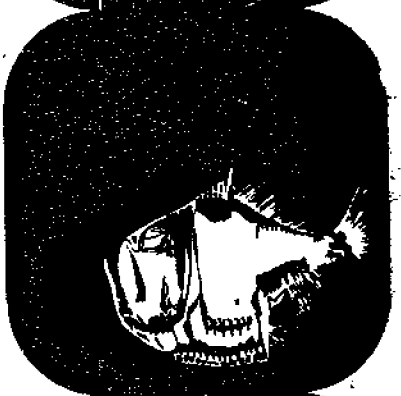


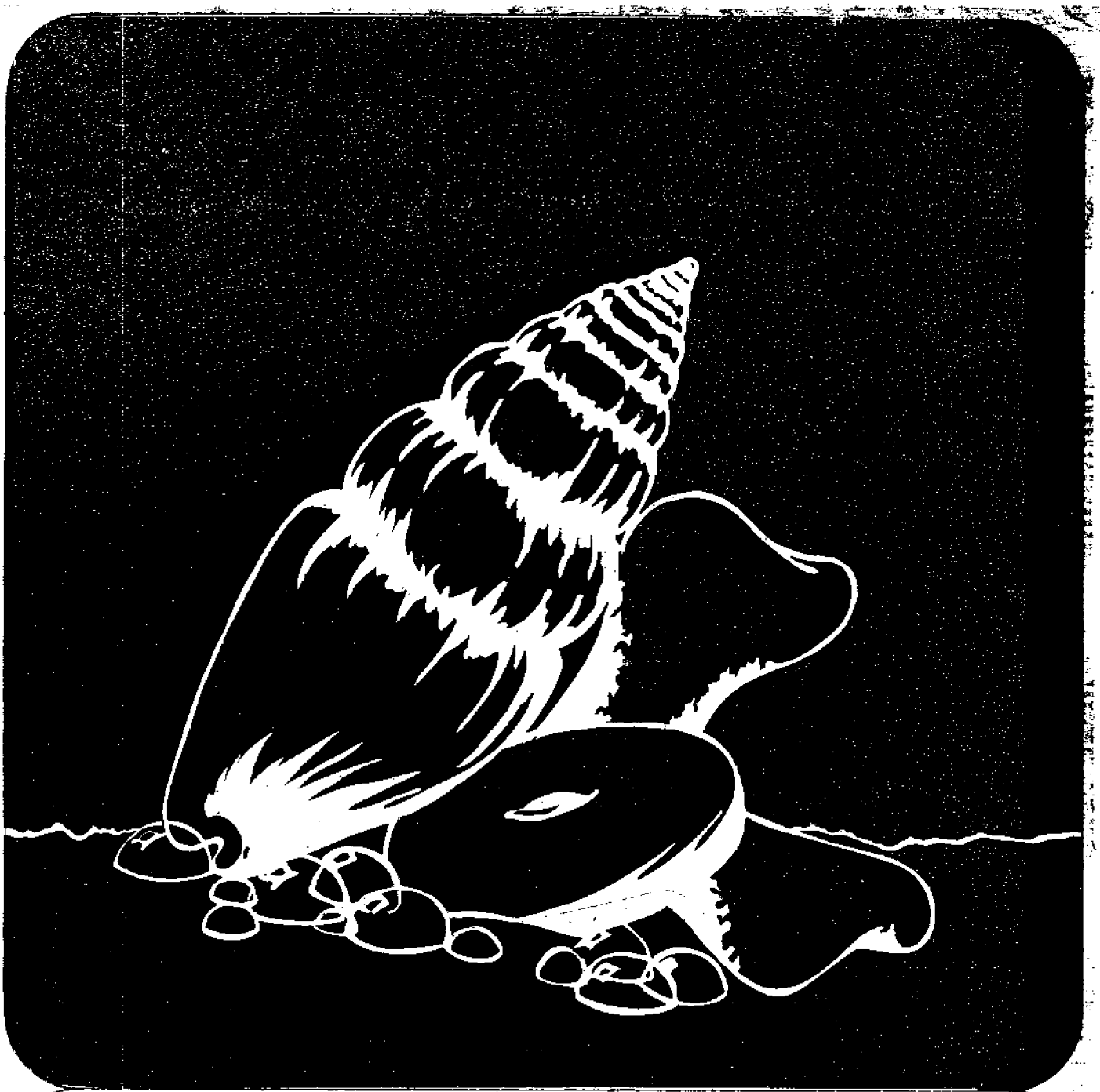
OUR HAWAIIAN SEASHORE

OUR HAWAIIAN REEF

DEEP BLUE WATERS

THE DARKEST DEPTHS

SEALAB



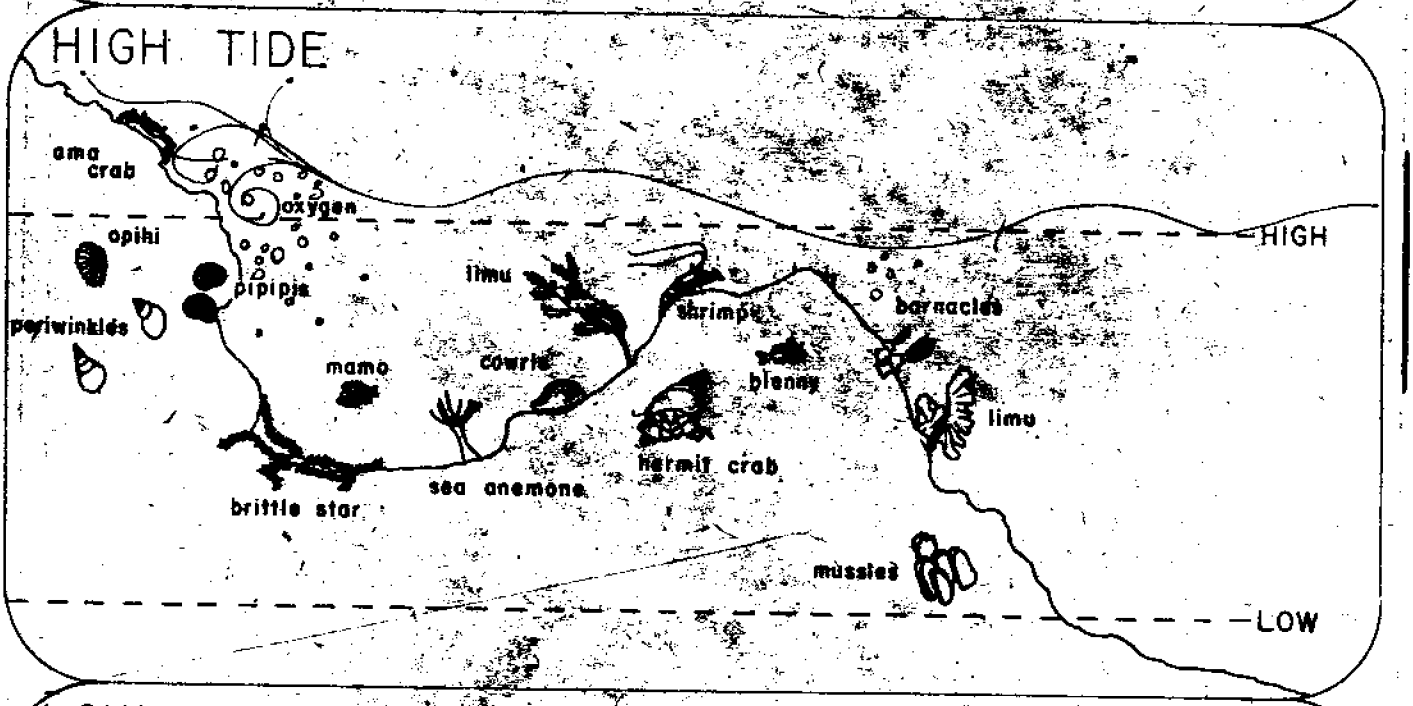
Our Hawaiian Seashore

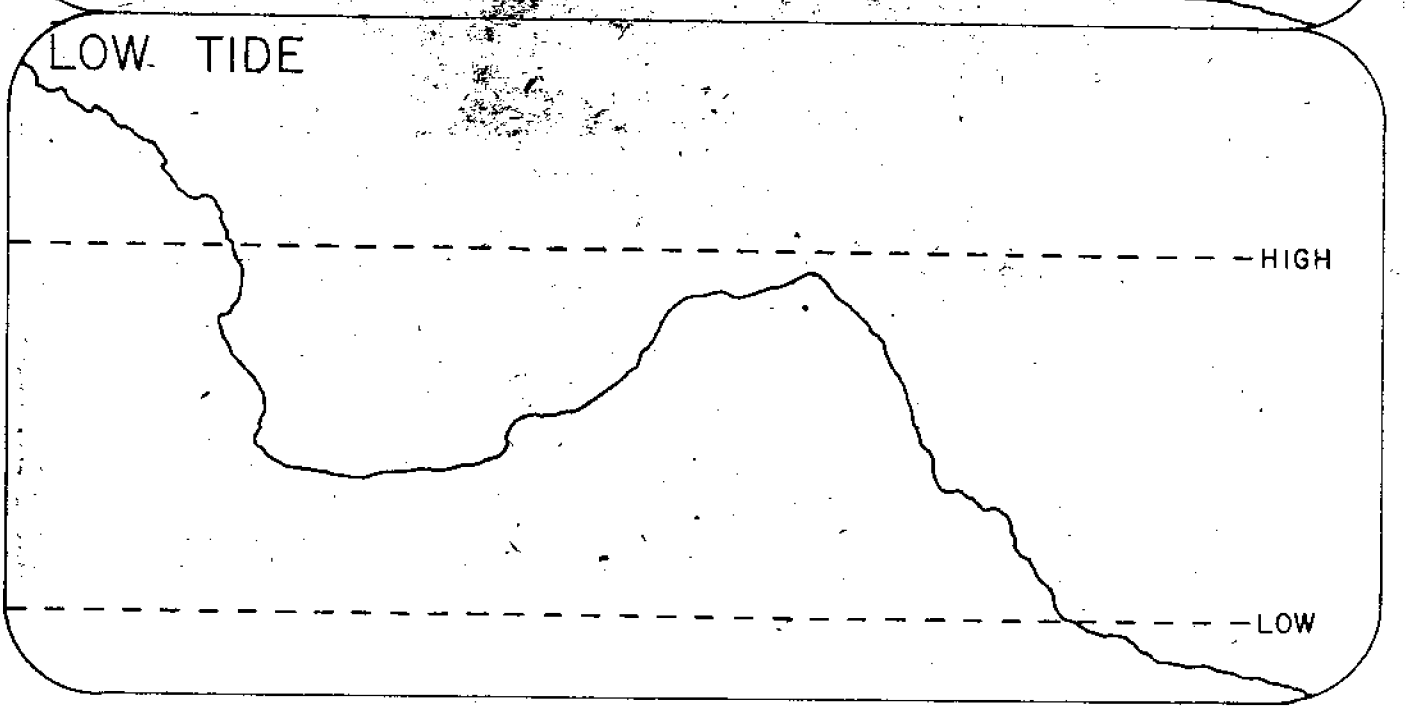
The Hawaiian coast is a constantly changing motion of shapes: a blend of the black, rocky Hamakua coastline to the beach at Hanalei. From the white sand to the green sand beaches, the beaches of Hawaii are unique places. Each place is a community inhabited by marine animals and plants that are specially adapted to that community. At some coastal areas, the waves gently ebb and flow but at others the waves race shoreward and crash against the black lava rocks.

4 THE HIGH & LOW POINTS OF TIDE POOL LIFE

Below is a diagram of a tide pool during HIGH TIDE. The tidal pool animals are busy eating, moving about and enjoying the cool, fresh sea water that is bringing in food and oxygen into the pool.

At LOW TIDE the tidal pool zone looks like a different place. Draw in, what it would be like in this tide pool at low tide.





SEASHORE LIFE ▫▫▫
a word search

5

AHOLEHOLE, SILVERPERCH
ALAIHI, SQUIRRELFISH
BANDANA PRAWN
BARNACLE
BLACK ROCK CRAB
BRITTLE STARFISH
CONE SHELL
CORAL
COWRIE
CRAB
EELS
FLOUNDER
GOBY
HE'E, OCTOPUS, TAKO
HERMIT CRAB
HINALEA, WRASSE
KUPIPI
LIMU, OGO, BROWN, GREEN, RED
LIZARDFISH
LOLI, SEA CUCUMBER
MAMO, MAOMAO
MANINI
MULLET
NEHU
NUDIBRANCH
OAMA, WEKE, GOATFISH
OIO, BONEFISH
OPIHI
OYSTERS
PALANI, SURGEONFISH
PIPIPI
ROCK SKIPPERS, BLENNY
SAND CRAB
SAND TURTLE
SEA ANEMONE
SHRIMP
TURTLE EGGS
ULA, LOBSTER
WANA, SEA URCHIN
WORMS

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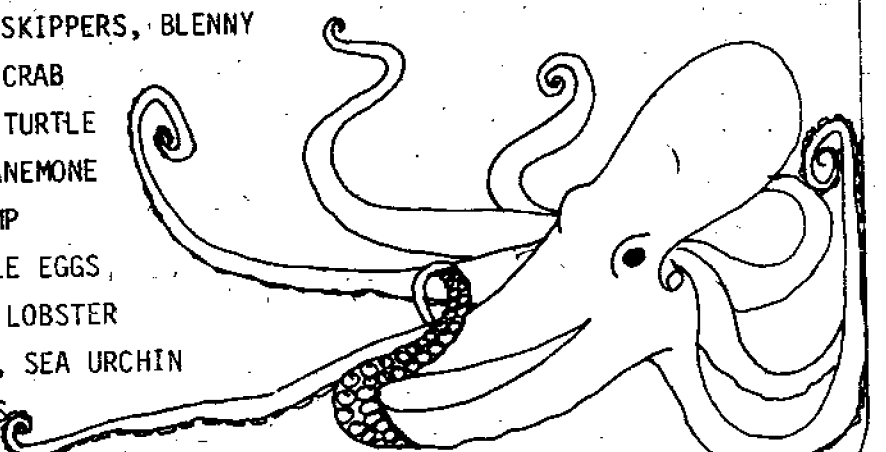


Circle all the animals that you would find living more in SANDY AREAS than rocky areas.

WAVES

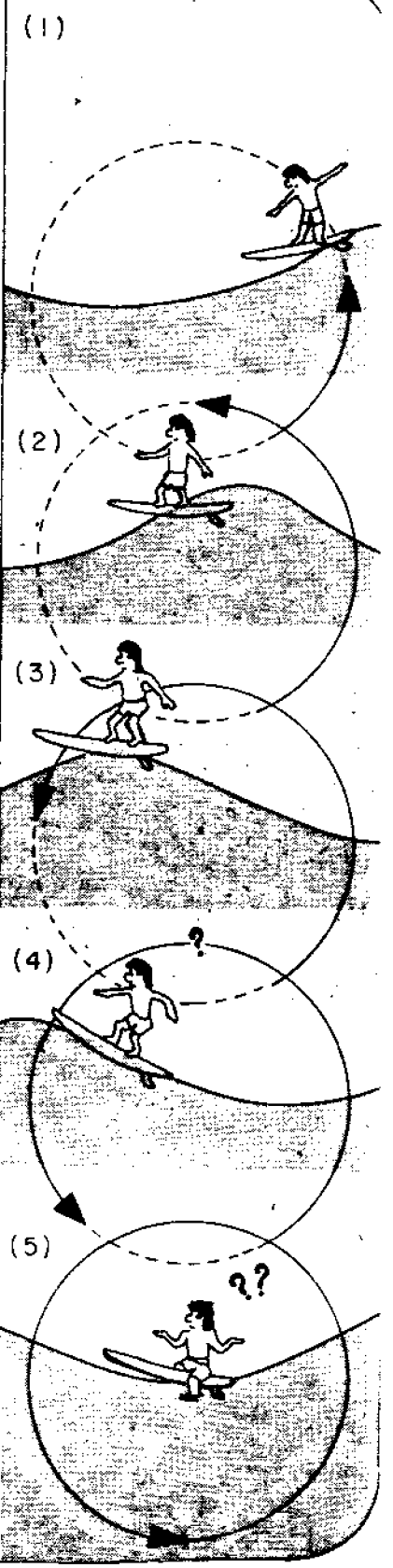
6

The energy that makes waves comes from (1) WINDS that blow across the ocean, (2) STORMS out at sea, and (3) MOVEMENTS of the SEA FLOOR. The waves you see breaking at the beach are usually made by the trade-winds.

The lowest part of a wave is called a TROUGH, the highest part is called the CREST. The WAVE HEIGHT is the distance between the trough and crest. If the surf report says the waves are breaking three to four feet, it is the wave height that is being measured. WAVE LENGTH is the time it takes for two crests to pass one spot.

Not all of the wave is above the surface. The wave energy goes down from the crest to the trough. The water itself in the open ocean does not move forward, only the energy of the waves moves. The diagram, at the right, shows the energy building up (1 and 2) and peaking as a wave crest (3); then, the energy passes on and causes the crest to drop (4) and creates a trough (5). The surfer will feel like he is on a swing--moving but going nowhere. However, when the wave nears the shore and touches the sea bottom, it starts to drag. This forces the water to pile up until the face becomes so steep that it spills over, or BREAKS. Then the water moves towards shore and takes the surfboard with it.

In the diagrams on the right, what is happening to the surfer who paddled out too far? Will he be able to catch a wave out there? Where would be the best place for him to be?



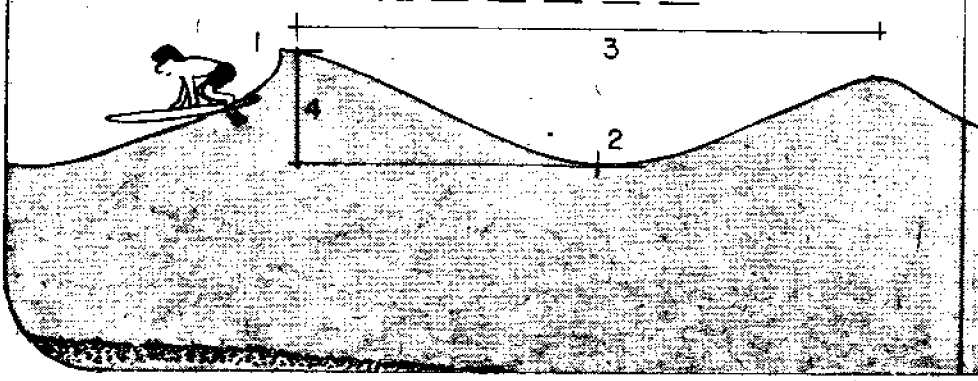
Name the parts of a wave:

1 _____

2 _____

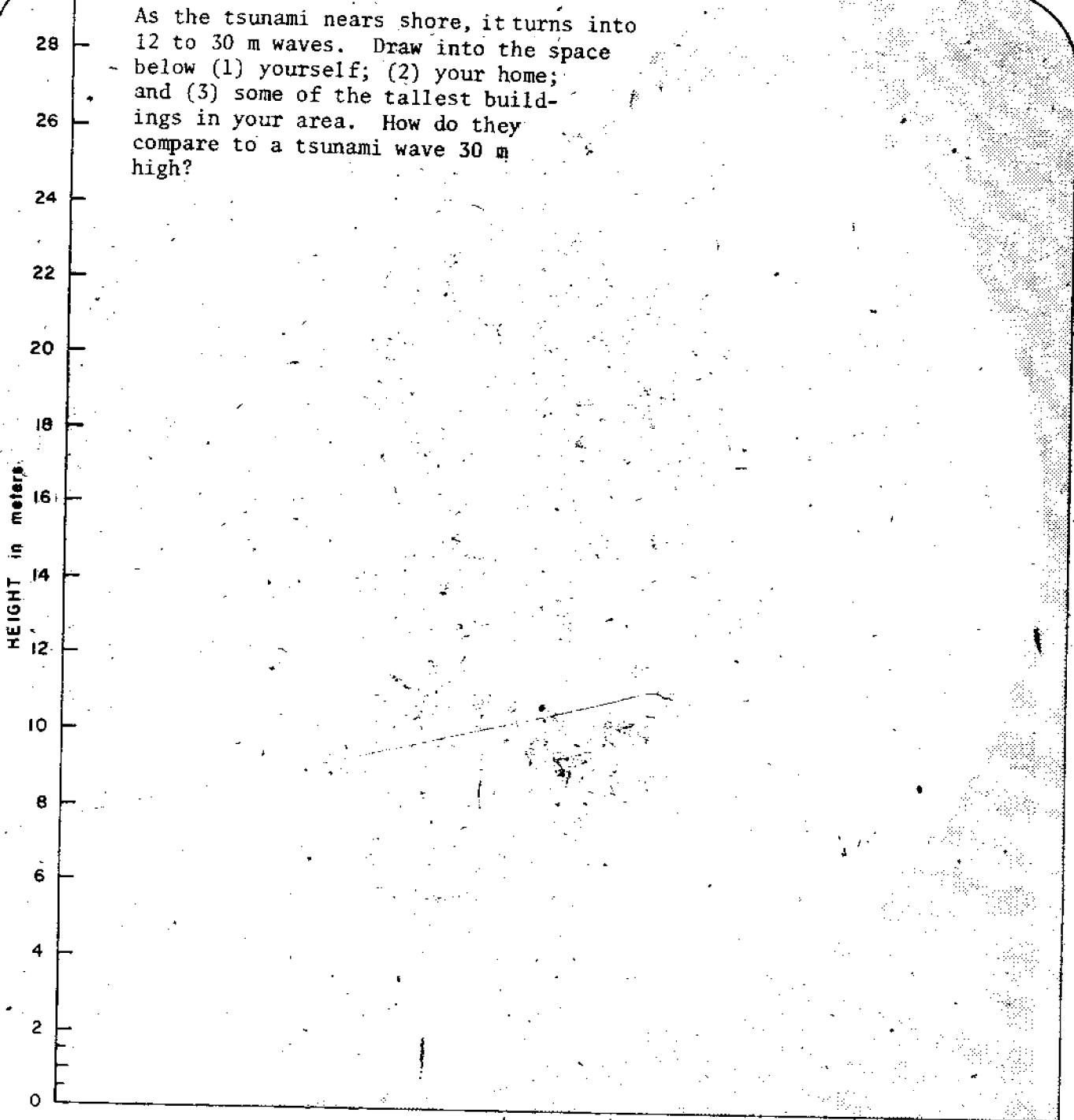
3 _____ _____

4 _____ _____



"TSUNAMI!"

As the tsunami nears shore, it turns into 12 to 30 m waves. Draw into the space below (1) yourself; (2) your home; and (3) some of the tallest buildings in your area. How do they compare to a tsunami wave 30 m high?



Tsunamis are giant waves made when the sea floor moves because of earthquakes, landslides or volcanic eruptions. Tsunamis are not just a single wave; they are a series of waves separated by 15 to 60 or more minutes. Over the past 150 years, the Hawaiian Islands have had an average of one tsunami every four years.

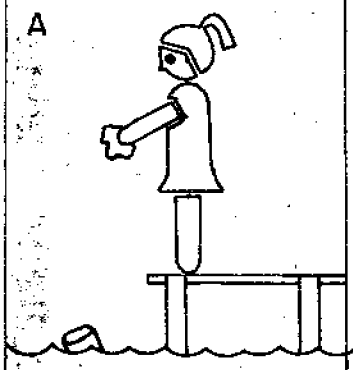
If there is an earthquake here in the Hawaiian Islands that causes you to fall or makes you hold on to something to keep you from falling, this should be a natural tsunami warning. Get to higher grounds right away if you are near the seashore.

SHORELINE CONSERVATION

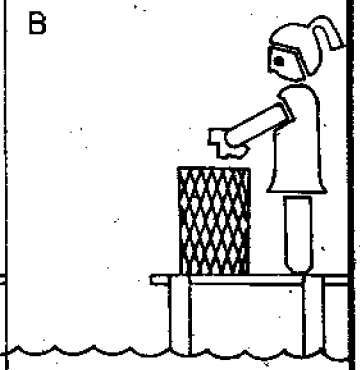
8

What is meant when the word conservation is applied to our seashore? It means the careful use of our shoreline resources. It means obeying rules to help keep plants and animals alive. It means taking only what you need and not more.
What can YOU do to help conserve our resources? In the six sets of drawings below, which posters best show things you can do to help? Write A or B in the boxes below each set.

A

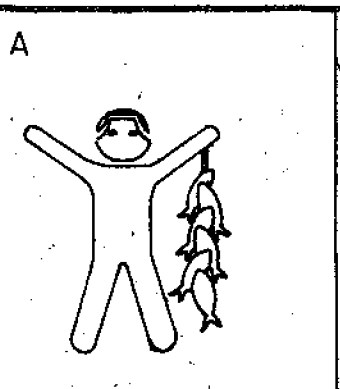


B

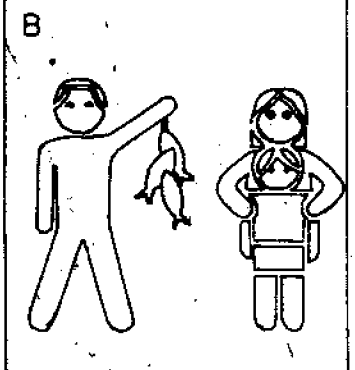


1) Put litter in its place!

A

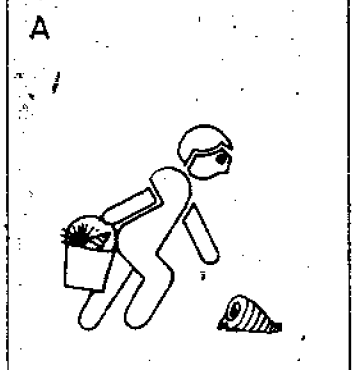


B

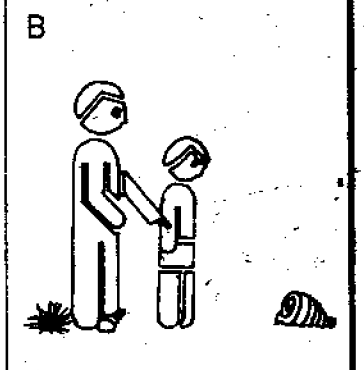


2) Catch only what you need!

A

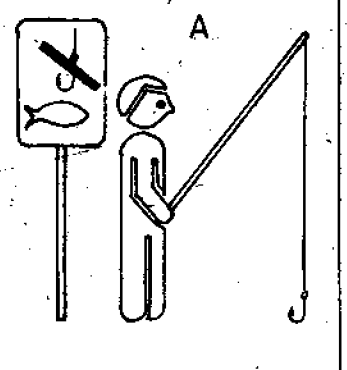


B

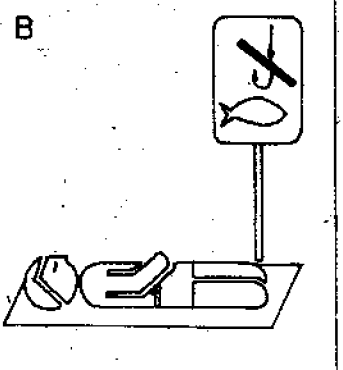


3) Do not collect everything in sight!

A

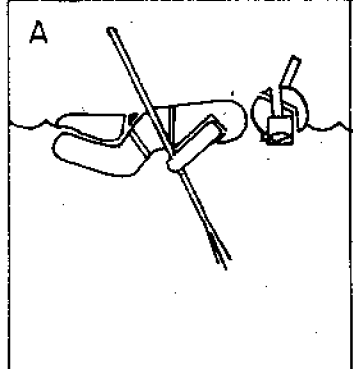


B



4) Follow posted conservation signs!

A



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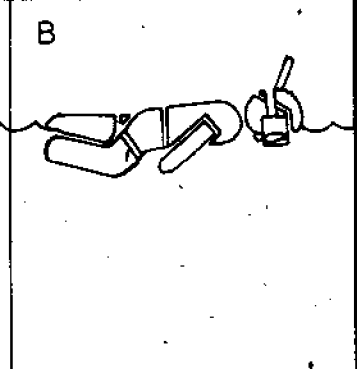
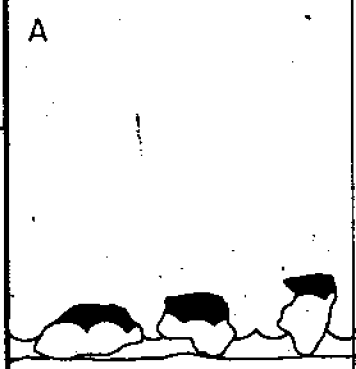
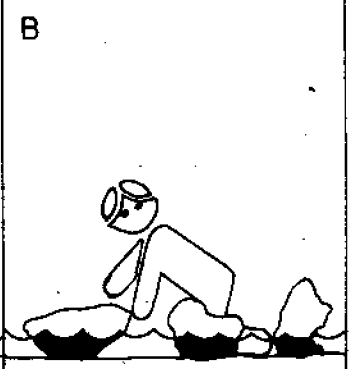


5) Do not spear lobsters

A



B



6) Replace rocks when you're through looking under them!

Our Hawaiian Reef

Some of the world's most colorful fishes dwell in the world-famous Hawaiian reefs. Many of the animals are so well adapted to their environment it is difficult to find them. There are strange but necessary "mutual aid societies" that have brought together predator and victim. The reef is a place where many communities co-exist in harmony but it is also a place which best illustrates nature's web of life.

CORAL REEFS

10

Coral reefs are made by tiny animals called POLYPS. Polyps, along with the coralline algae, Nullipore, which live around the reefs, get chemicals from seawater and make calcium carbonate to build and cement together the wave-proof reefs. In and around the coral reefs live a complex community of marine animals.

TYPES OF REEFS

As coral larvae settle on the lava or basaltic rocks, a FRINGING REEF is produced, that follows the shape of the island. Large, well developed fringing reefs can be found off Oahu between Laie and Kaneohe Bay and at Ala Moana and Waikiki. Near Hanalei Bay, Kauai, a large fringing reef extends as far as 300 m from shore.

If these fringing reefs continue to develop and the island erodes, a BARRIER REEF is formed. Far from shore, the outer reef protects reef flats and a large shallow lagoon. Kaneohe Bay, Oahu, has a barrier reef over a mile wide protecting small circular PATCH REEFS from the ocean waves.

Finally, over a great period of time, the island will erode and sink completely below the surface leaving a large lagoon from 30.5 to 94.5 m deep, in the center, surrounded by the reefs. Midway and Kure are coral ATOLLS that are part of the Leeward Islands north of Hawaii.

Find and paste or draw in pictures of the different types of coral reefs and label them.

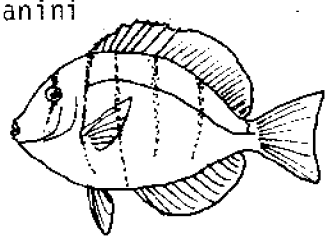
REEF VERTEBRATES AND INVERTEBRATES

11

Most animals can be divided into two broad groups--the vertebrates and invertebrates. VERTEBRATES are animals with backbones. Some of these animals have a spinal column while other more primitive vertebrates have notochords to support their bodies. INVERTEBRATES are animals without a backbone or skeleton inside their bodies. Some invertebrates "wear their skeletons on the outside of their bodies." Their bodies are supported by hard outer shells.

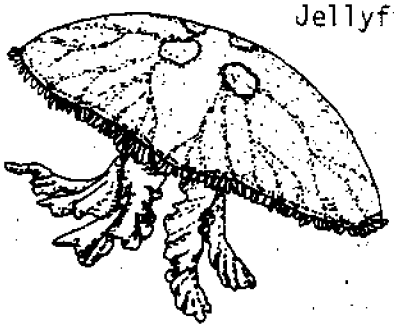
In the blank below each animal, write whether you think the animal is a vertebrate or invertebrate.

Manini

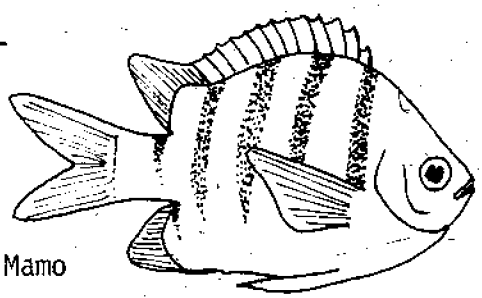


1 _____

Jellyfish



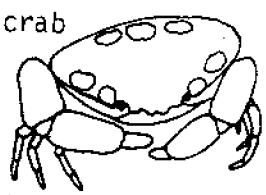
2 _____



Mamo

3 _____

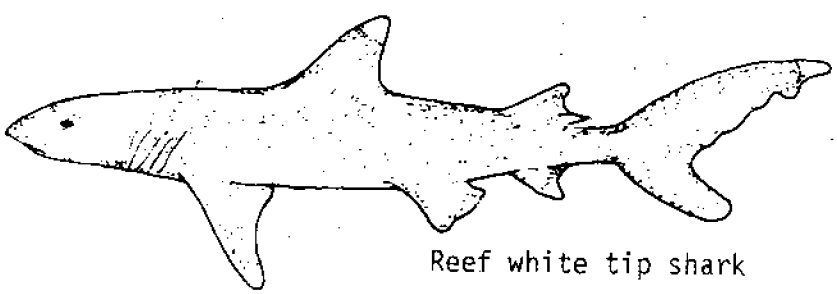
7-11 crab



4 _____

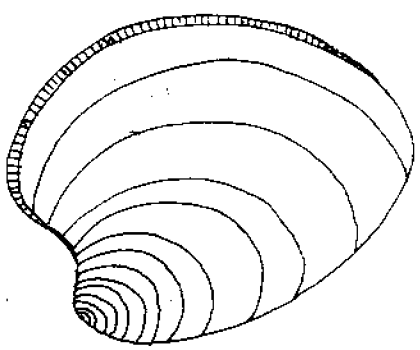
Sea cucumber

5 _____



Reef white tip shark

6 _____



Clam

7 _____

HIGH SEAS DRIFTER

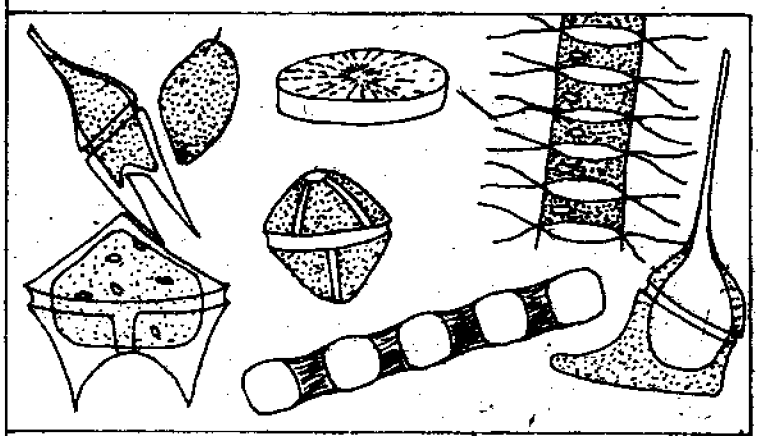
12

WHAT ARE PLANKTON?

The word "PLANKTON" means "DRIFTER." True to its name, plankton are tiny plants and animals that drift in ocean currents. Many of them are so small that you need a magnifying glass or microscope to see them. Plankton can also be the larger animals like jellyfish and portuguese man-of-war that are weak swimmers and can not swim against the wind or currents.

Scientists divide plankton into two groups--PHYTOPLANKTON, which are plants, and ZOOPLANKTON, which are animals.

PHYTOPLANKTON



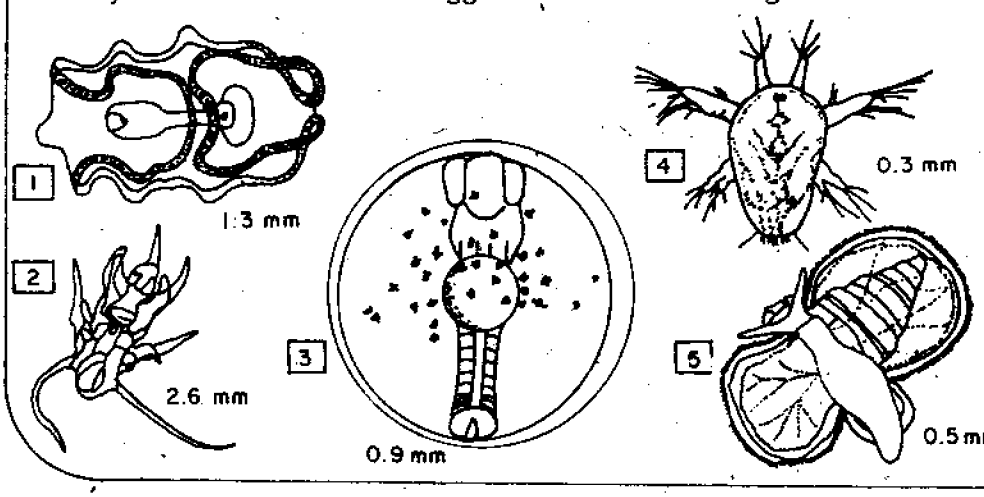
Phytoplankton are microscopic marine plants that use sunlight and minerals to grow like land plants. The most familiar sea plant is limu or seaweed, which grow attached to rocks, but phytoplankton spend their whole life floating near the sunlit surface of the ocean.

Plankton is the beginning of the MARINE FOOD WEB. They are called PRIMARY PRODUCERS and provide food mainly for zooplankton.

ZOOPLANKTON

Zooplankton are tiny animals that drift in the ocean currents like phytoplankton. Some zooplankton float for their entire life in the ocean. These PERMANENT ZOOPLANKTON do not change their body shapes as adults. Other zooplankton, called TEMPORARY ZOOPLANKTON, spend only part of their lives as plankton. These are the EGGS and LARVAE of many kinds of marine animals. As babies, these animals float around but as they grow older, they change their shape and become starfish, sea urchins, crabs, fish and many other animals.

Can you tell what these eggs and larvae will grow into?

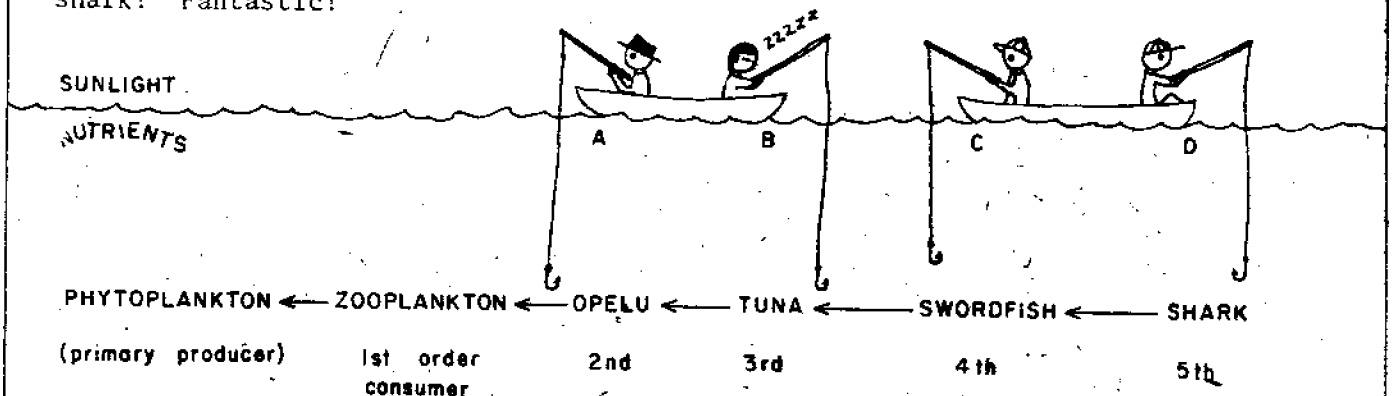


Write the number in the boxes below of the larval form of each animal.

	ulua
	crab
	sea cucumber
	snail
	sea urchin

'EATERS'

Let's imagine you were a tiny phytoplankton. You'd get your food from the sun and nutrients in the water. You'd be called a PRIMARY PRODUCER since you do not eat any other living things. Along comes a zooplankton and gobbles you up! The zooplankton is the FIRST ORDER CONSUMER since he's the first to eat you. There's an opelu swimming by and it eats the zooplankton. The opelu is a SECOND ORDER CONSUMER. A tuna eats the opelu and a swordfish eats the tuna. Here comes a shark and it eats the swordfish. You, the tiny phytoplankton, ends up feeding a shark! Fantastic!



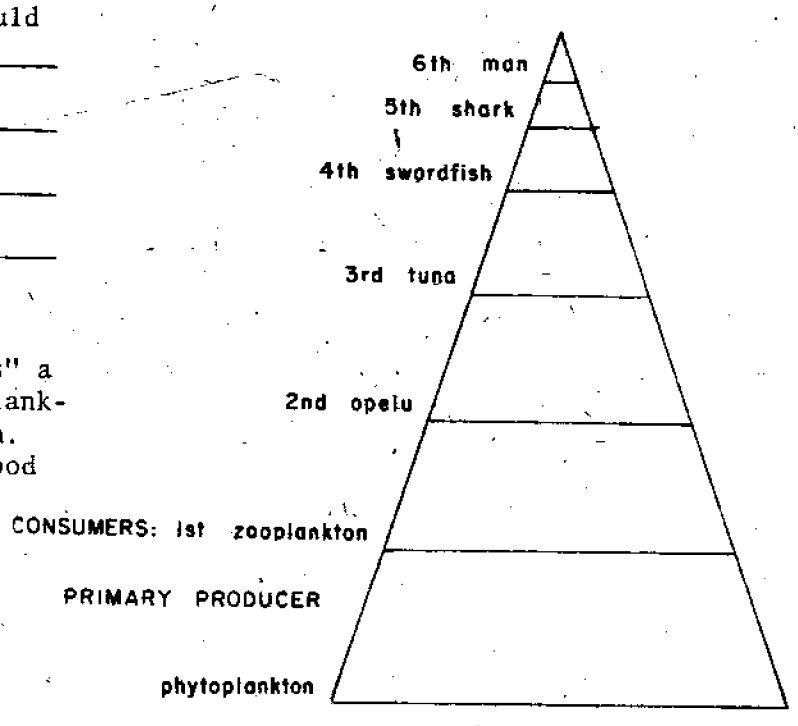
Now let's think about man. Where does he fit? He can eat the opelu, tuna, swordfish and shark. This means that man can fit in anywhere in this food web. If fisherman A caught an opelu for dinner, what order consumer would he be? _____

What about fisherman B? _____

fisherman C? _____

and fisherman D? _____

We call this series of "eatings" a FOOD CHAIN. Of course, a zooplankton eats more than one plankton. The relationship of how much food each animal needs to eat can be shown in a FOOD PYRAMID (right).



The opelu, tuna, swordfish and shark aren't the only animals in the ocean. When you consider all the animals and what they eat, a complicated picture of these relationships emerges. We call this picture the FOOD WEB.

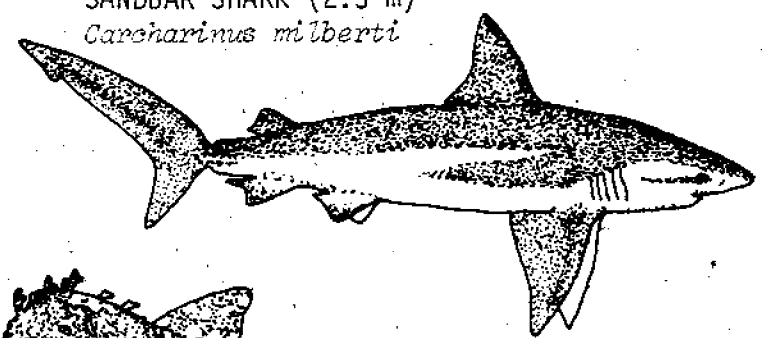
ADAPTATION OF SHARKS

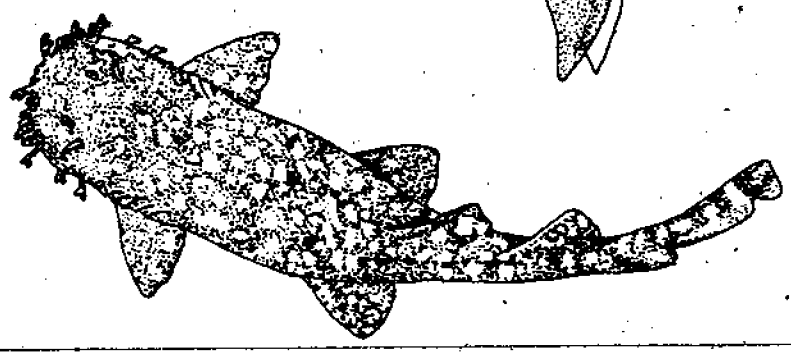
14

Of all the animals in the ocean, it is the shark that has the perfect form for living in the water. Sharks are so well adapted to their watery world that they exist today in nearly the same form as its prehistoric ancestor, *Carcharodon megalodon*.

Some sharks have evolved a little in ways to fit into the environment which they live. Pelagic or oceanic species of sharks have streamlined, torpedo shaped bodies that allow them to swim great distances. Some bottom dwelling or benthic sharks have adapted and are flat bellied.

SANDBAR SHARK (2.5 m)
Carcharinus milberti

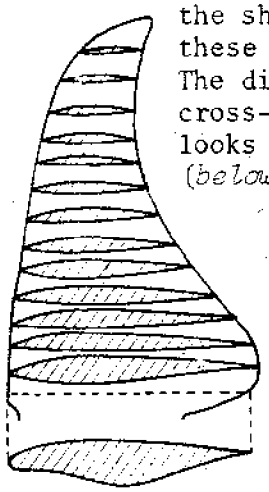




Like other surface fish, most sharks are countershaded, which means they are dark colored on top and light underneath. Sharks that live on the sea floor, like the AUSTRALIAN WOBBEGONG or CARPET SHARK, *Orectolobus barbatus*, blend in with the sea floor and are camouflaged. (*left*)

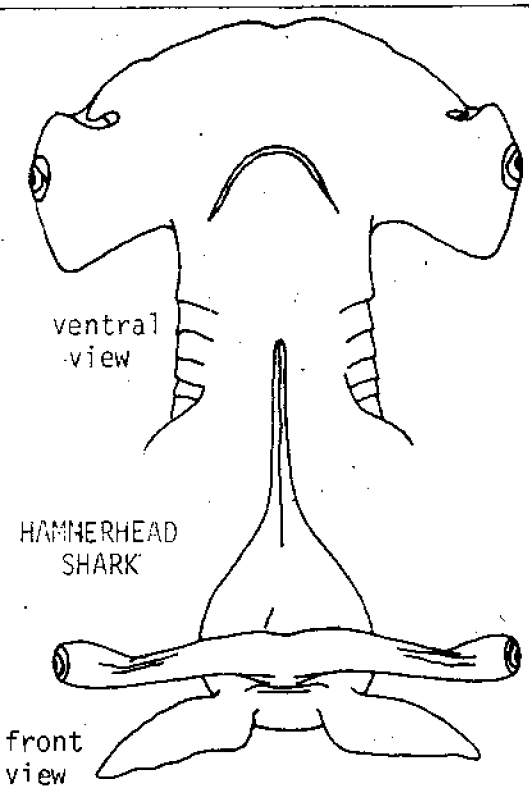
AUSTRALIAN WOBBEGONG or CARPET SHARK (1.5 m)
Orectolobus barbatus

The PECTORAL or side, and DORSAL or top fins, act like the stabilizers of an airplane. These fins help the shark to dive, turn, or go up to the surface. However, these fins cannot help the shark to "brake" so it uses these fins to veer off instead. The diagram below shows how the cross-section of a shark's fin looks just like an airplane wing. (*below left*)



PECTORAL FIN

The HAMMERHEAD SHARK has a specially shaped head that is an extra maneuvering "wing" or fin. (*right*)

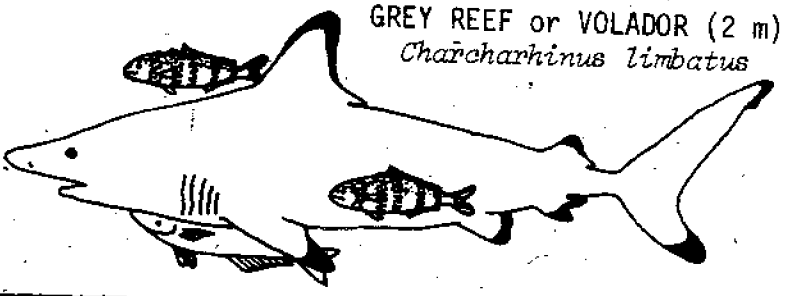


FRIENDS

15

SYMBIOSIS is a special relationship between 2 living things. There are three kinds of symbiotic relationships:

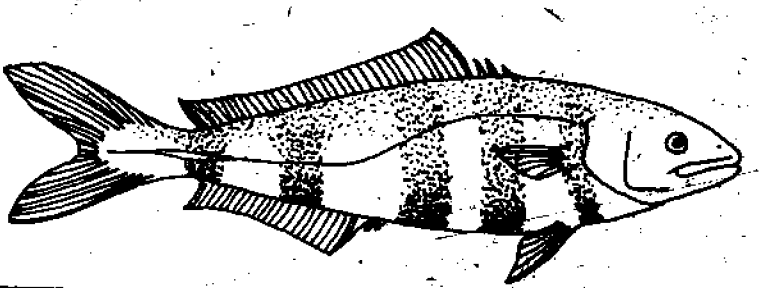
1) both organisms helping each other out,
2) only one helping the other without anything, in return, and
3) one harms the other.



GREY REEF or VOLADOR (2 m)
Charcharhinus limbatus

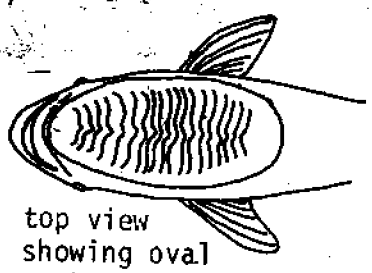
As dangerous as sharks may be the PILOTFISH, *Naucrates ductor*, a relative of uluas or jacks and REMORAS or (SHARK) SUCKERFISH, family Echeneitorms, have developed symbiotic relationships with the shark.

The pilotfish was believed to lead the shark to food and in return got to feed on the scraps. However, some sharks do not even know that the pilotfish is around. Papio, which is the name given to all juvenile ulua that are between 2 - 15 cm, pilot on the "bow wave" right in front of the sharks snout just a few centimeters away from their jaws. Since the sharks eyes are on the sides of its head, the papio are not seen. Most papio will leave the shark to become predators on their own, except for the fast *Naucrates ductor*.



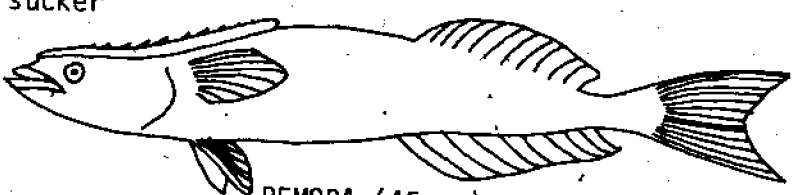
PILOTFISH (61 cm)
Naucrates ductor

The REMORA is not a strong swimmer and also not as fast as the pilotfish but it has a very effective way of staying out of the reach of the shark. It attaches itself to the body of the shark with flat, oval suckers that look like a venetian blind. Sharp denticles, which were originally its dorsal fin, along with the suction power helps the remora to ride long distances. When one animal carries another animal of a species, this is known as PHORESIS.



top view showing oval sucker

front view



REMORA (45 cm)
Remora remora

Which of the three types of symbiotic relationships do pilotfish and remoras have with sharks?

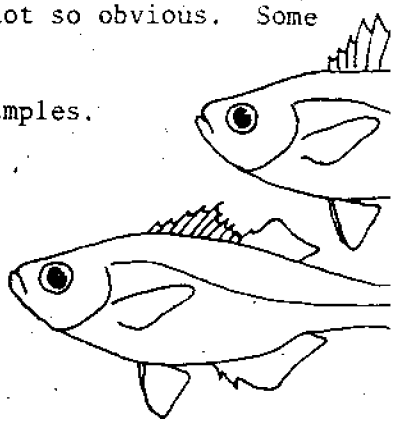
16

METHODS OF

In the reef world, the "fastest jaw in the West" is the survivor. Those who are small or otherwise defenseless have found ways of protecting themselves from PREDATORS who are looking for food and people who may also be looking for a meal.

Marine animals have ways of protecting themselves that are not so obvious. Some of these methods are listed below.

A. Find which animal uses the methods below and draw in examples.



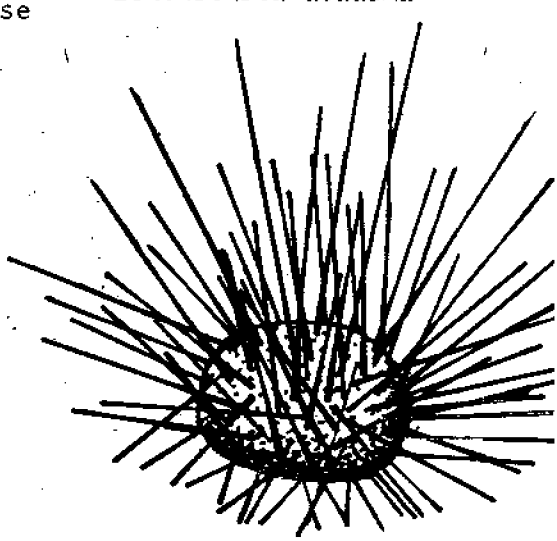
1. _____ uses COLOR to blend in with the surroundings.

2. _____ have a camouflaging SHAPE that makes it look like a part of its surroundings.

3. _____ REGENERATES body parts that it looses to escape from a predator.

4. _____ stay in SCHOOLS because there is safety in numbers.

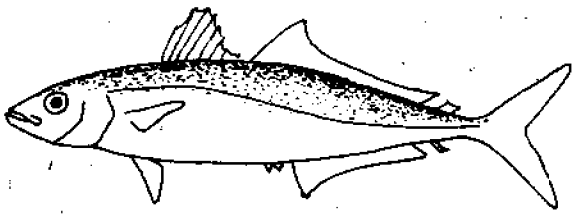
WANA or SEA URCHIN
Echinothrix diadema

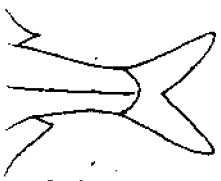


5. _____ has sharp SPINES to keep predators at a distance.

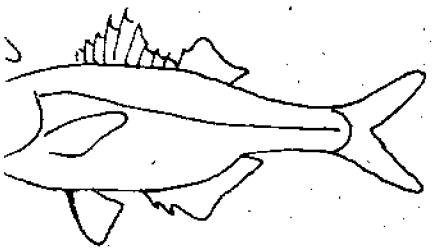
6. _____, like many other surface fish, are COUNTERSHADED, that means that they are dark on their back and light-colored on their bellies.

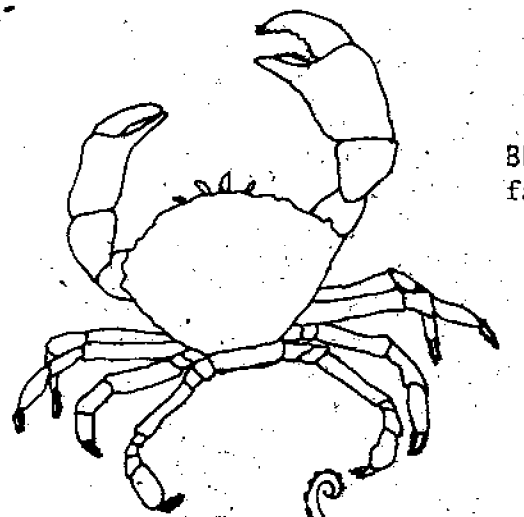
OPELU or MACKEREL SCAD
Decapterus pinnulatus





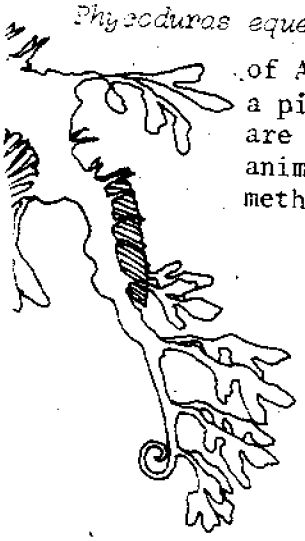
AHOLEHOLE or SILVER PERCH
Kuhlia sandvicensis





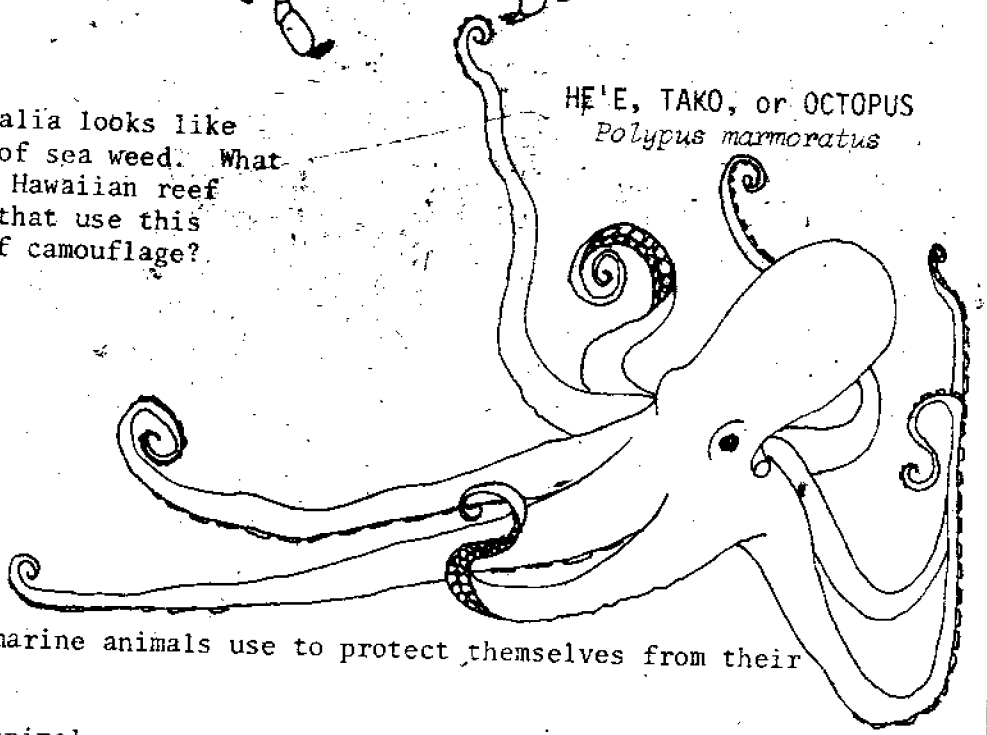
BLACK FINGERED CRAB
family: Xanthidae

SEA DRAGON
Phycodurus eques



of Australia looks like a piece of sea weed. What are some Hawaiian reef animals that use this method of camouflage?

HE'E, TAKO, or OCTOPUS
Polypus marmoratus



3. What other ways do marine animals use to protect themselves from their enemies?

Name of animal	Method of protection
1a. _____	1b. _____
2a. _____	2b. _____

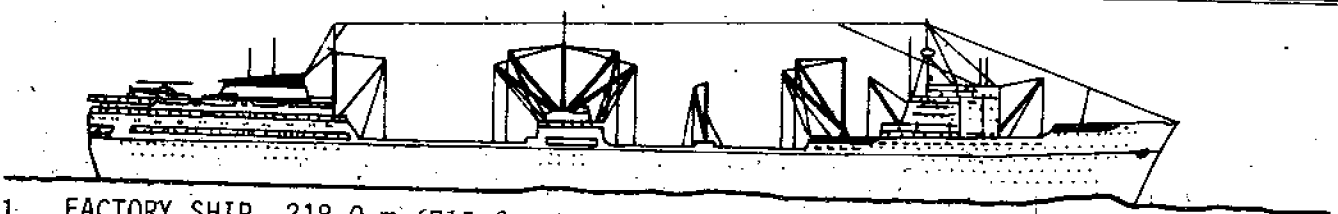
Deep Blue Waters

The world's most complex and largest rivers are not on land but at sea. Great current systems circle the world. Within the many layered waters of the ocean, the large deep-water fishes and mammals live and move about in pursuit of food. It is estimated that many thousands of pounds of aku (skipjack tuna) are in Central Pacific waters. The vastness of the ocean makes it difficult to take an accurate census of the inhabitants that live in the blue waters of the world's oceans.

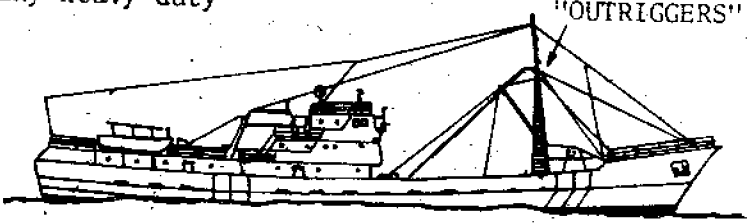
OCEAN HARVESTERS

19

Each of the boats below is equipped with different kinds of "fishing" gear. Depending upon the habits of each animal and where these animals can be found, different ways to catch them had to be developed. Can you match the animal with the way it is caught?

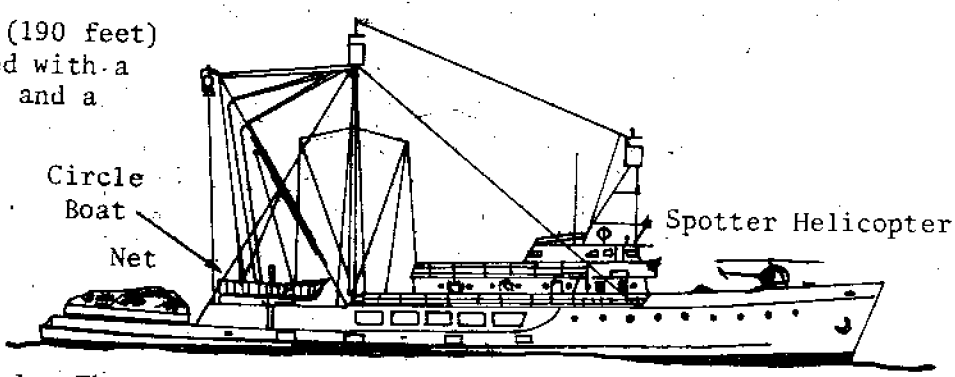


1. FACTORY SHIP, 218.0 m (715 feet)
   Extra large ship, fitted with many heavy-duty cranes and a helicopter pad.



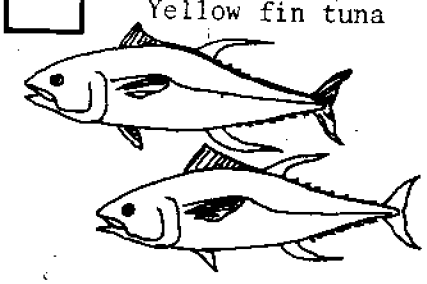
2. SIDE TRAWLER, 59.5 m (195 feet)
   Two "OUTRIGGERS" hold one small trawl net each, which are towed behind the ship at great depths.

3. PURSE SEINER, 57.9 m (190 feet)
   This boat is outfitted with a "spotter" helicopter, and a small boat to tow net in a circle to surround a school of fish. A crane then pulls the "draw strings" at the bottom of the net to close it, trapping the school. The crane then pulls the netted fish in.



Write the number of the ship in the box next to the animal it catches.

☐ Yellow fin tuna



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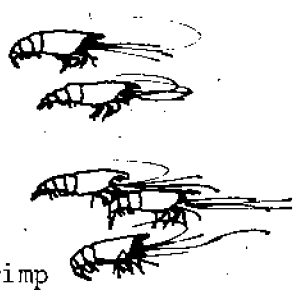
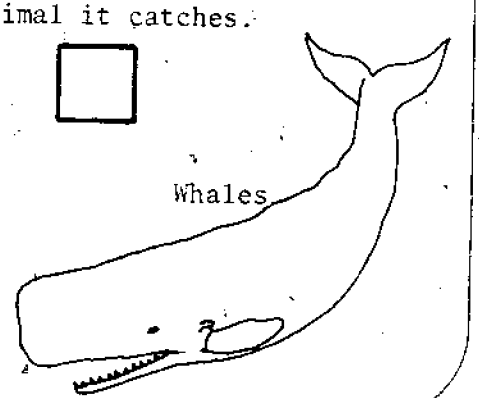


☐ Whales



UNDERWATER 'LANDSCAPE'

20 ▫▫ vocabulary

Scientists have measured the great depths and found that the shape of the ocean floor, or TOPOGRAPHY, is very much like that on land. Some of these underwater formations are listed below.

PART I. Draw a line from each word to the correct definition.

1. abyssal plain
2. atoll
3. continental margin
4. guyot or plateau
5. ridge
6. seamount
7. trench
8. volcanic island

A. a volcanic peak rising from the sea floor that is "flat-topped" because of wave action.

B. the seabed along continents that forms a gentle sloping SHELF covered by shallow water ranging from a few to hundreds of kilometers wide. The edge of the shelf is very steep.

C. a submarine volcanic peak

D. a seamount sinking below sea level that has a ring of coral growing around it.

E. narrow, deep cuts with steep slopes, 2 to 4 km below the surface

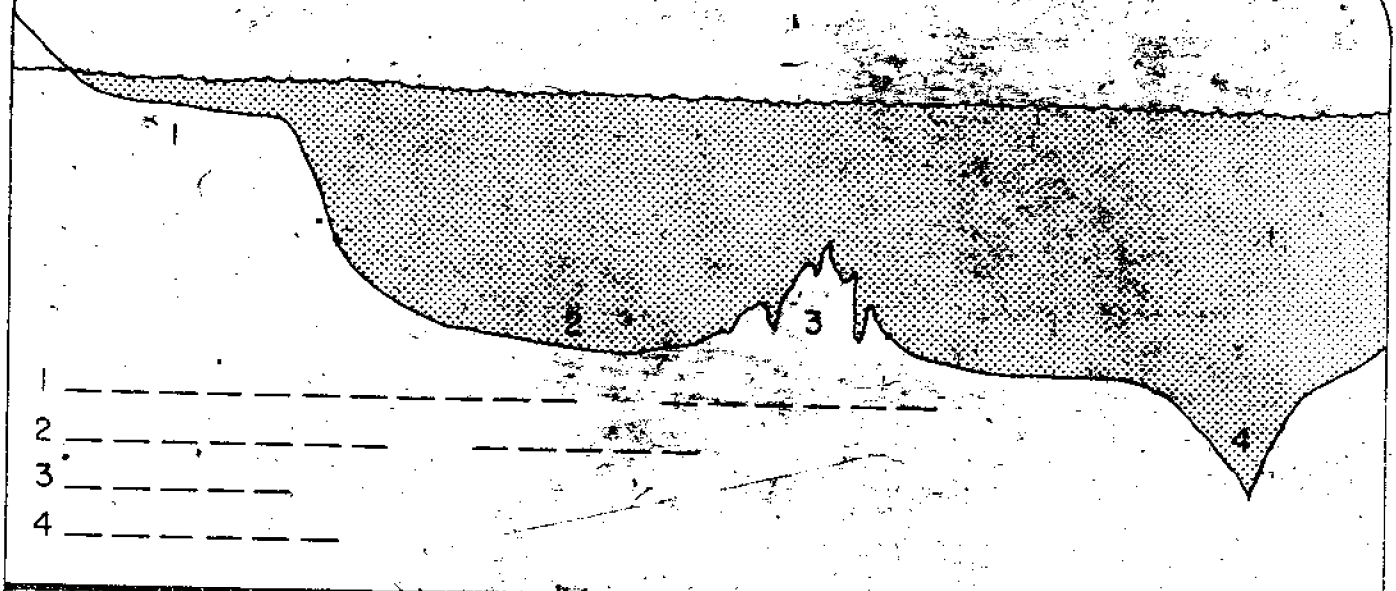
F. a peak formed by lava from the center of the earth, that rises above sea level.

G. a long, narrow rise in the sea floor with steep sides and a bumpy shape.

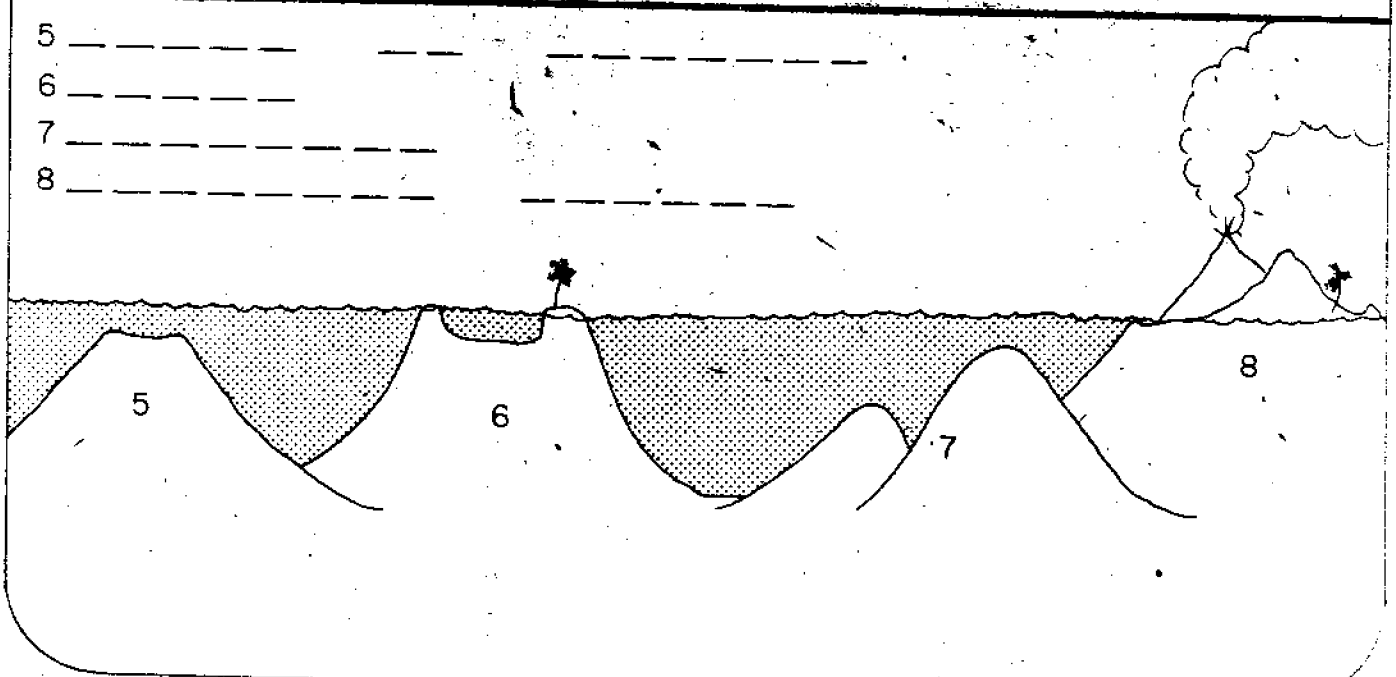
H. deep; covered with a thin layer of SEDIMENTS and chemical deposits like manganese nodules.

PART II. Find and label the underwater formations listed below:

A. abyssal plain
B. atoll
C. continental margin
D. guyot or plateau
E. ridge
F. seamount
G. trench
H. volcanic island



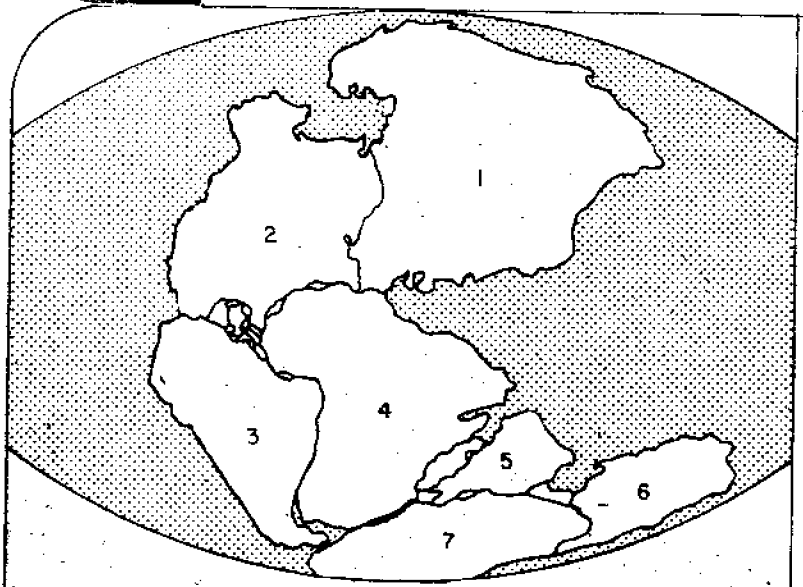
1 _____
2 _____
3 _____
4 _____



5 _____
6 _____
7 _____
8 _____

DRIFTING CONTINENTS

22



FIND THE CONTINENTS; WRITE THEIR NAMES BELOW:

1 _____

2 _____ _____

3 _____ _____

4 _____

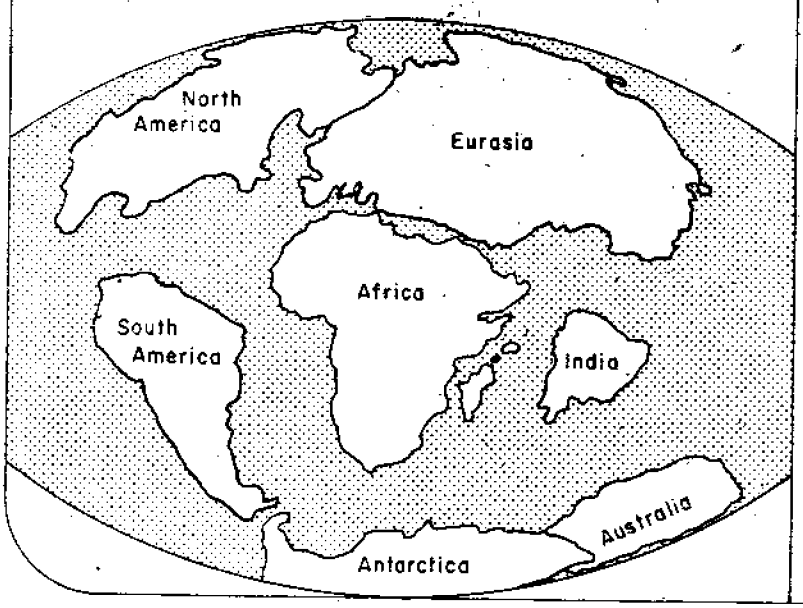
5 _____

6 _____

7 _____

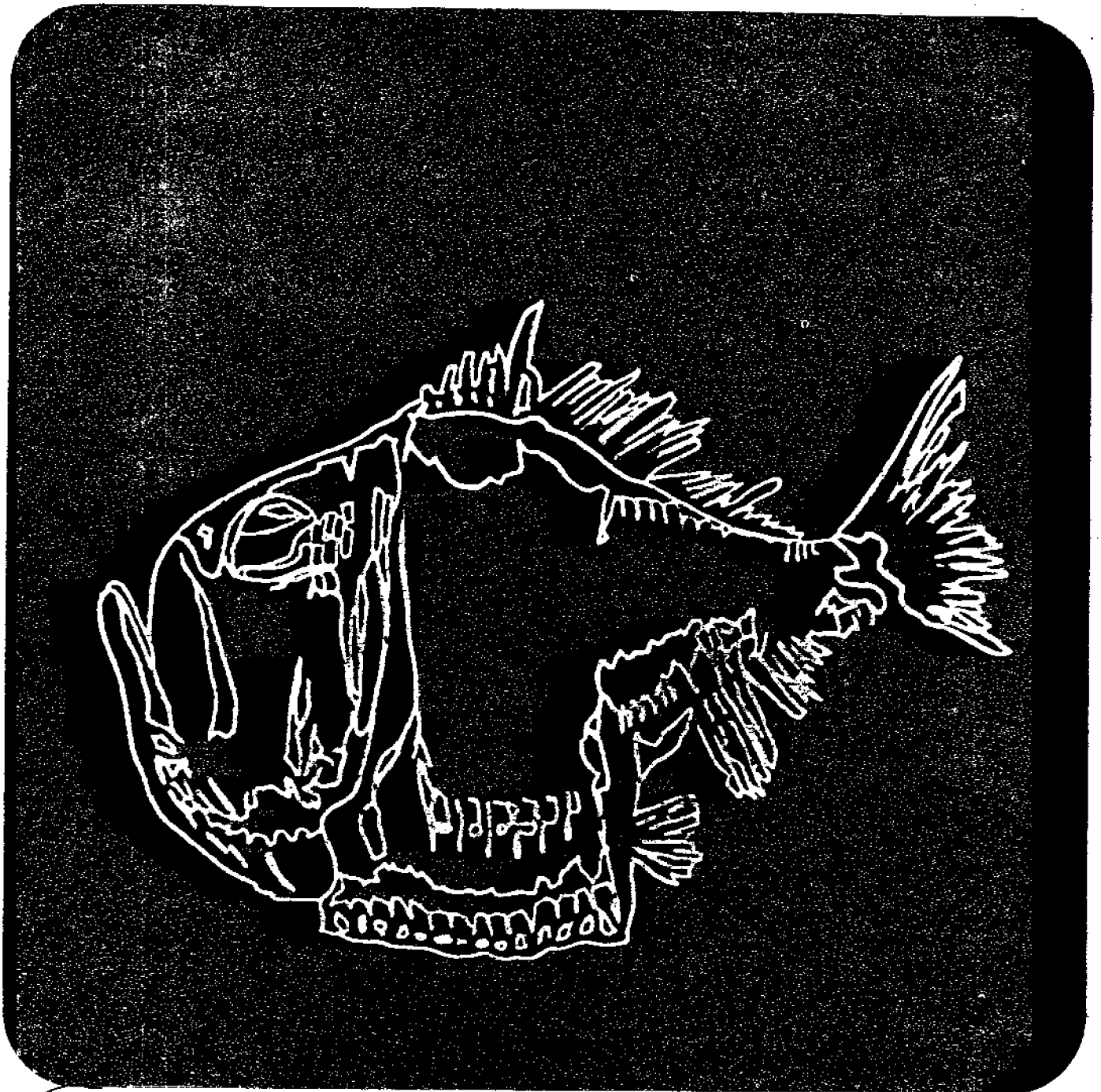
By fitting together the CONTINENTAL SHELVES of the major continents, geologists and oceanographers THEORIZE, or think, that the continents formed one large super-continent, called PANGAEA, which existed 200 million years ago.

Volcanic activity began to break up Pangaea 180 million years ago into the shape of the continents that exist today.



The Atlantic Ocean finally began to become a major ocean 65 million years ago. India is about to be attached to Asia and Australia is about to break away from Antactica.

The continents are still moving today. The Atlantic Ocean is getting wider, while the Pacific is closing.

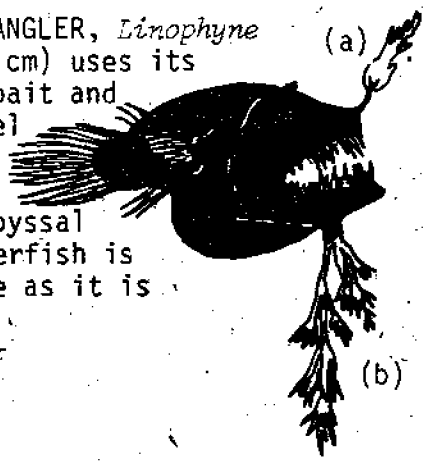


The Darkest Depths

Sunlight reaches down to a depth of 183 m (600 feet) in clear waters. Beyond that it is pitch black. For a long time it was thought that nothing lived in the abyssal depths of the ocean. When scientists developed submersibles and it was possible for human beings to go down to the bottom of the sea, they discovered that nature adapted fishes in wonderous ways. Fishes carry their own lanterns for "torching" and they are small and their bodies withstand the high pressure at the ocean bottom.

24 ANIMALS OF THE DARKEST DEPTHS

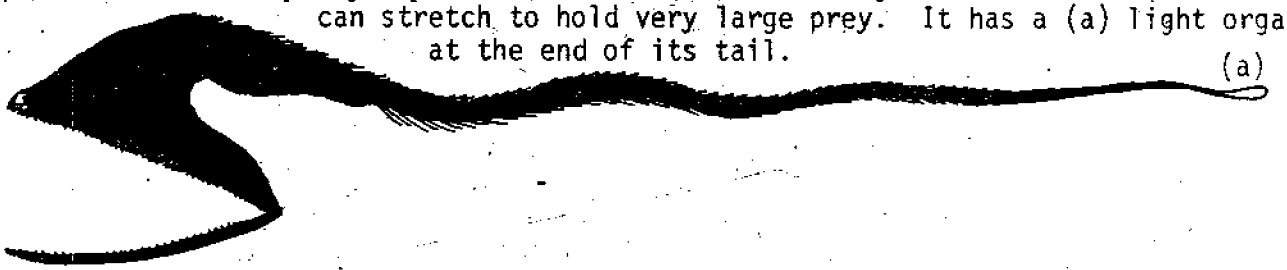
Only animals that are best suited to the place in which they live survive. The animals of the great depths, or abyss, have to be able to live in a place where no surface animal, including man, can live. The abyss is so far below the ocean's surface that it is out of reach of the sun's light and warming rays.



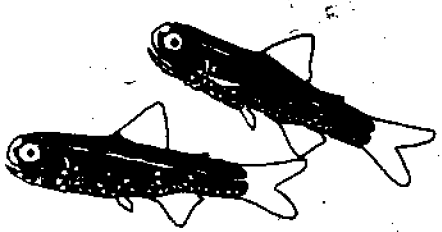
The DEEP-SEA ANGLER, *Linophyne arborifera* (7 cm) uses its (a) luminous bait and (b) chin barbel to attract food to it. Unlike most abyssal fish the anglerfish is almost as wide as it is long.

Stomias affinis also has a luminous chin barbel and is 9 cm long.

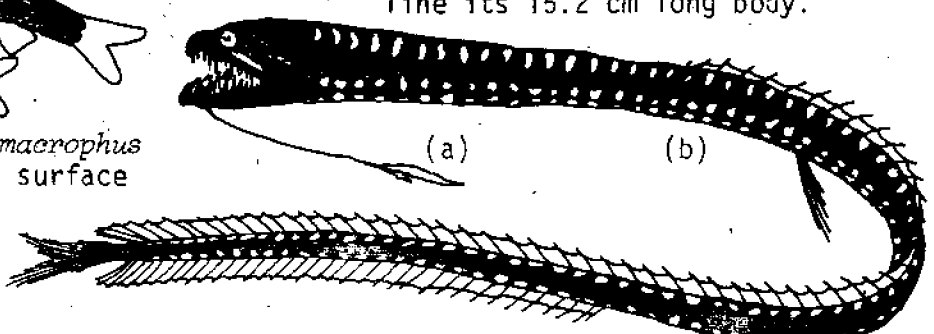
GULPER EEL, *Eurpharynx pelacanoides* (60 cm) has a huge mouth and a stomach that can stretch to hold very large prey. It has a (a) light organ at the end of its tail.



This STOMIATOID FISH, *Idiacanthus panamensis* has (a) a luminous organ at the end of its chin barbel and bluish-white patches, and (b) light organs that line its 15.2 cm long body.



LANTERN FISH, *Diaphus macrophus* (4 cm) comes up to the surface at night to feed.



This makes the abyss always pitch black and very cold, just above freezing. Another thing abyssal animals must adapt to is the great pressure from the weight of the water above. Mainly because of these three reasons, food is very scarce. To survive, the animals have adapted themselves so they can eat what comes along and they can also produce light to attract prey.

AT HOME IN THE DEPTHS

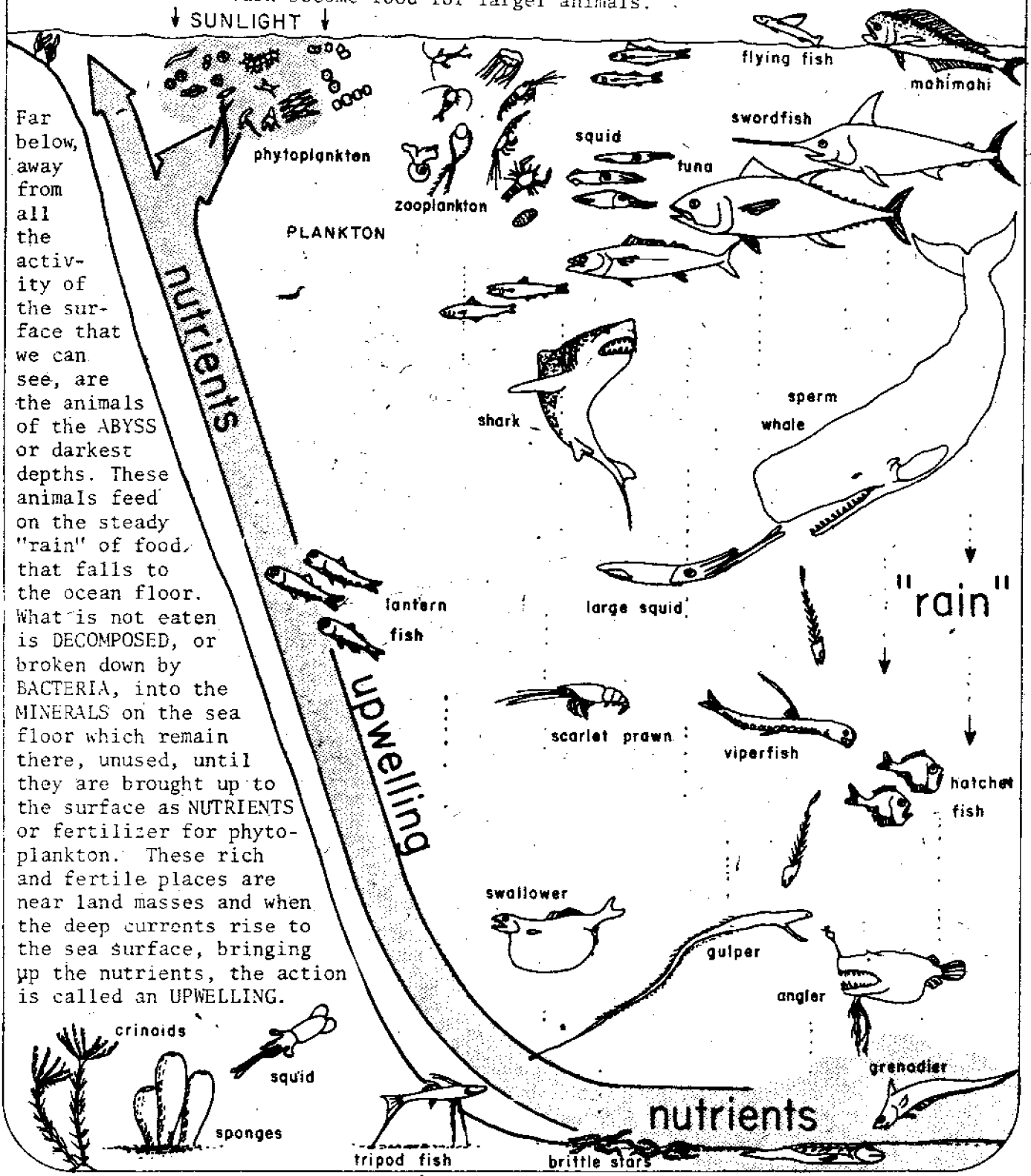
25

After seeing how abyssal animals are different from surface animals because they have adapted to living in the darkest depths of the ocean, draw what you think you would look like if you called the darkest depths "home."

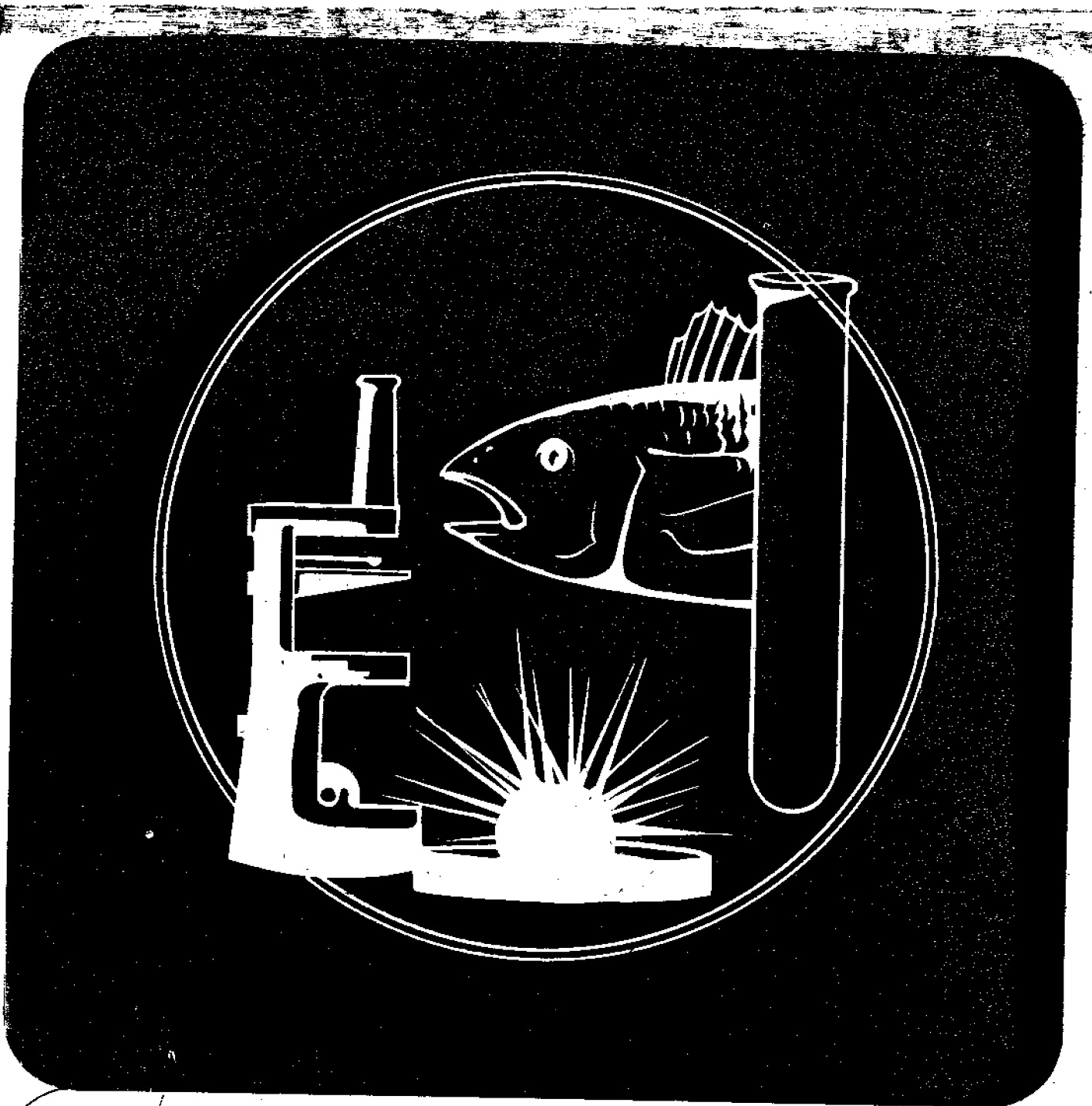
MARINE FOOD WEB

26

All life in the ocean is a part of the MARINE FOOD WEB. The beginning of the web is in the sunlit zone of the ocean. Here, microscopic phytoplankton use energy from the sun, to grow. The phytoplankton then serves as food for other microscopic animals which in turn become food for larger animals.



Far below, away from all the activity of the surface that we can see, are the animals of the ABYSS or darkest depths. These animals feed on the steady "rain" of food that falls to the ocean floor. What is not eaten is DECOMPOSED, or broken down by BACTERIA, into the MINERALS on the sea floor which remain there, unused, until they are brought up to the surface as NUTRIENTS or fertilizer for phytoplankton. These rich and fertile places are near land masses and when the deep currents rise to the sea surface, bringing up the nutrients, the action is called an UPWELLING.



SeaLAB

A fun way to experience the wonders of the ocean is to do experiments! It's exciting to be able to touch the animals and plants and find out what they're like. Oceanographers conduct experiments to find out not only about life in the ocean but also to find out about the physical properties of the ocean. Don't you wish you could go out on a boat cruise to take samples of the ocean bottom or ride in a submersible to study the ocean's darkest depths? Research is hard work but it helps us to learn about the ocean and all of its wonders.

A PORTABLE PORTHOLE

28

MATERIALS:

1 plastic gallon jug
1 tube silicone sealant
1 side of a plastic petri dish (size: 150 mm x 15 mm)

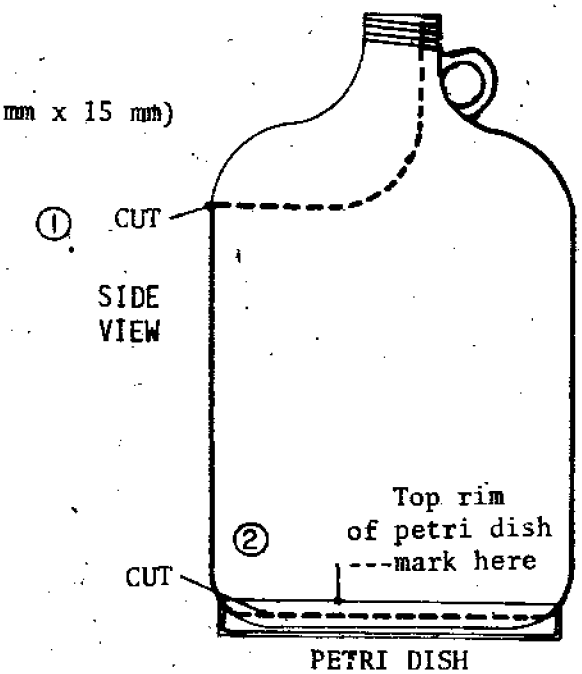
PROCEDURE:

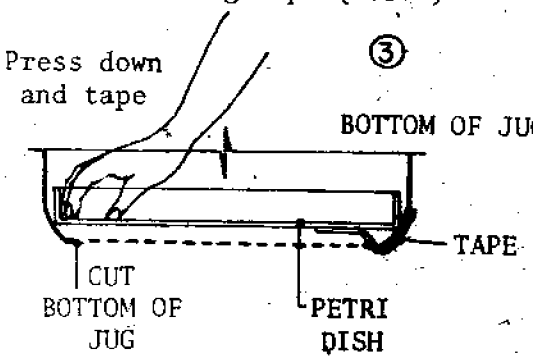
1. Cut top of jug as shown (right)

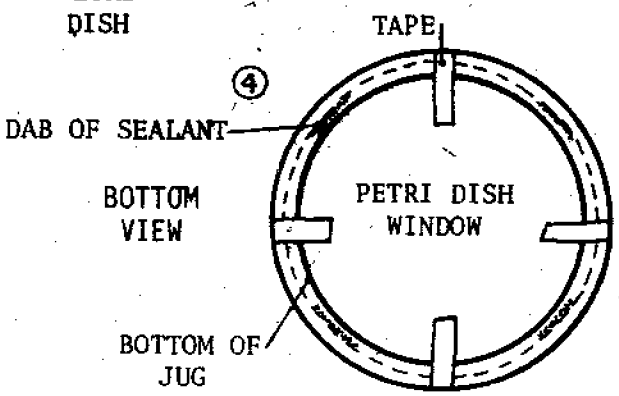
2. Set jug on petri dish; mark jug around top rim of dish (right)

3. Cut jug 1/4" below mark so the hole is slightly smaller than the dish (right)

Place one side of the petri dish inside of jug; push towards the bottom and hold in place with masking tape (below)



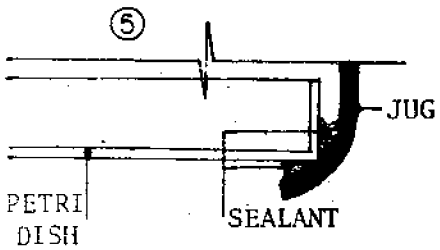




*4. Carefully dab sealant in 3 or 4 places around the edge to hold it into position. Let it set for 1 hour until it becomes firm. Remove masking tape.

*5. Lay a ribbon of sealant all around the crack between the petri dish and jug, both on the inside and outside.

Let stand to cure for 24 to 48 hours.



*WHEN WORKING WITH SEALANT, DO NOT GET IT ON THE FACE OF THE DISH, AND DO NOT TOUCH THE WINDOW WITH STICKY FINGERS. THIS MAKES THE WINDOW HARD TO SEE THROUGH.

ALGAE PRESS

29

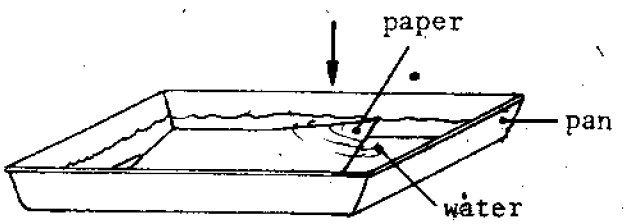
Seaweeds are the plants of the sea. In Hawaiian, they're called limu; scientists call it algae ("al-gee"). There are three major kinds of algae: reds, greens and browns.

In studying the different kinds of algae, the best method to preserve them is by pressing, much like you would the leaves of land plants. Once the algae is pressed and dried, it can be saved for future reference. Botanists, the scientists who study plants, press seaweed in an algae press. We can make our own press using much simpler materials.

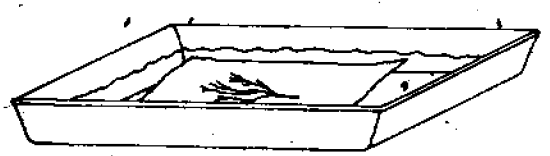
AN ALGAE PRESS

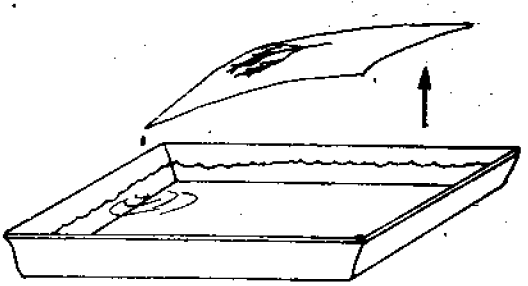
MATERIALS NEEDED:
- old magazines, newspapers
- smooth drawing or botany paper
- waxpaper
- scissors
- heavy weights: large books, bricks, stones, etc.
- a flat, shallow pan
- water
- seaweed

STEP 1: Fill the pan with about 1" of water. Cut a piece of drawing paper small enough to fit into the pan and lay flat on the bottom.

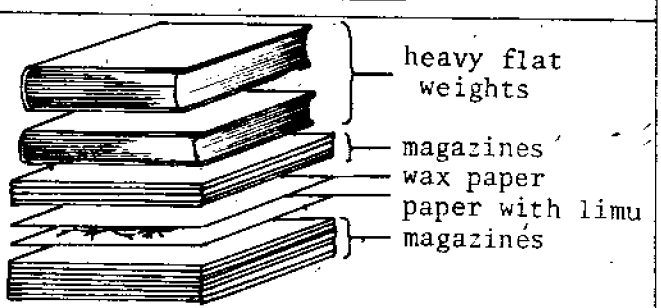


STEP 2: With the piece of paper lying on the bottom of the pan, float a piece of algae in the water to position it on the paper.





STEP 3: Carefully lift the paper, algae and all, out of the water.



STEP 4: In your "algae press" layer your materials as shown:

With some planning ahead, a booklet of different types of algae can be compiled. When the seaweed has been identified, this will be what botanists call an "herbarium" ("erb-a'-ree-um"). (If you are an artist at heart, these seaweed pressings can be made into greeting cards, wall hangings, collages, etc.!)

A FINAL NOTE ON COLLECTING ALGAE.

Algae is commonly found along the seashore in shallow waters. If you have ever gone to pick "ogo" to eat, you know where to look. Don't forget that seaweed also likes to grow around old pilings around the harbor, on old lines that have been hanging from the dock for a long time. Take along a zip-loc bag--it's handy for collecting specimens with a little bit of water.

GYOTAKU
30 Japanese fish printing

The techniques of Japanese fish printing has been used in Japan for over 100 years to record catches of sports fish and to gain ichthyological (fish biology) information. These prints have been used at the University of Washington to study how the physiology of a fish is related to its surface area.

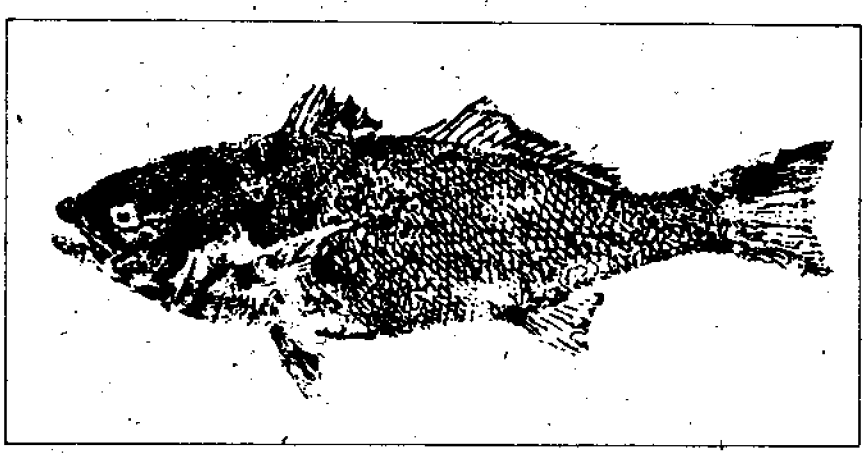
The art of gyotaku (ghio-ta-koo) is a good way to gain an understanding and appreciation of the beauty and great variety of marine organisms. You can also use this technique for making prints of shells, rocks, flowers and other items.

Before you make a print, identify the fish. What are the distinguishing characteristics of the fish? Study the life history of the fish. Where and how was it caught?

MATERIALS

Obtain a very fresh fish. If you buy the fish at a market, select one that has bright red gills, clear eyes, and a fresh smell. If the fish has been gutted, make sure that it has not been cut anywhere else on the body.

You also need:
*newspaper
*plastic modeling clay
*pins
*water base ink (linoleum block ink is best)
*a stiff 1/2" brush
*rice paper, newsprint, or other moisture tolerant paper. Since rice paper is expensive, you might prefer to start with newsprint.

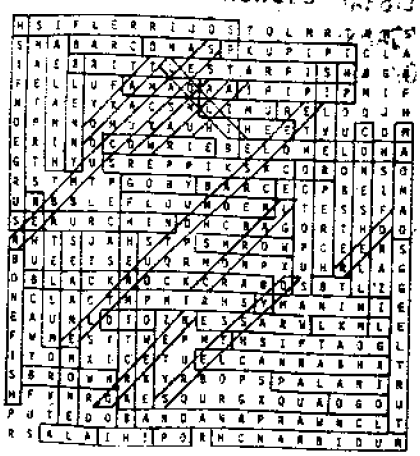


METHOD

1. Use soap and water to clean the outside of the fish as completely as possible. The cleaner the fish, the better the print. Dry the fish well.
2. Place the fish on a table covered with newspapers. Spread the fins out over some clay and pin them in this position. Continue to dry the fish.
3. Brush on a thin, even coat of ink. Leave the eye blank unless you prefer to fill it in.
4. Place a piece of newspaper or rice paper over the top of the fish.
5. Carefully lay the paper over the entire fish. Use your fingers to gently press the paper over the surface area of the fish. Be careful not to move the paper too much since this results in double prints. Then remove the paper and you have a fish print.
6. Use a small brush to paint the eye.

CHEAT SHEET

(p. 5)
Word Search answers



(p. 5)
Animals that live in SANDY AREAS:
FLOUNDER
LIZARDFISH
MULLET
OAMA
SAND CRAB
SAND TURTLE
TURTLE EGGS

(p. 6)
1. CREST
2. TROUGH
3. WAVE LENGTH
4. WAVE HEIGHT

(p. 8)

1. B		4. B
2. B		5. B
3. B		6. B

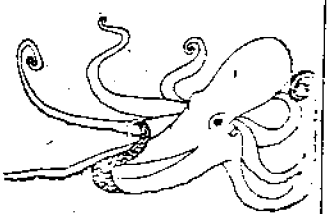
(p. 11)
1. vertebrate
2. invertebrate
3. vertebrate
4. invertebrate
5. invertebrate
6. vertebrate
7. invertebrate

(p. 12)
3 ulua
4 crab
1 sea cucumber
5 snail
2 sea urchin

(p. 13)
Fisherman A would be a 3rd order consumer.
Fisherman B would be a 4th order consumer.
Fisherman C would be a 5th order consumer.
Fisherman D would be a 6th order consumer.

(p. 15)
The shark helps both the pilotfish and remora but gets nothing in return.

(p. 16-17)
A. Part I
1. opelu, aholehole, sea dragon, he'e
2. crab, sea dragon, he'e
3. crab, sea urchin, he'e
4. aholehole, opelu
5. wana
6. opelu, aholehole



B. Part II

Many animals (fish & invertebrates)	Reproduce in great numbers to make sure a few will survive.
Crabs	Mask themselves with sponges and algae (seaweed).
Starfish and sea cucumbers	Regenerate body parts that they lose to escape enemies. Crabs & lobsters can also grow back their legs and claws.

(p. 19)

yellowfin	3	(purse seiner)
shrimp	2	(side trawler)
whale	1	(factory ship)

(p. 20)

1. H	4. A	7. E
2. D	5. G	8. F
3. B	6. C	

(p. 21)
1. CONTINENTAL MARGIN
2. ABYSSAL PLAIN
3. RIDGE
4. TRENCH
5. GUYOT or PLATEAU
6. ATOLL
7. SEAMOUNT
8. VOLCANIC ISLAND

(p. 22)
1. EURASIA
2. NORTH AMERICA
3. SOUTH AMERICA
4. AFRICA
5. INDIA
6. AUSTRALIA
7. ANTARCTICA

(p. 25)
How people would look:
1. very small
2. glowing lights to attract food
3. long needle-like teeth to hold fish or big mouth to swallow food whole
4. expandable stomach to hold anything
5. very big or very small eyes
6. soft body, no scales
7. colored black, silver or red

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 1976-77 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:

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