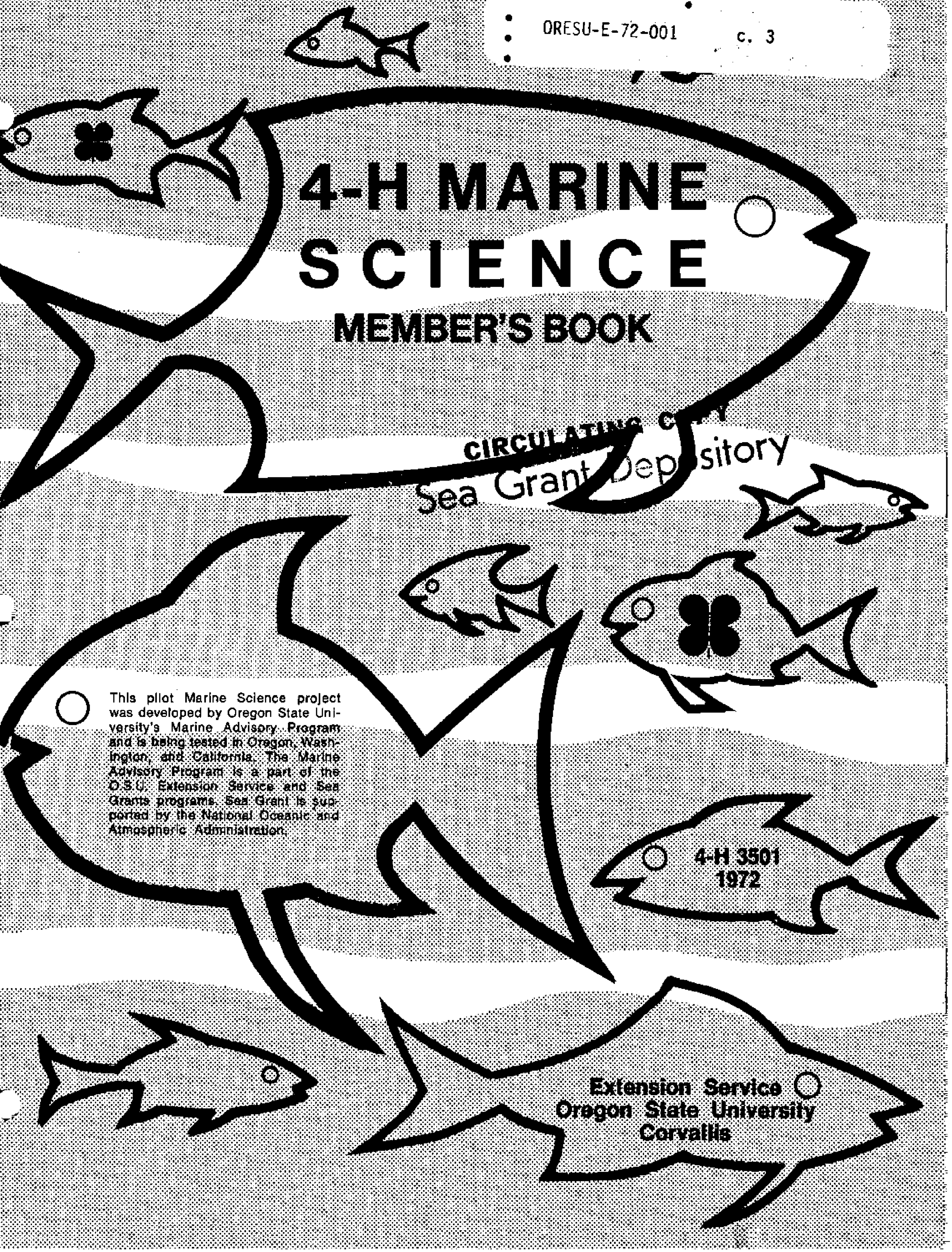

4-H MARINE SCIENCE

MEMBER'S BOOK

This pilot Marine Science project was developed by Oregon State University's Marine Advisory Program and is being tested in Oregon, Washington, and California. The Marine Advisory Program is a part of the O.S.U. Extension Service and Sea Grants programs. Sea Grant is supported by the National Oceanic and Atmospheric Administration.

4-H 3501
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Extension Service
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Corvallis

CONTENTS

Prepared by Mrs. Vicki Osis, Marine Science Education Specialist, assisted by Don Giles and others of the Oregon State University Marine Science Center staff, Newport, Oregon 97365. Questions about the project and the evaluation sheets should be sent to Vicki Osis. Requests for extra copies of these materials should be directed to county Extension offices in Oregon, Washington, and California. Requests from other states should be sent to the State 4-H--Youth Office, Oregon State University, Corvallis, Oregon 97331.

Cooperative Extension work in Agriculture and Home Economics, Lee Kolmer, director. Oregon State University and the United States Department of Agriculture cooperating. Printed and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.

4-H MARINE SCIENCE

A Pilot Project

In this project you will learn about: waves, tides, and ocean currents, beaches, bays and rocky headlands, and the animals and plants that live in the ocean and along its shores.

Each Marine Science Club will plan its own program by selecting activities from those listed below and by developing other similar activities. Instructions for some of these activities are in the Leader's Guide.

PROJECT ACTIVITIES

BEACH SAFETY

PHYSICAL OCEANOGRAPHY

Tides

Read pages 6 to 10. Study the illustrations.
Get a tide table.
Graph the tides for four days on page 11.
Discuss and fill in the Discussion Guide on page 12
Observe tides in relation to the location of the moon.

Waves

Waves and Beaches. Measure wave height and wave period - the time between waves

Longshore Currents

Man's Control of the Beach Environment

Upwelling

The Ocean Floor

Study the definitions and map on pages 19 & 20.
Make a model of the ocean floor. Label the features.

The Earth

Draw a cross section of the earth. Label the layers.

Ocean Currents

Sketch in the major surface currents on the map on pages 22 & 23.
Discuss and fill in Discussion Guide on page 21.

Prepare drift bottles to be placed in the ocean.

LIFE IN THE OCEAN AND ESTUARIES

Life in the Ocean

Make a scrapbook of animals and/or plants that live in the ocean. Clip pictures and articles from magazines or take photos or draw pictures and write about them.

Observe and/or read about one ocean mammal and one fish or bird, and report to your club.

Make a display (scrapbook or poster) showing animals that live in estuaries. This can be a team or club activity.

Food Pyramid of the Sea

Make a display (model or poster) showing the Food Pyramid of the sea. This can be a team or club activity.

Commercial Fishing

Learn about the commercially important fish and shellfish in your area.

Visit the waterfront of a coastal town to observe commercial fishing vessels and equipment and/or a sea food processing plant.

Visit your local market and make a list of the sea foods that are offered for sale - fresh, frozen, dried, smoked, canned or pickled. Check the labels to see which are processed in your state.

Personal Harvest Limit--Pocket Guide for 4-H Hikes

Field Trip to the Rocky Beach at Low Tide

Take a field trip to the rocky beach at low tide to observe animal and plant life on the exposed rocks. Observe where and how each species lives. How do they get their food, protect themselves from enemies, keep from drying out or being washed away by the waves.

Fill in the Rocky Beach Field Trip Guide, pages 25, 26 & 27.

Discuss your answers with your leader.

Preparation of a Marine Aquarium

Make a salt water aquarium. This can be a club project.

Collecting and Pressing Algae

Collect and press algae for a permanent mount. 4-H Mounting cards are available.

Label with name, date and place collected.

Sampling Plankton

Collect a sample of plankton.

BEACH SAFETY

Every year, people are stranded on offshore rocks, washed away by rip currents or waves, fall off cliffs or are crushed by drift logs. Many accidents can be avoided if people on the beach are aware of the dangers and know what to do if they find themselves in trouble.

One of the most common causes of deaths on the beach is by drowning while swimming or wading in the ocean. The swimmer is caught by the backwash, or by a rip current, or is surprised by an extra big wave. As waves break in the surf, there is a large surge of water toward the shore. After one wave passes and as the next one approaches, a strong flow of water returns seaward toward the next incoming wave. This flow seaward is called backwash, and can be fairly strong at times.

Rip currents, sometimes called undertows, present the greatest danger to swimmers. See the explanation of rip currents on pages 17 & 18. These currents can often be seen from the cliffs above the beach as the rapidly flowing water will carry sand or mud which discolor the water. Also, foam from the surf will be carried by the current creating a trail of foam from the beach seaward. Swimmers should avoid these areas. If they are caught by the current they should swim parallel to the shore until they are out of the current. Fighting to swim back to shore against the current is difficult and further tires and panics the swimmer.

Another common occurrence along the coast, is for the adventurous sightseers to make their way to the off-shore rocks which are accessible at low tide. During their exploration of the exposed rocks, the tide comes back in and cuts the explorers off from the beach.

Other deaths occur by falls. The cliffs along the beach are often crumbly and when the curious sightseer goes too close to the edge, the cliff gives away and he tumbles into the surf.

Beachcombing or playing among drift logs at high tide invites danger. High waves can move the logs around and crush a person.

Safe boating requires study. Tide tables often include information about safe boating practices.

PHYSICAL OCEANOGRAPHY

There is three times as much water as land on the surface of our planet, Earth. Yet man has only recently begun the systematic study of the oceans. Scientists call this study OCEANOGRAPHY. Oceanography is the study of all things about the ocean including geology, chemistry, physics, biology and other sciences.

Most oceanographers recognize four major bodies of water which they call oceans. The Pacific is the largest, the Atlantic second in size, the Indian third, and the Arctic the smallest. Some oceanographers recognize a fifth ocean, the Antarctic, but this depends on their definition of an ocean. Most oceanographers agree that an ocean should be bounded by continents, have distinctive bottom features, or other physical factors. These oceans are interconnected; water can pass from one to another.

Scientists once thought that all ocean floors were smooth plains with no hills or mountains on the bottom. However, modern methods of depth finding show that the ocean floor is very rough. There are hills, mountains, and valleys much like those found on the land. Some of these ocean mountains are much larger than those on land.

Man has long been familiar with the ways the ocean can change a coastline. He has often attempted to keep these changes from taking place. His attempts usually fail and more damage results.

These are just a few of the problems the modern oceanographers must deal with. In order for us to study the ocean and some of its effects, let's start at the edge of the land where the ocean is more familiar to us.

TIDES

One thing an "inlander" sees on a visit to the coast, is the rhythmic variation in the depth of the water at different times of the day. Coastal people would recognize this variation as the result of the TIDE.

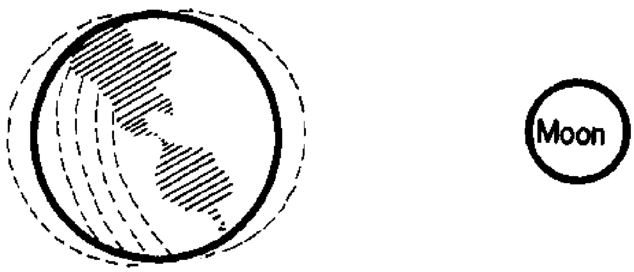
Tides are very important to people who live on the coast. Those who make a living from the sea are influenced in their fishing and shipping by the deep or shallow water resulting from the tides. Other coastal dwellers must keep a wary eye on storms. Storm winds can raise the level of the tide to greater heights. Many marine animals and plants (including commercially important species) are influenced by the tides.

Man has been observing the results of the tide since he took to the sea. Yet, it is only recently that he has been able to explain the tides. Ancient mariners thought the tide was caused by the breathing of an earth monster. Later in history, when man began recording the events around him, he found the tides to be closely related to the movements of the moon.

He found that every twenty-four hours and about fifty minutes a complete tidal cycle of two highs (floods) and two lows (ebbs) are completed. Modern science has confirmed that lunar cycles, along with solar and other cycles, influence the tides.

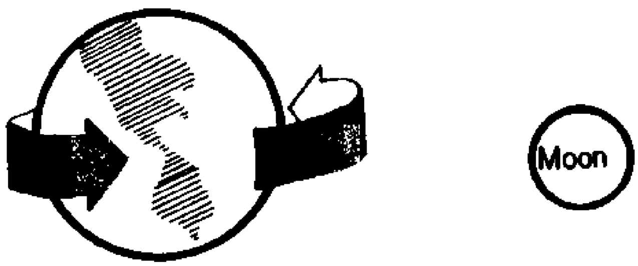
Although the sun is much larger than the moon, the moon's pull is greater. This is because the moon is so much closer to the earth than the sun. Other celestial bodies also exert a gravitational pull on the waters of the earth, but not very much.

How do the oceans on earth react to the pull of the moon and the sun? The gravitational pull of the moon causes a bulge of water toward itself and on the opposite side of the earth. It is as if the water directly under the moon were being pulled away from the earth, while the earth was being pulled away from the water on the other side. Actually it is more complicated and involves mathematical calculations of the moon's gravity and centrifugal forces on earth.



The moon's gravity causes two bulges of water on the earth's surface. One toward the moon and one on the opposite side of the earth.

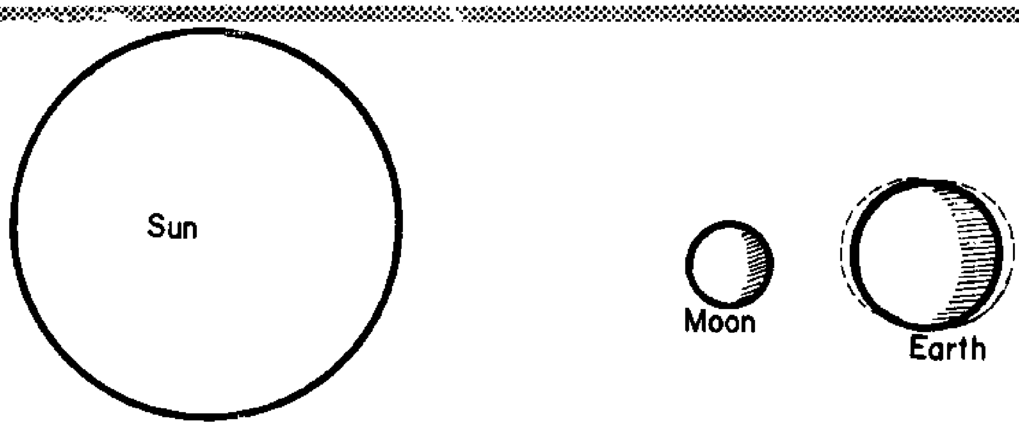
Since the moon travels around the earth once every month, we should have one low and one high tide each month. However, the earth rotates once every twenty-four hours. This results in the daily high and low tides. But, if the earth rotates every twenty-four hours, why does the tide average twenty-four hours and fifty minutes? This is because the moon is revolving around the earth in the same direction that the earth is rotating. It takes an a average of fifty more minutes for a spot on the earth to pass under the moon each day because the moon progresses in the earth's revolution.



If the moon remained in the same position with the earth at all times, Oregon would pass under the moon every 24 hours; but, the moon revolves around the earth in the same direction that the earth rotates. While Oregon makes a complete circle in 24 hours, the moon has traveled about 54,636 miles ahead. In order for Oregon to pass directly under the moon again, it must travel for about another 50 minutes. Thus, the tides are about 50 minutes later each day.

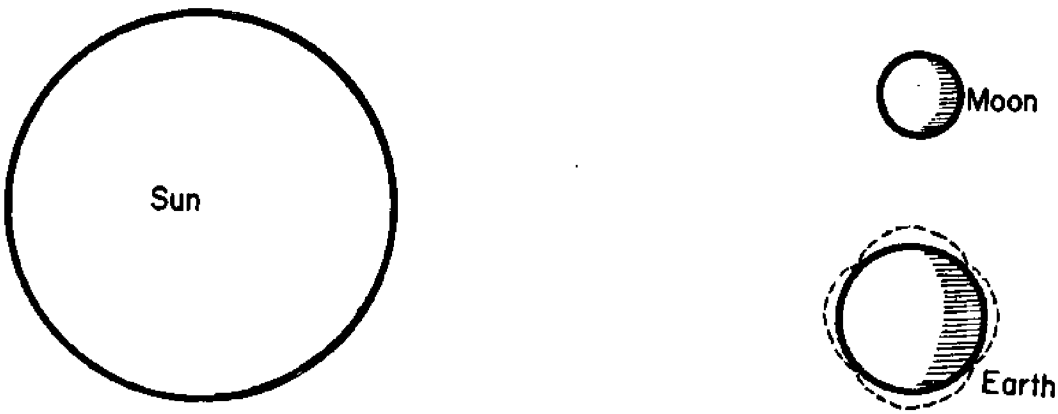
The sun exerts some influence on the waters of the earth. The smaller sun bulges are usually out of phase with the moon bulges and do not overlap them. However, two times a month the bulges are in phase and this produces SPRING TIDES. Spring tides occur at the time of the "new moon" (sun and moon lined up on the same side of the earth) and the "full moon" (sun and moon on opposite sides of the earth).

Spring tides represent the highest and lowest of the tides. New moons produce higher water than full moons. Why? Because the sun and moon are pulling in the same direction.



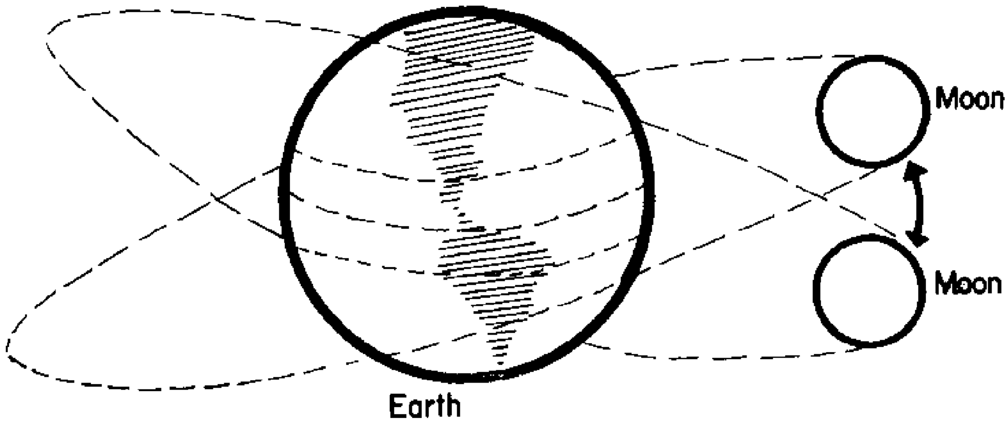
When the earth, moon, and sun line up at full and new moon, the tides are highest and lowest. The tides at that time are called SPRING TIDES.

Another and almost opposite effect is achieved when the moon is at first and last quarter. This produces the least high and low tides, which are called the NEAP TIDES. In this phase the moon, earth, and sun form a 90 degree angle and the bulges are out of phase. The change from spring tide to neap tide is gradual, following the progressive movement of the moon around the earth.



Neap tides occur when the earth, moon, and sun form a 90° angle with each other. The tides do not change as much from low to high at this time.

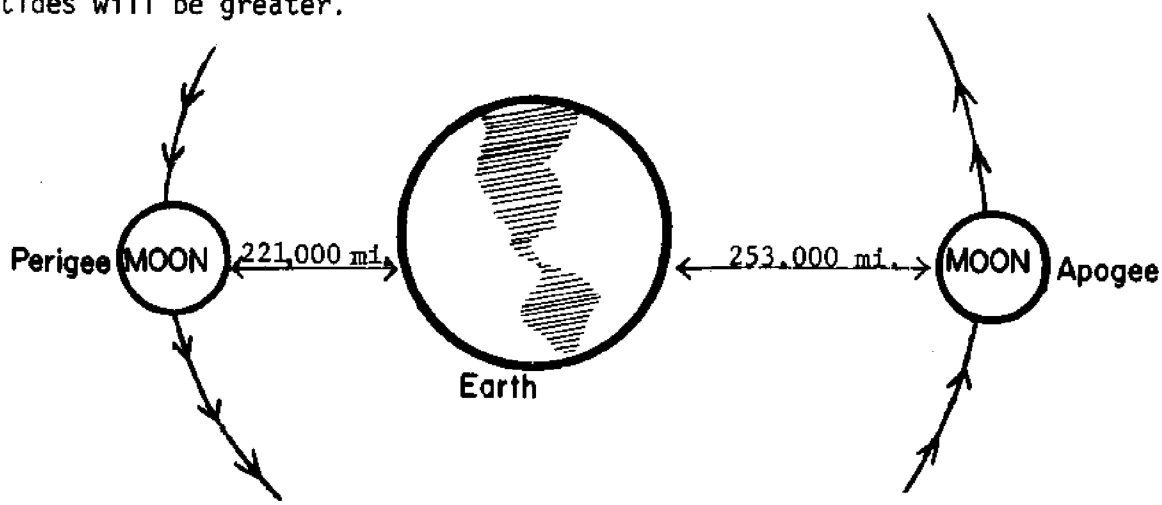
Besides spring and neap tides, there are other reasons why the tides are not equally high or low. The moon and sun are not always directly over the equator, but vary north or south. The moon varies as much as 28 degrees north or south each month. However, two times in the 30 day period the moon will be directly over the equator.



The moon changes positions in relation to the earth each month. Since the tidal bulges follow the gravity of the moon, they will also change with the moon.

Likewise, the sun is over the Tropic of Cancer (23½ degrees north) and the Tropic of Capricorn (23½ degrees south) once each year and over the equator two times a year. As the sun and moon vary from northern to southern hemispheres and back again, the tidal bulges follow their movement.

The orbit of the moon around the earth is not round. Rather, it is eliptical with a distant point (apogee) and a near point (perigee). The same is true for the orbit of the earth around the sun. Since gravity exerts the strongest influence on objects when they are nearest, perigee tides will be greater.

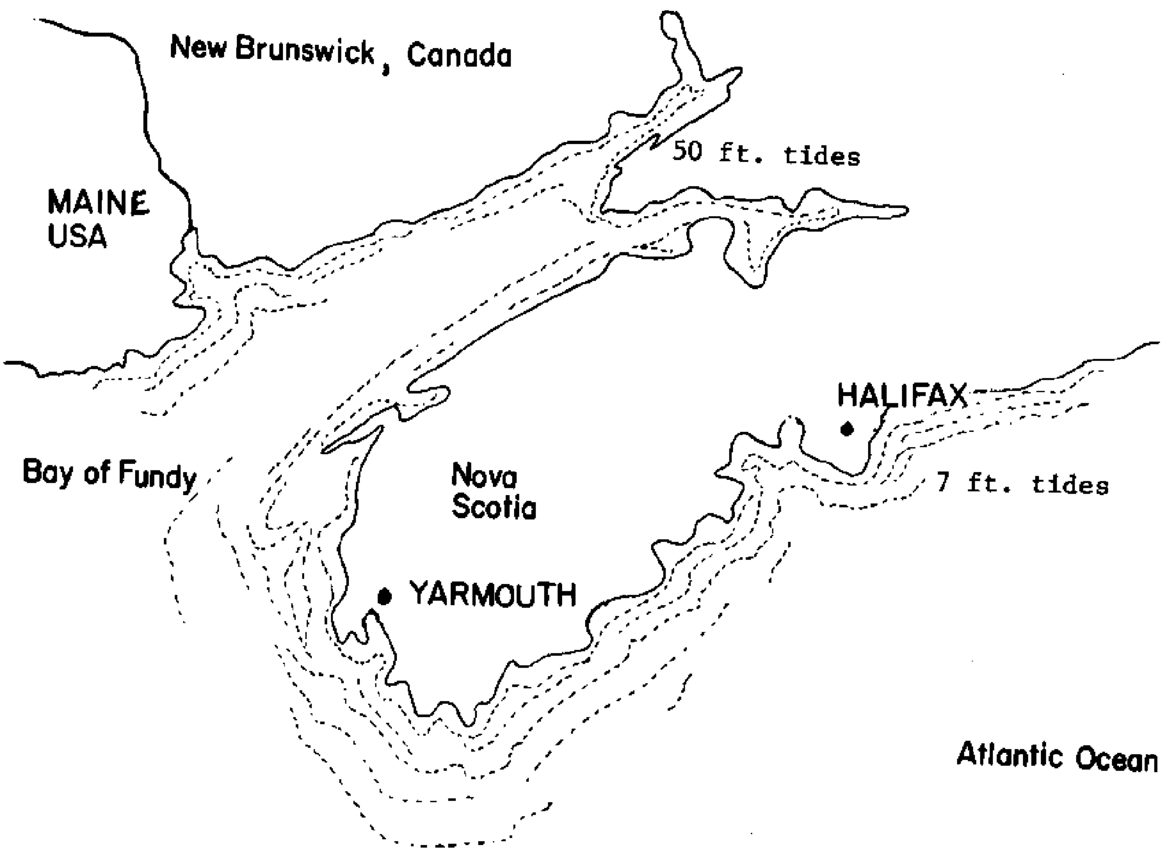


Perigee tides will be more extreme than apogee tides because the moon is closer at perigee.

Winds also produce variation in the tides. If a strong wind is blowing with a flooding tide, the water may be several feet higher than predicted. Likewise, if a wind is blowing in the opposite direction to the ebbing tide, the water may remain higher than at normal ebb tide. This is caused by friction of the air against the water. Witness the extreme tides of hurricanes, when water is actually blown in or out according to the direction of the wind.

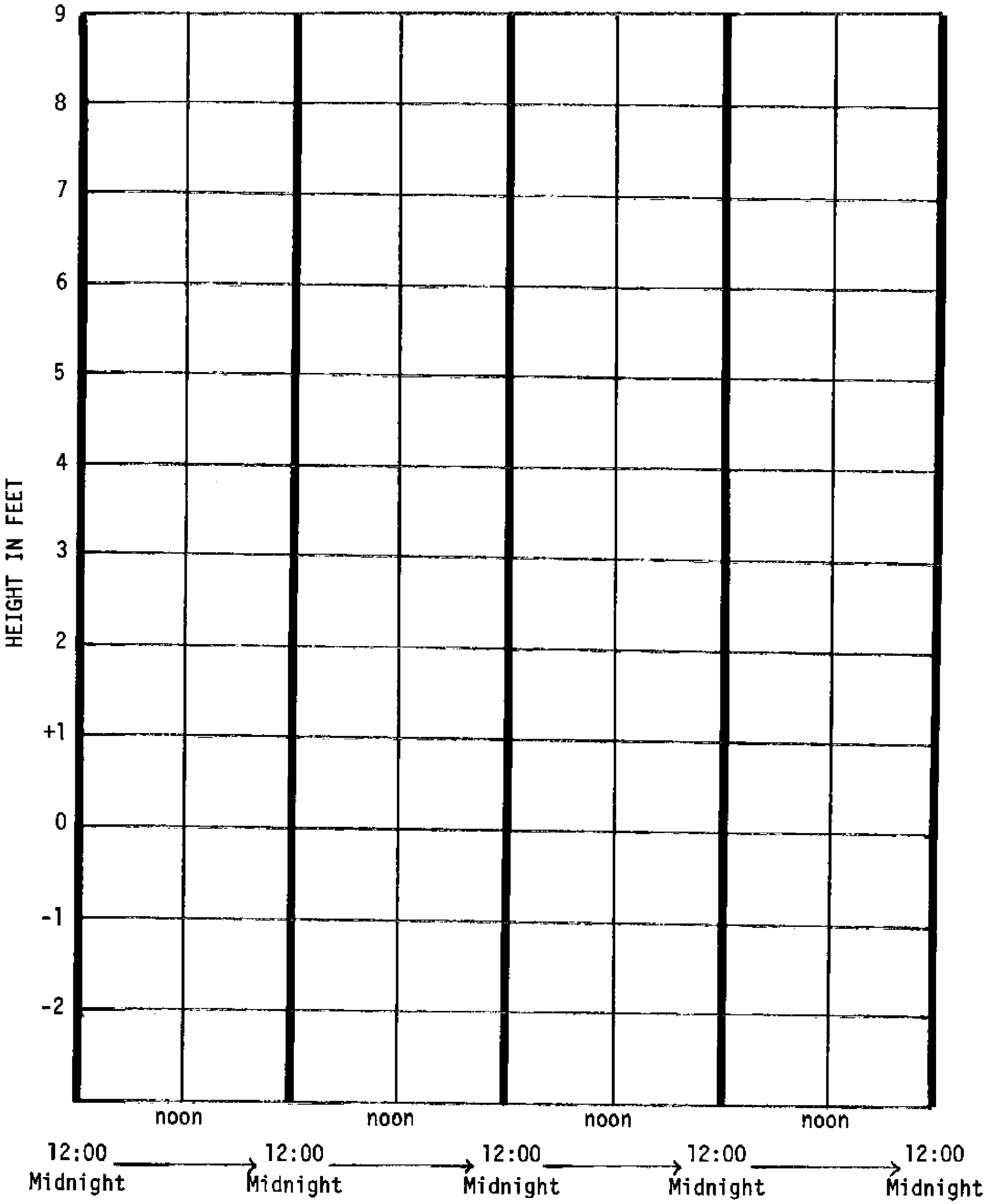
The topography of the earth beneath a body of water exerts tremendous influence on the depth variation between high and low tides. The Bay of Fundy, with fifty foot tides at its head, is an excellent example. Although Fundy is deep and wide at its mouth, it narrows gradually, and the floor slopes upward toward the head. At low tide the upper reaches of the Bay are dry, but as the tide changes, large volumes of water entering the mouth quickly fill the limited space, and greatly raise the water level. At high tide (flood) the water level rises as much as fifty feet and the tidal currents reach a speed of eight knots. These conditions make it very dangerous for fishermen caught in the basin on changing tides.

In contrast to the Bay of Fundy are the tides at Halifax, Nova Scotia. Halifax is located on the Atlantic and the water is rather deep near shore. Tides here range at the most only seven feet. Also associated with bottom topography and flooding tides, are TIDAL BORES. A tidal bore is a wave of water created by the flooding tide as it moves up a coastal river, and is caused by an incoming tide.



Map of New Brunswick and Nova Scotia showing the Bay of Fundy.

GRAPHING TIDE LEVELS



24 hour time span

Tide Table Discussion Guide

1. Where are the high tides listed on the page for this month in your tide book?

2. How is a.m. written differently from p.m. in your book?

3. Under the heading HIGH WATER, Time and Feet is written twice. What does the measurement in "ft." mean?

4. How many high tides, and how many low tides does the Oregon coast have each day?

5. List the time and the tide level for all four tides today.

6. Are the two high tides the same height today? Are they the same height any day this week?

7. Which is the lower tide, a -1.1, or a 1.1?

8. If there is a bad storm blowing on the day you want to go clamming, how do you think the storm will affect the tide level?

9. Give the date, the tide level, and the time that you would like to go clamming.

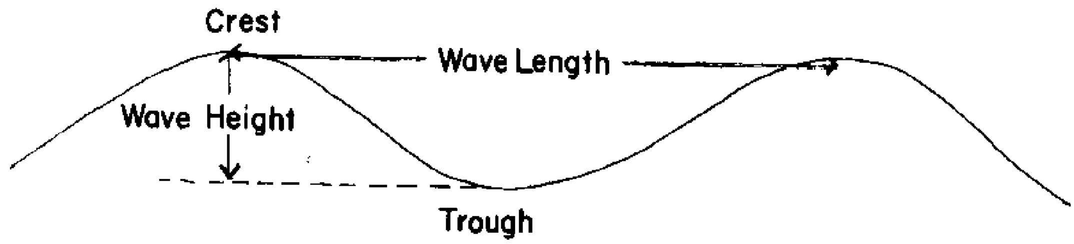
10. Give one example of other information you can obtain from your tide table.

WAVES

If you have ever been surfing, you know that there is more to it than just standing on a board. In fact, the first thing a beginner must learn is how to get out through the surf. The next thing he must learn is to judge when the next wave will get to him so that he can catch a ride. With a little practice at this, he will see that the waves seem to follow each other in a pattern. In fact, they seem to break at about the same spot each time. Each one breaking at this spot will seem to be about the same size. Only after acquiring this bit of knowledge is the surfer ready to concentrate on riding the board.

Most of us may never go surfing, but waves are still important to us. Not only can waves cause serious damage, but they can benefit us when we harness their energy. Let's begin a study of waves by looking at their anatomy.

Waves are made up of the CREST and TROUGH. The crest is the highest part, and the trough is the lowest part. Waves can be measured for length and height. The horizontal distance between wave crests is called the WAVE LENGTH. The vertical distance between the crest and the trough is called the WAVE HEIGHT.



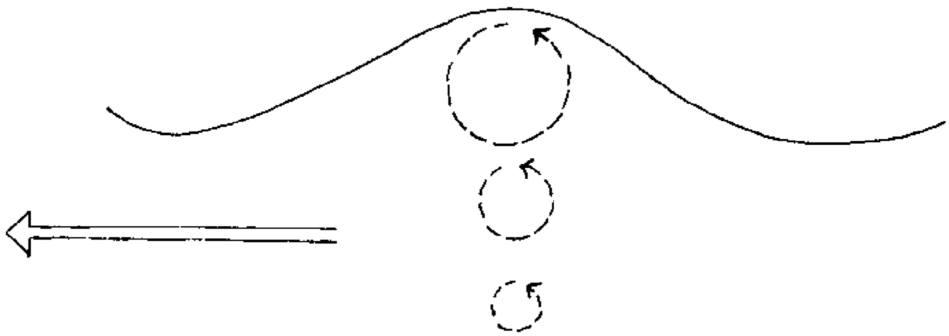
Anatomy of a Wave

Waves are timed by measuring the time it takes for two wave crests to pass the same spot. This time is called the WAVE PERIOD.

We know that waves move from place to place as SWELLS. We also know that those same swells will end their journey on some beach as BREAKERS, but do these waves carry water from one place to another? In order to find this out, scientists build wave tanks. The wave tank is a long rectangular structure with glass sides. Waves are generated at one end and can be observed as they move to the other end. Neutrally buoyant particles are introduced in the tank and their movement observed as swells pass. Interestingly, the particles do not appear to move forward. To see exactly what is happening the observers can trace the movement of the particles on the side of the glass. They find that the particles make a complete circle as a swell passes. This can be observed on a windless day on the ocean when there are swells present. Throw a floating object into the water and watch its movements.

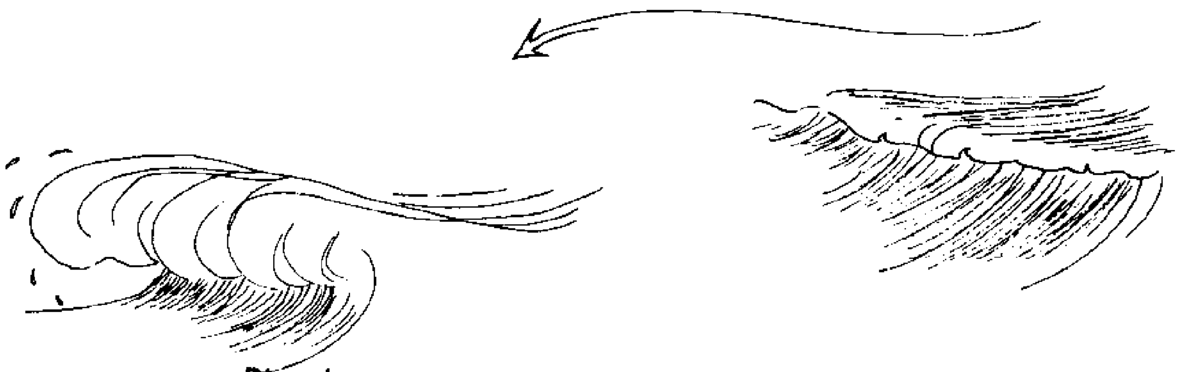
How far below the surface of the water does this circular movement occur? The wave tank again becomes useful as a scientist's tool. Neutrally buoyant particles are placed from the surface of the water to the bottom. When waves pass they disturb the water to a depth of one-half the wave length. Below this, there is no disturbance caused by the wave.

When waves encounter water shallower than one-half their wave length, such as at a beach, they are said to "feel bottom." As the water becomes shallower, the circular motion at the bottom is altered. The water there is slowed down. At the surface the circular motion is still moving very rapidly. In fact, it moves so much faster than the bottom of the wave that the top will spill over in front. Then the wave is known as a BREAKER.



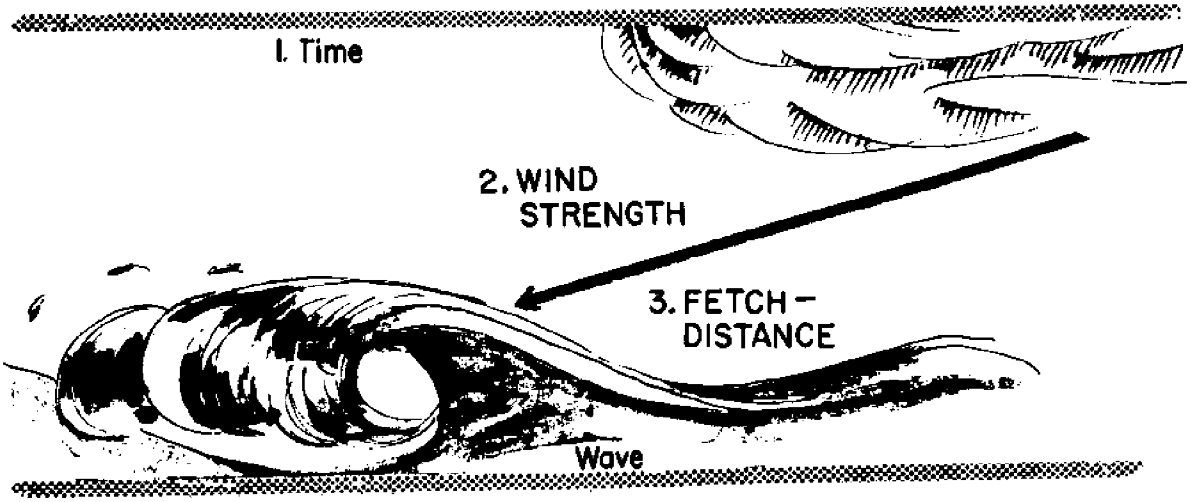
Motion of a particle of water in a wave. Notice the path forms a circle. There is slight movement forward, but not very noticeable. When many waves pass however, a large mass of water is moved very slowly. We call this mass movement.

Breakers do carry water along with them. Waves that transport water are called TRANSLATION WAVES. If the wave breaks very quickly, the crest will be thrown into the trough in front. This leaves, for a short time, a tunnel of water (surfers call this the Banzai Tunnel) and the wave is known as a PLUNGING WAVE. If the process is slow, the crest simply tumbles down the front of the wave into the trough. This kind of breaker is known as a SPILLING WAVE. Surfers prefer spilling waves because they last much longer than plunging waves.



Two Types of Breakers

Now we know a little about waves, but what generates them and where do they come from? The waves we commonly see at the seashore are WIND WAVES. These are generated by the friction of wind blowing across water. Usually wind waves are rather small, but storms can produce large waves. The size of wind waves is dependent on three factors, the fetch (distance over which the wind blows), and the strength of the wind and the length of time the wind blows. If all three factors are large, the waves will be large.



The size of wind waves is dependent on 3 factors: the length of time the wind blows, the strength of the wind, and the distance over which the wind blows (fetch).

Large storm waves can cause great damage. We must remember that even normal waves can erode vast areas of shoreline.

The most spectacular kind of wave is the SEISMIC WAVE. These are commonly called "tidal waves," but that name is unfortunate. Seismic waves are the results of movements of the sea bottom or undersea landslides. In fact, the word "seism" means earthquake in Greek. Since seismic waves have nothing what-so-ever to do with the tides, scientists have named seismic waves TSUNAMI (pronounced su-nah'-mee). Tsunami is the Japanese word for seismic waves.

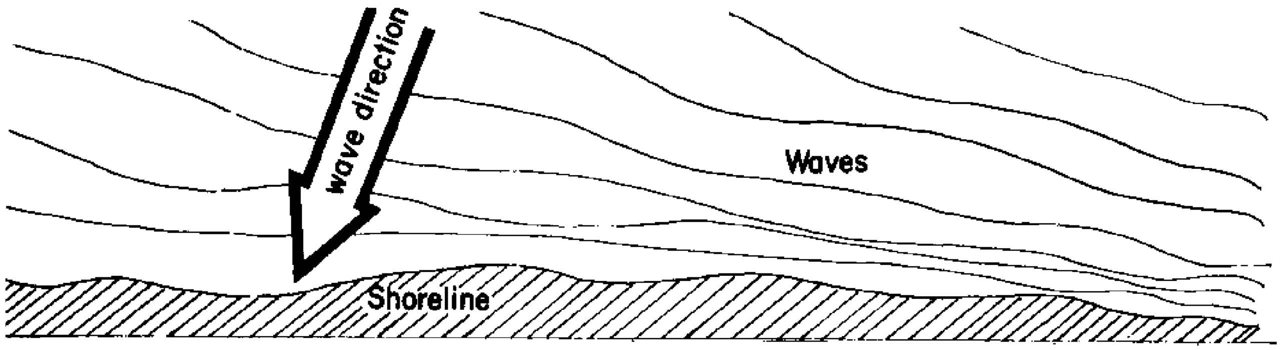
Although tsunamis are large at the coast, a ship at sea would hardly notice one passing. This is because their crests and troughs are so far apart. In shallower water the situation is completely different. The waves may become breakers as much as 100 feet high. On April 1, 1946, at Scotch Gap, Alaska, a tsunami completely demolished a radio tower that was placed on a rock 103 feet above the sea.

On the same day, Dr. Francis P. Shepard witnessed the results of the same disturbance in Hawaii. The wave took many lives and wrecked much property. Today there is a tidal wave warning system around the Pacific Ocean. When a seismograph station detects an earthquake, a warning is sent to all areas that could be hit by a tsunami.

Waves and Beaches

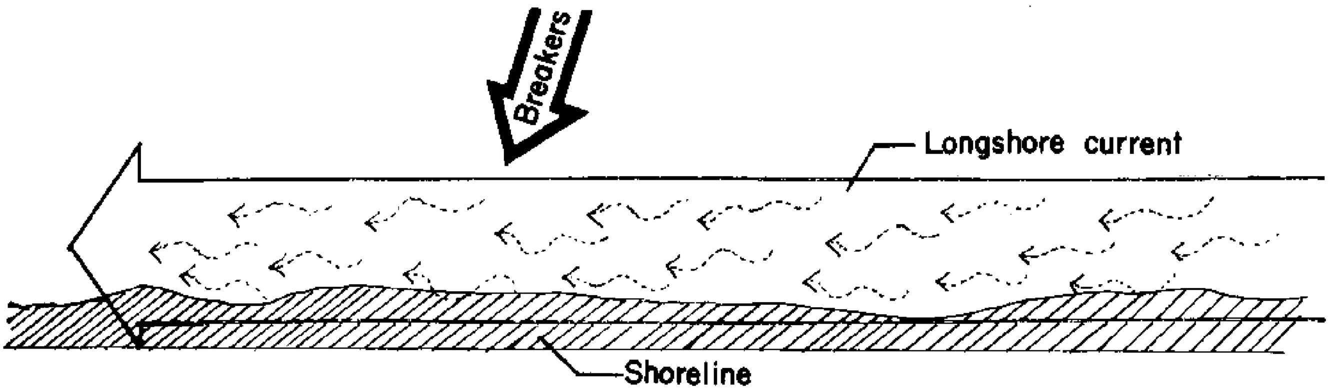
If you live inland, you probably think the ocean beach is a never-changing spread of sand. But, this is far from what a beach is really like. The beach bordering an ocean is constantly changing. This is due to the force of the wind and waves. As we have already said, the energy of the wind is picked up by the waves far at sea. When these waves travel to a beach all this energy is released on the beach. The larger the wave, the more energy it releases.

Although waves appear to hit the beach straight on, they seldom hit exactly parallel. Instead, they come from an angle. When a wave comes to a beach at an angle, the part closest to the beach feels bottom first. This part is then slowed down by friction with the bottom. This allows the rest of the wave to "catch up." From the air, the wave would appear to be bent so that it would be parallel to the beach. This bending is referred to as REFRACTION. Refraction takes most of the angle with the shoreline out of a wave, but there is usually a slight angle remaining.



Waves approaching a beach at an angle will be refracted. As they approach the beach, the part of the wave near shore will feel bottom and slow down. The other part will continue to move as fast as always and will seem to catch up with the other part.

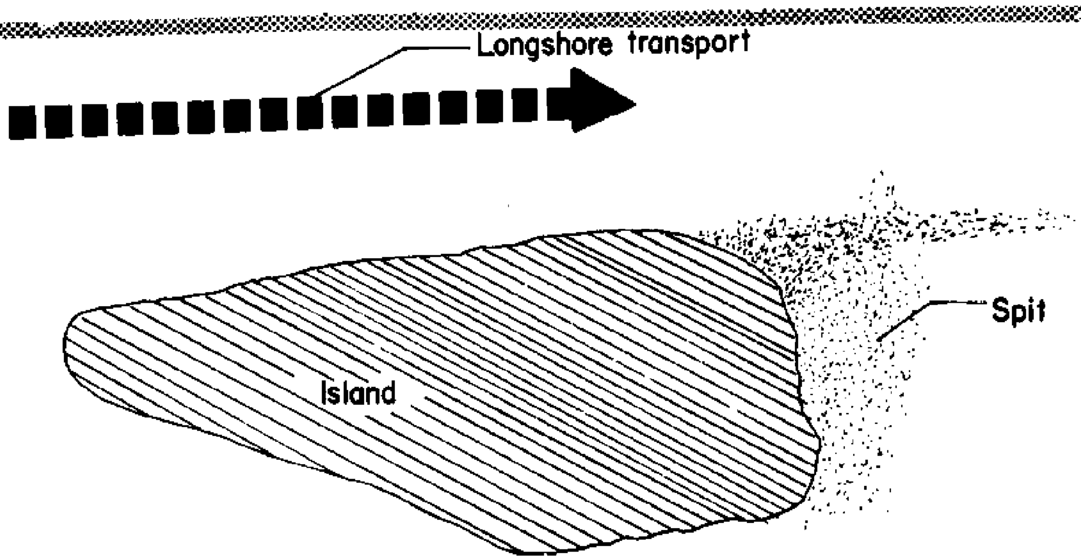
Since breakers are translation waves that carry water, many breakers hitting the beach at the same angle can transport large amounts of water along the beach. This movement of water along the beach is called the LONGSHORE CURRENT. The longshore current is only found in the breaker zone.



Waves hitting the shore at a slight angle cause a water current in the surf zone (wave zone) in the direction of the wave.

Longshore Currents

The longshore current is responsible for many of the natural alterations taking place on beaches. It can and does move tons of sand from one spot on the beach to another. For instance, next time you go to the beach notice the sand kicked up by incoming breakers. This sand kicked up from the bottom is moved along by the longshore current. The movement of sand along the beach is called the LITTORAL DRIFT or LONGSHORE TRANSPORT. The effects of the littoral drift can be seen on the ends of islands or peninsulas where the longshore current is operating. There, the waves no longer hit against the shoreline and the longshore current loses its energy. Sand is no longer carried along, but settles to the bottom. The results are long extensions of sand on the ends of these islands or peninsulas. We call these SPITS.

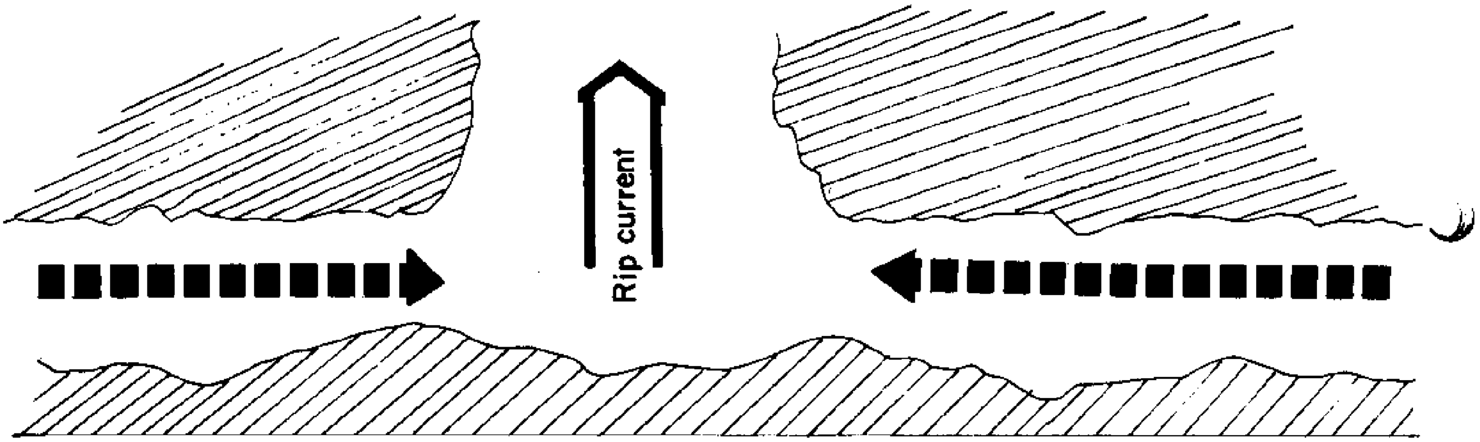


Island with a sand spit deposited on the end by the litoral drift.

Another common movement of sand at the beach is a movement offshore and onshore. The results of this movement are long mounds of sand parallel to the beach called SAND BARS. Sand bars are usually present offshore after a week or two of high breakers. When the waves are small for long periods, the sand bar is pushed toward shore and spread out by the waves.

Associated with sand bars are RIP CURRENTS. Breaking waves carry large amounts of water over the sand bar. The force of many waves breaking over the bar keeps water trapped between the bar and the beach. If the bar is broken anywhere along its length, water will go back to the ocean through the hole. This water comes from both directions inside the bar and a current going straight away from the beach results. This is the rip current.

Rip currents are responsible for carrying many bathers "over their head" at the beach. Rips are strong and should be avoided. However, when necessary, surfers and lifeguards can use rips to get through the surf rapidly. Coming back through a rip is very difficult and should be attempted only if you are an excellent swimmer. If you are ever caught in a rip, swim parallel to shore. When you get out of the current, swim to shore. With just a little practice you can learn to spot rip currents. They usually hold back waves and are sometimes discolored by sand and other debris picked up from the bottom.



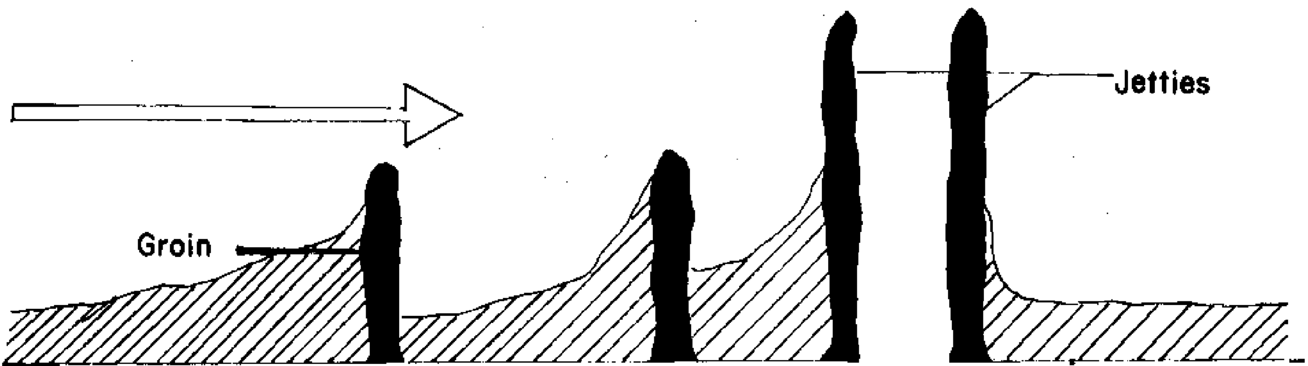
Water getting trapped between a sand bar and the beach can escape through a hole in the bar. This may produce a strong current running away from the beach. This current is called a rip current.

<u>Man's Control of the Beach Environment</u>

Years ago, ocean engineers thought barriers were the best way to keep a beach from washing away. Lately, they have found that stabilizing a beach in one spot can cause trouble somewhere else along the beach. For instance, if we stopped the littoral drift at the middle point on one of Oregon's beaches, the down current section of the beach would be soon deprived of its normal flow of sand. Eventually that section of the beach would erode away. The upcurrent section of the beach would build up and become much wider because the barrier stops the sand here.

Many materials have been tried as barriers, but large rocks are the cheapest and easiest to obtain. These rocks are used to form JETTIES, GROINS, and BREAKWATERS. Jetties are structures that extend into the ocean at the entrance of rivers or bays. They restrict the flow of water out of the river to a narrow channel. This tends to prevent SHOALS (sand mounds in rivers or lagoons) from accumulating at the river mouth.

Groins are similar to jetties but are usually placed perpendicular to the shore. They are grouped in a series, at critical points, to catch or hold sand.



System of groins and jetties. The groins are perpendicular to the beach and are used for actching and holding sand from the littoral drift. The jetties are found on each side of the mouth of the inlet or river; their purpose is to keep sand from "shoaling up" in the entrance.

UPWELLING

Upwelling occurs off the Washington, Oregon, and California coasts and is important to the marine life, economy and climate of those states. Upwelling occurs when surface waters are displaced and bottom water rises to the surface to replace it. On the Oregon coast the N.W. winds of summer and the rotation of the earth move the surface waters southward and seaward. Deep water then rises to the surface. This upwelled water is cold and cools the Oregon coast during the summer. Warm, moist winds passing over this cold water cause fog. Also, this cold bottom water carries nutrients from the floor of the sea which serve as fertilizer for the tiny plants found in the water. These plants grow and flourish, providing food for a vast number of tiny animals, which, in turn, provide food for larger animals. The result is a sea teeming with life which can support a commercial fishery found along the West Coast of the U.S.

THE OCEAN FLOOR

Definitions:

Continental Shelf - A part of the continent that extends as a shallow platform below the surface of the ocean for 10 to 100 miles before dropping sharply to the ocean floor.

Continental Slope - The steep sloping edge of the continent that extends from the edge of the shelf to the ocean floor.

Estuary-------------- A body of water where a river empties into the ocean. They are commonly called bays.

Islands-------------- Mountain tops that extend above the surface of the water.

Ridge---------------- A mountain range below the surface of the ocean.

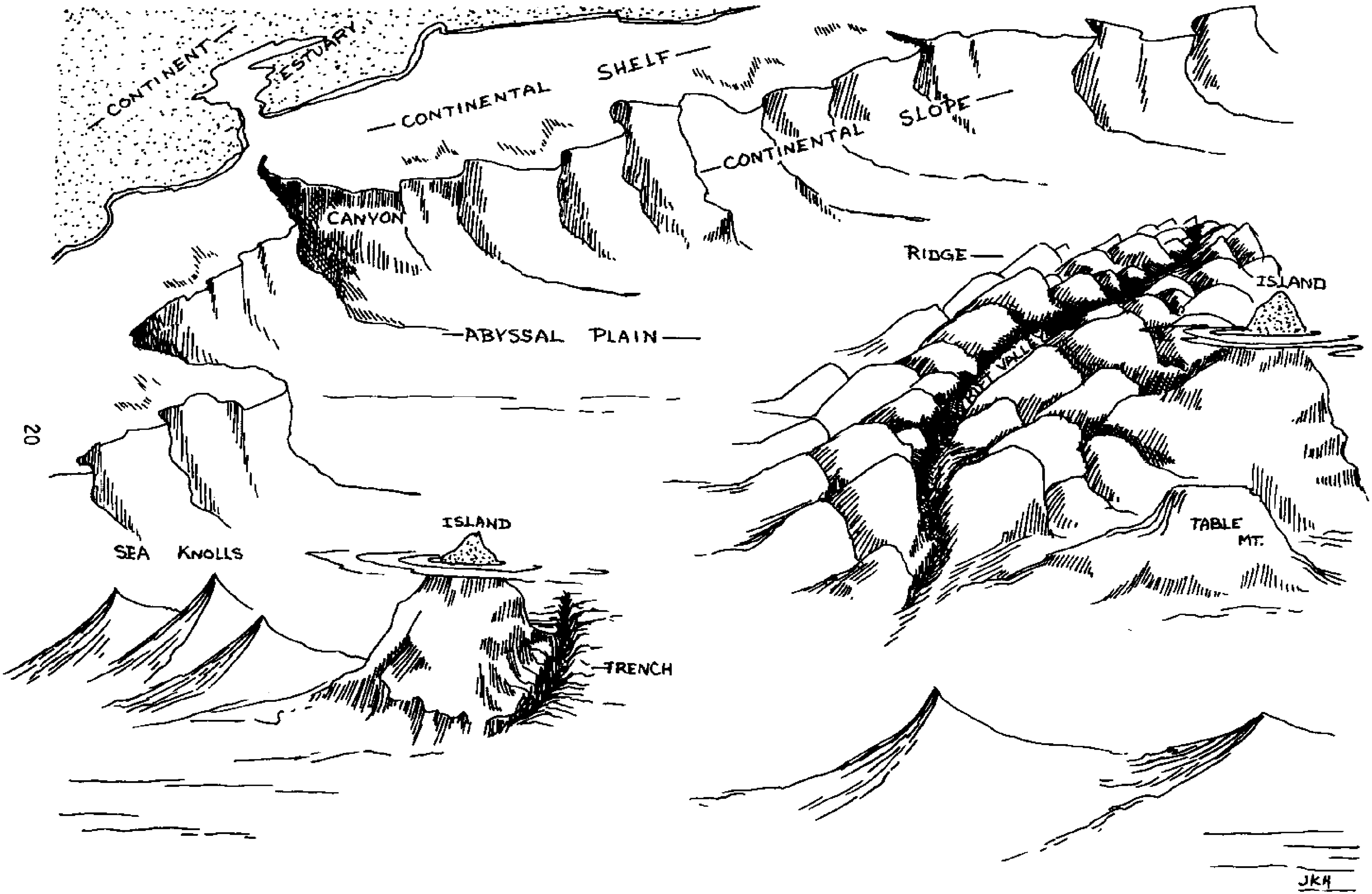
Rift Valley---------- A deep valley which extends down the center of a ridge.

Sea Mounts----------- Mountains which rise from the ocean floor, but do not extend above the surface of the water.

Table Mounts--------- Mountains which have flat tops and lie below the surface of the water.

Trench--------------- A long narrow, deep depression of the sea floor with steep sides.

Find these features on the map on the next page. How do you think they might have been formed?


CONTINENT
ESTUARY
CONTINENTAL SHELF
CONTINENTAL SLOPE
CANYON
RIDGE
ISLAND
ABYSSAL PLAIN
TABLE MT.
SEA KNOLLS
ISLAND
TRENCH
JKH

OCEAN FLOOR

OCEAN CURRENTS

Ocean Currents Discussion Guide

Fill in this guide after you have sketched in the currents on the map on the following pages.

1. The west coast of the U.S. is warmed by what currents?

2. Why is the weather along the coast of Chile, in South America, apt to be cooler than the west coast of America?

3. Why was it important that the captains of the old sailing ships knew about currents?

4. How do the Japanese floats get to our Oregon coast?

5. Where do you predict your drift bottles will land if we dump them into the ocean from a boat?

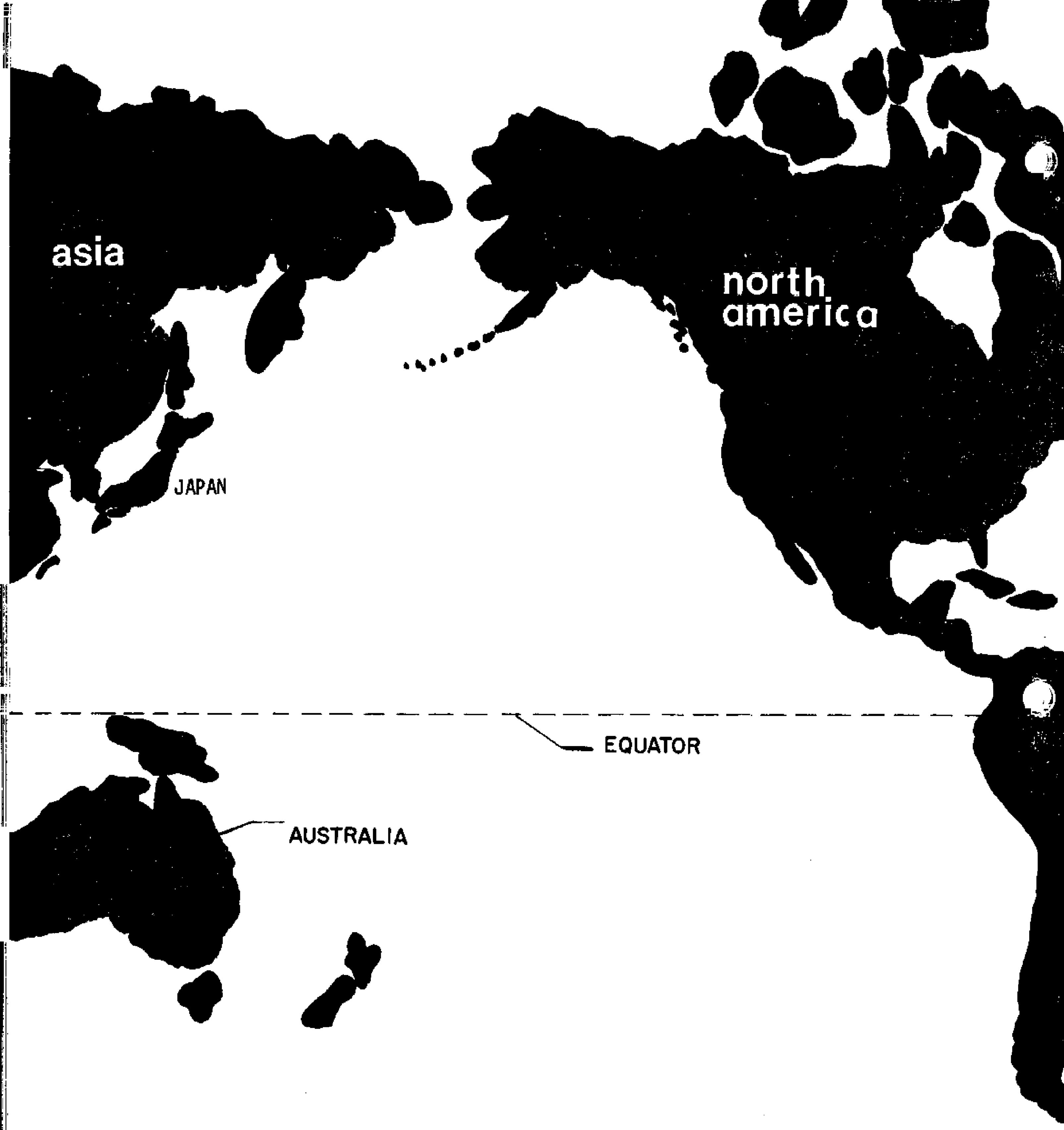
6. Tell, in your own words, why you think ocean currents are important to us.

7. Why are some currents warm and others cold?

8. Does Davidson's current flow in the summer or winter?___________
   Is it a cold or warm current?____________

9. Do you think the water in the bottom of the ocean flows in currents like the surface water currents you have just drawn? ____________

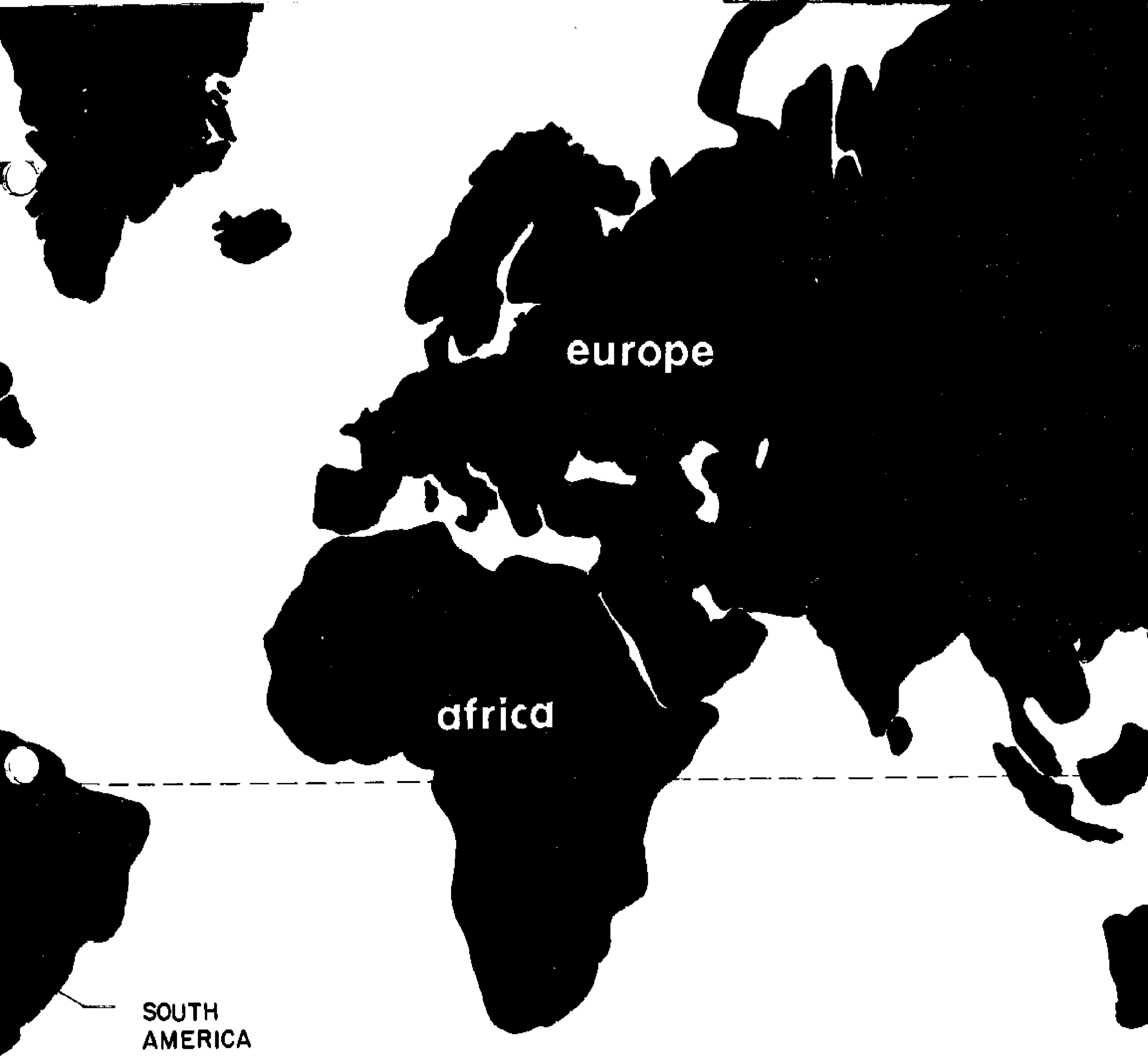
10. What do you think makes the water move?



Sketch and label major ocean currents on this map.

Refer to map in Leaders Guide.

——————> Warm Currents --------> Cold Currents ooooo Upwelling


europe
africa
SOUTH
AMERICA

LIFE IN THE OCEAN AND ESTUARIES

Pocket Guide for 4-H Hikes

Take this guide with you on your hikes and field trips.

The animals, plants and geological features of the earth that you find should be looked up in a reference book when you get home and discussed at your next 4-H meeting. This hike guide is for all Natural Science projects. You can learn about the forests, mountains and other life, also.

Personal Harvest Limit Discussion Guide

1. What is the daily limit for bay clams? First_____dug.
2. What is the daily limit on razor clams? First_____dug. No more than __________Horseneck (Gapers).
3. What is the daily limit for Dungeness crabs? _____ How large do they have to be before you can take them?__________inches across the back.
4. May you take both male and female Dungeness crabs? _____Only _______ Dungeness crabs may be taken.
5. Why do you think we have to have regulations such as these?
6. What is the limit for intertidal non-food animals?________________
7. May you freely collect intertidal animals on all of the beaches of Oregon? ____________
8. What is the minimum length limit for striped bass? ______inches.
9. Is it unlawful to dig any part of anothers' limit for him? ______

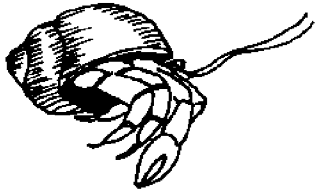
   Why?
10. How many daily limits of razor clams may be held in a 7 day period?____

Field Trip to the Rocky Beach at Low Tide

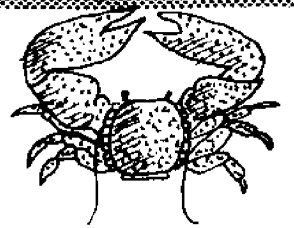
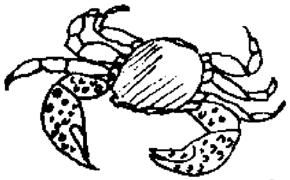
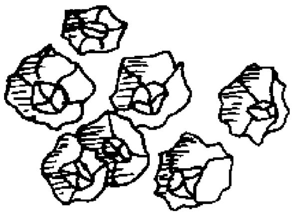
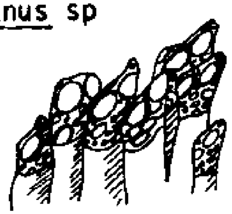
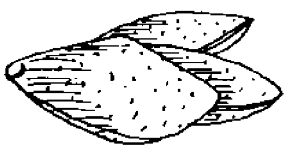
This may be the most interesting activity of your 4-H Marine Science project. You will find and learn about many forms of sea life. You will want to make several trips to the rocky beach and tide pools to find more marine animals and plants, and to learn more about them.

Study the pictures on the following pages so you will recognize these animals when you find them. Then observe how they protect themselves from the waves and from drying out and when they are found and how they feed.

ROCKY BEACH FI TRIP GUIDE

	wave survival	protection from drying	level on rocks	niche	method of feeding
 Anemone <u>Anthopleura</u> spp.					
 Tube worm <u>Serpula</u> <u>vermicularis</u>					
 Common sea star <u>Pisaster</u> <u>ochraceous</u>					
 Limpets <u>Collisella</u> spp.					
 Hermit crab <u>Pagurus</u> spp.					

ROCKY BEACH FIELD TRIP GUIDE

	wave survival	protection from drying	level on rocks	niche	method of feeding
 Porcelain crab *Petrolisthes cinctipes*					
 Purple shore crab *Hemigraphsus nudus*					
 Acorn barnacle *Balanus* sp					
 Leaf barnacle *Pollicipes polymerus*					
 California mussel *Mytilus californianus*					

ROCKY BEACH FIELD TRIP GUIDE

	wave survival	protection from drying	level on rocks	niche	method of feeding
 Sea urchin <u>Stronglyocentrotus</u> sp.					
 Black chiton <u>Katharina tunicata</u>					

1. Turn over a rock and record what animals you find.

2. Why is it important that you return the rock to its original position?

3. What will this beach be like if everyone collects these animals to take home with them?

4. Why do you think these animals are found here but not on a sandy beach?