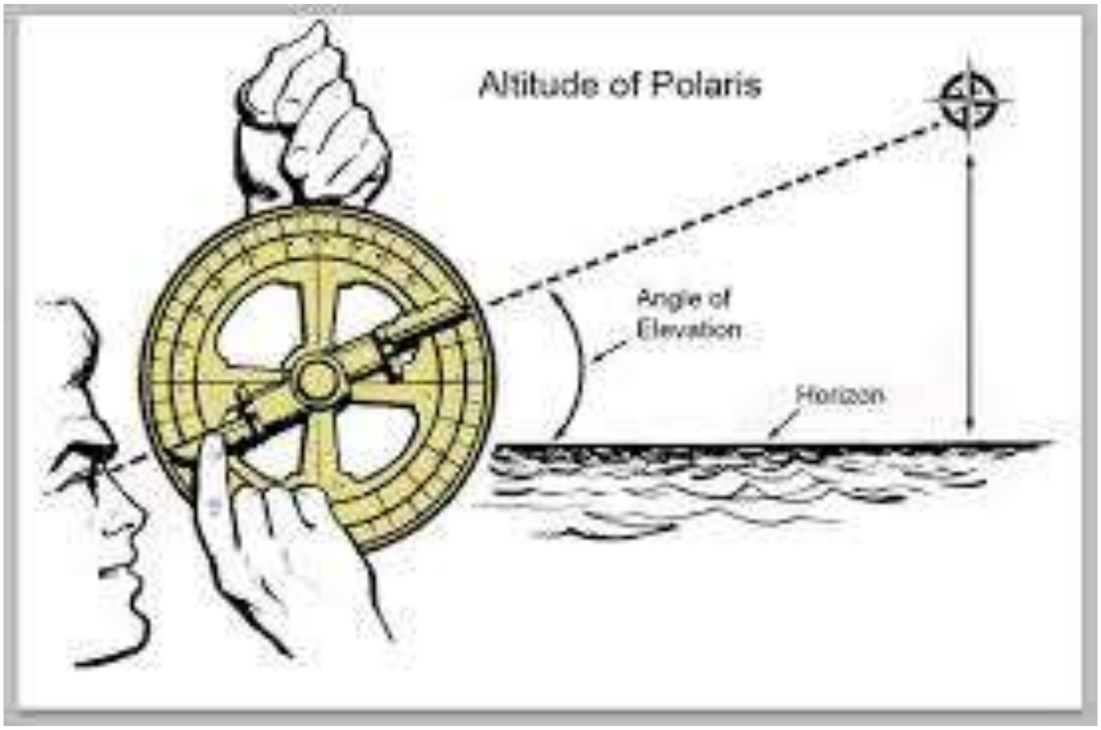
WEEK THREE

So what was the role of the chronometer in navigation?

LATITUDE AND LONGITUDE

One of the critical problems in ocean travel is the absence of landmarks. The locating of oneself on the ocean is done by locating oneself where 2 lines cross one another. The lines running from north to south are called longitude lines and the ones circling the globe parallel to the equator are called latitude lines. The finding of both lines is done in the past in the west largely astronomically reckoned. There is a form of navigation called dead reckoning which is actually derived from deduced reckoning, in which the navigator estimates t he speed and direction of a vessel and “deduces” where it is.

Finding one’s latitude is fairly simple, but requires some knowledge of the stars at night. The earth rotates once on its axis roughly every 24 hours. During the time when the stars are visible, they can be used to determined ones latitude fairly simply. The earth’s rotation axis points to the star “Polaris” sometimes called “The Pole Star”. If one were standing directly at the North Pole it would be directly overhead at 90 degrees above the horizon. As one travels further south, the pole star would appear to leave its position overhead and finally rest on the horizon - or 0 degrees above the horizon when the observer was on the equator. So one’s latitude can be told by measuring how many degrees above the equator the North Star appears on a sextant



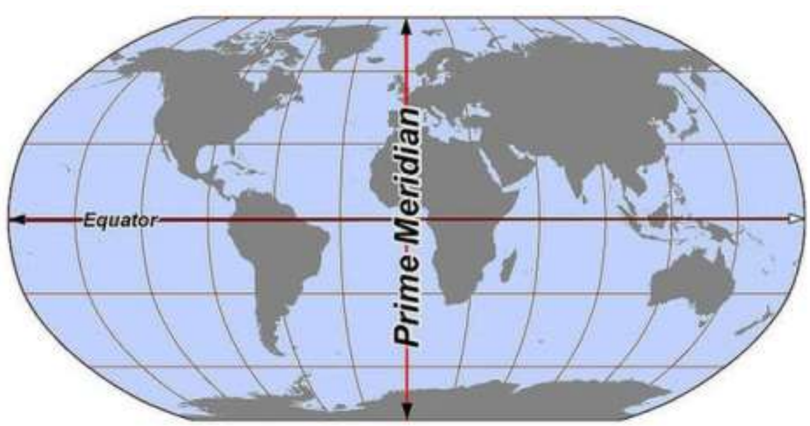
and that would be one’s latitude. This works in the northern hemisphere. In the southern hemisphere the same principle applies but with a different marker.

Finding one's longitude is a bit trickier.
The North Pole is an easy point of identification for north. It is the point around which the world rotates. But how does one discover east and west?

Here is a problem. Which of the United States is furthest north? Which is furthest east? Which furthest west? Remember you can go from NY to California by travelling either east or west. One just takes longer!

North? Alaska
South? Hawaii
West? Alaska
East? Alaska

Alaska can be the furthest in two directions because we have to define a starting point from which east and west are measured. That point is recognized as the Greenwich Prime meridian which is the point of the Greenwich observatory in London.



Anything east of that line is considered to be “east longitude” anything west of it is “west longitude”. So the highest number for any place longitudinally is 180 degrees. After that, you are in the other “direction”. If you travel 180 east or west you will meet on the other side of the globe which is roughly the position of the International Date Line. So, since Alaska crosses the International Date Line, it is on both sides – therefore it is the furthest east as well as the furthest west. (remember you always have to mark with your meridian is EAST or WEST)

The actual international date line is rather zig-zag so that some countries can have all of their area on the same day. All of Alaska is on the same side of the date line, but not on the same side of east/west division 180º opposite the prime meridian!


Time for
the Navy


PATENTEE
GALVANO-MAGNETIC CLOCK
The Shepherd
24-hour Gate Clock
The Time Ball
Ordnance Survey
Bench Mark
Public Standards
of Length
BRITISH YARD
TWO FEET
ONE FOOT

With this in mind we can discuss how one can finds one longitude. How many degrees are there in a circle? 360. How many hours in a

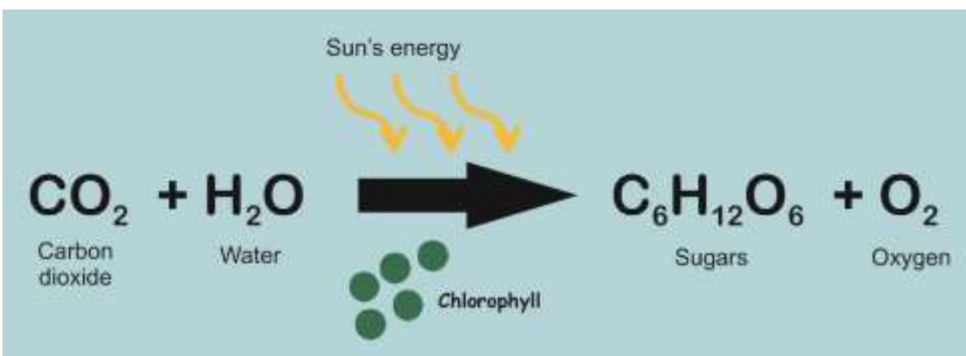
day? 24. So how many degrees are there in an hour? (divide 360 by 24 and the answer is 15). So for every hour away from the p
rime
meridian you are 15 degrees away from it. Ships would take a chronometer or a clock on the ship set at the time at the Prime Meridian. When the sun was directly overhead on the ship, the navigator would know it was “noon” and look at the clock which might say 1300 hours (1 p.m.) So there is an hour difference in time between the ship and London. This would mean that the ship is 15 degrees west of the prime meridian.

Charles Darwin

Darwin traveled on a ship called “The Beagle” captained by Robert Fitzroy. The ship was to undertake a journey that would last nearly 5 years. The ship left on 27 Dec, 1831. Charles Darwin as naturalist whose job, basically was to disprove the idea of evolution which was growing in popularity at the time.

Darwin made two significant hypotheses on the trip. One had to do with his theory of reef formation, The other had to do with the idea of biological evolution. We deal here with the first of the two – reef formation

First. What is a reef made of? Largely coral. What is coral? Coral is an animal belonging to a phylum called Cnidaria. This phylum contains animals which are sessile (don't move) like sea anemones and corals and well as some organisms which are motile (can move) like jelly fish. Animals, which are motile, may be able to propel themselves against a current which are called "nekton" while those which are moved about by the current are called "plankton". Now the coral are small animals which secrete a calcium carbonate which forms the hard kind of "exoskeleton". The coral are involved in a symbiotic relationship (mutually beneficial) with a dinoflagellate – that photosynthesize (are able to create their own food by taking water and carbon dioxide and in the presence of sunlight, turn it into sugar and oxygen and share some the material with the coral.



Uses carbon dioxide and gives off oxygen

EQUATION 1. PHOTOSYNTHESIS.

$$6\,CO_2 + 6\,H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

carbon dioxide | water | chlorophyll sunlight | sugar | oxygen

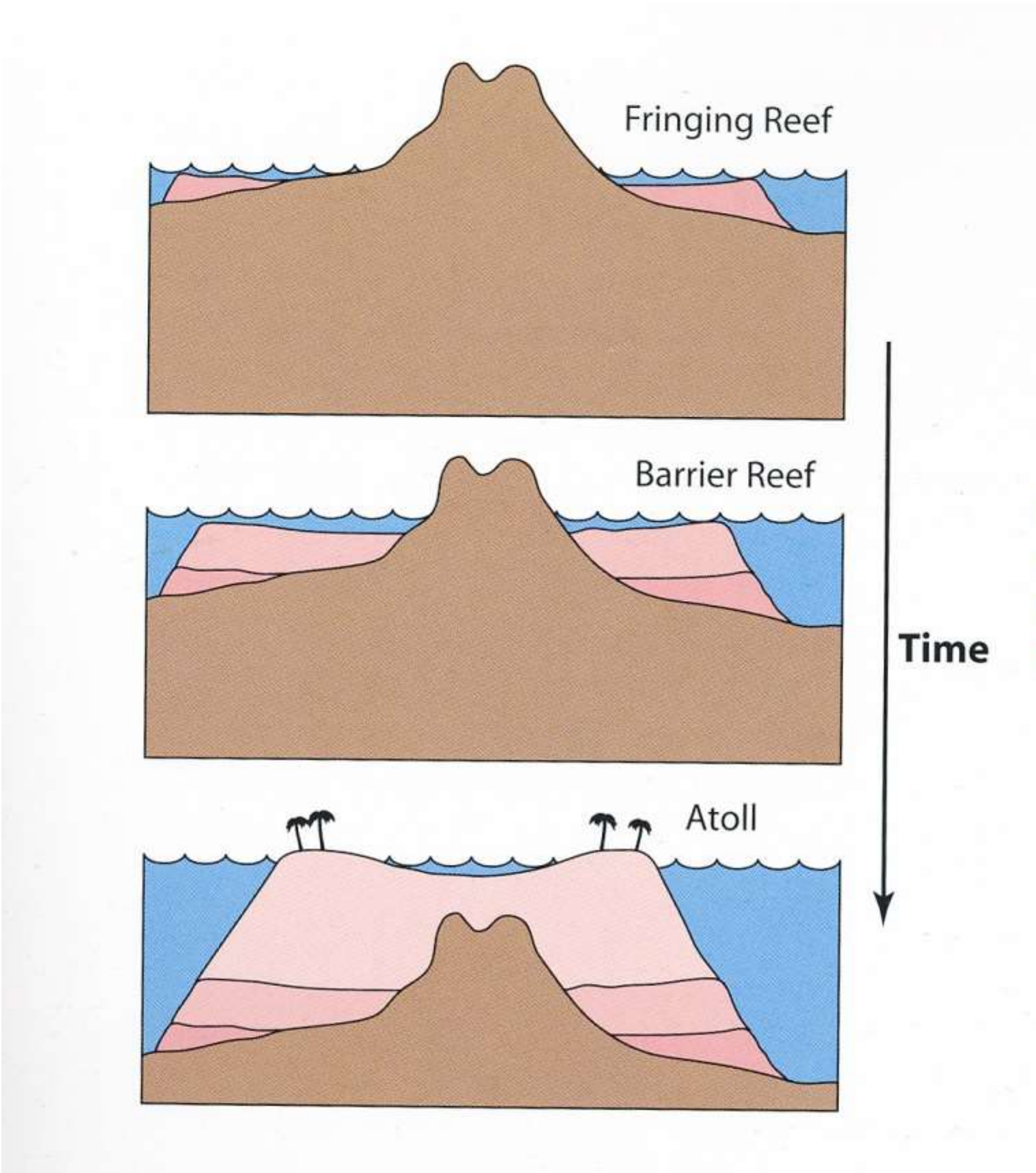
EQUATION 2. RESPIRATION.

$$C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$$

sugar | oxygen | carbon dioxide | water

Uses carbon and gives off carbon dioxide

This makes them “autotrophs” and opposed to “heterotrophs” which have to eat to survive. Autotrophs are considered “primary producers” and are at the very bottom of the food chain. The dinoflagellates benefit from the protection of the coral whose nematocysts or stinging cells (like those in jelly fish) are used to neutralize prey. The coral exhale CO_2 that is needed by the dinoflagellates for photosynthesis. The dinoflagellates are a kind of algae (more about algae later) and give the coral their color. In times of stress, the coral may expel the dinoflagellates and appear pale. This is a process called “bleaching”. This gives the coral a short term survival for whatever causes the stress. The later can regain the algae if the stress isn’t severe enough to kill them Darwin’s theory of coral formation was based on an observation of many reefs. Some reefs surrounded islands, others had lagoons and still others had not island in the middle. He postulated that the islands arose from undersea volcanos which stopped erupting. Then the corals begin to form around the island. They need to be close enough to the surface for there to be the sunlight needed for the algae’s photosynthesis.



Video on atoll https://www.youtube.com/watch?v=pRD8ZwdPYsY

An undersea volcano spews up an island and stops erupting. Coral begins to build up around the island's edge called a fringing reef. After a while erosion tales place and the edge of the island disappears and the top of the volcano also erodes. At this point the reef is a barrier reef.

Finally the entire islands is eroded away and all that is left is the reef, now called an "Atoll"

The Challenger Expedition

This voyage is seen as the beginnings of the scientific study of the ocean – oceanography. It lasted from 1872 to 1876. Organized by Charles Wyville Thomson from the University of Edinburgh and the Merchiston - Castle School organized the expedition. The ship, The Challenger, was gotten from the Royal Navy. Traveling over 70,000 miles it collected an immense amount of information. The expedition catalogued over 4,000 previously unknown species.

The goals were to investigate the physical conditions of the deep sea in the great ocean basins (as far as the neighborhood of the Great Southern Ice Barrier) in regard to depth, temperature, circulation, specific gravity and penetration of light.

a. To determine the chemical composition of seawater at various depths from the surface to the bottom, the organic matter in solution and the particles in suspension. To ascertain the physical and chemical character of deep - sea deposits and the sources of these deposits.

b. To investigate the distribution of organic life at different depths and on the deep seafloor.

There were many misconceptions about water and what was in it.
An example of this had to do with the nature of water itself.
It was originally thought that as one descended in the ocean, the water would become more and more dense reaching a rather thick consistency. It was thought that things would not sink to the bottom because the water would be compressed to such a density that things would no longer sink any further and would be suspended at some level among the ocean floor. Even as late as the sinking of the Titanic, it was thought by many that the ship would have not reached the bottom and would in fact be “floating” at a level somewhere in the depths, but not at the bottom. Although it was known that this was not the case, many people still believed it.

While the ocean does not become more dense at lower depths, it does become heavier as water piles up above it. It simply is not heavy enough to compress the water any great degree. Every 33 feet (or 10 meters) down, there is an increase in pressure of one atmosphere (which is about 15 pounds per square inch). Inn whether I atmosphere is 1.013.25 millibars.
Interestingly enough water does get somewhat denser as it get colder, but when it freezes, it becomes less dense and the molecules form a different structure. This is why ice floats.

WHAT KIND OF WAYS ARE THERE TO DEFINE THE GEOGRAPHY OF THE OCEAN?
In order to talk about the ocean, we need to know something about the way scientists classify its areas. There are two dimensions involved – one has to do with the distance from the shore, the other has to do with the depth of the water. These are critical distinctions since they have a strong impact on the kinds of adaptation that life forms make to those zones Ocean Zones
Starting at the shore line there is a zone which is called “the splash zone”. This zone is one which is generally not covered by water at any time, but receives a “spray” from the surf. Because it is generally not under water for any period of time, it will not be discussed particularly here.

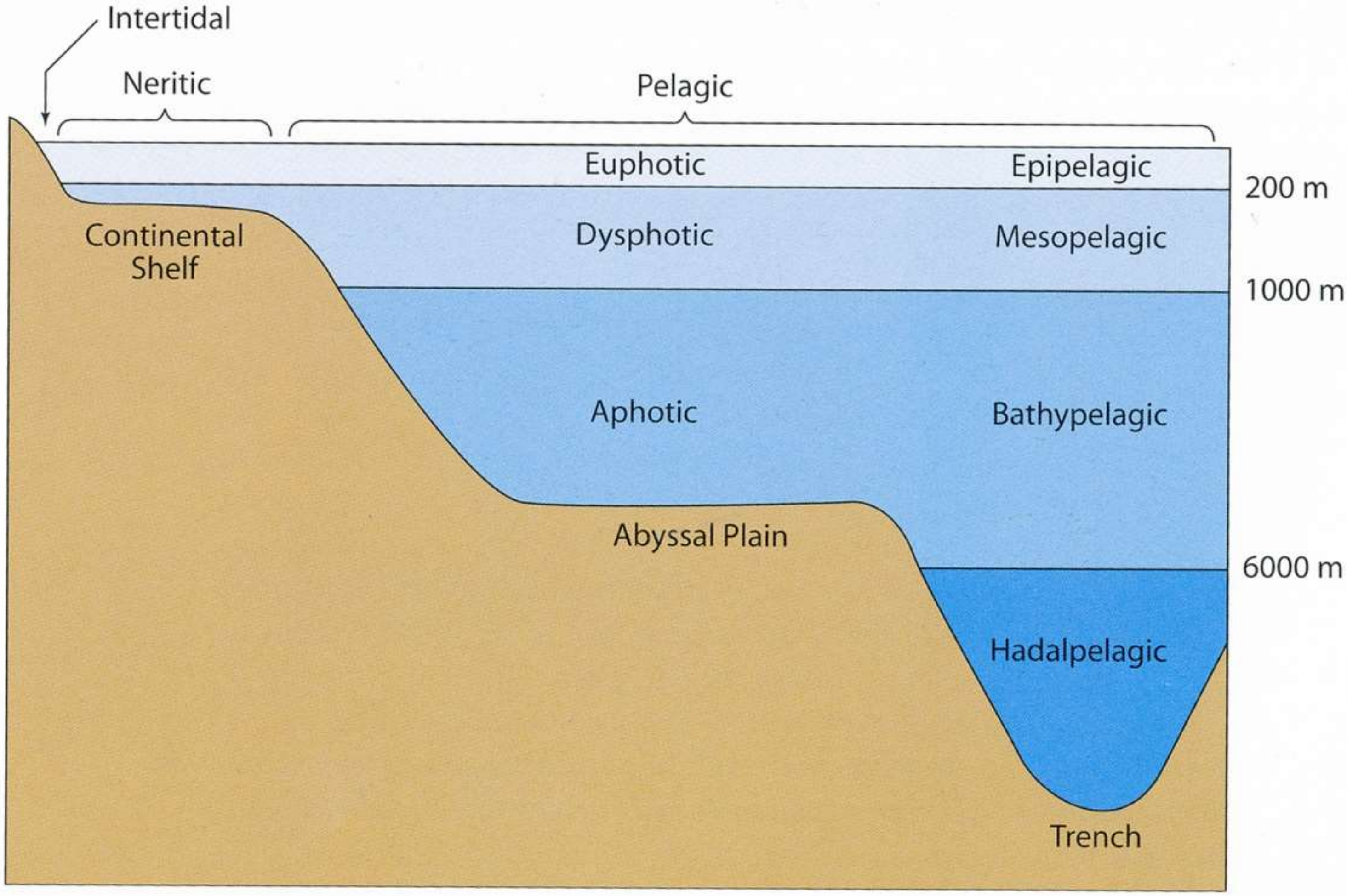


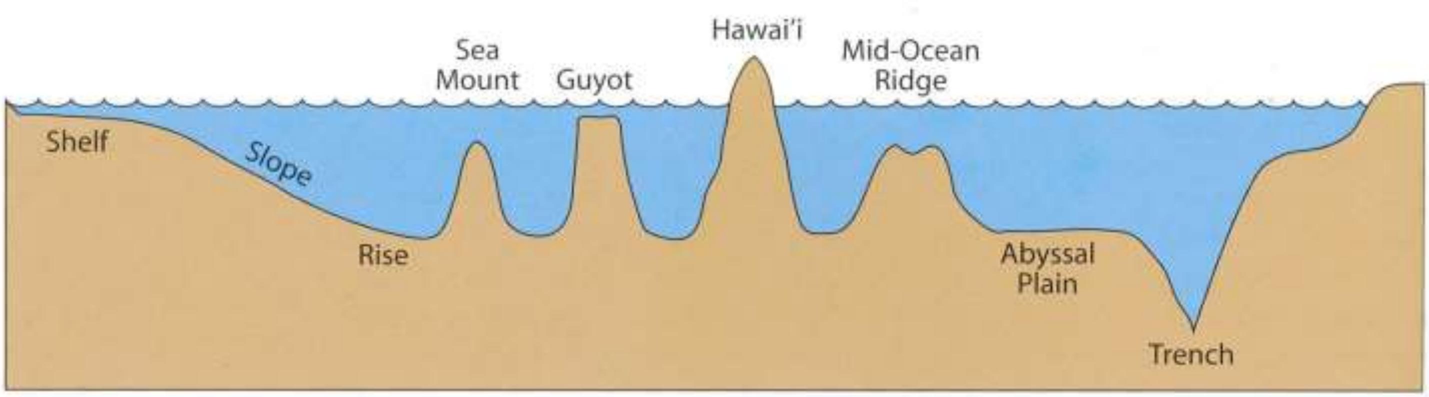
Figure 2.10. The named zones of the ocean.

The next zone out is the intertidal zone, sometimes called the “littoral zone”. This is the area that is underwater part of the time and exposed to the air at other times. Organisms found in this area must be able to handle periods when they are exposed toair and other times when they are not. This means, among other things that the organisms which need buoyancy – that is they may lack any kind of support system like a skeletal system or they need the water to keep them up would have to handle periods of time when the water was not there to do that. The animals and plants that live in the zone, such as anemones, barnacles, chitons, crabs, green algae, isopods, limpets, mussels, sea lettuce, sea palms, sea stars, snails, sponges, and whelks, must often deal with rough waters and well as exposure.

The next section from the shore is called the “neritic zone” and refers to that part of the ocean that is over the continental shelf. This the area where the continent drops off toward the deep ocean called the abyssal plain. The water that lies over the abyssal plain is called pelagic.

In terms of depth, the upper level of the ocean is called Euphotic (or epipelagic). Euphotic means “good light” and refers to those areas where sunlight can penetrate enough for photosynthesis to take place Below that layer lies the dysphotic (bad light) level (or mesopelagic) Here the is some light but not enough for photosynthesis to occur. Bel ow that is the aphotic zone (no light) or bathypelagic.

In the deep trenches in the ocean the term hadalpelagic is sometimes used.



Common features of the ocean floor (not drawn to scale).

The underlying structure of the ocean floor was thought to be just a basin, but in fact the terrain is as varied as on land.

Starting with the shore, the continental shelf drops off slowly and then rather rapidly. The bottom of the ocean is not smooth like the bottom of a bowl. The ocean has a number of complex features that include mountain ranges , sea mounts, and trenches A seamount is a mountain that rises from the ocean floor; a submerged flat-topped seamount is termed a guyot. By arbitrary definition, seamounts must be at least 3000 ft (about 900 m) high, but in fact there is a continuum of smaller undersea mounts, down to heights of only about 300 ft (100 m). Some seamounts are high enough temporarily to form oceanic islands, which ultimately subside beneath sea level. There are on the order of 10,000 seamounts in the world ocean, arranged in chains (for example, the Hawaiian chain in the North Pacific) or may occur as isolated features. In some chains, seamounts are packed closely to form ridges (for example, the Walvis Ridge in the South Atlantic). Very large oceanic volcanic constructions, hundreds of kilometers across, are called oceanic plateaus (for example, the Manihiki Plateau in the South Pacific).

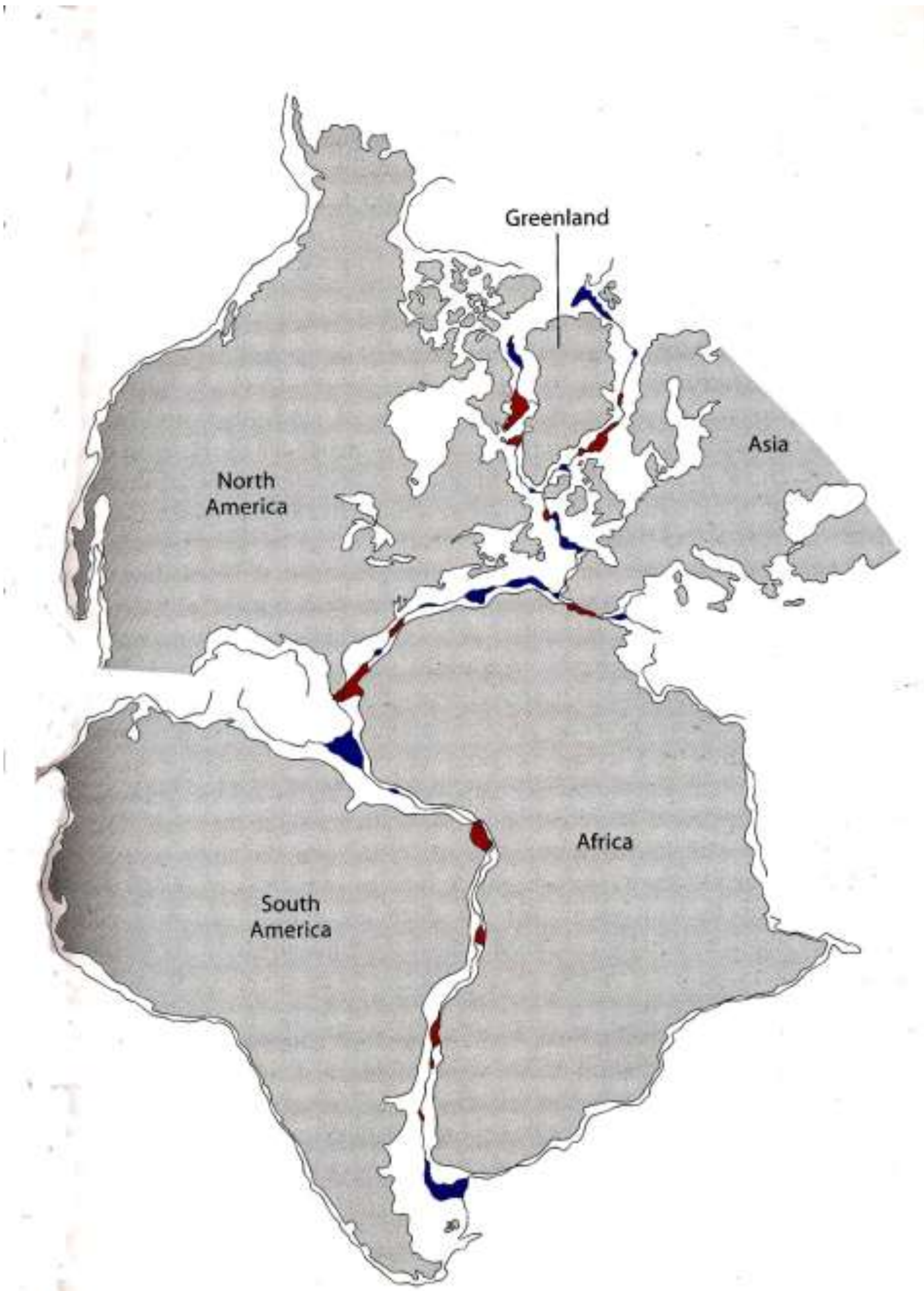
Seamounts are formed by volcanic activity and can be taller than 10,000 feet. They can be isolated or part of large mountain chains. The New England Seamount contains more than 30 peaks that stretch 994 miles from the coast of New England. Seamounts often have a high level of biological productivity because they provide habitats for many species of plants and animals. Over 200 species of sea creatures have been observed at a single guyot in the New England Seamounts are great locations to discover new species because each seamount houses different types of animals, including many that can only be found in guyot habitats.Seamounts are home to many commercial fish and are therefore very beneficial to our economy. Seamounts are also important to the field of medicine, as any number of undiscovered species may lead to new drugs or medical treatments.

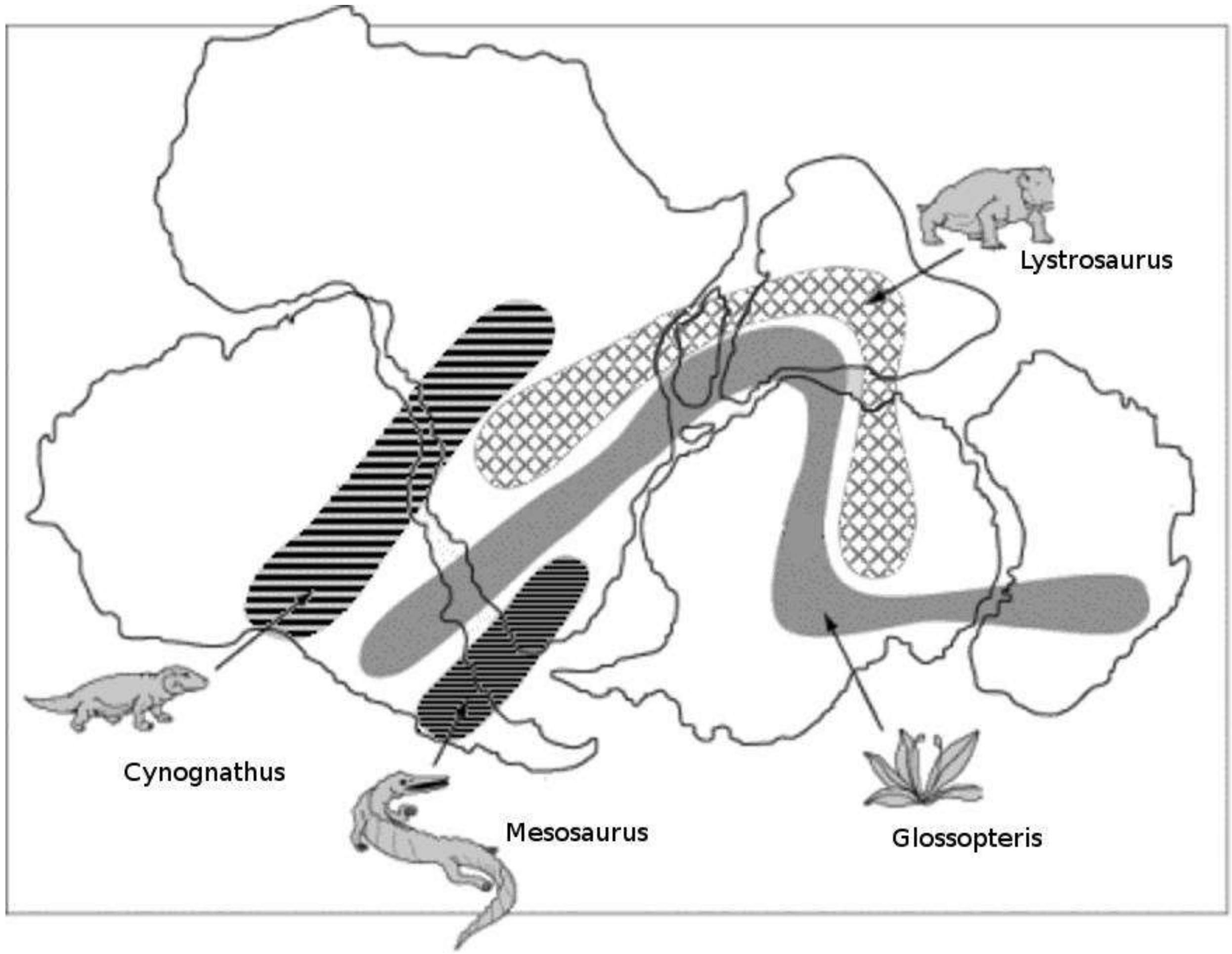
Guyots are seamounts that have built above sea level. Erosion by waves destroyed the top of the seamount resulting in a flattened shape. Due to the movement of the ocean floor away from oceanic ridges, the sea floor gradually sinks and the flattened guyots are submerged to become undersea flat-topped peaks.

CONTINENTAL DRIFT AND MID OCEANIC RIDGE

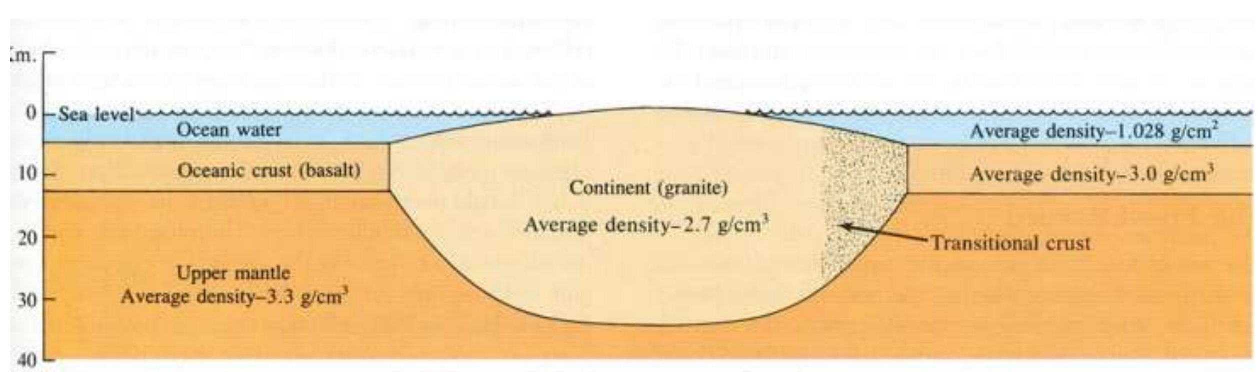
Alfred Wegener, in 1912 proposed the idea that the continents were actually floating and moved.

This appeared to be the solution to distributions of fossils that were found in S. America and Africa



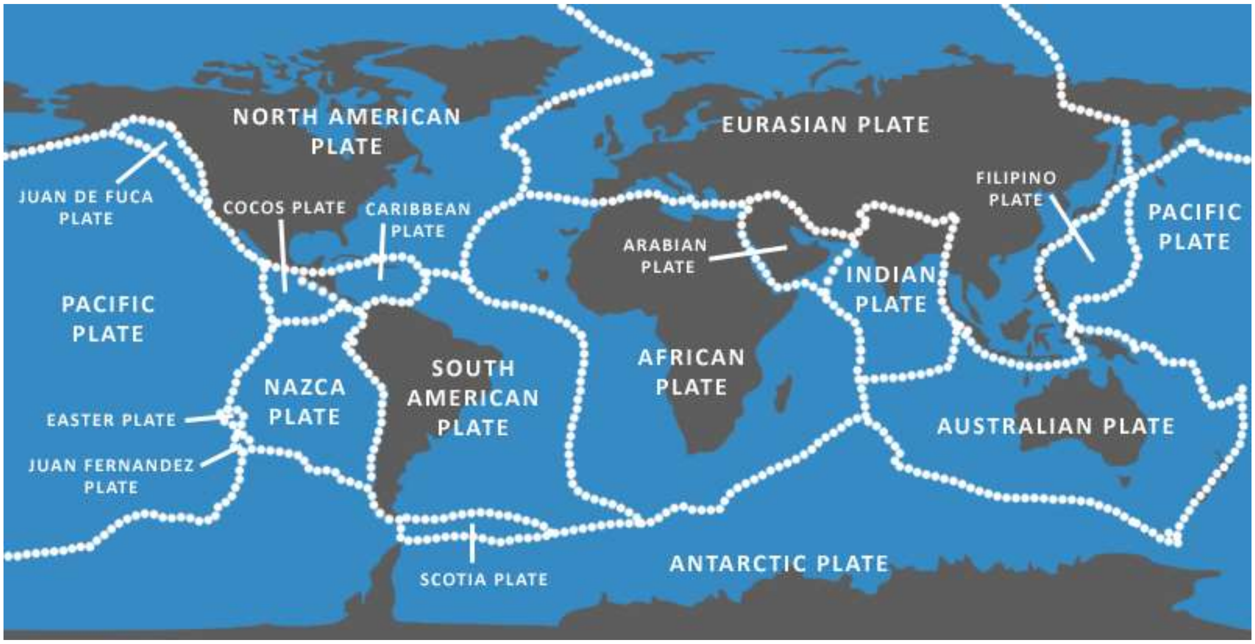


The idea was generally rejected because there was no way to show how the continents could be moved. The continents are less dense than oceanic crust and the upper mantle and so could “float” on them.



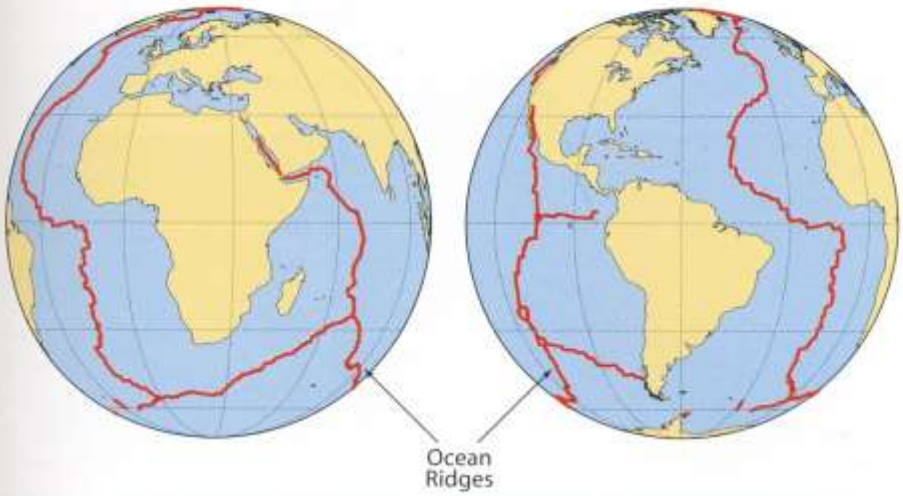
Although the theory was not initially accepted since the idea of continents floating seemed inconceivable. The idea gained more and more acceptance as new evidence appeared. The idea is now accepted.

VIDEO Continental Drift 11 Stock animation

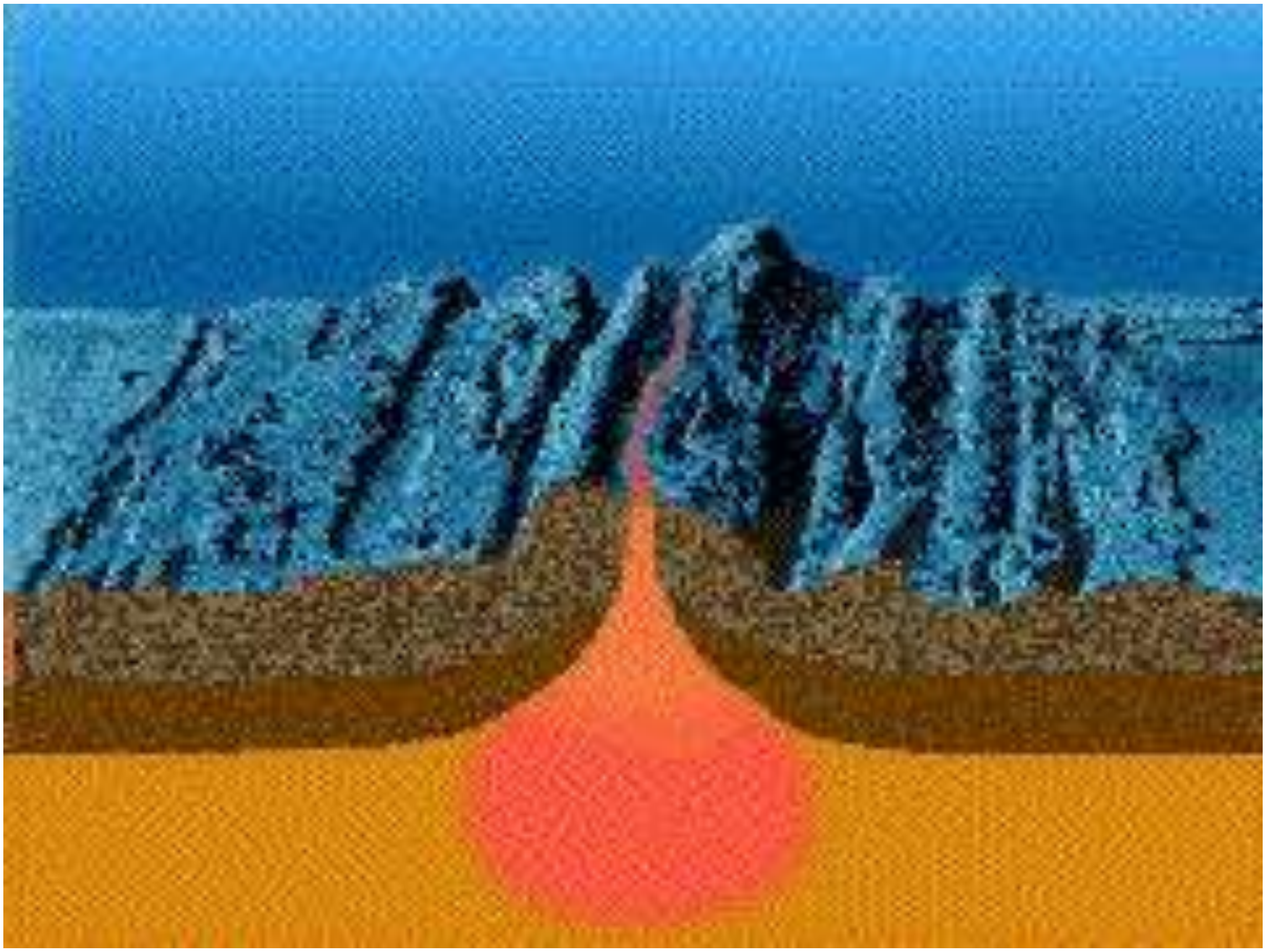


MID OCEANIC RIDGE

Along the boundries of the plates is The Mid-Ocean Ridge system that forms the most extensive chain of mountains on Earth, with more than 90 percent of the mountain range lying in the deep ocean. It runs about 40,390 miles and averages about 8,200 feet. However, some of the ridge appears above the water. Iceland is an example. Along the ridge boundaries, molten rock rises through the sea floor. These volcanic eruptions are very deep and often go unnoticed. In 1783 an eruption in Iceland was sufficiently bad that it destroyed crops, and killed more than 10.000 Icelanders – about a quarter of the population. NOAA says “Like the rest of the deep-ocean floor, we have explored less of the mountains of the Mid-Ocean Ridge system than the surface of Venus, Mars, or the dark side of the Moon. Use of submersible or remotely operated vehicles to explore the mid-ocean ridge has provided information on less than 0.1 percent of the ridge!”

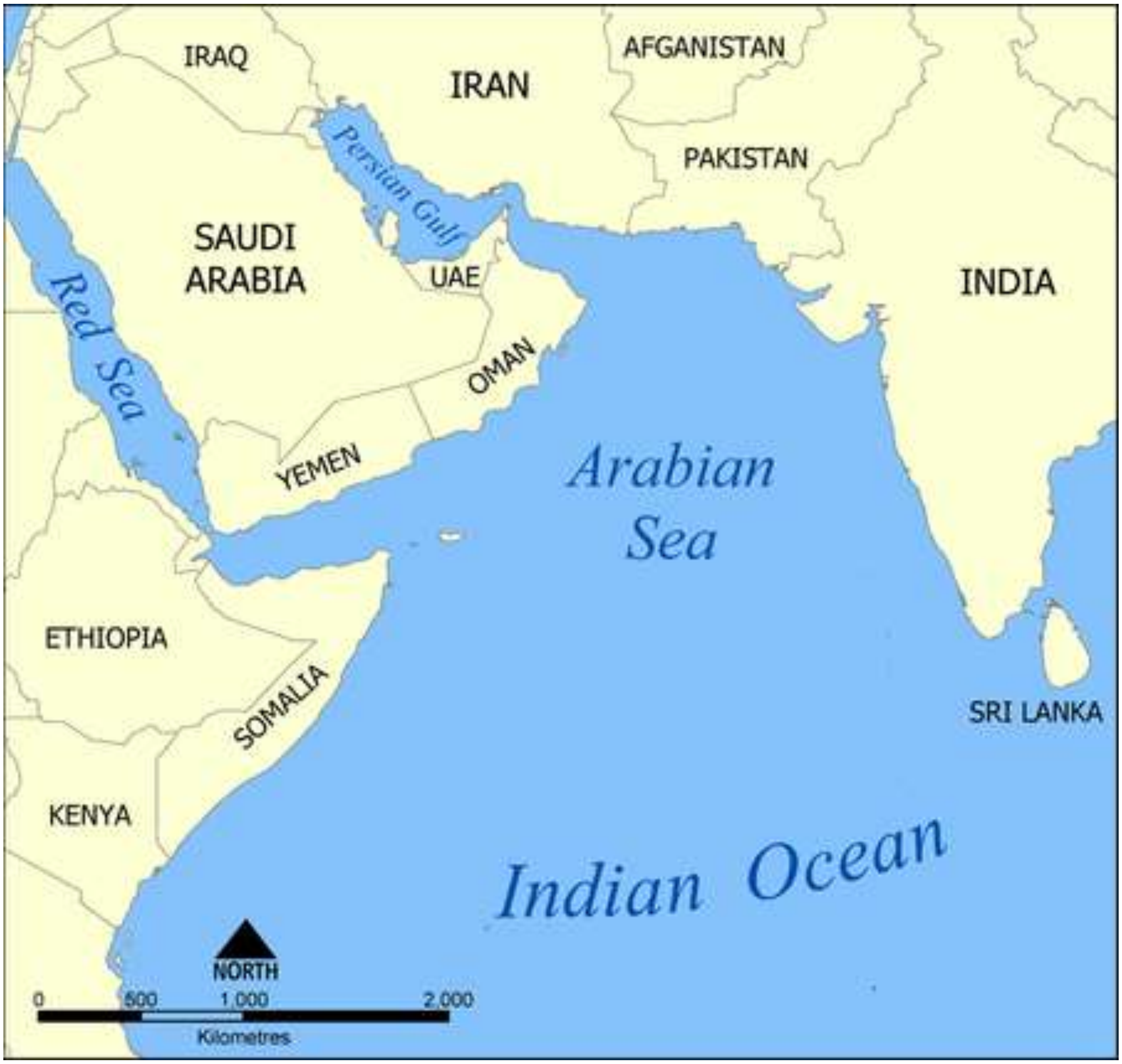


Spreading sites between tectonic plates form an extensive system of ocean



The meeting of two plates sometimes makes it possible for water to enter the area as happens with the Red Sea, which was formed when the Arabian peninsula was split from the “Horn of Africa” but the Red Sea Rift – he space formed by the African and Arabian plates. This started in the Eocene and had greater movement in the Oligocene.

On the other hand, water may overrun the land as a result of the increasing amounts of water from a warming trend as happens with the Persian or Arabian Gulf



THE OCEAN IS ALWAYS IN MOTION. WHY IS THIS IMPORTANT?

First we need to know what kinds of movement there are in the ocean.

Three Kinds of Water Movement

I. Tides
II. Waves
III. Currents

TIDES
Tides are regular movement of the ocean, most noticeable at the shore line as the water moves further and further up the shore and then recedes.
Much of the world has 2 a day but some places are somewhat different. Variation is caused by a number of factors, but the basic movement of the ocean's water in tides remains the same.

We have heard about them already, rather briefly when we mentioned the littoral or intertidal zones. The intertidal zone is the area that is covered and uncovered as the tides some in and out. But what causes that and what problems does it make?

Caesar and tides in Britain

When Caesar invaded Britain, his ships arrived at a high tide. The soldiers disembarked and when they wound up in a battle, they attempted to retreat onto the ships and leave. Unfortunately for them, the tide had "gone out" (ebbed) and the ships they had arrived in were now on the beach and not in the water. They had to continue fighting until the tide came in (flowed) and the ships were lifted back up and could sail away.
Caesar was of course, familiar with the tides, but in the Mediterranean where they behave somewhat differently!
Tides are classified in terms of whether they are high, low, spring or neap tides. The term "rip tide" is inaccurate in that what is being discussed there is a "rip current". It isn't a tide. What used to be called "tidal waves" have more recently

been called “tsunami” (the Japanese for a “harbor wave”) since tsunami have nothing to do with tides (although as we will see they tend to look like a tide).
When the tide is coming in – that is the water is moving further and further up the shore, it is said to “flow”. When the water is moving down and away from the shore it is said to “ebb”. High tide is when the water comes in and low tide is when it goes out. Spring tides are exceptionally high tides and neap tides are exceptionally lower tides. What causes the tides?

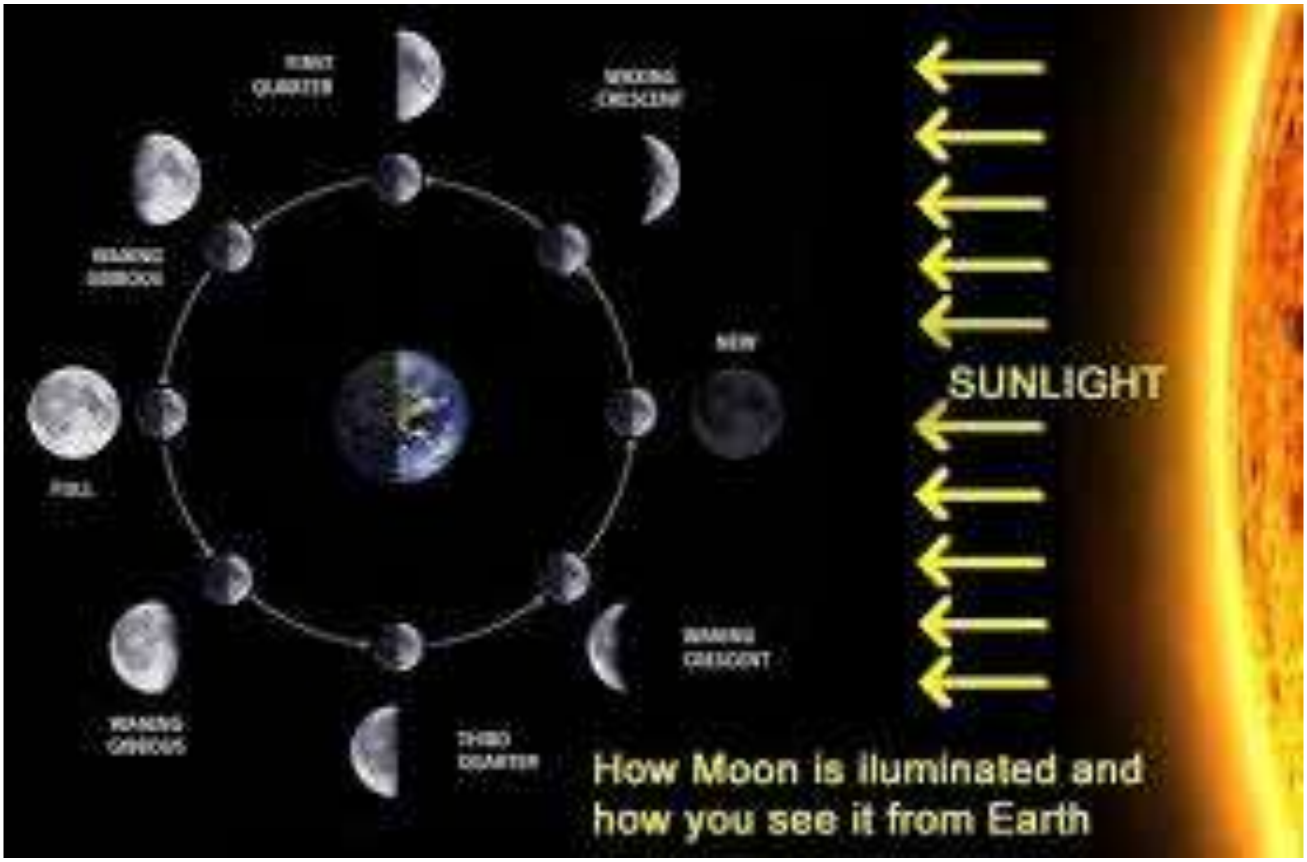
The tides are caused by the gravitational pull of the sun and the moon on the Earth. The moon circles the earth and the Earth circles the sun. Now the moon is MUCH smaller than the Sun and smaller than the Earth. Here are the dimensions. Like geological time astronomical distance is difficult so there is a figure

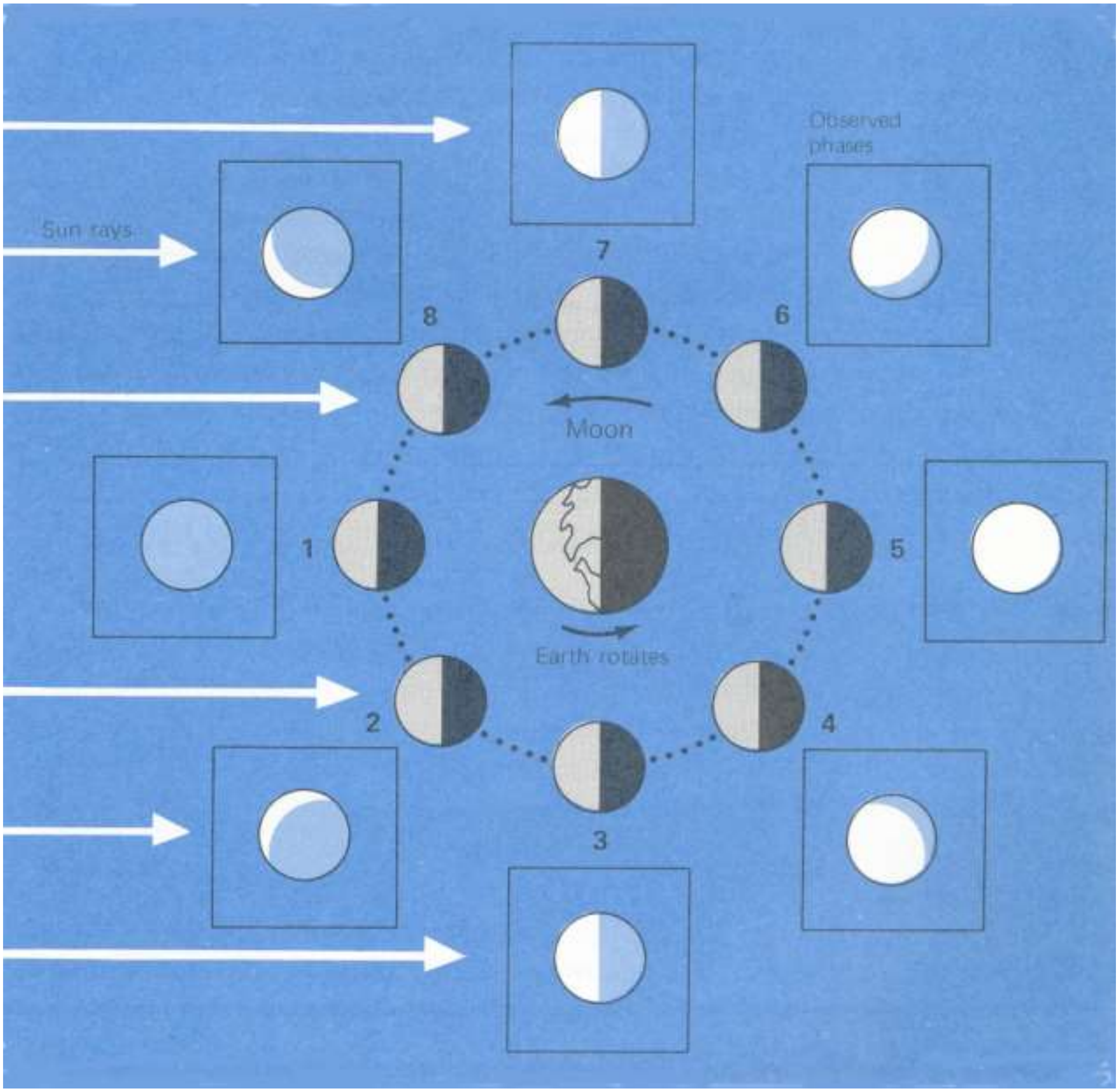
	Diameter		Circumference
Moon	3,476 km		
	2,120 miles	(4 inches)	~6,786 miles
Earth	12,756 km		
	7926 miles	(16 inches)	~25,000 miles
Sun	1,392,000 km		
	865,000 miles	(145.5 feet)	~2,720,984miles

So while you might think the sun being much larger, would have a greater impact, the problem is it is much further away. The sun in about 93,000,000 miles from the Earth, the moon is only about 239,000 miles from the Earth. This is why during a total eclipse of the sun, the much, much smaller body (the moon) can completely cover the much larger body of the sun. Interestingly enough, the apparent size of the sun and the moon is the same! So the moon’s influence on the tides is much greater. Both the sun and the moon have a gravitational force that pulls things on the earth toward them. The Earth in return pulls back enough that the material doesn’t fly out into space. Water, being liquid in the ocean, tends to rise somewhat in the direction of the pull. This causes a kind of bulge in the ocean. Since the Earth is rotating faster than the moon is circling it, that bulge “moves” around the Earth.

Because the Moon revolves around the earth, each day it rising about 50 minutes later, so each day the tides will occur roughly 50 minutes later. You can get “tide charts” that will tell you each day when there will be high tides and when there will be low tides.

Also because the moon goes around the earth, it position relative to the sun changes and this causes the phases of the moon.


SUNLIGHT
How Moon is iluminated and
how you see it from Earth



So at sometimes, the moon and sun and Earth are in a straight line, with the moon either on the same side of the Earth as the sun, or on the opposite side of the Earth, from where the sun is.

MOON--------EARTH--------------------SUN

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EARTH-----MOON--------SUN
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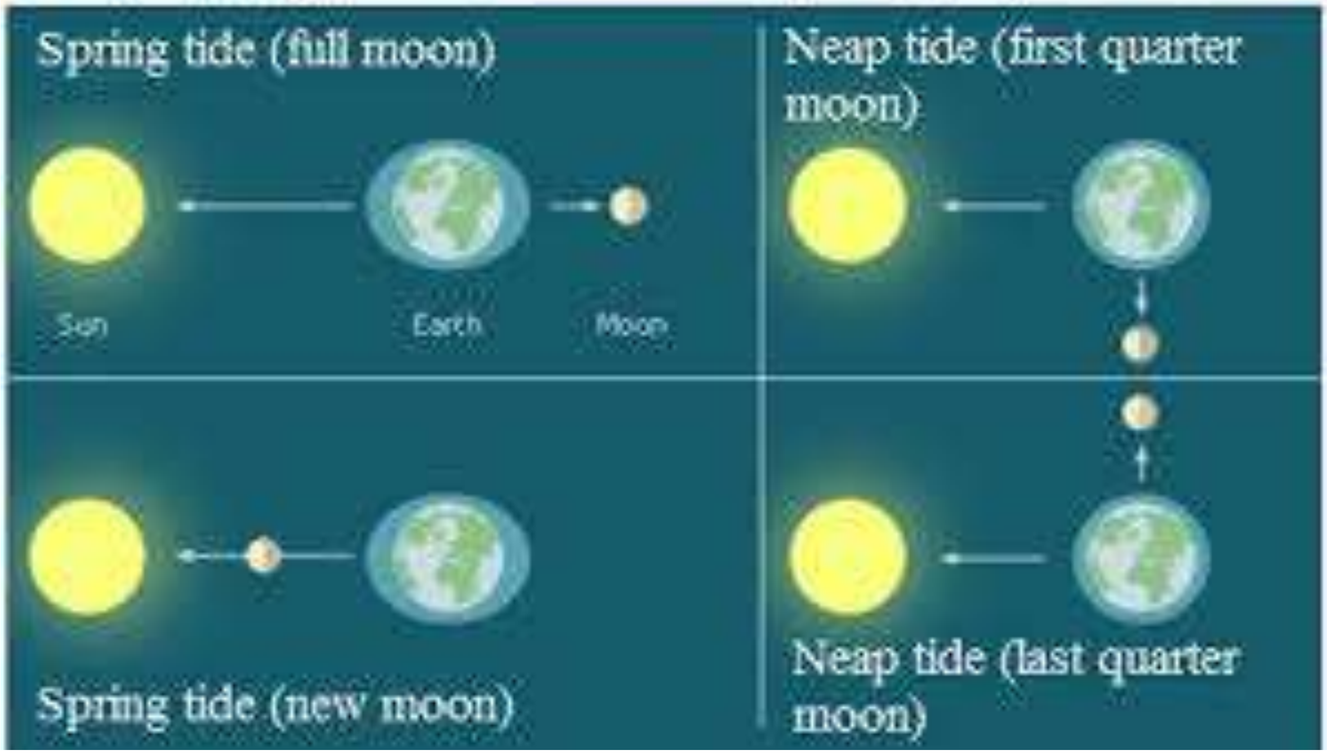
At other times the moon and sun make a right angle with the Earth

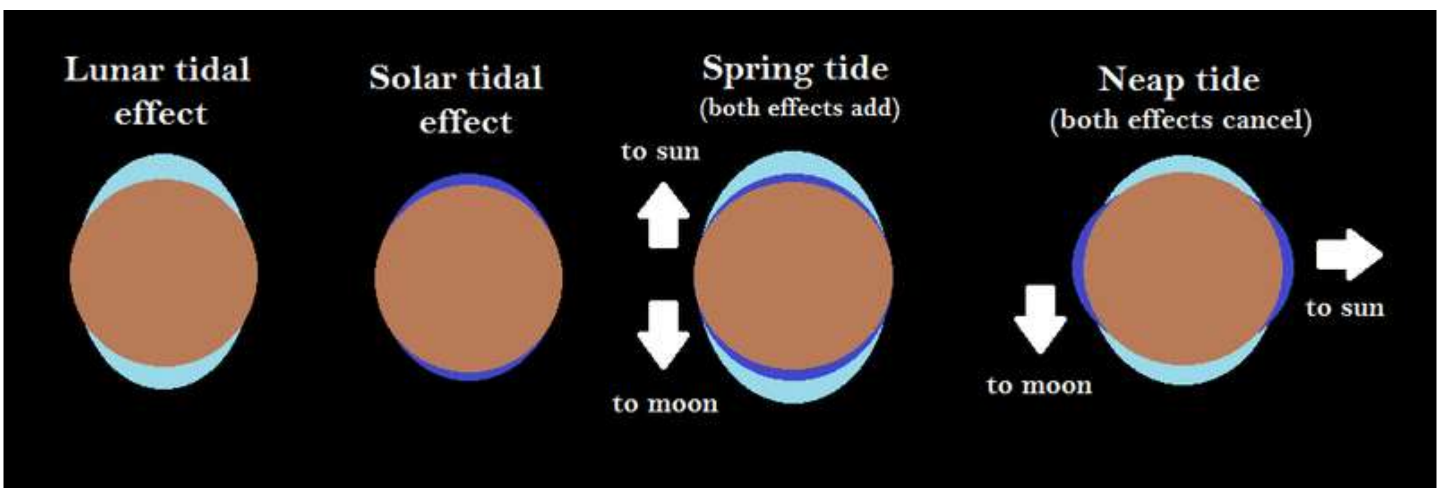
```
  MOON
    |
    |
EARTH------------------------ SUN
```

Or

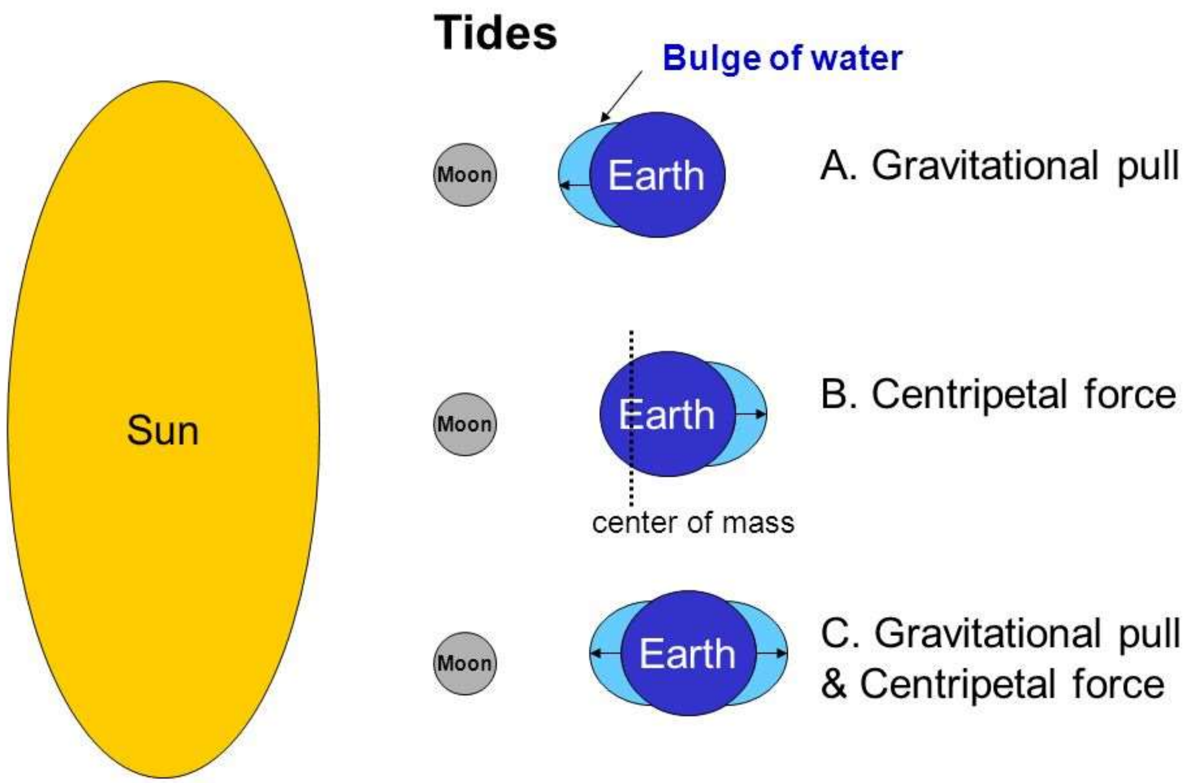
```
EARTH------------------------SUN
   |
   |
MOON
```

So at some periods the moon and the sun are operating together, and at other times they are operating at cross purposes. When they operate together, the tide will be much higher and “spring up”. These are cleverly called “spring tides”. When they operate at cross purposes the tides, the tides will be much lower. These are called “neap tides”. So while every day there will be 2 high and 2 low tides, each month there will be 2 spring and 2 neap tides.





When the sun and moon are on the same side, why should there be a bulge on the opposite side? That bulge is caused by the Earth circling the sun which also causes the water to move away from the center of the Earth.



Bay of Fundy video

WAVES

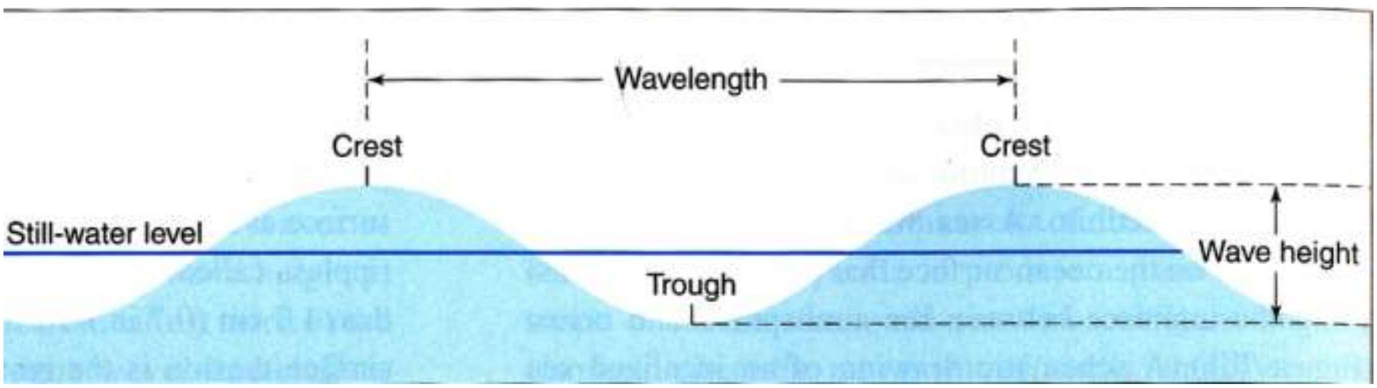
We will discuss 5 different kinds of waves:
1. Wind driven
2. Rogue
3. Tsunami
4.Tidal
5. Underwater or undersea

Waves are important to people since the have an impact on life in the ocean, travel on the ocean and land near the ocean. So we need to look at some of the different types of waves and how they have an impact on things.

WIND DRIVEN WAVES

While there are many kinds of motions in the ocean, probably the most obvious are the waves. We need a way to discuss waves, so first we need to see how they are measured

Waves are measured in specific ways



There are many kinds of waves as well. Most of the waves are called “wind driven waves”. These waves are caused by two fluids of different densities moving across one another. In this case one is air the other is water.
(You can notice this on a small scale if you blow across a cup of water, or coffee. When you try to cool the liquid and blow across the surface you will notice small “ripples” forming. It is the same principle.)
As the wind blows across the water, it sets small “capillary” waves in motion. These are often called “ripples”. (The surface tension of the water, works to end them) These

ripples give greater surface area for the wind to blow against and the waves become larger. (These are called “gravity waves” because the force of gravity works to pull them back down to a level ocean.)

The area where wind driven waves are created are called “seas”. When waves continue to move outside the area in which they are generated they are called “swells”. Since they move out of the area where the wind produced them it is possible for them to move faster than the wind!

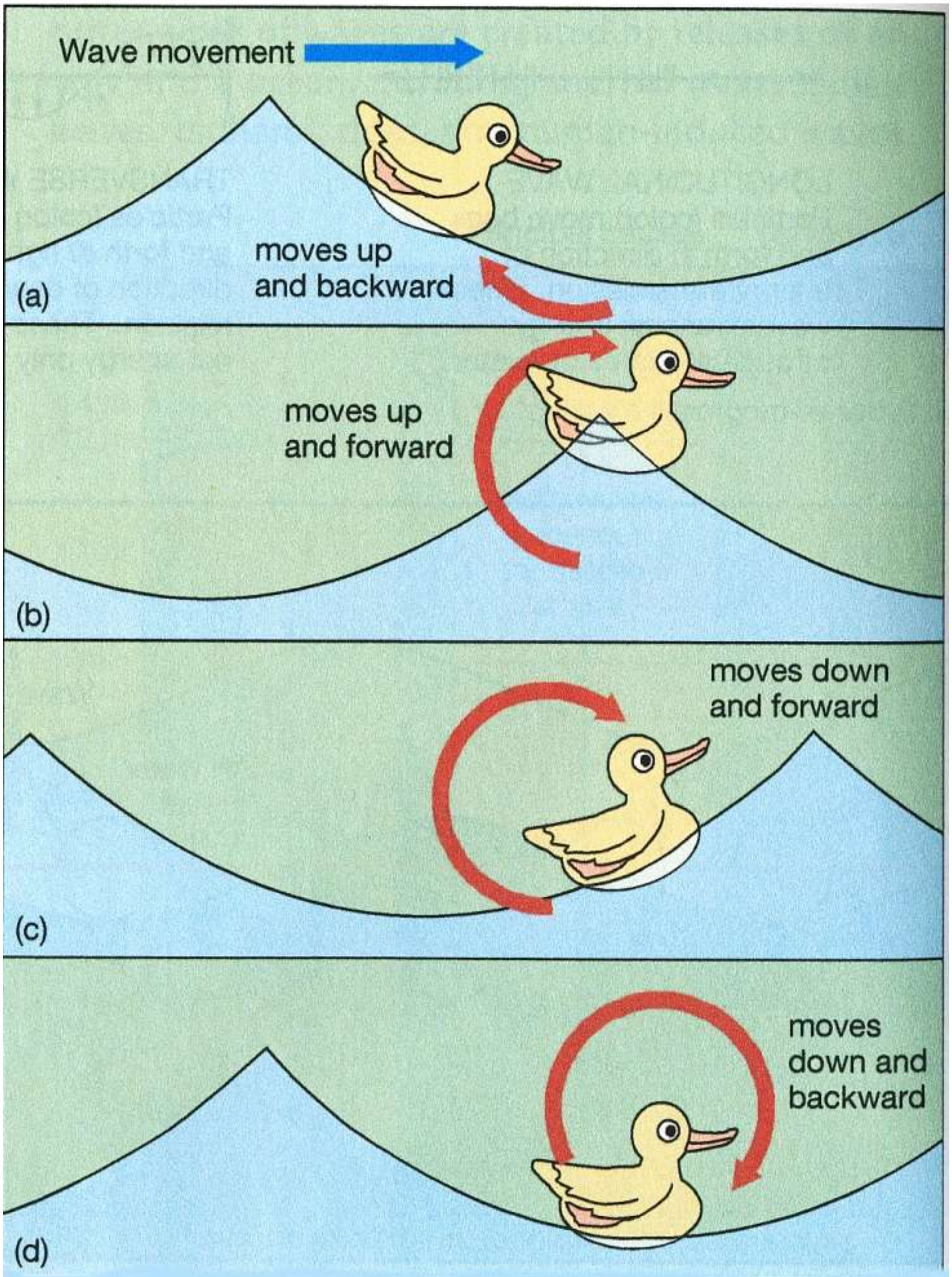
Ocean waves during storms can become very high and very dangerous. Even large ships can be in danger.

VIDEO of 100 ft high wave

https://www.youtube.com/watch?v=t8xNfMBoMMM

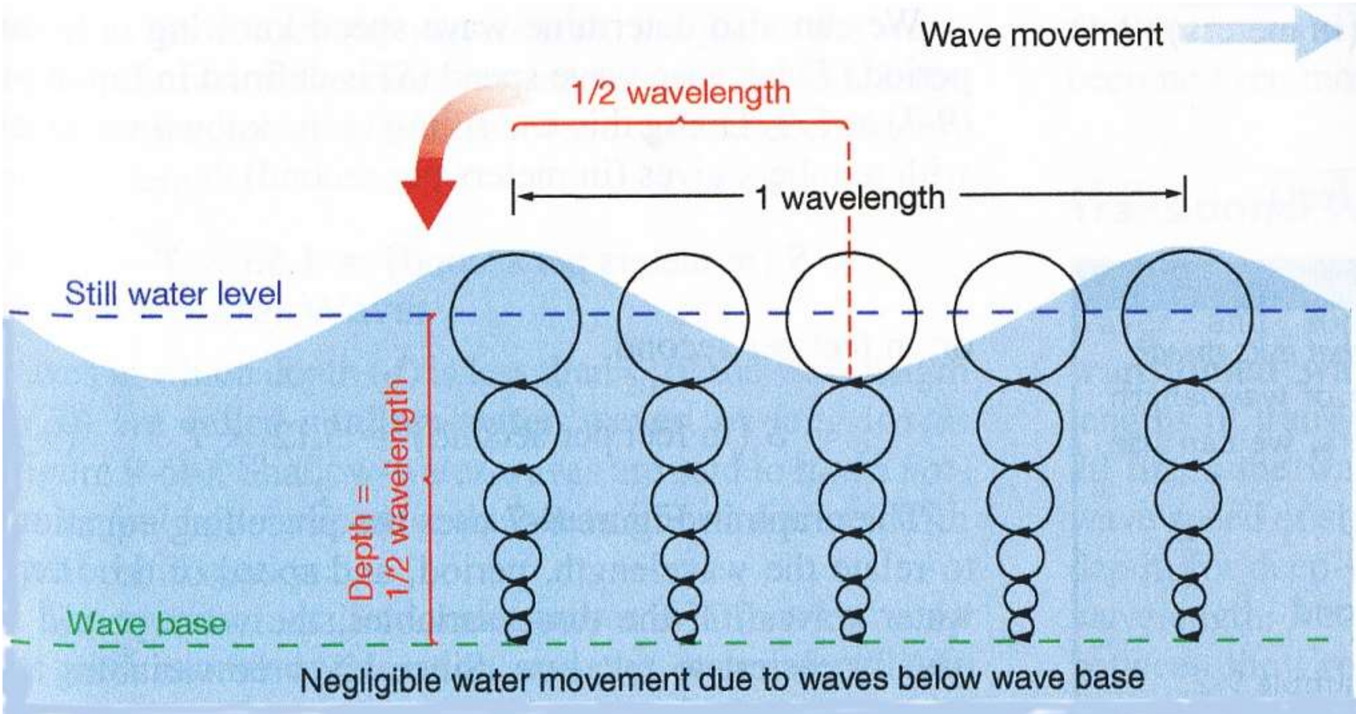
When the wind blows, it transmits energy to the water and the energy moves through the water. This energy is what causes the wave. The water in the wave does not move forward any more than wheat does when wind blows across it and causes the wheat to bend. The energy moves across the field, the wheat doesn’t. Similarly, the energy moves across the ocean and in the ocean and the water rises and falls as the energy passes by.

This can be seen by the movement of an object in the water when a wave comes by:



SEE VIDEO IN POWER POINT

https://www.youtube.com/watch?v=7yPTa8qi5X8



2 WAVE PHASE VIDEOS

As the top level starts to rotate, it presses against a lower level which also starts to rotate and so on down into the depths. At a certain level, the is negligible rotation and this is the wave “base” There are three factors that have an impact on the wave. One is how long the wind is blowing, the second is how hard the wind is blowing and the third is over what distance the wind is blowing. The distance over which the winds blows without interruption is called the “fetch’

.

Wind speed is measured in a scale called the Beaufort scale.

BEAUFORT WIND SCALE WITH CORRESPONDING SEA STATE CODES					
Beaufort Number	Wind Velocity (Knots)	Wind Description	Sea State Description	Sea State	
				Term and Height of Waves (Feet)	Condition Number
0	Less than1	Calm	Sea surface smooth and mirror-like	Calm, glassy 0	0
1	1-3	Light Air	Scaly ripples, no foam crests		
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Calm, rippled 0 – 0.3	1
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Smooth, wavelets 0.3-1	2
4	11-16	Moderate Breeze	Small waves, becoming longer, numerous whitecaps	Slight 1-4	3
5	17-21	Fresh Breeze	Moderate waves, taking longer form, many whitecaps, some spray	Moderate 4-8	4
6	22-27	Strong Breeze	Larger waves, whitecaps common, more spray	Rough 8-13	5
7	28-33	Near Gale	Sea heaps up, white foam streaks off breakers	Very rough 13-20	6
8	34-40	Gale	Moderately high, waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks		
9	41-47	Strong Gale	High waves, sea begins to roll, dense streaks of foam, spray may reduce visibility		
10	48-55	Storm	Very high waves, with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	High 20-30	7
11	56-63	Violent Storm	Exceptionally high waves, foam patches cover sea, visibility more reduced	Very high 30-45	8
12	64 and over	Hurricane	Air filled with foam, sea completely white with driving spray, visibility greatly reduced	Phenomenal 45 and over	9

Figure 8-1. Beaufort wind scale.

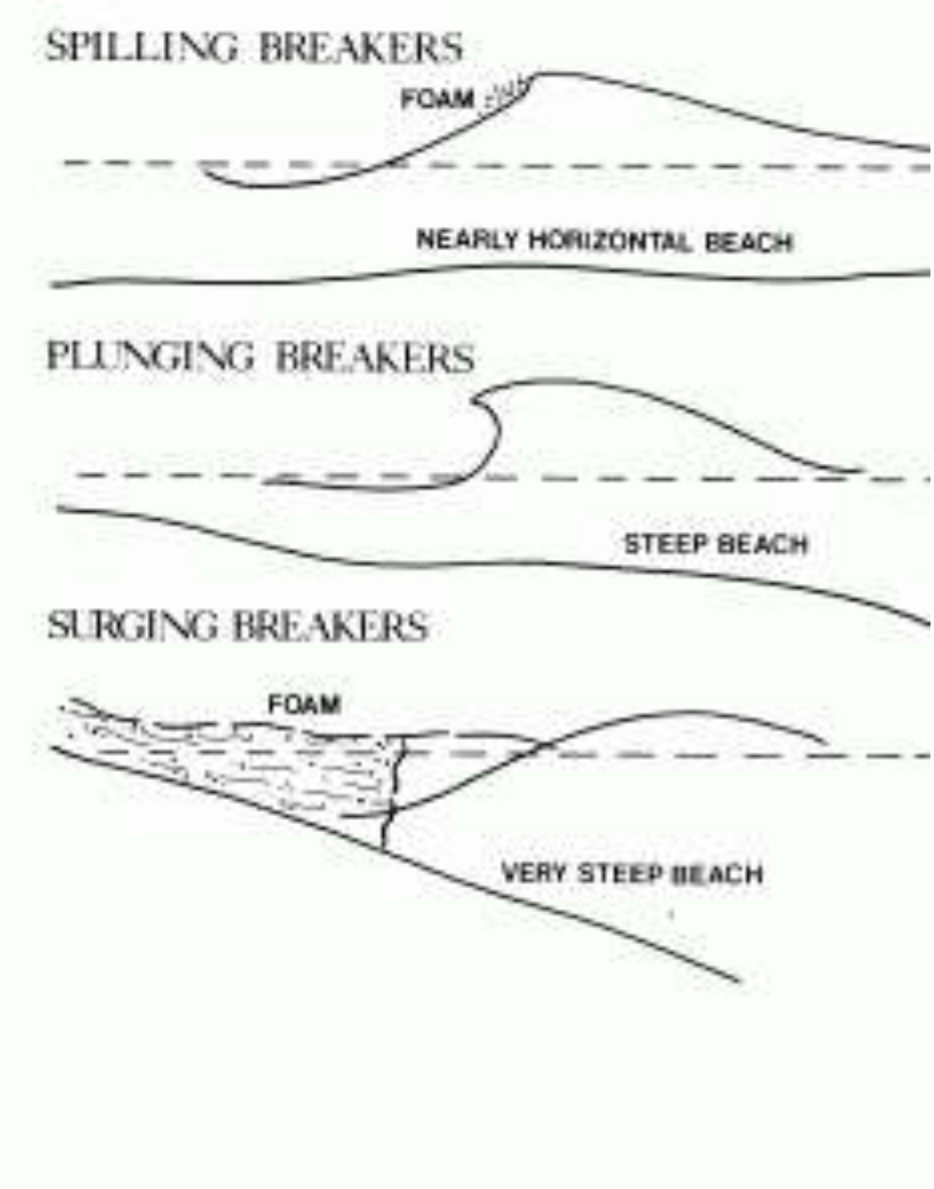
When a wave approaches the shore, it ‘breaks”.

When the water depth decreases to one half of a wave’s wavelength, the wave starts to “feel the bottom”. That means that the deepest water molecules set into circular motion by the wave’s energy run into the seafloor. This forces the wave to grow upwards, so wave height increases. The base of the wave is slowed down by friction against the sea bottom, while the top of the wave rushes ahead, so the wave crest begins to lean more and more forward until it topples over, and breaks on the shore.

Waves begin to break when the ratio of wave height/wavelength exceeds 1/7. Example: when a 14-foot wave length reaches a height of two feet, the wave breaks.

WHY IS THIS IMPORTANT?

The way the wave breaks is both caused by the shoreline and has an effect on the shore line. The way the waves break are classified as spilling, plunging or surging and are the result of different kinds of sea bottoms. The different kinds of breakers are significant because of the way they impact the coast. Generally there are 3 basic kinds of beakers (although they can be subdivided) (Notice here the definition of the kind of breaker is based on specific criteria –technical definitions. The definition is made for specific reasons)
If a beach is nearly horizontal (little slope) it will produce “spilling breakers”. If the beach is steep, it will cause the breaker sot be of the “plunging” type. Extremely steep beaches will produce “surging” breakers.

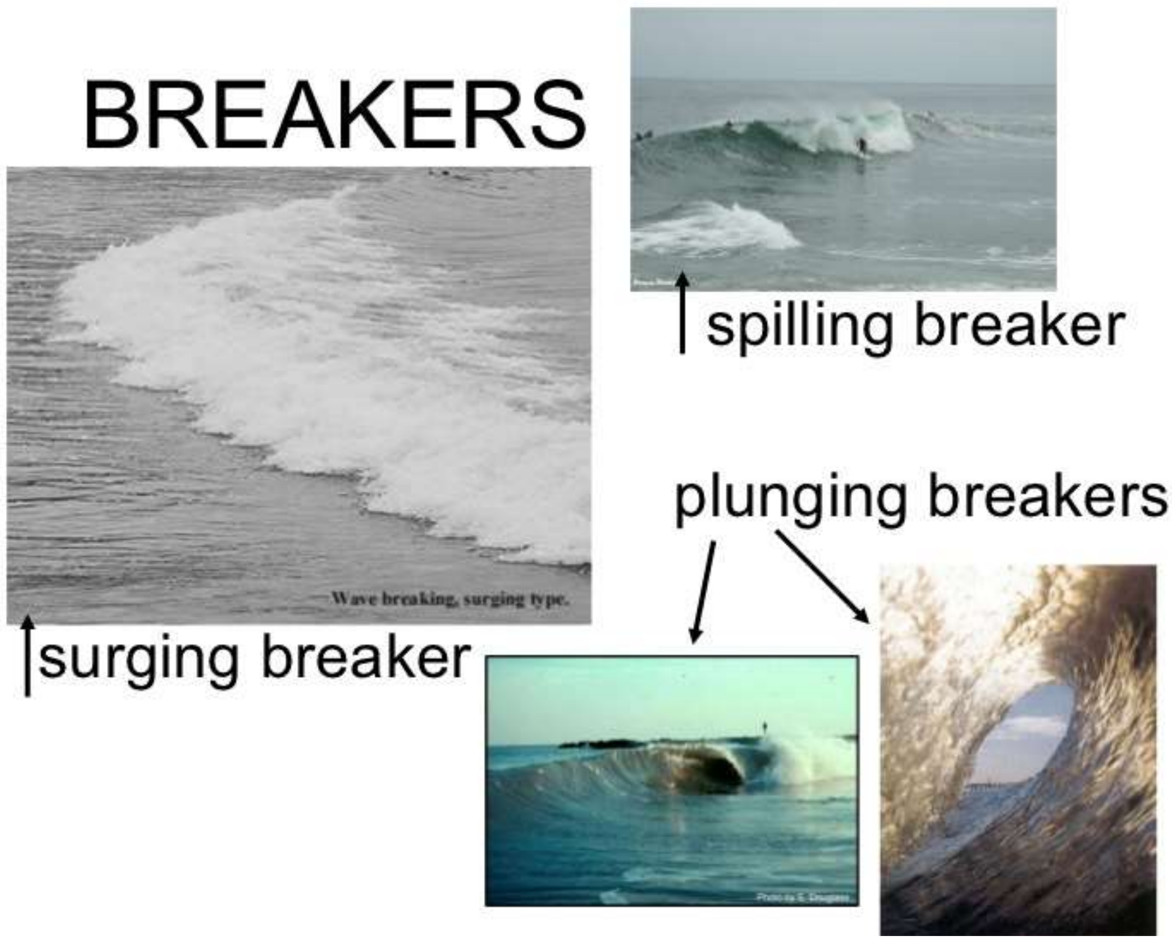

SPILLING BREAKERS
FOAM
NEARLY HORIZONTAL BEACH
PLUNGING BREAKERS
STEEP BEACH
SURGING BREAKERS
FOAM
VERY STEEP BEACH

3 Main Types of Breakers

1. Surging:
   - Steep slope beach; wave rolls instead of breaks right onto beach
2. Plunging:
   - Moderate slope; wave curls; surfing!

Manos, Northern Indonesia

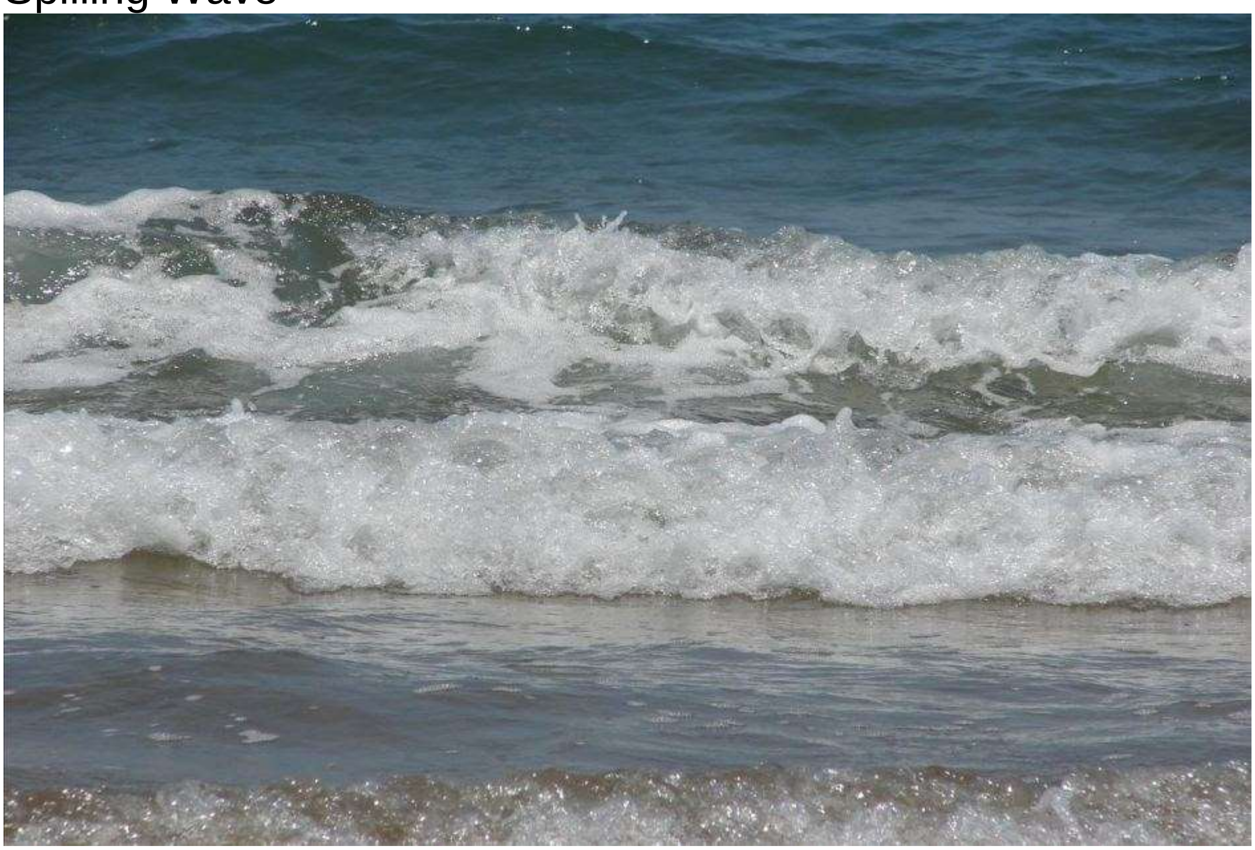
3. Spilling:
   - Gentle slope; break far from shore over long distance; crest spills down face of wave



SURGING WAVE (Never breaks)

Plunging
These are the kinds most surfers like.

Spilling Wave



A NOAA site (http://oceanexplorer.noaa.gov/edu/learning/9_ocean_waves/activities/breaking_waves.html) asks these questions and gives these answers.

Surging waves cause the most coastal erosion.

Which type of breaker - spilling, plunging, or surging – will cause the most coastal erosion? Explain.

A surging breaker will cause the most erosion because it slams into the beach at full speed. Spilling and plunging breakers slow down as they drag across the seafloor, so their energy is dissipated over a wider zone.

Spilling waves deposit more sand on shore and expand Beaches

Which type of breaker - spilling, plunging, or surging – will deposit sand onshore and expand beaches? Explain.

Waves can move sand when their energy is in contact with the bottom. Spilling breakers spend the most time and energy dragging across the seabed, so they should be able to push more sand onto the beach. Surging waves hardly interact with the bottom at all, so they will have little effect on offshore sand.

So wave types is important not only to surfers, but to people who worry about coastal erosion –especially to those who build houses, highways, and other edifices on the shoreline.

It became necessary to move the Cape Hatteras Lighthouse that was built on Cape Hatteras Barrier Island in 1870 1500 feet (457 meters) from the shore. By 1970 the water was a mere 120 feet from the base of the lighthouse because of erosion. In 1999 it was moved 2900 feet (884 meters) from its original location!

Cape Hatteras Light House (2) Dangerously near the water