- Mountain ranges are visible reminders that the shape of Earth's surface changes constantly
- Deformation is the bending, tilting, and breaking of Earth's crust.

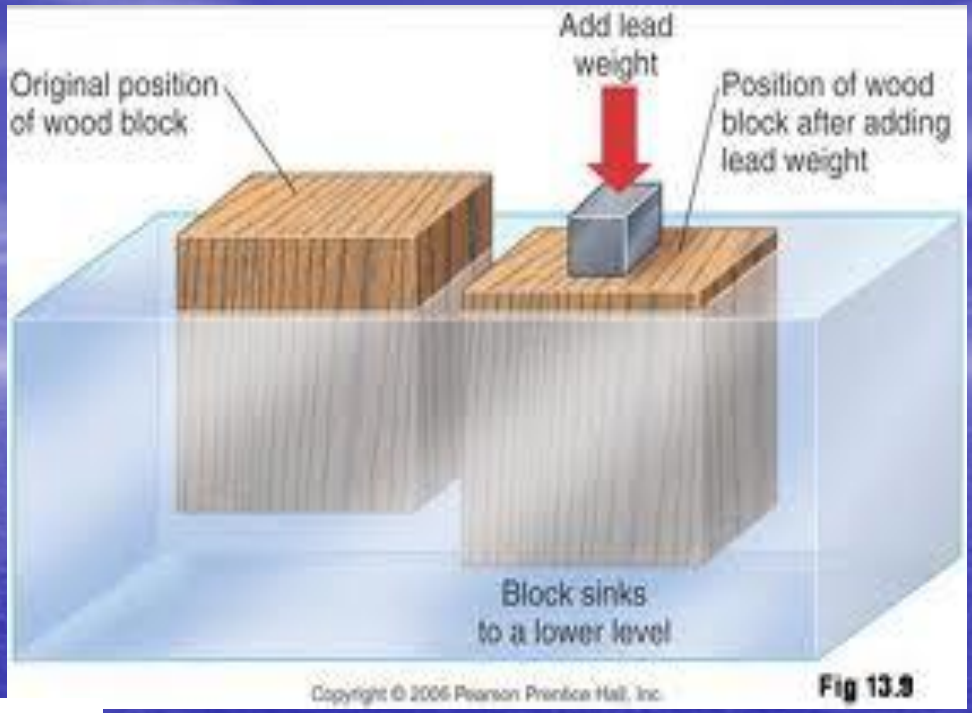
# Lesson 1 (Ch 20) – How Rock Deforms

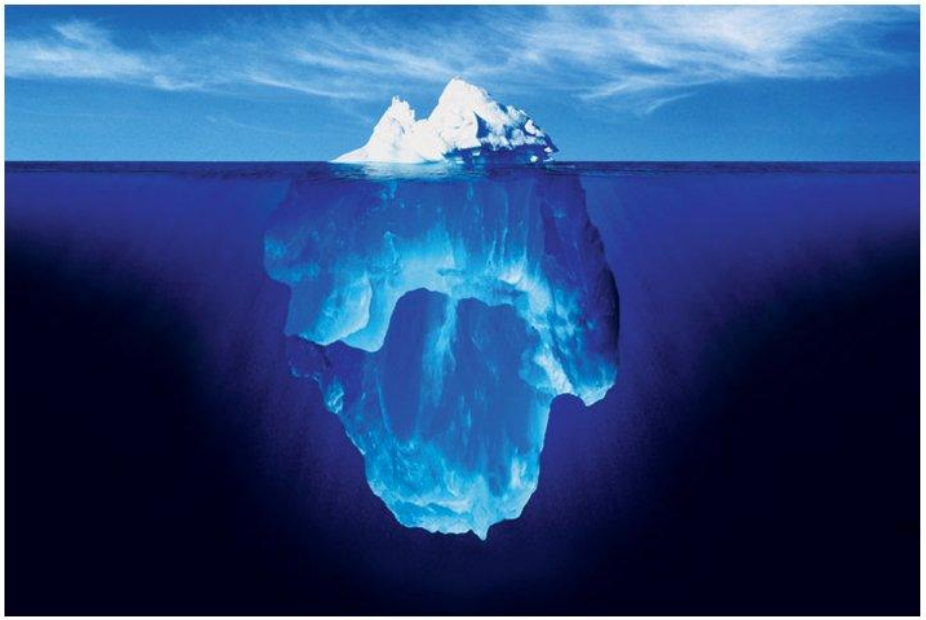
Chapter 11

- Deformation can occur when the weight of some part of the Earth's lithosphere changes.
- When the forces acting on the lithosphere and asthenosphere are balanced and in a state of isostasy.

# How Rock Deforms

- Isostasy is a condition of gravitational and buoyant equilibrium between Earth's lithosphere and asthenosphere.



# Isostasy

- When the weight of the lithosphere changes, the lithosphere sinks or rises until a balance is reached once again.


# Isostasy

# Check for Understanding

1. What is the difference between deformation and erosion?
2. In your own words, explain isostasy. Provide an example.

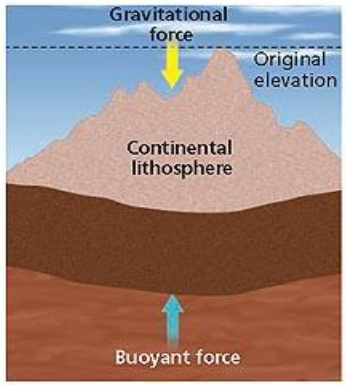

***Write using complete sentences***

# Isostatic Adjustments

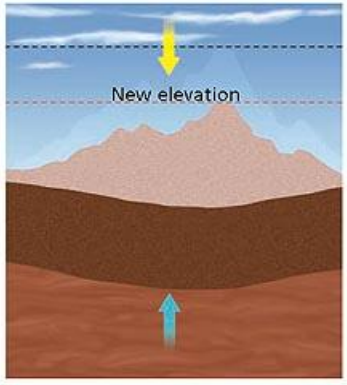
- The movements of the lithosphere to reach isostasy are called isostatic adjustments.

- There are 3 reasons why these adjustments would occur on Earth:
- (1) Mountain Erosion
- (2) Sediment Movement / Deposition
- (3) Glacier Movement

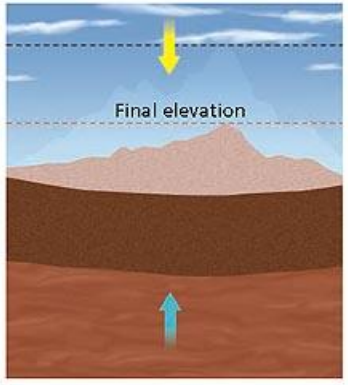
# (1) Mountains Erosion




When the gravitational force equals the buoyant force, the lithosphere and asthenosphere are in isostasy.




As erosion wears away the crust, the lithosphere becomes lighter and is pushed up by the asthenosphere.



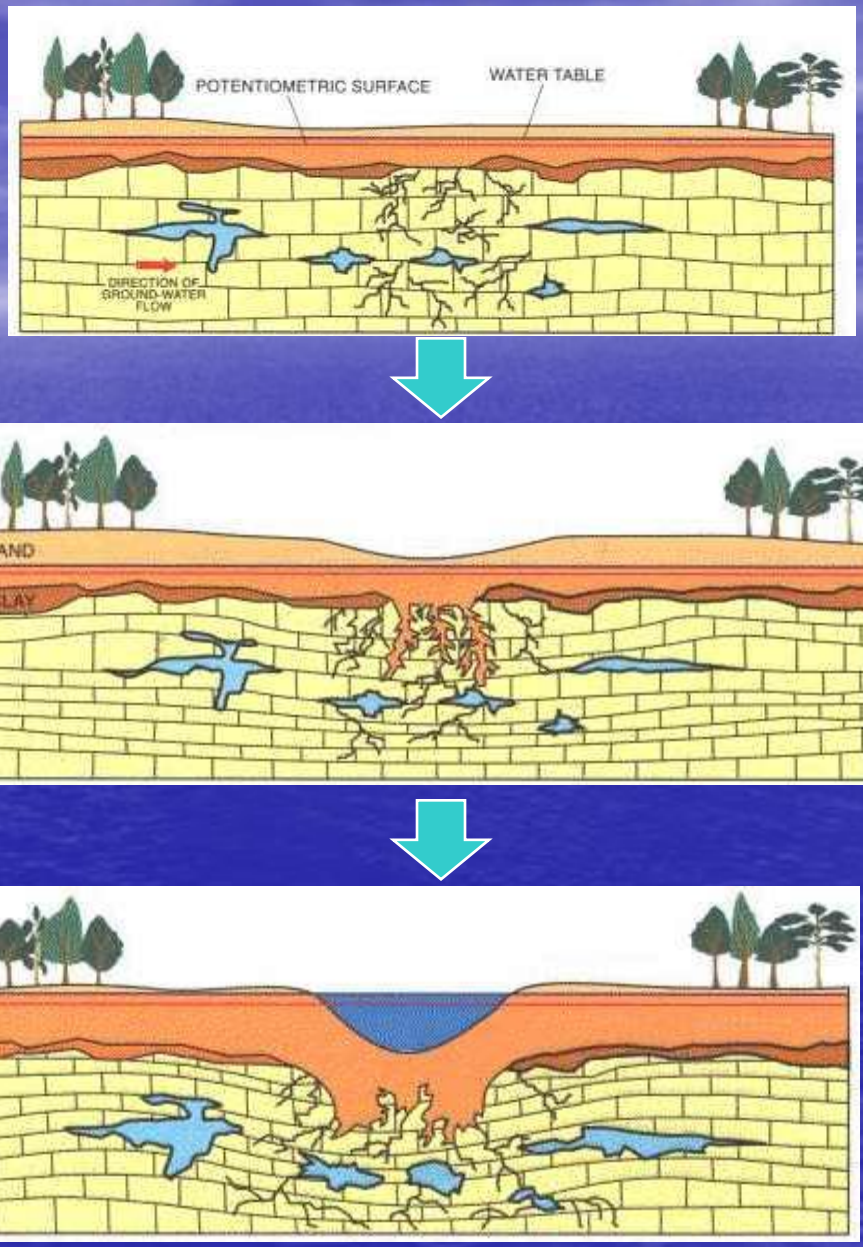

As erosion continues, the isostatic adjustment also continues.

- The surface of mountains is worn away by erosion over millions of years, resulting in a reduction of height and weight of the mountain range.
- The surrounding crust becomes lighter, and the area rises by isostatic adjustment in process called *uplift.*

- Adjustments occur in areas where rock and dirt are moved away creating a sink hole.

# (2) Sediment Movement

- Adjustments can also occur when rivers, carrying large amounts of mud, sand, and gravel deposit this material into a central area.
- The added dirt weight causes the area or ocean floor to sink by isostatic adjustment.

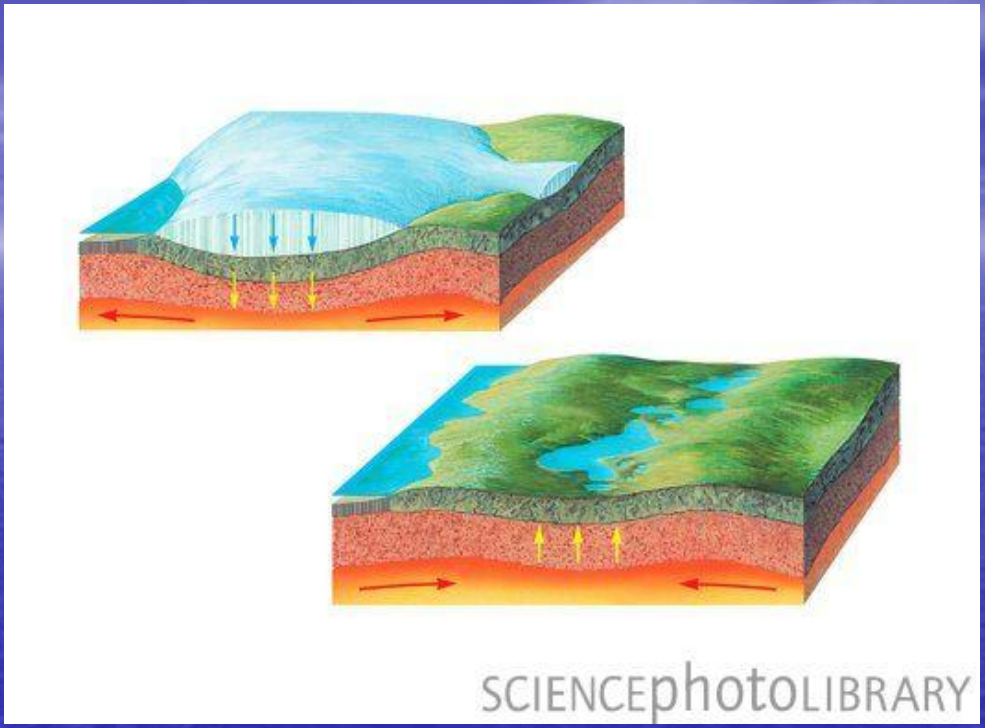



# (2) Sediment Movement

- The sinking of land is also known as subsidence.
- This process is occurring in the Gulf of Mexico at the mouth of the Mississippi River, where a thick accumulation of deposited materials has formed.

# (2) Sediment Deposition

- Isostatic adjustments also occur as a result of the growth and retreat of glaciers and ice sheets.



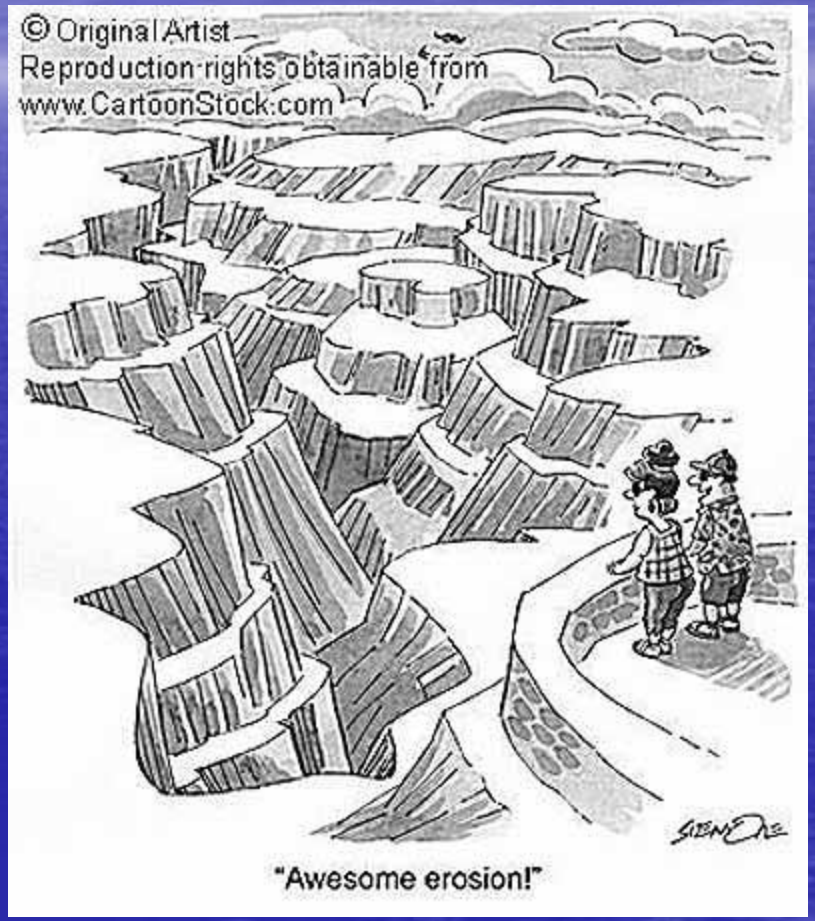

# (3) Glacier Movement

# (3) Glacier Movement

- The weight of the ice causes the lithosphere to sink, while the ocean floor rises because the weight of the overlying water is less.
- When glaciers melt, the land that was covered with ice slowly rises as the weight of the crust decreases.
- As the water returns to the ocean, the ocean floor sinks.

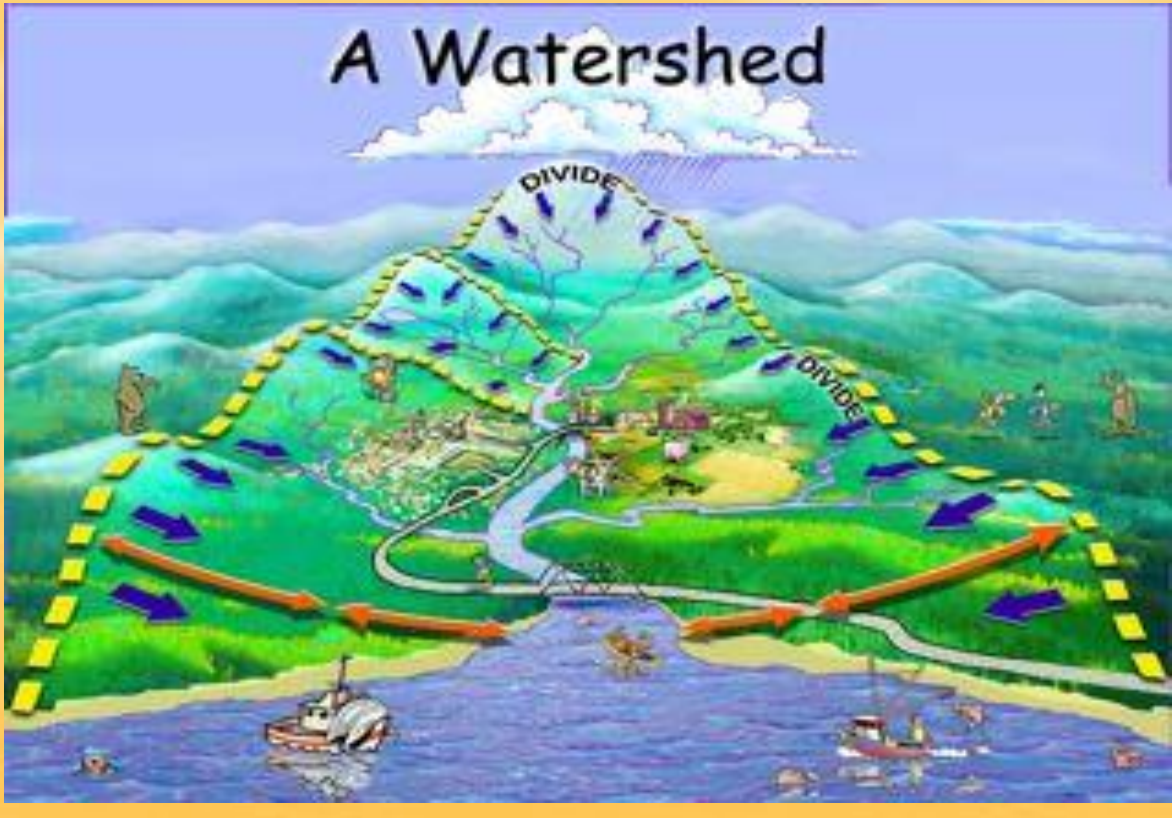
# Check for Understanding

1. In your opinion, which type of isostatic adjustment has the greatest influence on the lithosphere? Be able to justify your response.



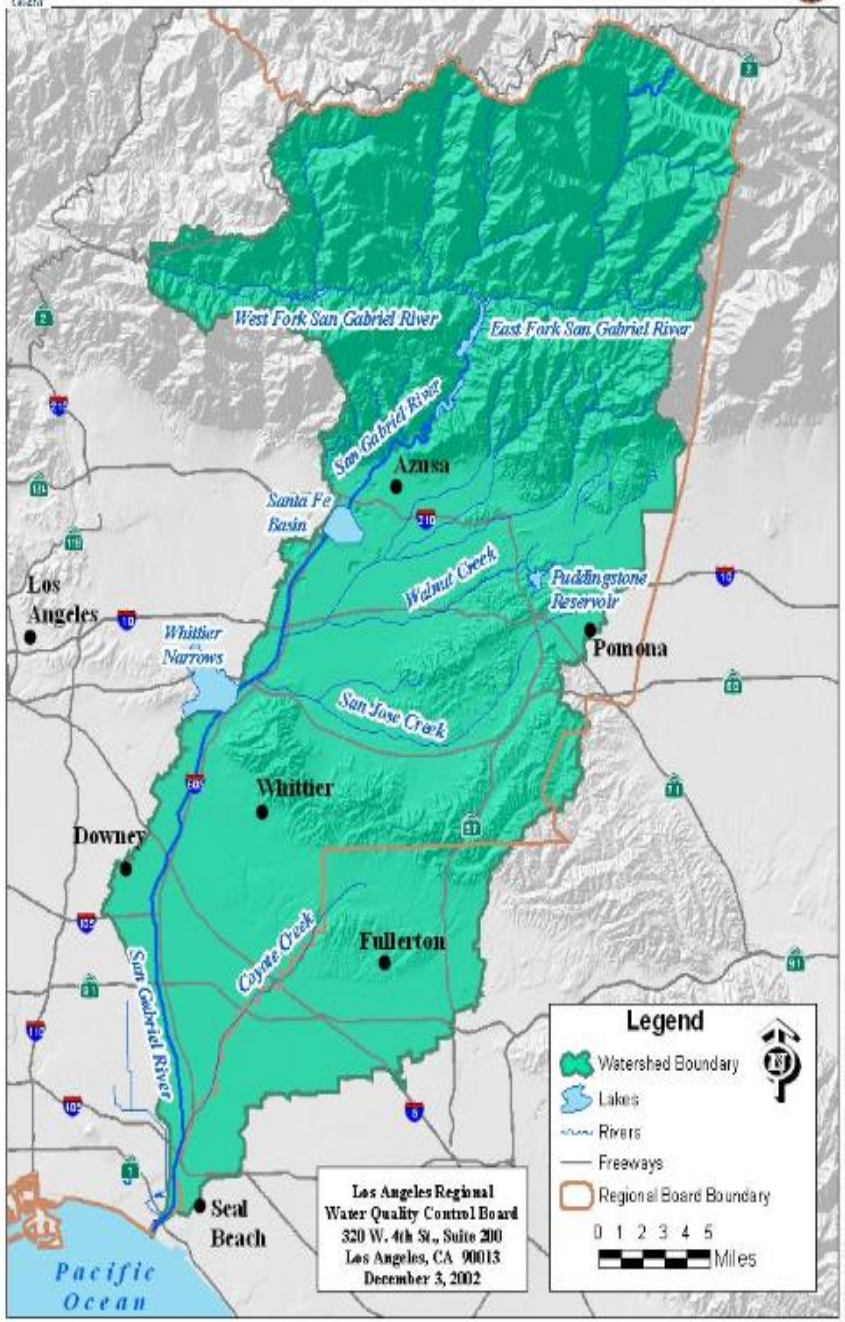

***Write using complete sentences***

- Tributaries are streams that flows into a lake or into a larger stream.
- The watershed area or basin is the area of land that is drained by a river system and no matter where you're at, we all belong to some sort of watershed.




# Lesson 2 (15.2) - River Systems

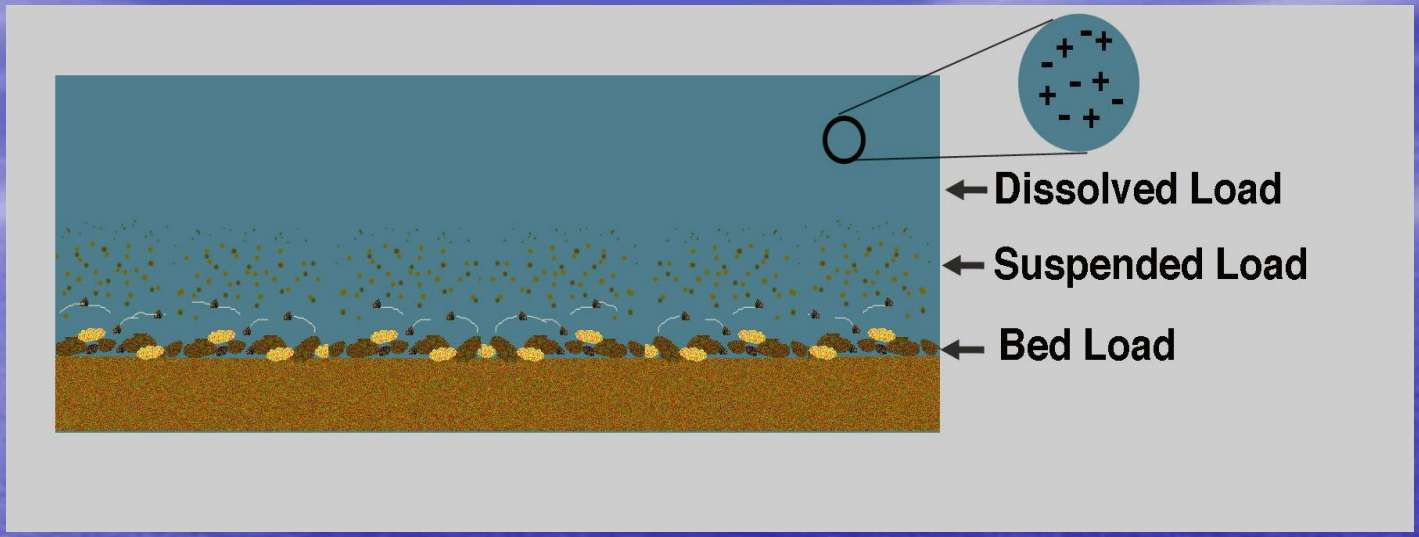
# San Gabriel River Watershed



- A river system is made up of a main stream and tributaries. (Ex – Mississippi River)
- River systems change continuously because of erosion.

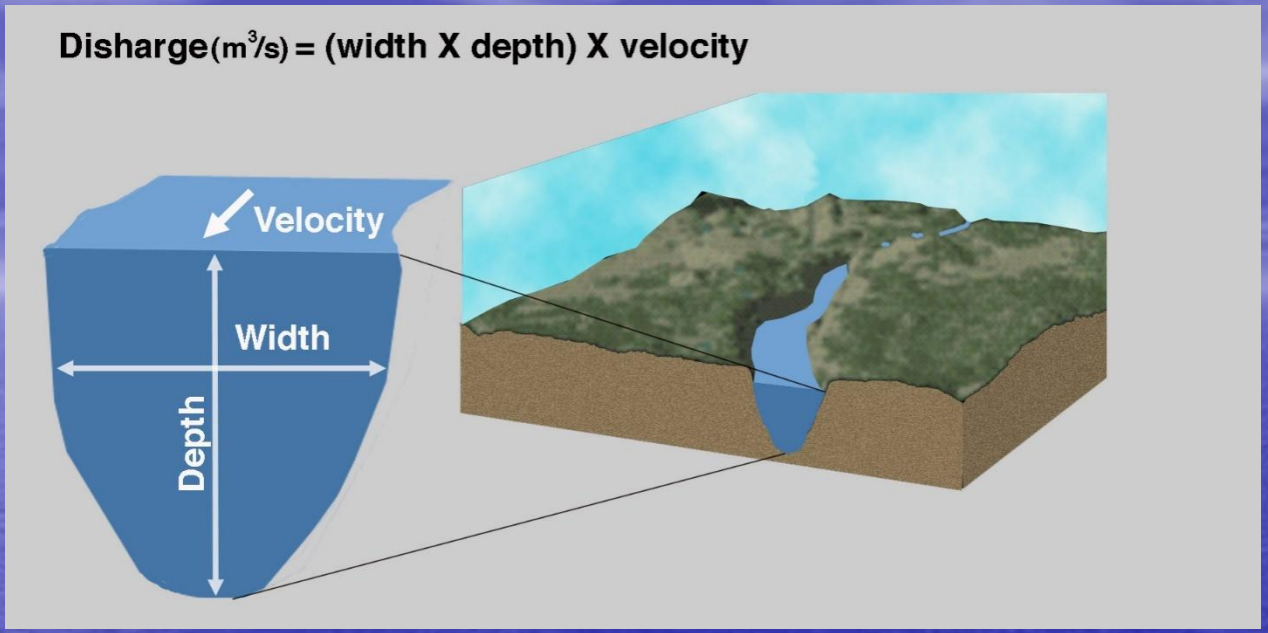

# River Systems

# What is in the River




- The stream load is the materials other than the water that are carried by a stream.
- A stream transports soil, loose rock fragments, and dissolved minerals as it flows downhill from the basin.

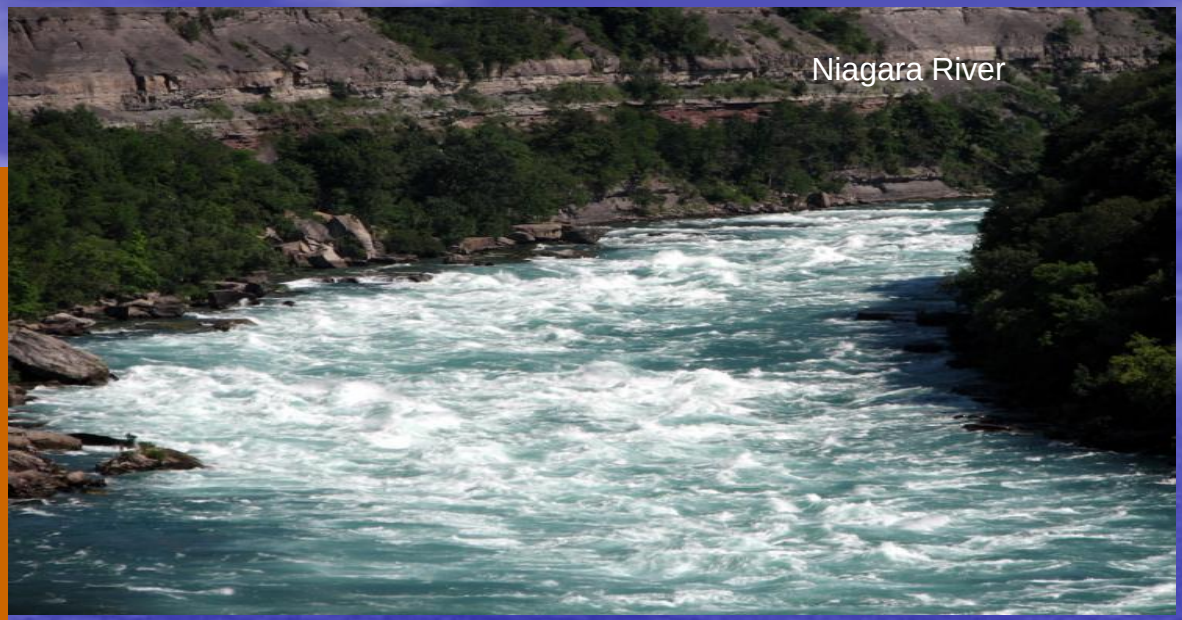
# What is in the River



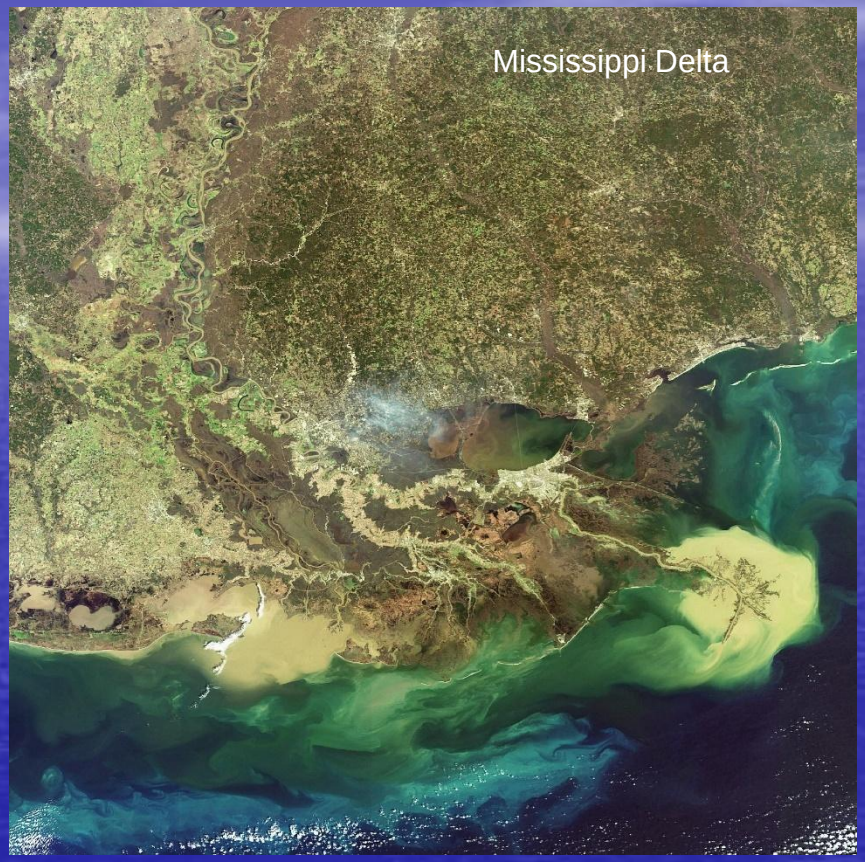

- The faster a stream flows, the more sediment it will carry.
- A stream's velocity also affects the depth of its channel.

- Swift streams erode their channels more quickly than slow-moving streams do.
- A stream or river will end in either a delta or alluvial fan.

# What is in the River




- A river delta is a landform that is formed at the mouth of a river, where the river flows into an ocean, sea, estuary, lake, or reservoir.



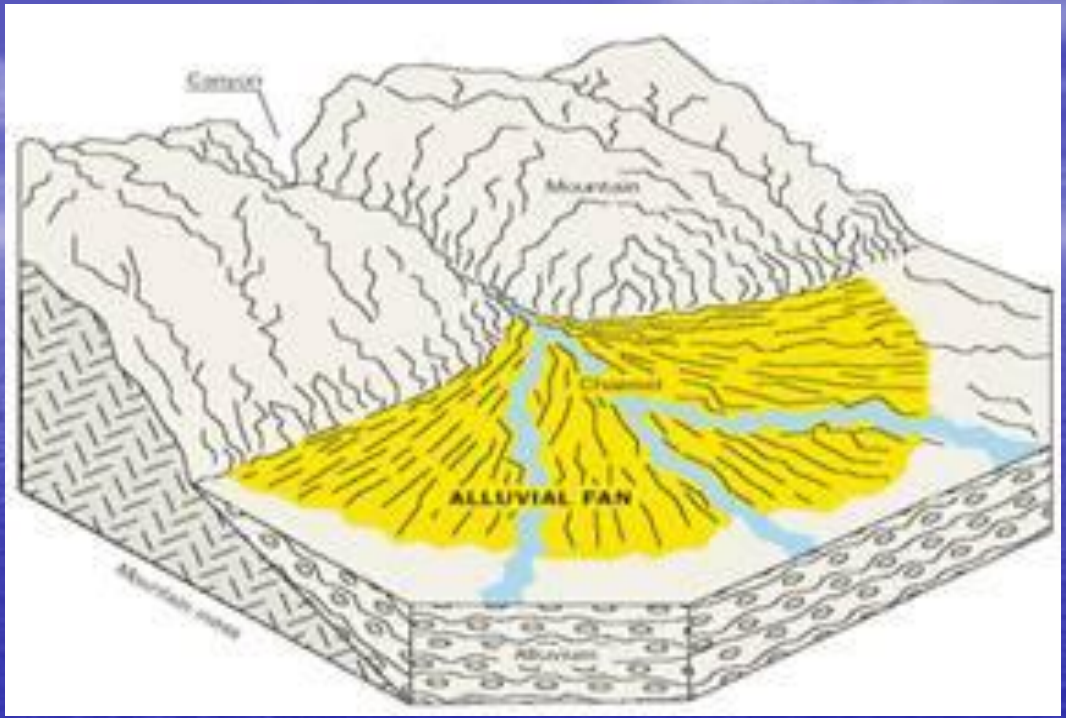

# Delta and Alluvial Fan

- Deltas are formed from the deposition of the sediment carried by the river as the flow leaves the mouth of the river.
- Over long periods of time, this deposition builds the characteristic geographic pattern of a river delta.

Nile River

# Delta and Alluvial Fan

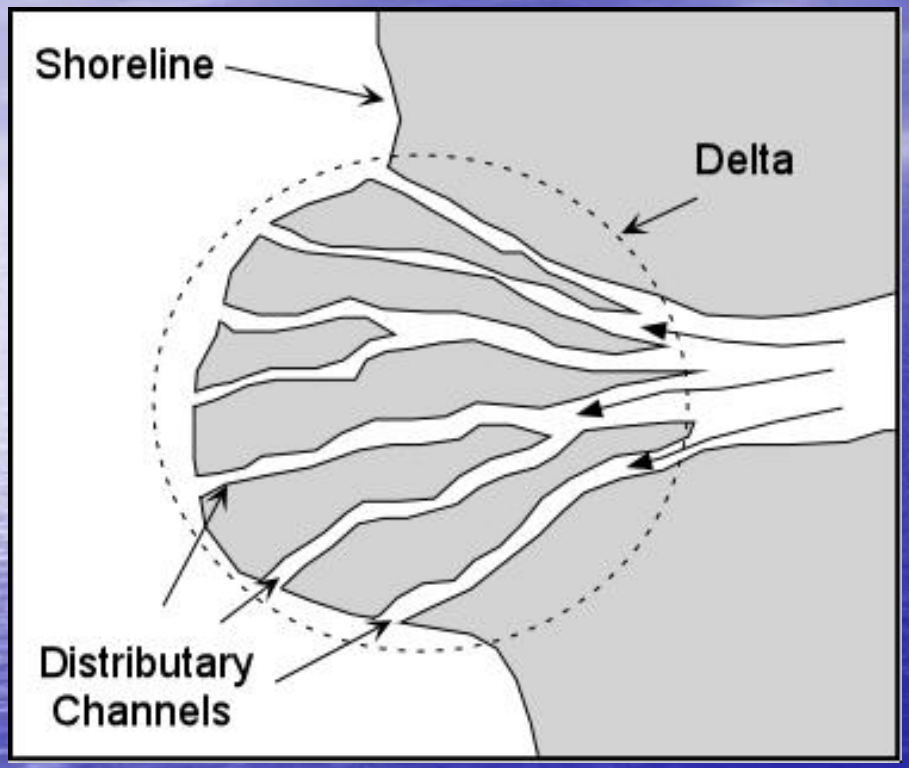
- An alluvial fan is a fan-shaped mass of rock material deposited by a stream when the slope of the land decreases sharply.

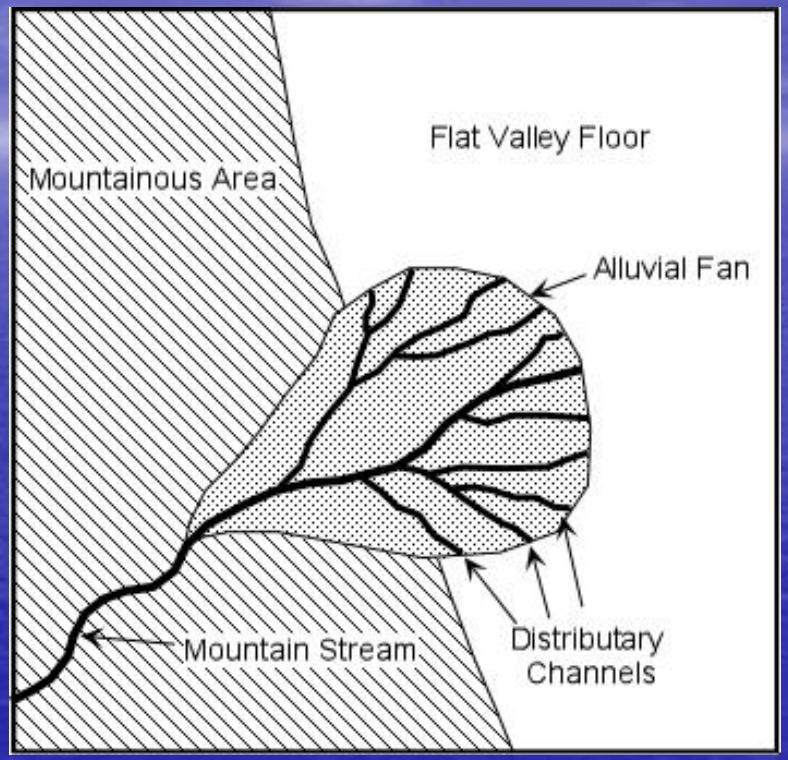



**Delta and Alluvial Fan**

- Fans are typically found where a canyon draining from mountainous terrain emerges out onto a flatter plain, and especially along fault-bounded mountain fronts.
- Alluvial fans differ from deltas in that alluvial fans form on land instead of being deposited in water.

**Delta and Alluvial Fan**




# Delta and Alluvial Fan

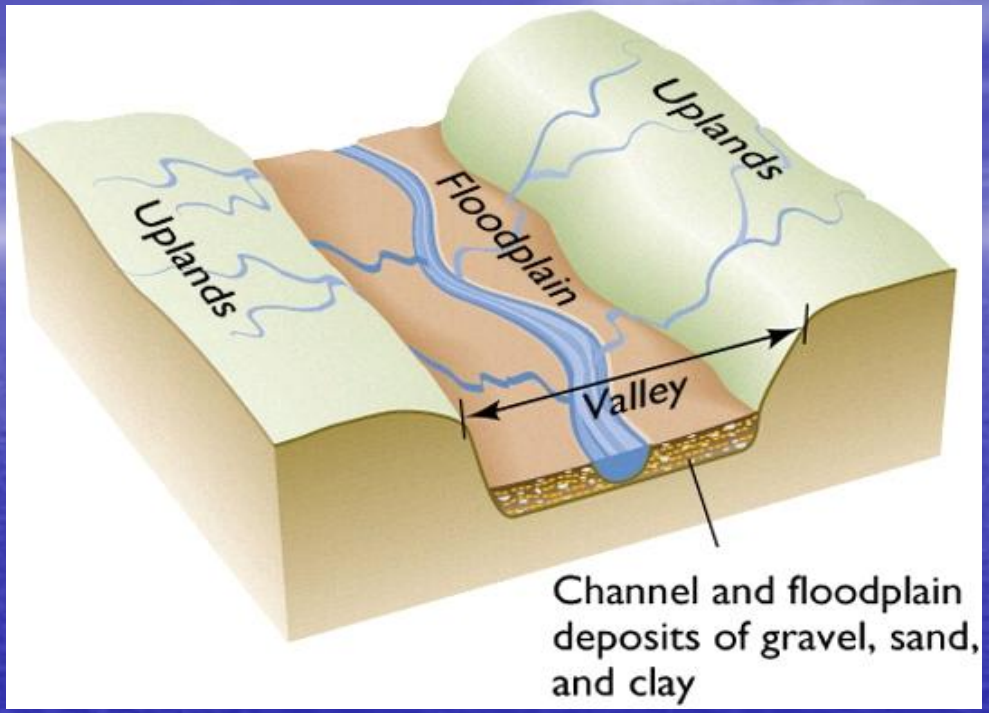
# Check for Understanding

1. In your own words describe how a Delta and an Alluvial fan differ from one another.

***Write using complete sentences***

# Floodplains

- A floodplain is an area along a river that forms from sediments deposited when the river overflows its banks.



- When a stream overflows its banks and spreads out over the floodplain, flooding the area.

## Natural Levees

- The accumulation of these deposits along the banks eventually produces raised banks, called *natural levees*.

# Natural Levees

# Human Activity and Flooding

- Human activity can contribute to the size and number of floods in many areas.
- Vegetation, such as trees and grass, protects the ground surface from erosion by taking in much of the water that would otherwise run off.

# Human Activity and Flooding

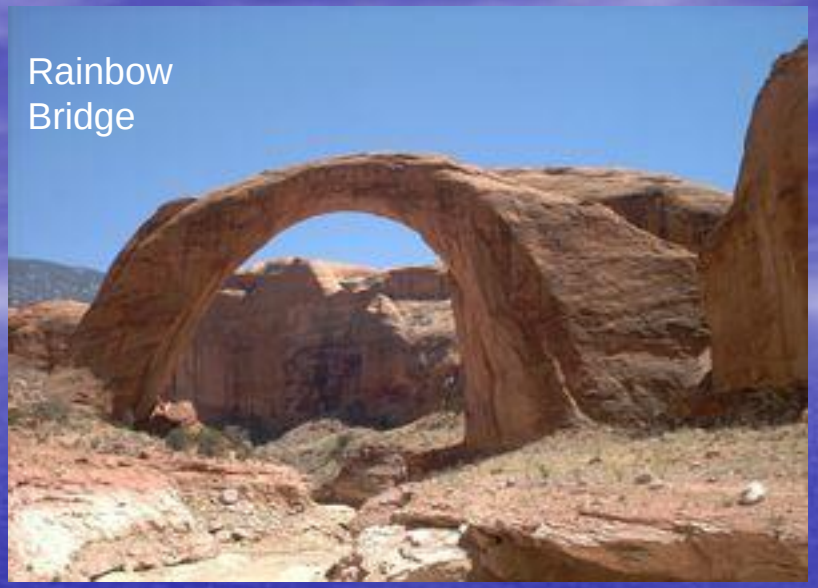

- Logging and the clearing of land for agriculture or housing development can increase the volume and speed of watershed runoff, which can lead to more frequent flooding.

- Indirect methods of flood control include forest and soil conservation.
- More-direct methods include the building of artificial structures like dams and artificial levees, that redirect the flow of water.

# Human Flood Control

# Life Cycle of Lakes

- Most lakes are relatively short lived in geologic terms.
- Many lakes eventually disappear because too much of their water drains away or evaporates.




- Lake Powell is the second largest man-made reservoir in maximum water capacity in the U.S. behind Lake Mead (Hoover Dam) and was created by the Glen Canyon Dam in 1969. Filled by 1980 it deepest parts reach 500 feet both are filled by the Colorado River.

# Lake Powell

# Lake Powell from Space intro for CA water

- Some lakes do not get enough water to replenish the water level lost by evaporation and runoff. Therefore the lake system dries out.


# Life Cycle of Lakes

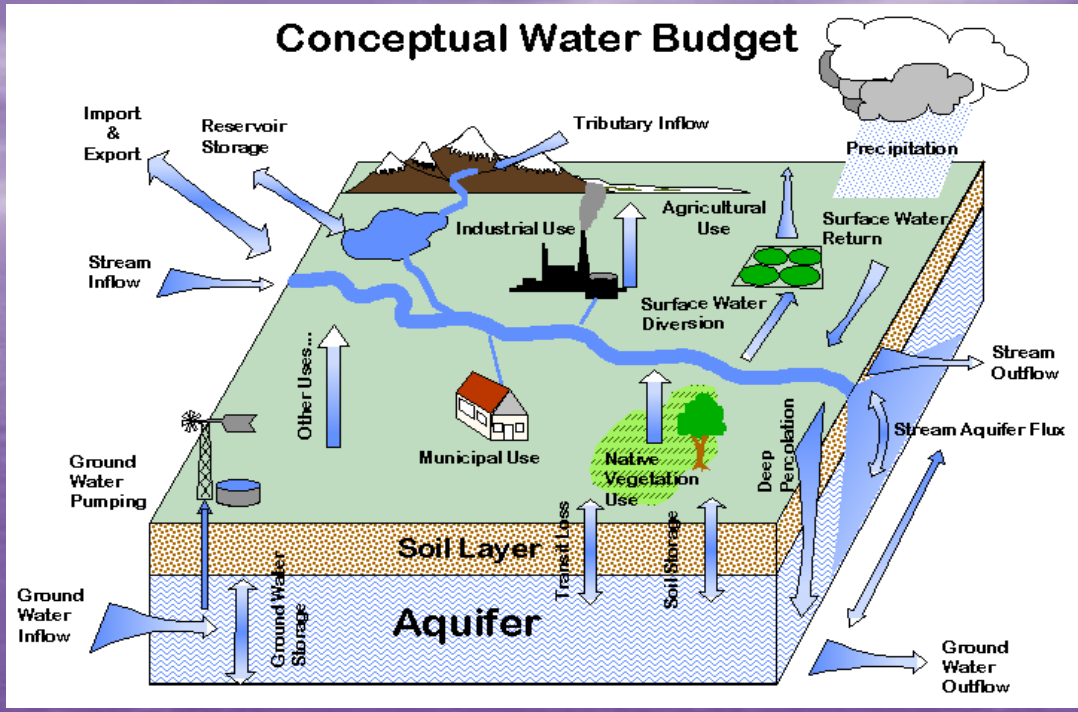
# Check for Understanding

1. A faster stream will carry _____ (more or less) sediment and be _____ (deeper or shallower) than a slower stream. Explain your answers.

2. Name and describe 2 negative impacts humans can have on rivers and lakes.

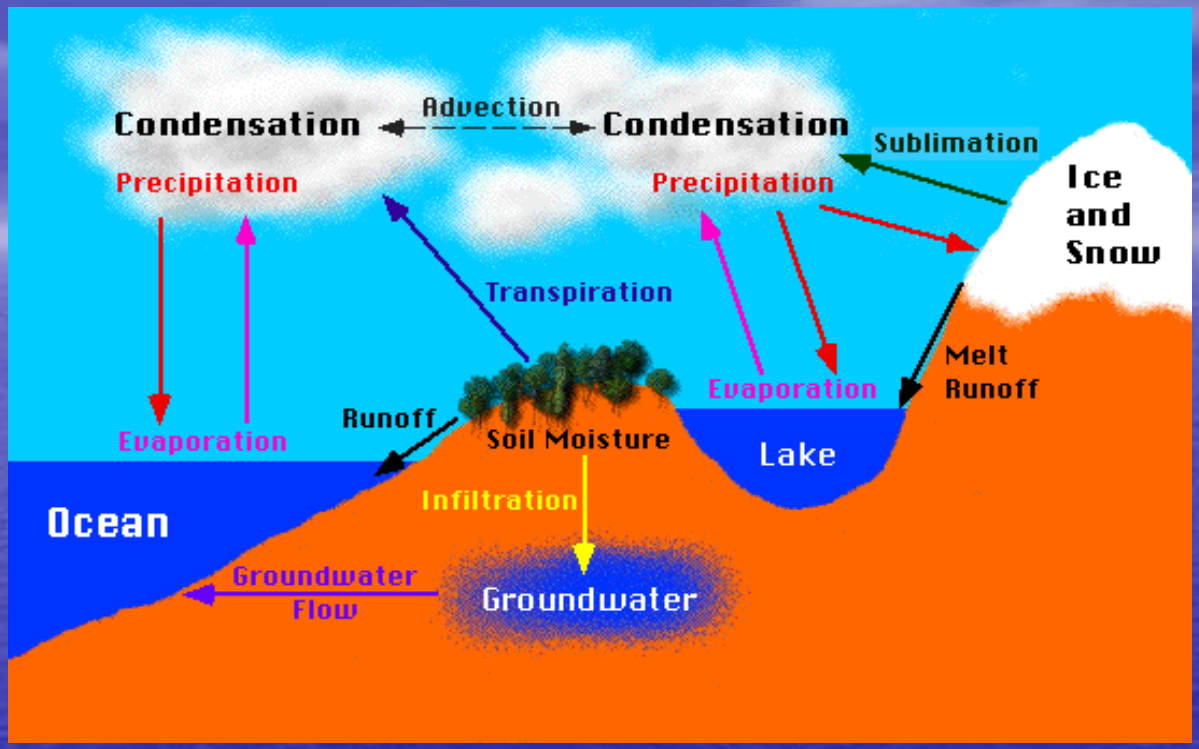
***Write using complete sentences***

- The water cycle is the continuous movement of water between the atmosphere, the land, and the oceans.
- In Earth's water budget, precipitation is the *income*.
- Evaporation transpiration, and runoff are the *expenses*.




# Lesson 3 – Water Cycle and Budget

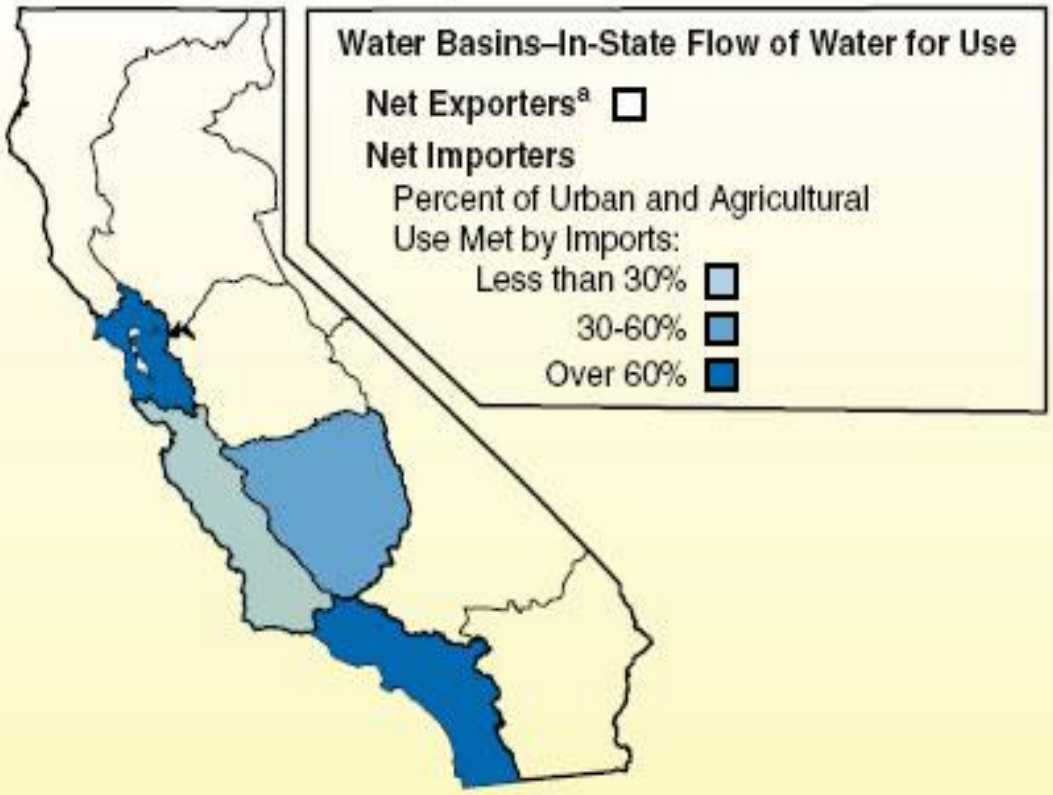
# Water Budget




- The water budget of Earth as a whole is balanced because the amount of precipitation is equal to the amount of evaporation, transpiration and runoff.

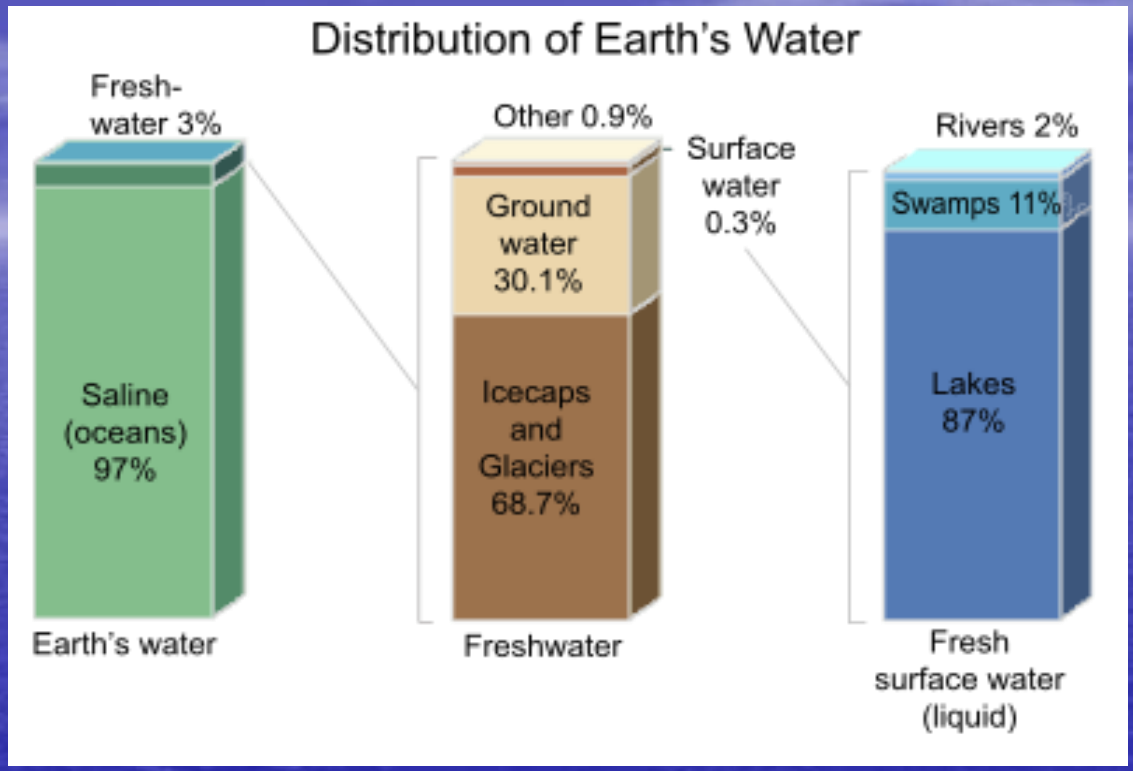
# Water Budget

- Although Earth's water budget is balanced, as is the case in Los Angeles, *local water budgets*, are usually not balanced.
- A major factor that affects the local water budget is the amount of precipitation each year.




[a]While the Colorado River region is a net exporter of water within California, its main source of water is imported from the Upper Colorado River Basin.

- The Main Sources of CA's Freshwater supply are:
- 1) Precipitation – which starts as snow in the mountains
- 2) Surface Water
- 3) Groundwater




# California's Water Budget

# Check for Understanding

Two men walk into a bar.
One man orders $H_2O$.
The other says,
"I'll have $H_2O$, too."

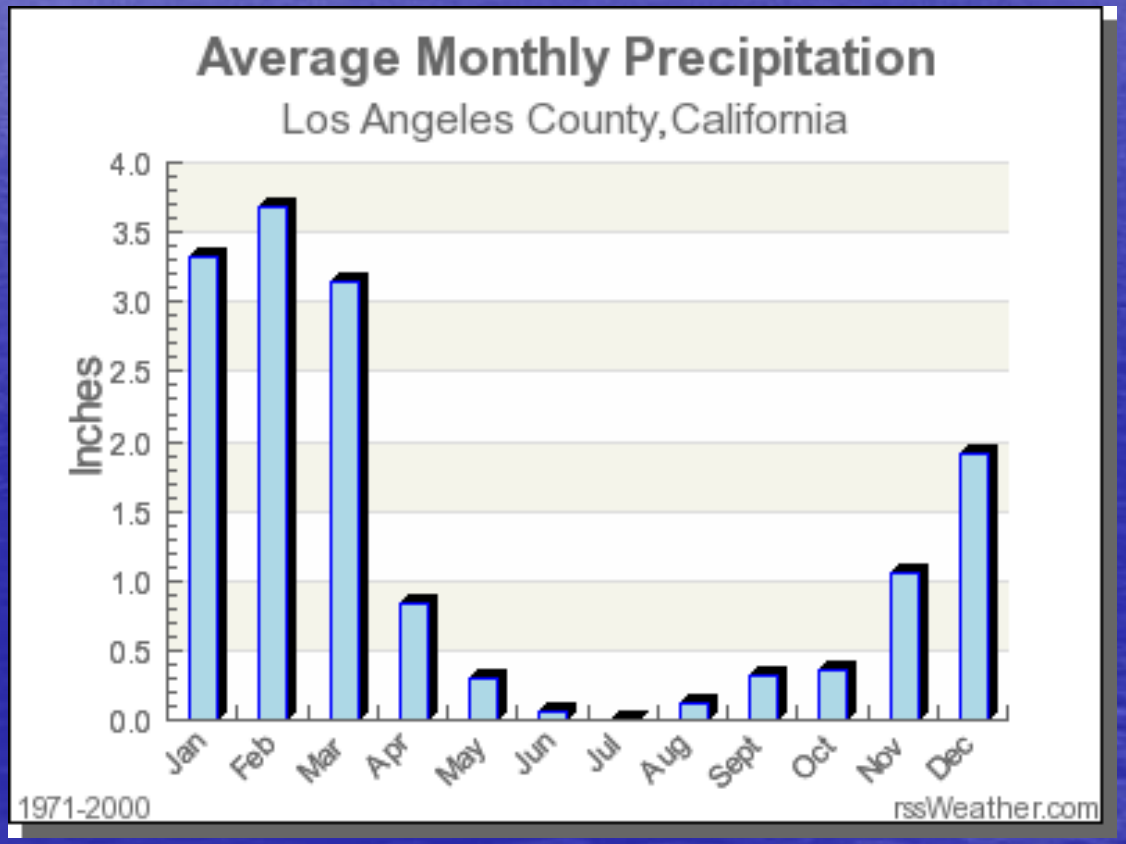
The second man dies.

1. What geological event could potentially take place to the surface of the Earth if the ground water is removed?
2. Explain how the Earth's water supply is balanced.

***Write using complete sentences***

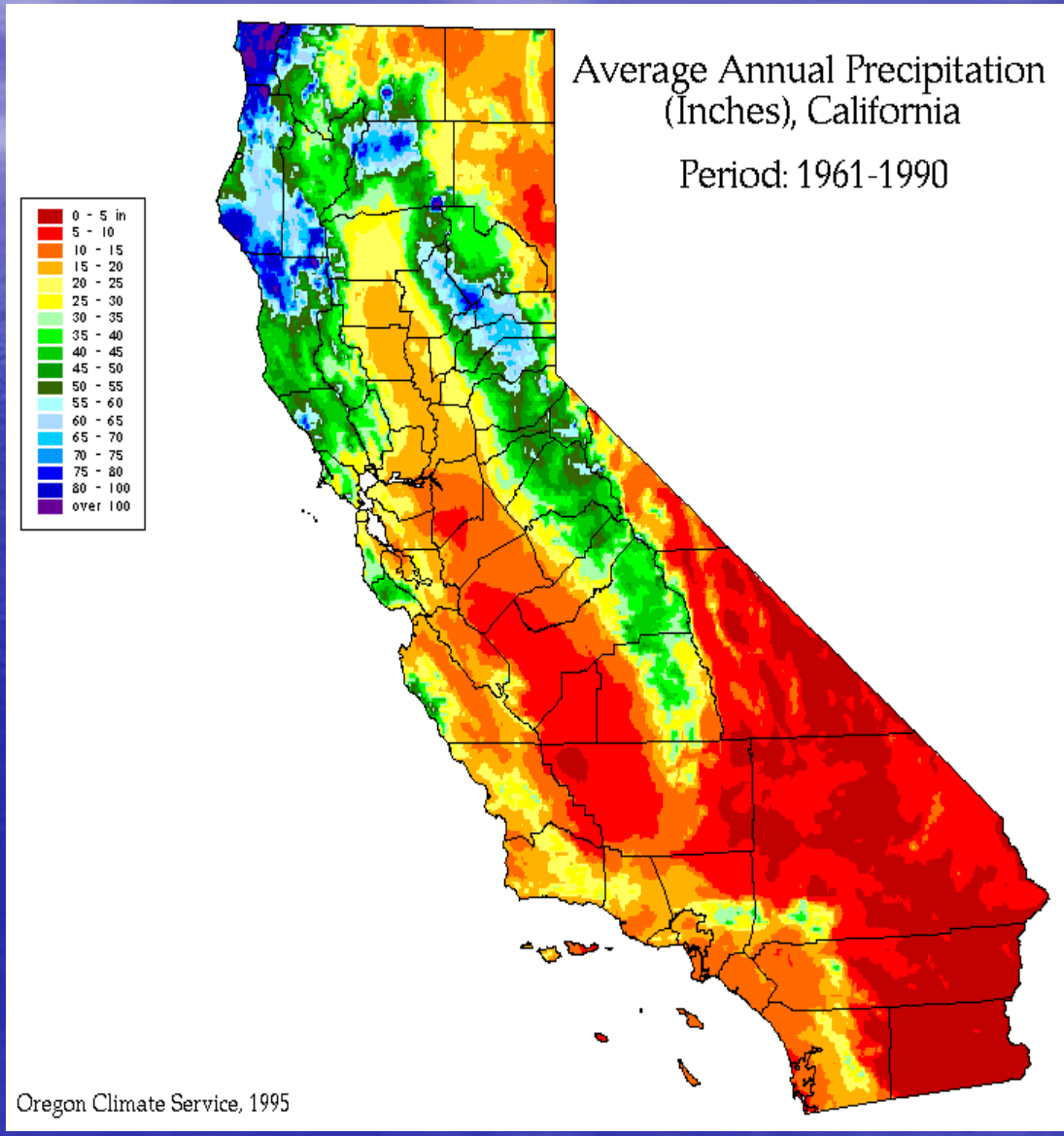
# 1) Precipitation

- The average rainfall in CA is 22.9 inches (La Verne 16”) and it not evenly distributed.
- Only 35% of CA’s precipitation stays at the surface or seeps into the ground.
- The rest is lost to evaporation, transpiration or runoff.



# 1) Precipitation

- On average Northern California receives 75% (SoCal 25%) of all precipitation in CA.
- Yet our water usage and needs are reversed for urban usage- (NoCal uses 30% - SoCal uses 70%).



- Southern California gets 60-70% of its water imported from the California Aqueduct, the Los Angeles Aqueduct (Owens Valley), and the Colorado River.


# 2) Surface Water

# 2) Surface Water

- The Colorado River is the principal surface water resource for seven states & parts of Mexico.

# The California Aqueduct

- Sometimes referred to as the "SWP", the State Water Project is a water storage and delivery system of reservoirs, aqueducts, and powerplants bringing an irrigation supply to the Central (San Joaquin) Valley and water to Southern California.

# The Los Angeles Aqueduct

- Not to be confused with the SWP the Los Angeles Aqueduct is a separate gravity fed aqueduct which brings water from the Owens Valley and Mono Basin.

# The Story Behind the Los Angeles Aqueduct

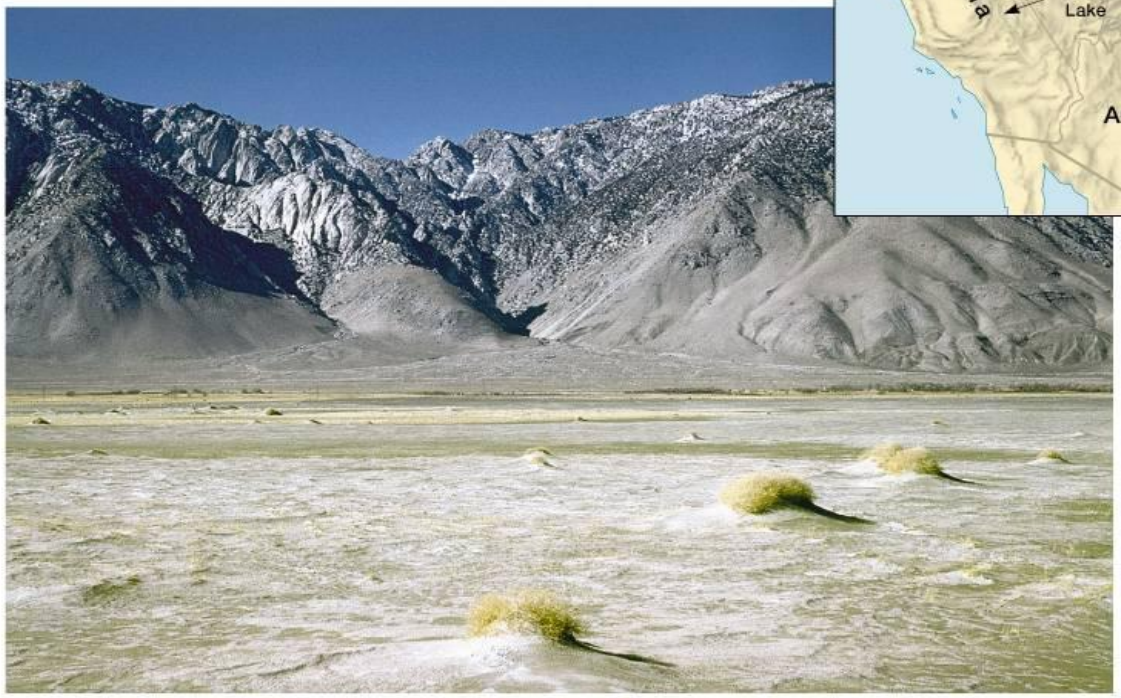
- 1908 -William Mulholland recognized city would run out of water.
- Heard about remote valley with a river flowing through it, Owens Valley.
- buying up strips of land, all the while maintaining he was working for the US Reclamation Service on a public irrigation project
- a group of investors bought land in the San Fernando Valley based on inside knowledge that the Los Angeles aqueduct would soon irrigate it not for farm but for houses.

# The Negative Affects of Human Water Needs



- The dewatering of the Owens Valley has not been without it's ill effects on the Owens Valley and on Mono Lake.

- The export of water south to Los Angeles has decimated a thriving agricultural community, dried up Owens Lake, and turned parts of the Owens Valley into a desert.




# The Negative Affects of Human Water Needs

- After World War II, the City began the Mono Basin Project extending the L.A Aqueduct (taping into 4 of 7 tributaries to Mono Lake).
- By 1982, 30% of the lake was drained.

# The Negative Affects of Human Water Needs

- Mono Lake is now rebounding thanks to an order to protect all 7 of its tributary streams on September 28, 1994.
- Its deepest parts are currently around 150 feet.
- Best and worst of times 900ft/100ft

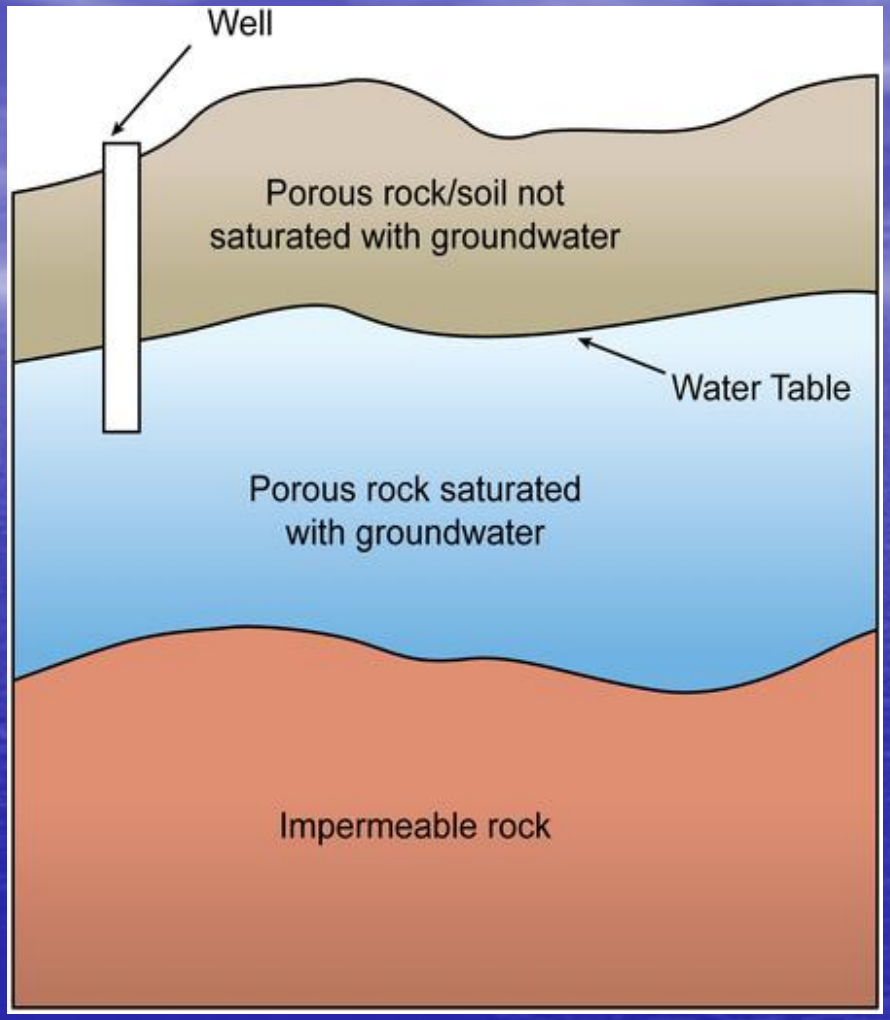
# The Negative Affects of Human Water Needs

# Check for Understanding

1. Explain the long lasting impacts of dewatering Owens Valley.

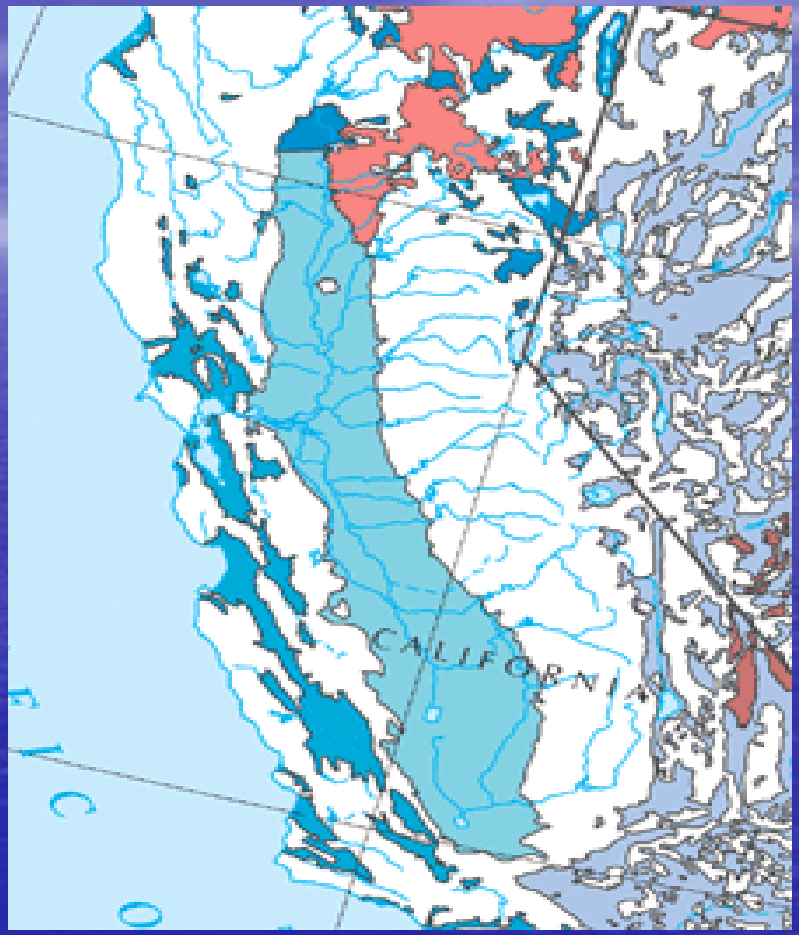

***Write using complete sentences***

- Groundwater is the water that is beneath Earth's surface also known as a aquifer.
- Groundwater accounts for 30 to 40% of the fresh water used in CA and most comes from aquifers: rocks or soils containing groundwater.




# 3) Ground Water

- The largest aquifer in California is the Central Valley aquifer system, it fills a large basin between the Coastal Ranges and the Sierra Nevada's.



# 3) Ground Water

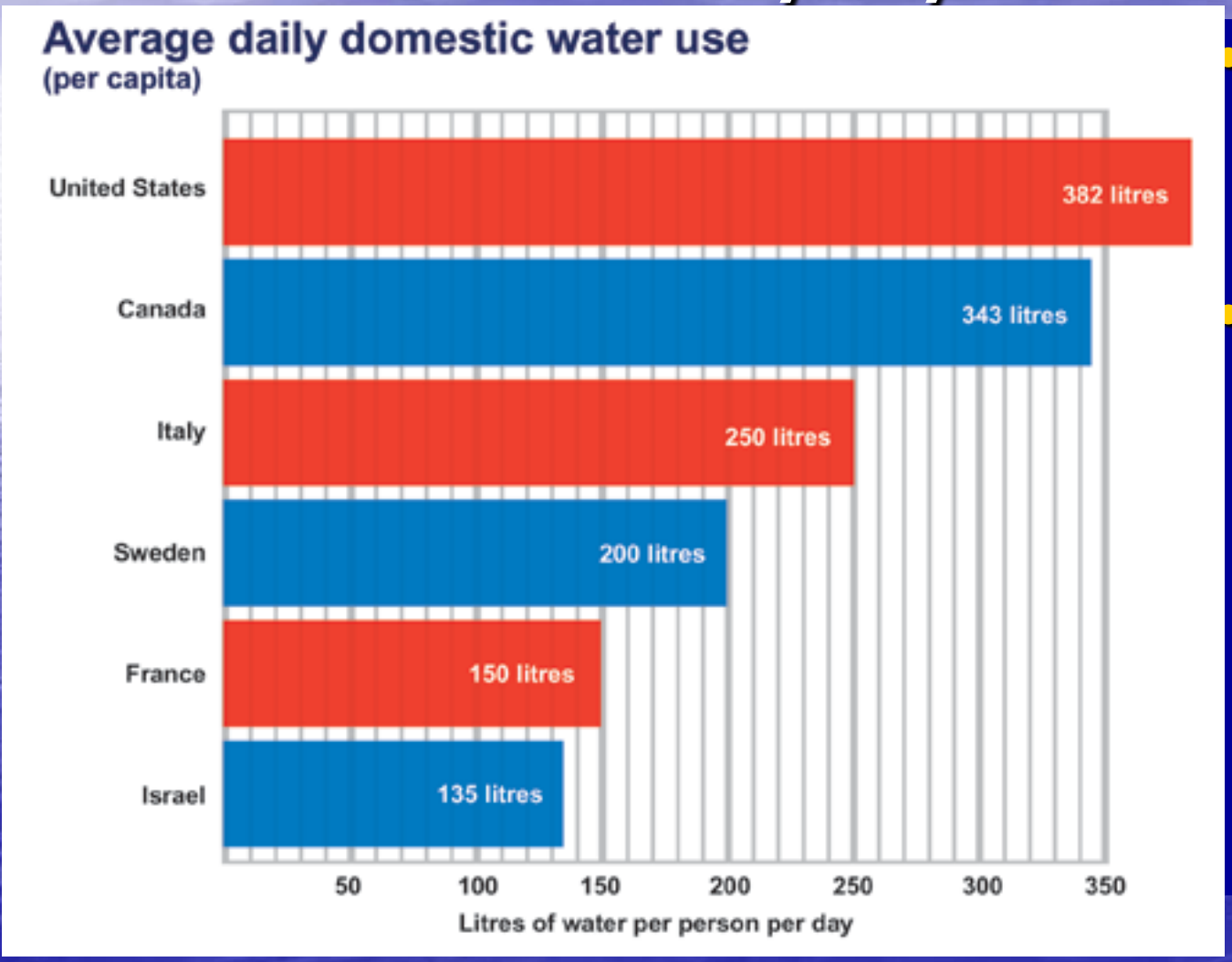
- The water from this system has transformed the Central Valley into the largest producer of agricultural products in the United States.
- 1 out of 6 jobs in California is tied to agriculture in some way.

# 3) Ground Water

# Conserving Groundwater

- Groundwater's importance means communities often regulate the use of groundwater to help conserve this valuable resource.

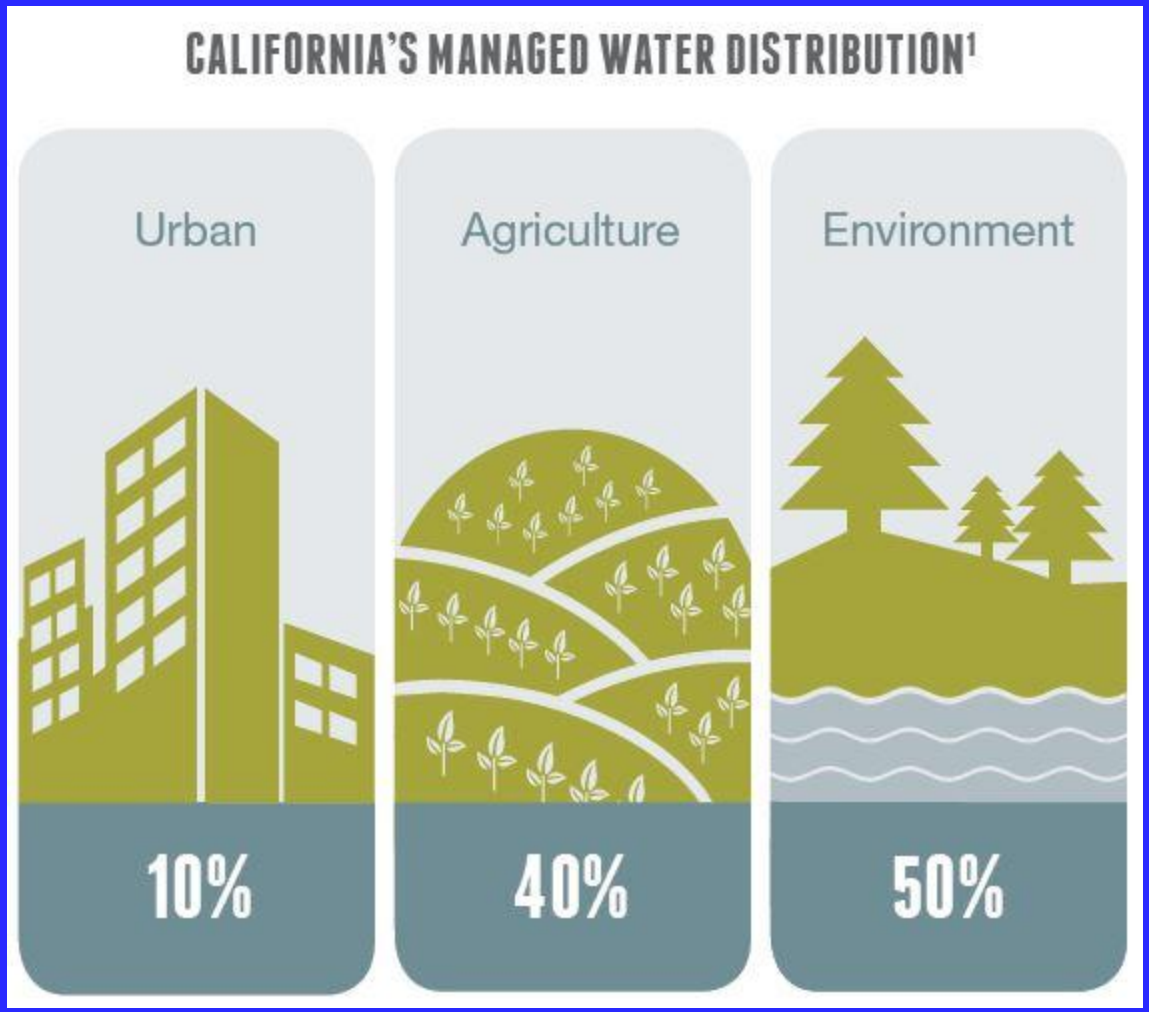
# Comparison of Water Used Per Person Per Day by Country




- Think by yourself and answer the question.
- Look at the chart to the left and answer, Why do US citizens use more water compared to other global citizens?

# Comparison of water distribution

- Urban- People, lawn, sewer plants, industry.
- Agriculture- Farming and growing of crops (almonds, tomatoes etc.)
- Environment- Growth of trees, lakes, streams etc.



# Why not use ocean water?

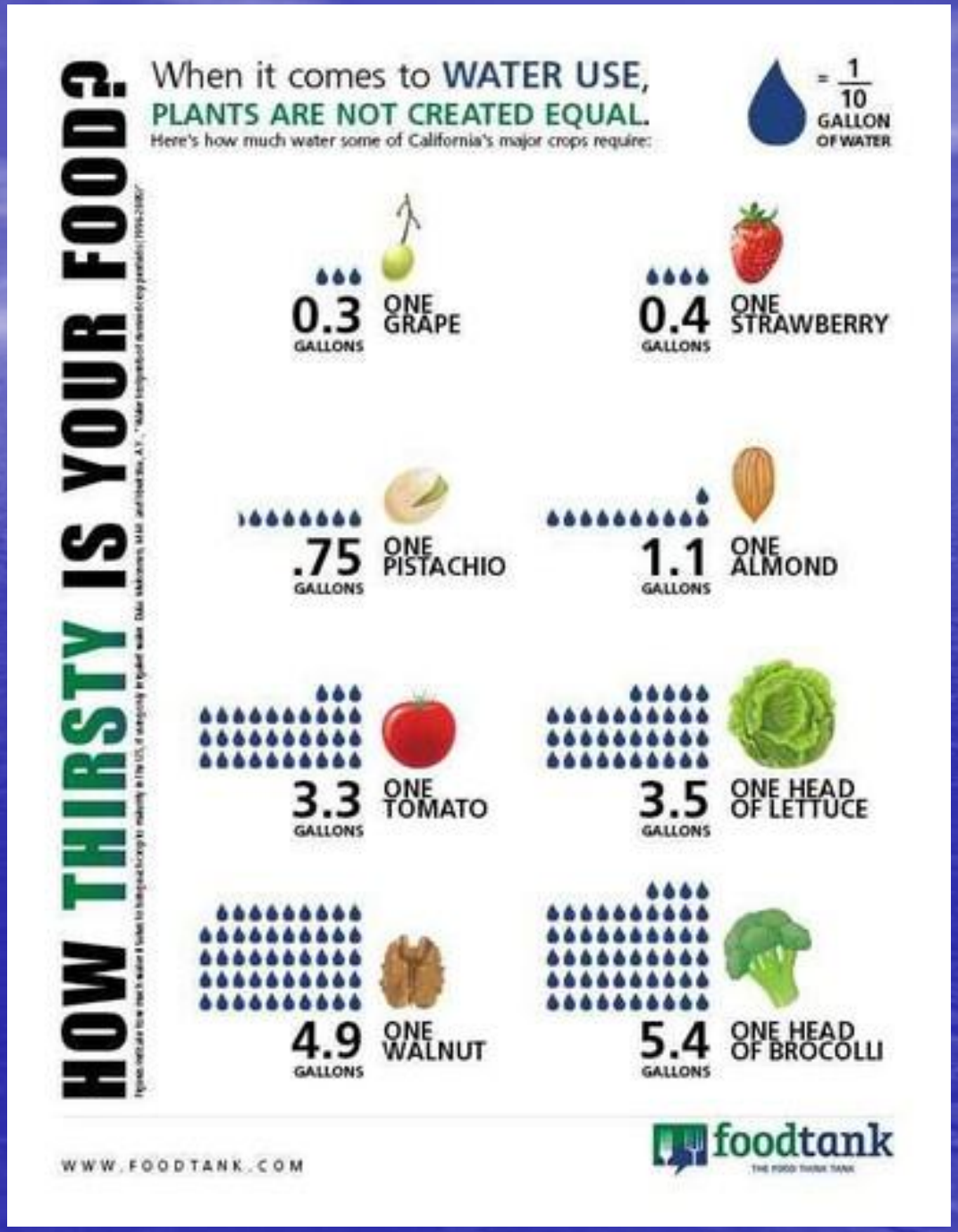
# Water Usage

The Top Three water consumers are

1. China 1.357 Billion people
2. India 1.252 Billion people
3. United States 317 Million people

So what are the reasons the US consumes so much water?

# How Thirsty is your Food?



# Lesson Highlights

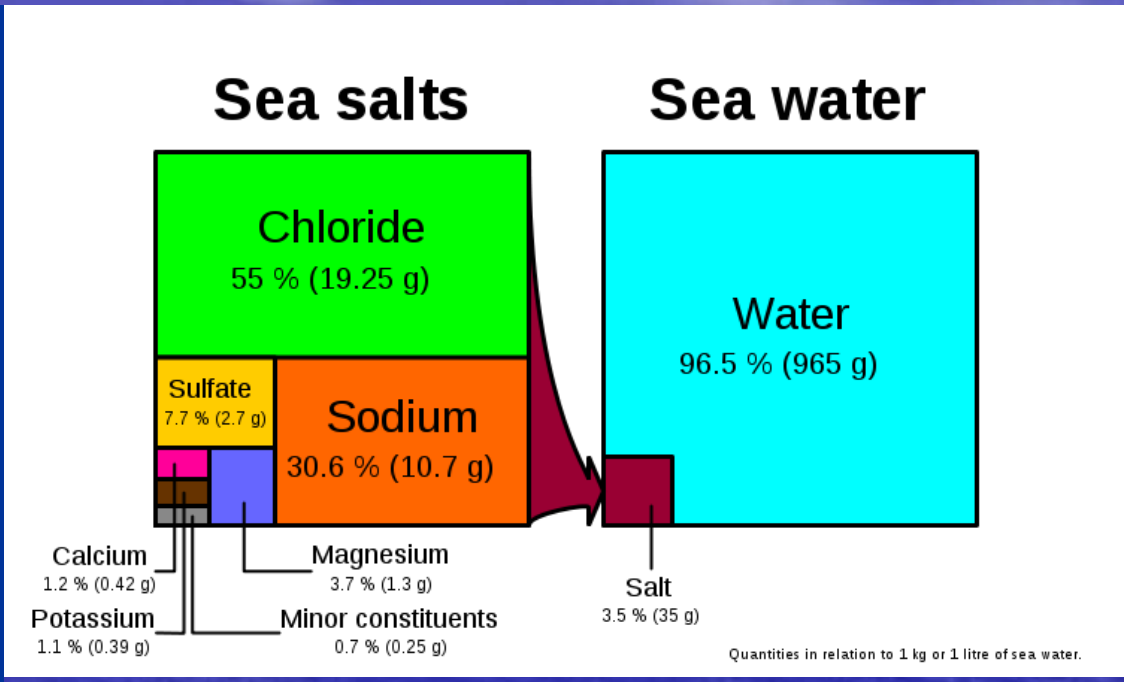
- Scientists describe ocean water by using a variety of properties, such as:

- (1) the presence of dissolved solids
- (2) salinity
- (3) the presence of dissolved gases,
- (4) temperature,
- (5) density
- (6) color.

# Lesson 4 - Properties of Ocean Water

Chapter 20

- Ocean water is 96.5% pure water, or $H_2O$.
- Dissolved solids make up about 3.5% of the mass of ocean water.

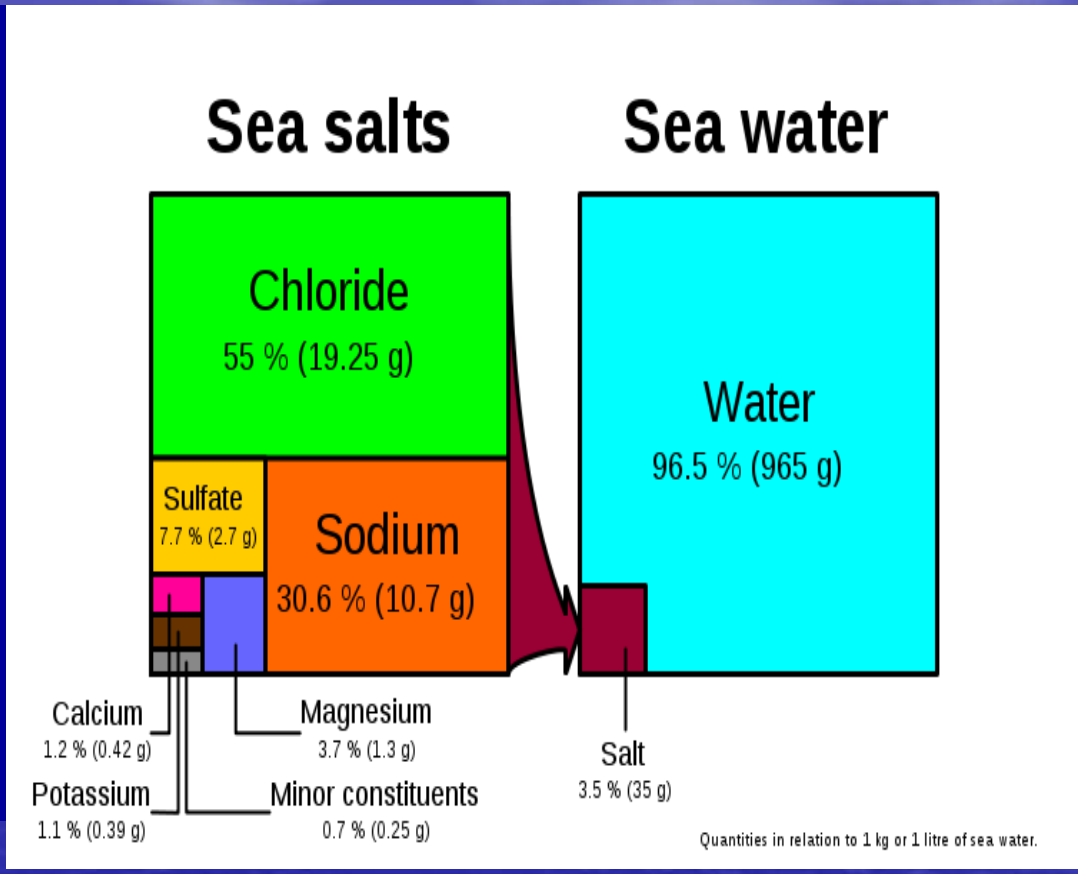



# Dissolved Solids in Water

Chapter 20

- The two most abundant elements found in the dissolved solids are:
- (1) Chlorine and
- (2) Sodium

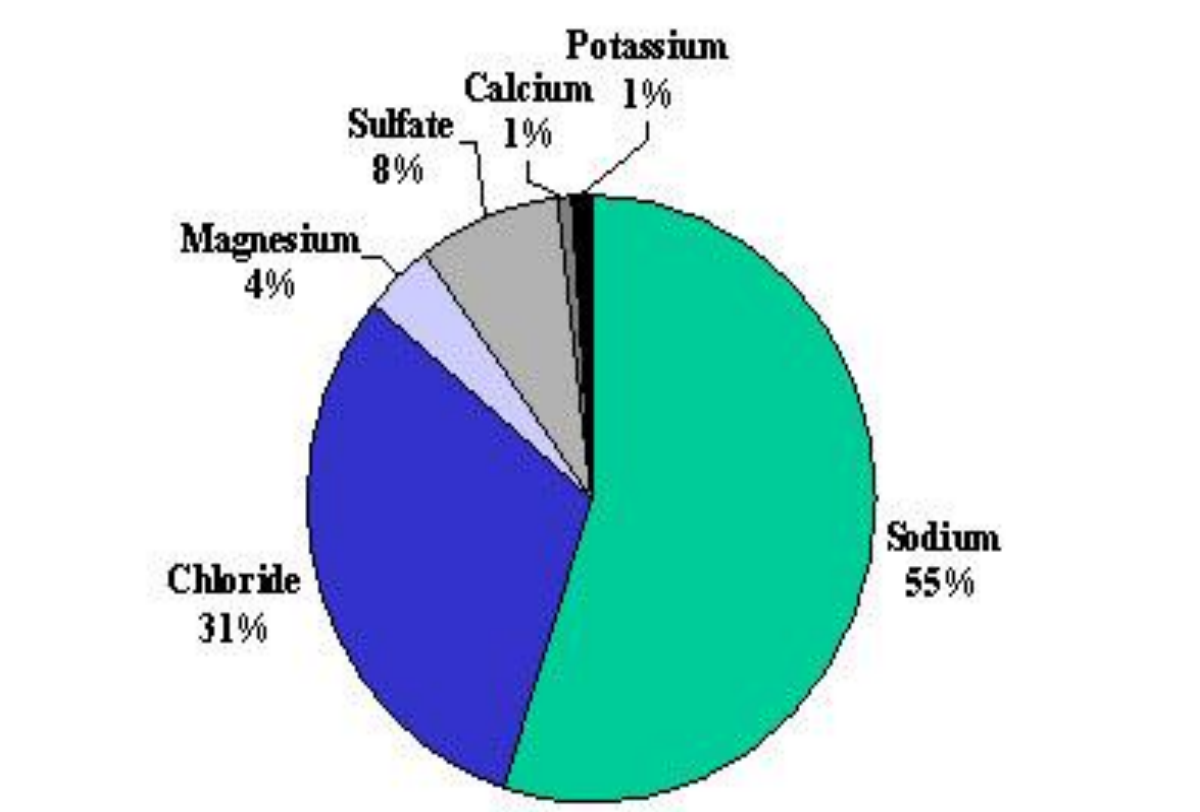
- Chlorine becomes chloride when it adds an electron (ion).




# Most Abundant Elements in Water

- The natural attraction of sodium (+) and chloride (-) creates salt (hense – Na+Cl- for salt).
- Salt makes up more than 85% of the ocean's dissolved solids.

Brainiac




# Most Abundant Elements in Water

Chapter 20

# Origins of Salt

- The direct origin of the elements found in the ocean are rarely easy to identify.
- There have been two main sources for salt: sea water and rock salt also known as halite.

- An example of an outdoor salt mine can be found up north at the Cargill Salt Company in San Francisco (was 45 square miles).

# Salt Water Harvesting

Chapter 20

Salt Harvest

- They allow sea water into the shallows then weathering (evaporation) turns it into salt.
- Due to variable micro-organisms concentrations, vivid colors – from pale green to bright red – are created in the evaporation ponds

# Salt Harvesting

Chapter 20

- Up close look

# Salt Harvesting

Chapter 20

- From there, salt is packaged and transported in more than 250 different salt products.

# Salt Harvesting

- A salt can also be mined from the extraction of rock salt or halite underground.
- Canada has the largest mine in the world owned by Sifto Salt – Compass Minerals

# Salt Rock Mining

Salt Mining

- Most of the salt found in the ocean is believed to come from the chemical weathering of rocks on land.
- Hydrothermal vents and volcanoes are assumed to play a small role.

# Where Does the Salt Come From

Chapter 20

- Chemical weathering is the breakdown (weathering) of rock, the most obvious is hydration (precipitation).

# Chemical Weathering

- Once chemical weathering has taken place on land, rivers carry the minerals of eroded rocks into the ocean.

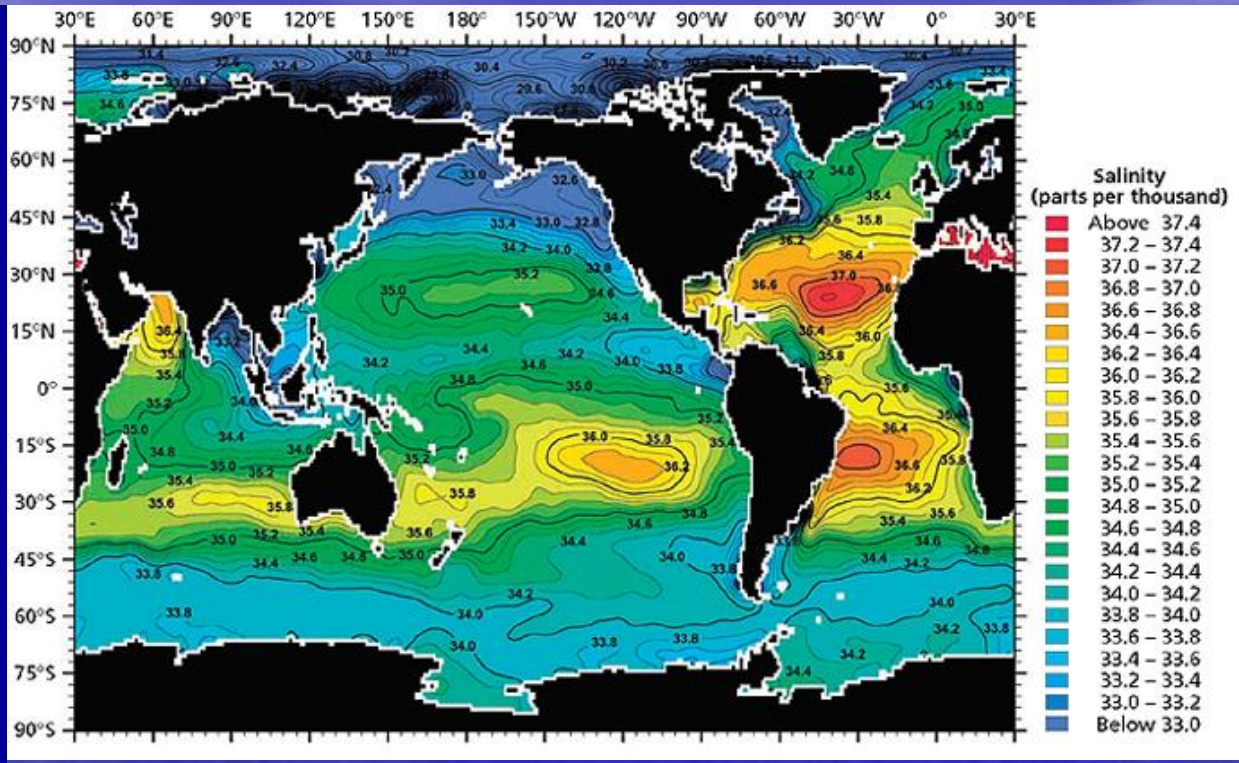
# Chemical Weathering

- Salinity is the measure of the amount of dissolved salts in a given amount of liquid.
- Ocean water has a higher concentration of salt then a fresh water lake (fresh water is 0.1% of salt).

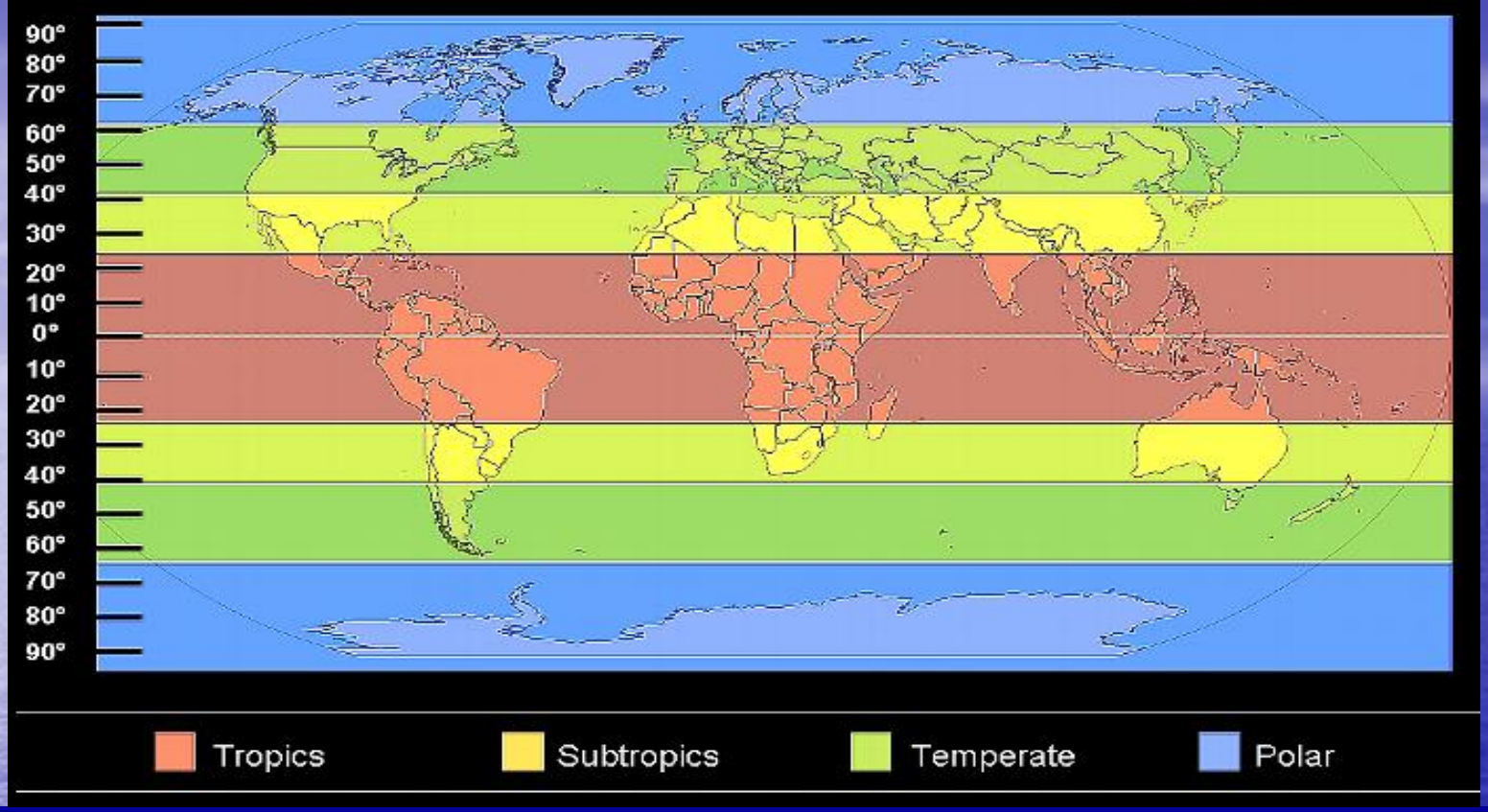
# (2) Salinity of Ocean Water


Mono Lake, CA (6,417 ft above sea level) – Its about 3 times as salty as the ocean

- Where the rate of evaporation is high, the salinity of surface water increases.
- Therefore, subtropical waters have a higher salinity at the surface than polar waters.



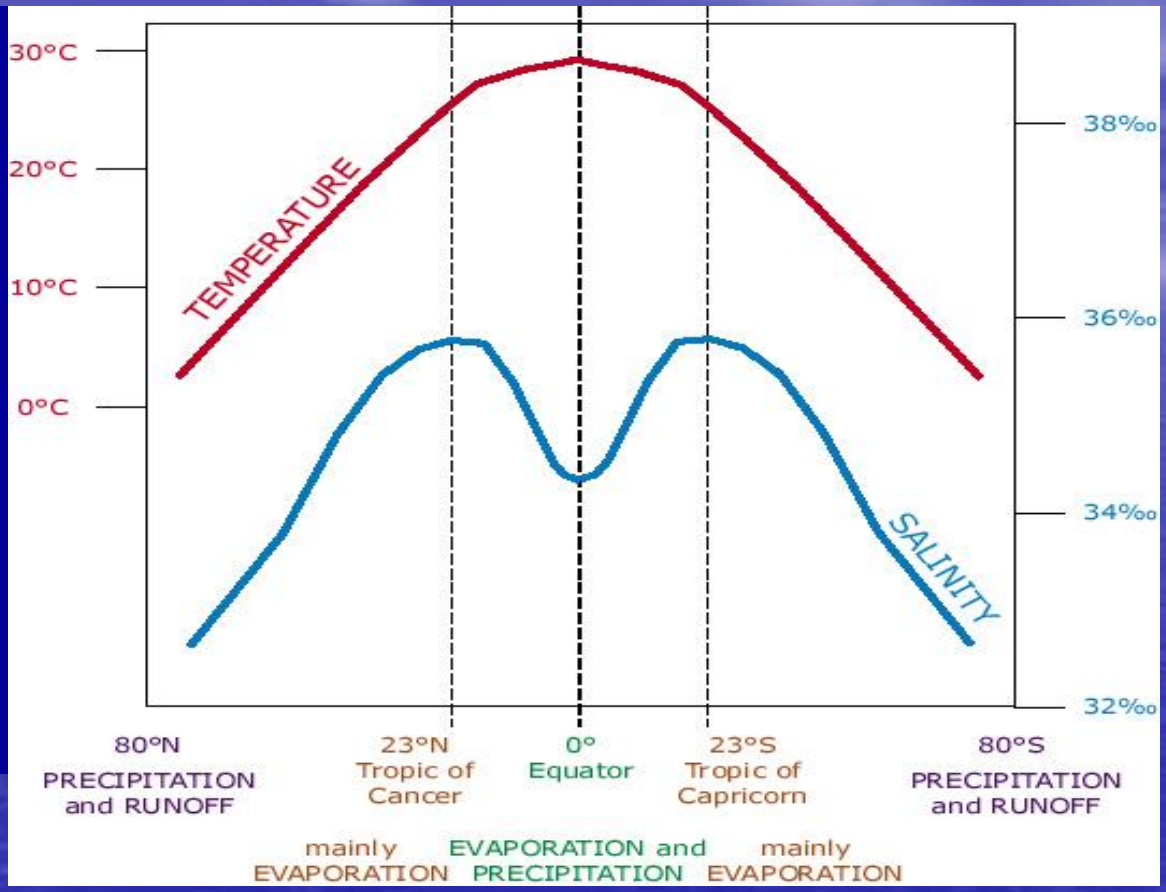

# The Major Factor that Effect Salinity is the Rate of Evaporation




- However there is an anomaly at the tropical region.

## The Major Factor that Effect Salinity is the Rate of Evaporation

- Despite high levels of evaporation at the equator the salinity levels at the equator and poles actually decrease rapidly and this occurs for different reasons.




# The Major Factor that Effect Salinity is the Rate of Evaporation

- It is like allowing ice to melt in your soda - it doesn't taste as good because it has been diluted.


# Factors that Change Salinity

- At the equator there are larger amounts of precipitation which dilutes the salinity levels.


# Factors that Change Salinity

- While at the poles the dilution of salinity in the ocean is due to melting ice.

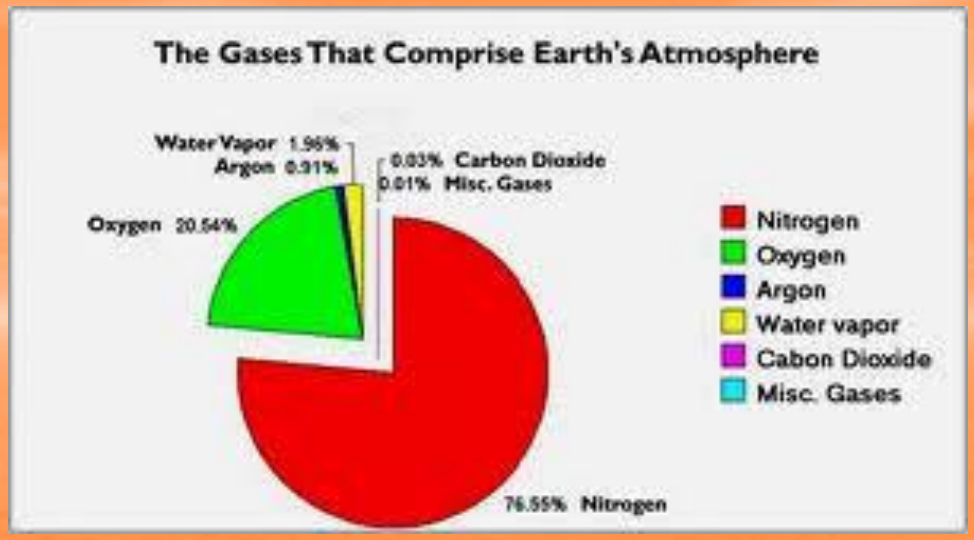

# Factors that Change Salinity

# Check for Understanding

1. What are two ways in which humans can harvest salt?
2. In your own words explain what salinity is.
3. In your own words describe chemical weathering?

Write your answers using complete sentences.

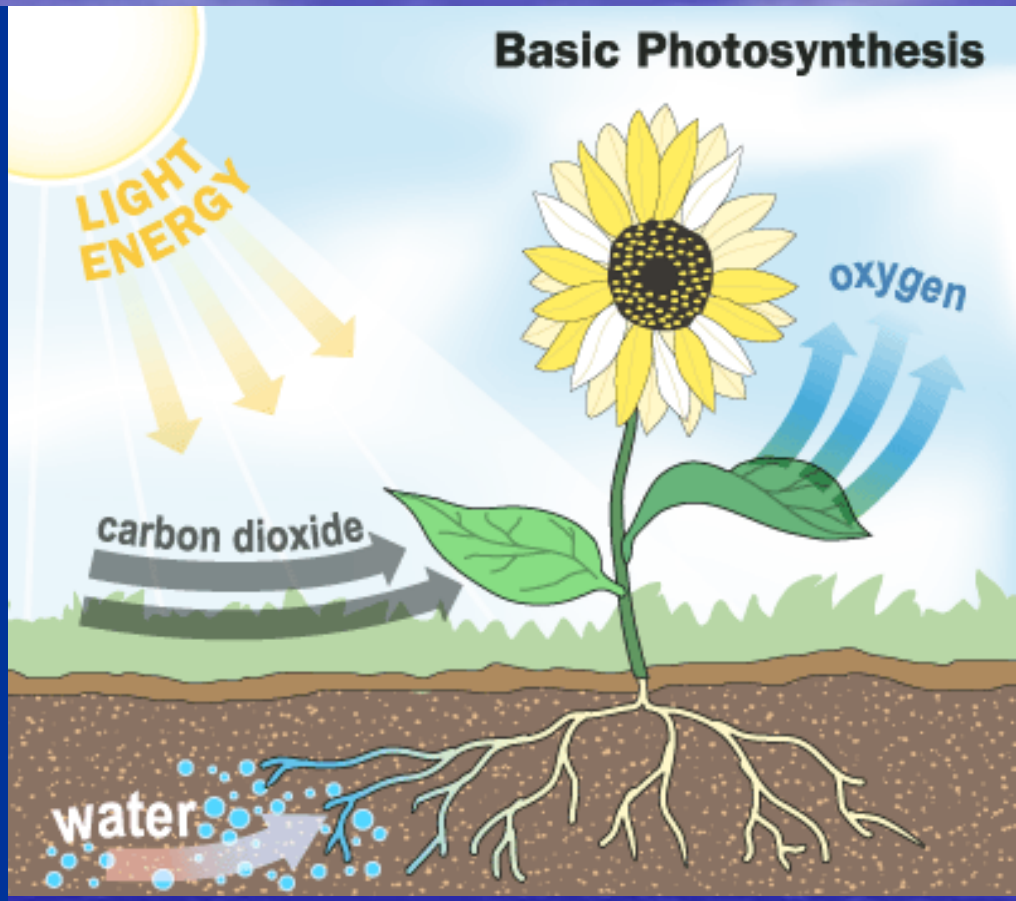
- The two principal gases in the atmosphere are nitrogen (78%) and oxygen (21%).
- While carbon dioxide, $CO_2$, is not a major component of the atmosphere, a large amount of this gas is dissolved in ocean water.




# Lesson 5 – Ocean Properties (Gases & Temperature

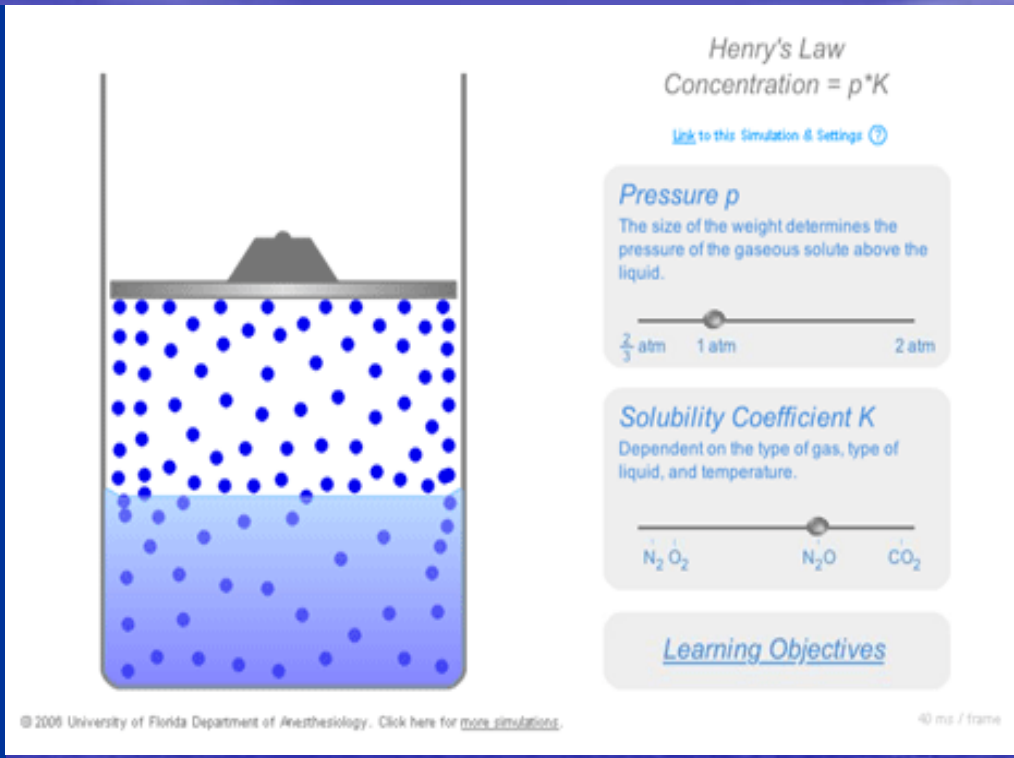
- Like solids, gases can enter the ocean from streams (rivers) and volcanoes, but there are other ways.

- The other ways include organisms (photosynthesis) and by the dissolving of the atmospheric gases.



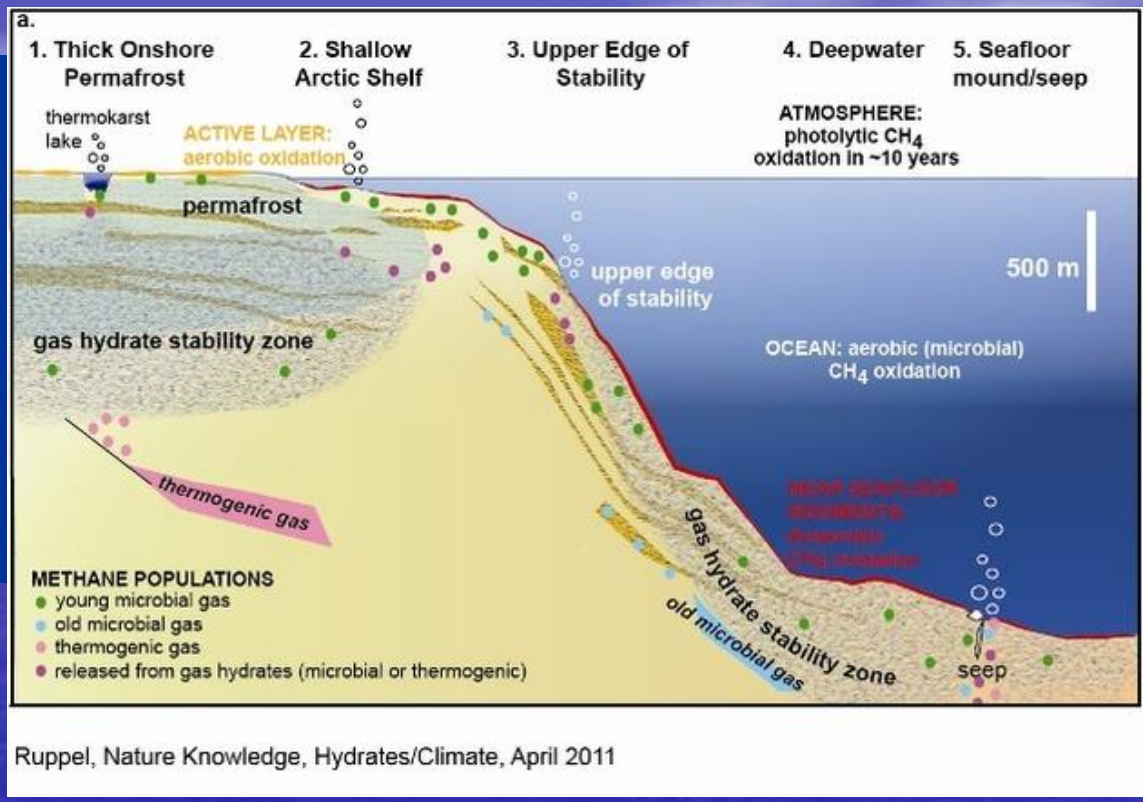

# The Presence of Dissolved Gases

- The temperature of water affects the amount of gas that dissolves in water.
- Gases dissolve more readily in cold water than in warm water.
- Ex. – soda can, in warm weather goes flat quicker.




The Effect of Temperature on Dissolved Gases

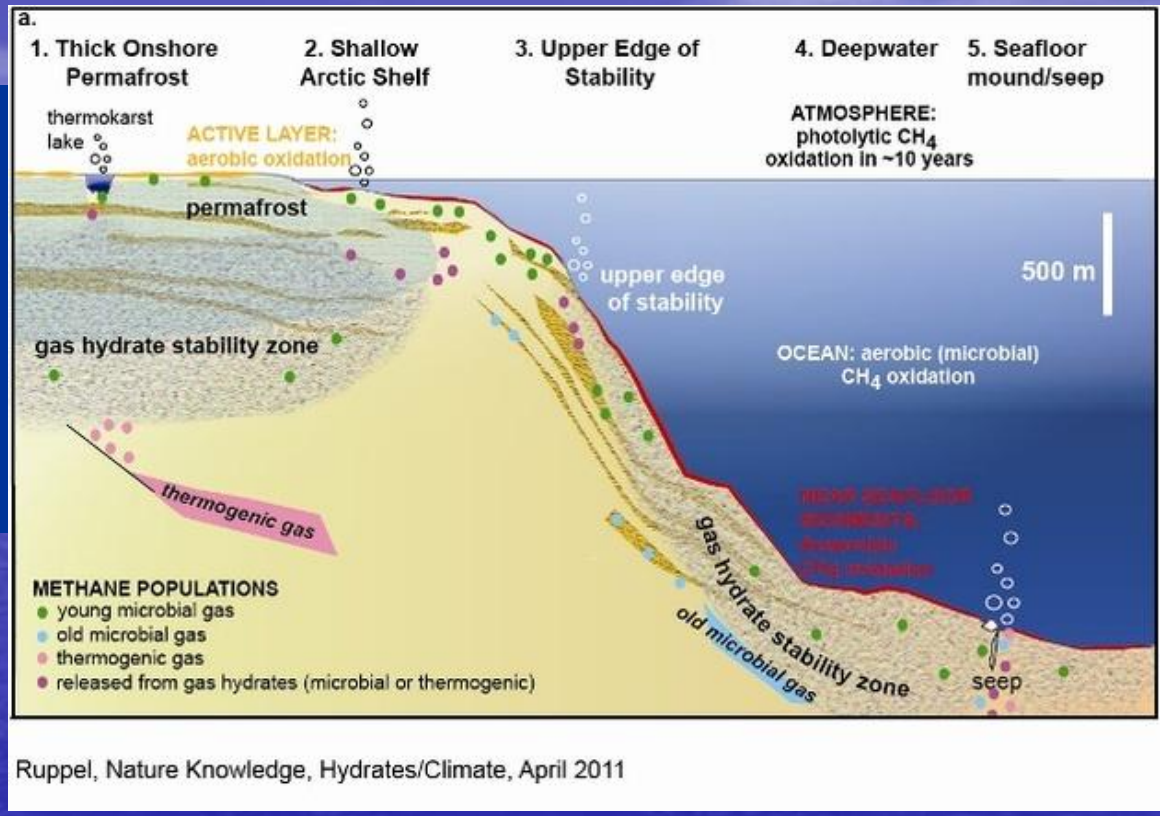
- If the water temperature rises, less gas will remain dissolved, and the excess gas will be released into the atmosphere.




Ruppel, Nature Knowledge, Hydrates/Climate, April 2011

## The Effect of Temperature on Dissolved Gases

- Therefore the ocean and the atmosphere are continuously exchanging gases as water temperatures change.

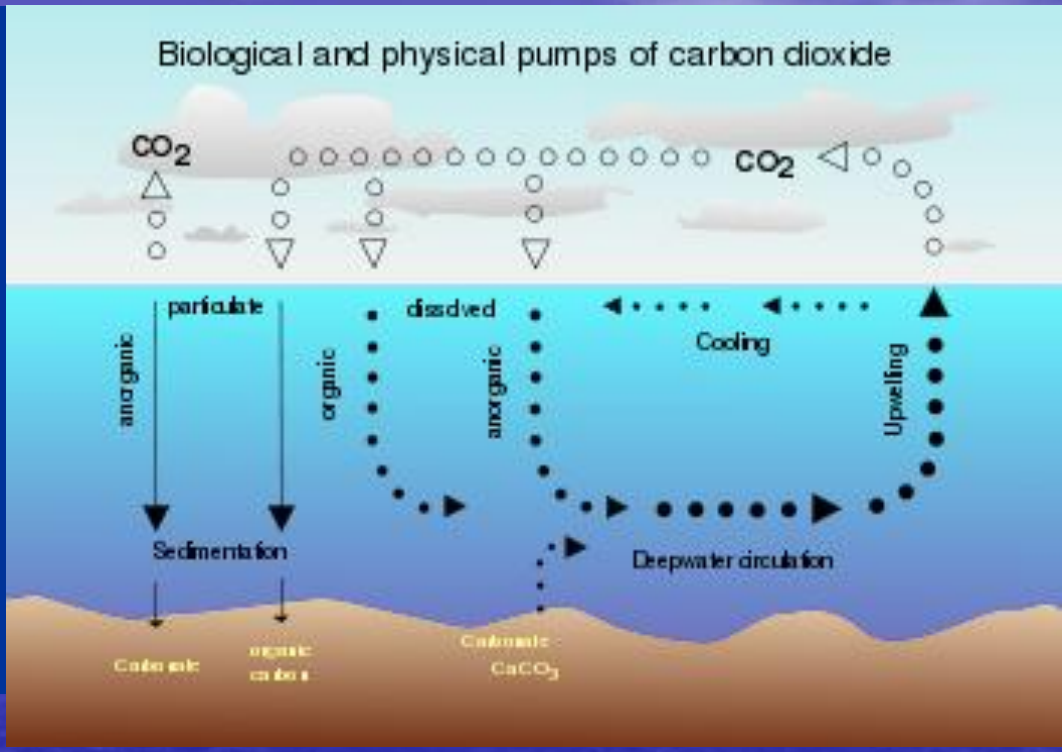



Ruppel, Nature Knowledge, Hydrates/Climate, April 2011

The Effect of Temperature on Dissolved Gases

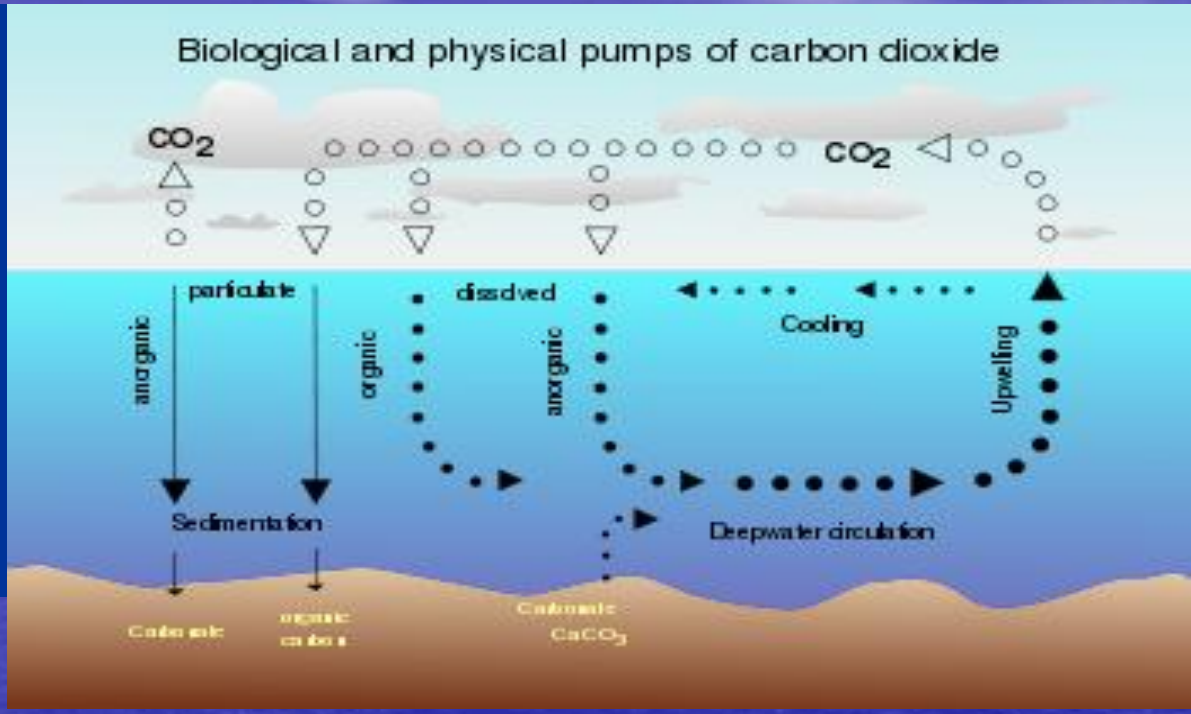
Chapter 20

- Oceans contain more than 60 times as much carbon as the atmosphere does.
- Dissolved $CO_2$ may be trapped in the oceans for hundreds to thousands of years.



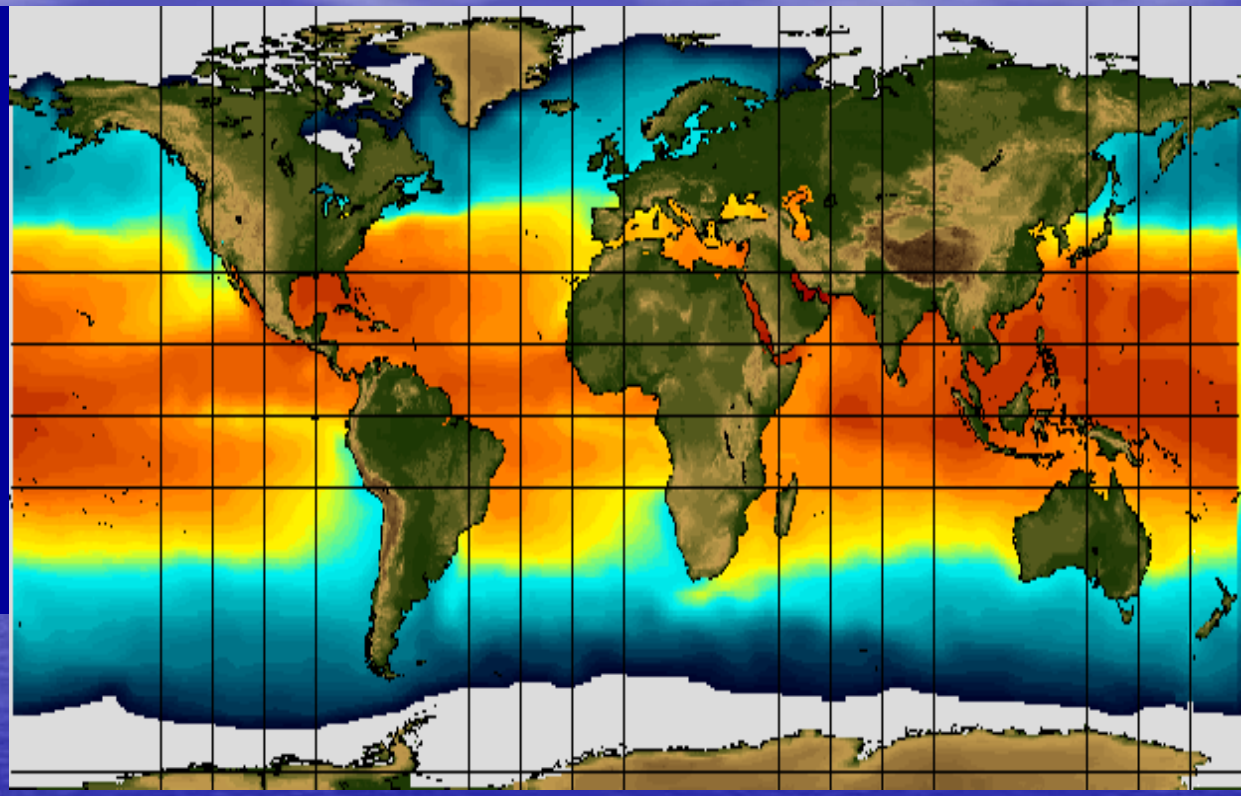

# The Oceans as a Carbon Sink

- Because of this ability to dissolve and contain a large amount of $CO_2$, the oceans are commonly referred to as a *carbon sink*.



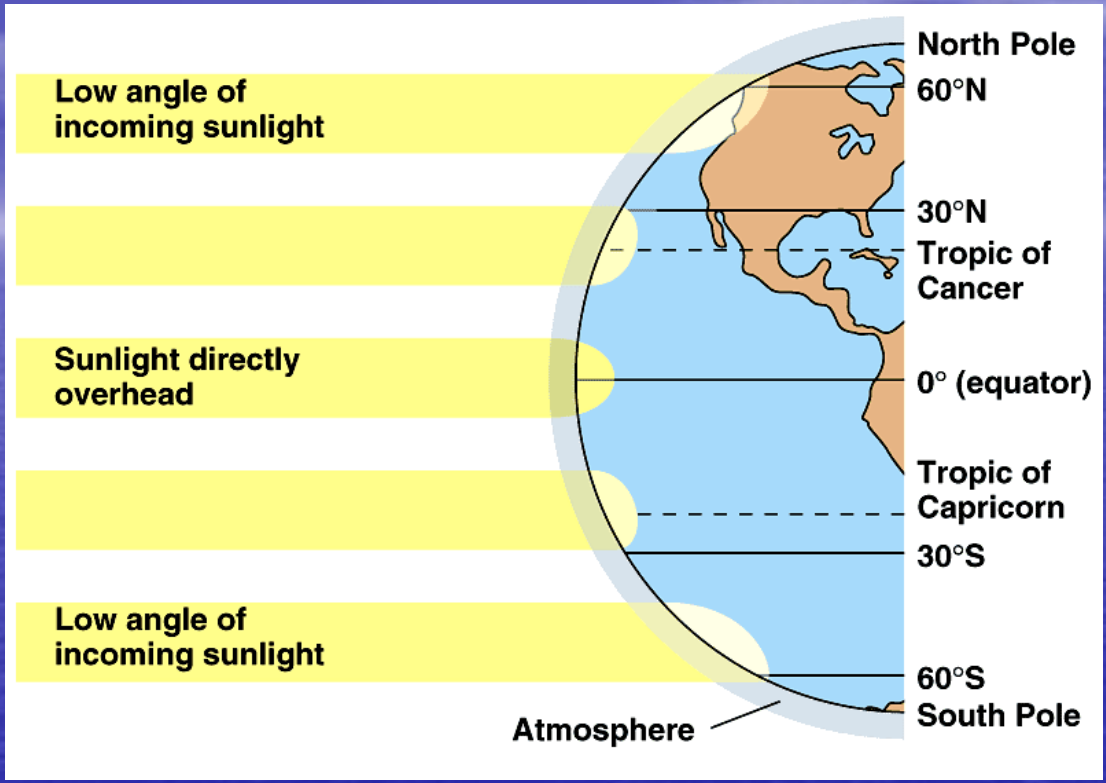

**The Oceans as a Carbon Sink**

- Like ocean salinity, ocean temperature varies depending on depth and location on the surface of the oceans.



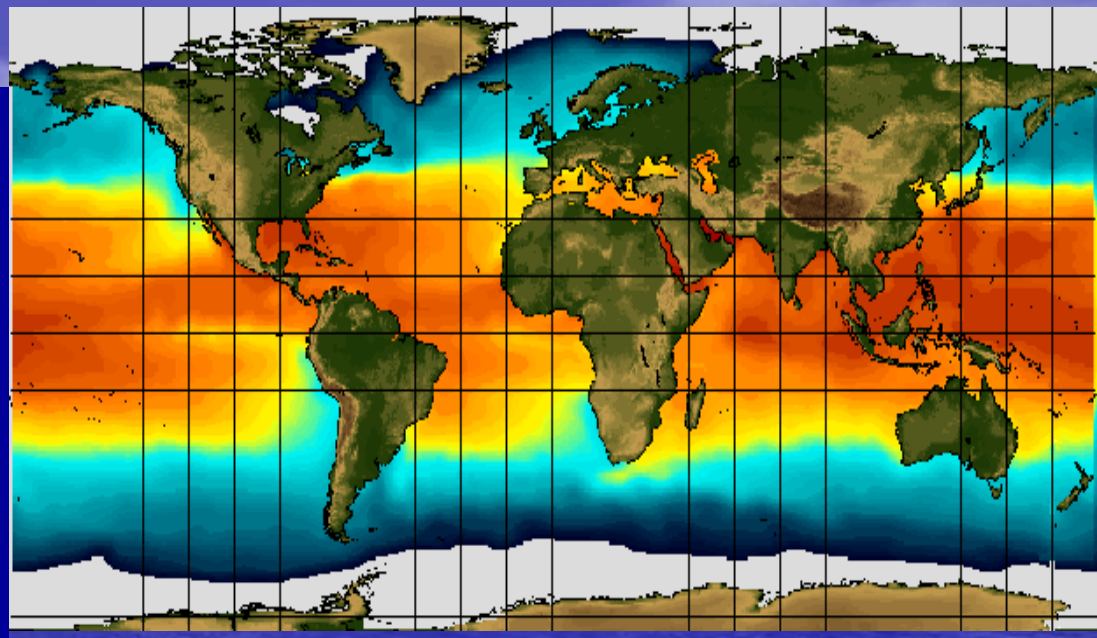
# (4) Temperature of Ocean Water

- The range of ocean temperatures is affected by the amount of solar energy an area receives and by the movement of water in the ocean.




# (4) Temperature of Ocean Water

- Because the total amount of solar energy that reaches the surface of the ocean is much greater at the equator, you can say the temperature of oceanic surface water decreases as latitude increases.
- The further you go North / South the colder the water will get.



**Surface Water Temperature's**

- Water is different from most compounds.
- Not only does water get harder as it gets colder but it also gets bigger (expands) and lighter.

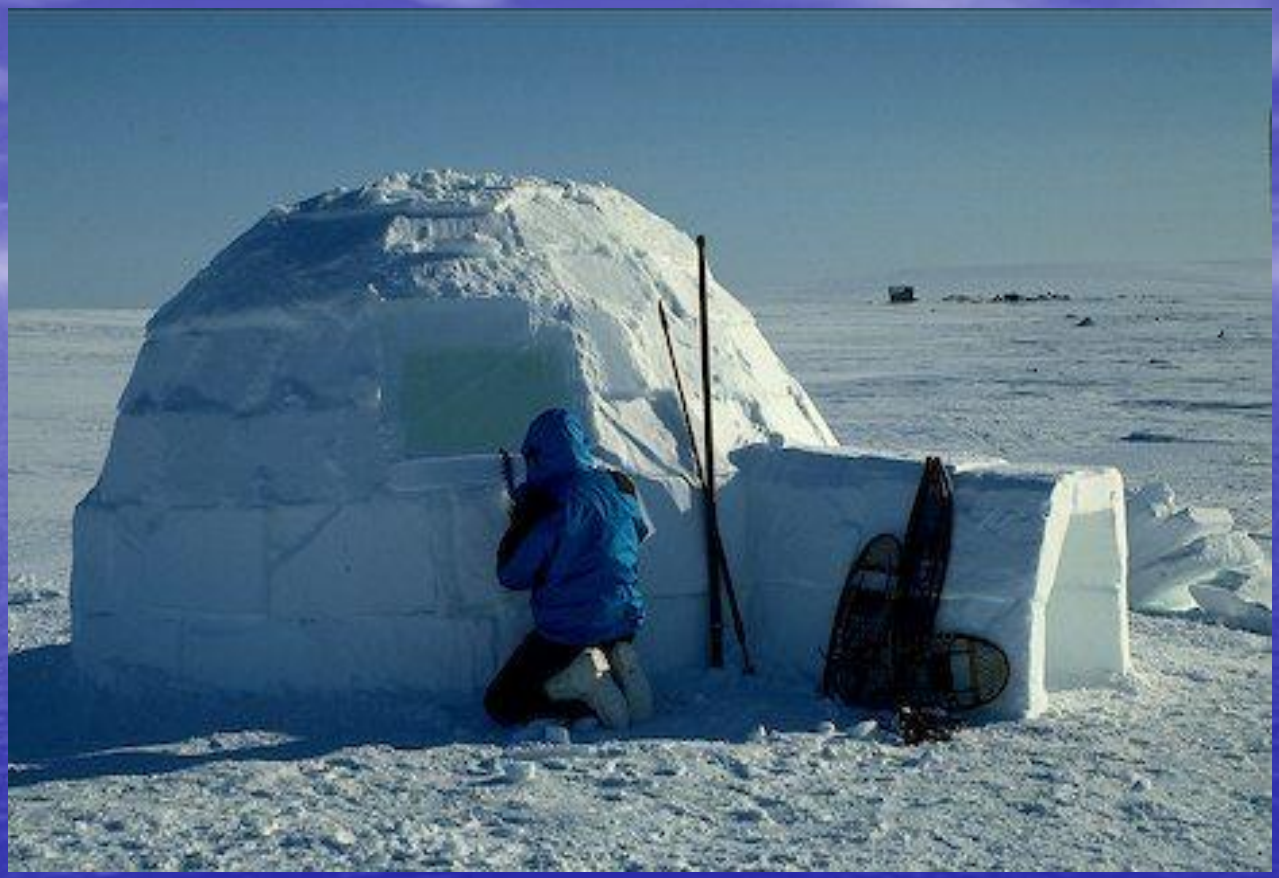
**Question -Why does Water not Freeze all the way Through**

- By the time it does freeze and expand it is actually less dense than liquid water.
- Ice floats on water instead of sinking creating a thermal layer of packed ice.


**Question -Why does Water not Freeze all the way Through**

Chapter 20

- The packed ice insulates the water below and prevents it from freezing.
- Like an igloo on land creates an insulating house from the cold Arctic air.



**Question -Why does Water not Freeze all the way Through**

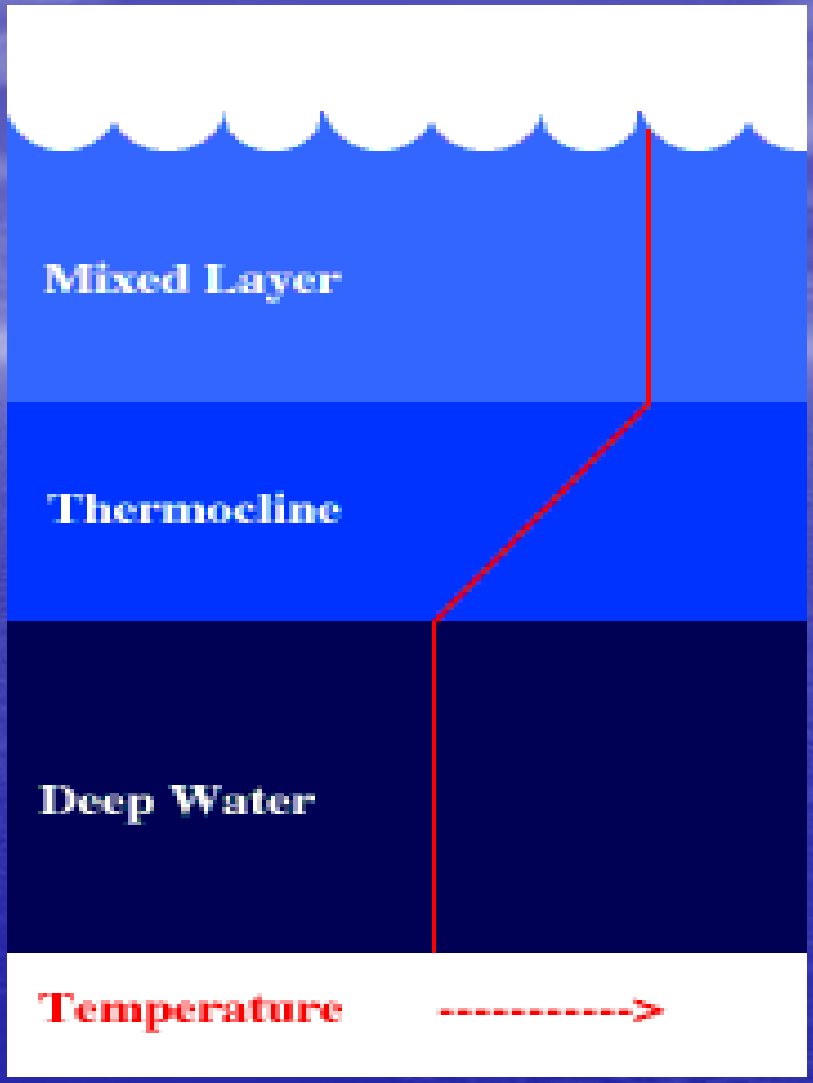
- Polar water is always cold and Tropical water is always warm.
- The only water that changes is the mid-latitude waters which change with seasons.
- Ex. - HB waters high 60's in summer and mid 50's in winter.


# Temperature of Ocean Water

Chapter 20

# The Thermocline

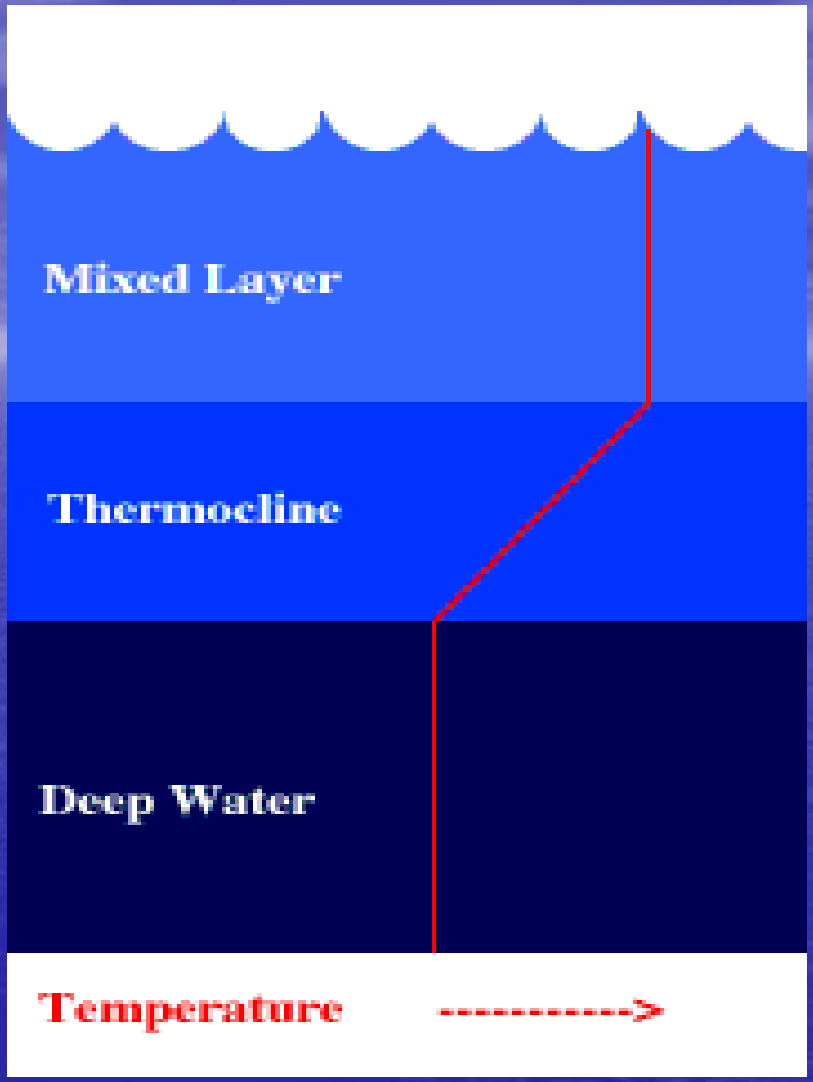
- Because the properties of ocean waters change the deeper you go-different layers are defined based on temperature.



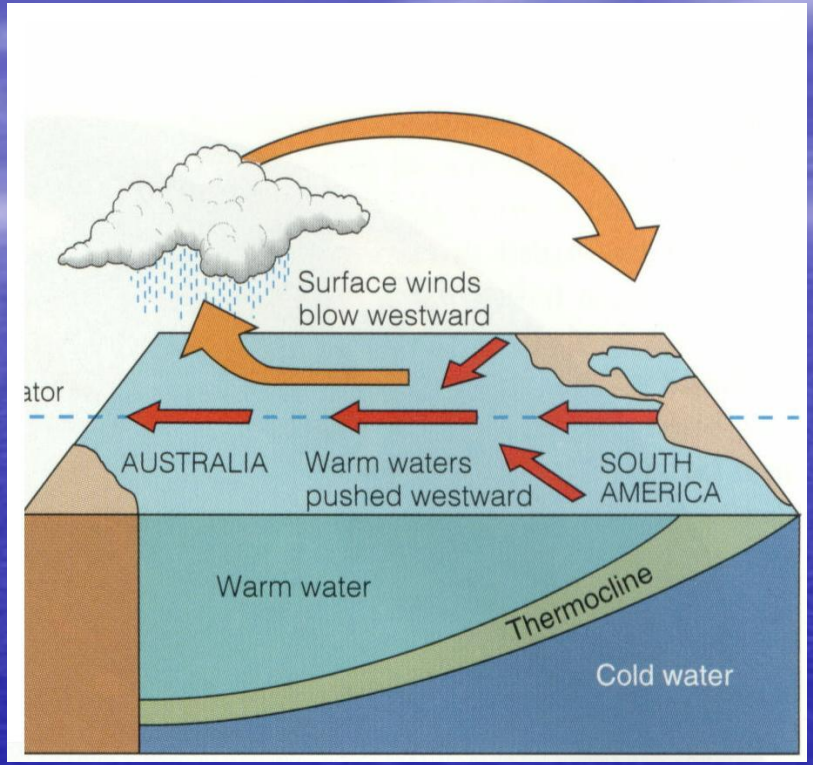
# The Thermocline

Chapter 20

- The thermocline is the transition layer between the mixed layer at the surface and the deep water layer.
- The thermocline is where the water temperature suddenly changes from a warm surface temperature to a colder bottom temperature in a relatively short space in the vertical water column.
- Frequently, it'll change between 20-30° F in just the space of 1-3 feet.



- The mixed layer is near the surface where the temperature is roughly that of surface water (forming due to the summer sun-warm water rises and cold water sinks)
- Soon a strong separation boundary exists between the mixed layer of water and the deep ocean waters, sometimes creating extreme temperature differences in our Ocean waters.

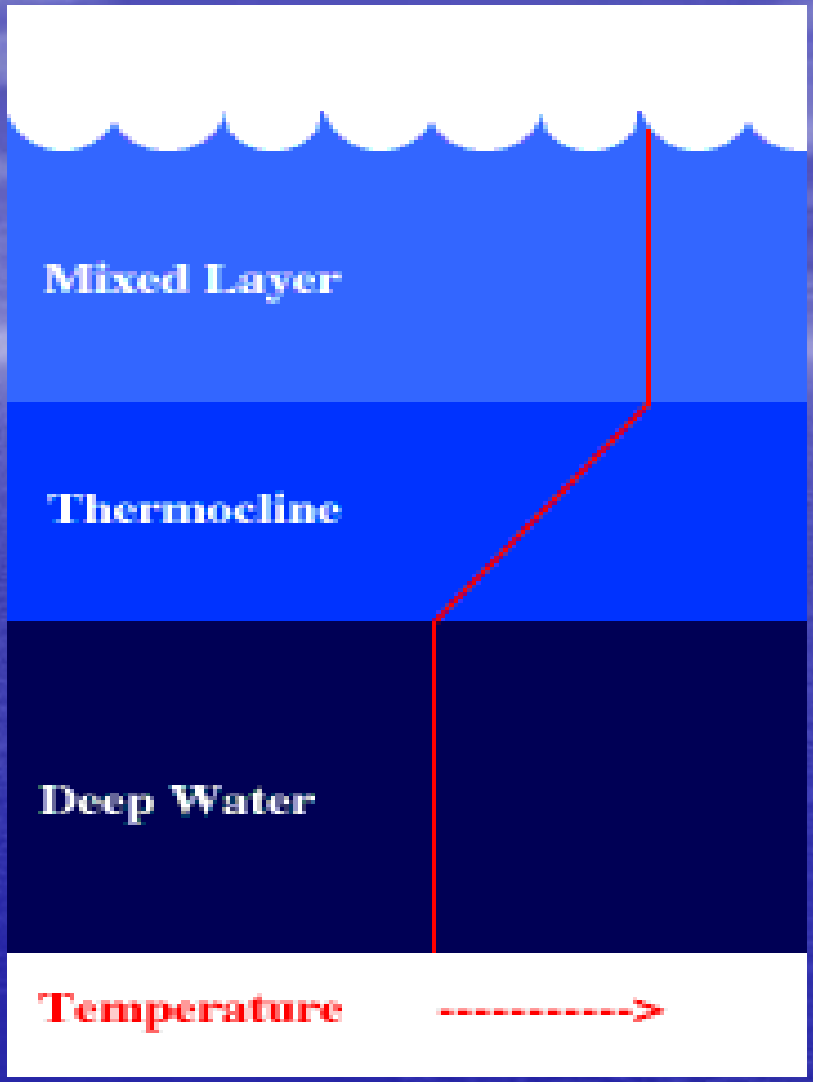



# The Thermocline

Chapter 20

# The Thermocline

- In the thermocline, the temperature decreases from the mixed layer temperature to the much colder deep water temperature.
- Soon a strong separation boundary exists between the mixed layer of water and the deep ocean waters.
- The mixed layer and deep water layer are relatively extreme in temperature, while the thermocline represents the transition zone between the two.



# Check for Understanding

Answer using complete sentences and in your own words.

1. Explain why the ocean is considered a carbon sink.
2. Explain the thermocline.

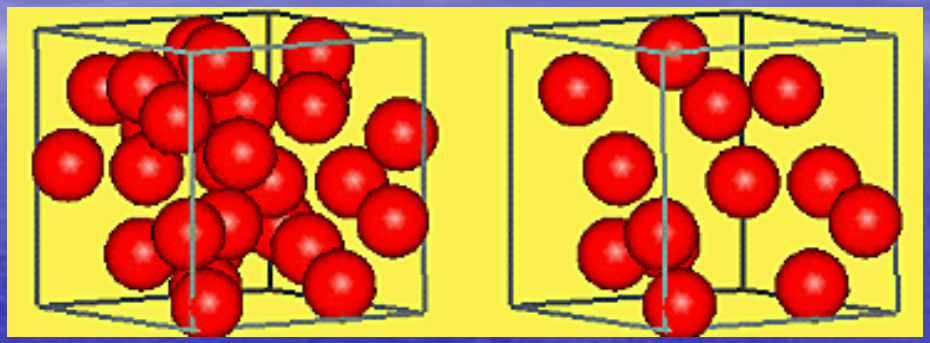
# Lesson 6 – Density & Color of Ocean Water

- Two factors affect the density of ocean water:
- (1) salinity
- (2) temperature of the water.

- Density is the ratio of the mass of a substance to the volume of the substance or how much "stuff" is smashed into a particular area.

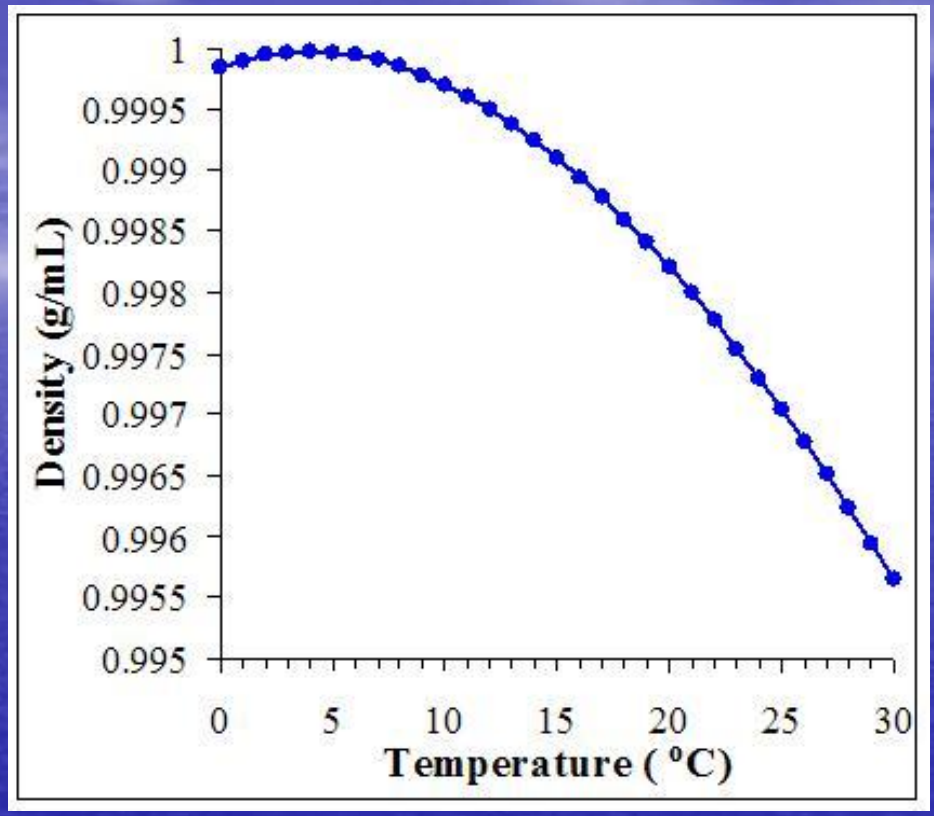
# (5) Density of Ocean Water

- In the ocean the dissolved solids, which are mainly salts, adds to its mass.
- By adding these dissolve solids, ocean water is denser than fresh water.



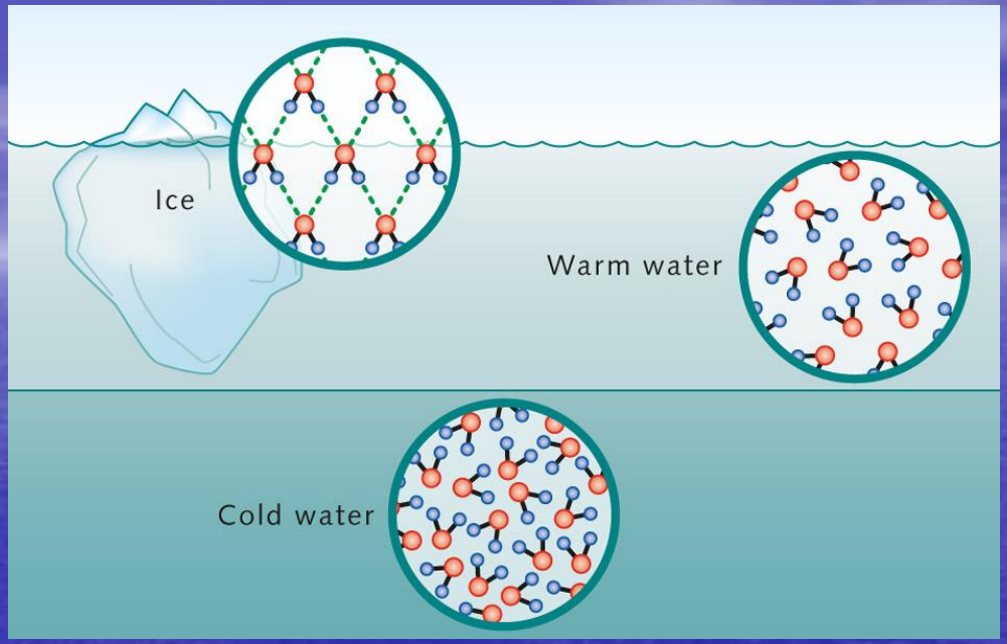
# (5) Density of Ocean Water

- Salinity is important but water temperature has the largest affect on the density of ocean water.
- Ocean water becomes denser as it becomes colder and less dense as it becomes warmer.




# (5) Density of Ocean Water

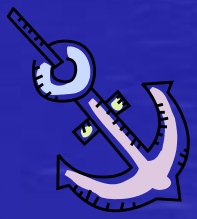
- This means the densest ocean water is found in the polar regions, where the ocean surface is the coldest.
- In the deep zones of the ocean, the temperature of the water is just above freezing (35.6°F / 2°C).

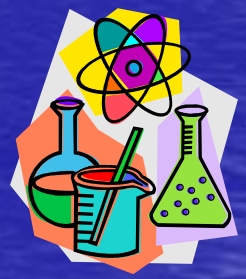



# Properties and Location of Dense Water

- The density of cold, deep water controls the slow movement of deep ocean currents.
- Cold, deep ocean water also holds more dissolved gases than warmer ocean water.


# (5) Density of Ocean Water





Chapter 20

# Check for Understanding

- What 2 factors have an effect on ocean water's density AND how?

- The last important property of ocean water is its color.
- Water color is determined by the way it absorbs or reflects sunlight.

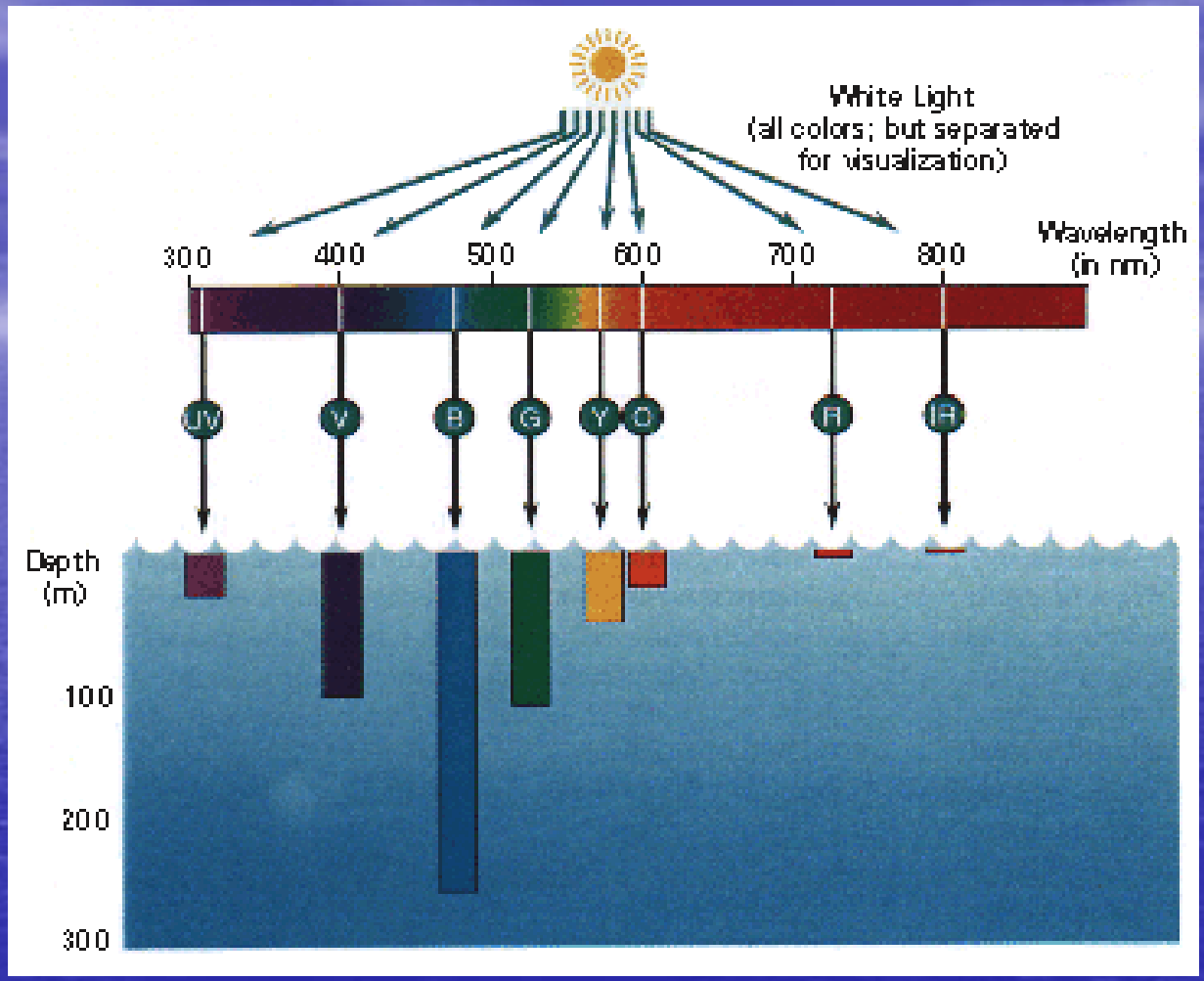
# (6) - Color of Ocean Water

- The ocean is blue for the reasons that are similar to why the sky is blue.
- Particles in water can absorb light, scatter light, and reflect light.
- http://littleshop.physics.colostate.edu/tenthings/SkyPurple.pdf

# Why the Color of Ocean Water is Blue

Chapter 20

- The ocean like the sky absorbs the longer energy wavelength (red light) and scatters the shorter energy wavelengths (blue light).




# (6) - Color of Ocean Water

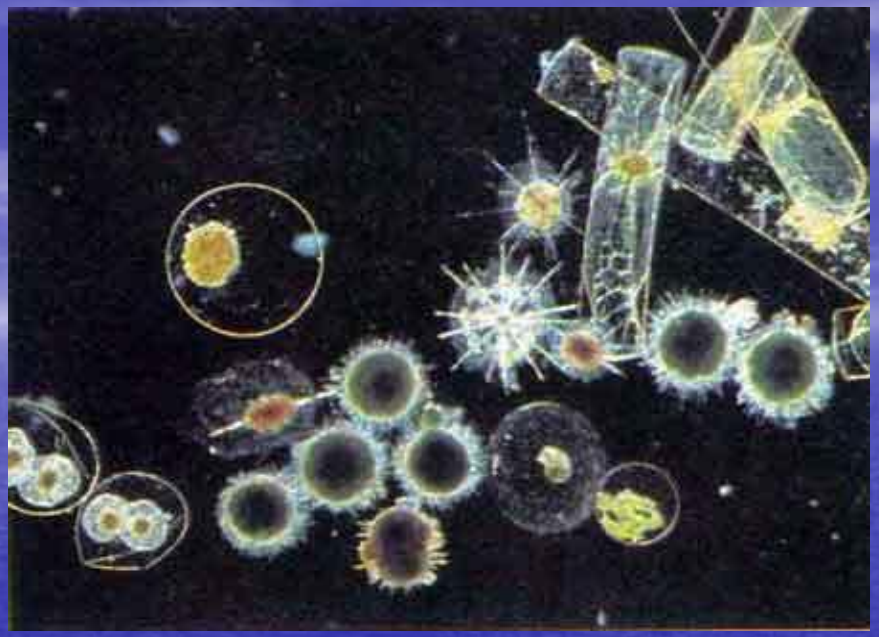
Chapter 20

- Ocean water should appear blue unless something else is present and its blueness is very apparent when diving.
- As one goes deeper, lower energy wavelengths penetrate the water less, eventually leaving only blue light from the higher energy end of the spectrum.

# Color of Ocean Water

- Substances or organisms in ocean water, such as phytoplankton, can affect the color of the water.

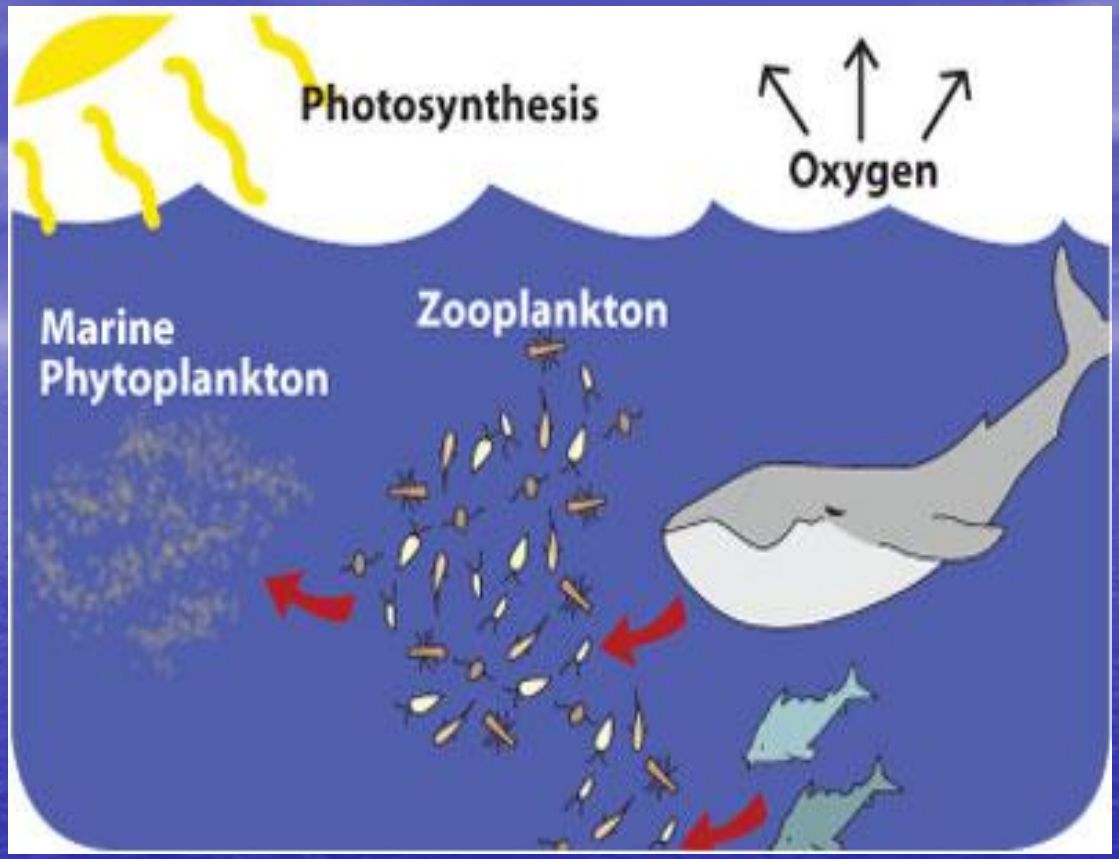
- Phytoplankton also known as marine micro-algae, are microscopic single-cell plants that are the most abundant "vegetation" in the ocean and the foundation for life in the ocean.



## Why is Ocean Color Important

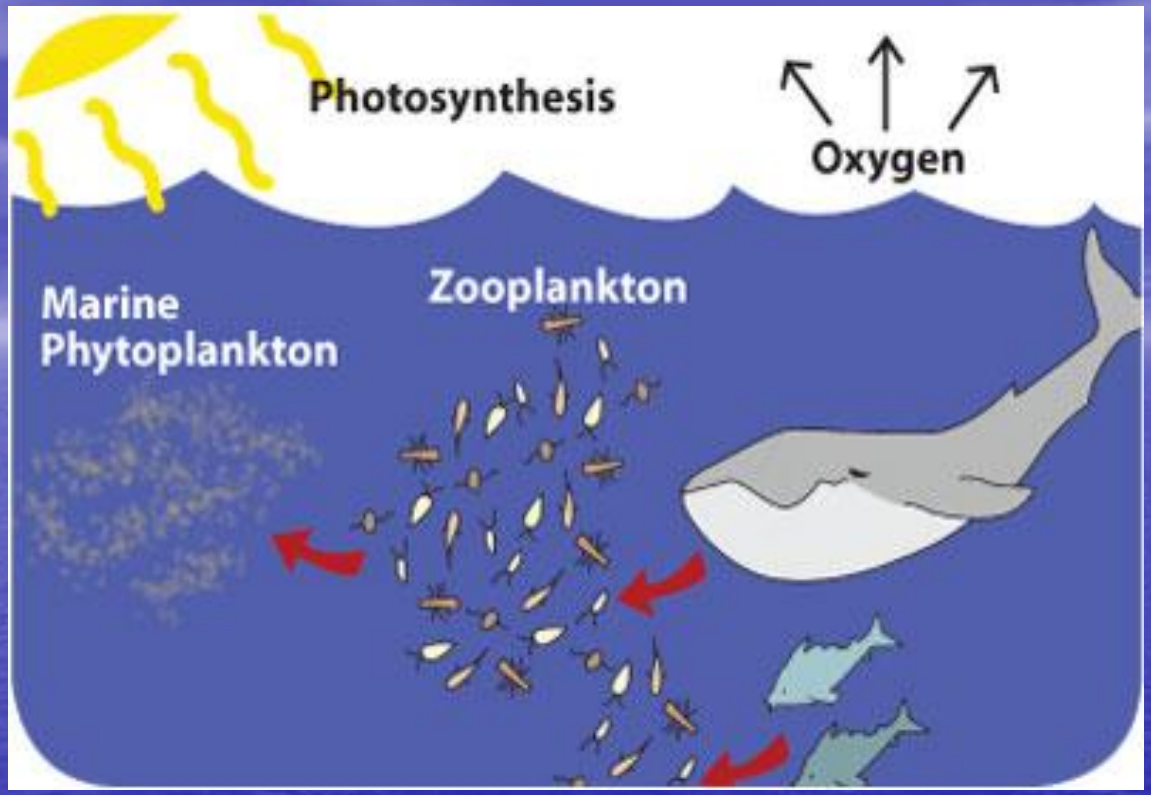
Chapter 20

- They turn water and light energy from the sun into nutrients and oxygen (Photosynthesis).
- *They take carbon dioxide out of the surface waters*

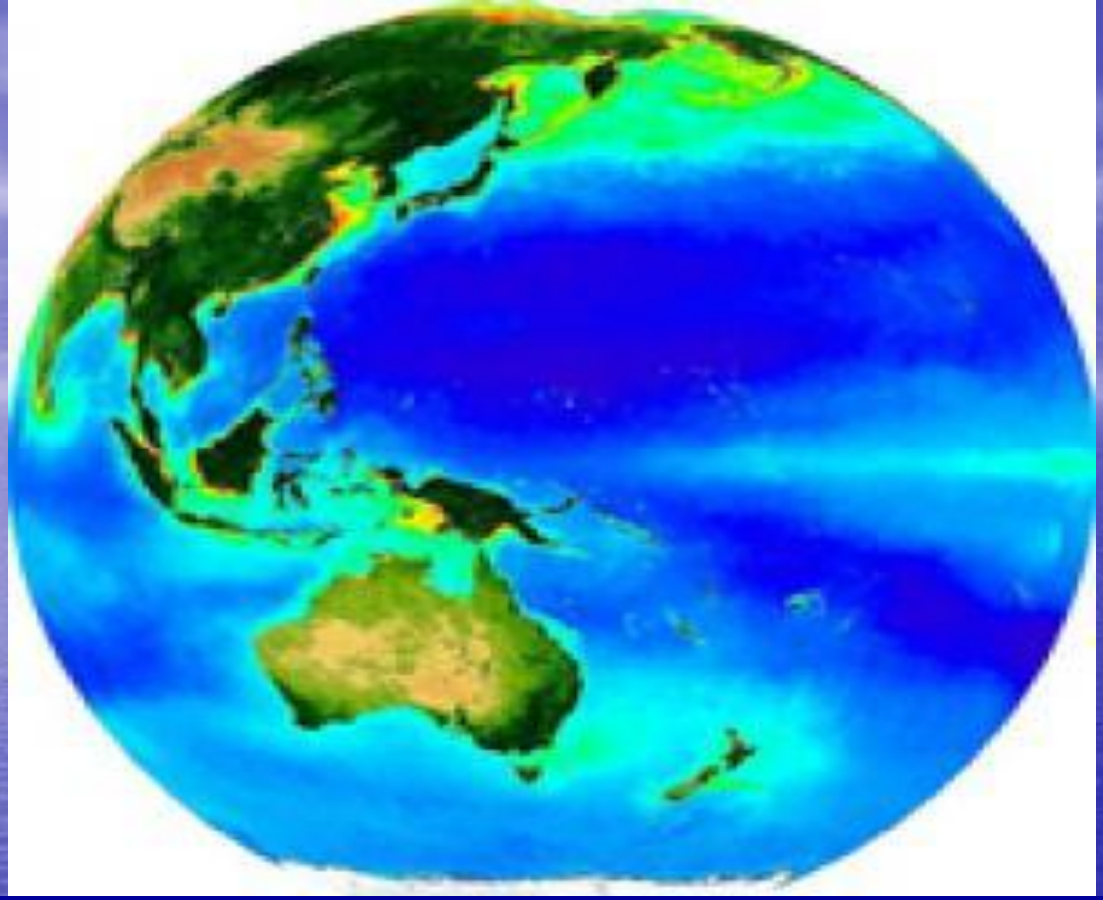



**Why is Ocean Color Important**

- More phytoplankton= more oxygen in the air and the more food in the ocean.



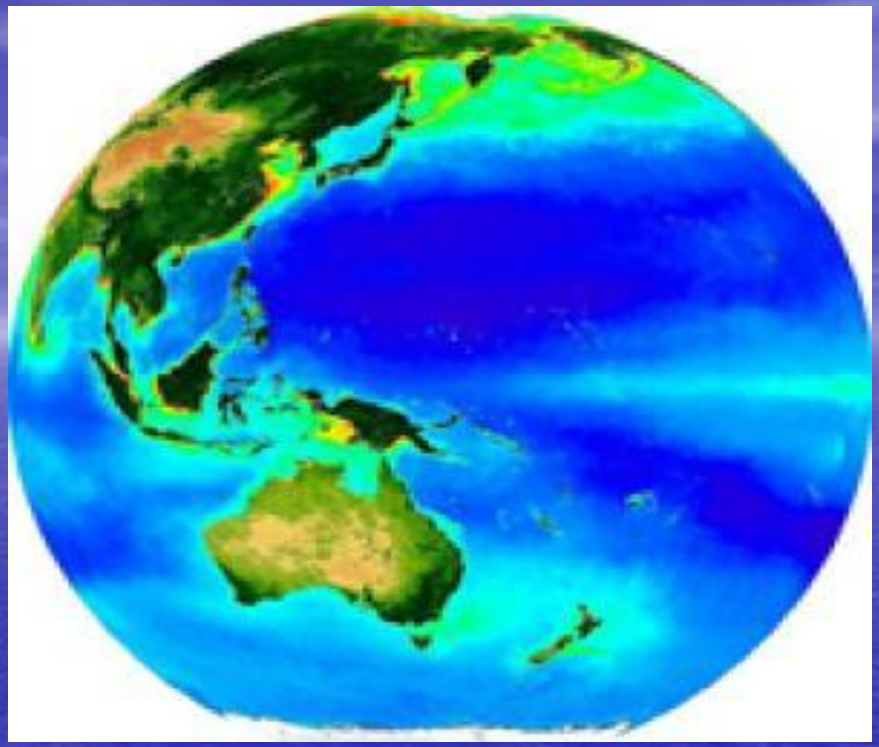

# Importance of Phytoplankton



- Because phytoplankton require nutrients, the presence (green) or absence (dark blue) of phytoplankton can indicate the health of the ocean.

# Phytoplankton

- The ocean plays a vital role in the global climate and carbon cycle.
- The ocean provides nearly 50 percent of Earth's oxygen and 20 percent of the world's protein supply: National Oceanic and Atmospheric Administration (NOAA).
- Species from the ocean are also potential sources of new medicines and fuels.



## Why is the Ocean important

# Check for Understanding

- Explain why ocean water appears blue.

- The oceans have been used as a dumping ground for many kinds of wastes including garbage, sewage, and nuclear waste.

## Ocean-Water Pollution

- Recognizing the negative affects, The U.S. has banned the use of
- DDT (pesticide)
- The lead (tetraethyl lead) used in gasoline.

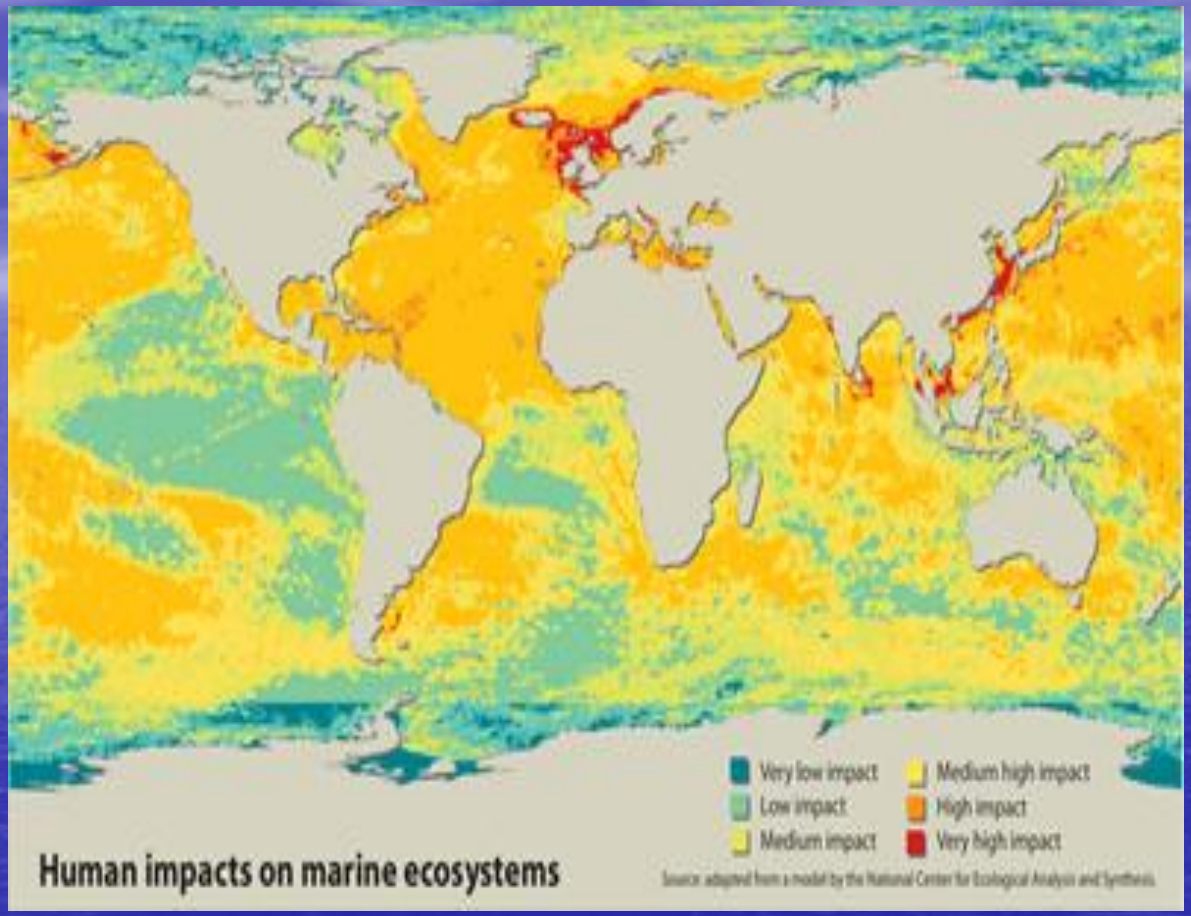

**DDT**

dichloro-diphenyl-trichloro-ethane

- NASCAR in 2008 switched to unleaded fuel after years of research and when blood tests of NASCAR teams revealed elevated levels of lead.

# Ocean-Water Pollution

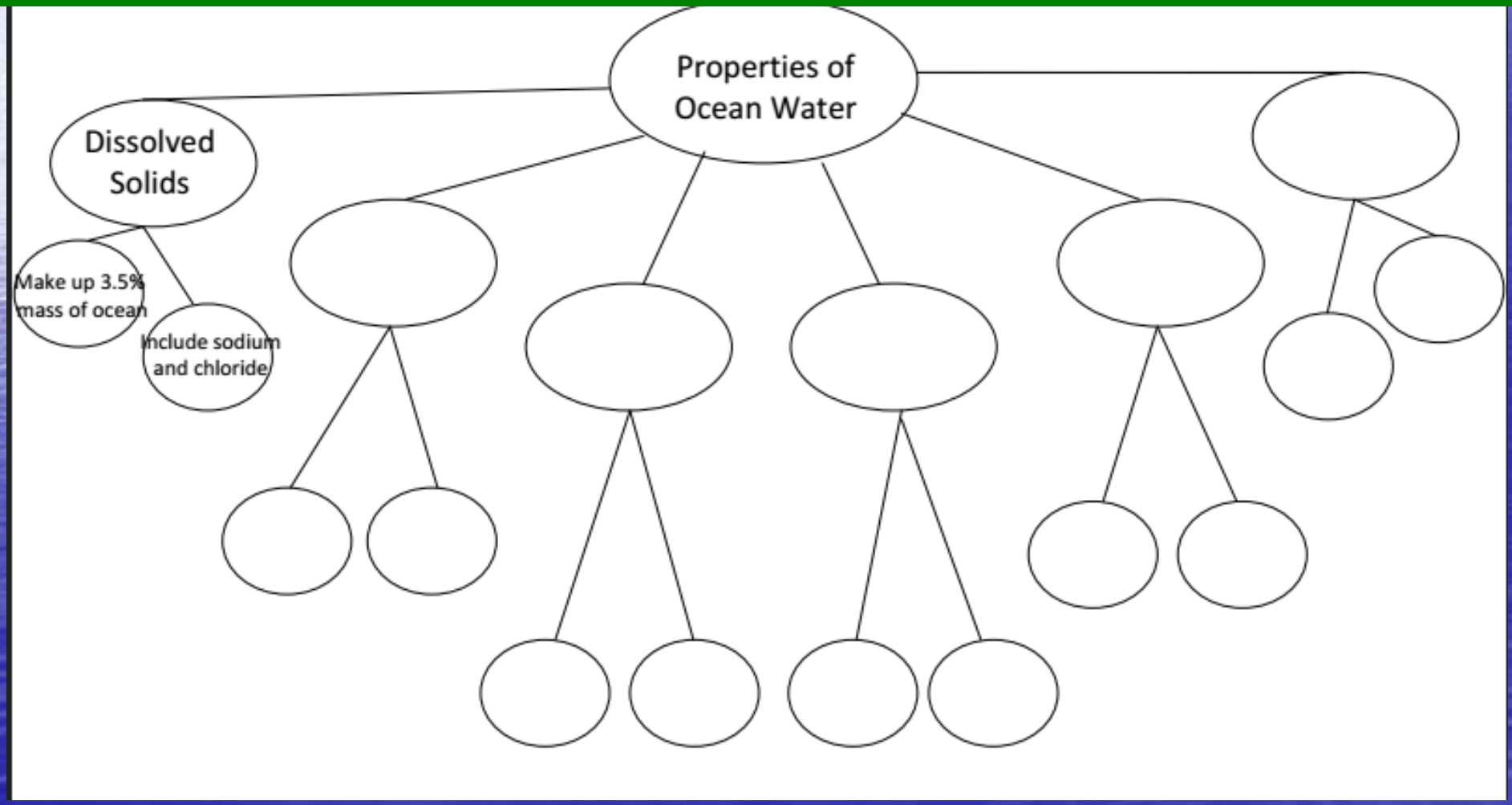
- Ocean-water pollution threatens both marine organisms and humans by damaging food resources in the ocean.




**Ocean-Water Pollution**

# Homework

1. Students take out a sheet of paper
2. Draw the graphic organizer you see below.
3. List the 6 properties of ocean water we have discussed in class and provide 2 facts for each property. See example below….



- Most marine organisms depend on two major factors for their survival:
- (1) essential nutrients available in the ocean water
- (2) sunlight
- Continental Shelf map

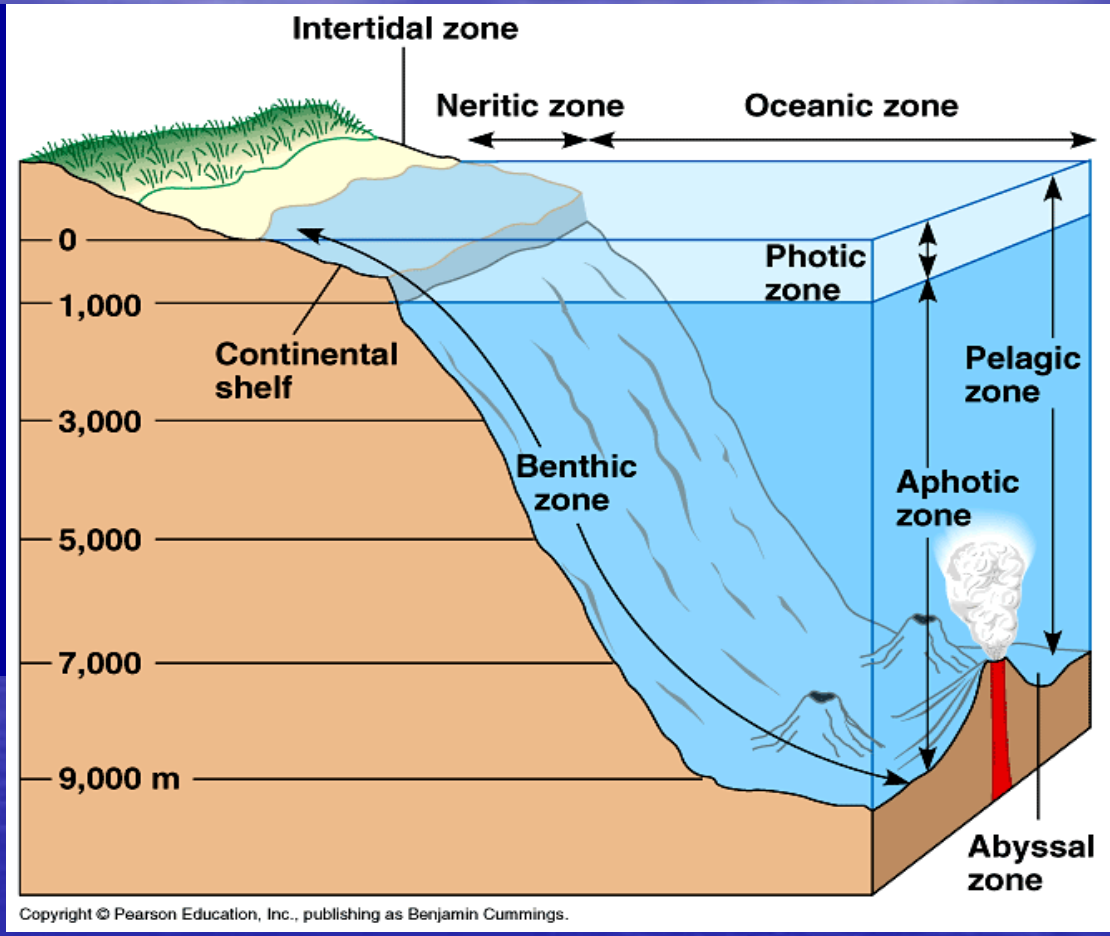
# Lesson 7 - Ocean Chemistry and Marine Life

Chapter 20

# What Determines Life in the Ocean

- The distribution of marine life is determined by three things:

- (1) amount of sunlight,
- (2) water temperature,
- (3) water pressure.



- Marine organisms help maintain the chemical balance of ocean water and produce about 50-70% of the oxygen in the world.

# Ocean Chemistry and Marine Life

Chapter 20

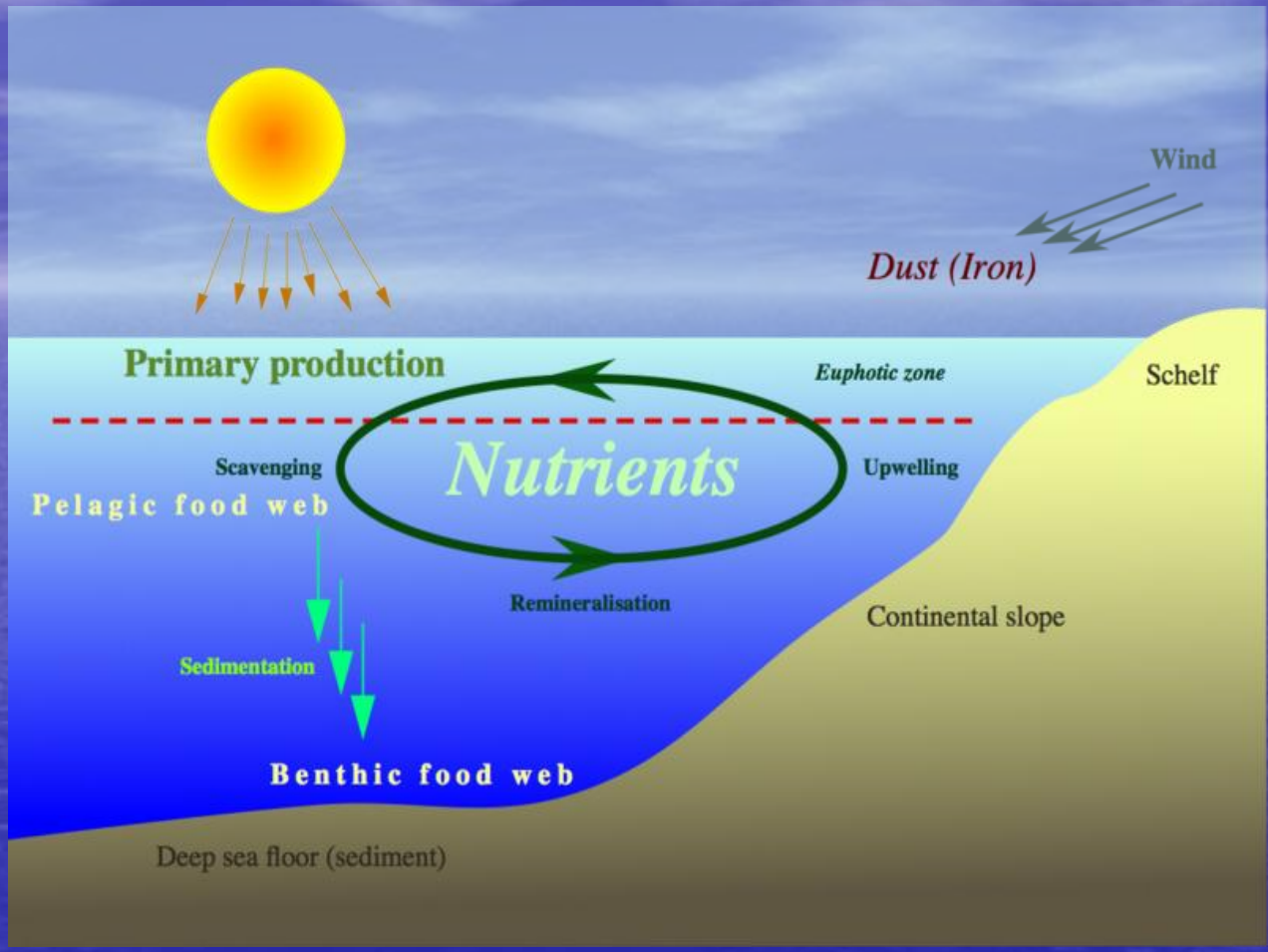
- For ex. a marine plant:

Takes in: carbon, hydrogen & sulfur

Returns: oxygen.

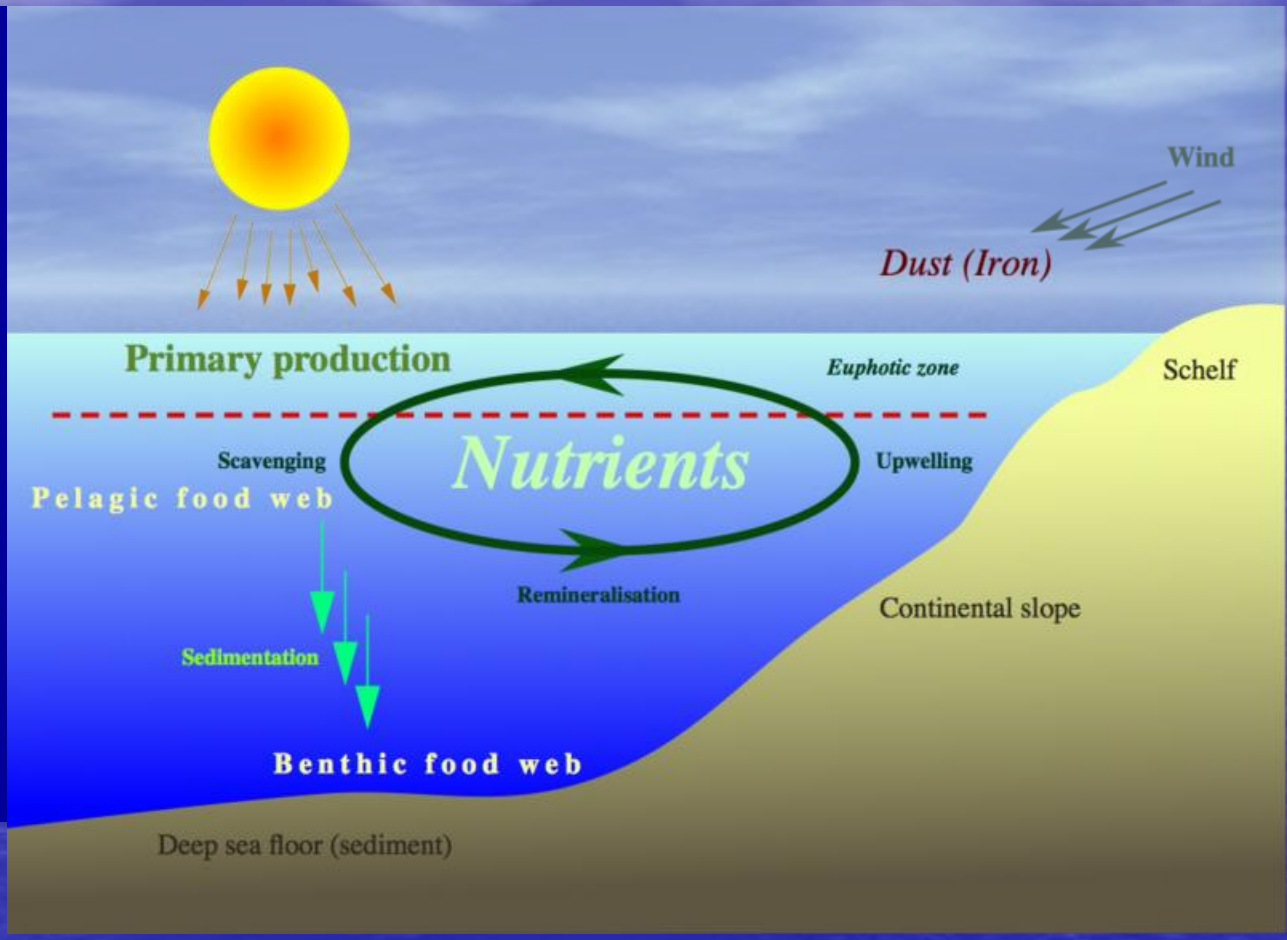
# Ocean Chemistry and Marine Life

- During a marine organism's lifetime, the organism absorbs and stores nutrients from the sea.



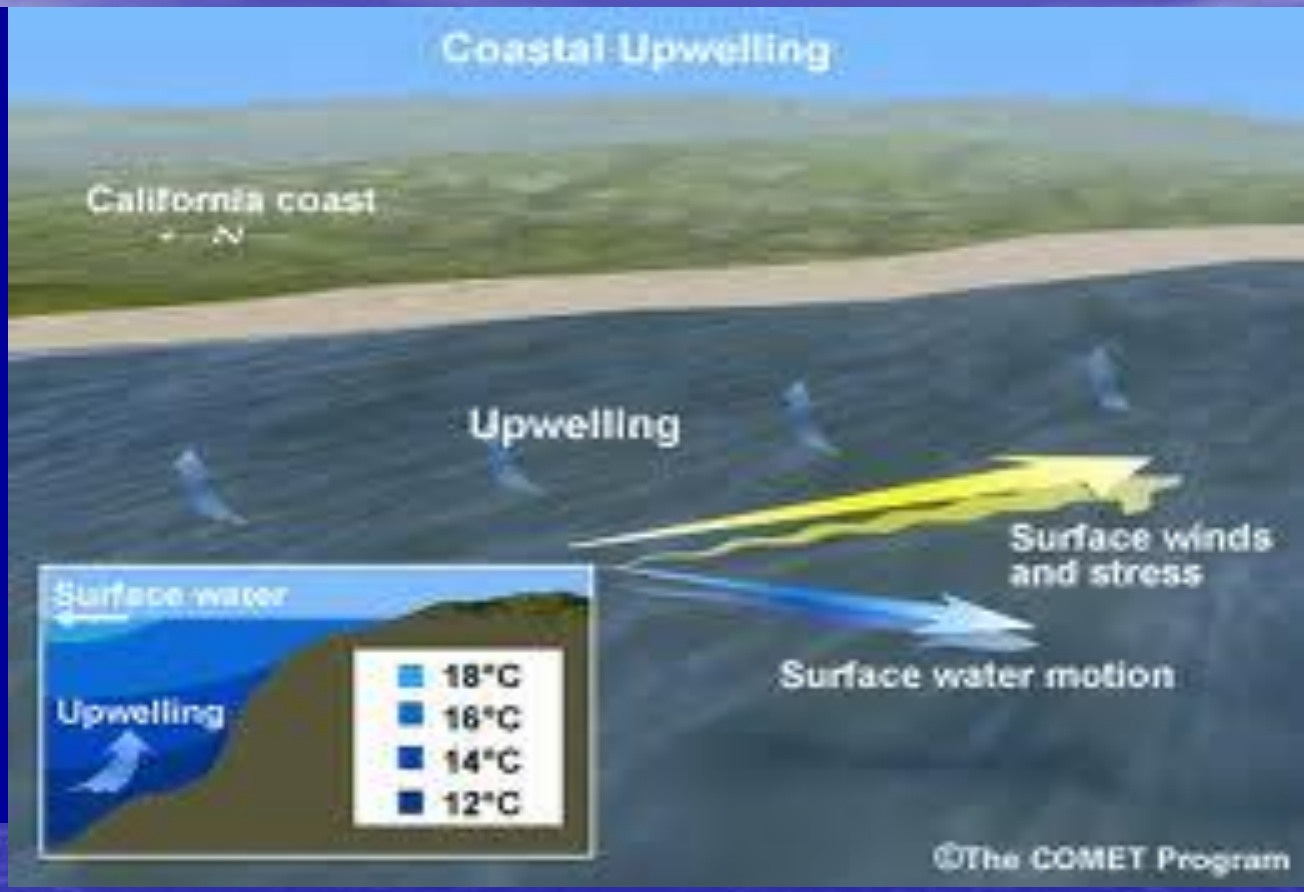

## Nutrient Cycle

- These nutrients are eventually returned to the bottom waters when the organism dies and its remains float to the bottom forming a “nutrient cycle.”



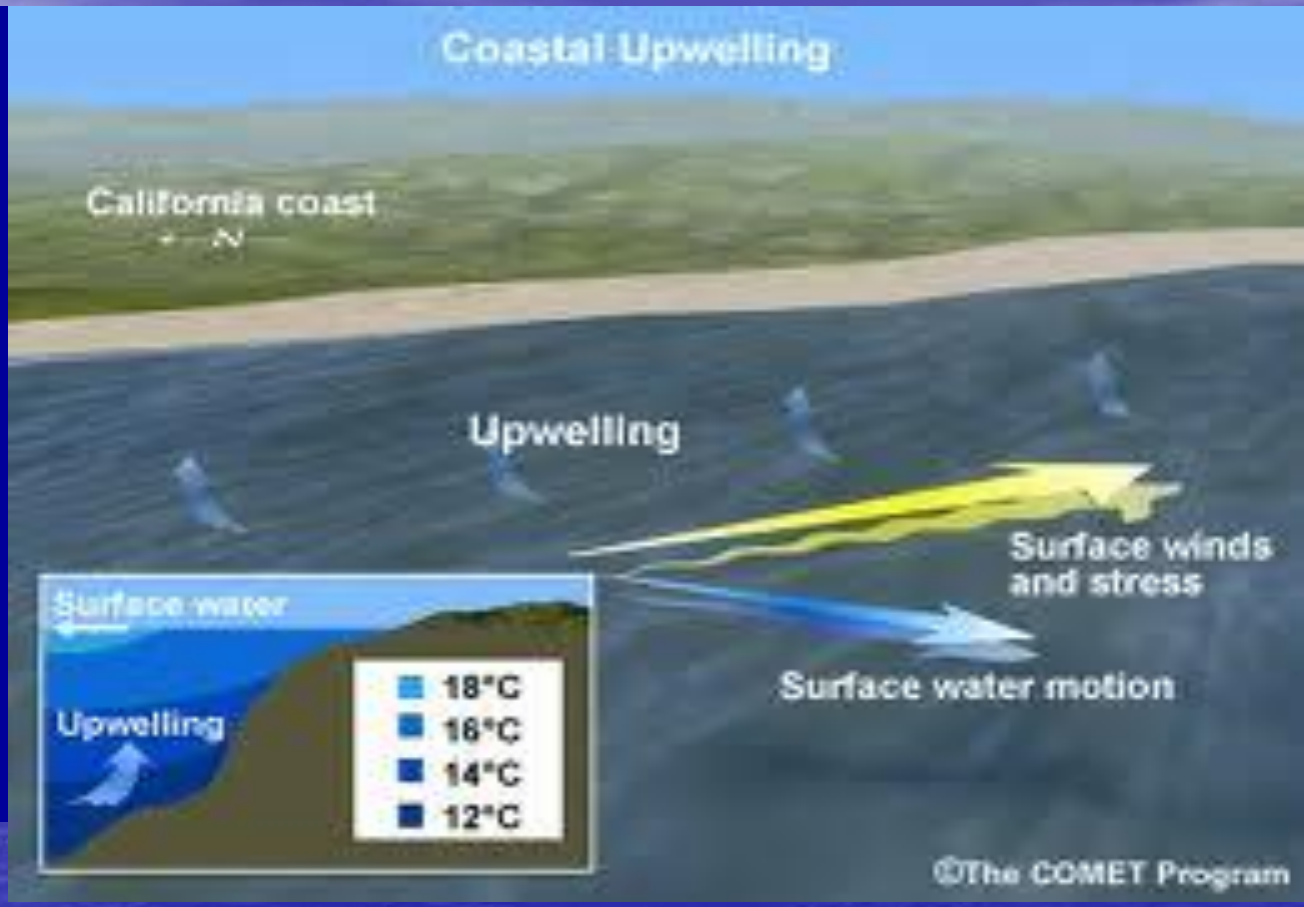

## Nutrient Cycle

- The nutrient cycle is completed when the movement of deep, cold, and nutrient-rich water is brought to the surface by an upwelling.




## Upwelling

- An upwelling occurs when wind blows away warmer surface waters from the top allowing colder nutrient rich water to rise and replace it.




# Upwelling

https://www.youtube.com/watch?v=XV90dy0ns1U

# Check for Understanding

- Explain the role of upwelling in nutrient cycling.

Use your own words and complete sentences.



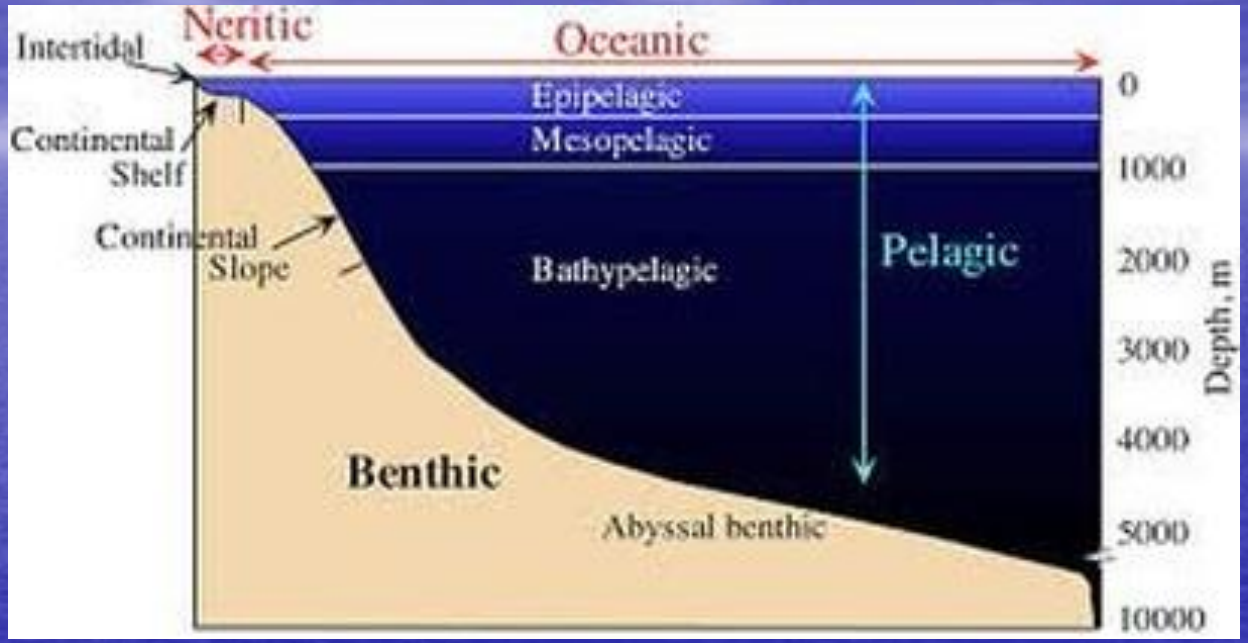
- The ocean is divided into two basic environments:

- (1) The Benthic Zone.
- (2) The Pelagic Zone.

# Two Basic Ocean Environments

Chapter 20

- The benthic zone is the ecological region at the lowest level of a body of water such as an ocean or a lake, including the sediment surface and some sub-surface layers.



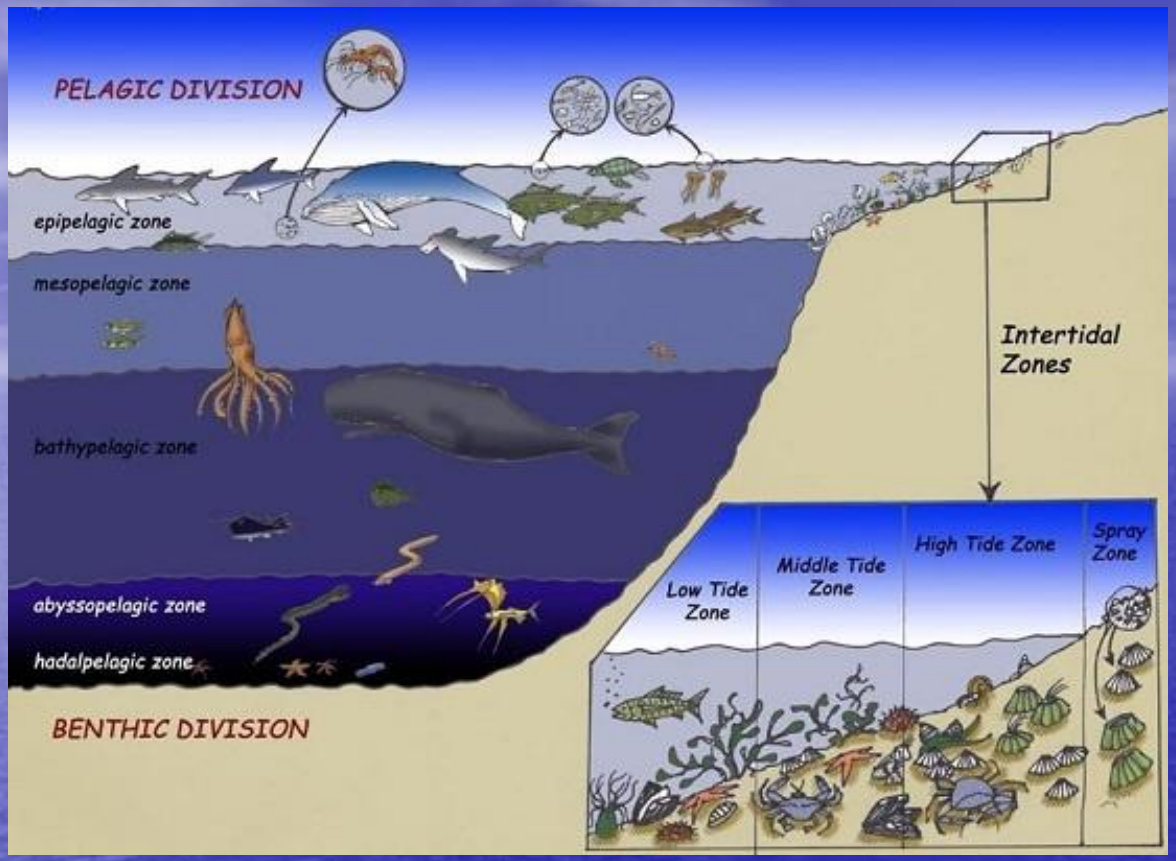

# (1) Benthic Zone

- Organisms living in this zone are called benthos.
- They generally live in close relationship with the substrate bottom and many such organisms are permanently attached to the bottom.

**Benthos Live in Benthic**

- They include oysters, sea stars and mussels.

## Benthos Live in Benthic



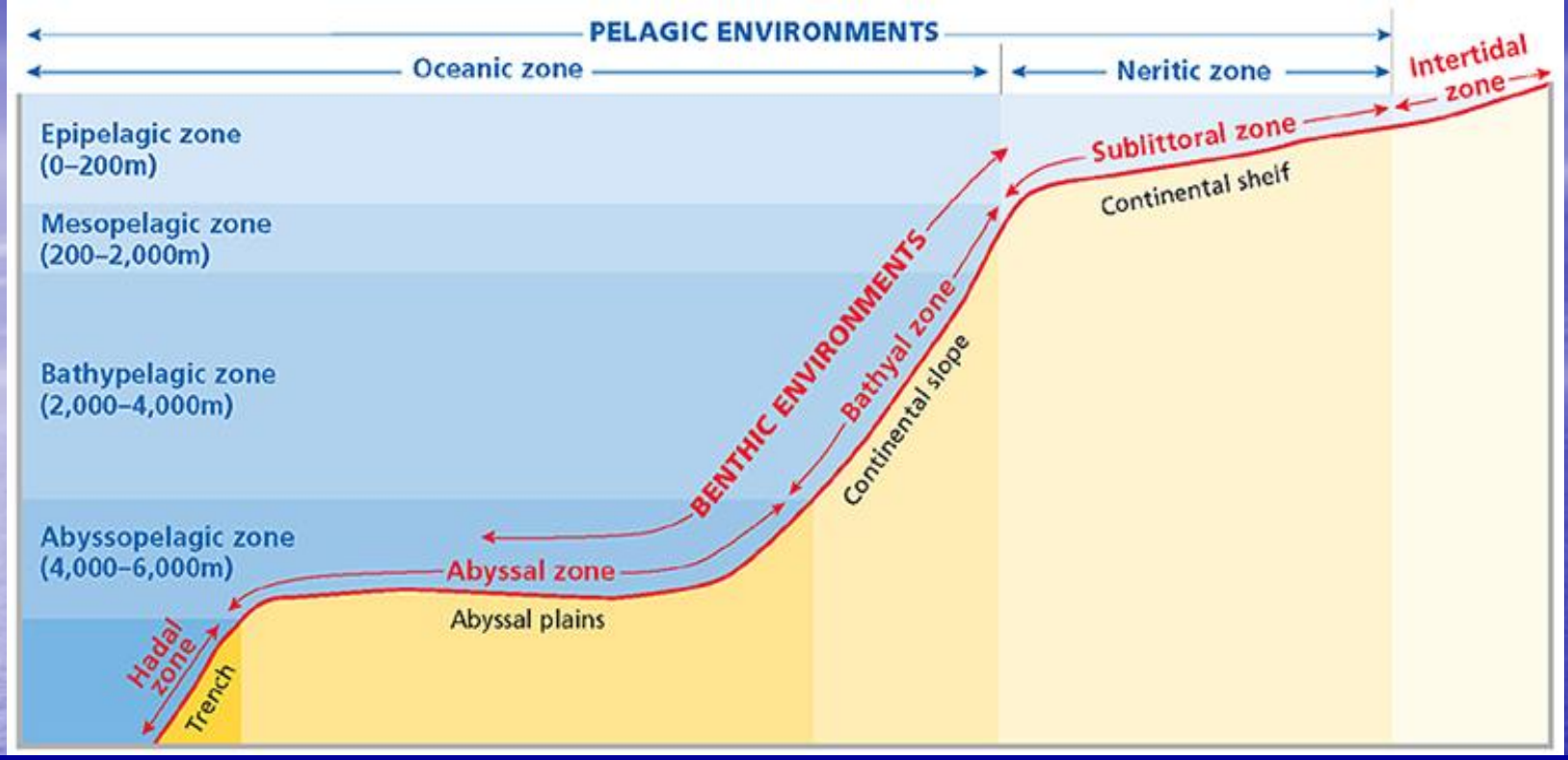

- Most of the organisms that live in the benthic zone live in a place called the intertidal zone which lies between the low-tide and high-tide lines of the continental shelf (shallow waters).

## Intertidal Zone

Chapter 20

- The second major ocean environment is the Pelagic zone.

## (2) Pelagic Zone




- Any water in a sea or lake that is not close to the bottom or near to the shore can be said to be in the pelagic zone.

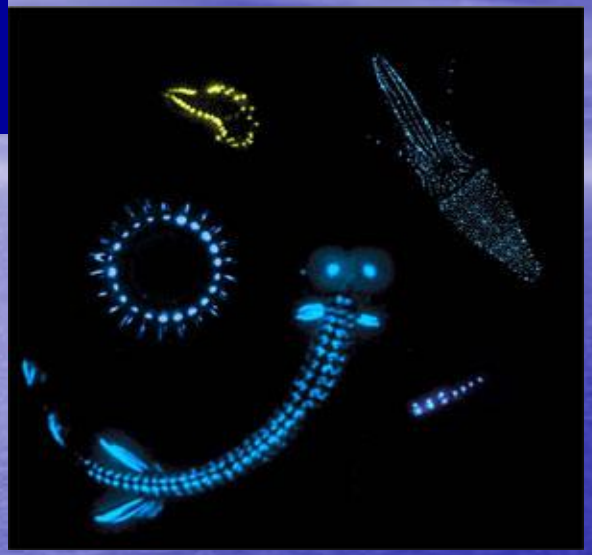
- The word pelagic is Greek for "open sea". (Nemo)

# (2) Pelagic Zone

Chapter 20

https://www.youtube.com/watch?v=8101vCjM7nY

# Pelagic Zone



- Most life in the ocean is found in the top 2% of the water (650f).
- Below 1,000 feet (Mesopelagic) is when we see species with luminescents after 3,200 feet (Midnight Zone) there is not much to be seen.

- The fish living in the Pelagic Zones are called the Nekton.
- The Nekton represents all organisms that swim actively in open water, independent of currents (ex. fish, sharks & squid).

# Nekton Live in the Pelagic Zone

# Check for Understanding

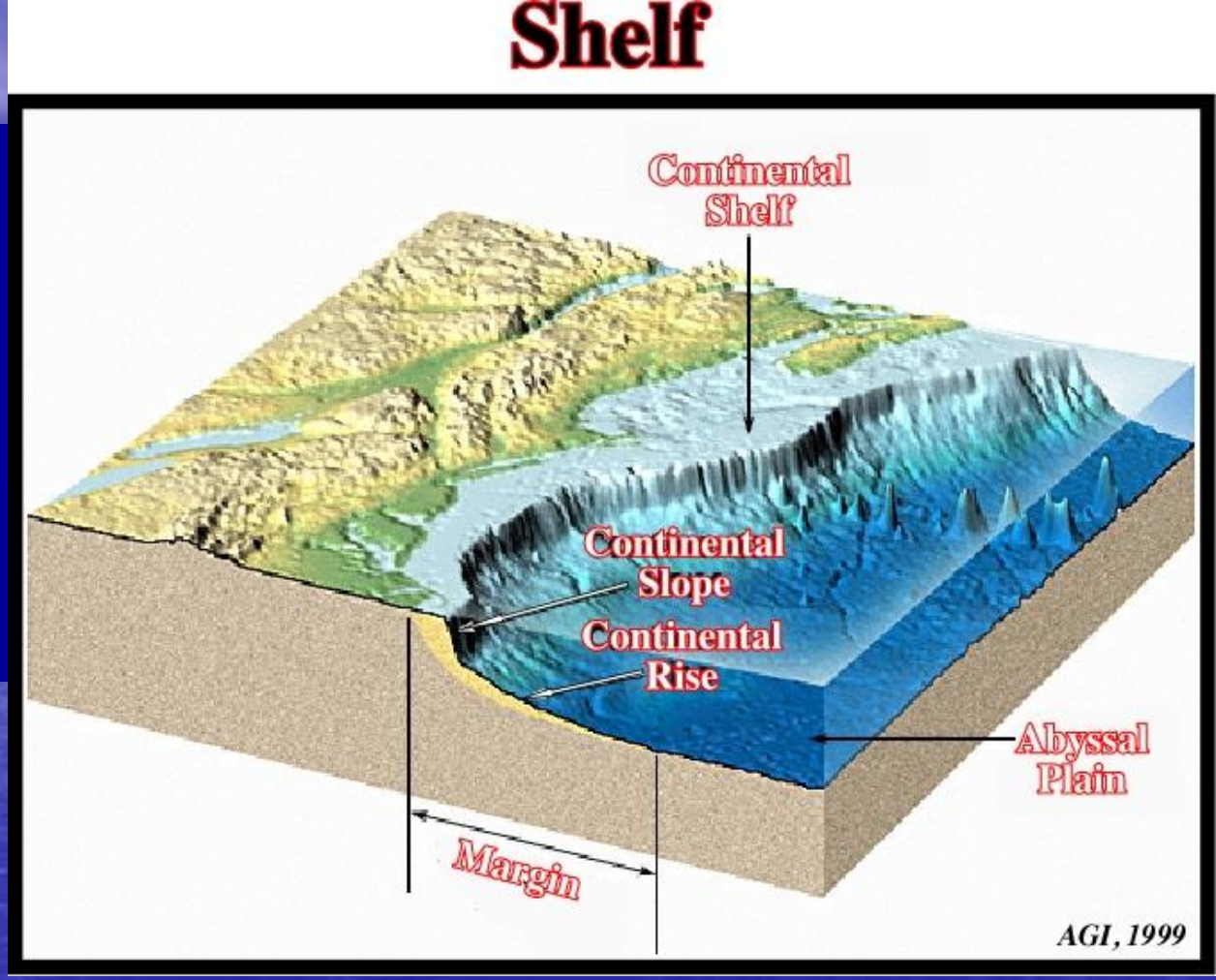
1. Why are phytoplankton vital to the survival of nearly all species here on Earth?
2. Describe the two oceans zones we learned about in class and how are they different?

***Answer question using your own words and with complete sentences*.**

- The California continental shelf varies in width.
- The widest area of shelf extends about 13.8 miles from the shore to the shelf break, where the water depth is about 325 ft.


# California Continental Shelf

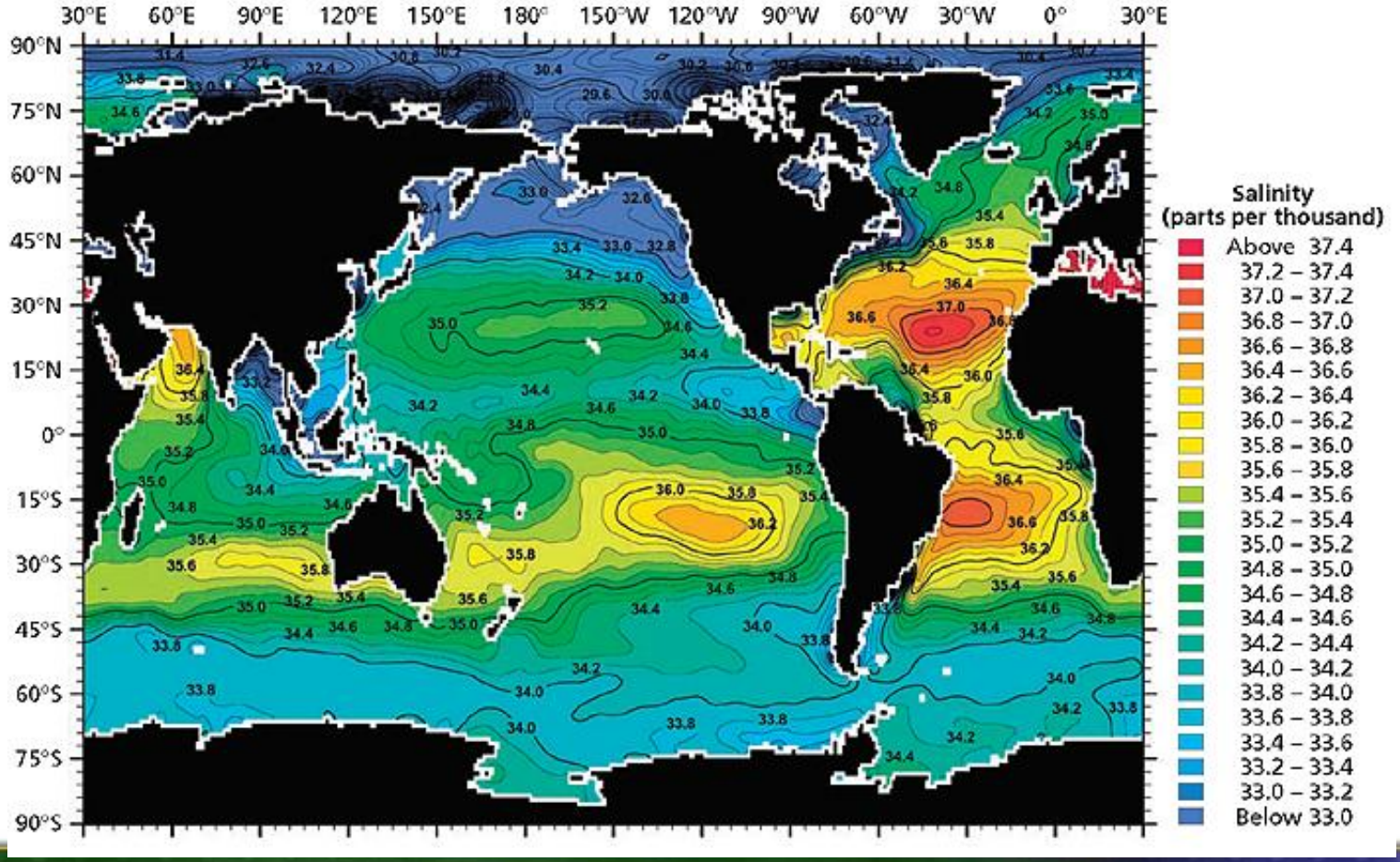
- On the east coast New York for example is about 230 feet deep before the sudden drop off the continental shelf.




**The continental shelf**

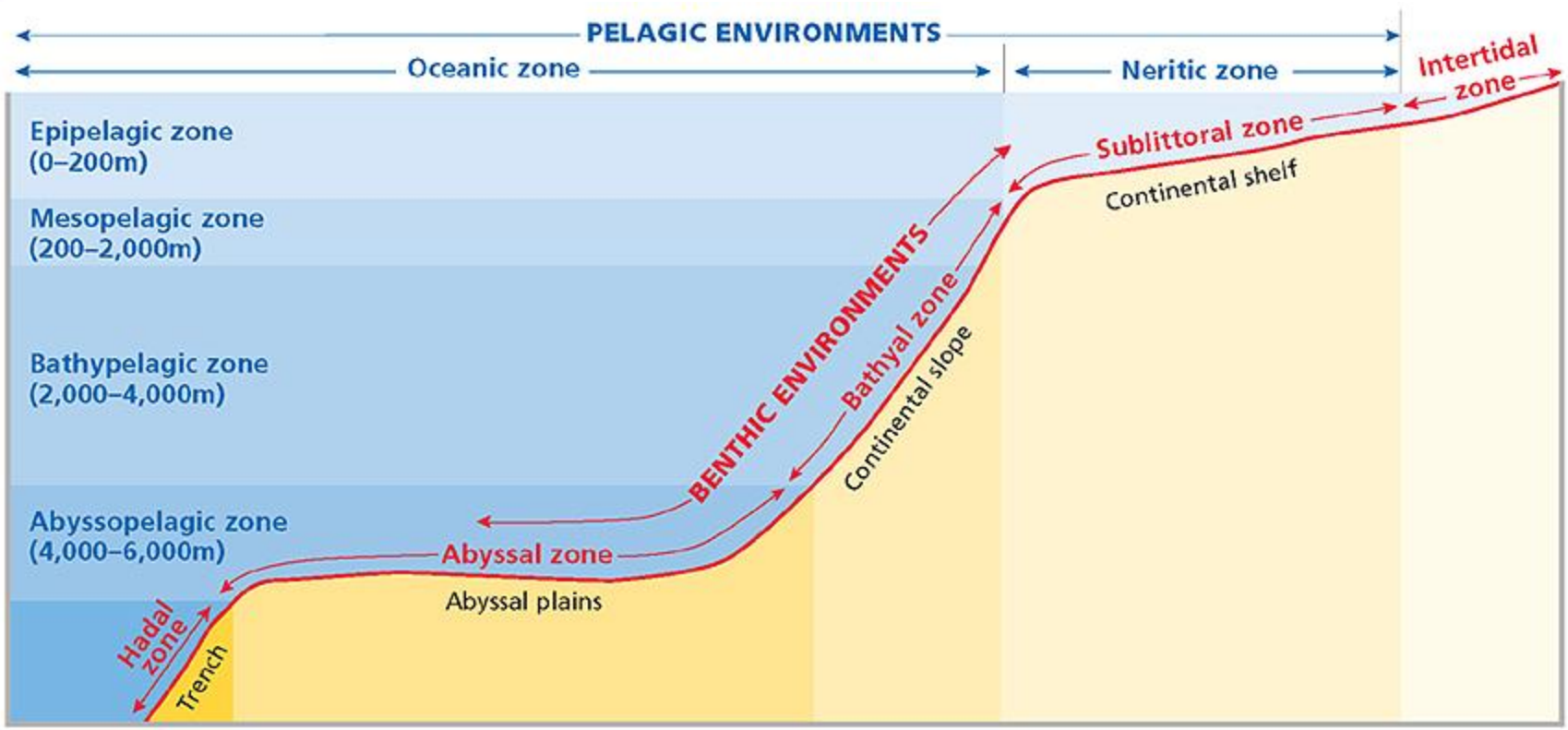
Chapter 20

# Average Surface Salinity of the Global Ocean



Chapter 20

# Marine Environments



Chapter 20

# Sea Surface Temperatures in August