

Physical and Chemical Factors

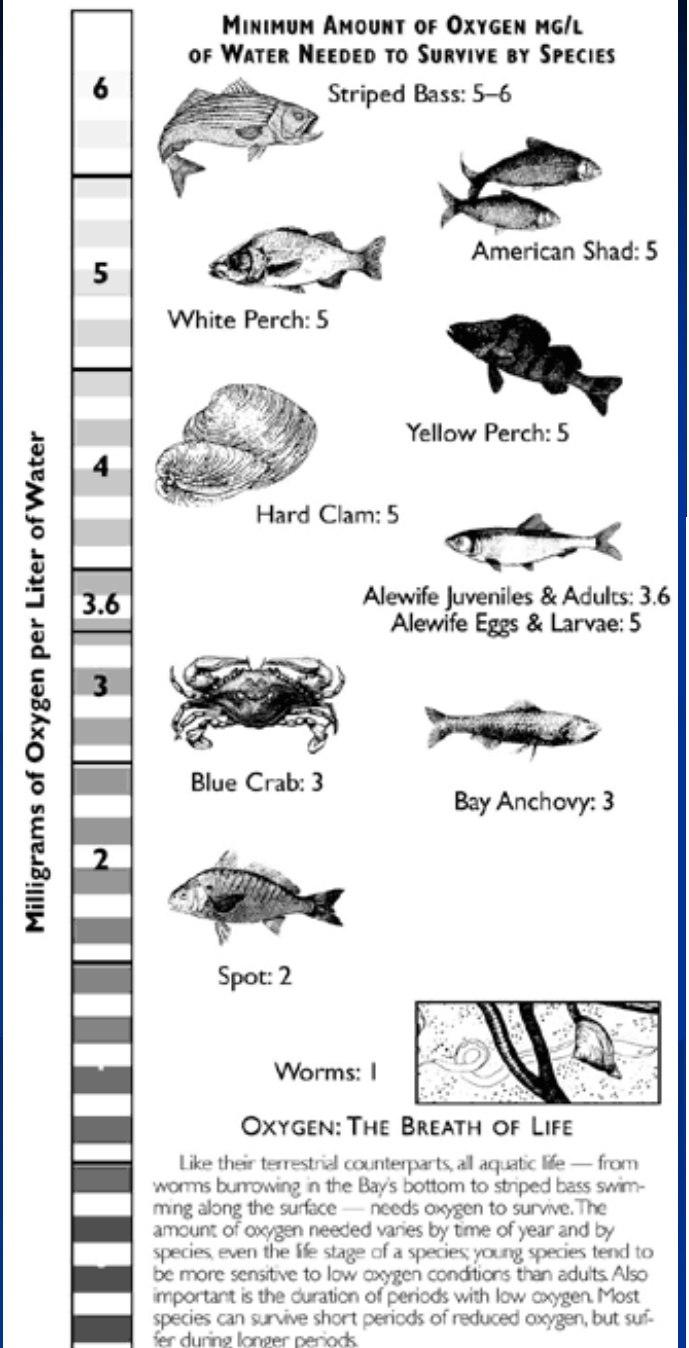
Physical and Chemical Factors

- What is known about molecular oxygen and its distribution in the ocean?

Oxygen

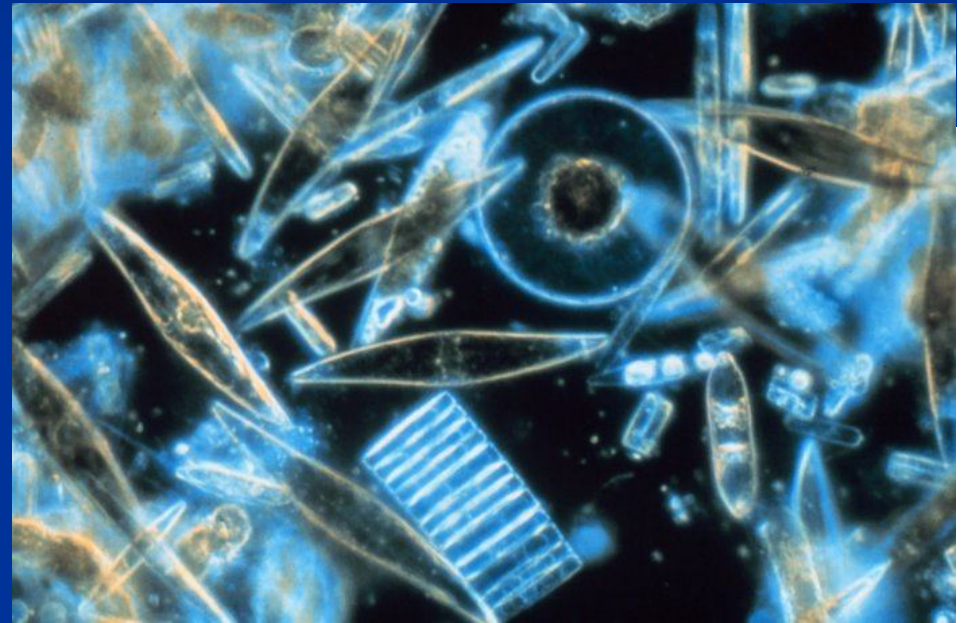
- Non-photosynthetic organisms need oxygen to make energy through respiration.
- Oxygen in water is referred to as *dissolved oxygen*
- The more DO there is in the water, the more life can be supported
- Things that effect the amount of DO:
 - Turbulence
 - Photosynthetic organisms
 - Bacteria
 - Eutrophication
 - Tides

DISSOLVED OXYGEN CRITERIA



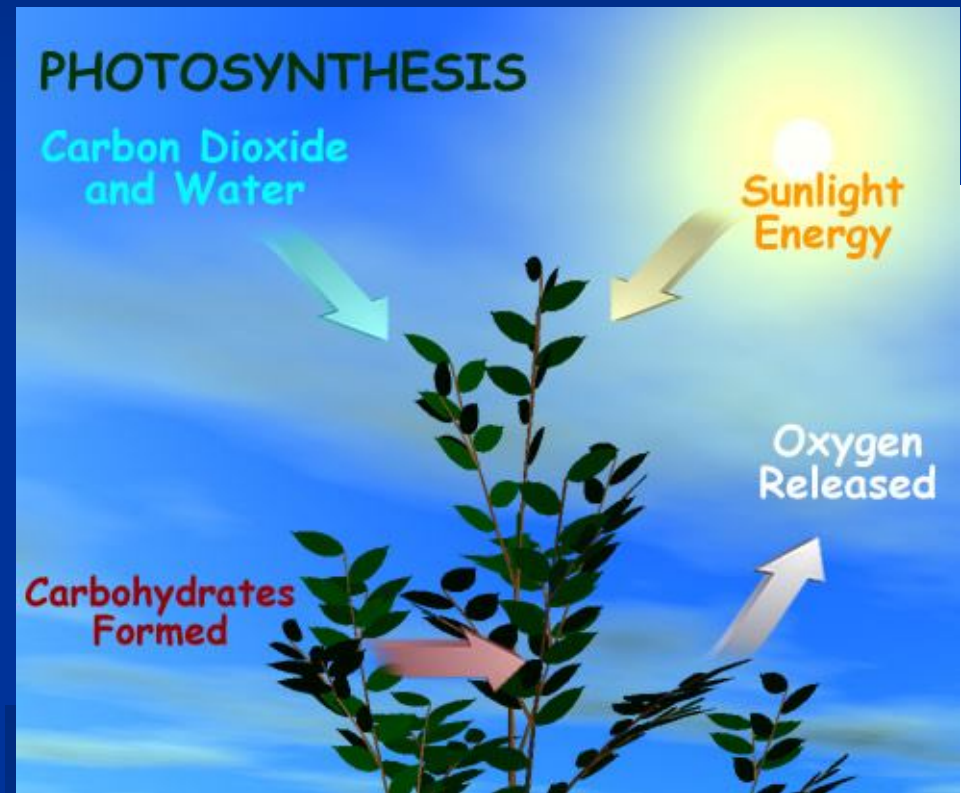
Oxygen

- Where does oxygen in the water come from?
 - Algae (most)
 - Includes single-celled organisms collectively called phytoplankton
 - “Sea Weed”
 - Wave action and other turbulence
 - Oxygen content in air is 200 ppm while in ocean it is 1 – 12 ppm



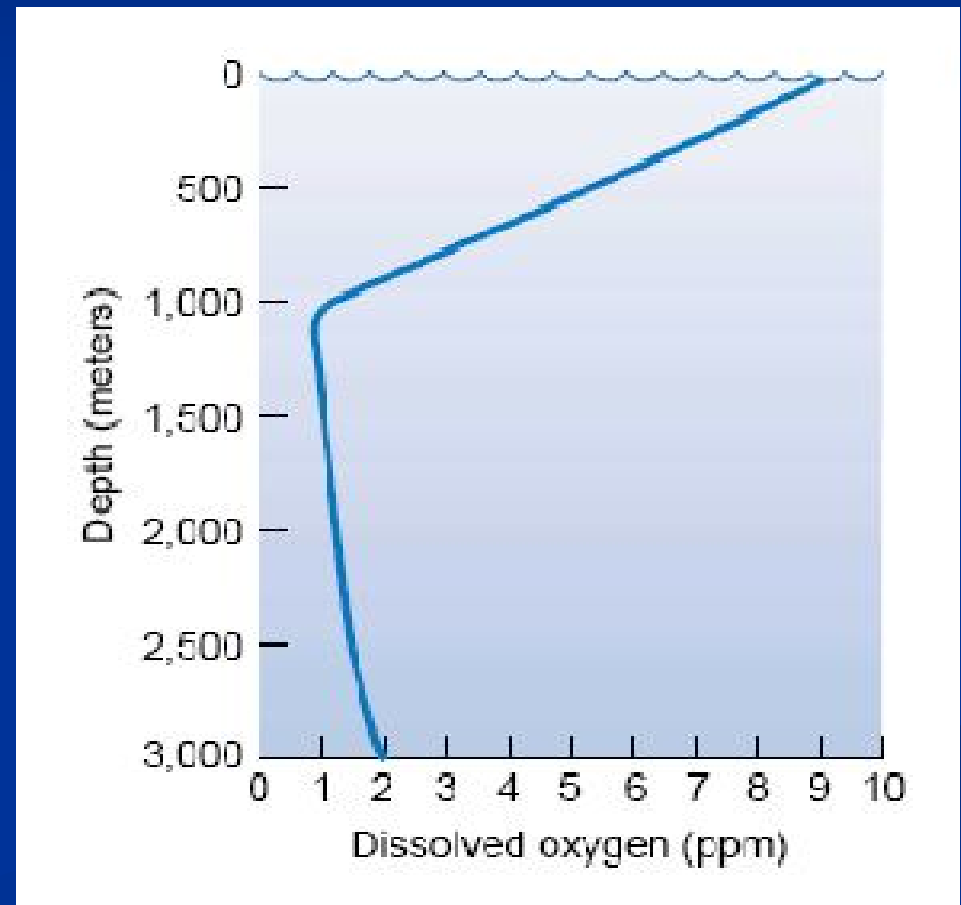
Oxygen

- Photosynthesis
 - Energy from sunlight is used to convert carbon from the environment into carbohydrates
 - Oxygen is released into the environment



Oxygen

- Photosynthesis in the ocean occurs at the surface, dependent on access to light
- Most oxygen diffuses into the atmosphere
 - 70% of our oxygen comes from the ocean
- Oxygen content decreases with depth until the oxygen-minimum zone, around 1000m
- Oxygen content slightly increases due to drop in temperature and increase in pressure at depth
 - Colder water holds more oxygen and pressure prevents the gas from escaping



Physical and Chemical Factors

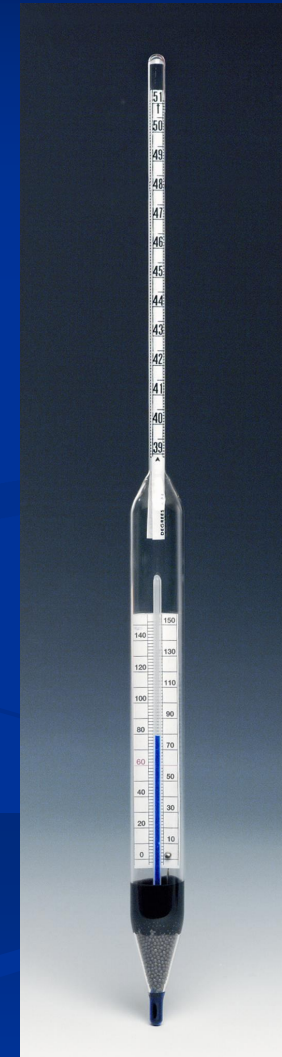
- What is known about molecular oxygen and its distribution in the ocean?

Salinity

- What do we know about the density and salinity of ocean water?

Salinity

- Density
 - Equal to mass per unit volume
- Salinity
 - The salt concentration of a volume of water
 - Concentration = units/volume
- Buoyancy
 - Describes the condition when an object in water displaces a volume of water relative to its mass
 - When the volume displaced is equal to its mass, the object is neutrally buoyant, more than, it is positively buoyant
 - Buoyancy in salt water is higher than fresh water
 - Salt increases mass of salt water
- Hydrometer
 - Measures buoyancy through specific gravity, a measure of displacement
 - Distilled water has specific gravity of 1



Salinity

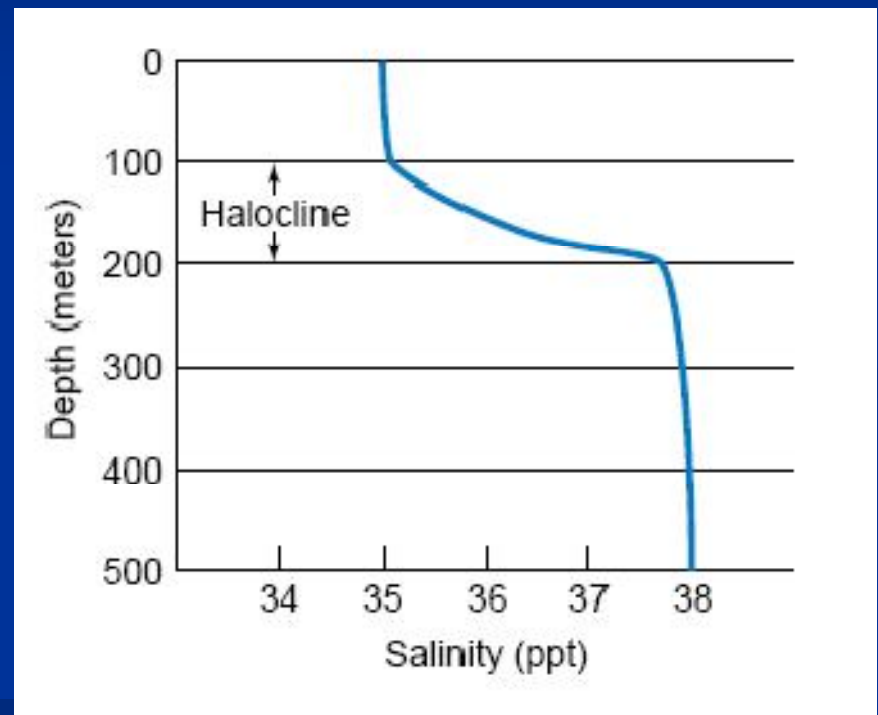
- What do we know about the density and salinity of ocean water?

Salinity

- How does salinity vary in the ocean?

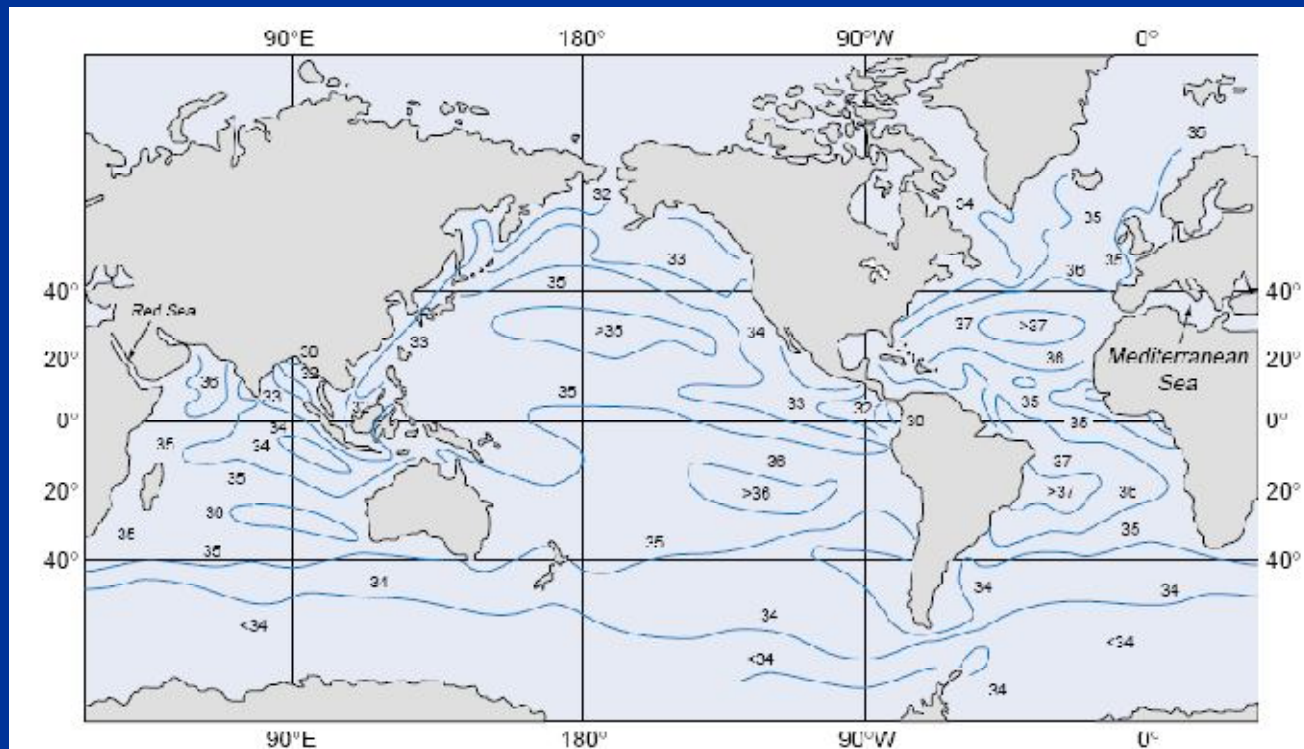
Salinity

- Salinity varies with depth
 - Between 100 and 200 meters is the Halocline
 - Salinity increase sharply due to a decrease in temperature
 - Warmer temperature causes molecules to be farther apart, decreasing concentration
 - Colder temperature causes molecules to be closer together, increasing concentration



Salinity

- Surface salinity varies by latitude
 - Areas with increased evaporation have higher salinities
 - Salinity lower at equator due to input from fresh water (rain)
 - Coastlines also can be lower due to fresh water input from rivers



Salinity

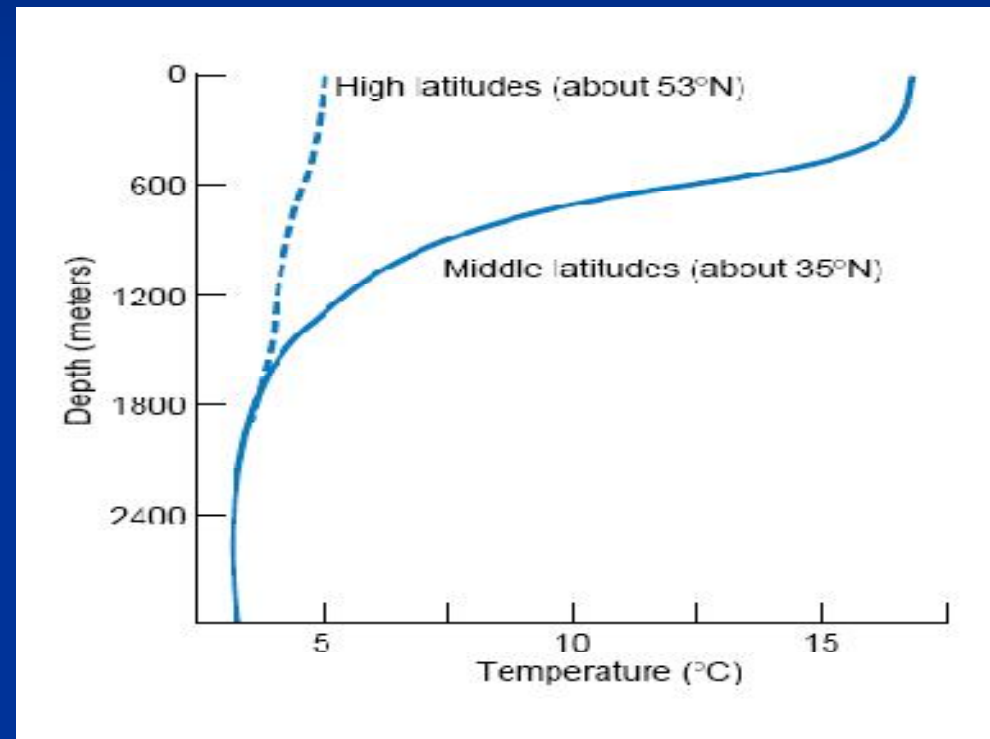
- How does salinity vary in the ocean?

Temperature

- What do we know about ocean temperature and its effects on living things?

Temperature

- As depth increases, temperature decreases
- Thermocline is a permanent boundary between 200 and 1000 meters that separates warmer surface waters from colder water below
- Warmer water is less dense, colder water sinks and displaces the bottom water



Temperature

- Fish are more active with warmer temperature
- They are ectothermic
 - When the temperature of the environment changes, so does their body temperature
 - Metabolic activity decreases with colder temps
- The Ice Fish
 - Has a type of natural antifreeze in its blood



Temperature

- What do we know about ocean temperature and its effects on living things?

Pressure

- How does underwater pressure vary with depth?

Pressure

■ Atmospheric Pressure

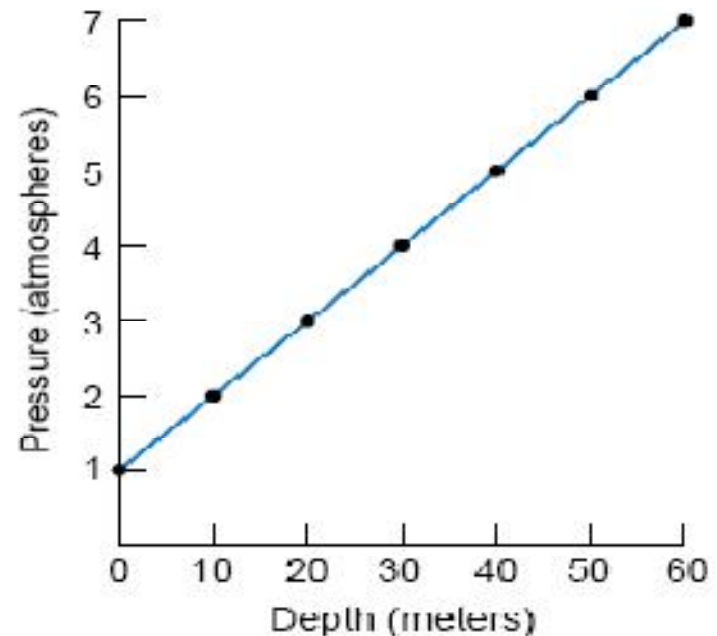
- Molecules of gas in the atmosphere have mass and due to gravity's pull, exert pressure on the Earth's surface.
- Pressure is less with increasing altitude due to being farther away from the center of the planet
- Measured in atm's, or atmospheres

■ Hydrostatic Pressure

- Pressure caused by the mass of water molecules

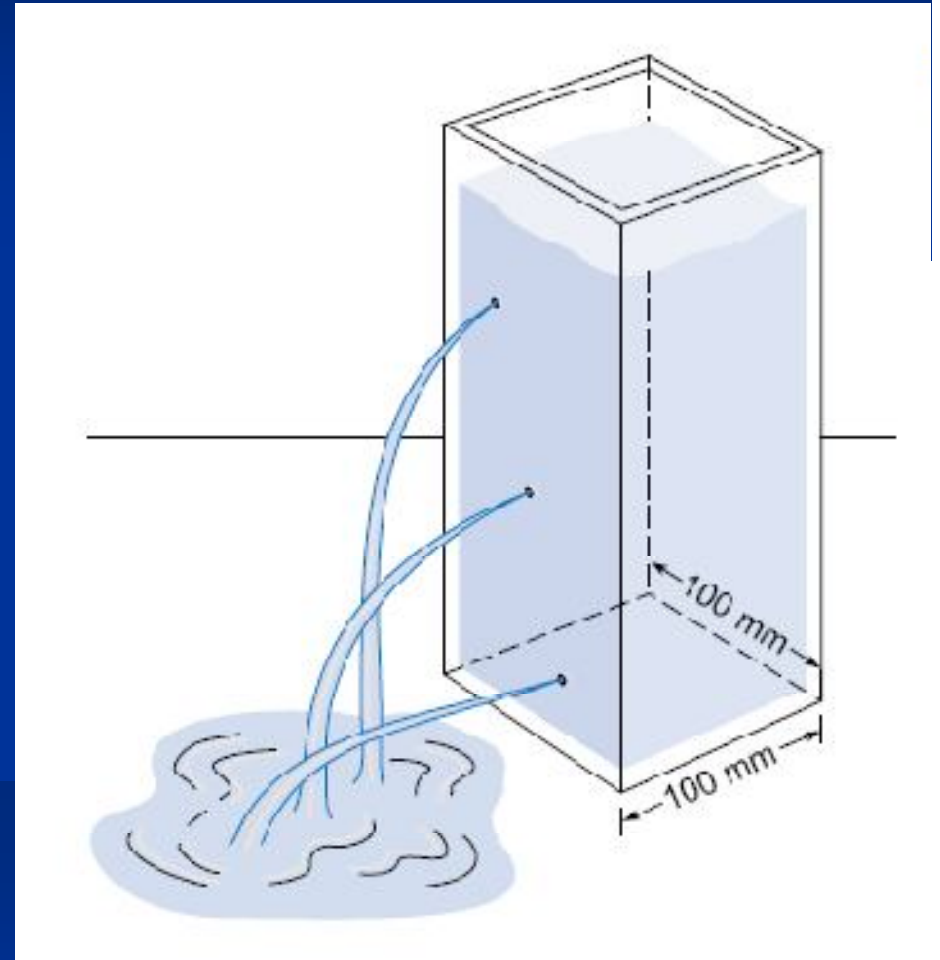
Pressure

- Hydrostatic pressure increases directly with depth
- Every 10 meters is an increase of 1 atm
- 1 atm of pressure at the surface due to the pressure of the atmosphere



Pressure

- Why is the water shooting out farthest at the bottom of the tank?
- So why does the base of a dam have to be the thickest?



Pressure

- Barotrauma
 - Injury related to water pressure
- A “squeeze”
 - Mask
 - Ear
- Nitrogen Narcosis
- The Bends

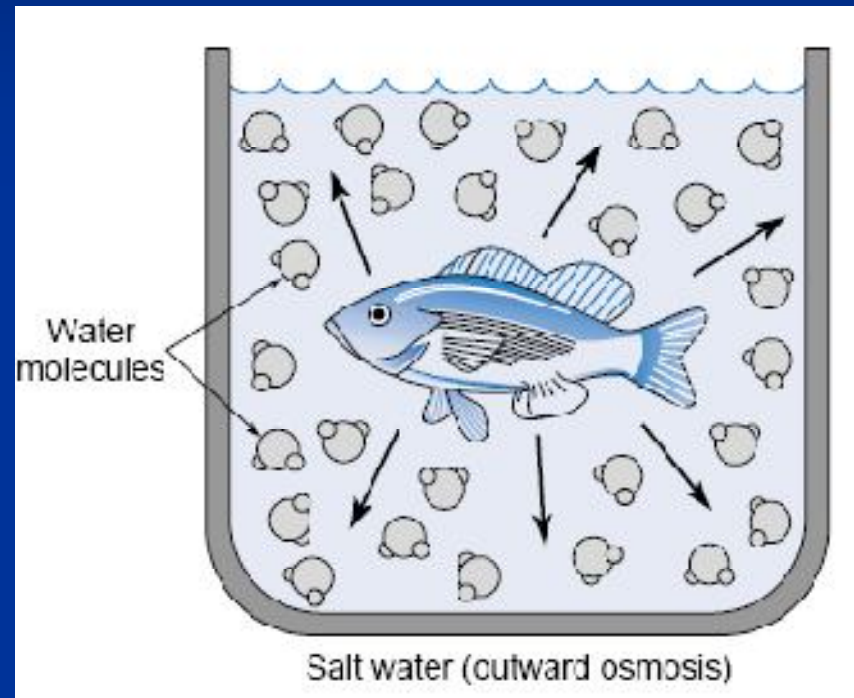


Pressure

- How does underwater pressure vary with depth?

Osmoregulation

- Osmoregulation
 - Regulation of the water content of the body
 - All animals need fresh water
 - Osmosis
 - Diffusion of water
 - Fresh water
 - Water moves in as there is more water outside the animal
 - Salt water
 - Water moves out as there is more water inside the animal



Osmoregulation

■ Poor osmoregulators

■ Sea star

- Unable to eliminate extra water
- Can survive only at particular salinities
- Sea star's internal environment has a salt concentration close to the water's



■ Gold Fish

- Unable to compensate for water loss if placed in salt water would die of dehydration



Osmoregulation

■ The Salmon

- A good osmoregulator
- Is born in a freshwater river
- Swims out to the ocean
- Returns to freshwater to spawn
- In salt water salmon drink salt water and secrete excess salt through gills and a salty urine
- In fresh water, salmon excrete excess water through dilute urine
- Salinity of body tissues remains the same

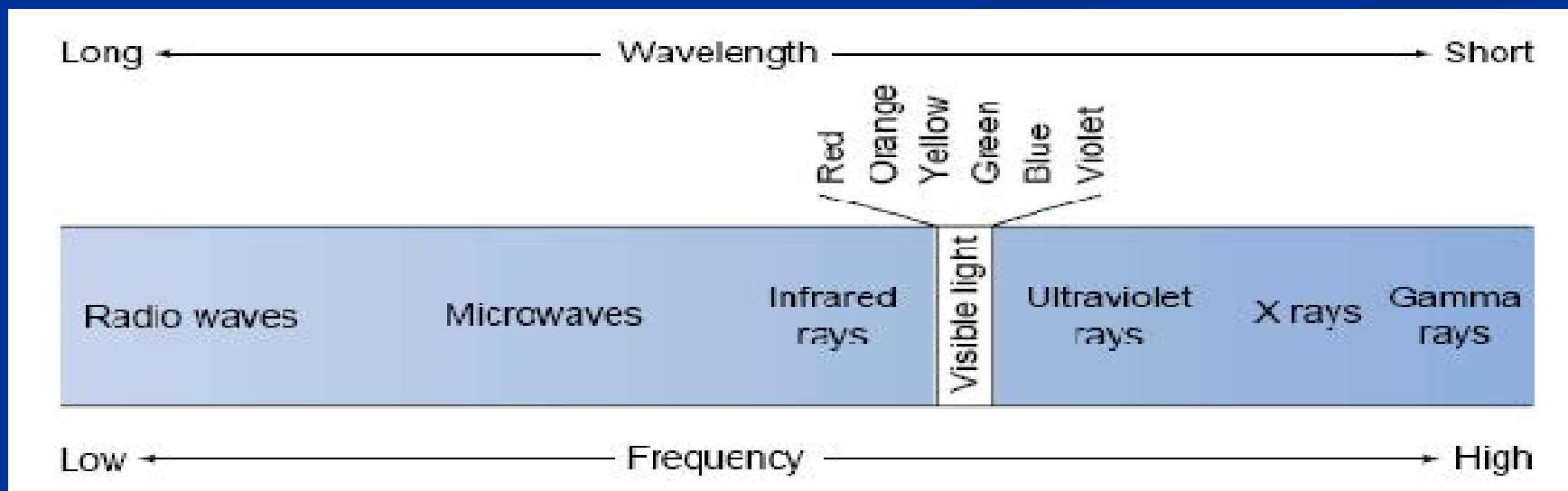


Light

- What is light and how does it behave in the ocean?

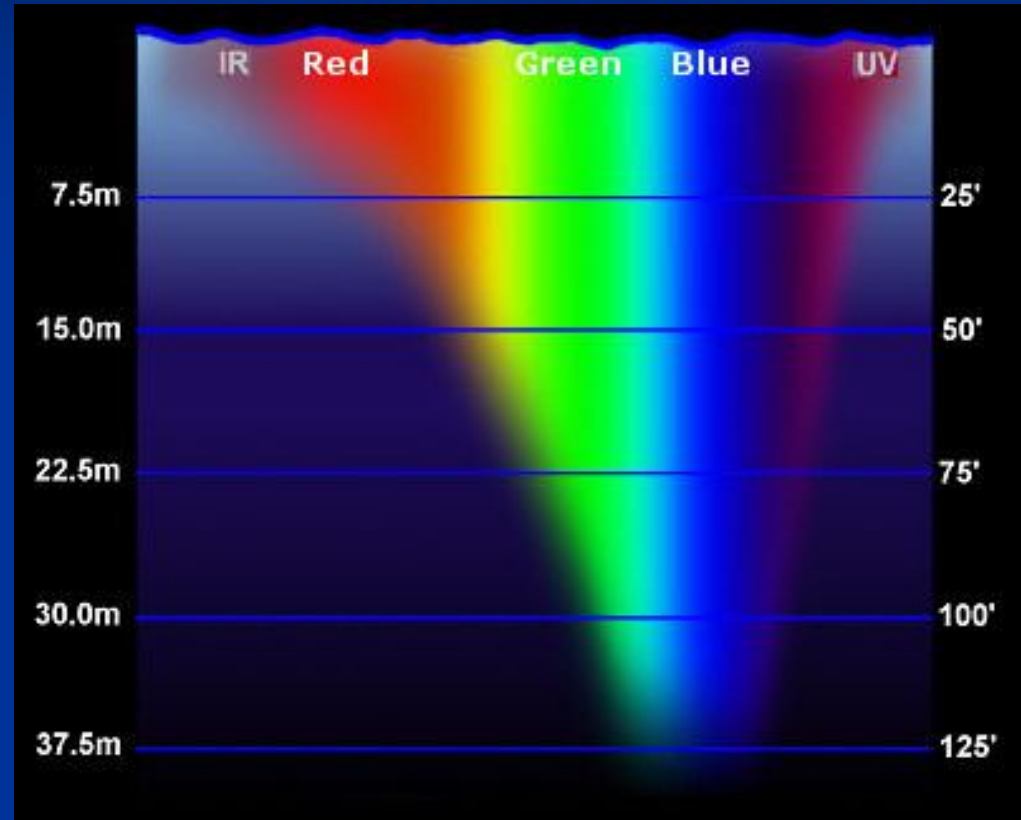
Light

- Electromagnetic Spectrum
 - Made of all forms of solar radiation
 - Wavelength is the length of one complete wave cycle
 - Frequency is number of wavelengths per second
 - Similar measurements as ocean waves, except these are light



Light

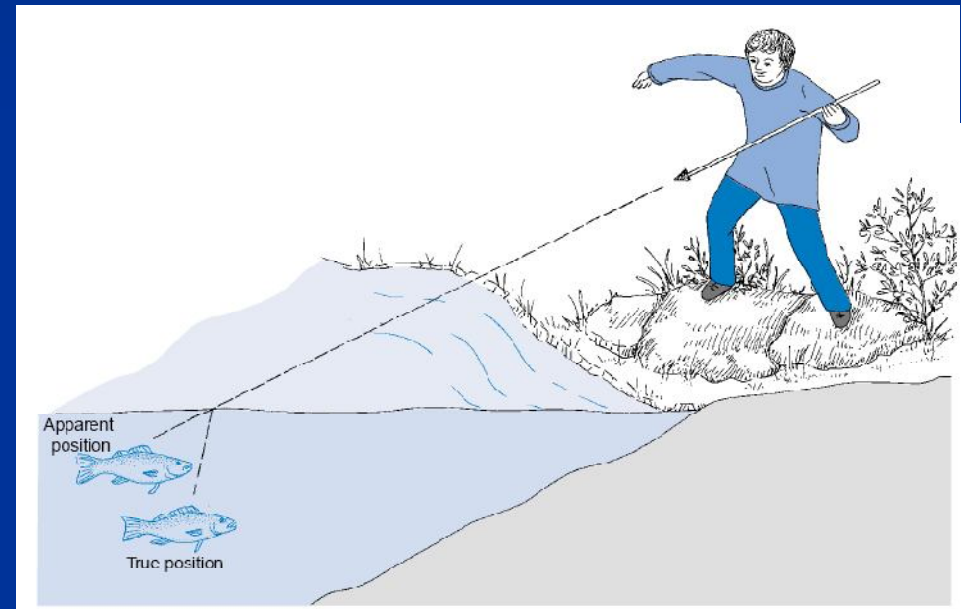
- Reflected Light
 - When light bounces off a surface
 - The reason why we see things
- Absorbed Light
 - Light that is taken up by a substance
 - A visual “cloak” would absorb all visible light
- Transmitted Light
 - Light that passes through a substance



Light

■ Refraction

- When light enters water at an angle less than 90 degrees it bends
- From the surface, submerged objects are not where they appear to be (depending on viewing angle)
- Process that produces rainbows as light is refracted through water droplets



Light

- Why is the ocean blue?
 - Blue wavelength of light is scattered by water and reflected back to the observer
 - Ocean color also depends on suspended particles and bottom composition, i.e. sand or mud

Light

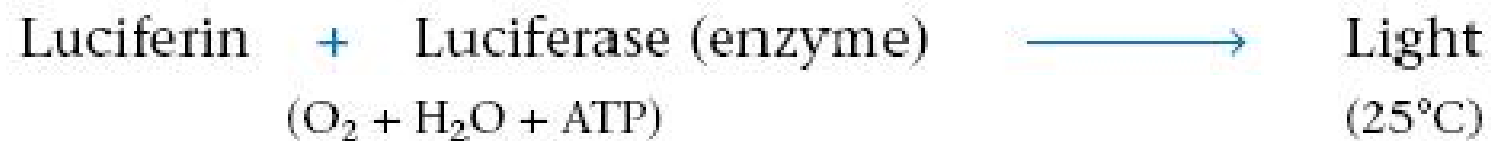
- What role does light play in the lives of marine organisms?

Light

- Most organisms in the ocean depend on light
 - Photosynthesis
- Light also effects marine organisms in other ways
 - Vertical Migration
 - Vertical movement of organisms from deeper water during the night and towards deeper water during the day
 - To avoid predation
 - Helps with nutrient cycling

Light

- Bioluminescence
 - Occurs in phytoplankton, bacteria, invertebrates and some fish
 - May be used to attract prey or mates, defend territories or to confuse predators

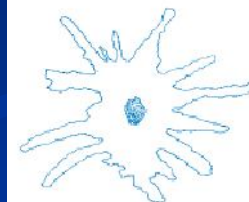


Light

- Other uses of light in the ocean
 - Color contrast
 - Found mostly in tropical fish
 - Used as a warning, but more often to identify members of the same species
 - Counter Shading
 - Used to help camouflage fish found in the pelagic zone
 - Light below and dark above
 - Chromatophores
 - Cells used to change colors
 - Contraction lightens



Branched granules
(dark chromatophore)



Contracted granules
(light chromatophore)

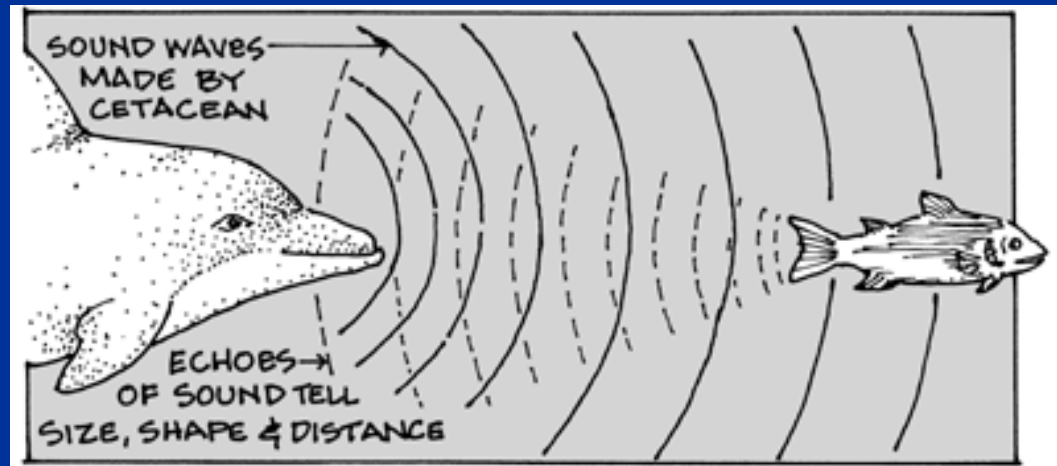
Sound

- Three requirements for sound to exist
 - 1. the object producing a sound has to vibrate
 - 2. compression wave must travel through a substance
 - Sound can not travel through a vacuum like space
 - 3. Waves must reach a sound receptor



Sound

- Echolocation
 - Use of sound waves to locate objects
 - Can tell size, shape, distance and speed
- Same process may be used to stun prey
 - Sperm whale/dolphin



Sound

- Sonar
 - Use of artificially produced sound waves for the same purposes as echolocation

