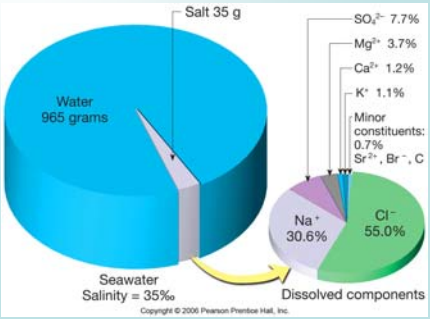
Ocean Water

Composition

- The composition of sea water includes
  - Water, ~96.5 %
  - Dissolved mineral substances (“salts”); ~3.5%
- Although the percentage of sea salts is small, the actual quantity is extremely large, due to the vastness of the oceans
- The term to describe the saltiness of the oceans is salinity and is expressed as parts per thousand
- Average salinity of the oceans is 3.5 % or 35 parts per thousand

Composition



Source of Salt

- The primary source of the salts is from dissolved minerals brought to the oceans by rivers and streams
  - Rivers and streams deliver approximately 2.3 billion metric tons of slats every year
- A second source can be found in volcanic eruptions
  - Outgassing from volcanoes provides large amounts of chlorine, sulfur, bromine, and boron

Source of Salt

- Why doesn't the ocean continue to get saltier with time?
  - Because material is being removed as fast as its being delivered
  - Material is removed by organisms building shells or skeletons or precipitating out as sediment

Oceanic Gases

- Gases can move between the atmosphere and the oceans
- Atmospheric gases dissolve in seawater and are distributed through all depths by mixing processes and currents
- Common gases include
  - Nitrogen
  - Oxygen
  - Carbon dioxide
  - Argon
- Some gases, like nitrogen and oxygen, are important in life processes. Other gases, like argon, are less important

Processes Affecting Salinity

- Because ocean water is mixed, the components of seawater are relatively constant
- Surface processes can alter the amount of water in seawater and therefore can affect salinity
- A decrease in salinity results from
  - Precipitation
  - Runoff
  - Melting icebergs and sea ice
- An increase in salinity results from
  - Evaporation
  - Formation of sea ice

Processes Affecting Salinity

- High salinities occur where evaporation is high
- Dry subtropical regions
- Low salinities occur where large amounts of precipitation dilute ocean waters

Processes Affecting Salinity

- Salinity in polar regions varies due to the formation and melting of ice
  - Salinity decreases in the summer as sea ice melts and dilutes the ocean waters
  - Salinity increases in the winter as sea ice forms

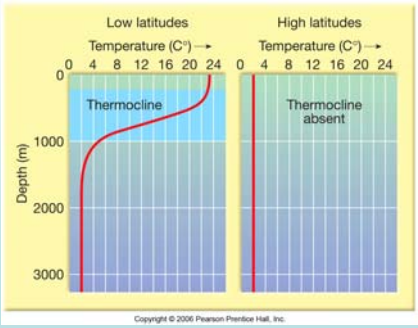
Ocean Temperature

- Variations in the temperature of ocean water depends upon the amount of solar radiation received
- One would expect that surface waters would be warmer than deeper waters due to the effect of the sun
  - The actual pattern, however, is dependent upon the latitude

Ocean Temperature

- At low latitudes, surface temperatures are high but decrease rapidly with depth
- At a depth of ~3,300 feet, the temperature is just above freezing and remains constant to the ocean floor
- The thermocline represents the change in water temperature with depth
- At high latitudes, the thermocline is absent (due to relatively cold surface waters)
- No thermocline exists, instead there is a isocline

Ocean Temperature



Ocean Density

- Density is referred to as the mass per unit volume
  - A measure of how heavy something is
- Density is an important factor because it determines its vertical position in the ocean

Ocean Density

- Factors affecting density include
  - Salinity
    - An increase in salinity adds dissolved substances and results in an increase in density
  - Temperature
    - An increase in temperature causes thermal expansion and causes a decrease in salinity
    - Temperature has the greatest influence on density because variations in temperature are greater than variations in salinity
- Density varies with depth with varying trends for low and high latitude regions

Ocean Density

- At low latitudes, high surface temperatures yield low densities
- Density increase rapidly with depth as the water gets colder
- At ~3,300 feet, density reaches a maximum value
- The pycnocline represents the change in water density with depth
- At high latitude regions, practically no pycnocline exists because the surface water, which is relatively cool, already has high density
- Thus, there exists an isopycnal.

Layers of the Ocean

- The ocean, like the earth, is layered according to density
  - Low density water is usually found near the surface and high density water is usually found at depth
- The ocean exhibits a three-tiered structure that includes
  - A shallow surface mixing zone
  - A transition zone
  - A deep zone

Layers of the Ocean

- The shallow surface mixing zone
  - Water temperatures are the highest
  - Rapid vertical heat transfer from mixing action of waves and currents
  - Nearly uniform temperatures
  - Thickness and temperature vary by latitude
  - Usually extends to ~300 meters but may extend up to ~450 meters
  - Accounts for only ~2% of ocean water

Layers of the Ocean

- The transition zone
  - Prominent thermocline found
  - Prominent pycnocline found
  - Accounts for ~18% of ocean water

Layers of the Ocean

- The deep zone
  - Sunlight never reaches this layer
  - Temperatures a few degrees above freezing
  - Water density high and constant
  - Includes ~80% of ocean water

Layers of the Ocean

- At high latitudes, the three-tiered structure does not exist because of the absence of the thermocline and pycnocline
- Good vertical mixing between surface and deep waters can occur; cold surface water forms, sinks, and initiates deep water currents