

OCEANS

1. Role of Ocean
 - a. Major player in the hydrologic cycle – evaporation, precipitation
 - b. Controls weather and climate
 - c. Cycles nutrients
 - d. Exchanges gases between the atmosphere and ocean, i.e. CO₂, O₂, etc.
2. Composition of the Ocean Water
 - a. Chemical Composition
 - i. Not pure water
 - ii. Contains dissolved salts ~ 35 g salt/ kg water
 - iii. Halite (NaCl) – Table Salt 30 g/kg
 - iv. Mg, Sulfate, Calcium, K, Bicarbonate lesser amounts
 - v. Salinity – measure of all dissolved salts in water
 - (1) Varies with the amount of freshwater input from rivers, glaciers, and groundwater
 - (2) Varies with the amount of evaporation
 - (3) Higher salinity waters are denser than the low salinity waters
 - b. Thermal Structure
 - i. Water has a high heat capacity – can transport, store, & release heat
 - ii. Water temperature decreases with depth (Figure 9.10)
 - iii. Surface water temperature ~ air (atmospheric) temperature
 - iv. Deep water ~ 3-4 °C (40 °F)
 - c. Density and temperature differences drive ocean circulation patterns
 - d. Surface water
 - i. Warm low-density water
 - ii. Top 100 m – well mixed, exchanges gas with atmosphere (H₂O, CO₂, O₂, etc.)
 - iii. Mixing is driven by wind and wave energy
 - e. Deep Water
 - i. Cold high-density water
 - ii. Uniform temperature
 - iii. Thick – most of the ocean volume
 - iv. Density of the water inhibits upward movement of deep water – ocean stays stratified
 - v. Isolated from the atmosphere so they are poor in O₂,
 - vi. Rich in nutrients
 - f. Sea Ice
 - i. Reflects sun's waves (heat and energy)
 - ii. Permanent on poles (size varies, but ice is constant)
 - iii. ~ 4 m thick
 - iv. Sea water freezes @ ~ 2°C instead of 0°C, because of the salinity
 - v. As water freezes higher density water remains
3. Energy & Motion of Oceans
 - a. Wind-driven circulation controls the surface waters
 - i. Atmospheric circulation controls prevailing winds (Fig. 9.8 & 9.13)
 - ii. Wind from uneven heating of the Earth's surface
 - iii. Landmasses also influence wind patterns and thus surface water circulation
 - b. Density Driven Deep Water Circulation

- i. Deep water not influenced by wind
 - ii. Density controlled by temperature and salinity
 - iii. Water sinks at poles (Cold & Dense waters)
 - iv. Migrates away from the poles hugging the sea floor, stratification prevents upward movement
 - v. Cycles 1000 yrs. To go from surface to deep to surface.
 - vi. Deep waters are rich in nutrients
- c. Coastal Upwelling
- i. Winds cause surface waters to move away from the coasts
 - ii. Surface waters are replaced by deep-waters
 - iii. Deep waters are rich in nutrients and when combined with oxygen become highly productive areas (Large ecosystems – fish, birds, plankton, etc.)
 - (1) Important for fish trade
 - (2) Important source of phosphates used in fertilizers