

Chapter 2

Setting The Stage: Water As An Environment

We are learning about the physical and chemical properties of water in order to better understand limnology and freshwater ecology.

Key Terms:

milieu, phases, density, fluid

polar, hydrogen bonds, viscosity, solvent, solute, soluble, concentration, molarity, equivalents, hydrophobic, anoxic, dissociate, hydrogen ion, hydroxide ion, pH, acid, alkaline, alkalinity, buffered, salinity, conductivity, primary productivity, total dissolved solids, hardness, calorie, evaporation

stratification, vertical temperature profile, isothermal, epilimnion, hypolimnion, metalimnion, thermocline, inverse stratification, fetch, dimictic, monomictic, amictic, polymictic, meromictic, orthograde, clinograde, phytoplankton, turbid, heterograde, Secchi disk, euphotic zone, compensation depth, aphotic zone, scattering, absorbance, algae, macrophytes, clear water phase, emergent, benthic zone, zoobenthos, zooplankton, planktonic or pelagic zone, DVM, eutrophic, oligotrophic, mesotrophic

diffusion, zero flow, turbulence, Reynolds number, inertia, eddies, billows, gyres, amplitude, period, wavelength, whitecaps, foam, seiches

Key Questions:

- 1) The Diversity of Limnological Organisms
 - a) How does water differ from air?
- 2) Fundamental Characteristics of Water as a Substance
 - a) Describe and/or draw the molecular shape of water (H₂O). Note the hydrogen atom separation angle. What is this angle a result of?
 - b) Why is a water molecule polar?
 - c) Water molecules readily form hydrogen bonds with other polar molecules. What causes a hydrogen bond to form?
 - d) List five consequences of hydrogen bonding for water.
 - e) Describe the flow of a fluid at and near the surface of an object that is due to viscosity (i.e., the “boundary” layer).
 - f) At what scale is viscosity most significant? How does it affect organisms?
 - g) What causes the phenomenon of surface tension?
 - h) Why is water a good solvent?
 - i) Discuss the three ways of expressing the amount of chemical dissolved in water.
 - j) List three factors that affect the solubility of gas in water. How do they affect the solubility of gas in water?
 - k) Water dissociates into what two ions?
 - l) Calculate the pH given the hydrogen concentration.
 - m) Identify the following ions commonly found in freshwater environments by name and/or formula: calcium ion (Ca²⁺), magnesium ion (Mg²⁺), bicarbonate ion (HCO₃⁻), sodium ion (Na⁺), potassium ion (K⁺), sulfate ion (SO₄²⁻), chloride ion (Cl⁻), nitrate ion (NO₃⁻), phosphate ion (PO₄³⁻), and silicate ion (SiO₄²⁻).
 - n) What causes water hardness and how is it removed?
 - o) At what temperature is liquid water most dense?

- p) Describe the phase changes of water, solid to liquid to gas, in terms of particle arrangement/movement, hydrogen bonding, temperature, and density.
 - q) Why does evaporation cool lakes, streams, etc.?
- 3) Vertical Stratification in Lakes
- a) Identify and/or describe the layers of a vertical temperature profile (epilimnion, thermocline, metalimnion, hypolimnion).
 - b) List five factors that thermal stratification depends on.
 - c) Describe the following annual mixing patterns: dimictic, monomictic, amictic, polymictic, and meromictic.
 - d) Compare the freeze and thaw patterns of large vs. small lakes.
 - e) Describe the three patterns of vertical oxygen profiles: orthograde, clinograde, and heterograde.
 - f) Why does a lake look blue?
 - g) Photosynthesis Review
 - h) Cellular Respiration Review
 - i) Ecological Principles Review
 - j) Discuss how global warming can affect lakes and streams.
- 4) Water Movements
- a) How does water move at a microscopic (small) vs. macroscopic (large) scale?
 - b) Describe mass transport in terms of laminar flow and turbulent flow.
 - c) How is the Reynolds number calculated and what does the value tell us?
 - d) Describe the periodic movement of surface waves.
 - e) How can one calculate the maximum wave height of a lake?
 - f) What causes seiches?
 - g) Can lunar tides occur in lakes?