Water and Life

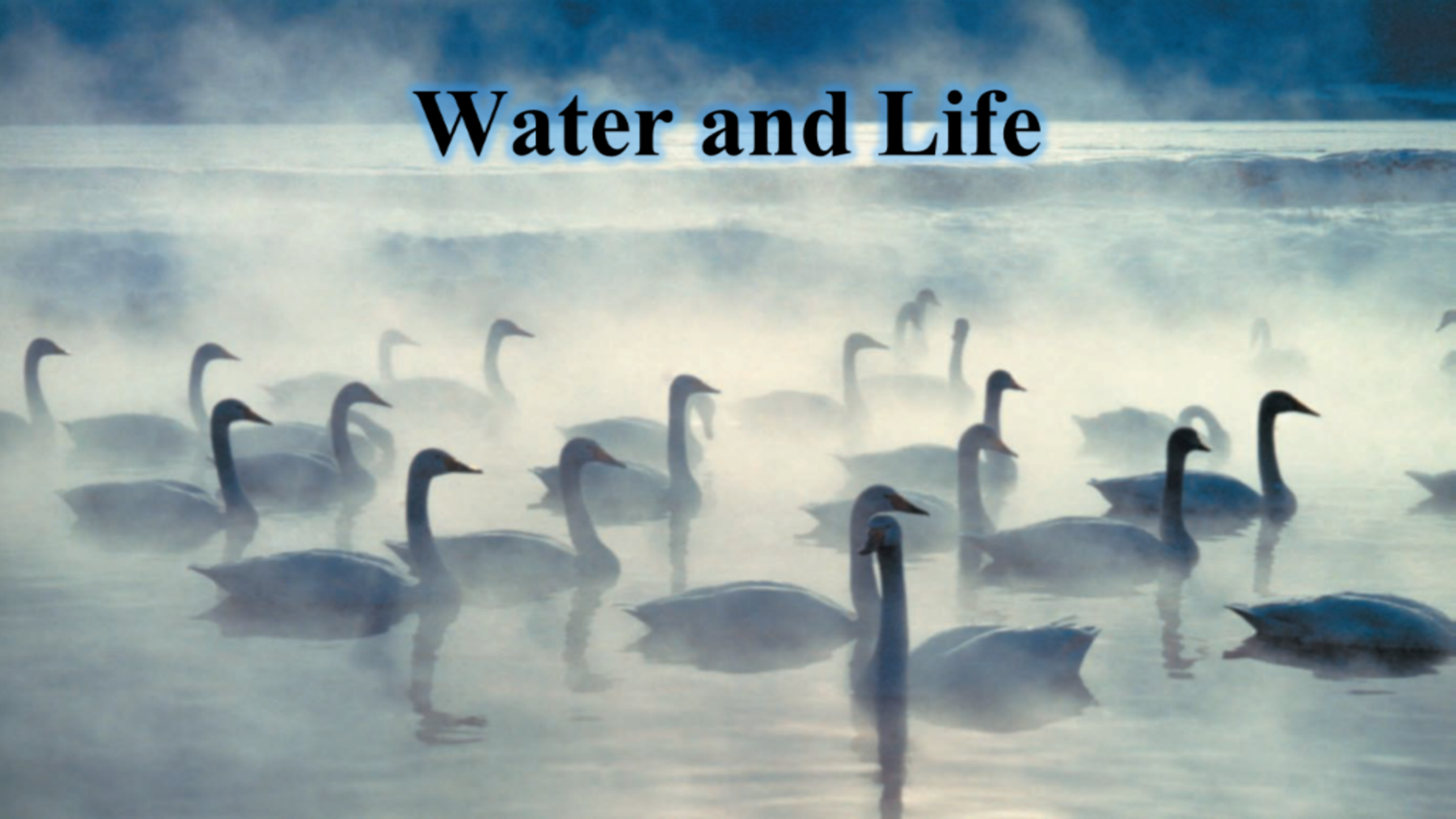
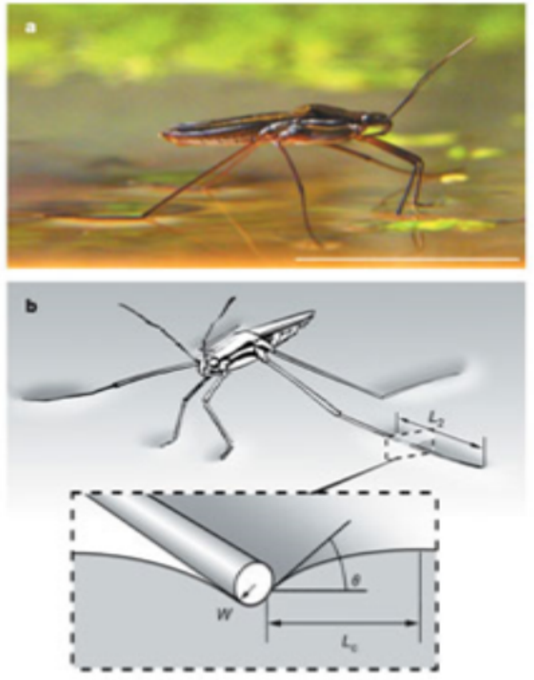
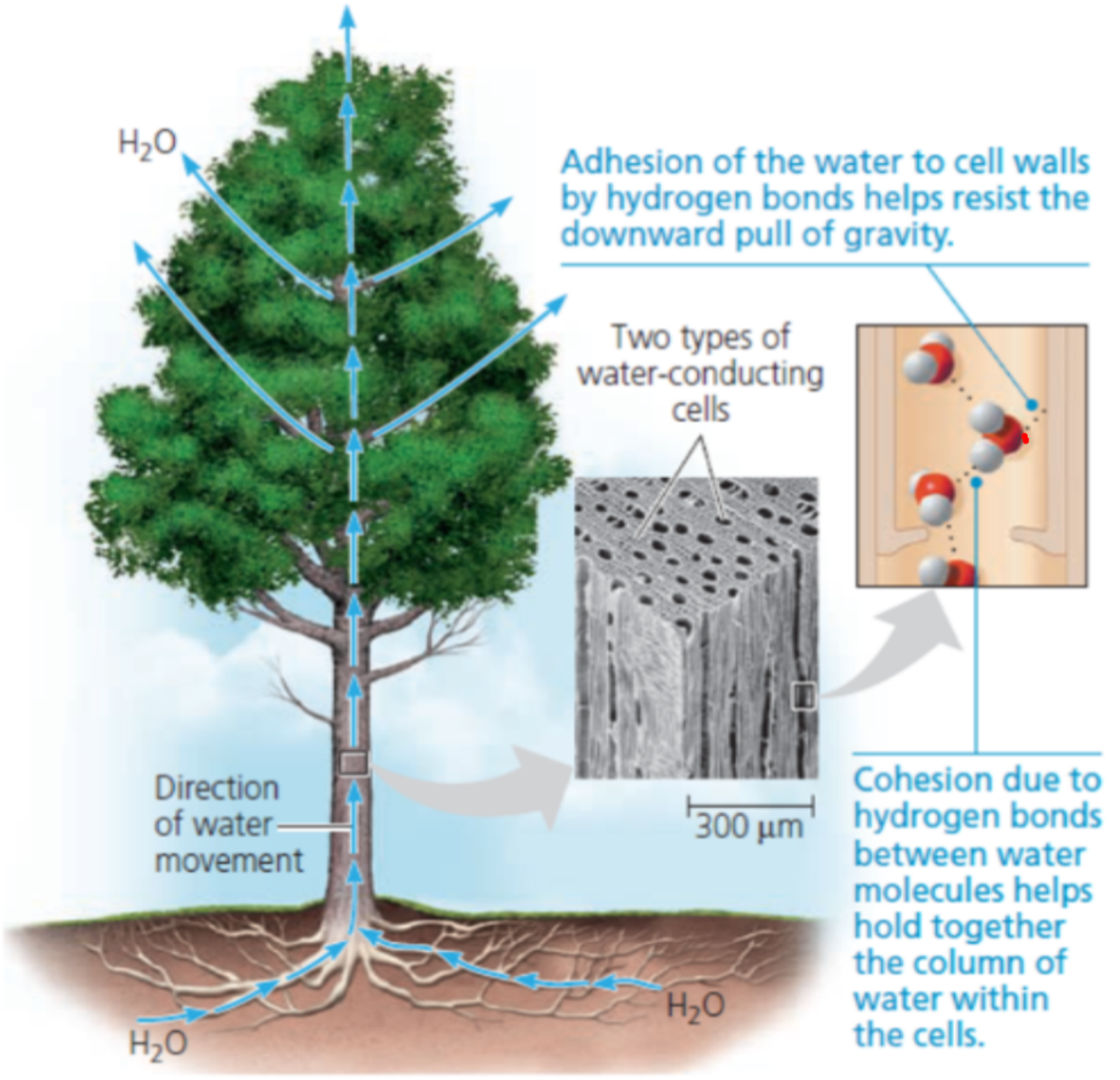


Table 2.2 The Properties of Water

Property	Explanation	Example of Benefit to Life
Cohesion	Hydrogen bonds hold water molecules together	Leaves pull water upward from the roots; seeds swell and germinate
High specific heat	Hydrogen bonds absorb heat when they break, and release heat when they form, minimizing temperature changes	Water stabilizes the temperature of organisms and the environment
High heat of vaporization	Many hydrogen bonds must be broken for water to evaporate	Evaporation of water cools body surfaces
Lower density of ice	Water molecules in an ice crystal are spaced relatively far apart because of hydrogen bonding	Because ice is less dense than water, lakes do not freeze solid
High polarity	Polar water molecules are attracted to ions and polar compounds, making them soluble	Many kinds of molecules can move freely in cells, permitting a diverse array of chemical reactions

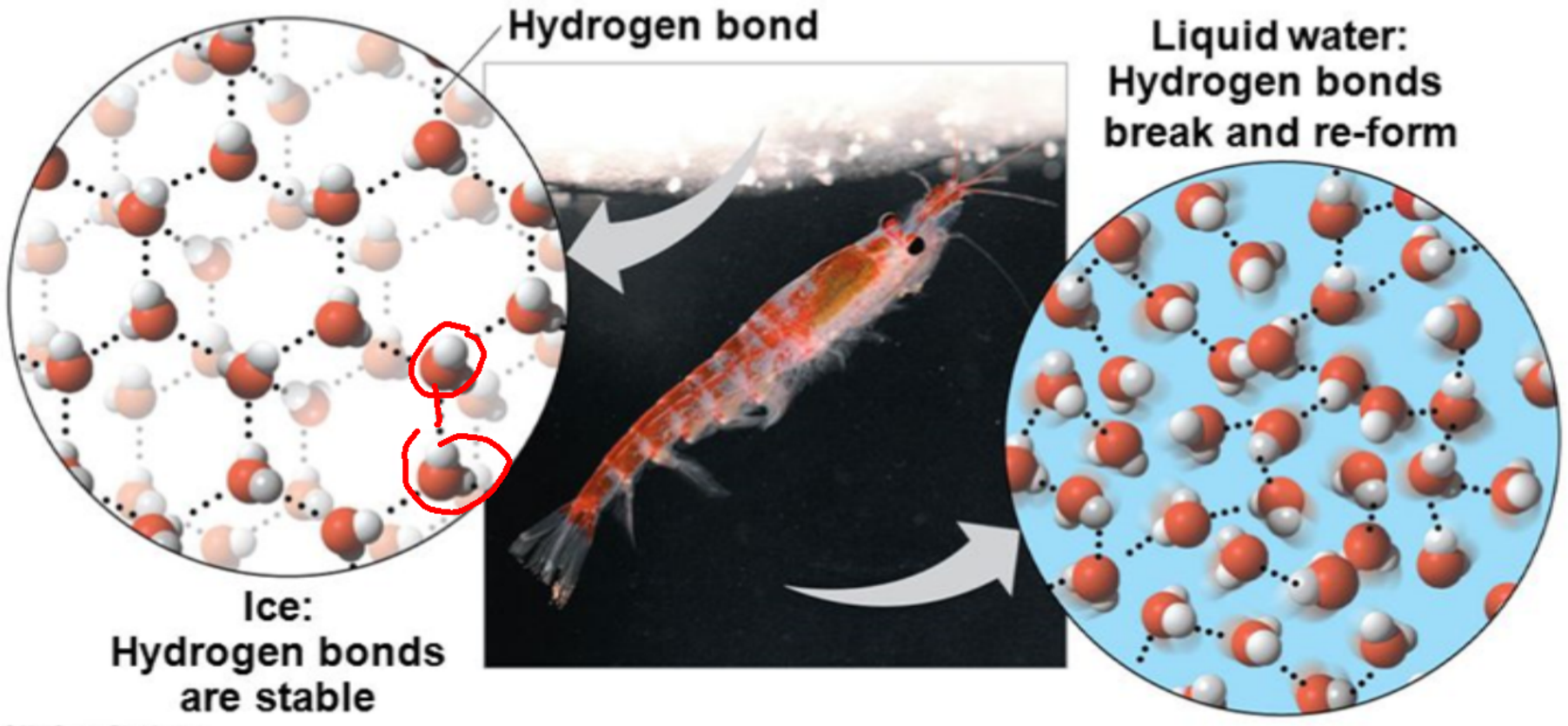
Cohesion of Water Molecules

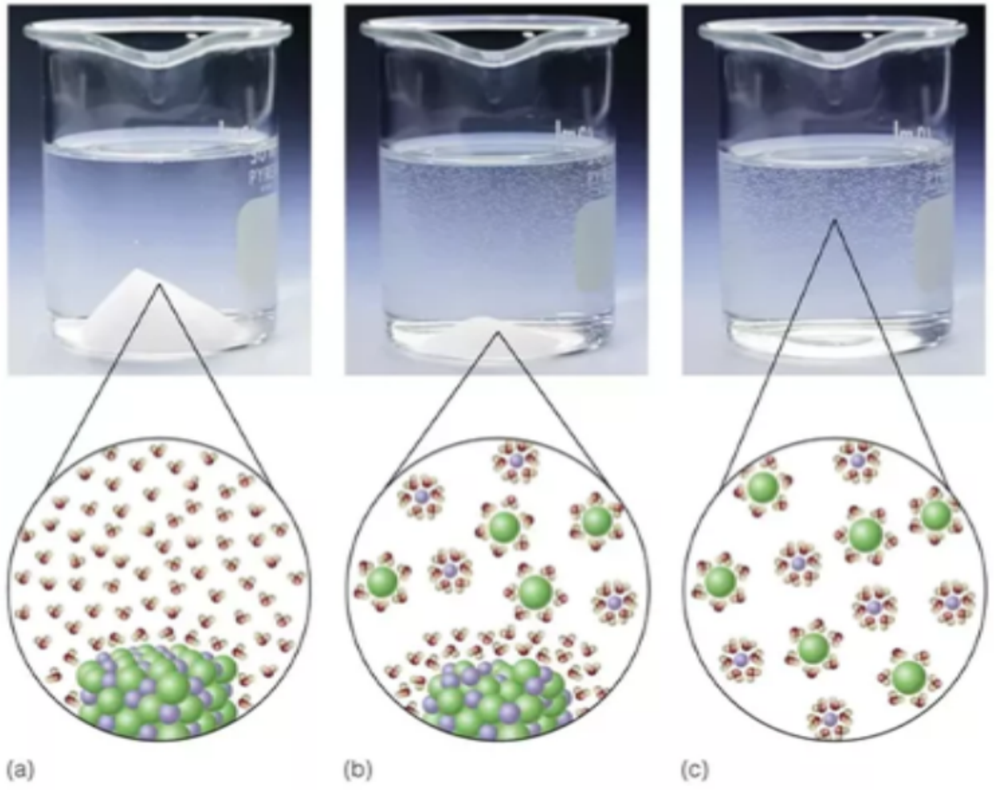


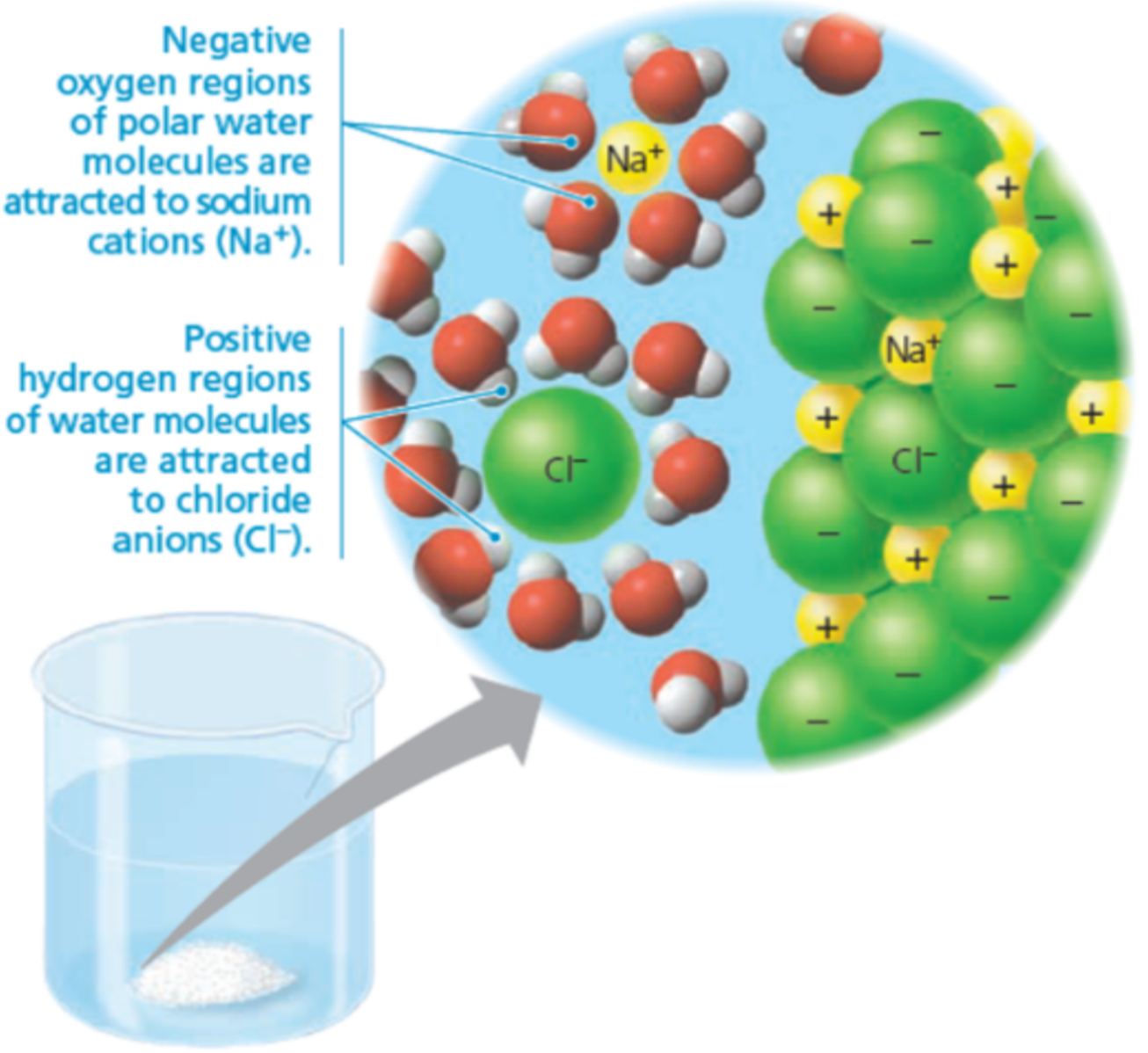


▲ **Figure 3.3 Water transport in plants.** Evaporation from leaves pulls water upward from the roots through water-conducting cells. Because of the properties of cohesion and adhesion, the tallest trees can transport water more than 100 m upward—approximately one-quarter the height of the Empire State Building in New York City.

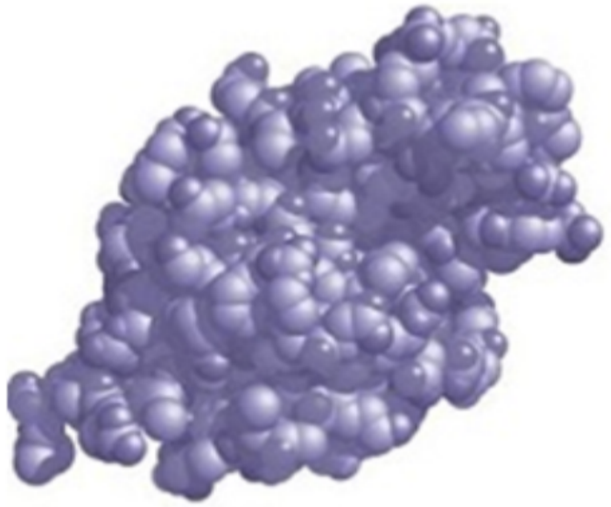
Figure 3.6



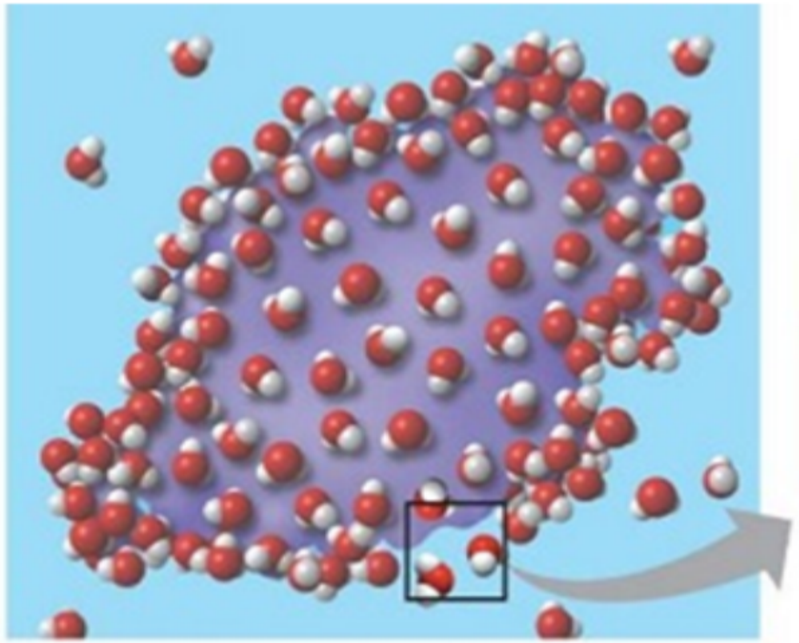




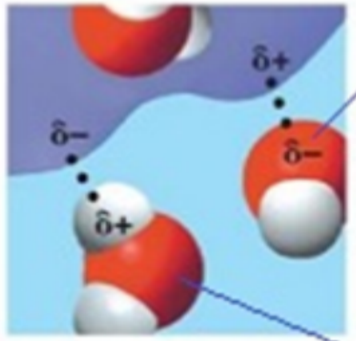
▲ **Figure 3.7 Table salt dissolving in water.** A sphere of water molecules, called a hydration shell, surrounds each solute ion.



Lysozyme molecule in a nonaqueous environment



Lysozyme molecule (purple) in an aqueous environment



This oxygen is attracted to a slight positive charge on the lysozyme molecule.

This hydrogen is attracted to a slight negative charge on the lysozyme molecule

Human lysozyme is a protein found in tears and saliva that has antibacterial action. This modelshows the lysozyme molecule (purple) in an aqueous environment. Ionic and polar regions on the protein's surface attract water molecules.

Buffers

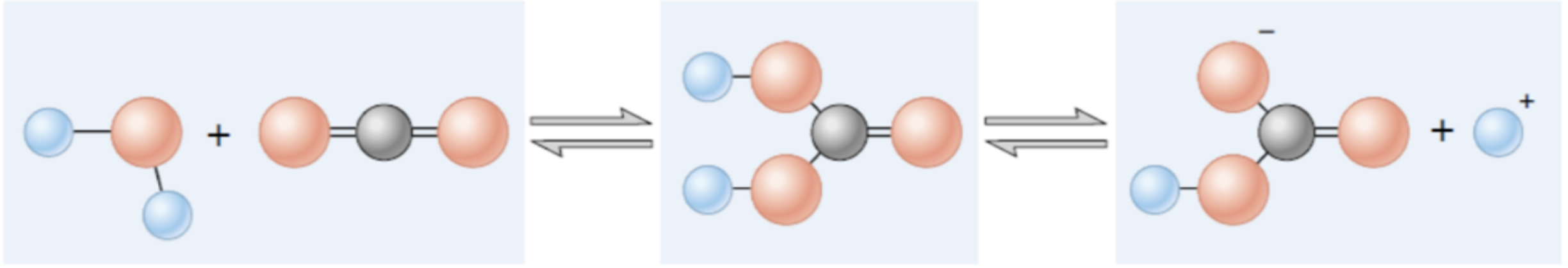
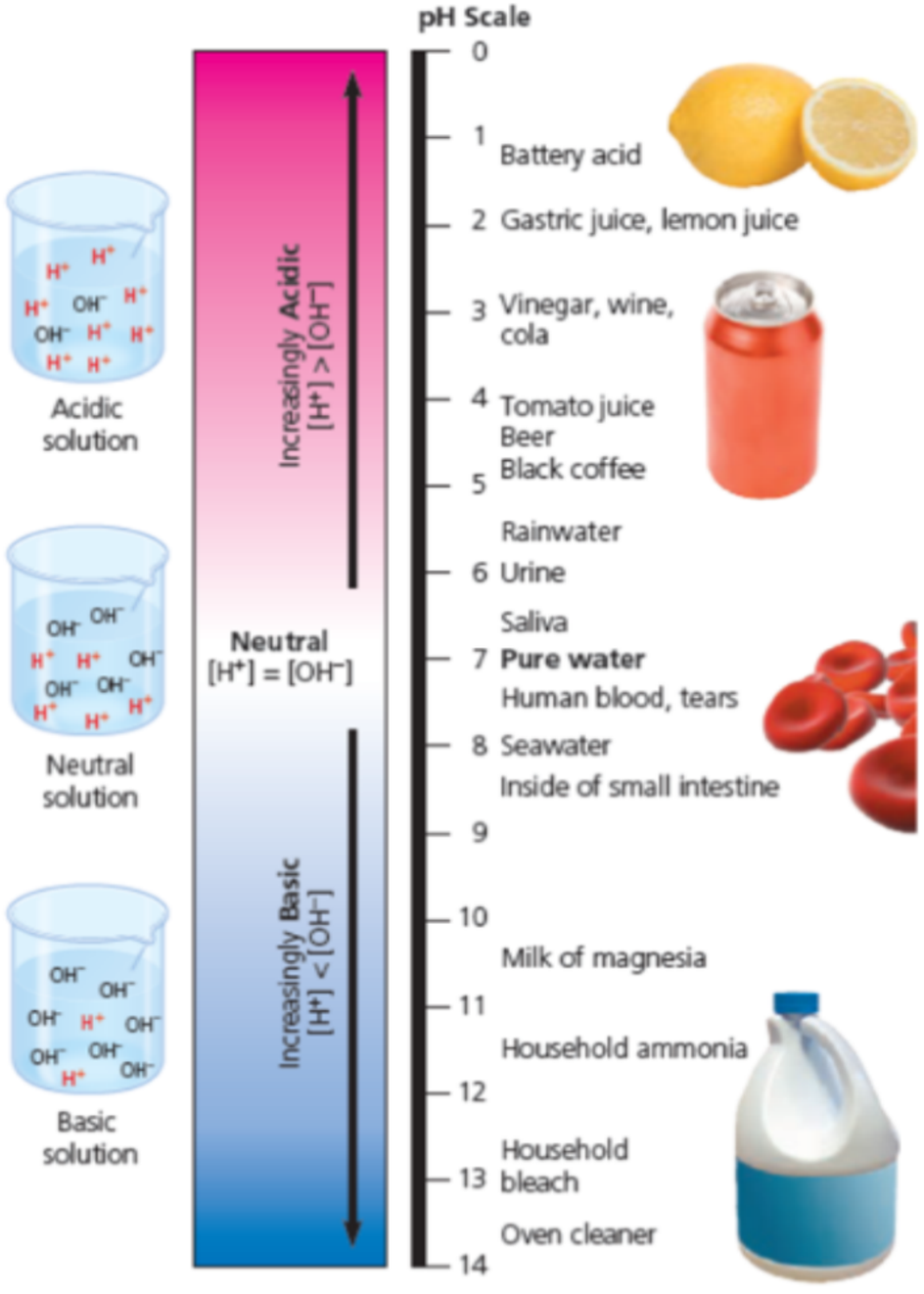
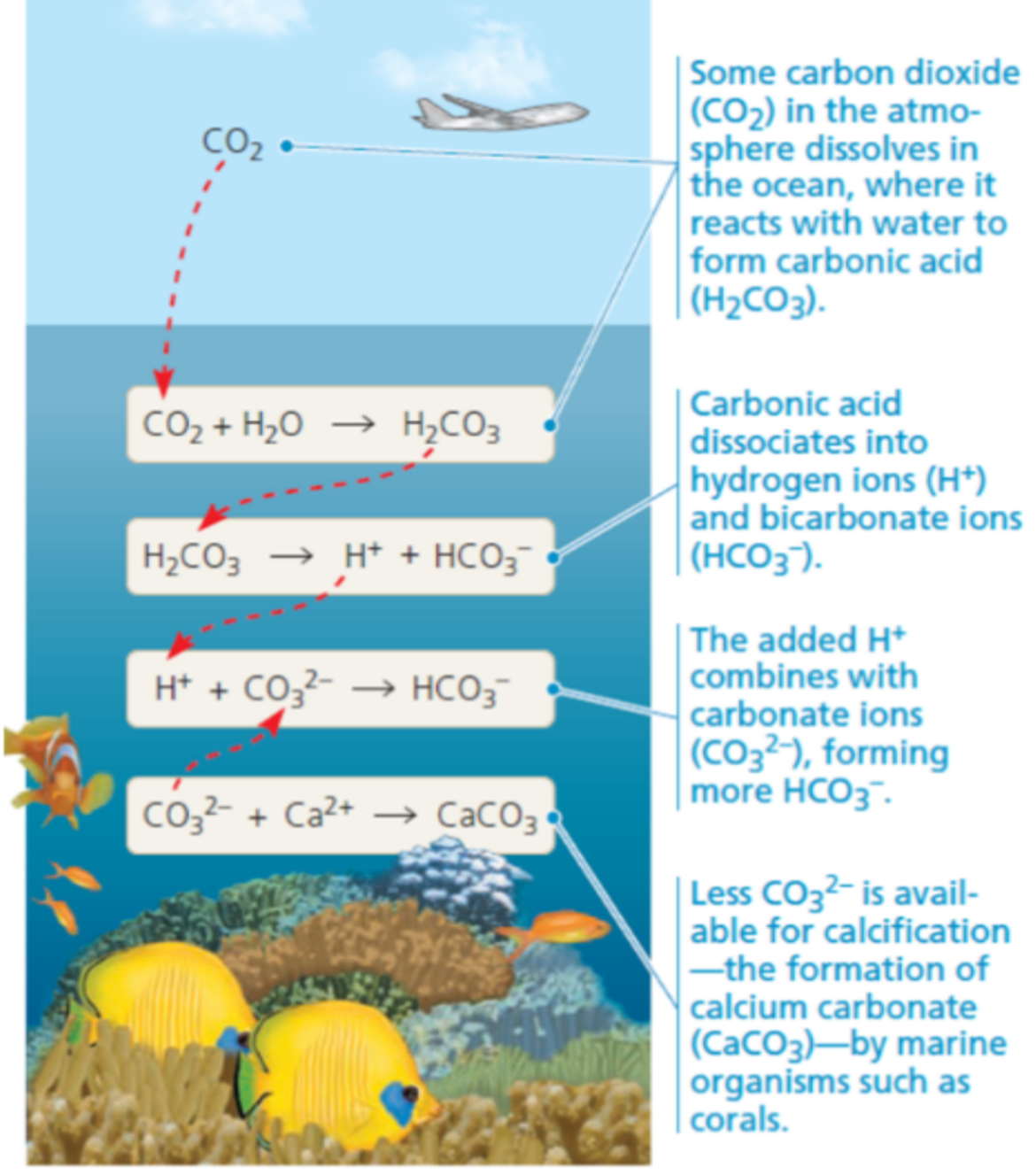


FIGURE 2.20
Buffer formation. Carbon dioxide and water combine chemically to form carbonic acid (H_2CO_3). The acid then dissociates in water, freeing H^+ ions. This reaction makes carbonated beverages acidic, and produced the carbon-rich early oceans that cradled life.



▲ **Figure 3.10** The pH scale and pH values of some aqueous solutions.



▲ **Figure 3.11** Atmospheric CO_2 from human activities and its fate in the ocean.

Biomolecules

Mass composition data for the human body in terms of major types of biochemical substances.