

## 2.2 Properties of Water

### KEY CONCEPT

**Water's unique properties allow life to exist on Earth.**



## 2.2 Properties of Water

### ▶ Life depends on hydrogen bonds in water.

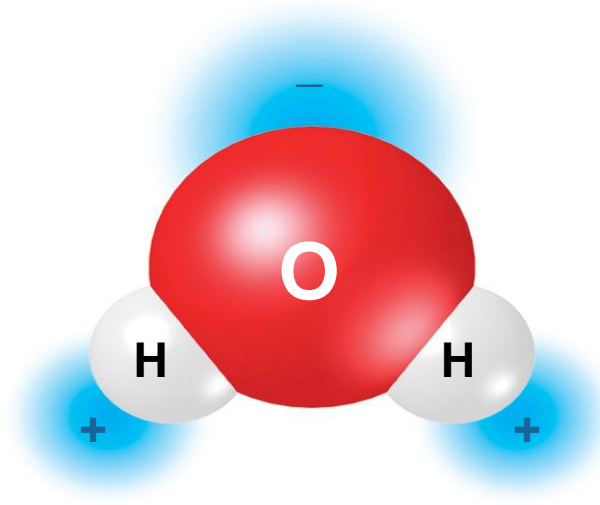
- How does fish survive a cold winter if their pond freezes?
  - Water expands when it freezes.



- Water is less dense as a solid (ice).
- Ice floats and covers the water's surface. It acts as an insulator that allows the water underneath to remain a liquid.

## 2.2 Properties of Water

- ▶ Life depends on hydrogen bonds in water.
  - **Water** is a polar molecule.
    - **Polar** molecules have slightly charged regions.



- **Nonpolar** molecules do not have charged regions.
- Hydrogen bonds form between slightly positive hydrogen atoms and slightly negative atoms.

## 2.2 Properties of Water

- Hydrogen bonds are responsible for three important properties of water.
  - high specific heat
  - cohesion
  - adhesion

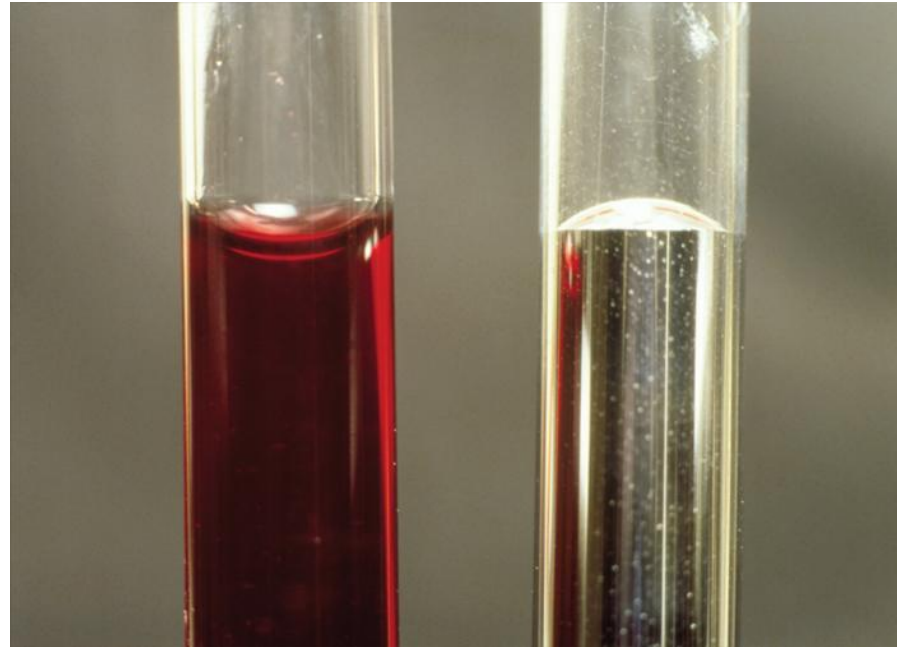
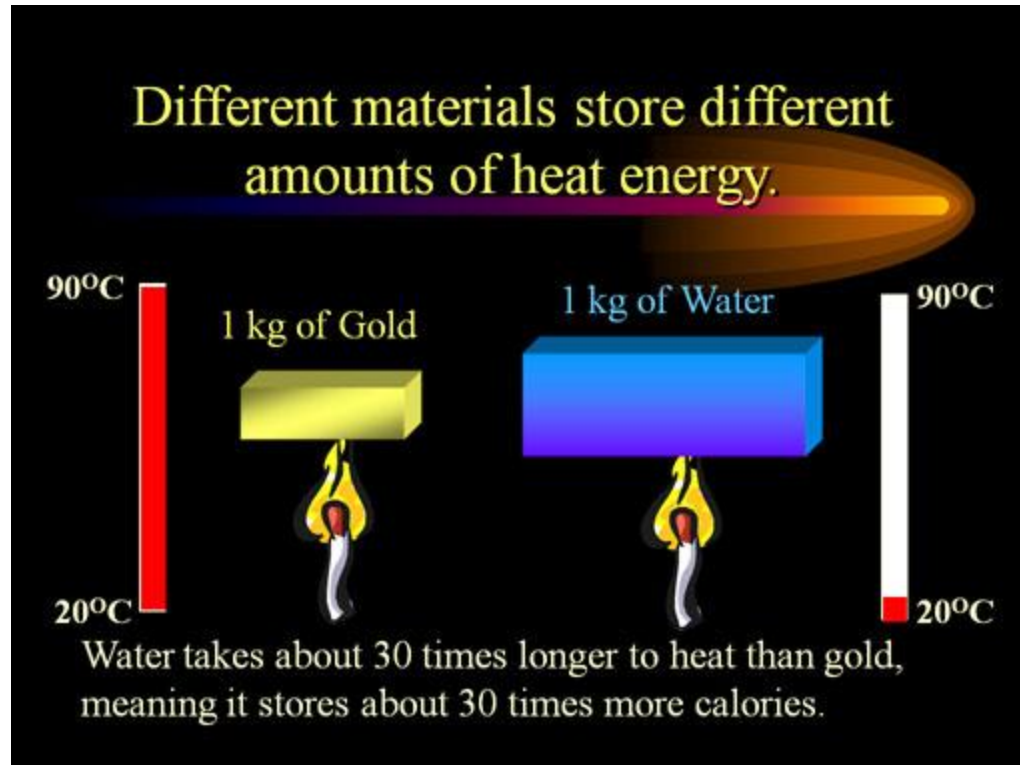


FIGURE 2.3 The water's surface (left, dyed red) is curved down because water has greater adhesion than cohesion. The surface of the mercury (right) is curved up because mercury has greater cohesion than adhesion.

## 2.2 Properties of Water

### (1) High Specific Heat

- Water resists changes in temperature due to its hydrogen bonds



## 2.2 Properties of Water

### (2) Cohesion

- Cohesion from hydrogen bonds make water molecules stick to each other.
- Cohesion produces **surface tension**.



## 2.2 Properties of Water

### (2) Adhesion

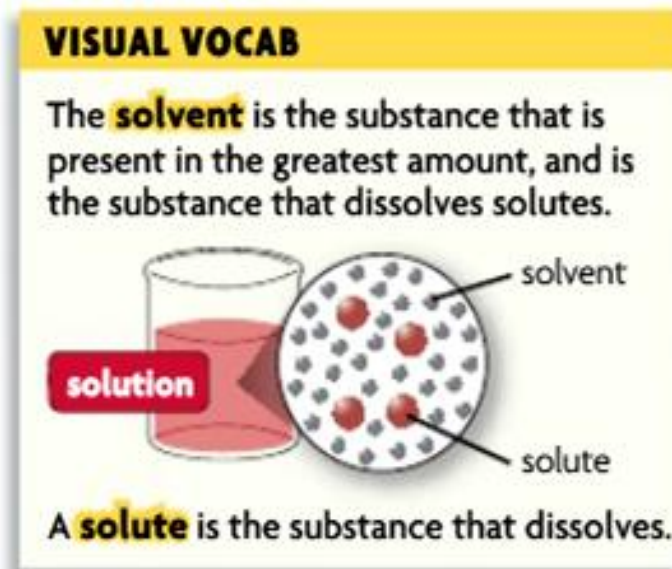
- Water molecules stick to other things.
- Adhesion is responsible for the upward curve on the surface of the water.



## 2.2 Properties of Water

### ▶ Many compounds dissolve in water.

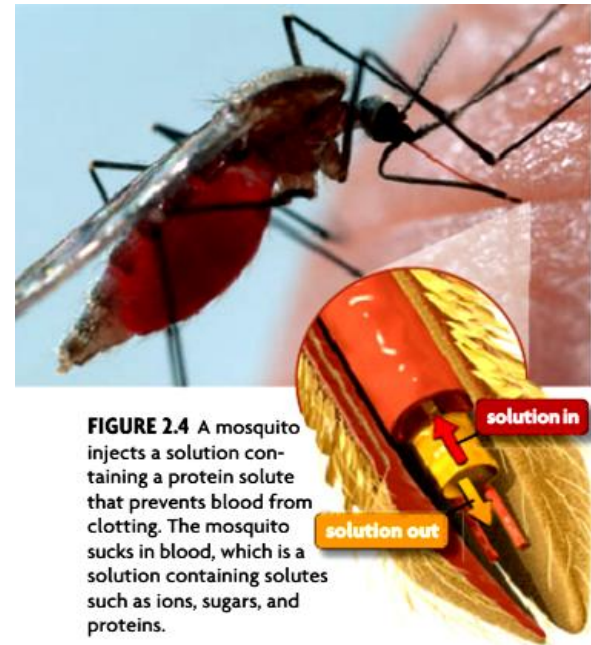
- A **solution** is formed when one substance dissolves in another.
  - A solution is a **homogeneous** mixture.
  - **Solvents** dissolve other substances.
  - **Solutes** dissolve in a solvent.





## 2.2 Properties of Water

- “Like dissolves like.”
  - Polar solvents dissolve polar solutes.
    - Sugars & proteins dissolve in the water of the blood plasma
  - Nonpolar solvents dissolve nonpolar solutes.
  - Polar substances and nonpolar substances generally remain separate.
    - “Oil and water don’t mix”.

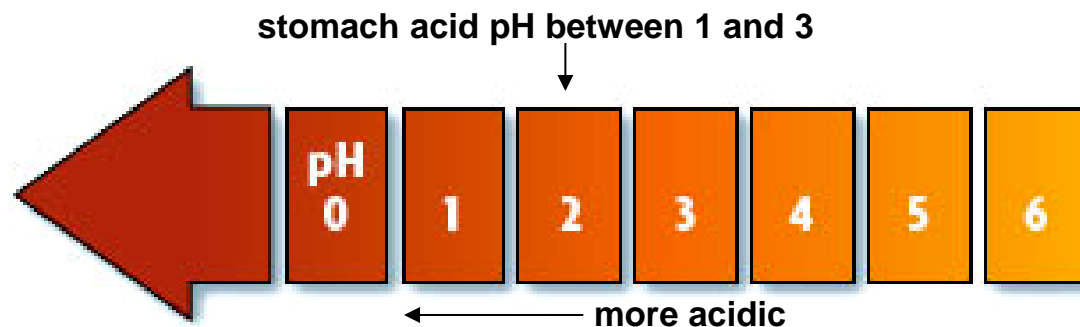


**FIGURE 2.4** A mosquito injects a solution containing a protein solute that prevents blood from clotting. The mosquito sucks in blood, which is a solution containing solutes such as ions, sugars, and proteins.

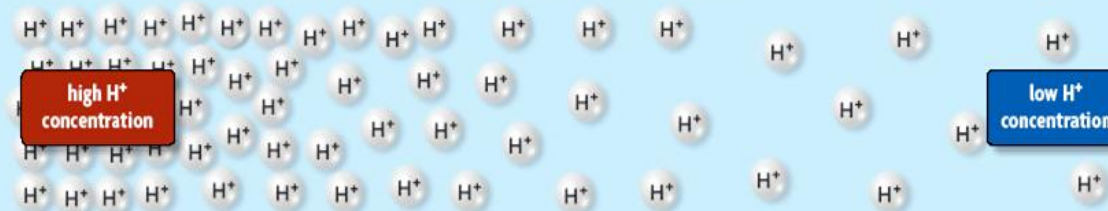
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### ► Some compounds form acids or bases.

- An **acid** releases a hydrogen ion when it dissolves in water.
  - high  $H^+$  concentration
  - pH less than 7

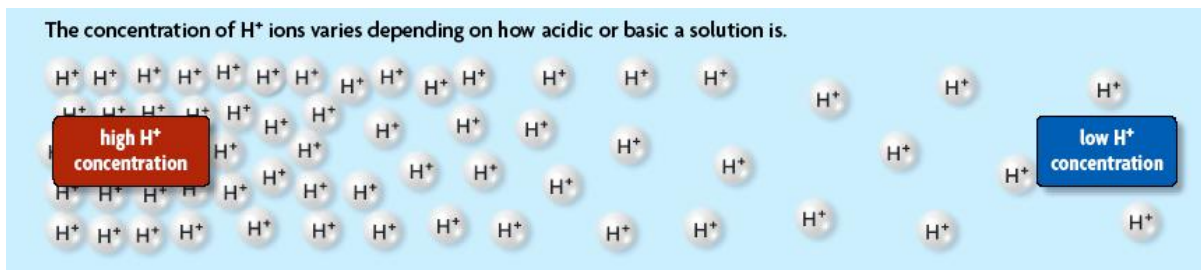
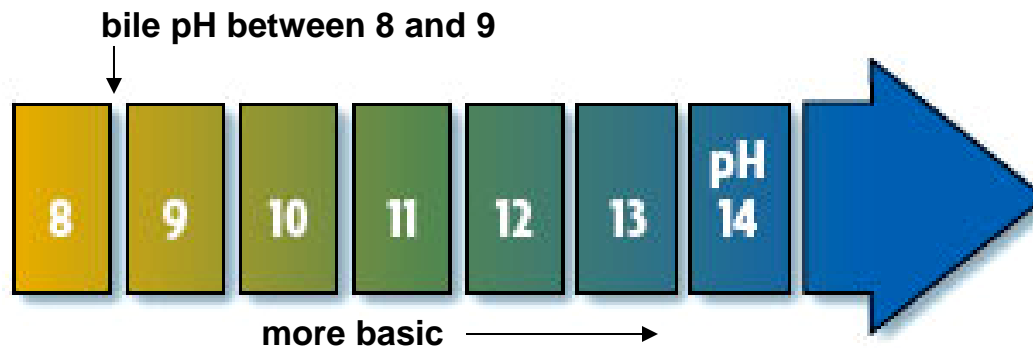


The concentration of  $H^+$  ions varies depending on how acidic or basic a solution is.



## 2.2 Properties of Water

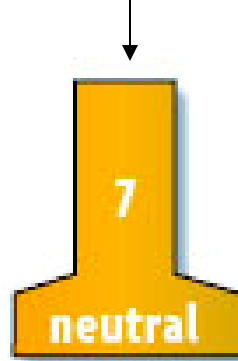
- A **base** removes hydrogen ions from a solution.
  - low  $H^+$  concentration
  - pH greater than 7



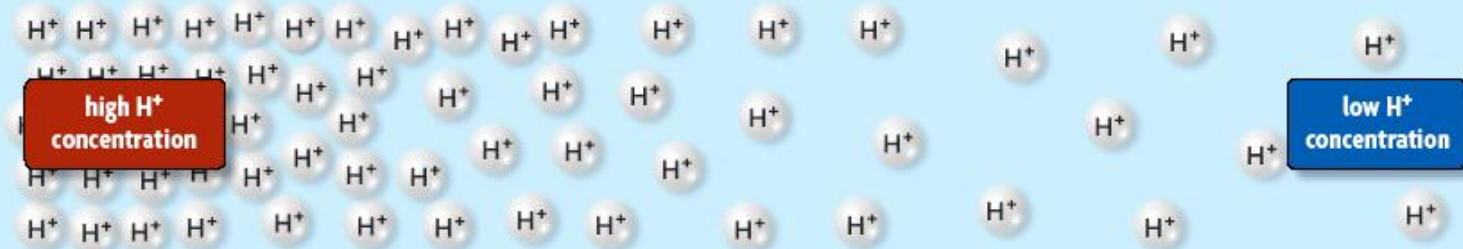
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- A **neutral** solution has a pH of 7.

pure water pH 7

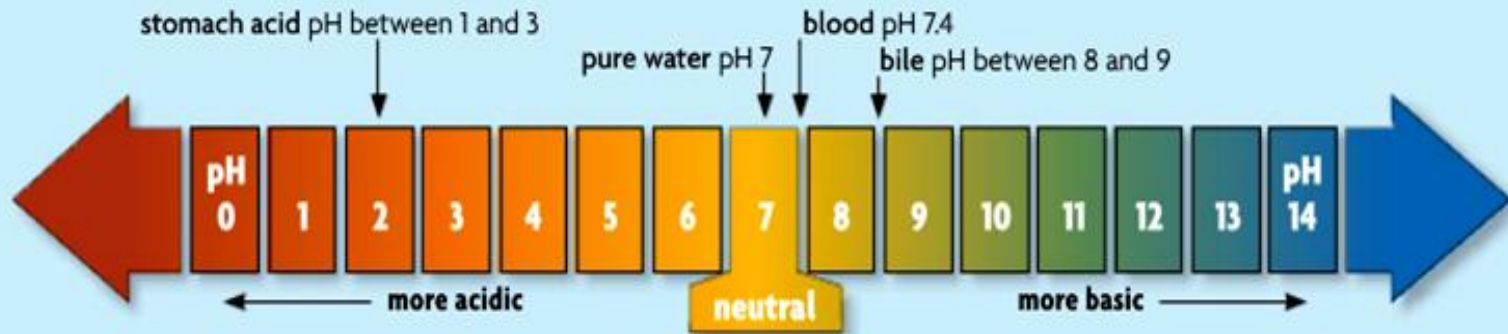


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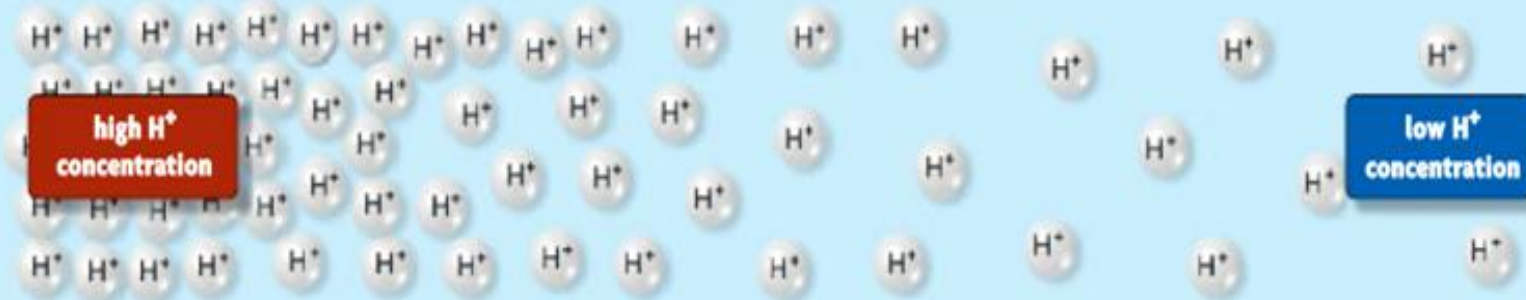


# 2.2 Properties of Water

The pH of a solution depends on the concentration of  $H^+$  ions.



The concentration of  $H^+$  ions varies depending on how acidic or basic a solution is.



## 2.2 Properties of Water

### ► Buffers

- A buffer is a compound that can bind to an H ion when the H<sup>+</sup> concentration increases, and can release an H<sup>+</sup> ion when the H<sup>+</sup> concentration decreases.
- For example, the normal pH of human blood is between 7.35 and 7.45, so it is slightly basic. Just a small change in pH can disrupt processes in your cells, and

