

2.2 Properties of Water

Teacher Notes and Answers

SECTION 2

Instant Replay

1. It is caused by the attraction between the slightly negative charge of an atom in one molecule and the slightly positive charge of another atom in another molecule.
2. the solvent and the solute
3. An acid has a high concentration of H^+ and a base has a low concentration of H^+ .

Vocabulary Check

1. solution, solvent, solute
2. cohesion
3. adhesion
4. pH
5. acid, base
6. Hydrogen bonds

The Big Picture

7. Because they give water special properties like high specific heat, cohesion, and adhesion.
8. about 7

2.2 Properties of Water

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

Life depends on hydrogen bonds in water.

Unlike most things, water expands, or gets bigger, when it freezes. Because of this, ice is less dense than water. Therefore, ice floats in water. When a lake freezes, fish can still survive because the ice floats. The ice layer on the surface of the lake insulates* it and allows the water underneath to stay liquid.

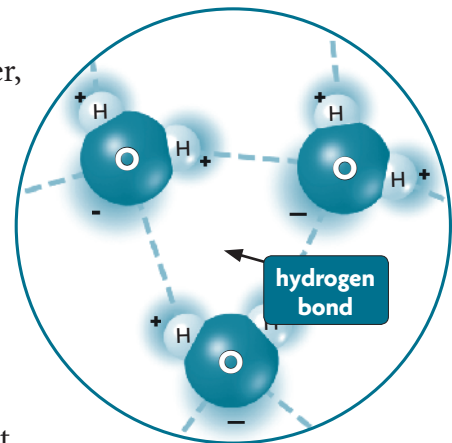
Water and Hydrogen Bonds

Water molecules have special properties. The oxygen has a slightly negative charge, and the hydrogens have slightly positive charges. This makes the molecule polar—like a magnet, a water molecule has positive and negative ends. The positive charge from the hydrogen atom of one water molecule can attract a negative charge from another molecule. This attraction is called a **hydrogen bond**. Hydrogen bonds occur among water molecules and also in proteins, in DNA, and in other molecules.

Properties Related to Hydrogen Bonds

Each individual hydrogen bond is not very strong, but all together, hydrogen bonds give water properties that are important to life.

- **High specific heat** Hydrogen bonds give water a high specific heat. This means that water resists changes in temperature, which is important in helping cells to maintain homeostasis.
- **Cohesion** The attraction among molecules of the same substance is **cohesion**. Cohesion from hydrogen bonds makes water molecules stick to each other. Cohesion is why water forms beads, or droplets, like those you see on a car that has just been washed.
- **Adhesion** The attraction among molecules of different substances is called **adhesion**. In other words, water molecules stick to other things. Adhesion helps plants move water from their roots to their leaves because the water molecules stick to the sides of the tubes that carry water through the plant.



Hydrogen bonds form between neighboring water molecules. They cause water molecules to stick together.



How does a hydrogen bond form?

* **ACADEMIC VOCABULARY**

insulates keeps warm, or prevents heat from escaping

Many compounds dissolve in water.

To take part in life processes, many molecules and ions must be dissolved in water-based fluids, such as blood or plant sap. When one substance dissolves in another, a solution forms. A **solution** is a mixture of substances that is equally mixed throughout. A solution has two parts:

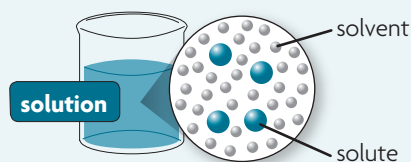
- The **solvent** is the substance that there is more of, and that dissolves the other substance.
- The **solute** is the substance that dissolves in the solvent.

The amount of solute dissolved in a certain amount of solvent is the solution's concentration. A tiny bit of drink mix in one cup of water has very little flavor. Four spoonfuls of drink mix in one cup of water tastes stronger because it has a higher concentration.

Polar molecules—molecules with positive and negative ends—dissolve in water. But some compounds are nonpolar, like fats and oils. Nonpolar molecules do not have charged parts—no positive or negative ends—so they are not attracted to polar molecules like water. Nonpolar molecules will dissolve in nonpolar solvents. For example, vitamin E is nonpolar and dissolves in fats in human bodies.

VISUAL VOCAB

The **solvent** is the substance that is present in the greatest amount, and is the substance that dissolves solutes.



A **solute** is the substance that dissolves.

VOCABULARY

In everyday use, the word *solution* means “an answer.” This meaning of solution is different, and means “a mixture.”



What are the two parts of a solution?

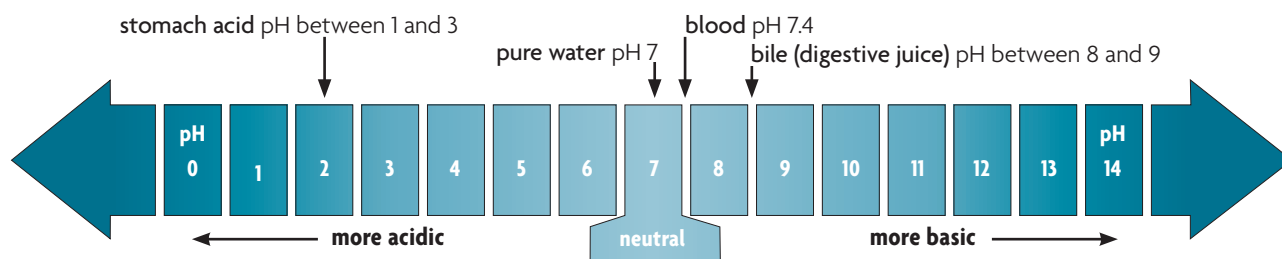
Some compounds form acids or bases.

Some compounds break up into ions when they dissolve in water.

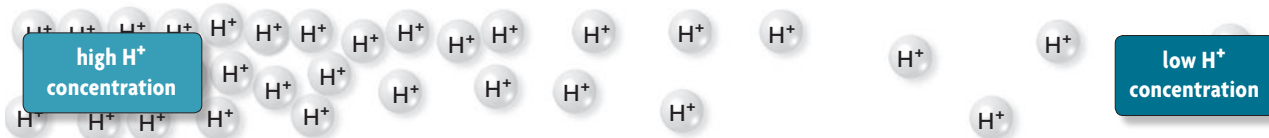
- An **acid** is a compound that releases a proton when it dissolves in water. A proton is a hydrogen ion (H^+). An acid increases the concentration of H^+ ions in a solution.
- A **base** removes H^+ ions from a solution. After a base dissolves in water, the solution has a low H^+ concentration.

The acidity of a solution is the concentration of H^+ ions. Acidity is measured on the **pH** scale. In the figure of the pH scale, you can see that pH is usually between 0 and 14. A solution with a pH of 0 is very acidic, with a high H^+ concentration. A solution with a pH of 14 is very basic, with a low H^+ concentration. Solutions with a pH of 7 are neutral—neither acidic nor basic. Most organisms, including humans, need to keep their pH close to 7. However, some organisms need very different pH ranges to live.

THE pH SCALE



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



What is the difference between an acid and a base?

2.2 Vocabulary Check

hydrogen bond	solution	acid
cohesion	solvent	base
adhesion	solute	pH

Mark It Up

Go back and highlight each sentence that has a vocabulary word in **bold**.



1. A _____ is a mixture made of two parts, the _____, which is the bigger part, and the _____, which dissolves.
2. Attraction among molecules of the same type is called _____.
3. Attraction among molecules of different types is called _____.
4. The _____ scale measures the concentration of H^+ ions.
5. A high concentration of H^+ ions makes something a(n) _____ and a low concentration of H^+ ions makes something a(n) _____.
6. _____ give water special properties such as cohesion.

2.2 The Big Picture

7. Why are hydrogen bonds important for life? _____
8. What is the pH level for most human cells? _____