chapter 6

Chemistry in Biology

section 3 Water and Solutions

MAIN Idea

The properties of water make it well-suited to help maintain homeostasis in an organism.

What You'll Learn

- why water is a good solvent
- the differences between suspensions and solutions
- how acids differ from bases

Before You Read

Have you ever stirred a spoonful of a powdered drink into water? On the lines below, describe what happened to the powder. Then read the section to learn the properties of different types of mixtures.

Mark the Text

Restate the Main Point
Highlight the main point in each paragraph. Then restate each main point in your own words.

Read to Learn

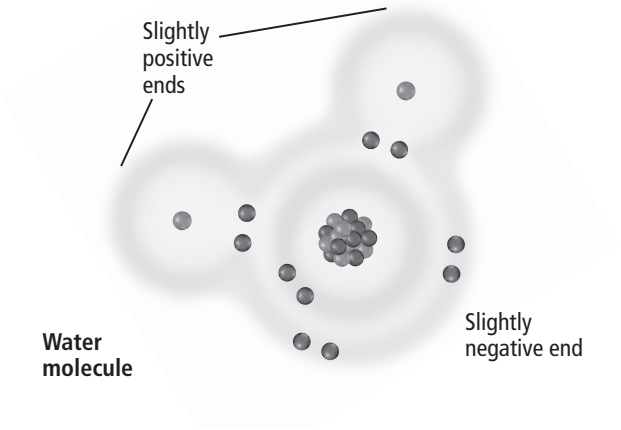
Water's Polarity

Earlier you learned that water molecules are formed by covalent bonds that link two hydrogen (H) atoms to one oxygen (O) atom. The electrons in a water molecule are attracted more strongly to an oxygen atom's nucleus. As a result, the electrons in the covalent bond are not shared equally. The electrons spend more time near the oxygen nucleus than near the hydrogen nuclei, as shown in the figure below.

Note that the water molecule has a bent shape. This shape and the unequal distribution of electrons result in oppositely charged regions. The oxygen end has a slightly negative charge. The hydrogen end has a slightly positive charge.

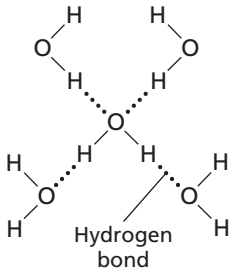
Picture This

1. Label the H and O atoms. Then label each electron with the symbol for a negative charge (−). Most negative charges are close to the nucleus of which atom?



Why is polarity important?

Molecules that have an unequal distribution of charges are called **polar molecules**. Polarity means having two opposite poles, or ends. A magnet has polarity. When the opposite poles of a magnet are close to each other, they attract. In the same way, when oppositely charged regions of polar molecules are close together, they attract each other. In water, the attraction is called a hydrogen bond. A **hydrogen bond** is a weak interaction involving a hydrogen atom and a fluorine, oxygen, or nitrogen atom. The hydrogen bonds between water molecules are illustrated by dotted lines in the diagram below.



Mixtures with Water

When you make a fruit-flavored drink, you dissolve drink powder in water. It does not react with water to form a new product. A mixture has been created. A **mixture** is a combination of two or more substances in which each substance keeps its individual characteristics and properties.

What is a homogeneous mixture?

A homogeneous (hoh muh JEE nee us) mixture has the same composition throughout. A **solution** is another name for a homogeneous mixture. A solution has two parts: a solvent and a solute. A **solvent** is a substance in which another substance is dissolved. A **solute** is the substance that is dissolved in the solvent. In the fruit-flavored drink, water is the solvent and drink powder is the solute.

How does a heterogeneous mixture differ?

In a heterogeneous mixture, the parts remain distinct—that is, you can identify the individual parts. For example, in a salad, you can tell the lettuce from the tomatoes.

Sand mixed with water is a suspension—a type of heterogeneous mixture. Over time, the particles in a suspension will settle to the bottom. Paint is a heterogeneous mixture called a colloid, whose particles do not settle out.

Picture This

2. Circle each water molecule in this diagram. Remember, a water molecule is made up of two H atoms and one O atom. Hydrogen bonds link the water molecules together. How many water molecules are shown in this diagram?

Think it Over

3. Apply Are coins in your pocket a homogeneous mixture or heterogeneous mixture? Explain.

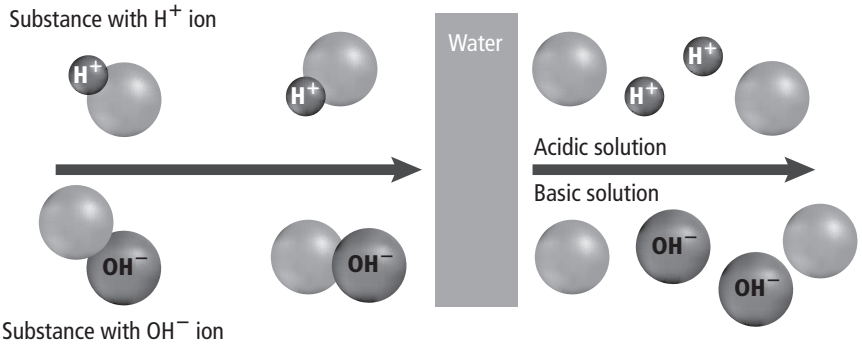
How do acids differ from bases?

Water's polarity enables many solutes to dissolve easily in water. The human body is about 70 percent water and contains many solutions. When a substance containing hydrogen is dissolved in water, the substance might release a hydrogen ion (H^+), as illustrated in the figure below. Substances that release hydrogen ions when dissolved in water are called **acids**. The more hydrogen ions released, the more acidic the solution.

Substances that release hydroxide ions (OH^-) when dissolved in water are called **bases**. The more hydroxide ions released, the more basic the solution.

Reading Check

4. Identify the property of water that makes water a good solvent.



Picture This

5. Apply Suppose you want to make the acid solution in this figure more acidic. Add drawings that would result in a more acidic solution.

How do buffers affect pH?

The measure of concentration of H^+ in a solution is called **pH**. Scientists use a pH scale like the one below to compare the strengths of acids and bases. Water is neutral and has a pH of 7.0. Acidic solutions have more H^+ and have pH values lower than 7. Basic solutions have more OH^- and have pH values higher than 7. To maintain homeostasis, H^+ levels must be controlled. **Buffers** are mixtures that can react with acids or bases to keep the pH within a certain range.

Picture This

6. Determine which solutions are acidic and which are basic. Draw a circle around the buffer.