Chapter 9: Mixtures, Solubility, and Acid/Base Solutions

Chapter 9 Lesson 1- Substances and Mixtures

Matter: Substances and Mixtures

Matter can be sorted into just two major categories—substances and mixtures

1. Substances (elements and compounds)

Elements and compounds are two examples of substances. A substance has a fixed composition, which means it is always made of the same things that combine in the same way.

Elements *are made of only one kind of atom.*

Compounds *are made up of two or more kinds of atoms bonded together.*

2. Mixtures

This differs from a mixture, which contains two or more substances that have not bonded together. A mixture has a variable composition, which means the substances used to make it don't always combine in the same way.

Two types of mixtures—

homogeneous mixtures (solutions) that are evenly mixed

heterogeneous mixtures are mixtures that are not evenly mixed.

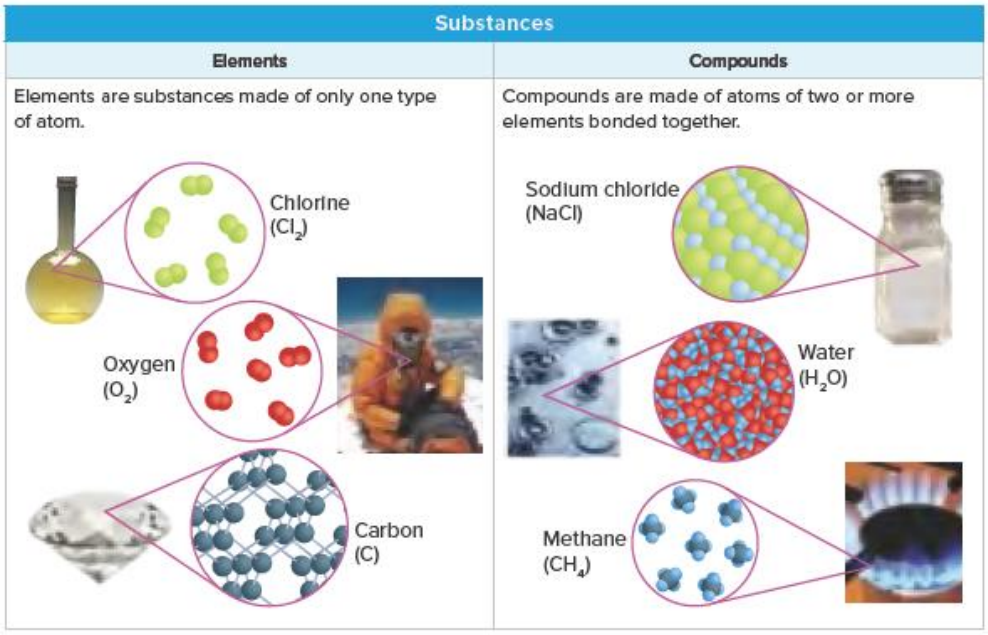
How do compounds and mixtures differ?

Mixtures

Mixing is a physical change, not a chemical change. The substances that make up a mixture do not chemically bond together. As a result, they retain their properties in the mixture and can be separated from each other using physical methods.

Compounds

A chemical change occurs when elements bond together to form compounds. The properties of the elements are not observable in the compound and the compound cannot be separated into elements using physical methods.



Chapter 9 Lesson 2- Properties of Solutions

Parts of Solutions A homogeneous mixture is also known as a solution. Solutions have two different parts—the solvent and the solute(s).

Solvent- is the substance that exists in the greatest quantity in a solution.
Solutes- All the other substances in a solution are called solutes.

Types of Solutions

solutions can exist in all three states of matter. They can be solids, liquids, or gases. The state of the solvent determines the state of the solution.

Like Dissolves Like

In nature, water forms aqueous solutions because it dissolves many substances. But it can't dissolve everything. Each water molecule has a positive end and a negative end. Polar compounds, such as rubbing alcohol, easily dissolve in water. This is because "like dissolves like." The positive ends of the water molecules attract the negative ends of the alcohol molecules.

Also, the negative ends of water molecules attract the positive ends of alcohol molecules. Ionic compounds, such as table salt, which have alternating negative and positive ions, also mix with water in a similar way. However, nonpolar molecules, such as vegetable oil, do not dissolve in water.

Concentration—How much is dissolved?

Concentration is the amount of a particular solute in a solution—the greater the amount of solute, the higher the concentration.

When a solution is composed of a solid solute and a liquid solvent, concentration is the mass of solute in a given volume of solution. Any unit of mass or volume can be used to express the concentration. When a solution contains only liquids or gases, concentration is the volume of solute in a given volume of solution. In this case, the units of volumes must match and the concentration can be expressed as a percentage.

Solubility—How much can dissolve?

Solubility is the maximum amount of solute that can dissolve in a given amount of solvent at a given temperature and pressure. The higher the solubility, the more of the solute can dissolve.

Saturated Solution- *a solution that contains the maximum amount of solute the solution can hold at a given temperature and pressure.*

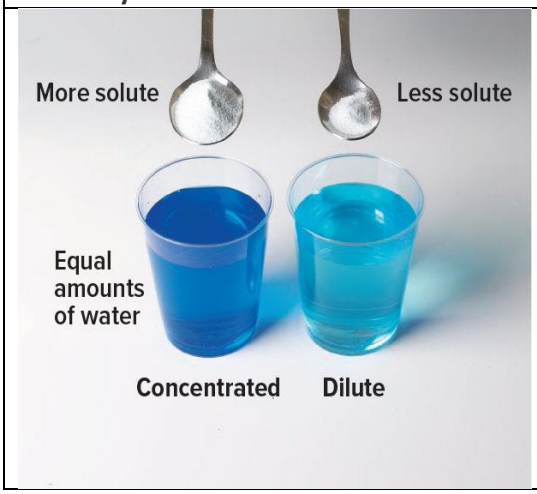
Unsaturated Solution- *a solution that can still dissolve more solute at a given temperature and pressure.*

Many solid solutes become more soluble when the temperature increases. Conversely, many gas solutes become less soluble at higher temperatures, but more soluble under pressure. However, pressure does not affect the solubility of a solid solute in a liquid solution.

How Fast a Solute Dissolves

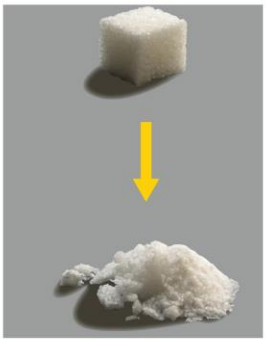
When the particles of a solvent and a solute come into contact with each other more frequently, the solute dissolves faster. Stirring the solution, crushing the solute, and increasing the temperature of the solution can make a solid solute dissolve faster in a liquid. However, the only way to change the solubility of a solute is to change the temperature or, for a gas, the pressure. Stirring or crushing has no effect on solubility.

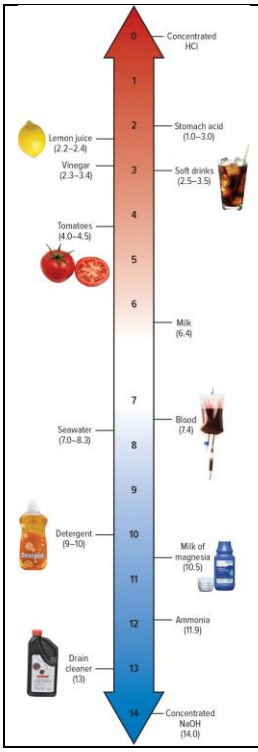
Solubility



How Fast a Solute Disolves

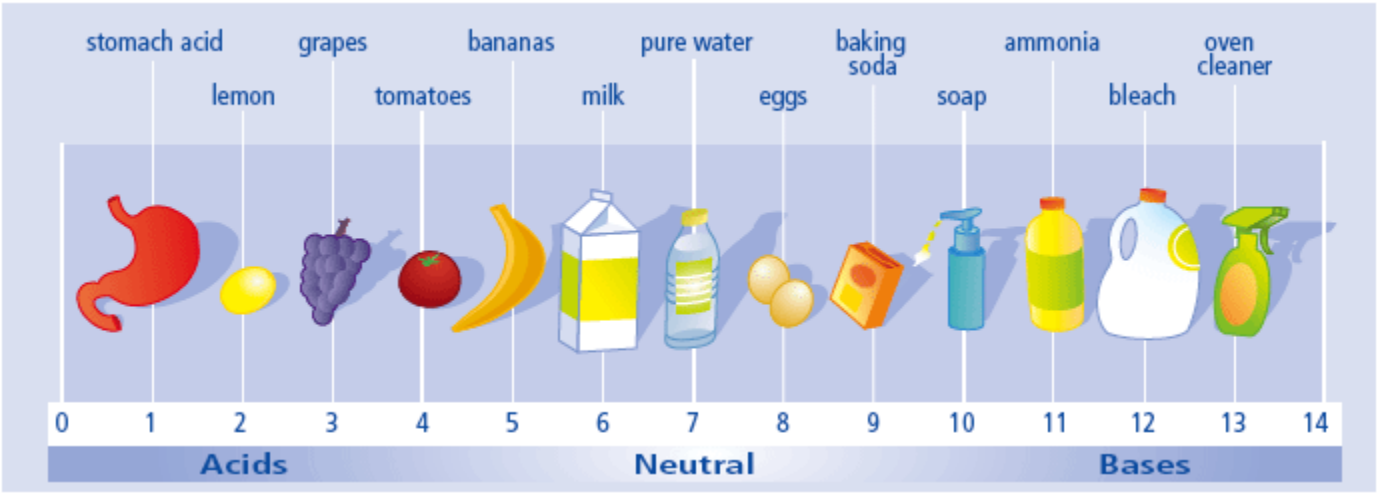
Factors that Affect the Speed of Dissolving

Stirring the solution	Crushing the solute	Increasing the temperature
		



Common Salts and Their Properties and Uses

Name, Formula	Common Name	Properties	Uses
Sodium chloride (NaCl)	salt	white crystalline solid, odorless, brittle, density = 2.16 g/mL, melting point = 801°C	food, manufacture of chemicals
Sodium hydrogen carbonate ($NaHCO_3$)	sodium bicarbonate, baking soda	white crystalline solid, odorless, brittle, density = 2.20 g/mL, breaks down at 50°C	food, antacids
Calcium carbonate ($CaCO_3$)	calcite, chalk	white powder, odorless, brittle, density = 2.71 g/mL, melting point = 1,339°C	manufacture of paint and rubber tires
Potassium nitrate (KNO_3)	potash	white crystalline solid, odorless, brittle, density = 2.11 g/mL, melting point = 334°C	manufacture of soap and glass
Sodium phosphate (Na_3PO_4)	TSP	white crystalline solid, odorless, brittle, density = 2.54 g/mL, melting point = 1,583°C	detergents
Ammonium chloride (NH_4Cl)	sal ammoniac	white crystalline solid, odorless, brittle, density = 1.53 g/mL, melting point = 338°C	dry-cell batteries



Chapter 9 Lesson 3- Acid and Base Solutions

Compounds can be classified in several ways, including:

- acids, bases, salts
- inorganic and organic compounds.

ACIDS AND BASES

What are acids and bases?

An acid is a substance thatproduces a hydronium ion when it dissolves in water. A base is a substance that produces a hydroxide ion in water. Acids and bases are found in many everyday items, including the foods we eat.

What is pH?

pH is an inverse measurement of hydronium ions in a solution. As the concentration of hydronium ions increases, the pH decreases. Acids have a pH below 7 on the pH scale (because they have a higher concentration of hydronium ions) and bases have a pH above 7 on the pH scale (because they have a lower concentration of hydronium ions). Solutions that are neutral measure exactly 7 on the pH scale. When the pH decreases by 1, for example, the acidity increases 10 times.

How is pH measured?

Test kits used to measure pH include chemicals called indicators that cause a change in color when an acid or a base is added. To perform the test, place a drop or two of the indicator into the solution and watch it change color. Different indicators will change the solution into different colors, depending on the pH value of the solution tested. You can also perform a similar test using pH strips. Simply dip the testing strip into the solution and watch as the strip changes color. The pH testing strips will have a color correlation chart to give the approximate pH value. The most accurate way to measure pH is to use a pH meter, which is an electronic device that is sensitive to the hydronium ion concentration in a solution.

pH is an inverse measure of the **hydrogen ion** (H_3O^+) **concentration** in a water-based solution. The **pH scale** measures **how acidic or basic** a substance is. It ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is **acidic**, and a pH greater than 7 is **basic**.

As the concentration of hydronium ions increases pH decreases and acidity increases

As the concentration of hydronium ions decreases pH increases and acidity decreases

Acids	Bases
Less than 7 (pH scale)	More than 7 (pH scale)
Taste sour	Taste bitter and feel slippery
H+ ions when dissolved in water	OH- ions when dissolved in water
Changes blue litmus paper red	Changes red litmus paper blue

A **salt** *is a compound formed when the negative ions from an acid combine with the positive ions from a base.*