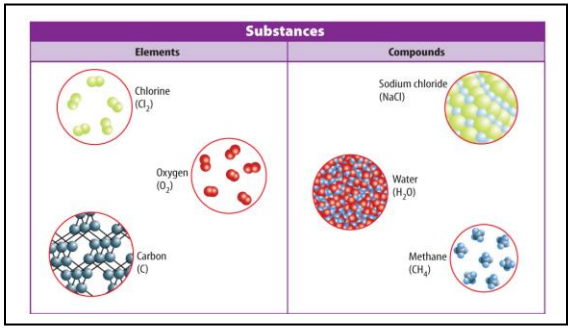
Chapter 9 Lesson 1: Substances and Mixtures

Vocabulary

-Substance	-Heterogeneous mixture
-Mixture	-Homogeneous mixture
-Solution	

Matter: Substances and Mixtures

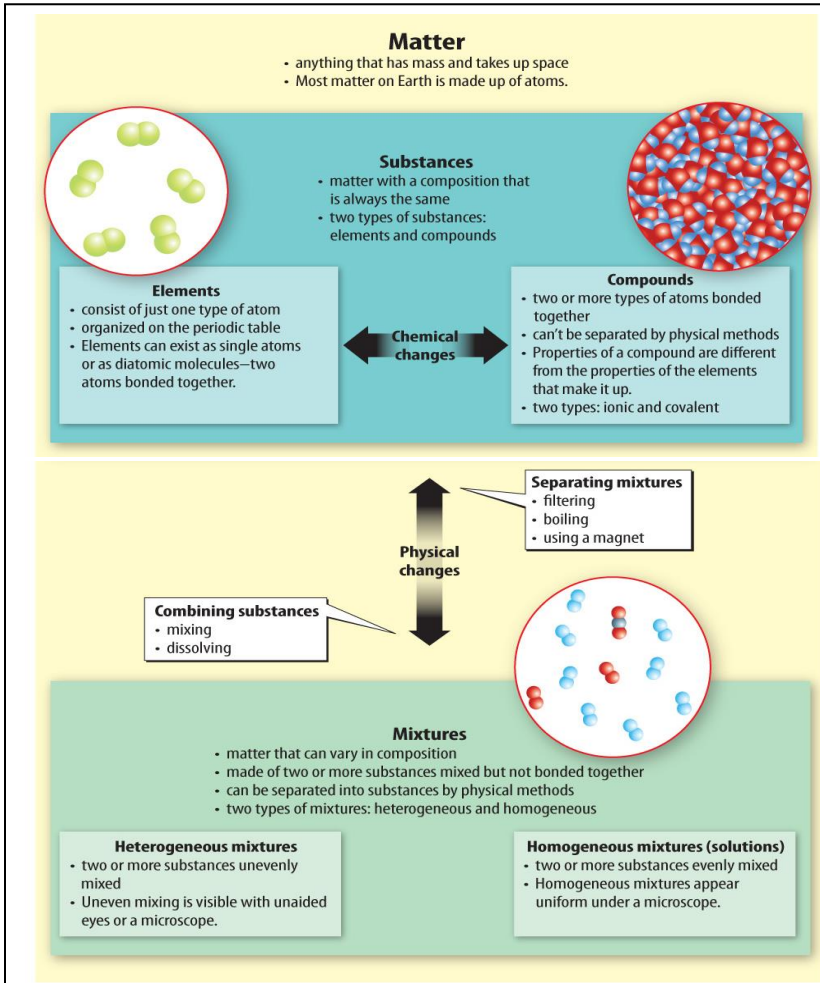
- Nearly all types of matter can be sorted into just two major categories— substances and mixtures.
- A **substance** is matter that is always made up of the same combination of atoms.
- A compound is matter made of atoms of two or more elements chemically bonded together.
- There are two types of substances – elements and compounds



- A **mixture** is two or more substances that are physically blended but are not chemically bonded together.
- The amounts of each substance in a mixture can vary.
- There are two different types of mixtures—heterogeneous and homogeneous.
- A **heterogeneous mixture** is a mixture in which substances are not evenly mixed.
- A **homogeneous mixture** is a mixture in which two or more substances are evenly mixed on the atomic level but not bonded together.
- Another name for a homogeneous mixture is **solution**.

How do compounds and mixtures differ?

- Because substances that make up a mixture are not changed chemically, some of their properties are observed in the mixture.
- The properties of a compound can be different from the properties of the elements that make it up.
- Because the substances that make up a mixture are not bonded together, they can be separated from each other using physical methods.
- The difference in physical properties, such as boiling points, of substances can be used to separate the substances.



Chapter 9 Lesson 2: Properties of Solutions

Vocabulary

-Solvent	-Polar molecule	-Solubility
-Solute	-Concentration	-Saturated Solution
-Unsaturated Solution		

Parts of Solution

- The **solvent** is the substance that exists in the greatest quantity in a solution.
- All other substances in a solution are **solutes**.

Types of Solutions

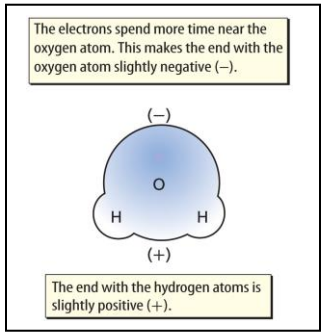
- Solutions can exist in all three states of matter—solid, liquid, or gas.
- The state of the solvent, because it exists in the greatest quantity, determines the state of the solution

Types of Solutions

State of Solution	Solvent Is:	Solute Can Be:
Solid	solid	**gas or solid (called alloys)** A saxophone is a solid solution of solid copper and solid zinc.
Liquid	liquid	**solid, liquid, and/or gas** Soda is a liquid solution of liquid water, gaseous carbon dioxide, and solid sugar and other flavorings.
Gas	gas	**gas** A lighted sign contains a gaseous mixture of gaseous argon and gaseous mercury.

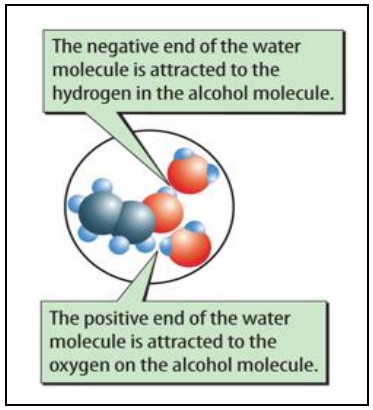
Water as a Solvent

- Water is one of the few substances on Earth that exists naturally in all three states—solid, liquid, and gas.
- In nature, water almost always exists as a solution; it contains dissolved solutes.
- A water molecule is a covalent compound.
- Water is a **polar molecule**—a molecule with a slightly negative end and a slightly positive end.
- Nonpolar molecules have an even distribution of charge.

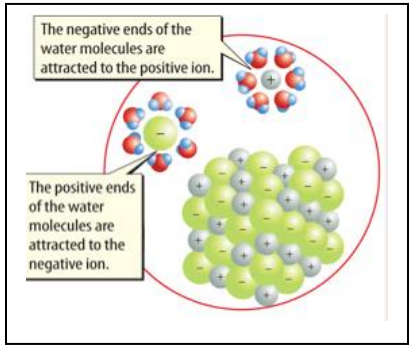


Like Dissolves Like

- Water is often called the universal solvent because it dissolves many different substances.
- Polar solvents dissolve polar solutes easily. Nonpolar solvents dissolve nonpolar solutes easily.
- Because water is a polar solvent, it dissolves most polar and ionic solutes.
- When a polar solute, such as rubbing alcohol, dissolves in a polar solvent, such as water, the poles of the solvent are attracted to the oppositely charged poles of the solute.



- When ionic solutes dissolve, the positive poles of the solvent are attracted to the negative ions.
- The negative poles of the solvent are attracted to the positive ions.



Concentration – How much is dissolved?

- **Concentration** is the amount of a particular solute in a given amount of solution.
- The terms *concentrated* and *dilute* are one way to describe how much solute is dissolved in a solution.

- To calculate concentration, you must know both the mass of solute and the volume of solution that contains this mass, and then, divide the mass of solute by the volume of solution.

$$\text{Concentration } (C) = \frac{\text{mass of solute } (m)}{\text{volume of solution } (V)}$$

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- Example in class:

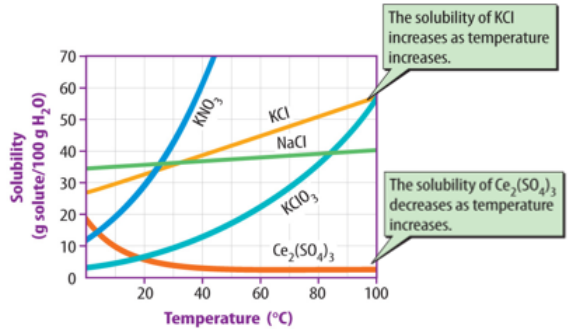
Solve for Concentration Suppose you want to calculate the concentration of salt in a 0.4 L can of soup. The back of the can says it contains 1.6 g of salt. What is its concentration in g/L? In other words, how much salt would be contained in 1 L of soup?

- If a solution contains only liquids or gases, its concentration is stated as the volume of solute in a given volume of solution.
- Percent by volume is calculated by dividing the volume of the solute by the total volume of solution and then multiplying the quotient by 100.

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.
- If a substance has a high solubility, more of it can dissolve in a given solvent.
- A **saturated solution** is a solution that contains the maximum amount of solute the solution can hold at a given temperature and pressure.
- An **unsaturated solution** is a solution that can still dissolve more solute at a given temperature and pressure.

Changing either temperature or pressure changes how much solute can dissolve in a solvent.



How Fast a Solute Dissolves

- If solute and solvent particles come into contact more often, the solute dissolves faster.
- Stirring a solution, crushing the solute, and increasing the temperature are three ways to increase how often solute particles contact solvent particles.

Chapter 9 Lesson 3: Acid and Base Solutions

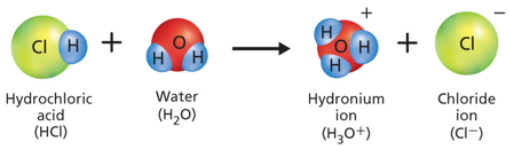
Vocabulary

-Acid	-Hydronium ion	-Base	-pH
-Indicator			

What are acids and bases?

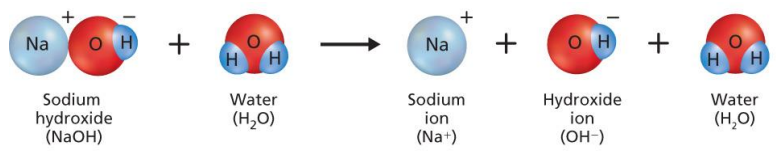
- An **acid** is a substance that produces a hydronium ion (H_3O^+) when dissolved in water.
- Nearly all acid molecules contain one or more hydrogen atoms.
- A **hydronium ion**, H_3O^+, is a positively charged ion formed when an acid dissolves in water.

When an acid mixes with water, the hydrogen atom separates from the acid and quickly combines with a water molecule, resulting in a hydronium ion.

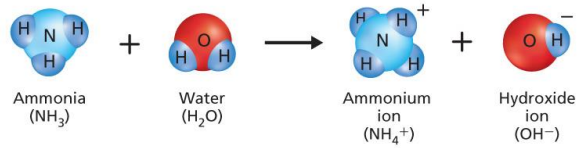


- A **base** is a substance that produces hydroxide ions (OH^-) when dissolved in water.
- When a hydroxide compound mixes with water, hydroxide ions separate from the base and form hydroxide ions in water.

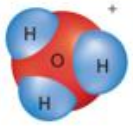
When a hydroxide compound mixes with water, hydroxide ions separate from the base and form hydroxide ions in water.



Bases that do not contain hydroxide ions produce hydroxide ions by taking hydrogen atoms away from water, leaving hydroxide ions.



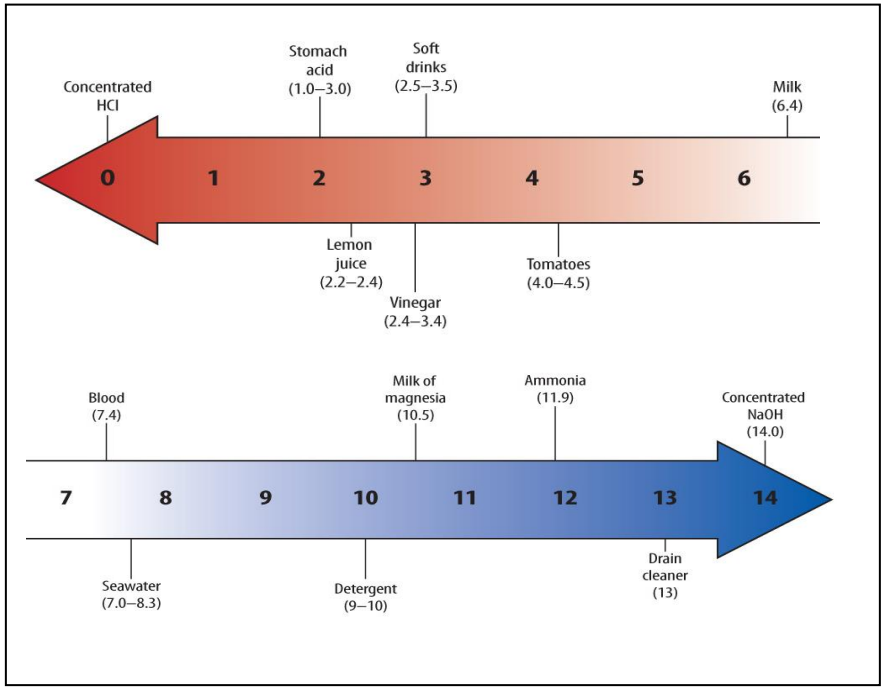
Properties and Uses of Acids and Bases

	Acids	Bases
Ions produced	 Acids produce H_3O^+ in water.	 Bases produce OH^- ions in water.
Examples	• hydrochloric acid, HCl • acetic acid, CH_3COOH • citric acid, $H_3C_6H_5O_7$ • lactic acid, $C_3H_6O_3$	• sodium hydroxide, NaOH • ammonia, NH_3 • sodium carbonate, Na_2CO_3 • calcium hydroxide, $Ca(OH)_2$
Some properties	• Acids provide the sour taste in food (never taste acids in the laboratory). • Most can damage skin and eyes. • Acids react with some metals to produce hydrogen gas. • H_3O^+ ions can conduct electricity in water. • Acids react with bases to form neutral solutions.	• Bases provide the bitter taste in food (never taste bases in the laboratory). • Most can damage skin and eyes. • Bases are slippery when mixed with water. • OH^- ions can conduct electricity in water. • Bases react with acids to form neutral solutions.
Some uses	• Acids are responsible for natural and artificial flavoring in foods, such as fruits. • Lactic acid is found in milk. • Acid in your stomach breaks down food. • Blueberries, strawberries, and many vegetable crops grow better in acidic soil. • Acids are used to make products such as fertilizers, detergents, and plastics.	• Bases are found in natural and artificial flavorings in food, such as cocoa beans. • Antacids neutralize stomach acid, alleviating heartburn. • Bases are found in cleaners such as shampoo, dish detergent, and window cleaner. • Many flowers grow better in basic soil. • Bases are used to make products such as rayon and paper.

What is pH?

- The **pH** is an inverse measure of the concentration of hydronium ions (H_3O^+) in a solution.
- A solution with a lower pH is more acidic.
- As the concentration of hydronium ions decrease, the pH increases.
- All acid and base solutions contain both hydronium and hydroxide ions.
- In a neutral solution, such as water, the concentrations of hydronium and hydroxide ions are equal.
- Acids have a greater concentration of hydronium ions than hydroxide ions.
- Bases have a greater concentration of hydroxide ions than hydronium ions.

The pH scale helps classify solutions as acidic or basic.



- The pH scale is used to indicate how acidic or basic a solution is.
- The pH scale contains values that range from below 0 to above 14.
- On the pH scale acids have a pH below 7.
- Bases have a pH above 7.
- Solutions that are neutral have a pH of 7—they are neither acidic nor basic.
- A change in one pH unit represents a tenfold change in the acidity or basicity of a solution.

How is pH measured?

- An **indicator** is a compound that changes color at different pH values when it reacts with acidic or basic solutions.
- There are many different indicators—each indicator changes color over a specific range of pH values.
- The pH of a solution can be measured by dipping a pH testing strip into the solution.
- A more accurate way to measure pH is to use a pH meter.