

Intro – What is Chemistry?

Chemistry gets its roots from a “science” called Alchemy
Alchemists were known for trying to create gold from common metals

Chemistry is a physical science that studies matter and its changes

A chemist could study...

How many atoms are in a grain of sand?

What metals react violently with water?

At what temperature does ice melt?

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Matter

Matter – Anything that has mass and takes up space
This is all the “stuff” in the universe

Atom – smallest unit of matter
Everything is made of atoms. There are only a little over 100 different types of atoms, each with unique properties.

Mass – Amount of matter
The SI unit to measure mass is the kg. This can be considered the combined total of all atom parts put together.

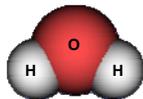
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Atoms and Substances

Element – A pure substance made up of 1 type of atom
ex. Gold, Iron, Hydrogen, Nitrogen, etc. These are listed on a periodic table.

Compound – Pure substance made up of 2 or more elements
ex. Table salt is sodium chloride (NaCl), a combination of sodium metal and chlorine gas.

Molecule – Smallest unit of a substance that behaves like the substance (made of nonmetal atoms)
ex. Water is made of H₂O molecules. A single molecule is two hydrogen atoms bonded to an oxygen atom.



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Pure Substances and Mixtures

Pure substance – compound or element that is same throughout
ex. Table Salt

Mixtures – blend of two or more pure substances where each retains its identity and properties

homogeneous – substances are evenly mixed (solution)
ex. Salt water: every drop will be exactly the same

heterogeneous – substances are unevenly mixed
ex. Concrete: each little piece can be different

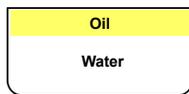
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Solutions

Solution – homogeneous mixture in a single phase.
This can be any combo gases, liquids, and solids
ex. Salt water, metal alloy, water vapor, vinegar, seltzer water

Miscible – substances can be mixed into solution in any proportion
ex. Alcohol and water

Immiscible – cannot be mixed together
ex. Oil and water



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Chemical Formulas

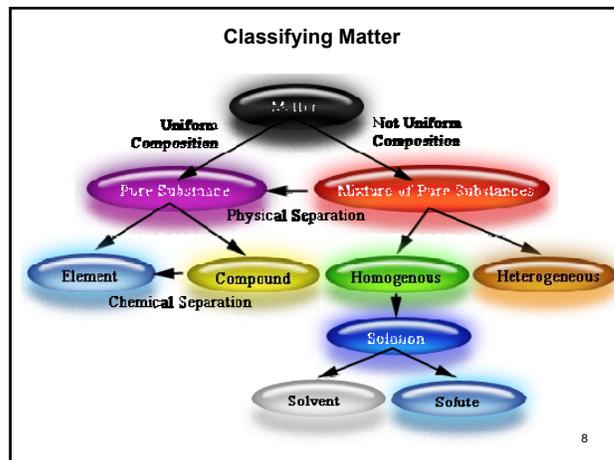
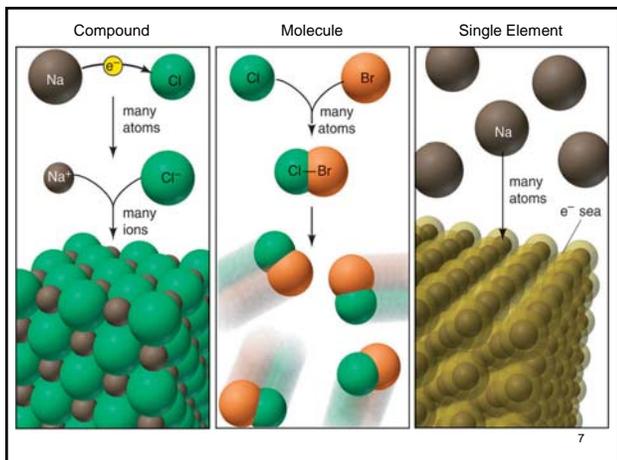
Chemical Formulas – Shows how many atoms of each element are in a substance. A subscript shows the number atoms of each element.

Water – dihydrogen monoxide
 $\text{H}_2\text{O} \rightarrow 2 \text{ Hydrogen atoms \& 1 Oxygen atom}$

Table Salt – sodium chloride
 $\text{NaCl} \rightarrow 1 \text{ Sodium atom \& 1 Chlorine atom}$

Rust - Iron(III) oxide
 $\text{Fe}_2\text{O}_3 \rightarrow 2 \text{ Iron atoms \& 3 Oxygen atoms}$

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Physical and Chemical properties

Physical Property – can be measured or observed without changing the identity of the substance.

These are usually very easy to observe or measure. They also help identify substances and determine uses.

Examples: shape, color, odor, texture, state, melting point, boiling point, strength, hardness, magnetism, the ability to conduct electricity or heat

melting point: temperature where a solid becomes a liquid

boiling point: temperature where a liquid becomes a gas

Physical and Chemical properties

Density is a physical property

Density – the mass to volume ratio of a substance

Density is how heavy something is compared to the room it takes up. A block of metal weighs more than wood taking up the same room.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \quad D = \frac{M}{V}$$

The common units for density are $\frac{g}{cm^3}$ or $\frac{g}{mL}$

Physical and Chemical properties

Density Practice

If 10.0 cm³ of ice has a mass of 9.17 g, what is the density of ice?

V = 10.0 cm³ M = 9.17 g

$$D = \frac{M}{V} = \frac{9.17g}{10.0cm^3} = 0.917 \frac{g}{cm^3}$$

Physical and Chemical properties

Chemical Property – relates to ability of a substance to change or transform into a new substance (ex. Iron metal reacts with oxygen in the air to form rust, paper burns to form ashes, etc.)

Examples of chemical properties include flammability and reactivity.

Flammability – the ability to burn

Reactivity – the capacity of a substance to combine chemically

Physical and Chemical properties

Physical and chemical properties are measured or observed differently.

Physical properties can be observed without changing the identity of a substance.

Chemical properties can be observed only in situations in which the identity of the substance changes.

In many cases, once a substance has a chemical change, you cannot change back.

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Comparison of Physical and Chemical Properties

Substance	Wood	Iron	Red dye
			
Physical property	has a grainy texture	bends without breaking	has red color
Chemical property	is flammable	reacts with oxygen to form rust	reacts with bleach; loses color

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Physical and Chemical Changes

Physical Change – affects one or more physical properties of a substance without changing its identity

Examples:

Change in state

solid ↔ liquid ↔ gas ↔ plasma

Melting changes the state of matter of a substance.



Change in size

sawing a board in half

Cutting changes the size of a substance.



Crushing changes the shape of a substance.



Change in shape

crushing a can

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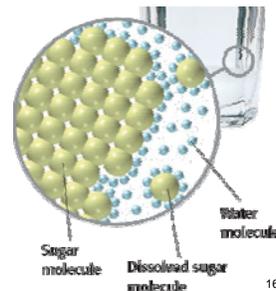
Physical and Chemical Changes

Physical changes can be reversed

Ice can be heated into water and then steam. Steam can condense to a water and frozen to make ice.

Dissolving is a physical change

Sugar can be dissolved into water. Water can be boiled to leave the sugar behind.



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Physical and Chemical Changes

Chemical Change – Material changes to a new substance that has different properties

Reactant → Products

Examples:

Iron begins to rust

Batter turns into a cake

Leaves turn colors in fall

Burned paper creates ashes

A cavity forms in a tooth

Bread is turned into toast

Popcorn is made

An egg turns rotten

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Physical and Chemical Changes

Signs of a chemical change:

Odor is given off – food burns

A color change has taken place – paint fades

Fizzing or Foaming – baking soda and vinegar are mixed

Sound is made – a firecracker is lit

Heat is given off – a fire cooks food

Light is given off – a glow stick lights up

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Section 1-2 Matter and Change

A mixture can be separated by physical changes. Mixtures are not chemically bonded.

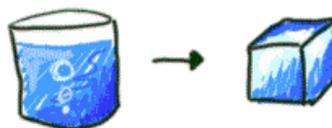
Ex: Salt water can be separated by boiling off water to leave the salt behind

Chemical changes create new substances. These cannot be reversed by physical changes.

Some substances can be separated through chemical changes. This breaks the bonds between atoms.

Ex: Water can be broken into oxygen and hydrogen gas.

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PHYSICAL CHANGE OF
WATER INTO ICE



CHEMICAL CHANGE OF
WATER INTO
HYDROGEN PEROXIDE

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