

Chapter 4: Properties of Matter

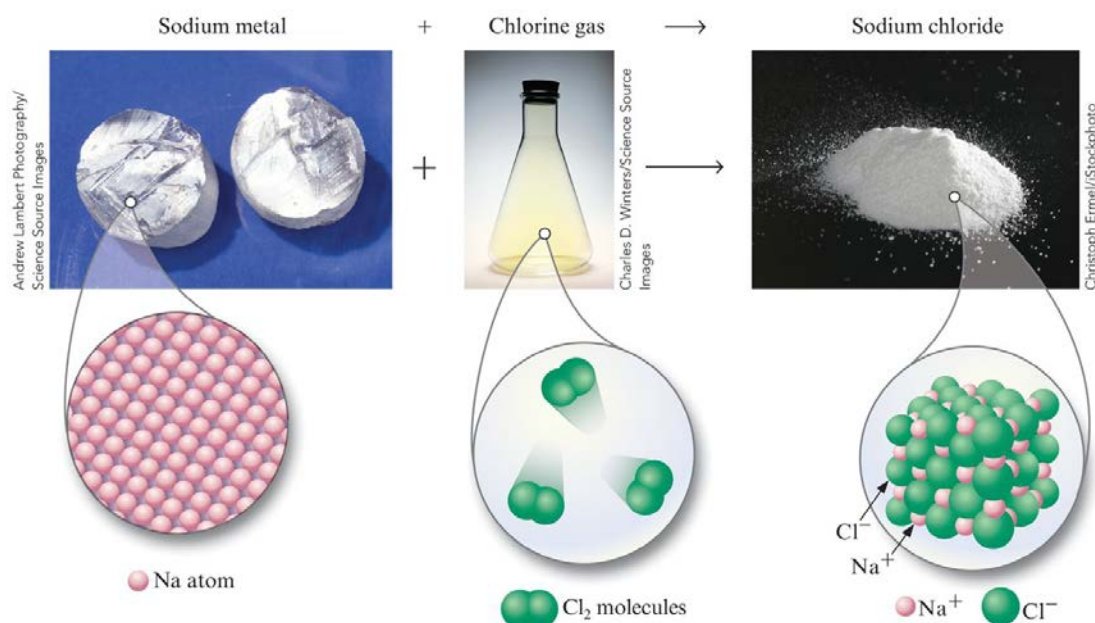
4.1 Properties of Substances

- Every substance has a set of **properties** that characterize it and give it a unique identity.
 - **Physical properties** can be determined without altering the composition of the substance.
 - state, color, taste, odor, mp, bp, density

TABLE 4.1 | Physical Properties of Selected Substances

Substance	Color	Odor	Physical state	Melting point (°C)	Boiling point (°C)
Chlorine	Greenish yellow	Sharp, suffocating	Gas (20°C)	-101.6	-34.6
Water	Colorless	Odorless	Liquid	0.0	100.0
Sugar	White	Odorless	Solid	—	Decomposes 170–186
Acetic acid	Colorless	Like vinegar	Liquid	16.7	118.0
Nitrogen dioxide	Reddish brown	Sharp, suffocating	Gas	-11.2	21.2
Oxygen	Colorless	Odorless	Gas	-218.4	-183

- **Chemical properties** describe the ability of a substance to form new substances via a chemical reaction.
 - composition changes, that is chemical bonding and formula



- Substances are recognized and differentiated by their properties.
 - No two substances have identical physical and chemical properties.

4.2 Physical and Chemical Changes

- Substances can undergo two types of changes:
 - **Physical changes** are changes in physical properties.
 - state, size, shape, density
 - A physical change does not change the composition of a substance.
 - **Chemical changes** form new substances with different compositions.
 - **Chemical equations** are used to express chemical changes.



Electrolysis of Water					
Type of equation	Reactants			Products	
Word	water		$\xrightarrow[\text{energy}]{\text{electrical}}$	hydrogen	+ oxygen
Molecular			$\xrightarrow[\text{energy}]{\text{electrical}}$		+
Symbol (formula)	2 H ₂ O		$\xrightarrow[\text{energy}]{\text{electrical}}$	2 H ₂	+ O ₂

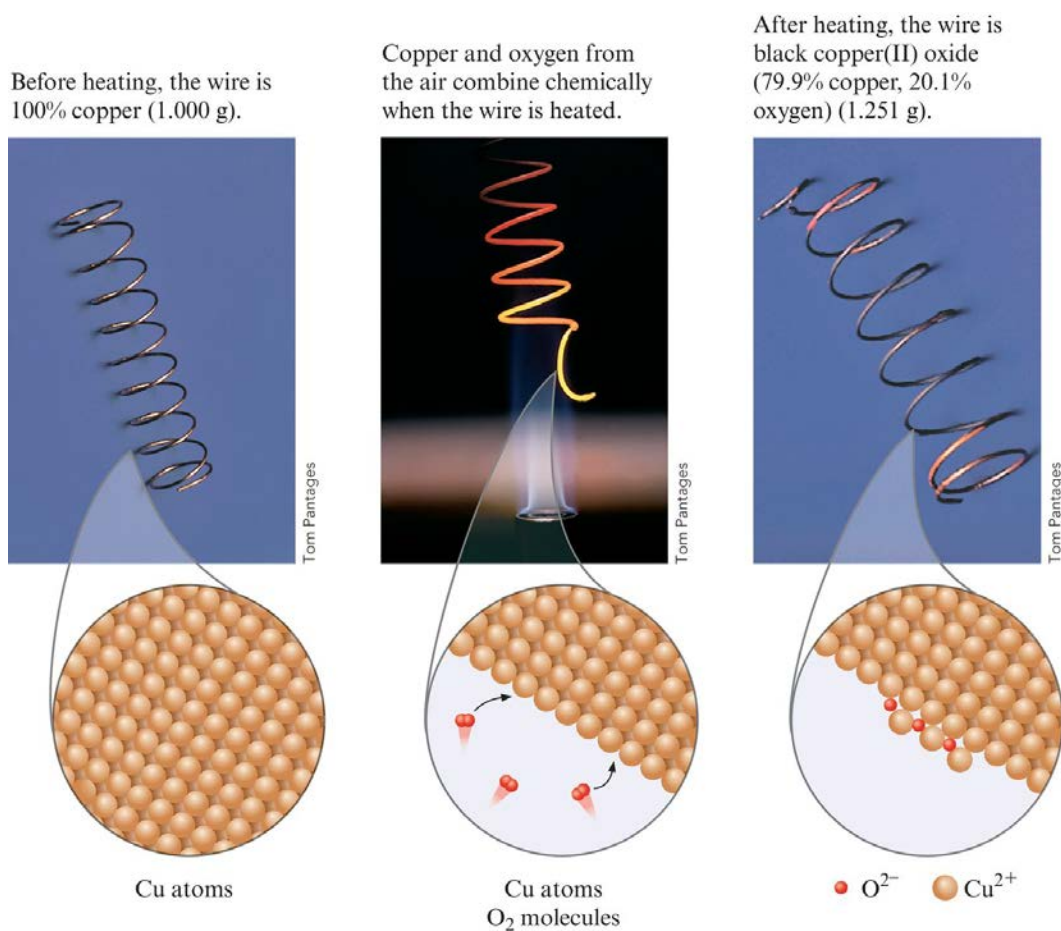


TABLE 4.2 | Physical or Chemical Changes of Some Common Processes

Process taking place	Type of change	Accompanying observations
Rusting of iron	Chemical	Shiny, bright metal changes to reddish brown rust.
Boiling of water	Physical	Liquid changes to vapor.
Burning of sulfur in air	Chemical	Yellow, solid sulfur changes to gaseous, choking sulfur dioxide.
Boiling of an egg	Chemical	Liquid white and yolk change to solids.
Combustion of gasoline	Chemical	Liquid gasoline burns to gaseous carbon monoxide, carbon dioxide, and water.
Digestion of food	Chemical	Food changes to liquid nutrients and partially solid wastes.
Sawing of wood	Physical	Smaller pieces of wood and sawdust are made from a larger piece of wood.
Burning of wood	Chemical	Wood burns to ashes, gaseous carbon dioxide, and water.
Heating of glass	Physical	Solid becomes pliable during heating, and the glass may change its shape.

4.3 Learning to Solve Problems

- I encourage you to read this short section over, as well as two of the links in the 'Skills Advice' section of the website: 'Problem Solving' and 'Polya.'
 - All of these provide advice on how to approach solving problems, but to gain expertise, you must...solve problems! The advice will help you develop a systematic approach, rather than tackling each problem haphazardly.

4.4 Energy

4.5 Heat: Quantitative Measurement

- We'll get back to these topics later, probably in chapter 9.

4.6 Energy in the Real World

- Not covered, but worth reading!

Corollary

Chapter 4 homework will be brief!