

Chemistry



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Chemistry: Chapters 1 & 2

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Chemistry is.....

- ◆ The Study of Matter
- ◆ Change Study
- ◆ Study of the Composition of Substances & the Changes They Undergo

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Matter:

anything that has *mass* and *takes up space*

Mass:

amount of matter an object contains

Volume:

amount of space an object occupies

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Chemistry Specializations

- Inorganic Chemistry: substances *without* carbon
- Organic Chemistry: substances *with* carbon
- Biochemistry: chemistry of *living* organisms
- Analytic Chemistry: *composition* of substances
- Physical Chemistry: *behavior (changes)* of chemicals

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Scientific Methods: Approaches to the Solution of Science Problems

Observe

- Gather data using the senses
- Measure using tools
- Organize and Graph

Form a Hypothesis:

- Propose an explanation for the observations
- Describe a pattern or trend

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Test

- Experiment
- Find Different Set of Supporting Facts
- More Observations
- Use Different Strategies

Conclude

- Accept/Verify
- Refine
- Discard

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Some Definitions

Theory:

An explanation of a pattern
linked hypotheses that are well-tested and
verified

Law:

A description of a pattern
a broad summary statement

Fact:

Verified observations

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Alchemy

Purpose:

to transmute common metals into gold.

Actual:

Discovered new chemicals.

Designed lab equipment.

Developed procedures.

Distillation.....Sublimation...etc.

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Aristotle

Reasoning/intellect

Dominant force in scientific thought till
end of Middle Age

Good descriptions but no testing

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Roger Bacon (1627~1691)

The Sceptical Chemist

Observation and experimentation will lead to understanding of the natural world

Do experiments to test ideas obtained by reason

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Antoine Lavoisier (1743~1794)

Founder of modern chemistry

Transformed chemistry from a science of *observation and description* to a science of *measurement*

Experiments and precise measurements of mass changes in chemical experiments

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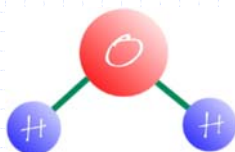
Molecules Are Pure Substances

Elements

made of single type of atom

Compounds

Made of more than one type of atom



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Physical Properties

Physical Properties

Quality of a substance:

Intrinsic: *does not change* with size changes:

Color, hardness, density, melting point, boiling point, solubility, normal state at room temperature, etc.

Extrinsic: *does change* with size changes

Mass, size, shape

Physical States & Physical Changes

Solid, Liquid, Gas

Change of state without change in composition

water to ice

melting metal

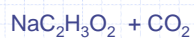
Reversible



Chemical Properties

Susceptibility to change in composition

Reactivity



Chemical Changes

Composition of substance changes

Irreversible

Signs:

- Bubbles (production of a gas)
- Change in temperature (explosion, fire, heat, or cold)
- Change in color or odor
- Production of a solid (precipitate)

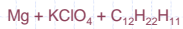
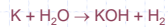


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Signs of a Chemical Reaction



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States of Matter

Solid

Matter with definite shape and volume

Particles packed together and highly attracted

Coal, sugar, ice, iron, gold...

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Chromium Powder & Melting Gallium



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Copper Powder & Magnesium Flakes



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States of Matter

Liquid

Matter with fixed volume

Takes shape of container

Flows

Particles farther apart and slightly attracted to each other

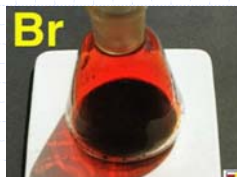
Water, cooking oil, vinegar, alcohol, nail polish remover

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Mercury and Bromine, Liquid at Room Temperature



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States of Matter

Gas

- No definite shape nor volume
- Takes shape and volume of container
- Expands to fill any container
- Particles separated with no attraction

Oxygen, nitrous oxide, methane, helium, water vapor*

* (vapor = substance that is normally liquid or solid at room temperature but which is in a gaseous state)

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Hydrogen and Chlorine



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Substances	Mixtures
Pure Elements: one type cannot be separated by physical or chemical methods	Physical blend of 2 or more substances
Compounds: 2 or more substances joined together Can only be separated by chemical methods	Heterogeneous Not uniform throughout 2 or more phases
	Homogeneous (solution) Uniform 1 phase

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Common Mixtures

Solid~solid	Sand, granite
Solid~liquid	Salad dressing
Liquid~liquid	Oil and water

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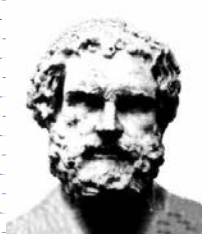
Common Solutions

Gas~Gas	CO ₂ in air
Gas~Liquid	CO ₂ in H ₂ O (soda water)
Gas~Solid	Ice cream
Liquid~Gas	H ₂ O vapor in air
Solid~Liquid	NaCl in H ₂ O (salt water)
Solid~Solid	Cu in Ag (sterling silver)

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Brief History of Chemistry

Democritus (circa 460~371 B. C.)



All matter is
composed of
atoms:....the rest
is opinion

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Democritus Atomic Theory

1. All matter is composed of atoms, which are bits of matter too small to be seen. *These atoms CANNOT be further split into smaller portions*
2. There is a void, which is empty space *between* atoms
3. Atoms are completely *solid*
4. Atoms are *homogeneous, with no internal structure*
5. Atoms are different in their size, *shape*, weight, arrangement

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Atomists and Atomic Theory

Atomists considered the void to be *between* atoms

Current atomic theory holds that the void is *within* the atom

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Aristotle (384–322 B. C.)



Dominant philosopher of his time and through Middle Ages and Renaissance.
Rejected Democritus' atomism, dooming that concept through ancient and medieval times.

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Aristotle's Concept of Matter

primitive matter consists of
4 primary entities
possessing
4 general qualities

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Elements and Qualities

Elements

Air
Fire
Water
Earth

Qualities

Hot
Dry
Cold
Fluid (moist)
