Classification of Matter

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Energy

Physics: the study of energy and its interaction with matter. Energy is the ability to do work or cause change.

Matter

Chemistry: the study of matter and its properties and composition. Matter occupies space and has mass.

Living Matter

Biology: the study of the interaction of matter and energy in living organisms and systems.

Nonliving Matter

Can be physically separated?

No

Yes

Pure Substances

Chemically bonded
Definite composition
Compound has properties different from its elements

Can be chemically separated?

No

Yes

Elements

- Metals
- Metalloids
- Nonmetals

Atomic Number
Atomic Mass
Atomic Radius
Atomic Symbol
Electronegativity (EN)
Electron Affinity (EA)
Electron Configuration
Ionization Energy (IE)
Isotope / Allotrope
Mass Number
Mole / Molar Mass
Oxidation Number
Phase (solid, liquid, gas)
Valence Electrons
Quantum Theory

Periodic Table Trends:
EN, EA, IE increase L to R
EN, EA, IE decrease T to B

Compounds

- *Ionic:* Metal + Nonmetal or Metal + Polyatomic Ion. Crystalline structures (salts) with ionic bonds: formula units. (Polyatomic ions consist of two or more atoms linked by covalent bonds). Usually inorganic compounds. Base: substance (Ex. NaOH) that can release OH^- ions in water, or that can accept a proton.

- *Molecular:* Nonmetal + Nonmetal. Molecules with covalent bonds: molecular formula. Usually organic compounds: carbohydrates, lipids, proteins, and nucleic acids. Acid: substance (Ex. HCL) that releases H^+ ions in water, or that can donate a proton.

Electronegativity Difference

0	0.5	1.8 or greater
Covalent Bonds		Ionic Bonds

Mixtures

Not chemically bonded
Variable composition
Each substance keeps its properties

Is uniform throughout?

No

Yes

Heterogeneous

Immiscible

Examples:
- Oil and water (l)
- Tossed salad (s)
- Smoke (g)
- Milk and cereal (multiphase)

Suspensions / Colloids

Separation methods:
- Centrifugation
- Decanting
- Funneling
- Magnetism
- Manual
- Sieving/Filtering

Homogeneous

Miscible

Examples:
- Salt water (l). (Salt, an ionic compound, dissolves in water, a molecular compound, producing an aqueous solution of Na^+ and Cl^- ions held between intact H_2O molecules)
- Alloys (s)
- Air (g)

Solutions

Separation methods:
- Chromatography
- Distillation
- Evaporation
- Crystallization

The principles of Conservation of Mass, Kinetic Molecular Theory, and Mass-Energy Equivalence apply to all matter.