

Matter and Energy

Phases of Matter

- Matter is anything that has mass and volume.
- Solid – particles are very close together and locked in position.
- Liquid – particles have moved apart a little, and are now free to move past each other, but are still restricted from free movement.
- Gas – particles are very far from each other and have complete freedom of motion.
- The only difference between the three phases is the spacing. Chemically they are the same.

Changes

- Physical changes do not alter the chemical make-up of the substance. May change the shape of the substance or the distance between the particles.
- Ex. Crushing, bending, tearing, phase changes.
- Chemical changes require a permanent change to the chemical make-up resulting in a new substance with different properties.

Conservation of matter –matter cannot be created or destroyed through any physical or chemical process

Properties of Matter

- Physical properties – can be determined without chemically changing the substance.
- Ex. Density, color, melting point, boiling point, freezing point, condensing point, magnetic, heat and electric conductivity, luster, malleability, crystal structure, etc
- Chemical properties – require a chemical reaction to determine.
- Ex. Reaction with oxygen, reaction with water, reaction with sulfur, etc.

Definitions

- Element – substance that can not be separated into simpler substances by a chemical change.
- Atom – smallest particle of an element that retains the properties of the element.
- Compound – two or more atoms bonded together to make a new substance.
- Pure substance – substance made of one type of particle that has its own set of chemical and physical properties.
- Can be an atom or a compound.

Mixtures

- Mixture – a physical blend of two or more pure substances.
- Can be separated by their individual physical properties. Examples:
 - Filtering – separation by particle size
 - Distillation – separation by boiling point
- Heterogeneous mixture – particles are not evenly distributed (chocolate chip cookies)
- Homogeneous – particles are evenly distributed (air, salt water)

Types of mixtures

- Solution – homogeneous mixture where small particles (atoms, ions, molecules) are evenly distributed throughout. (salt water) Cannot be filtered!
- Colloid – homogeneous mixture where larger particles (large enough to see with a microscope) are evenly distributed. (milk)
- Suspension – heterogeneous mixture where very large particles are mixed but will eventually settle out. (muddy water)

Energy

- Conservation of Energy – energy cannot be created or destroyed....ever!
- Matter can be since $E=mc^2$, and nuclear process can convert matter to energy and back.
- Energy is the capacity to do work.
- Amounts of energy are measured in Joules or calories.

Energy Conversions

- 1 calorie = 4.184J
- 1000 calories = 1 Calorie = 1 kcal
- 1 kcal = 4.184kJ = 4184J
- All energy is the same and can be transferred to different forms.
- Potential, Kinetic, Nuclear, Electrical, Chemical etc.

Temperature

- Temperature is a measure of the average kinetic energy of a sample.
- Kinetic energy is the energy of motion.
- Temperature does not measure the amount of energy contained within a substance.
- You can tell how much energy a substance has gained or lost by its change in temperature though, but that's related to mass and specific heat capacity.

Temperature scales

- Celsius – based on the freezing point of water (0 degrees) and boiling point of water (100 degrees)
- Would not work in later mathematical formula so a new scale was needed.
- Kelvin – based on absolute zero, the coldest temperature possible where all molecular motion stops.
- $0 \text{ K} = -273^{\circ}\text{C}$ so...
- $\text{K} = ^{\circ}\text{C} + 273$