

# Chemistry Conceptual Flow: Matter and Its Interactions

Matter is anything that takes up space and has mass.

Density is a ratio of an objects mass to volume ( $d = \frac{m}{v}$ ) and is an intensive (does not depend on size) physical property  
**MS-PS1-2** (should not be covered until middle school)

Physical properties are properties that can be measured without changing the substance. Physical properties include: color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, solubility, flammability, odor, melting point, etc.  
**2-PS1-1**

Physical properties affect what materials we choose for an intended purpose.  
**2-PS1-2**

Chemical properties of substances are observed during chemical reactions and include: gas production, precipitate formation, color change, temperature change, odor, or light production.  
**5-PS1-4, MS-PS1-2**

In solids particles are close together and vibrate in a given position. In liquids particles are close together but are able to move past each other. In gases particles are far apart and move freely.

The state of matter is a physical property. There are four states of matter: solid, liquid, gas, and plasma.

As particle motion increases the substance changes from a solid to liquid to gas.  
**MS-PS1-4**

Physical reactions are a result of changes in thermal energy or pressure (Examples: melting, freezing, evaporating, condensing). Mass is conserved during physical reactions.  
**5-PS1-2, 2-PS1-4**

Physical reactions are reversible by heating or cooling.  
**2-PS1-4**

Graphing heat vs. temperature of a pure substance results in a heating curve.

Chemical reactions involve reorganization of the atoms. Changes in the way they are bound together results in one or more new substances forming. The atoms themselves are not changed in a chemical reaction.  
**MS-PS1-5**

When things are mixed together either a mixture is formed or a chemical reaction occurs.

The majority of chemical reactions are not reversible.  
**2-PS1-4**

Changes in chemical energy between the reactants and products results in the release (exothermic) or absorption (endothermic) of heat.  
**MS-PS1-6**

When two or more substances are mixed, regardless if a reaction occurs, the mass of the starting material is equal to the mass of the ending material. (Law of Conservation of Mass)  
**2-PS1-3, 5-PS1-2**

Pure Substance are made from a single type of atom or compound: each pure substance has characteristic physical and chemical properties that can be used to identify it.  
**5-PS1-3**

Physical properties can be used to separate mixtures into pure substances

Mixtures

Dissolving is a process in which a substance disperses into another substance to form a solution.

Solutions can be combinations of solids, liquids, and gases. Examples: air ( $N_2, O_2, CO_2$ ), brass (Cu and Zn), soda water ( $H_2O$  and  $CO_2$ ) The parts of a solution cannot be distinguished by the eye.

Pure substances can be broken into smaller pieces and rearranged. The sum of the masses of the pieces is the same as the mass of the original.  
**2-PS1-3, 5-PS1-2**

Atoms are the smallest building blocks of matter.  
**5-PS1-1**

Chemical Properties can be used to separate compounds into atoms.

Compounds are made of two or more elements in a specific ratio.

The different types of atoms (elements) are organized by their physical properties on the periodic table.

Molecules (molecular compounds) are made up of non-metal atoms held together by sharing electrons, referred to as a covalent bond. (example:  $H_2O$ )  
**MS-PS1-1**

Salts (ionic compounds) are made up of metal and non-metal atoms and are held together by charges created by a transfer of electrons, referred to as a ionic bond. (example: NaCl)  
**MS-PS1-1**

Natural molecules can be modified to produce different materials. (examples: plastic or nylon)  
**MS-PS1-3**

Molecules can be either extracted from natural resources or man-made (synthesized) in a lab. (example: aspirin)  
**MS-PS1-3**