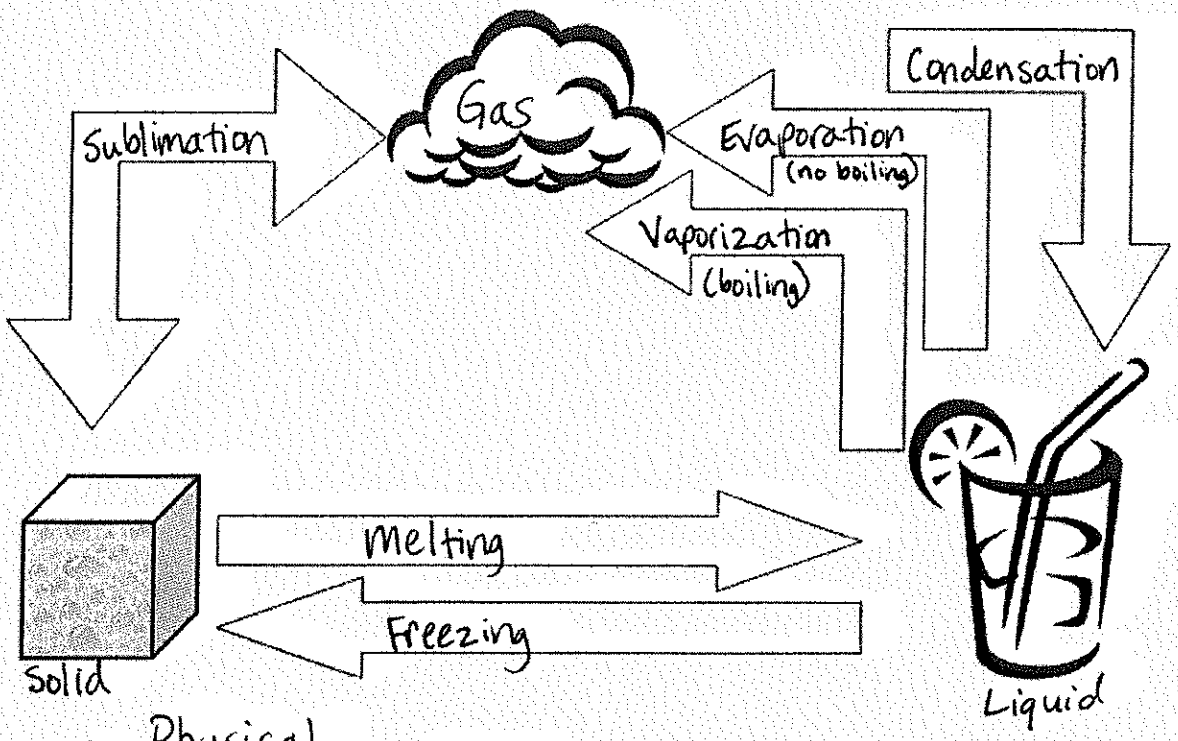
Chapter 2

Section 2.1

1. What is matter? Anything that has mass and occupies space (volume). There are three states of matter: solid, liquid, and gas
   a. Solid – definite shape, definite volume, not easily compressed. The particles are packed closely together in a rigid arrangement
   b. Liquid – indefinite shape (takes on the shape of its container), definite volume, not easily compressed. The particles are close together, but are free to flow past one another. Most expand slightly when heated.
   c. Gas – indefinite shape, indefinite volume (will expand to fill any volume), easily compressed. The particles are relatively far apart and can move freely.
      - Vapor – gaseous state of a substance that is generally a liquid or solid at room temperature (water vapor)
      - Gas – substances (like oxygen) that exist in the gaseous state at room temperature)
   d. Changes of state
      - Condensation – gas or vapor changes to a liquid (morning dew, water droplets on outside of a cup)
      - Melting – solid to liquid (popsicles on a hot day)
      - Freezing – liquid to solid (making ice cubes)
      - Evaporation – liquid changes to gas or vapor without boiling (water level decreasing in a fish tank)
      - Vaporization – liquid changes to gas or vapor due to boiling (boiling water in a tea kettle)
      - Sublimation – gas or vapor changing directly to a solid (frost) or solid changing directly to a gas or vapor without becoming a liquid first (dry ice)



2. Physical Properties
   a. Characteristics that can be observed or measured. A quality or condition of a substance that can be observed or measured without changing the substance's composition.
      - Substance – matter that has a uniform and definite composition.
   b. Can be used to describe the substance:
      - Freezing point, melting point, boiling point, color, size
3. Physical Changes
   a. These changes don't change the identity of the substance. Some properties of a material change, but the composition of the material doesn't change.
      - Tearing a piece of paper, sharpening a pencil, cutting a log, freezing, melting, or boiling a substance
      - Can be classified as reversible (boil, freeze, melt, condense, and all changes of state) or irreversible (break, grind, cut, crush)

4. Intensive Properties of Matter
   a. Depends on the type of matter in a sample, not the amount of matter.
      - Freezing / melting / boiling point, density, ability to conduct heat or electricity.
5. Extensive Properties of Matter
   a. Depends on the amount of matter that is present
      - Volume – measure of the space occupied by the object
        - Smaller volume will heat up or cool down quicker
        - Larger volume will heat up or cool down slower
      - Mass – measure of the amount of matter the object contains
        - Mass
          - Measurement of the amount of matter that makes up an object
          - Is measured by using a balance comparing a known amount of matter to an unknown amount of matter
          - Mass does not change because of location
          - Units are grams or kilograms
        - Weight
          - Is measured on a scale, using downward force
          - Measurement of how heavy something is when exposed to gravity
          - Gravity can change, so can weight
          - The moon's gravity is 1/6 as strong as earth's gravity
            a. Weight on earth would appear to be more than weight on the moon
            b. Ex: 150 pounds on earth = 25 pounds on the moon

Section 2.2

6. Building blocks of matter
   a. Atoms –smallest unit of all things, made up of protons, neutrons, and electrons
   b. Elements – pure substances that are made up of only one type of atoms. Found on the Periodic Table of Elements. Simplest form of matter that has a unique set of properties
   c. Compounds – Made from the atoms of two or more elements that are chemically bonded. Substance that contains two or more elements chemically combined in a fixed proportion.
7. Mixtures
   a. Blend of two or more kinds of matter, each retaining its own identity and properties.
   b. Components are simply mixed together (physical change) and can usually be Separated
   c. Two types of mixtures:
      - Homogeneous mixtures – same proportion throughout. Also called Solutions. Can be liquids, gases (air), or solids (stainless steel)
      - Heterogeneous mixtures – not uniform throughout. Sometimes, the heavier items will settle
      - Examples:
        - Air — Homogeneous
        - Black coffee — Homogeneous
        - Blood — Heterogeneous
        - Cupcake with frosting — Heterogeneous
        - Hot Tea — Homogeneous
        - Italian Salad Dressing — Heterogeneous
        - Milk, straight from the cow — Heterogeneous
        - Milk, in a container from the store — Homogeneous

- Orange juice with pulp — Heterogeneous
- Root beer float — Heterogeneous
- Salt water — Homogeneous
- Sand — Heterogeneous
- Stainless steel (metal alloy) — Homogeneous
- Sugar water — Homogeneous
- Wood — Heterogeneous

8. Separating Mixtures
   a. Differences in physical properties can be used to separate mixtures
      - Filtration – process that separates a solid from the liquid in a heterogeneous mixture
      - Distillation – a liquid is boiled to produce a vapor that is then condensed into a liquid

Section 2.3

9. Pure Substances
   a. Fixed composition. See Figure 2.11
   b. Different than a mixture because:
      - Every sample of a pure substance has exactly the same characteristic properties (same physical and chemical properties).
      - Every sample of a pure substance has the same composition
   c. Pure substances can either be elements or compounds
      - Compounds can be broken down into elements by a chemical change. Elements cannot be broken down into simpler substances.
      - Chemical change – change that produces matter with a different composition than the original matter
   d. Properties of compounds are quite different from those of their component elements (See Figure 2.10)
   e. Chemists use chemical symbols to represent elements and chemical formulas to represent compounds.
      - Each element is represented by a one or two letter chemical symbol.

- The first letter of the symbol is always Capitalized but if there is a second letter, it is always lower case.
- Chemical symbols can be based on English, Latin or even the element's name in other languages.

  - Chemical formulas account for the elements in a chemical compound. Subscripts in chemical formulas are used to indicate the relative proportions of the elements in the compound.
    - H_2O – water, 2 Hydrogens | Oxygen
    - $C_{12}H_{22}O_{11}$ – sucrose, 12 Carbons 22 Hydrogens 11 Oxygens

Section 2.4

10. Chemical Properties
    a. Substance's ability to undergo changes that transform it into different substances
       - Carbon is able to be burned in oxygen and iron rusts in the presence of oxygen
       - Chemical properties can be observed only when a substance undergoes a chemical change.
11. Chemical Changes
    a. During a chemical change, the composition of matter always Changes.
    b. One or more substances are converted into different substances (Reaction takes place)
    c. Reactants – a substance present at the start of a reaction
    d. Products – substance produced in the reaction
    e. Example: Carbon burns in oxygen produces carbon dioxide

$$C + O_2 \rightarrow CO_2$$

carbon + oxygen → carbon dioxide

Reactants → Products

12. Recognizing Chemical Changes
    a. Transfer of energy (heat or light), change in color, production of gas, formation of a precipitate
       - Precipitate – solid that forms and settles out of a liquid mixture

Name: _____

13. Examples of Changes:
    a. P Sugar dissolves in warm water
    b. C A nail rusts.
    c. P A glass breaks.
    d. C A piece of paper burns.
    e. P Iron and sulfur mix and form a partially magnetic black and yellow mixture.
    f. C Iron and sulfur are heated and form a non-magnetic shiny grey substance.
    g. P Dry Ice (solid carbon dioxide -- CO_2) is sublimed at room temperature.
    h. C Vinegar reacts when mixed with baking soda.
    i. P Water boils at 100 degrees Celsius.
    j. C Zinc when immersed in hydrochloric acid produces hydrogen gas.

14. Conservation of Mass – during any chemical reaction, the mass of the products is always equal to the mass of the reactants.
    a. 1st law of thermodynamics – law of conservation of mass states that in any physical change or chemical reaction, mass is conserved. Mass is neither created nor destroyed.

HANDWRITTEN NOTES

- Element – listed on Periodic Table
- Compound – water (H_2O), sugar ($C_6H_{12}O_6$), salt (NaCl), hydrogen peroxide (H_2O_2), Chemically combined/reaction
- Mixture – koolaid, tap water, physical change, sand, cough syrup, sugar water, salt water

HANDWRITTEN NOTES

- Physical – change in temperature/state (p 2), change in appearance (bend, break, cut), mixed together (p 7), sugar or salt dissolved in water
- Chemical – "reacts" "produces" rust, gas given off, burning