Chemistry

Matter and Change
Lesson 3
Lesson Plan
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Matter

Objectives: Identify the characteristics of matter and substances, Differentiate among the 3 states of matter, Define physical property and list several common physical properties of substances

- Matter – anything that has mass and takes up space
    - Mass – the amount of matter an object contains
    - Compare golf ball and ping pong ball – golf ball has more mass and therefore contains more matter. – or use two objects around the room
- Substance
    - Sugar is a kind of matter with a chemical name of sucrose – it always is made up with the same chemical composition
    - Matter with a uniform and definite composition is called a substance
        - Substances only contain one kind of matter
        - Lemonade would not be a substance since the amount of water, sugar and lemonade juice can vary from batch to batch
- Physical Property
    - All samples of a substance have identical physical properties
        - Sugar dissolves in water and tastes sweet
        - Physical property is a quality or condition of a substance that can be observed or measured without changing the substance's composition. Includes:
            - Color
            - Solubility (how much can be dissolved into a given amount of water)
            - Odor
            - Hardness
            - Density (mass/volume)
            - Melting point
            - Boiling point.
    - Example – boils at 100°c and melts at 0°C – water
- States of Matter
    - What 3 forms does water exist in? (water, ice, steam)
    - Solid – (ice) – has a definite shape and volume
        - Particles are packed tightly together
        - Makes a solid almost incompressible
        - Expands only slightly when heated

- Liquid – (water) – takes the shape of the container, constant volume
  - Particles are in close contact, but not rigidly packed together
  - Makes a liquid almost incompressible
  - Expands moderately when heated
- Gases (oxygen) –takes the shape and volume of the contain
  - Particles are spaced far apart
  - Easily compressible
  - Gases refer to those substances that are in a gaseous state at room temperature
  - Vapor refers to substances that are normally a solid or a liquid at room temperature

Property	Solid	Liquid	Gas or vapor
Shape	definite	indefinite	indefinite
Volume	definite	definite	indefinite
Expansion on heating	very slight	moderate	great
Compressibility	almost Incompressible	almost incompressible	almost incompressible

- Physical Change
  - Altering a substance without changing its composition
    - Grinding, bending, cutting, boiling, freezing, crushing, splitting, condensing, dissolve

Mixtures

Objectives: Categorize a sample of matter as a substance or a mixture, Distinguish between homogeneous and heterogeneous samples of matter

- Mixtures – gold rush – how to separate gold from sand
  - Example – a salad is made up of lettuce, tomatoes, cucumbers, ham, egg, bacon bits, croutons, smoothed in Blue Cheese dressing – compare this to dissolving sugar into un-sweet tea
    - The salad is not a uniform mixture (one bite is different from the next – the salad is a heterogeneous mixture
    - The tea is a uniform mixture – once dissolved, the sugar is spread out evenly in the tea so one sip tastes like another – the tea is a homogeneous mixture
- Homogeneous mixtures are called solutions
  - Can be gas, liquid or solid
  - Has the same composition in any portion
- A part of a mixture with uniform composition is called a phase
  - Homogeneous mixtures have one phase

    - Oil and Vinegar when put together do not mix – this is a heterogeneous mixture with 2 phases
- Separating Mixtures
    - Heterogeneous mixtures can be separated by physical means
        - Salad – use a fork to separate the various components
        - A mixture of sulfur and iron filings you could use a magnet
    - Homogeneous mixtures can not be separated physical
        - Sugar water – boiling the water off will leave the sugar
        - Distilling the sugar water would leave the sugar behind and give you pure water

Elements and Compounds

Objective: Explain the difference between and element and a compound, Identify the chemical symbols of common elements when given their symbol

- Distinguishing Elements and Compounds
    - Carbon (lead in a pencil or a diamond), Oxygen (supports combustion), Hydrogen (explosive gas:Hindenburg) – together make up sugar
    - Elements are the simplest forms that matter can exist under normal laboratory conditions
    - Compounds are substances that can only be separated into simpler substances by chemical means
    - Show picture on Page 36 of heating sugar ($C_{12}H_{22}O_{11}$)
        - Adding heat, the H & O form water vapor that is driven off leaving behind the C) Further heating produces no changes, thus carbon is an element.
        - Sugar $\xrightarrow{heat}$ Carbon + Water
        - Comp. Element comp.
        - Water $\xrightarrow{electricity}$ Hydrogen + Oxygen
        - Comp element element
- Salt – Sodium Chloride - NaCl
    - Chlorine – used in bleach (Clorox)
        - At room temperature it is a colorless gas – deadly
        - Used to disinfect water
    - Sodium – used in sodium vapor street lights (orange color)
        - At room temperature is a metal – stored in oil
        - If available, drop a small piece of sodium into water

Activity: make up 20 numbered cards: 1 oxygen, 2 neon, 3 apple, 4 sand, 5 iron, 6 water, 7 air, 8 paint, 9 sodium chloride, 10 sucrose, 11 carbon dioxide, 12 granite, 13, laundry detergent, 14, citric acid, 15 cereal, 16 salad, 17 salad dressing, 18 copper, 19 salt water, 20 gold

Create 2 columns with 1&2 under column A and 3&4 under column B. Ask students to think about the criteria for each column.

Ask where you would put iron? (A)
Ask where you would put water? (A)
Continue on until the students understand the criteria – A is for uniform and definite composition (substances) B is for mixtures
Column A 1,2,5,6,9,10,11,14,18,20
Column B 3,4,7,8,12,13,15,16,17,19

- Symbols and Formulas
  - Each element is represented by a one or two letter chemical symbol
  - Most are the first or second letters of the name – others are derived from the Greek or Latin name – therefore the symbol does not correlate to the English name
  - 1st letter is always capitalized, if there is a second letter it is always lower case
  - Symbols allow a short hand to write formulas of compounds
    - Water – H_2O
    - Carbon Dioxide - CO_2
    - Sugar – Sucrose – $C_{12}H_{22}O_{11}$
    - Salt – Sodium Chloride NaCl

Learn the following symbols: 1-18.

Chemical Reactions
Objectives: Differentiate between physical and chemical changes in matter, Apply the law of conservation of mass

- Changing Reactions to Products
  - Rust – ever seen it – what is it, where did it come from?
    - Iron + Oxygen -> Rust
    - This is a chemical reaction
    - Reactant + Reactant -> Product(s)
    - Iron and Oxygen are reactants
    - Rust is the product
  - Ability of a substance to undergo a chemical reaction and form new substances is called a chemical property
    - Chemical properties are only observed during a chemical change
    - Chemical change always results in a change in chemical composition of the substances involved
    - Burn, rot, rust, decompose, ferment, explode, corrode
  - Previous example had a physical mixing of sulfur and iron – separation by a magnet was a physical change – same mixture heated produces a chemical change
    - Iron + sulfur $\xrightarrow{\text{heat}}$ iron sulfide
    - The arrow indicates "changes into" or "produces"
    - Reactants to the left, products to the right

    - Try hydrogen and water
        - Hydrogen + Oxygen $\longrightarrow$ water
- How do you know a chemical reaction took place?
    - Heat, light, odor, color change, gas from a solid or liquid
        - Chemical reactions are usually not easily reversed
            - Rust on your car – can not change it back to iron
        - Physical changes often are (ice to water to steam)
- Conservation of Mass
    - Burning a log leaves a small light pile of ashes
        - In reality, the burning produced the ashes, plus carbon dioxide and water vapor
        - Careful measurements would show that the mass of the log + the oxygen consumed would equal the mass of the ash+$C0_2$+H_20^{vapor}
        - The mass of the products is always equal to the mass of the reactants – mass is neither created or destroyed
        - The law of conservation – in any physical or chemical reaction, mass is neither created nor destroyed; it is conserved.