Properties of a Candle

- Amount of Light + Heat Energy - extensive
- Height - extensive
- Time it takes to burn - extensive
- Flammability, Ability to burn - intensive
- Temperature - intensive
- Mass - extensive
- Hardness - intensive
- Volume - extensive
- Color - intensive

- Solid Wax -> Liquid Wax -> Gaseous Wax
    - The wax melts, then travels up the wick by capillary action, then it evaporates
    - The wax (a hydrocarbon), reacts with the Oxygen in the air and forms Carbon Dioxide, water, and heat.

Extensive vs. Intensive Properties

- Extensive: A property that changes as the size of the sample changes.
- Intensive: Properties that don't change depending on the size of the sample

Physical Properties

- A physical property is a characteristic of a substance that can be observed or measured without altering the identity of the substance
    - Examples: Volume, hardness, mass, color, etc.

- A **physical change** is a change in appearance but not composition
    - Examples: State of matter

Chemical Properties

- A chemical property is the way a substance may react or change to form a different substance
    - Examples: flammability, amount of energy
- A **chemical change** is when bonds are broken and new ones are formed
    - Example: Iron rusting

See Video: Introduction: The Chemical History of a Candle by Michael Faraday (1/6)

Atoms

- Atom are constantly moving
- Atoms are attracted to each other
- Amount of energy atoms have influences their ability to interact with each other.

States of Matter

Solids

- Attractive forces btwn the molecules **>** energy causing them to move apart
- Motion of atoms is limited to vibrations
    - Fixed Shape
    - Fixed Volume
    - Non-compressible

Liquids

- Have more energy than solids
- Atoms can move freely past one another, but tend to remain close together
    - No fixed shape
    - Fixed volume
    - Non-compressible

Gases

- Attractive forces btwn the molecules **<** energy causing them to move apart
- Little interaction with each other, besides bumping into each other
    - No fixed shape
    - No fixed volume
    - Compressible

Plasma

- Atoms have so much energy that they break apart
- Atoms are destroyed in violent collisions

Classes of Matter

- Pure substances
    - Any variety of matter that is homogeneous and has a fixed composition

    - Elements: a pure substance made entirely of one type of atom
        - 118 Elements
        - Organized on the periodic table
        - Cannot be separated using a chemical reaction
    - Compounds: composed of 2 or more different elements, chemically combined in a fixed proportion
        - Fixed composition
        - Can be represented by a chemical formula
            - The ratios of the elements stay the same
        - They **can** be destroyed by chemical reactions
        - Compounds have **emergent properties**
        - Examples: Water (H_2O), Carbon Dioxide, $C_6H_{12}O_6$
- Mixtures
    - Composed of 2 or more pure substances, in which the substances retain their identity. No chemical reaction occurs.
    - Composition can be varied

- **Homogeneous Mixtures:** All parts of the mixture are alike. Does not vary from one region to the next.
- **Heterogeneous Mixtures:** Not uniformly dispersed.

How to Separate a Mixture

- Only mixtures can be separated by physical methods. You can't separate a compound with physical methods.
  - **Physical methods** are techniques that perform separation without changing the identity of the mixtures' components
- A common physical method is called **distillation** (works by boiling point)
  - You heat up the mixture to the boiling point of the solvent (water), not the solute (salt), so the water evaporates.
  - The evaporated water is put through a tube called a condenser, which is surrounded by a bigger tube that is being supplied with cold water, so that the heat from the H_2O gas is transferred to the external loop.
    - It's like water-cooling a PC.
  - Then, the cooled water condenses into a container, purified.
- **Filtration** is separating a heterogeneous mixture by difference in particle size
  - Filtering seawater and sand through a filter, because the sand can't fit through the holes in the filter.

If you have sand and salt, how do you separate them? You add water, then filter out the sand, then distill out the salt.

- **Chromatography** is separating a mixture using differences in solubility in water and attractiveness to the paper
  - Say you have a beaker of water and a piece of paper. You draw a line with black marker on the paper. Then, when you put the paper in the water, it will travel up the paper by capillary action. The ones with the most solubility and the least attractiveness to the paper will travel up

it in the water the farthest. The one with the least solubility and the most attractiveness will stay on the bottom.