Required Knowledge

Auburn Mountainview

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Math

- **Basic Algebra: In class formulas will be presented.**
  - **All but the variable to solve for should be given.**
  - **Isolate the variable (P E MD AS)**
  - **In class final answers should be rounded to the tenth and highlighted or boxed.**

Math

- **What is the volume of a 5.0-g block which has a density (ρ) of 3.0-g/cm^3?**

$$\rho = \frac{m}{V}$$

$$3.0 - \frac{g}{cm^3} = \frac{5.0 - g}{V}$$

$$V = \frac{5.0}{3.0} - cm^3$$

$$V = 1.66 - cm^3$$

$$\rho = 3.0 - \frac{g}{cm^3}$$

$$m = 5.0 - g$$

V = ?

$$\boxed{V = 1.7 - cm^3}$$

Math: Percentage

- **The ratio of part to whole.**
- **On a calculator will be in decimal form.**
  - **x100 for final answer (.956 is 95.6%)**
  - **÷100 to put in calculator (12.5% is .125)**

$$\% = \frac{Part}{Whole}$$

Accuracy and Precision

- **Accuracy: When a measured value is very close to the accepted value.**
  - **Error analysis measures against accuracy.**
- **Precision: When measured values are very close to each other.**

Accuracy ≈ Answer, Precision ≈ Placement

Accuracy v. Precision Visual

No Accuracy

No Precision

Good Accuracy

Good Precision

No Accuracy

Good Precision

Good Accuracy

No Precision

Which is Better?

- **Having a high degree of precision without accuracy shows that there is probably a variable affecting the outcome that is being overlooked.**
- **As for accuracy, remember even a broken clock shows the correct answer twice a day.**
- **It is best to be precisely accurate.**

How to use Accuracy

- **Error Analysis: For quantitative data only.**

$$\frac{|\text{Measured Value} - \text{Accepted Value}|}{\text{Accepted Ave}}$$

This is a Percentage. (ex: .15266 = 15.3%)

Accepted Values may be given by a teacher, found online, or self calculated.

Units

- **There are two types of scientific units (SI).**
  - **Base: Can not be broken down**
    - **Ex: Length = Meter**
  - **Derived: Two units combined (x or ÷)**
    - **Ex: Energy = Joules which is a derived from Force x Distance (Newton x Meter)**
- **In class try to avoid non SI units.**

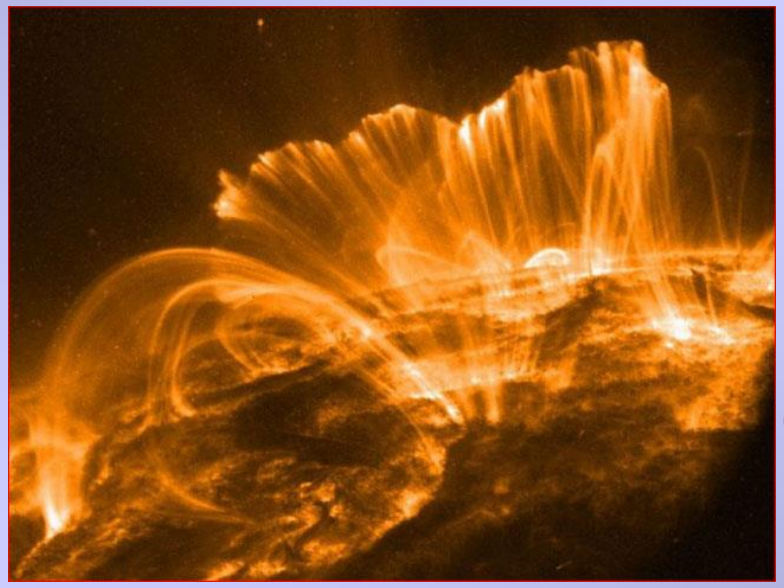
Base Units

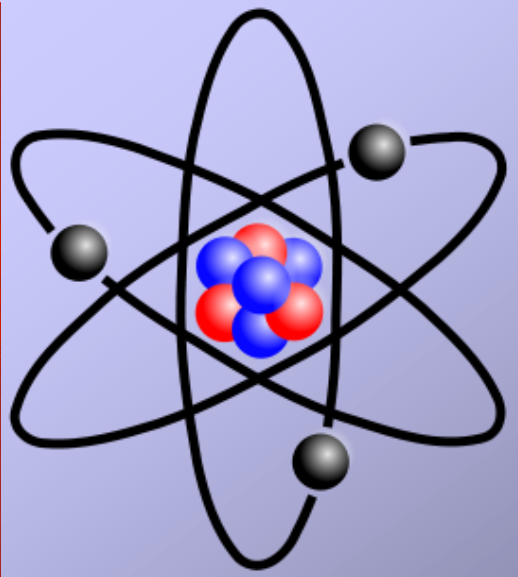
- **Mass: Kilogram-Kg**
- **Length/Width/Height: Meter-m**
- **Time: Second-s**
- **Chemical Amount: Mole-mol**
- **Temperature: Kelvin-K**
- **Electric Current: Ampere-A**
- **Luminous Intensity: Candela-cd**

Non SI common Base Units

- **Volume: Liter-L**
- **Temperature: Centigrade-C**
- **Energy: calorie-cal (Not Calorie-Cal)**
- **Pressure: Atmosphere-atm**
- **Pressure: millimeters of mercury- mm Hg**

Prior Atomic Knowledge





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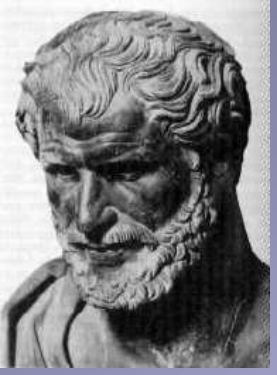


ca. 450-370

1766-1884

- Democritus was the first to think all stuff was made of the atom.
- In 1803 John Dalton came up with this:
  - Each element is composed of extremely small particles called atoms.
  - All atoms of any element are identical, but they differ from those of any other element.
  - Atoms are neither created or destroyed in any chemical reaction.
  - A given compound always has the same relative numbers and kinds of atoms.

The Atom

"There is nothing but atoms and space, everything else is only an opinion."
- Democritus from Abdera

Atomos: Greek for that which is indivisible, is the key building block of the Universe.

1789: French nobleman Antoine Lavoisier formulates the conservation of mass law, defining an element as a basic substance that can not be further broken down by the methods of chemistry.

1897: British physicist J. J. Thomson discovers the electron. Proposes that the electrons are distributed throughout the atom. Called the 'Plum Pudding' Model (Think of a Blueberry Muffin).

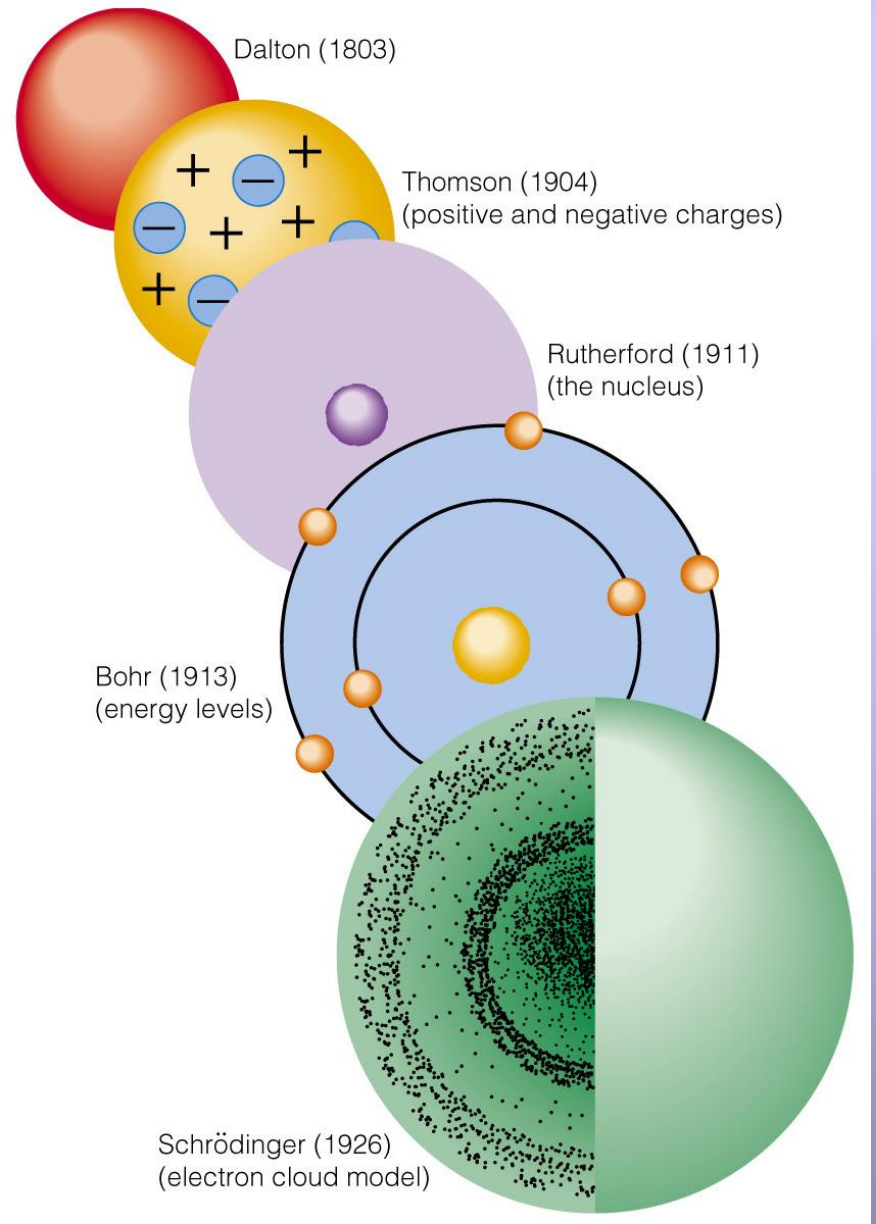
1909: British physicist Ernest Rutherford determines that the center of the atom must be positively charged. The 'Rutherford' Model

1913: Rutherford and others work to develop the idea of the Proton.

1919: American chemist Irving Langmuir determined that electrons can be the reason why elemental properties repeat.

1932: British physicist James Chadwick, while working with radiation, discovers the neutron.

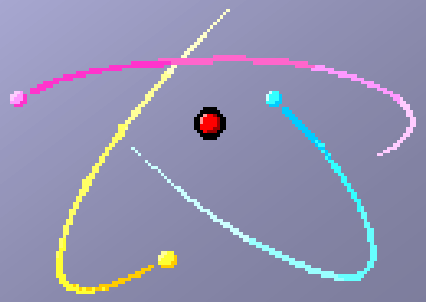
The Visual Atom



The Atom

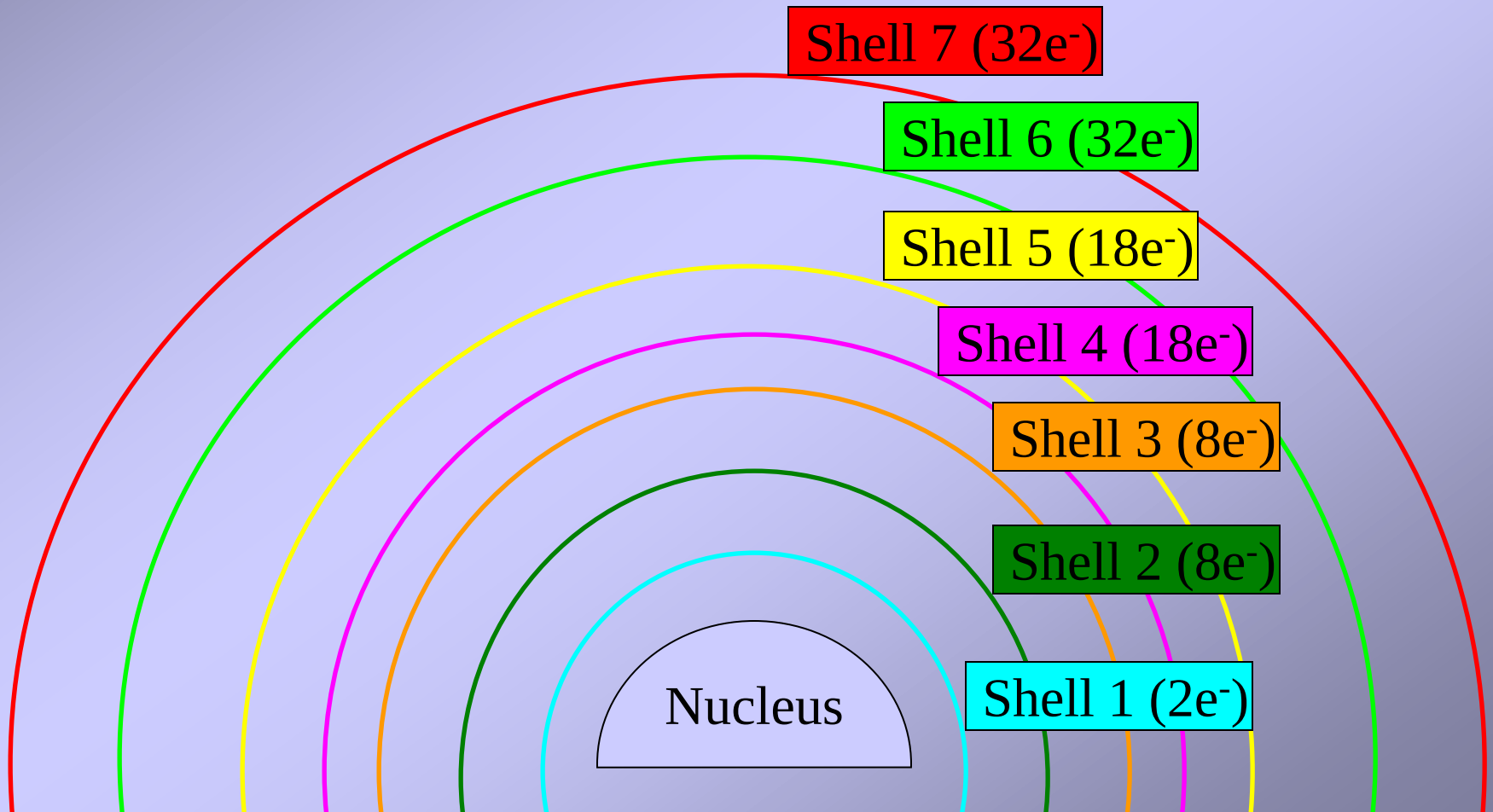
Current Theory

- **Atoms are made up of three sub-particles**
  - ✓**Positively charged particles are called protons.**
  - ✓**Negatively charged particles are called electrons.**
  - ✓**Non-charged particles are called neutrons.**
- **Atoms have two parts**
  - ✓**The central nucleus contains protons and neutrons.**
  - ✓**Electrons orbit the nucleus like bees around a hive.**
- **This model is called the "Planetary Electron Cloud Model."**



Electron's (Simplified)

- **Electrons orbit at set *distances* from the nucleus called shells or clouds.**



Energy

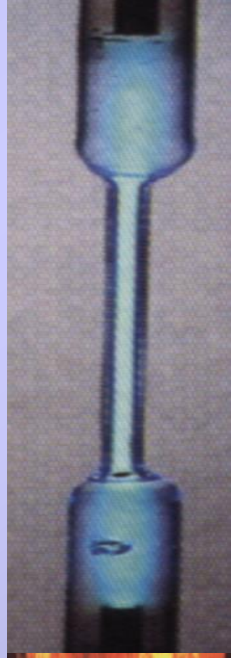
- **Energy is the capacity to do work or to produce heat.**
- **There are three broad types; Radiant, Potential, Kinetic.**
- **There is a finite amount of energy that can be used which brings about three rules.**

The Big Three

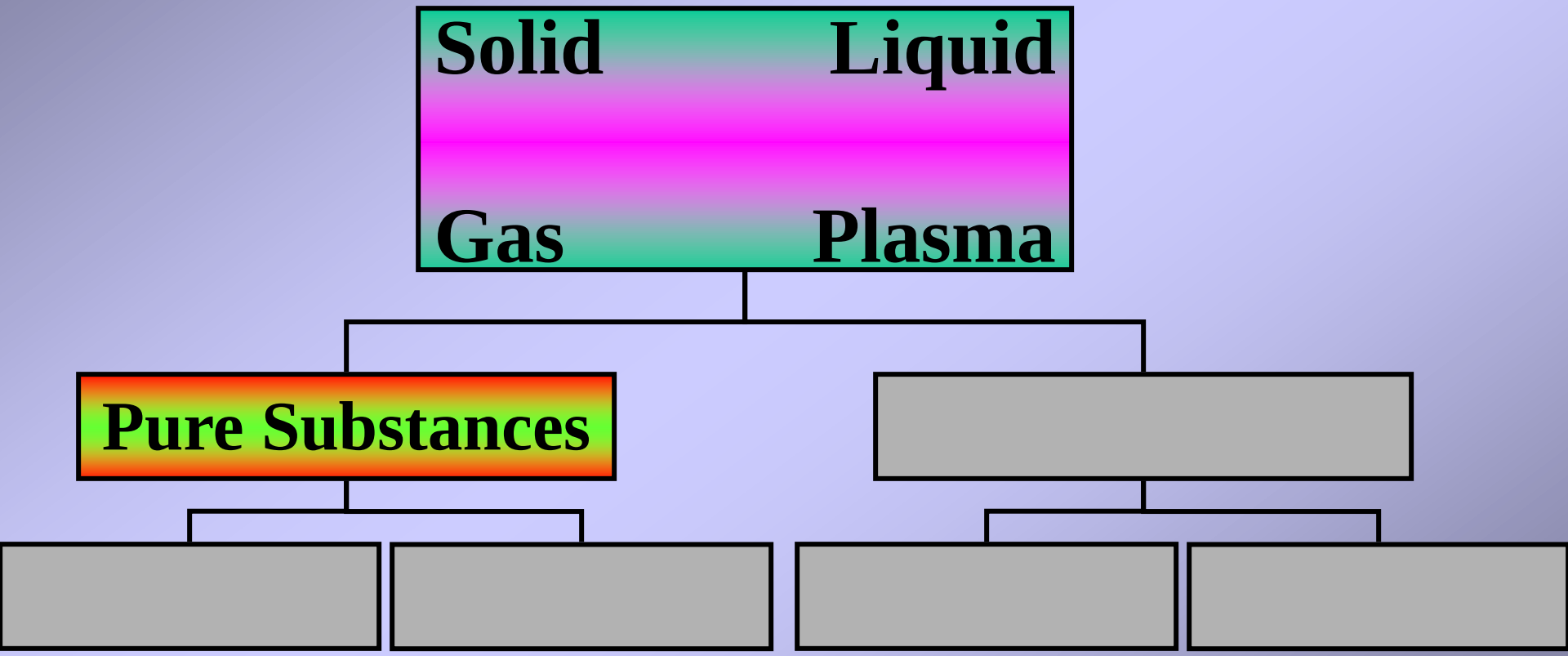
- **Energy can not be created!**
- **Energy can not be destroyed!**
- **Energy can be changed…**
  - **Energy can change from potential → kinetic potential → radiant or radiant → kinetic…**
- **Wasn't it Einstein who said $E=mc^2$?**
  - **Actually it's more like $E^2=m^2c^4+p^2c^2$**

Matter

- **Matter: Anything that takes up space and has a mass. There are five types of matter…**
- **Solid: High density matter that has both a definite shape and volume.**
  - **Example: Sucrose (Sugar)**
- **Liquid: High density matter that has a definite volume but no shape.**
  - **Example: Aqueous Copper II Sulfate**
- **Gas: Matter that has no fixed volume or shape. Density depends on pressure.**
  - **Example: Ionized Hg (Mercury)**
- **Plasma: Matter consisting of freely-moving charged particles. Density depends on pressure. Exists only at high temperatures.**
  - **Example: Gas Flame**
- **Bose-Einstein Condensation: The fifth state of matter that occurs at temperatures near absolute zero (point of no movement).**



Classifications of Matter

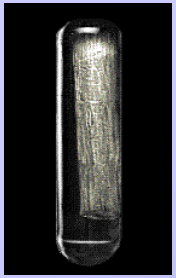


Pure Substances

Pure Substances

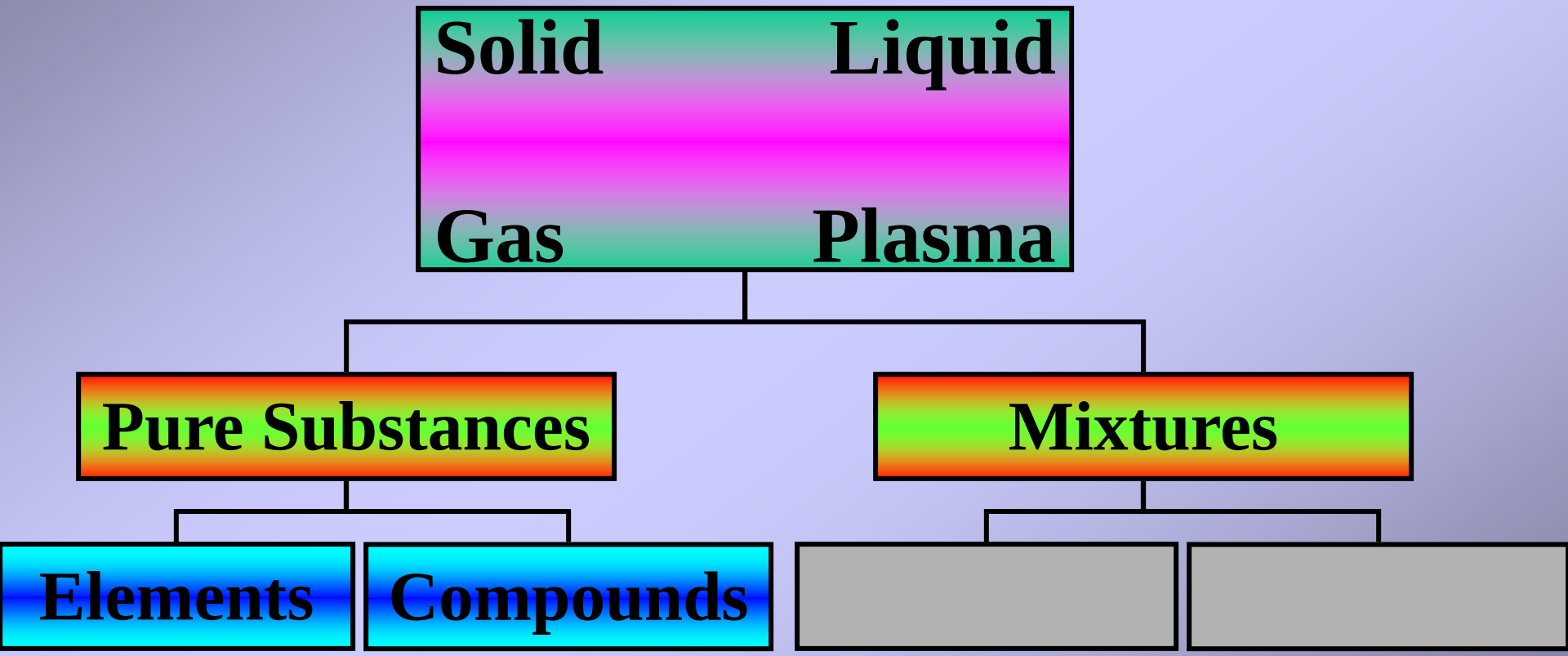
- **Elements**
  - **Lithium (Li)**
- **Compounds**
  - **Quartz (SiO_2)**

Elements are atoms with a set number of protons.



Compounds are two or more different atoms bonded together.

Classifications of Matter



Mixtures

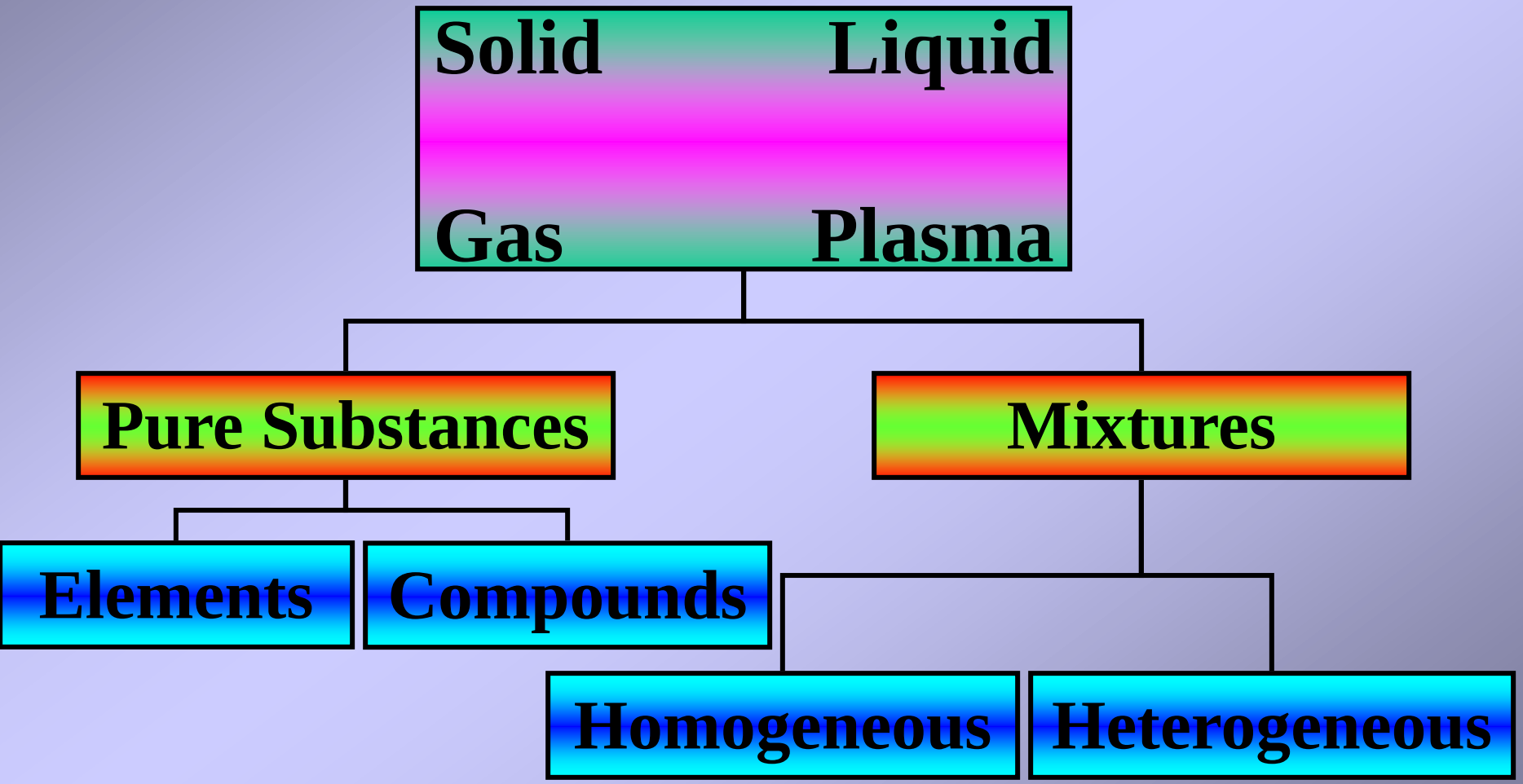
Mixture

- **Homogeneous**
  Salt Water
- **Heterogeneous**
  Salad Dressing

Homogeneous: Two or more compounds or atoms mixed (not bonded) together in equal proportions.

Heterogeneous: Two or more compounds or atoms mixed (not bonded) together in unequal proportions.

Classifications of Matter



Changing Matter

- **There are two ways to change matter:**
  - **Physical: Changes that do not alter the identity of the substance.**
    - **Phase Changes (Increasing/Decreasing Energy)**
    - **Magnetic (Temporary addition or removal)**
    - **Shape Changes (Molding, Drawing, Pounding)**
    - **Mixing/Crystallizing (Salt + Water, Carbon→ Diamond)**
    - **Breaking (Tear, Crush, Bend)**
  - **Chemical: Changes that alter the identity of the substance.**
    - **Oxidization/Reduction (Rust, Tarnish, Burn)**
    - **Cooking (Denaturing Proteins)**
    - **Organic (Photosynthesis, Ripening, Rotting)**
    - **Reacting (Synthesize, Decompose, Replace)**