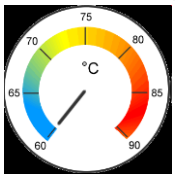
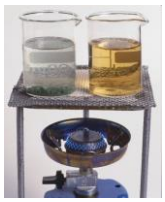
Physical Science

Chapter 14
An Introduction to Matter

Describing Matter:

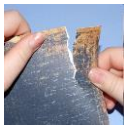
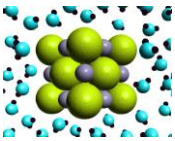
- **Matter -** is anything that has mass and occupies space
- **Properties of Matter** - How is it described: Hot, cold, hard, soft, rough, smooth, shiny, dull, solid, liquid, gas, etc.
- **Characteristic Properties** -Those properties of a given substance that do not change and therefore can be used to help identify the substance. **Boiling Point, Melting Point, Freezing point**





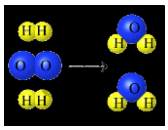
Changes in Matter

- **Physical Change** -A change that alters the form of a substance but not the chemical makeup of the substance, a change of state
  - Words like: *crush, smash, tear, evaporate, slice, breakdown, dissolve, absorb, swell, burst*
- **Chemical Change** - One or more substances combine or decompose to form a chemically different substance
  - Words like: *react, burns, forms, decomposed, rusting, sours, rotting, digesting, cooked, molecular change*

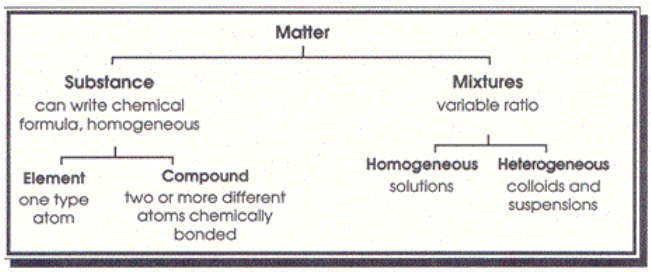









Types of Matter

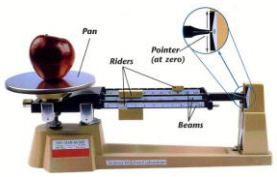


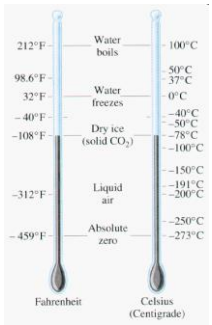
- **Pure Substances** – Those substances made up of one kind of matter. It has definite characteristic properties
  - **Elements:** Contain only one type of atom, H, He, Na, Mg, C, N, O,
  - **Compounds:** A pure substance formed by the chemical combination of two or more elements - CO_2, H_2O, $C_6H_{12}O_6$, NaCl
- **Mixed Substances (Mixtures)–** two or more substances that are mixed together but not chemically combined.
  - **Homogeneous** Mixture: a very well mixed mixture -solution of sugar water
  - **Heterogeneous** Mixture: not evenly mixed - handful of dirt, Rocky Road Ice Cream,

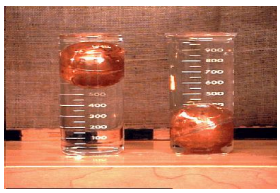
Measuring Matter

- SI – **International System of Units** = the metric system
  - **Length** – the one dimensional measurement of distance – SI unit is Meter, Kilometer
  - **Mass** – the amount of matter in a substance – SI unit: gram or kilogram
  - **Weight** – the force of gravity acting on an object – SI unit: Newton
  - **Volume** – how much space an object occupies – SI unit: liter, milliliter, cm3
    - **Solid Volume = Length x Width x Height = cm^3, $meter^3$**
    - **Liquid Volume = liter, milliliter**
    - **1ml = 1cm3**
  - **Density** – the amount of mass an object has in a given volume – SI unit: g/ml, g/cm3
    - **Density= Mass / Volume**
  - **Temperature** – the average kinetic energy of an object.
    - ^0C = Centigrade or degrees Celsius, ^0K = degrees Kelvin
    - 0 ^0C = 273 ^0K
  - **Time:** unit of measure: second, minute

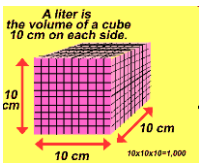
Measuring Matter





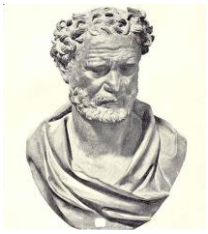


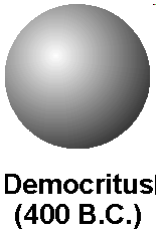
$$D=\frac{M}{V}$$



Particles of Matter

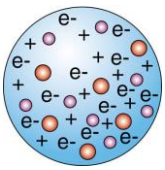
- **Atoms** – The smallest particle of an Element that retains the chemical properties of that element
- **Democritus** – 400 BC, a Greek philosopher that coined the term "**atomos**" which means "**uncuttable, indivisible**"



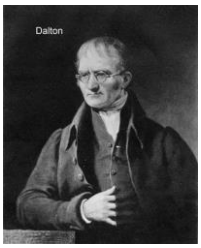


John Dalton -1802 - The Atomic Theory

- **Ding-a-Ling!! Ding-a-Ling!!**
- Atoms can not be broken into smaller pteces – atoms are like a solid marble (Not entirely accurate)
- In an element all atoms are exactly alike (Not entirely accurate)
- Atoms of two or more elements can combine to form compounds (this is true)
- Atoms of each element have a unique mass (Not entirely accurate)
- Compounds are always composed of whole number proportions of elements ie CO_2 – Carbon dioxide, H_2O – Water, $C_6H_{12}O_6$ – Glucose, NaCl – Table Salt (this one is true also)

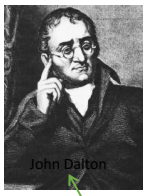


The basic particle of an Element is the Atom – H, He, Fe, etc
The basic particle of a Compound is the Molecule – a group of atoms that are chemically
bonded and act as a single unit until the bonds are broken: CO_2, H_2O, $C_6H_{12}O_6$, NaCl



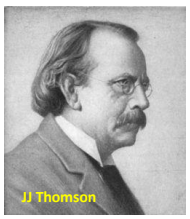
Atomic Models in History

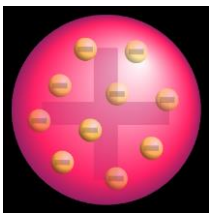
- **Democritus**, Greek philosopher, around 400 BC used the term "atomos" which means "indivisible-unbreakable" to describe (where we get the word "atom")



- **John Dalton**, 1808 – very similar to Democritus said atoms were like solid balls

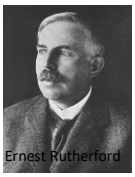
- **JJ Thomson**, 1897 – described the atom as a positively charged sphere with negatively charged electrons embedded inside to create a neutrally charged particle. Often described as a muffin w/ berries scattered throughout.

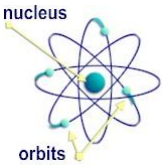




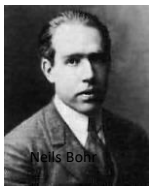
Atomic Models in History

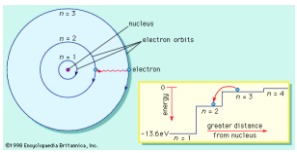
- **Rutherford**, 1911 – refined Dalton's theory & stated atom is mostly empty space and the negatively charged electrons randomly orbit the positively charged nucleus.





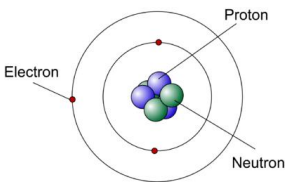
- **Bohr**, 1913 – Said electron NOT random but in specific layers or energy levels. Increasing in energy the farther from the nucleus





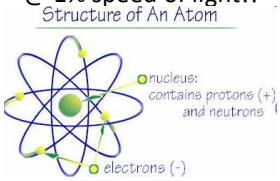
- **Chadwick**, 1932 – realized the mass of the atoms didn't correspond to the mass suggested by Bohr's model. He discovered the neutron and determined they were in the nucleus with the protons

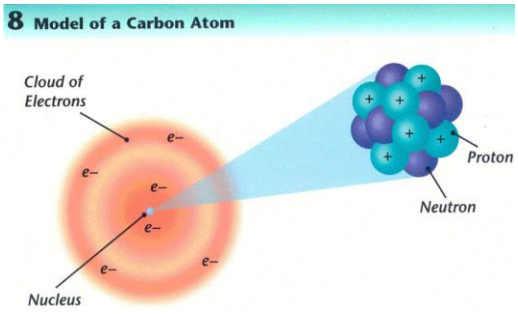
- **Modern Theory**, present – shows electrons not in orbits but specific clouds, each having their own level of energy



Parts of an Atom

- An atom consists of a nucleus surrounded by one or more electrons
- Atoms are **electrically neutral** w/ the **same number of protons as electrons**
- Majority of the atom is **empty space**. If nucleus were the size of a pencil eraser, the closest electron would be 100 yards away!
- Subatomic Particles
  - **Protons**
  - **Neutrons**
  - **Electrons**
- Nucleus: Tightly packed Protons & Neutrons
- Electrons Orbiting nucleus @ 1% speed of light!!





I give up!!
No mas!!
NO mas !!