Chapter 3-1

Sub-atomic Particle	Charge	Location	Mass
proton	positive	nucleus	1 amu
neutron	zero	nucleus	1 amu
electron	negative	on energy levels around the nucleus	very small

- **The most mass of the atom is in the nucleus since it contains the protons and the neutrons with considerable mass compared to electrons.**
- **The most volume of the atom is occupied by the fast-moving electrons around the nucleus.**
- **# of protons is called the atomic # and it is unique for each element.**
- **# of neutrons varies in the atoms of the same element.**
- **Atomic mass # equals to the sum of the # of protons and # of neutrons.**
- **Atomic mass equals to the mass of the protons and the mass of the neutrons in amu units.**
- **Since the mass of each proton or neutron is 1 amu, the number portion of the atomic mass # and the atomic mass is the same.**
- **# of electrons equals to the # of protons in the neutral atom.**
- **The valence electrons are found on the outermost energy level; they have an important role in chemical reactions by either being lost or gained or shared.**
- **Electron dot diagram shows the symbol and # of valence electrons in an atom.**

Chapter 3-2
The Periodic Table

- Elements are arranged according to their atomic #.
- Each square in the periodic table includes the element's
  - atomic # (# 0f protons)
  - chemical symbol (ex. C, Cl, Au, Ca)
  - name (ex. Carbon, Chlorine, Gold, Calcium)
  - atomic mass (mass of the protons and the neutrons)
- An element's properties can be predicted from its location in the periodic table.
  a. groups/columns/families:
     - 18
     - usually named based on the first element in the group
     - elements in the same group have similar characteristics because of the same # of valence electrons
  b. periods (rows)
     - 7
     - show the # of energy levels around the nucleus
     - elements in the same period have different properties
     - some elements in periods 6 and 7 have been separated out of the table and are at the bottom for convenience to keep the table from becoming too wide.

Chapter 3-3
Metals

- Physical Properties:
  - hard
  - shiny
  - ductile (drawn into wire)
  - malleable (pounded without breaking)
  - good conductors of heat and electricity
  - some have magnetic properties
  - most are solids at room temperature so they have high melting points. Mercury (Hg) is the only liquid metal.
- Chemical Properties
  - some are very reactive; are stored under oil in sealed containers, ex. Sodium (Na) in group 1.
  - some are non-reactive, ex. Gold (Au) used as gem since it's shiny, Chromium (Cr) used to make stainless steel to prevent iron from rusting
  - some are in between, ex. Iron (left in air will form rust, which is a form of corrosion)
- Alloy: mixture of 2 or more metals for better quality (heat resistant, rust resistant, stronger), ex. Bronze, brass, stainless steel

Metal	Group	Property	Name/Symbol	Use
Alkali Metals	1	* Most reactive * Lose 1 e * Very soft	Lithium Li Sodium Na Potassium K	Battery, drugs Part of table salt For diet
Alkaline Earth Metals	2	* Reactive * Fairly hard * Bright white	Magnesium Mg Calcium Ca	Bulbs, alloys (lightweight) For bones, teeth, muscles
Transition Metals	3-12	* Bridge between reactive and non-reactive * Unusual colors	Iron Fe Copper Cu Nickel Ni Silver Ag Gold Au Zinc Zn Mercury Hg	All for jewelry, coins Iron is also part of hemoglobin of blood needed to carry oxygen and give the blood bright red color
Metals in Mixed Groups with Nonmetals and Metalloids	13-16		Aluminum Al Tin Sn Lead Pb	Cans, airplane parts Coating against corrosion Car batteries Lead is no more used in paints because it is poisonous.
Lanthanides and Actinides known as Rare Earth Metals	Bottom of periodic table	----- After U all elements are synthetic and radioactive because they have unstable nuclei.	----- Uranium U	Make alloys In nuclear power plants

Chapter 3-4
Non-metals

- Physical Properties
  - dull
  - brittle: non-malleable and non-ductile
  - poor conductors of heat and electricity
  - have lower densities
  - mostly gases at room temperature and therefore have lower boiling points; some are solids and one is a liquid (Bromine Br)
- Chemical Properties
  - Most readily form compounds (except group 18 because they have complete outermost energy levels) by gaining or sharing electrons.

  - Diatomic Molecule: consists of the same two elements, ex. H_2

- Groups

  Carbon Family (14): 4 valence electrons
  The only non-metal there is Carbon C; all organic things and compounds contain carbon

  Nitrogen Family (15): 5 valence electrons
  Nitrogen N: 80% of air is nitrogen gas; nitrogen is part of proteins, it is found in fertilizers
  Phosphorus P: used in matches and flares

  Oxygen Family (16): 6 valence electrons
  Oxygen O: 20% of air is oxygen gas; ozone in the Stratosphere is a form of oxygen, O_3
  Sulfur S: has unpleasant odor; is used in tires, some medicines, rubber bands
  Selenium (Se): one of the rare elements on earth

  Halogen Family (17): 7 valence electrons
  They are the most reactive non-metals; most dangerous to humans
  Fluorine F: used in non-stick cookware and tooth decay prevention products
  Chlorine Cl: part of table salt; also used in compounds to melt snow
  Bromine Br: with silver used in photographic film
  Iodine I: used in antiseptic solutions

  Noble Gases (18): 8 valence electrons
  The only group with only non-metals
  They don't form compounds because they have complete outermost energy levels.
  Helium He: used in balloons
  Neon Ne: used in electric lights
  Other noble gases: used in electric lights; each one responsible for one color

  Hydrogen H
  Simplest element with 1 proton and 1 electron
  Its chemical properties are much different from those of other elements; it can't be grouped with others; it is placed on top of group 1 elements since it has 1 valence electron.
  Most of the Earth's hydrogen is combined with oxygen in water.

- Metalloids
  - border between metals and non-metals
  - have some characteristics of metals and some of non-metals
  - Silicon Si forms sand, glass, cement; Boron B is used in cleaning solutions; Arsenic As is very poisonous
  - Most useful property is their varying ability to conduct electricity depending on the temperature, light, or presence of impurities; therefore they are used as semiconductors in computer chips, transistors, and lasers

Chapter 3-5

- **At high pressures and temperatures, such as in the stars, matter exists in the plasma state where**
  - **atoms are stripped of their electrons**
  - **nuclei are packed together**
  - **nuclei collide with each other very fast**
  - **if the nuclei have enough energy, they can join to form larger nuclei releasing huge amounts of energy; this process is called nuclear fusion**

- **In stars larger than the sun, the temperature is much higher and therefore heavier elements can form.**

- **In the final hours of the most massive stars, a tremendous explosion (Supernova) occurs that breaks apart the star producing very high temperatures enough for nuclear reactions to occur.**