Chapter 4 Lesson 5 Notes: Radioactive Elements

Remember:

- Atoms are composed of particles (protons, neutrons, electrons)
- The **nucleus** is composed of protons and neutrons
- **Atomic Number** = the number of protons (this number never changes and is unique for each element).
- **Atomic Mass** = the number of protons + the number of neutrons
- **Isotopes** = elements of the **same atom** that have different numbers of neutrons
- The number of protons = the number of electrons

1. **Radioactive Decay**: the process in which the atomic nuclei of ***unstable isotopes*** release fast-moving particles and energy
    a. ***Unstable Isotopes*** = their nuclei do not hold together well (decay, break apart)
    b. Henry Becquerel (1896) first discovered the effects of radioactive decay in uranium.
        - He proposed that uranium spontaneously gives of energy all the time, thus is called it radiation.
        - Marie Curie and Pierre concluded that a reaction was taking place within the uranium nuclei, which became a property known as radioactivity.
        - **Radioactivity**: the spontaneous emission of radiation by an unstable atomic nucleus
        - Marie Curie discovered that some minerals containing uranium were even more radioactive.
        - She isolated two new elements: Polonium and Radium

2. **Types of Radioactive Decay**
    a. Alpha Decay
        - **Alpha Particle**: consists of two protons and two neutrons and is positively charged (essentially a Helium atom)
        - The release of an alpha particle decreases the atomic number by 2 and the mass by 4.
        - **Example**: thorium-232 (#90) nucleus decays to produce an alpha particle and a radium-228 nucleus (#88)
    b. Beta Decay – a neutron inside the nucleus of an unstable atom changes into a negatively charged beta particle and a proton.
        - **Beta Particle**: a fast-moving electron given off by a nucleus during radioactive decay
        - The new proton remains inside the nucleus
            1. The nucleus has 1 less neutron and 1 more proton

2. It's mass number remains the same but its atomic number increases by 1
3. **Example**: Carbon-14 nucleus decays to produce a beta particle and a nitrogen-14 nucleus.

c. Gamma Decay – usually follows alpha and beta decay.
- Gamma radiation: consists of high-energy waves, similar to x-rays.
    1. Also called gamma rays

3. Effects of Nuclear Radiation
    a. Alpha particles move very fast, but are stopped by collisions with atoms.
        - Alpha radiation can cause an injury to skin like a burn
    b. Beta particles are very fast and more penetrating than alpha particles.
        - These particles can go through paper but is blocked by aluminum.
        - The particles can penetrate skin and damage cells.
    c. Gamma rays are the most penetrating type of radiation.
        - Lead several centimeters thick or a concrete wall a meter thick can block the rays.
        - These rays can pass through a body and can deliver intense energy to cells and damage them severely.

4. Using Radioactive Isotopes – can be used in science and industry.
    a. **Tracers**: radioactive isotopes that can be followed through the steps of a chemical reaction or an industrial process.
        - Tracers can be used to find weak spots in metal pipes.
        - Gamma-ray images can detect small cracks in the metals of bridges and building frames.
        - Radioactive isotopes can be used to detect medical problems or treat some diseases.
            1. Radiation therapy can kill diseased cells.