

Chapter: Nuclear Chemistry

Section 3: Nuclear Radiation

Remember nuclear radiation includes alpha and beta particles and gamma rays:

- Alpha particles
 - Low penetrating ability (due to large mass and charge)
 - Cannot penetrate the skin
 - Dangerous if ingested or inhaled
- Beta particles
 - Travel at speeds close to the speed of light (3.0×10^8 m/s)
 - Can penetrate about 100 times greater than alpha particles
- Gamma Rays:
 - Greatest penetrating ability

Radiation Exposure:

- Nuclear radiation can transfer energy to electrons and cause ionization
 - Ionization remember is the amount of energy required to remove an electron from an atom
 - Ionization can damage living tissues
 - Cells are permanently damaged
 - Either die or reproduce different
- We are continually bombarded (exposed) by radiation from both natural and artificial sources
 - Infrared, Ultraviolet, Visible radiation from the Sun
 - Radio waves from radio and television stations
 - Microwaves from microwave ovens
 - X-rays from medical procedures
- Exposure to radiation increases when humans are at high altitudes
 - Increased cosmic-rays
 - Another use for our atmosphere!! ☺
- Radon-222 trapped inside homes will increase exposure
 - Radon is a noble gas...making it chemically unreactive
 - Inhaled with no direct chemical effect
 - After it decays, alpha particles are released and you are inhaling it
- **Roentgen:** unit used to measure nuclear radiation
- **Rem:** (roentgen equivalent, man)
 - radiation damage to human tissue is measured by rem

Radiation Detection:

- Nuclear radiation exposes film just as visible light does
- **Film badges:** exposure of film to measure the approximate radiation exposure of people working with radiation
- **Geiger-Müller counters:** instruments that detect radiation by counting electric pulses carried by gas ionized by radiation
 - used to detect beta-particle radiation

Applications of nuclear radiation:

- **radioactive dating:** process of finding the approximate age of an object using radioactive nuclides
 - using known half-lives
 - most common one used is carbon-14
 - measure the amount left inside you (animals consume carbon-14)
- **Medicine:**
 - Cobalt-60 is used in cancer treatments to destroy cancer cells (breast cancer)
 - Technetium-99 is used to detect bone cancer (injected into the body)
 - Lead aprons are used to reduce exposure during X-rays
- **Agriculture:**
 - Radioactive tracers (atoms incorporated into substances to monitor movement) are placed in fertilizers to determine effectiveness
 - Cobalt-60 is used to kill bacteria and insects that spoil and ingest food
- **Smoke Detectors**
 - Americium-241 is used in smoke detectors
 - Radiation ionizes air molecules and the ions conduct a small electric current. When this current is reduced by the presence of smoke particles, an alarm sounds

The end of section three talks about nuclear waste, nuclear fission, and nuclear fusion, which we will cover in section four.