RADIATION SAFETY

WHAT IS AN X-RAY?

- "… a form of radiant energy similar in several respects to visible light"
- As is the case for rays of light, a small part of an X-ray beam will be absorbed by air, and all of the beam will be absorbed by a thick metal barrier
- Main difference:
  - X-rays have much shorter wavelengths than those of UV light

WHAT IS AN X-RAY?

- X-rays are very short wavelength electromagnetic radiation
- The shorter the wavelength, the greater the energy and the greater the ability to penetrate matter
- X-rays are described as packets of energy called Quanta or Photons
- Photons travel at the speed of light
- Photon energy is measured in electron volts

IONIZATION

- An atom which loses an electron is ionized
- Photons having ≥ 15 electron volts can produce ionization in atoms and molecules
- **X-Rays**, **Gamma Rays**, and certain types of **UV** Radiation are Ionizing Radiation

IONIZING RADIATION IN RADIOLOGY

- **Ionizing Radiation can be carcinogenic and, to the fetus, mutagenic or even lethal**
- **Patients undergoing these types of studies are exposed to Ionizing Radiation:**
  - Radiographs
  - Fluoroscopy/Conventional Angiography
  - CT
  - Nuclear Medicine

GOALS OF RADIATION SAFETY

- Eliminate deterministic effects
- Reduce incidence of stochastic effects

EXPOSURE TO IONIZING RADIATION CAUSES TWO TYPES OF EFFECTS

- Deterministic Effects: A minimum threshold dose must be attained for the effect to occur. Examples include cataract formation, skin reddening (erythema), and sterility. Also referred to as "non-stochastic" effects
- Stochastic Effects: The effect may (potentially) occur following any amount of exposure – there is no threshold. Examples include cancer and genetic defects.

RADIOGRAPHY

- X-ray photons are produced when a Tungsten anode is bombarded by a beam of electrons
- Matter absorbs or scatters the X-rays
- Some X-rays reach the cassette, which contains an image receptor (either a sheet of film or an electronic device)

COLLIMATION – REDUCES SCATTER X-RAYS, THUS REDUCING DOSE TO HEALTHCARE WORKERS, AND ALSO IMPROVING IMAGE QUALITY

LIMITING YOUR EXPOSURE

Three basic methods for reducing exposure of workers to X-rays:

1. Minimize exposure **time**
2. Maximize **distance** from the X-ray tube
3. Use **shielding**.

LIMITING YOUR EXPOSURE: *YOU DO THE MATH!*

- Doubling your distance from the X-ray tube reduces your exposure by a factor of four
- Tripling your distance from the X-ray tube reduces your exposure by a factor of nine!

LIMITING YOUR EXPOSURE

- Maximize distance from the X-ray tube:
- Exposure varies inversely with the square of the distance from the X-ray tube

LIMITING WORKER EXPOSURE