

# Radiation Safety



Rules of Thumb

# Alpha Particle

- An alpha energy of at least 7.5 MeV is required to penetrate the protective layer of the skin (0.07mm).

# Beta Particle

- A beta energy of at least 70 keV is required to penetrate the protective layer of the skin (0.07mm).

# Beta Particle Continued

- The average energy of a beta-spectrum is approximately one-third the maximum energy.

# Beta Particle Continued2

- The range of beta particles in air is about 12 ft per MeV. (e.g. The maximum range of P-32 betas is:

$$1.71 \text{ MeV} \times 12 \text{ ft/MeV} \approx 20 \text{ ft}$$

# Beta Particle Continued3

- The skin dose rate from a uniform thin deposition of  $1 \mu\text{Ci}/\text{cm}^2$  is about 9 Rem/hr for energies above 0.6 MeV.

# Beta Particle Continued4

- For a beta emitter point source, the dose rate in rem/hr at one foot is approximately  $300 \times C_i$  where  $C_i$  is the source strength in curies.
- This calculation neglects any shielding provided by the air, which can be significant.

# Gamma & X-Ray

- For a point source gamma emitter with energies between 0.07 and 2 MeV, the exposure rate in R/hr at 1 foot is approximately  $6CEn$ , where C is the activity in curies; E is the energy in MeV; and n is the number of gammas per disintegration.



# Gamma & X-Ray Continued

- Gammas and x-rays up to 2 MeV will be attenuated by at least a factor of 10 by 2 inches of lead.