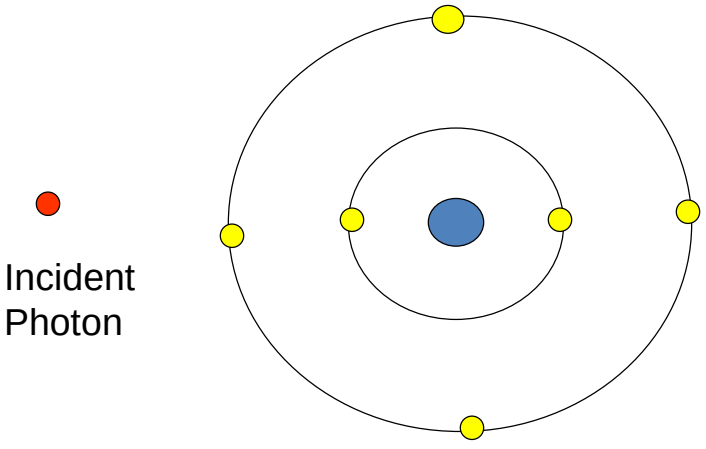
Introduction to Radiation

1C: X-Ray Interaction with Tissue; Inverse Square Law

Tissue Interactions

- Coherent, Thompson's or Classical Scatter
  - Low kinetic energy of motion
  - Excitation of an outer shell electron
  - Photon energy is not absorbed
  - Photon changes direction
  - Non-ionizing

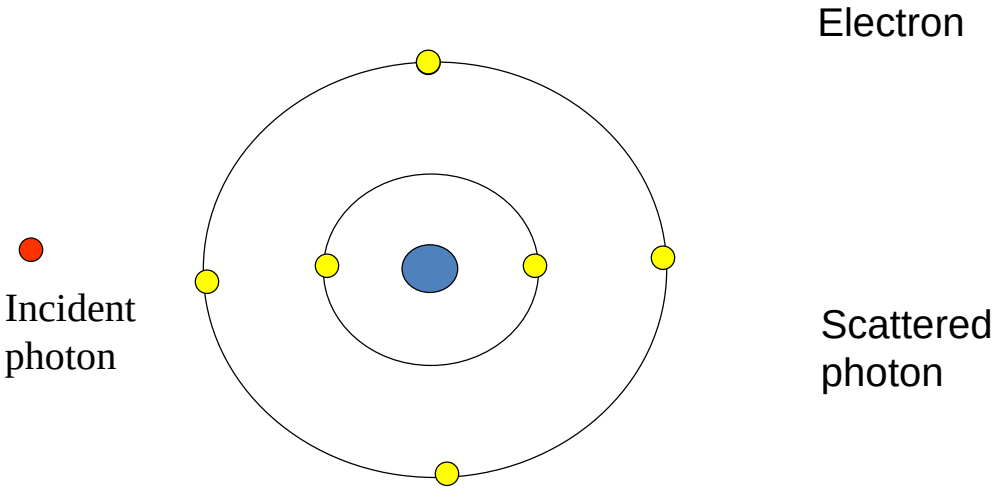
Coherent Scatter



Compton Effect (Scatter)

- Wide angle scattered photon
  - Operator-controlled radiation exposure
  - Outer shell ionization
  - Angle of scatter as much as 180°
  - Relevant as our exposure (as operators) is due to scatter radiation from the patient

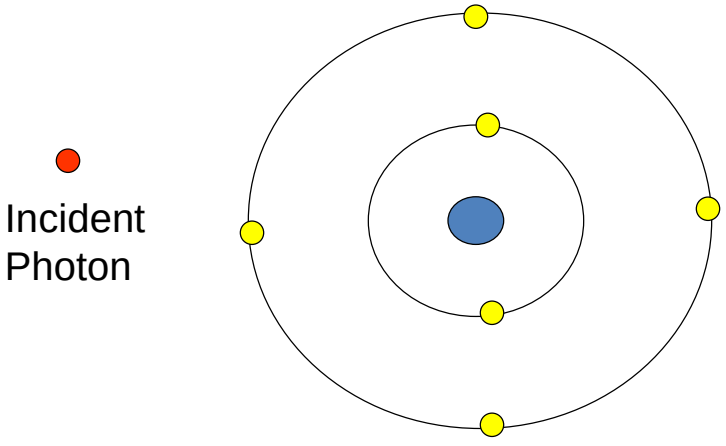
Compton Effect



Photoelectric Effect

- Optimum photon production
  - Discrete energy of the emitted photon
  - K shell interaction
  - Patient's absorbed dose

Photoelectric Effect



Inverse Square Law

- In regards to radiation exposure
- Intensity of the beam is inversely proportional to the square of the distance
- Dose or exposure <u>increases</u> by a factor of 4 if the distance is cut in <u>half</u>

$$\frac{I_1}{I_2} = \left(\frac{D_2}{D_1}\right)^2$$

Inverse Square Law

- At a distance of 3 feet from the source, one receives an exposure of 22 mrem. If that person moves to 6 feet from the source, what is the new exposure?
- I1 = 22; I2 = x; D1 = 3; D2 = 6

$$\frac{I_1}{I_2} = \left(\frac{D_2}{D_1}\right)^2$$

$$\frac{I1}{I2} = \left(\frac{D2}{D1}\right)^2$$

$$\frac{22}{x} = \left(\frac{6}{3}\right)^2$$

$$\frac{22}{x} = \left(\frac{36}{9}\right)$$

$$\frac{22}{x} = 4$$

$$4x = 22$$

$$\frac{4x}{4} = \frac{22}{4}$$

$$x = 5.5 \text{ mrem}$$