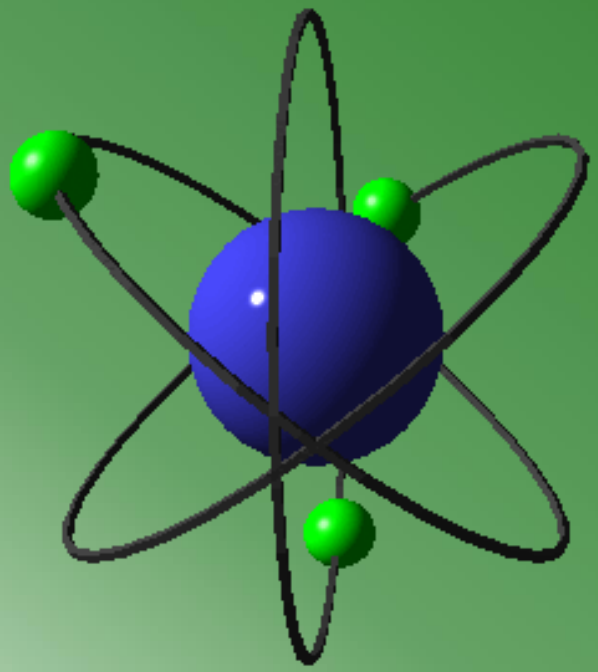
RADIATION

RADIATION

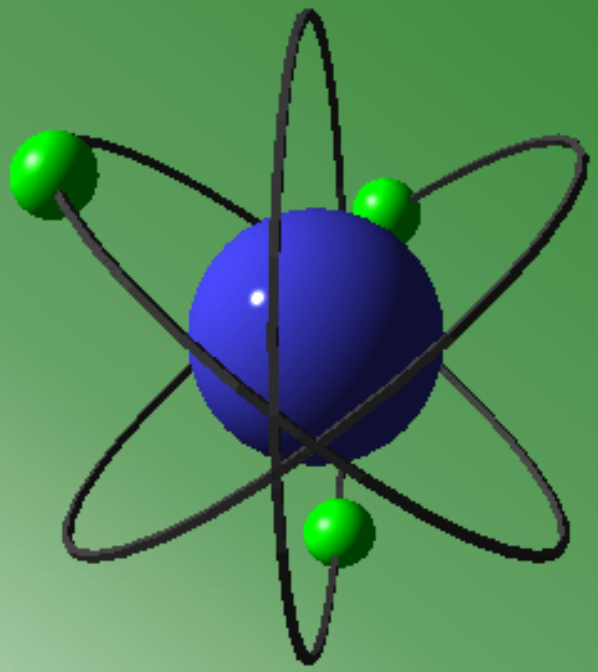
- There are three (3) primary categories of radiation that might be encountered in a field survey
  - Alpha
  - Beta
  - Gamma

RADIATION



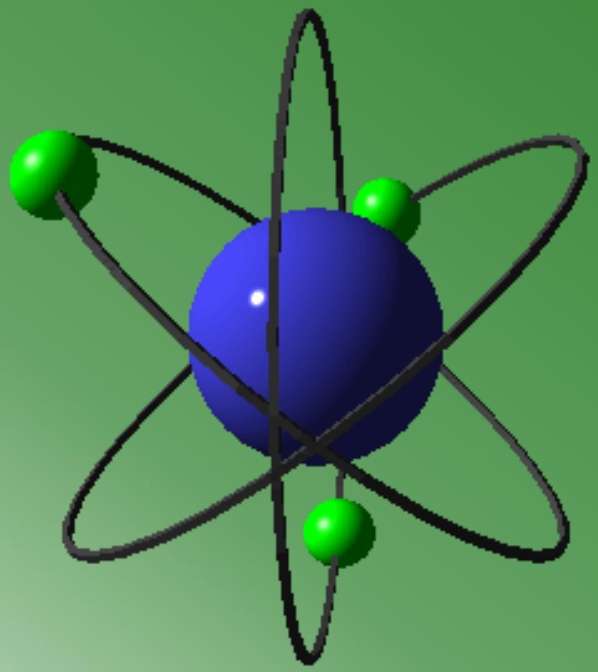
- Alpha
  - Energetic helium ions
    - (atoms that have lost their electrons)
  - Large size (compared to other forms of radiation)
  - High charge
  - Will not penetrate through much matter

RADIATION



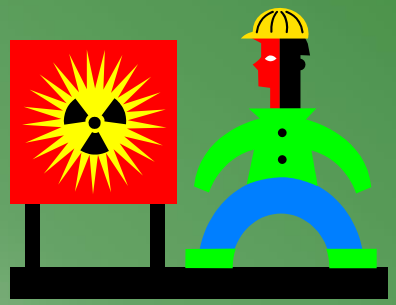
- Beta
  - Small size
  - Will penetrate through more material than alphas
    - Generally can be stopped by a thin piece of metal

RADIATION



- Gamma
  - High energy light
    - The most penetrating of the radiation types
  - Very high energy gammas can penetrate through several centimeters of lead

Definitions

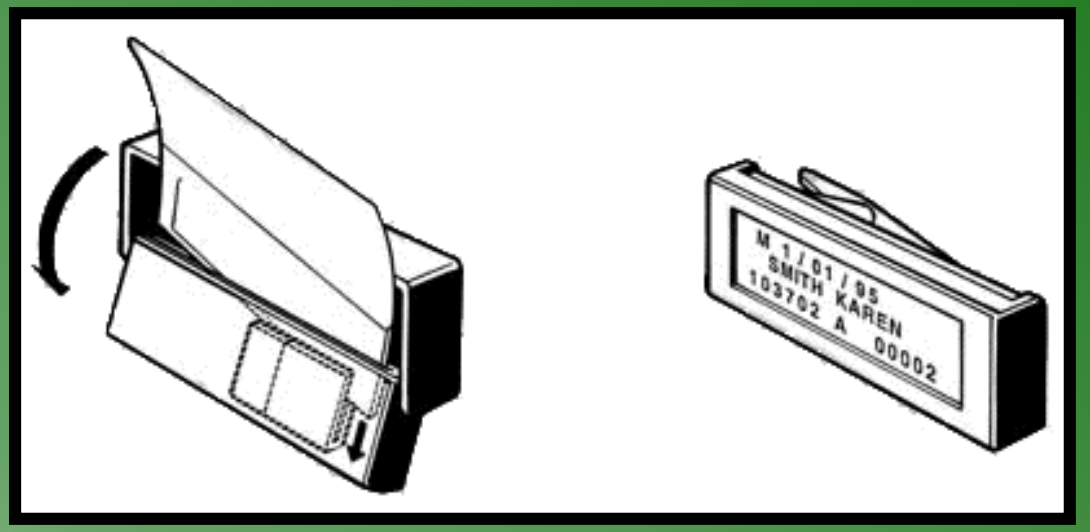


- Roentgen
  - The unit of measure for X or gamma radiation in air.
- Rad
  - The unit of measure for radiation energy transferred to an absorbing tissue.
- Rem
  - The unit of measure which represents the risk associated with the radiation exposure.

Definitions

- TLD:
  - Thermoluminescent Dosimeter
    - A device to measure Beta and Gamma exposure.

RING DOSIMETER



BADGE DOSIMETER

Definitions

- Gieger-Mueller Counter :
  - A device to measure Beta and Gamma exposure.

Definitions

- Curie:
  - 2,200,000,000,000 ($2.2x10^{12}$)
    - Disintegrations per minute (dpm)
- CPM:
  - Counts Per Minute
    - (Also known as the amount of disintegrations per minute (dpm))

Definitions

- Inverse Square:

$$IP = I_I \left(\frac{d_I}{d_2} \right)^2$$

A radioactive source with an activity of 10 µCi (microCuries) has a half-life of 100 days and gives a reading of 100 millirems per hour (mrem/hr) at 4 meters on a Geiger-Mueller counter.

What dose rate would you receive if you were 2 meters from the source?

4 meters

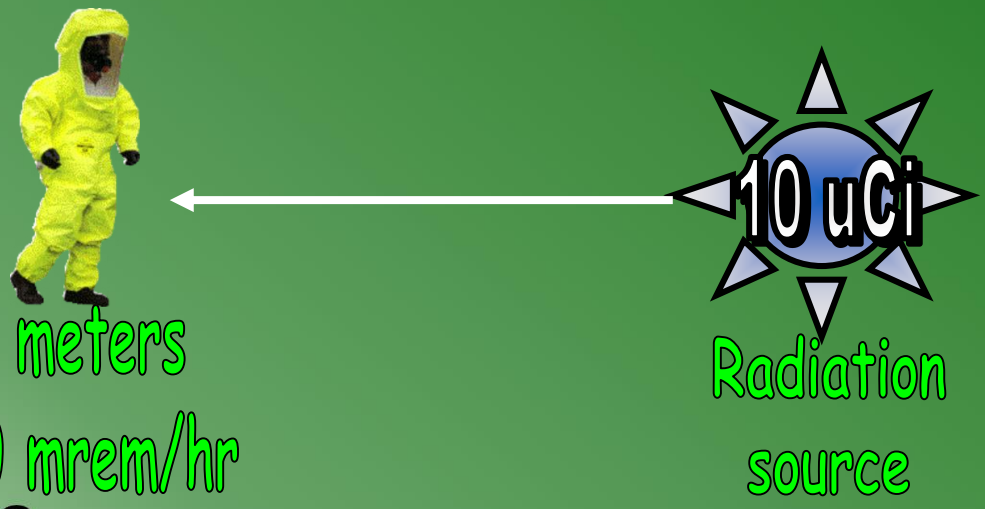
100 mrem/hr

10 uCi

Radiation source

A radioactive source with an activity of 10 µCi (microCuries) has a half-life of 100 days and gives a reading of 100 millirems per hour (mrem/hr) at 4 meters on a Geiger-Mueller counter.

What dose rate would you receive if you were 2 meters from the source?



A radioactive source with an activity of 10 µCi (microCuries) has a half-life of 100 days and gives a reading of 100 millirems per hour (mrem/hr) at 4 meters on a Geiger-Mueller counter.

What is the activity of the source after 100 days?

ALARA

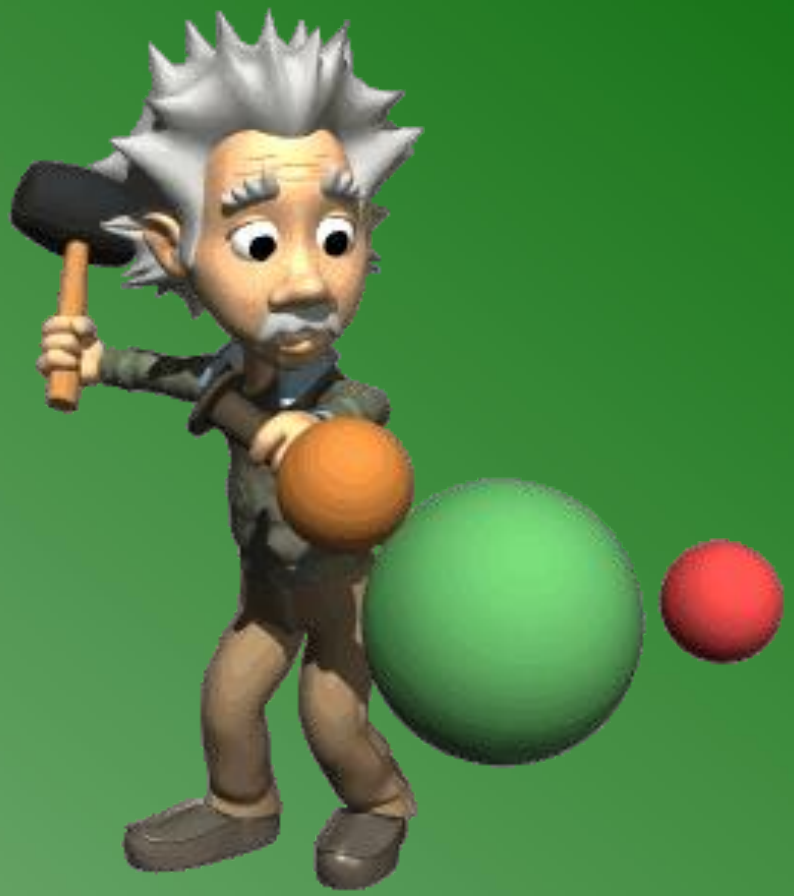
Always

Lie

About

Radiation

Accidents



Maintain Exposure ALARA

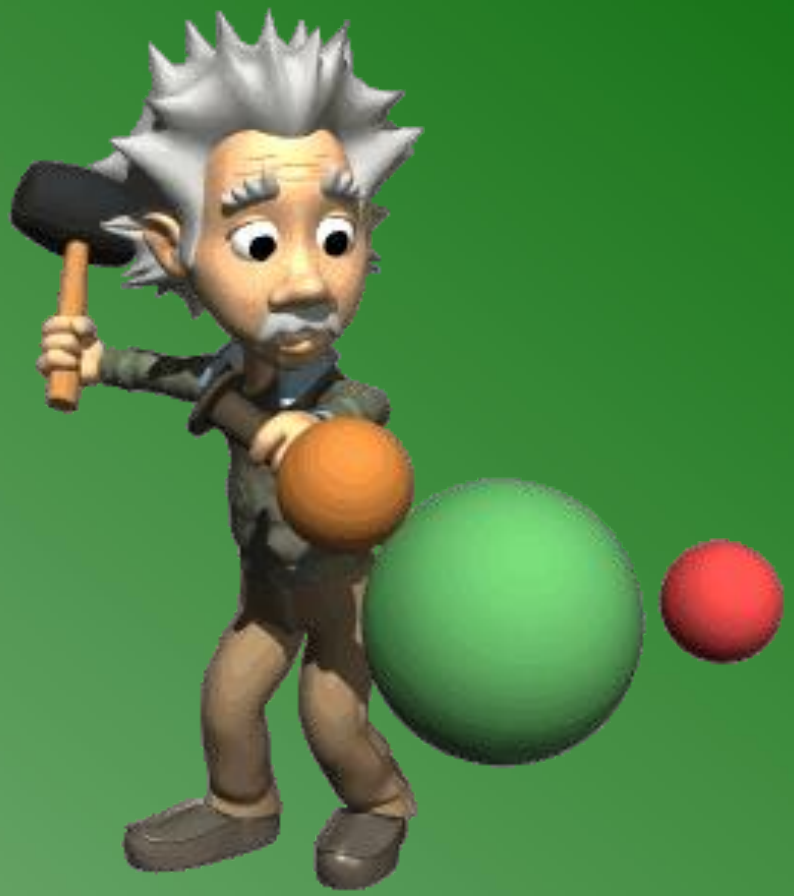
As

Low

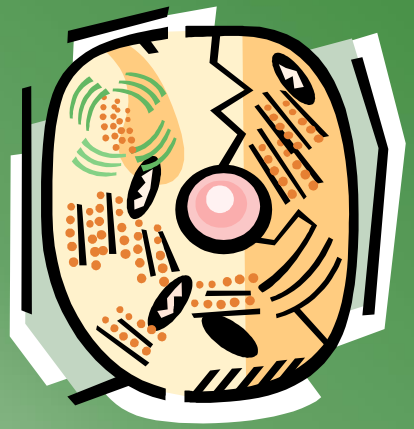
As

Reasonably

Achievable

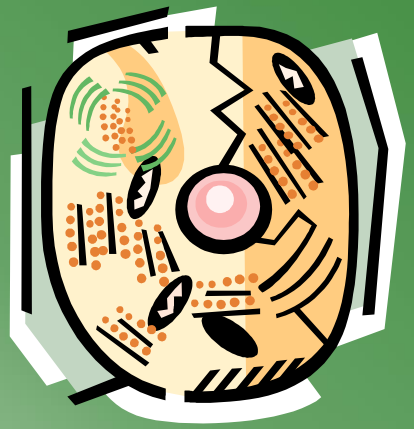


Radiation Exposure



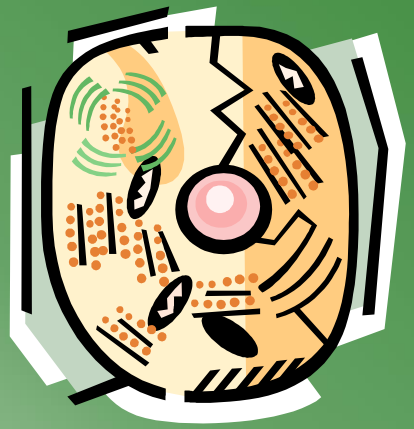
- One of four things may happen when radiation strikes a cell:
  1. The radiation may pass through the cell without doing any damage

Radiation Exposure



- One of four things may happen when radiation strikes a cell:
  2. The cell may be damaged but repairs itself

Radiation Exposure

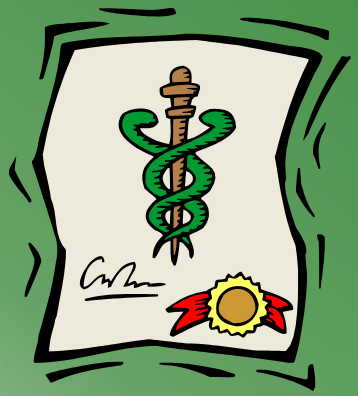


- One of four things may happen when radiation strikes a cell:
  3. The cell may be damaged so that it not only fails to repair itself, but reproduces in damaged form over a period of years
     - Incompletely or imperfectly repaired cells can lead to:
       - Delayed health effects
       - Cancer genetic mutations
       - Birth defects

Radiation Exposure

- One of four things may happen when radiation strikes a cell:
  4. The cell may be killed
     - Problems will occur if so many cells are killed that the body cannot properly function

Chronic Exposure Risk

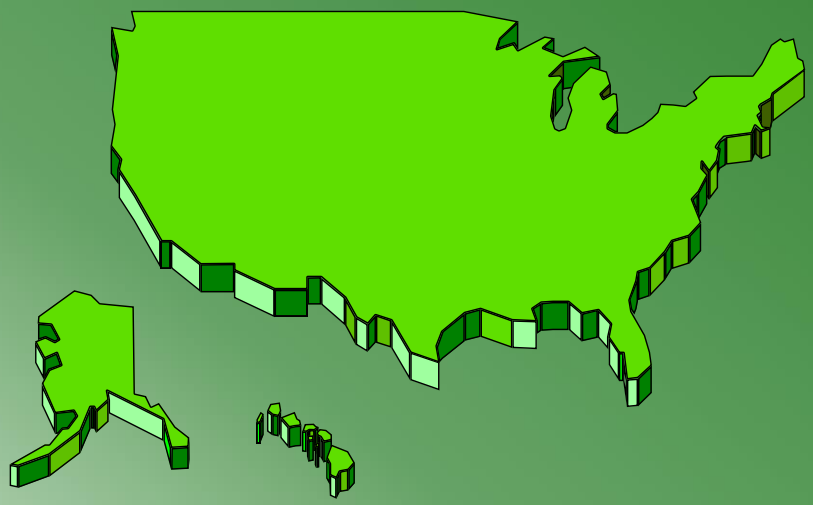


- A normal U.S. citizen has a 25% risk of cancer.
- 1 Rem increases risk to 25.03%
- 100 Rem increases risk to 28%.

Background Radiation

- Unavoidable
- Comes from cosmic sources & earth materials
- Averages .01 - .02 mR/hr gamma in the USA

Exposure Limits



- U.S. EPA Action Level:
  - 1 mR/hr gamma above background
- OSHA
  - 5 REM/year
- NRC
  - 5 REM/year

Exposure Reduction Mechanisms

- TIME
- DISTANCE
- SHIELDING

Summary

- There are three (3) primary categories of radiation
  - Alpha
  - Beta
  - Gamma
- Definitions
  - Roentgen
  - Rad
  - Rem
  - TLD
  - Curie
- Inverse Square
- ALARA
- Radiation Exposure
  - Background Radiation
  - EPA Levels
  - OSHA Levels
- Exposure Reduction Mechanisms
  - TIME
  - DISTANCE
  - SHIELDING