

Radiation Basics

Candace C. Davison, M.Engr.

Research & Education Specialist
Pennsylvania State University
Radiation Science and Engineering Center

Mary Lou Dunzik-Gougar, Ph.D.

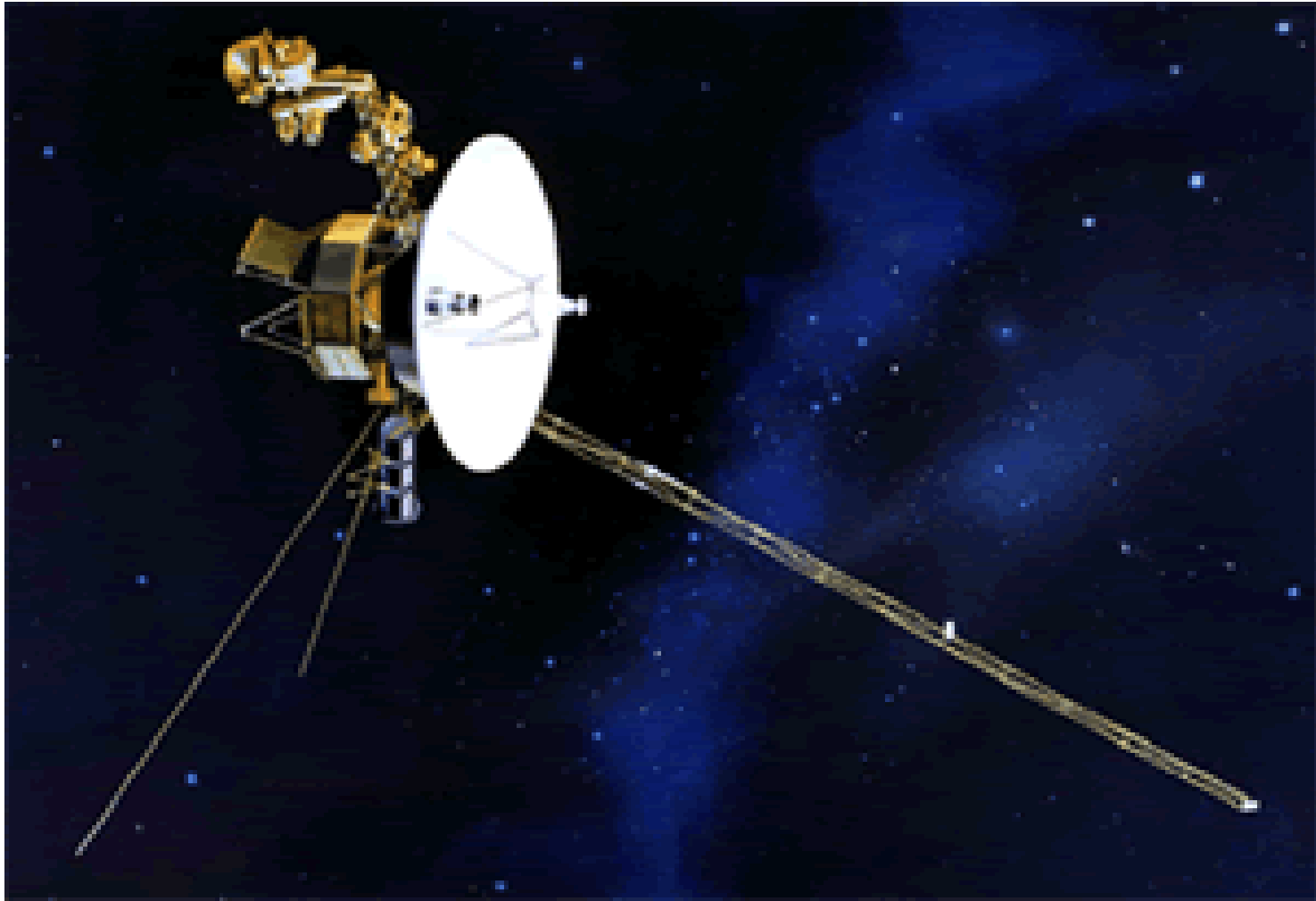
Assistant Prof of Nuclear Engineering
Idaho State University /
Idaho National Laboratory



Medicine/Health



Voyager



Soda Can



Bugs



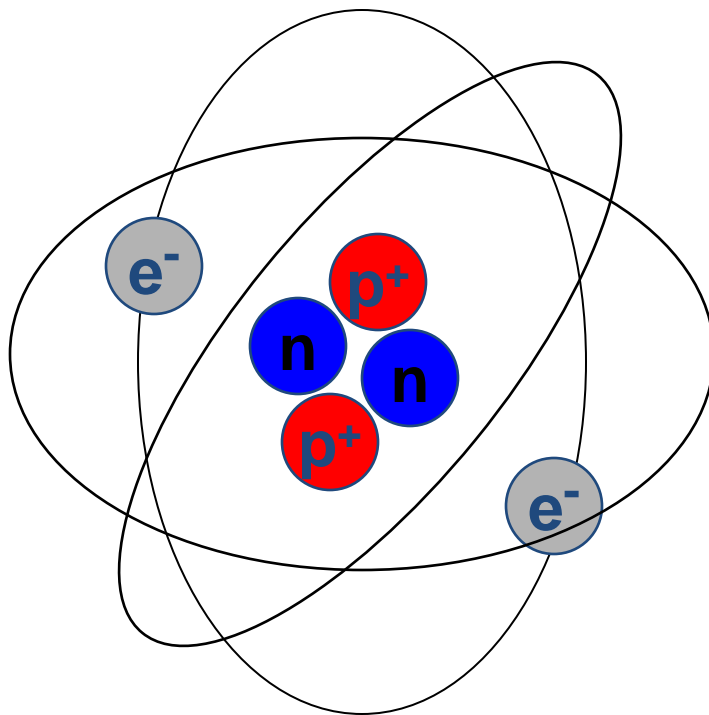
Questions we'll answer. . .

- **What is Radiation?**
- **Where does it come from?**
- **What is Radioactivity?**
- **What's the difference between Contamination and Irradiation?**
- **How does radiation interact?**



Remember atomic structure?

THE HELIUM ATOM



HELIUM'S subATOMIC COMPOSITION

2 Protons

2 Neutrons

2 Electrons



More on this helium *isotope* . . .

MASS NUMBER

is total number of
protons and neutrons

4

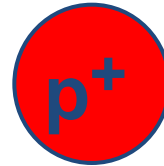
2

He

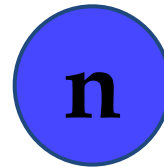
ELEMENT
SYMBOL

ATOMIC NUMBER

is number of protons &
identifies the element



Protons have a large mass and a positive charge.



Neutrons have large mass, approximately equal to proton mass, but no charge.

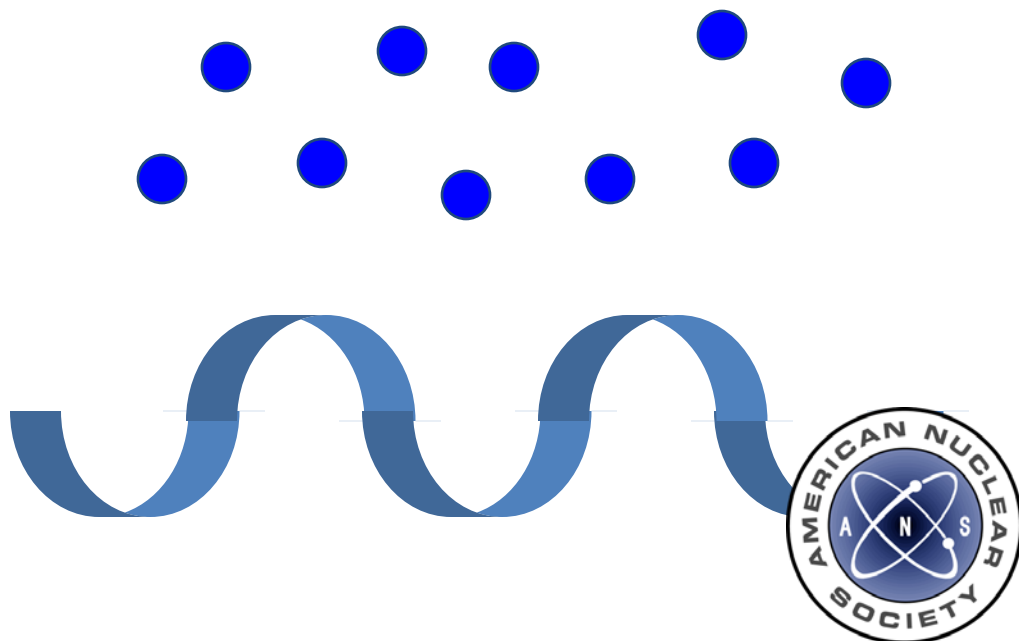


Electrons have a very small mass and a negative charge.
Electrons travel outside the nucleus.

What is Radiation?

Transmission of
energy via . . .

Particles
or
Waves



Types of radiation

Non-Ionizing

Radiowaves

Microwaves

Infrared

Ultraviolet

Visible Light

Ionizing

Alpha

Beta

Gamma (rays)

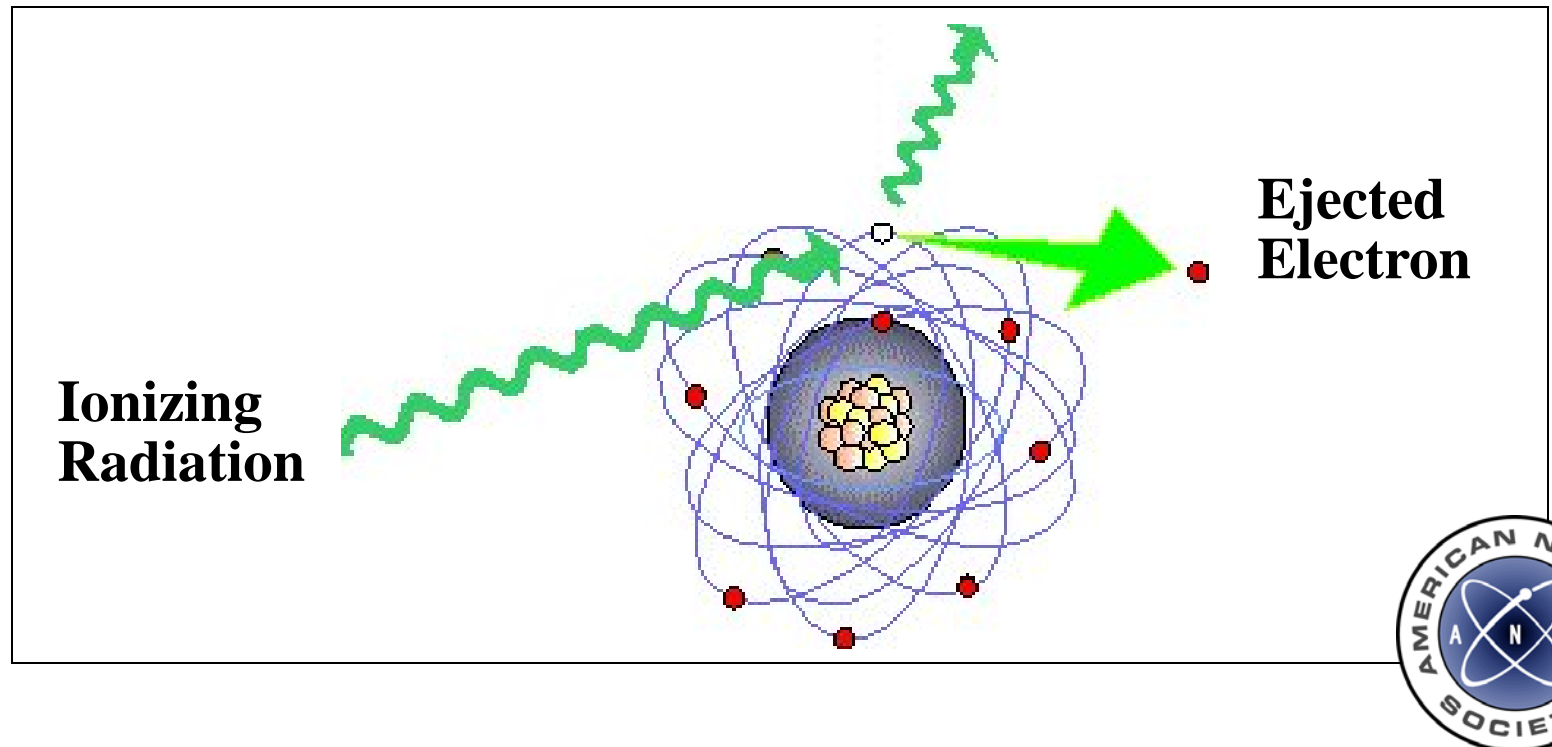
X-Rays

Neutrons



Why is it called *ionizing*?

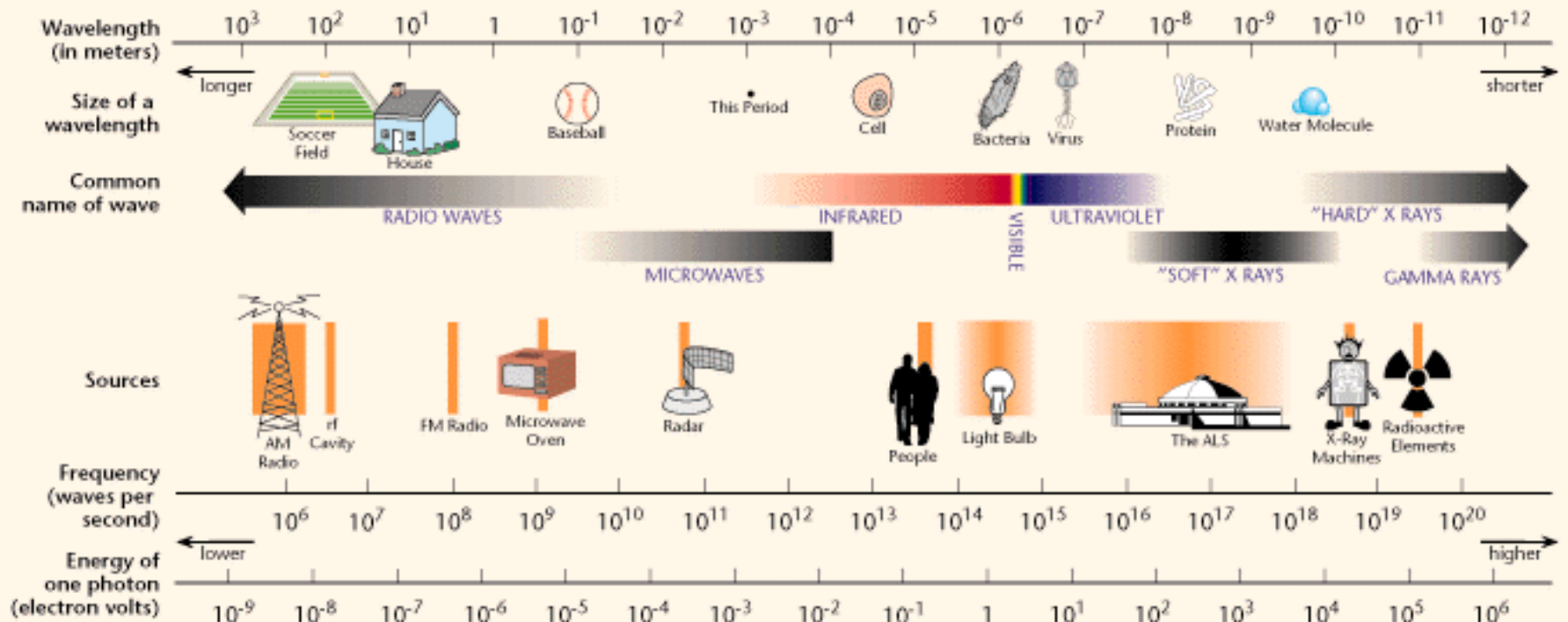
Because it creates *ions* . . .
atoms with a charge.



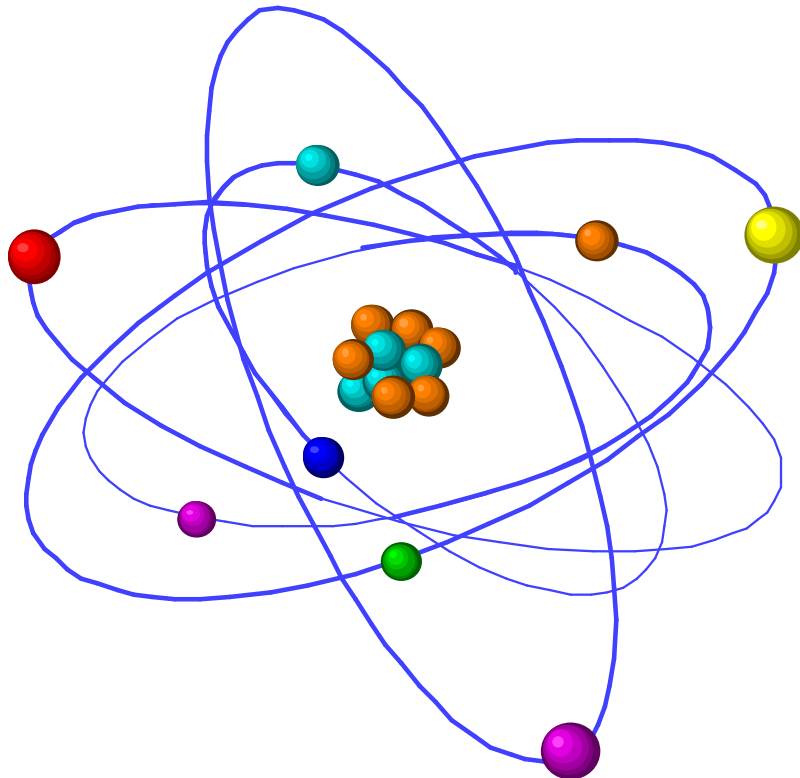
Electromagnetic Spectrum

<http://www.lbl.gov/MicroWorlds/ALSTool/EMSpec/EMSpec2.html>

THE ELECTROMAGNETIC SPECTRUM



Where does radiation come from?



Atoms . . .
from
radioactive
or unstable
atoms



What part of atoms?

The Nucleus!

Hence, we have terms such
as *nuclear*
science/medicine/reactors.



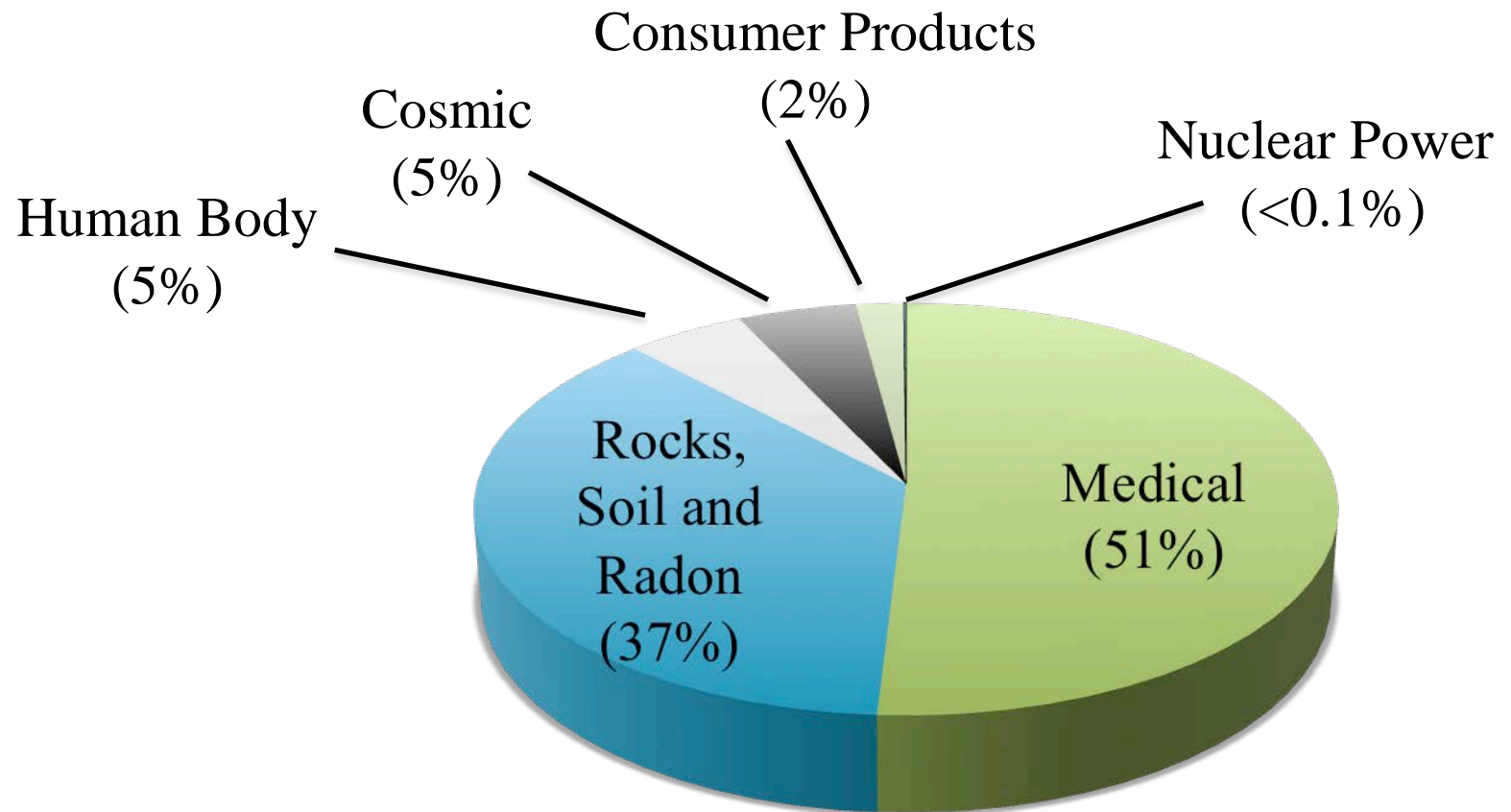
If radiation comes from atoms and everything is made of atoms, is there radiation around us right now?

You Betcha!

It's called background radiation.



Sources of average radiation dose in the US



Source: National Council on Radiation Protection and Measurement Report 160 (2006)

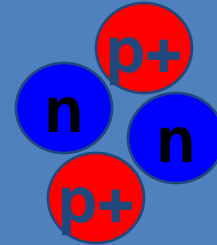


Radiation Types

Alpha (α)

2 protons, 2 neutrons

positively charged particle



Beta (β)

like an electron

negatively charged particle



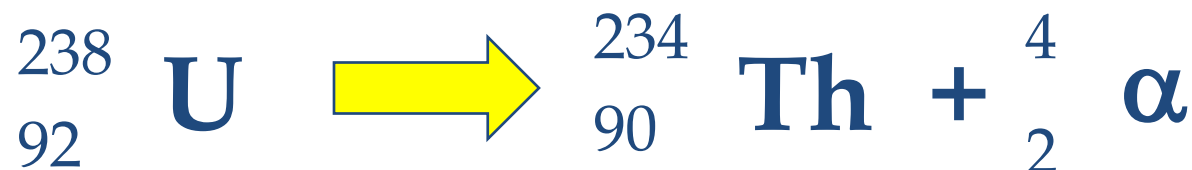
Gamma (γ)

Wave energy (*not* a particle)

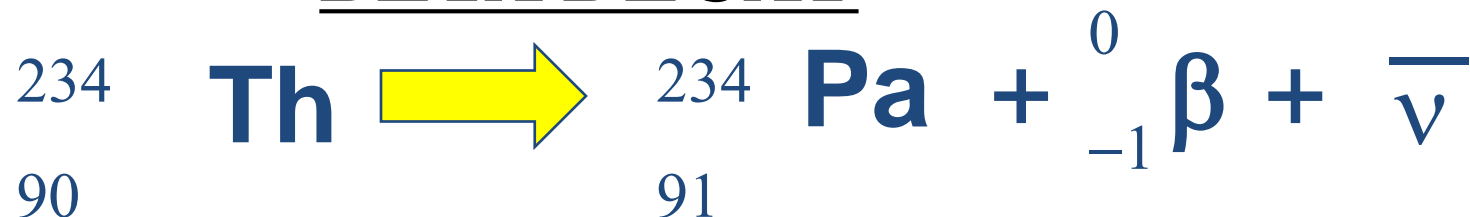


RADIOACTIVE DECAY REACTIONS

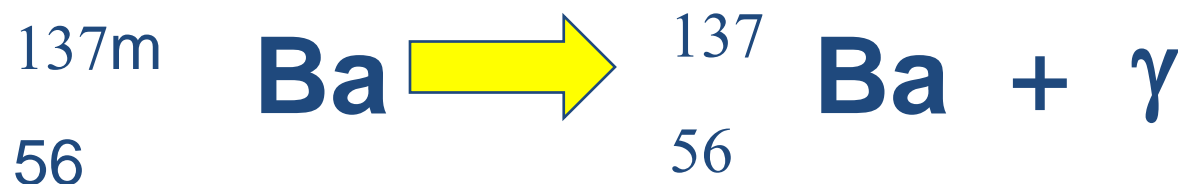
ALPHA DECAY



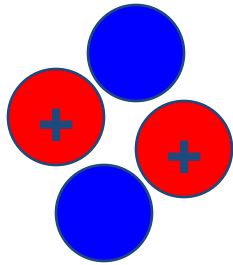
BETA DECAY



GAMMA DECAY



PENETRATING ABILITY



α



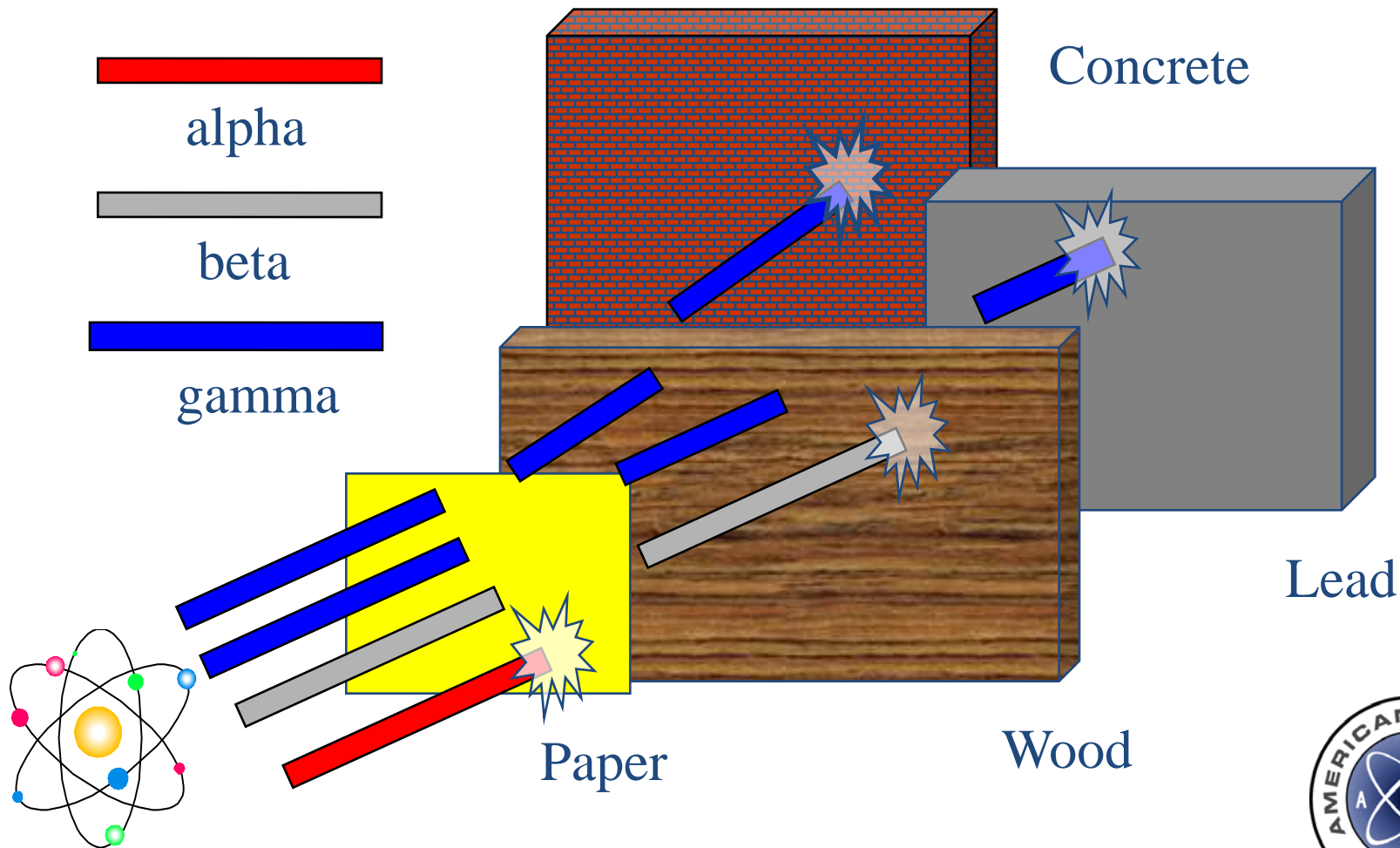
β



γ



SHIELDING

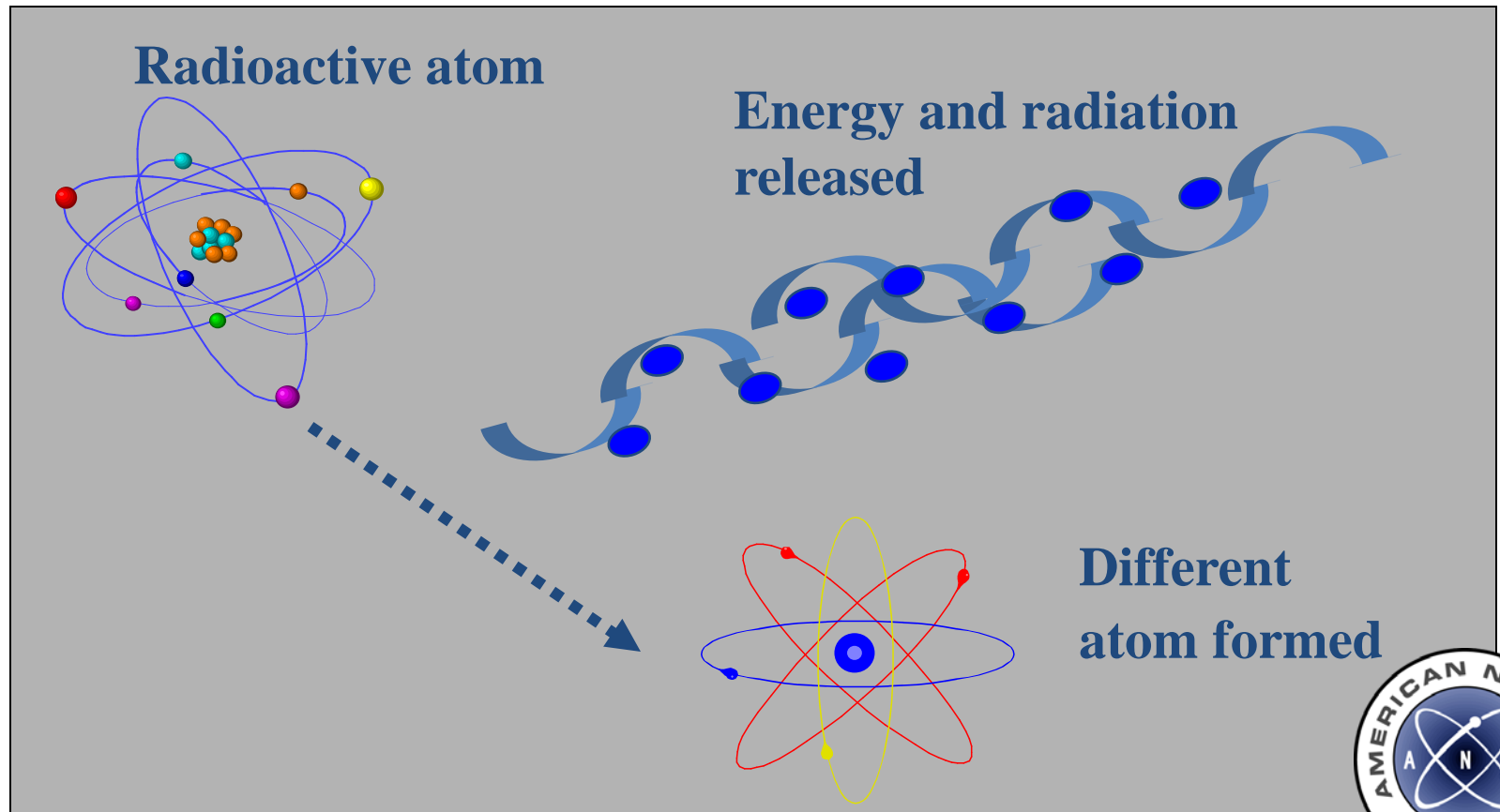


What's radioactivity?



What is radioactivity?

The spontaneous emission of “fragments” or “bundles” of energy from energetic nuclei creating more stable nuclei.

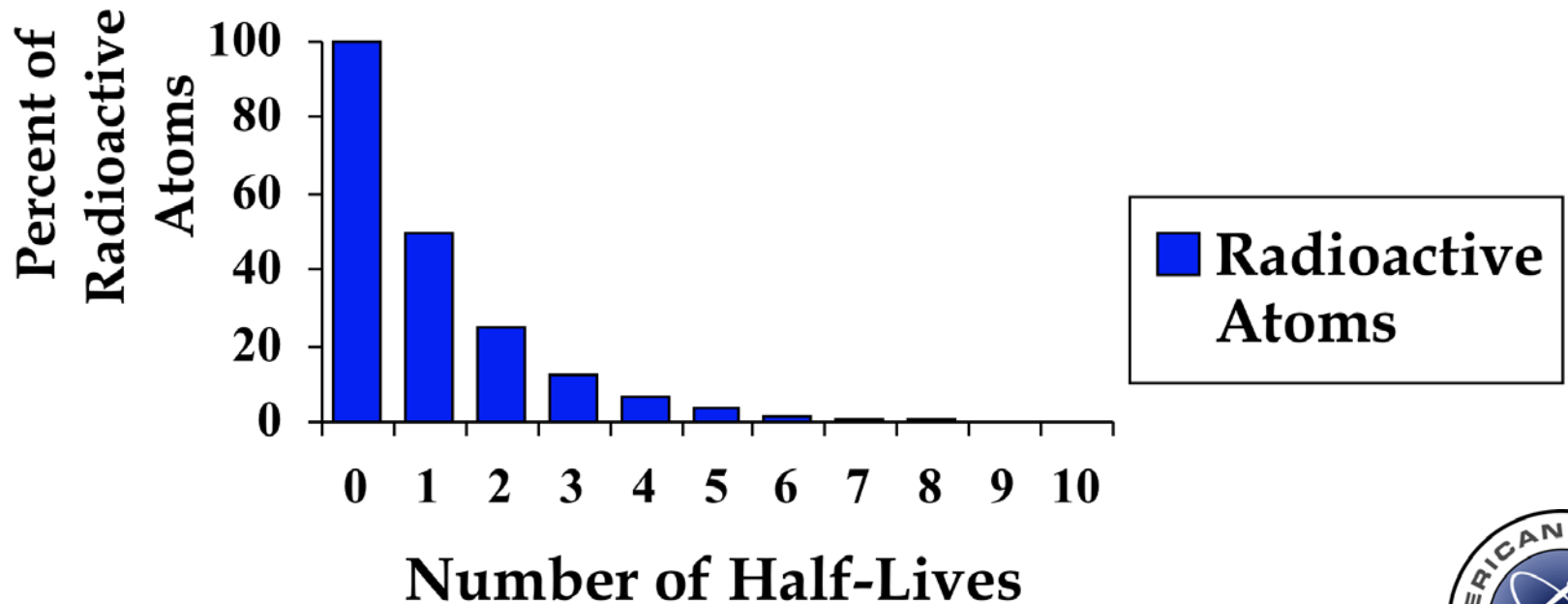


Radioactive atoms
emit *radiation*.



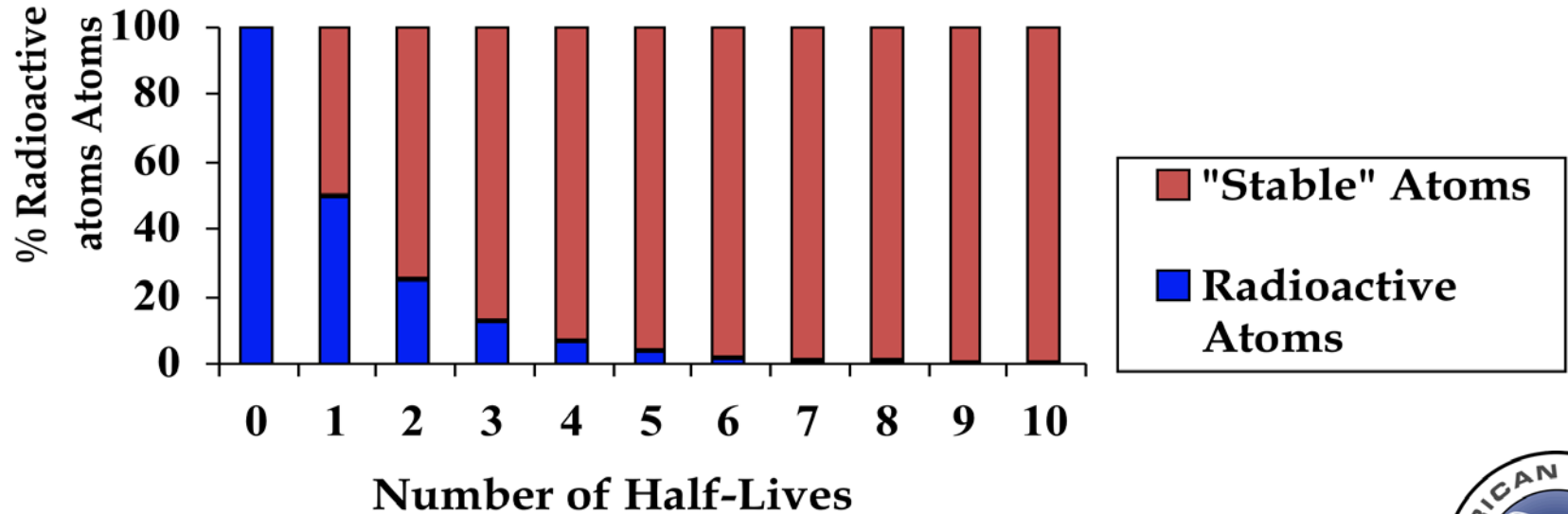
Half Life

Radioactive Decay



Half Life

Radioactive Decay



If I'm exposed to radiation, do I
become (more) radioactive?



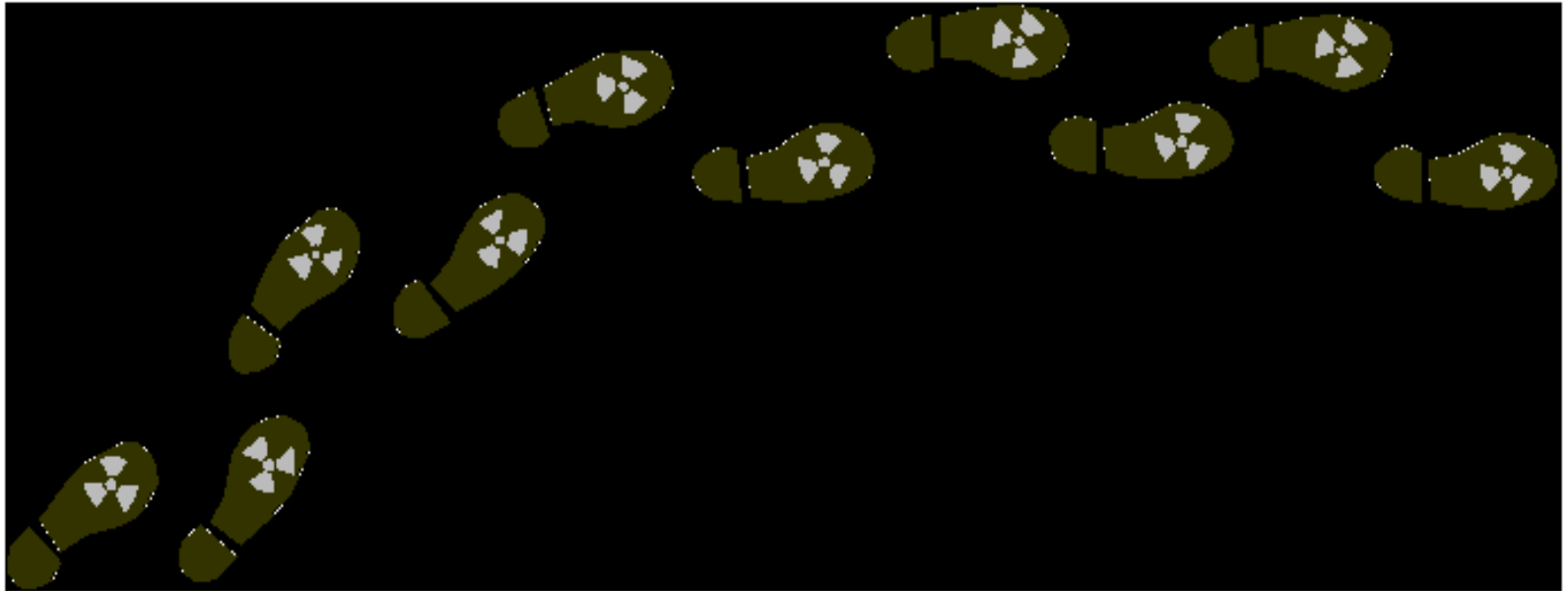
No!

You've been *irradiated*,
exposed to radiation.

Which is not to be confused
with . . .



Radioactive Contamination



Radioactive Contamination is radioactive material in an unwanted place.



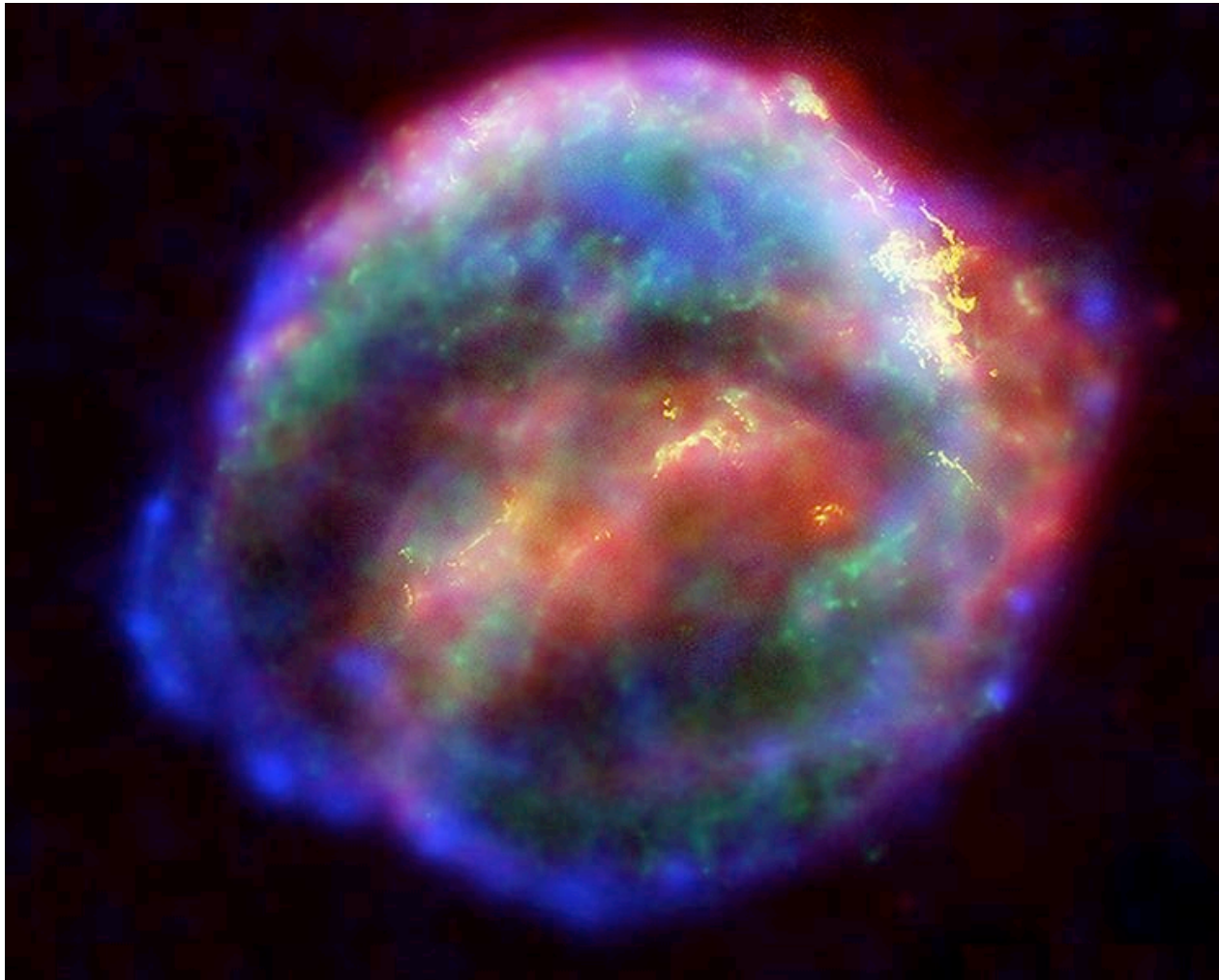
Question...

How were radioactive atoms
formed?



Answer . . .

Supernova Explosion



Question...

How do we make a stable atom
radioactive?



Answer...

- How do we make a stable atom radioactive?
 - By adding energy to the nucleus
 - This is done by adding a particle such as a neutron from a reactor or a high energy charged particle from an accelerator such as an electron or proton



Terms

- **Roentgen (R)** - unit of exposure - ionization of air by x or gamma rays
- **RAD (Radiation Absorbed Dose)** - energy deposited in material
- **rem** - **(Roentgen Equivalent Man)**
 - unit of dose equivalent

Units of “Activity”

Activity - a rate; the number of emissions (of radiation) per unit time.

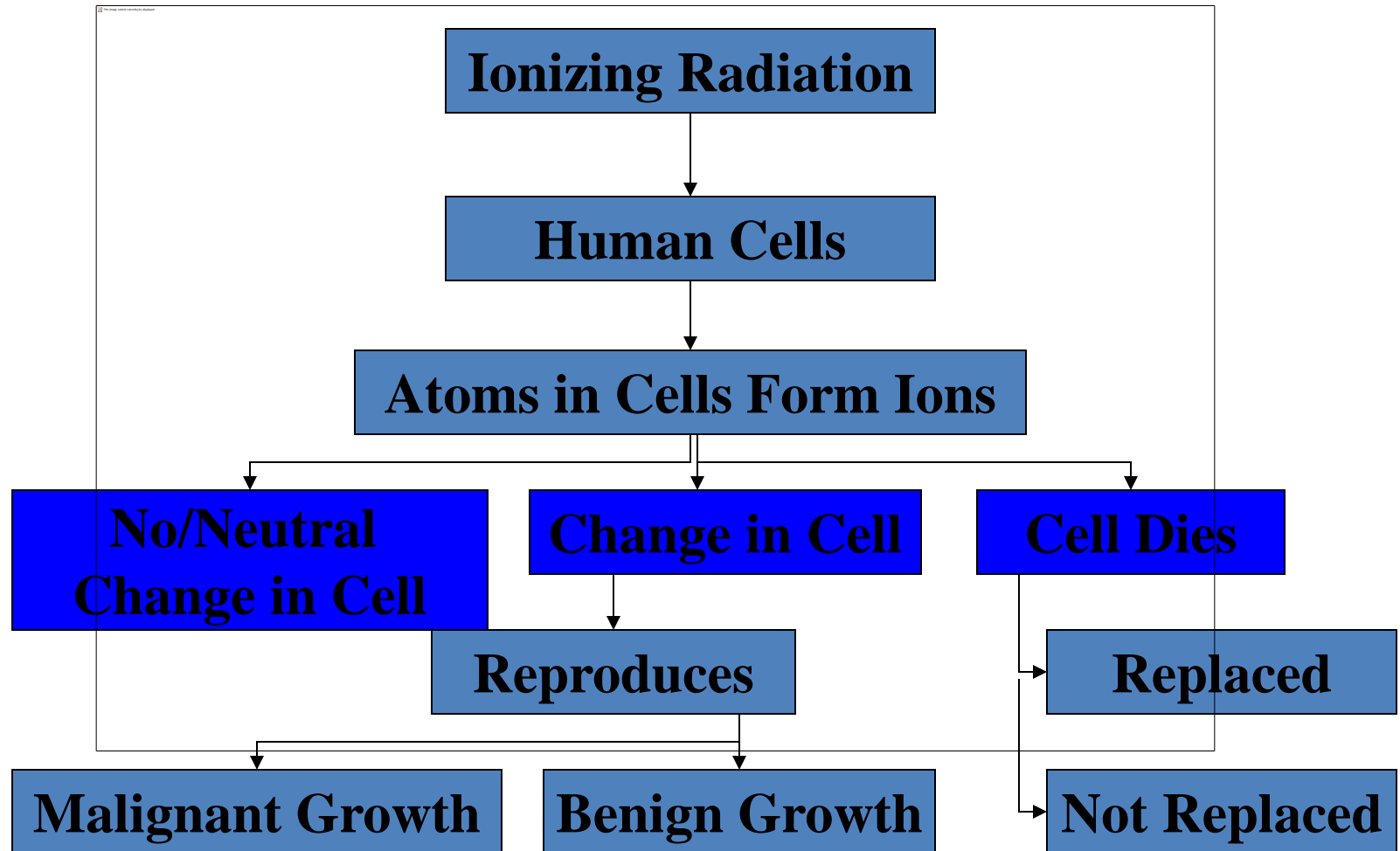
dps - disintegrations per second

Bequerel = 1 dps

Curie = 37,000,000,000 dps

Picocurie = 0.037 dps or 2.2 dpm

Why are we concerned about Radiation?



How do we protect ourselves?

