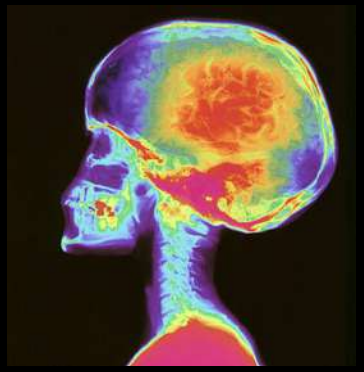
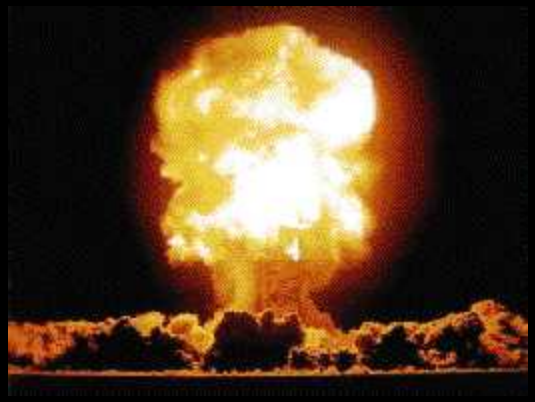
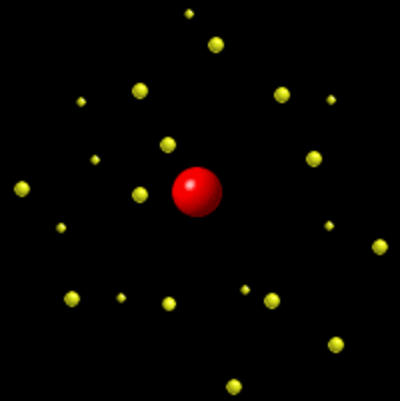
Radioactivity Activity

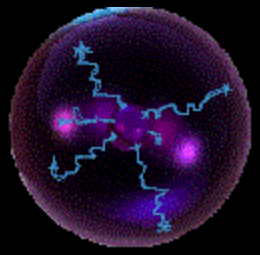






By Howard Alpert, July 2003 halpert@mail.org

Radioactivity Activity



PURPOSE

The purpose of this activity is to introduce you to the world of radioactivity.

You are to work alone and to follow the readings both in this activity and in the links which are part of it.

Your task is to answer a series of questions which are posted after the readings.

Go back to the readings or follow the links to find the answers to the questions.

Write the answers to the questions in the space provided, print it out and hand it in.

Radioactivity Activity

TEACHERS' PAGE

This lesson is intended as an introduction to radioactivity and radiation.

Students are to work independently to use both the slides and the web resources to find answers to the questions posed.

Students are to transfer this site into their personal folders and fill in their own answers.

Upon completing the questions, students are to hand in the typewritten answers.

READ THE FOLLOWING SLIDES AND FOLLOW THE LINKS TO ANSWER THE QUESTIONS BELOW:

1.a. What is the difference between radiation and radioactivity?

1.b. What is radiation?

1.c. Is all radiation harmful?

1.d. Give two examples of ionizing and non-ionizing radiation

http://www.physics.isu.edu/radinf/atom.htm

Idaho State University, Radiation Information Network

http://www.umich.edu/~radinfo/introduction/lesson/rads%26rads.html

University of Michigan, Health Physics Society, “Radiation and Radioactivity”

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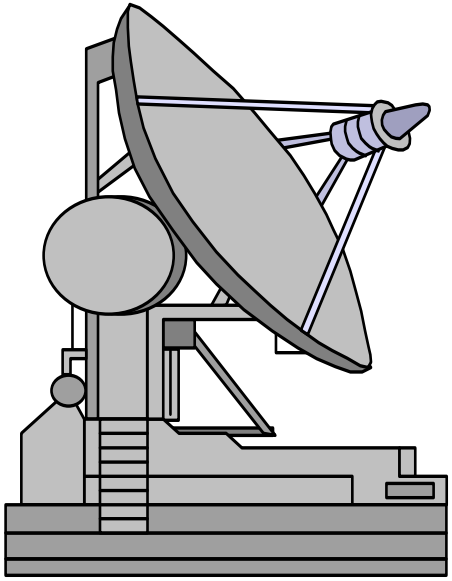
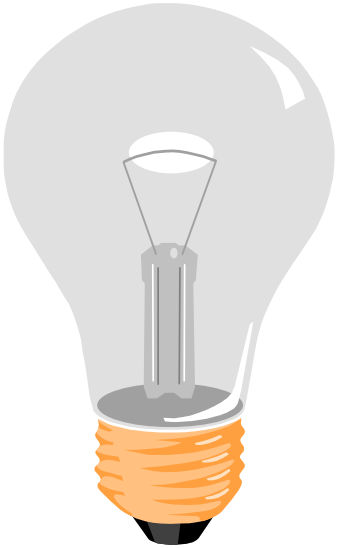
Radiation and Radioactivity

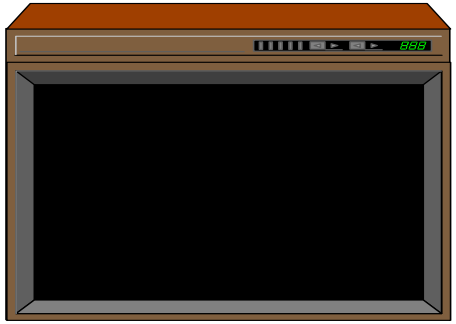
- Radiation: Energy in transit, either particulate or electromagnetic in nature
- Radioactivity: The characteristic of various materials to emit ionizing radiation
- Ionization: The removal of electrons from an atom. The essential characteristic of high energy radiations when interacting with matter.

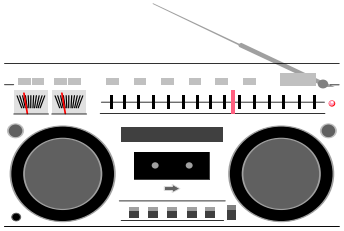
Non-Ionizing Radiation

Does not have enough energy to remove electrons from surrounding atoms









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Electromagnetic Waves

Energy waves, ranging from the low energy radio to high energy gamma

Characterized by:

Height (amplitude)

Length between wave peaks (wave length)

Ionizing Electromagnetic Radiation

These radiations do have enough energy to remove electrons from atoms

Examples:

- X-rays
- Gamma rays

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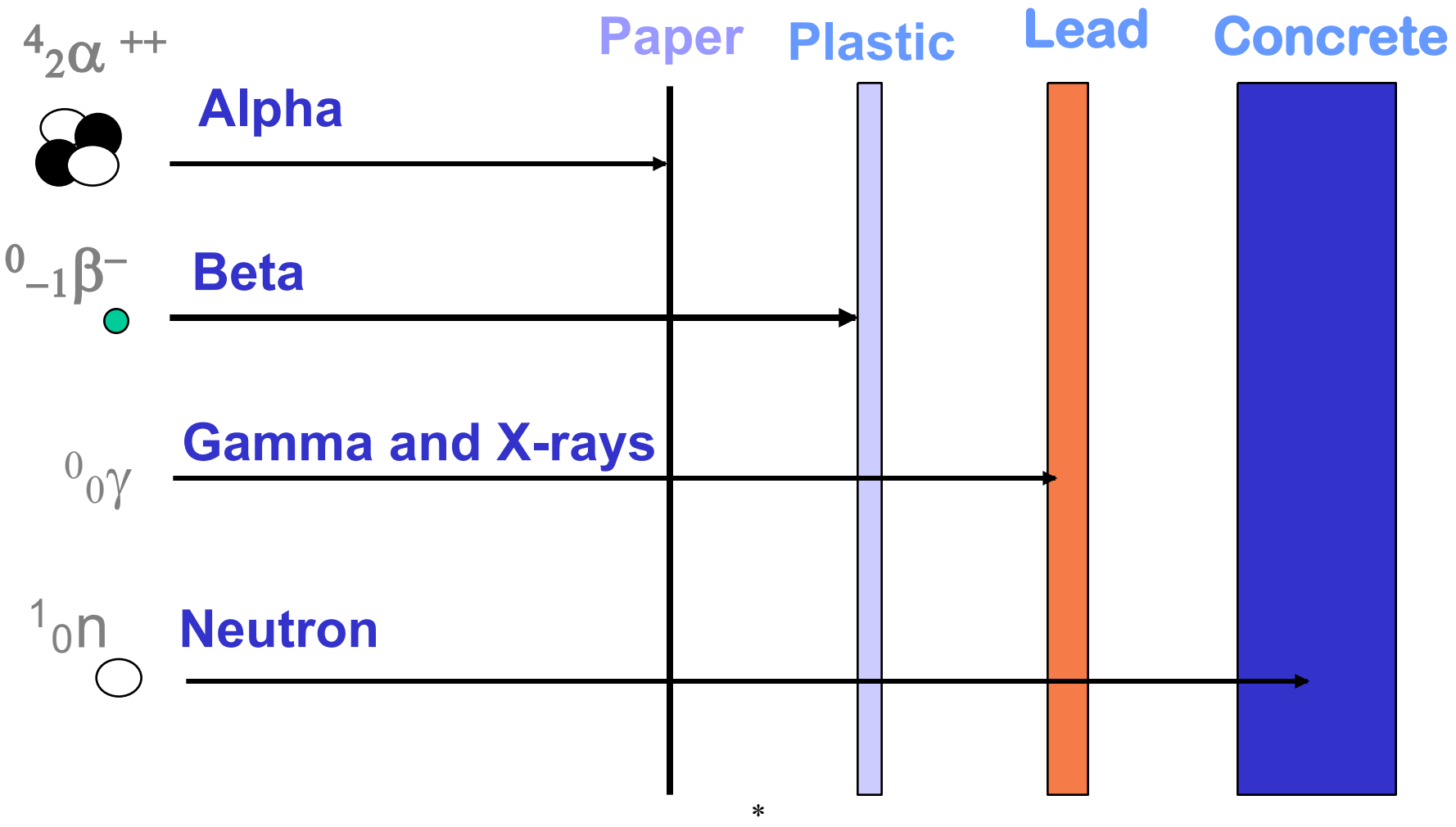
Types of Radiation



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UNSTABLE atoms emit energy

RF μwave infrared visible uv x-ray γ-ray cosmic

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low energy

non-ionizing

high energy

ionizing radiation

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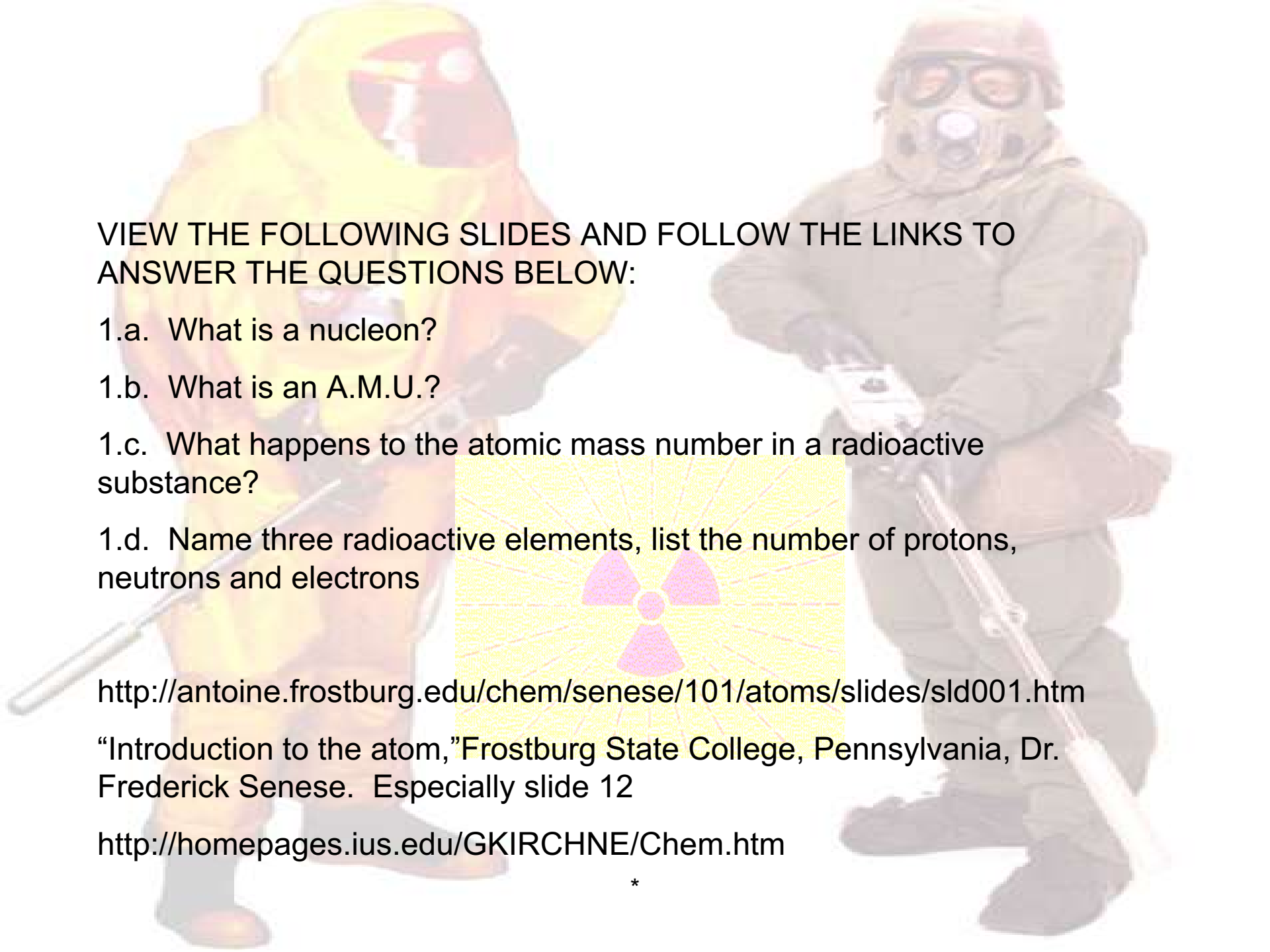

VIEW THE FOLLOWING SLIDES AND FOLLOW THE LINKS TO ANSWER THE QUESTIONS BELOW:

1.a. What is a nucleon?

1.b. What is an A.M.U.?

1.c. What happens to the atomic mass number in a radioactive substance?

1.d. Name three radioactive elements, list the number of protons, neutrons and electrons

http://antoine.frostburg.edu/chem/senese/101/atoms/slides/sld001.htm

“Introduction to the atom,”Frostburg State College, Pennsylvania, Dr. Frederick Senese. Especially slide 12

http://homepages.ius.edu/GKIRCHNE/Chem.htm

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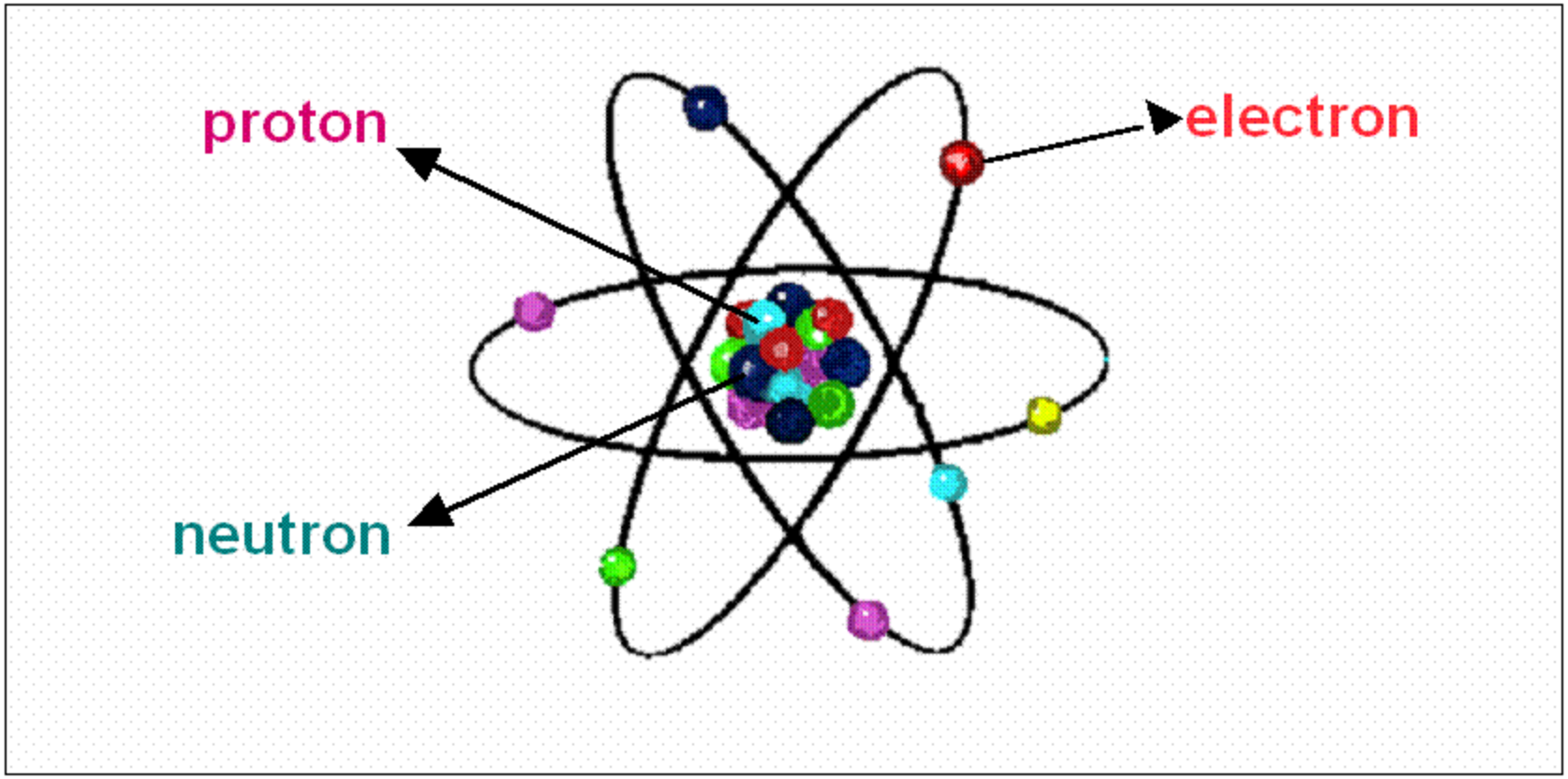
Atoms

- The building blocks of all matter
- Made up of protons and neutrons and electrons.

- Almost all atoms are very stable
- Some may have too much energy and be radioactive.

*

basic particles of the atom: PROTONS, NEUTRONS, ELECTRONS



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Elements

An element is the smallest amount of a substance that still exhibits the properties of that substance.

Elements are classified by the number of protons in each atom, and can be arranged in order in the Periodic Chart.

*

Molecules and Compounds

Atoms group together or bond to each other forming molecules and compounds.

Examples

water (2 hydrogen, 1 oxygen atoms)

sugar (6 carbon, 12 hydrogen and 6 oxygen atoms)

*

Three States of Matter

- Solid: Solids are items don't change their shapes like rocks, wood and ice.
- Liquid: Liquids flow, like water, alcohol and glass
- Gas: Gases are free flowing, like air, oxygen and steam.

The difference between each is the amount of energy the molecules have

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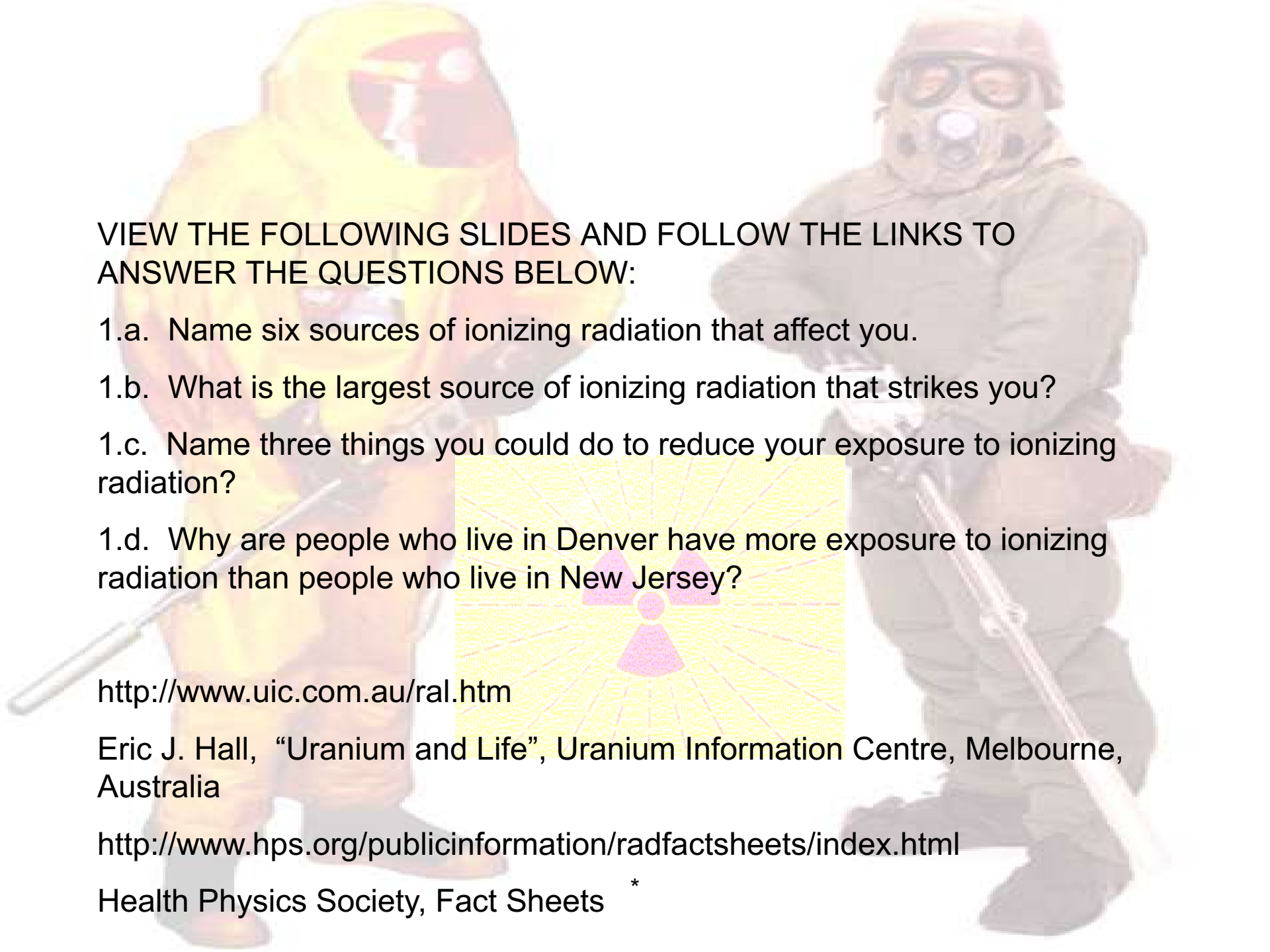


VIEW THE FOLLOWING SLIDES AND FOLLOW THE LINKS TO ANSWER THE QUESTIONS BELOW:

1.a. Name six sources of ionizing radiation that affect you.

1.b. What is the largest source of ionizing radiation that strikes you?

1.c. Name three things you could do to reduce your exposure to ionizing radiation?

1.d. Why are people who live in Denver have more exposure to ionizing radiation than people who live in New Jersey?

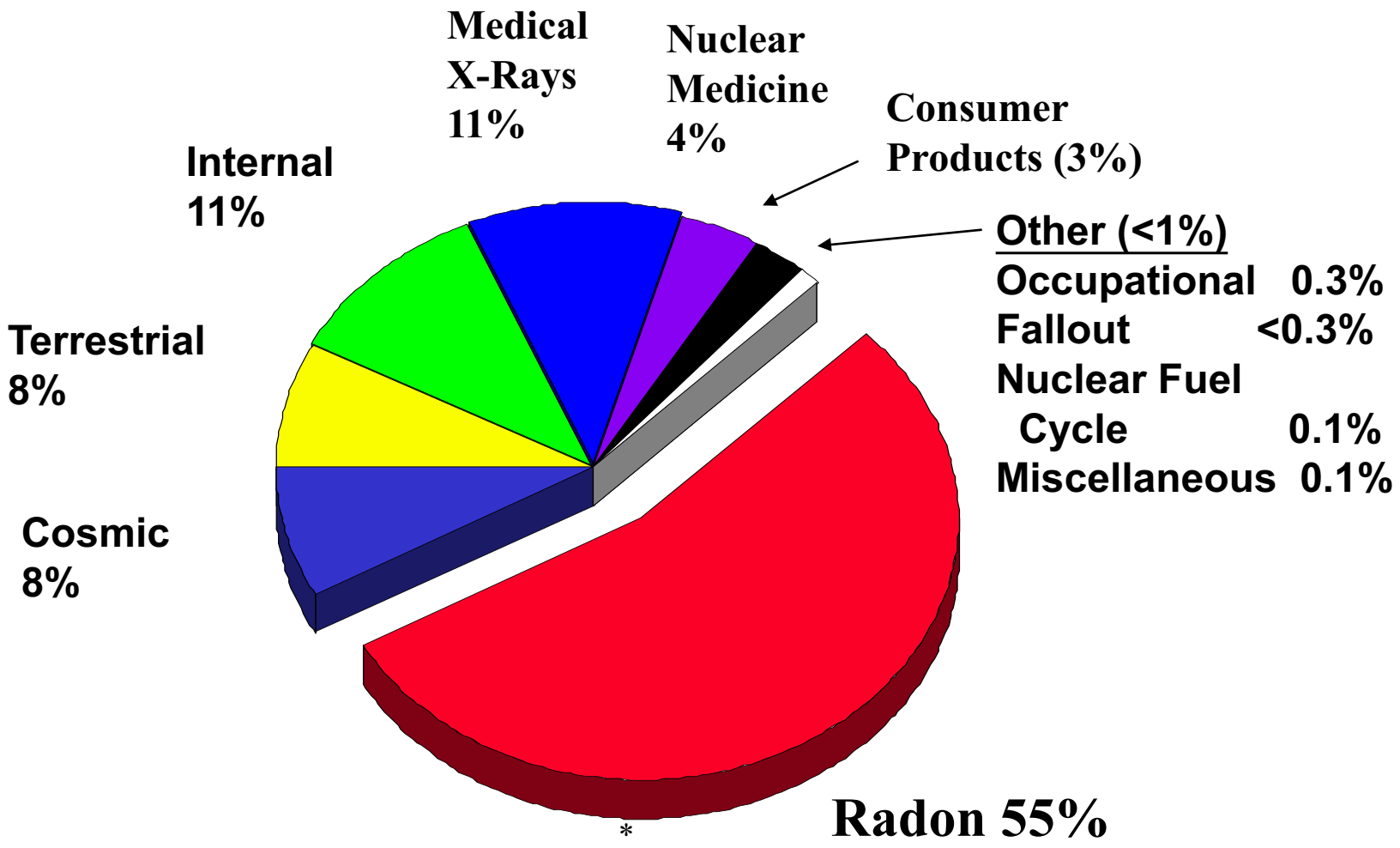
http://www.uic.com.au/ral.htm

Eric J. Hall, "Uranium and Life", Uranium Information Centre, Melbourne, Australia

http://www.hps.org/publicinformation/radfactsheets/index.html

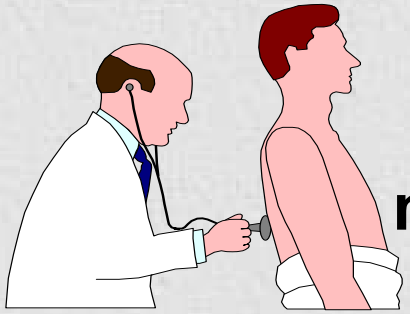
Health Physics Society, Fact Sheets *

Sources of Annual Radiation Dose



Manufactured sources of radiation contribute 60 mrem/year

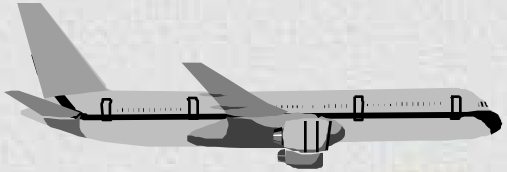
cigarette smoking - 1300 mrem

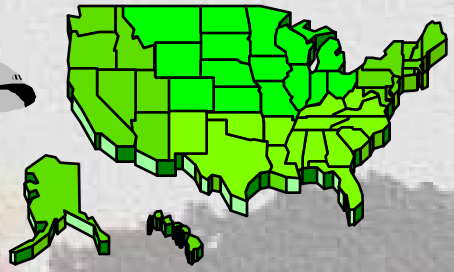


medical - 53 mrem

round trip US by air

5 mrem per trip





building materials - 3.6 mrem

smoke detectors - 0.0001 mrem

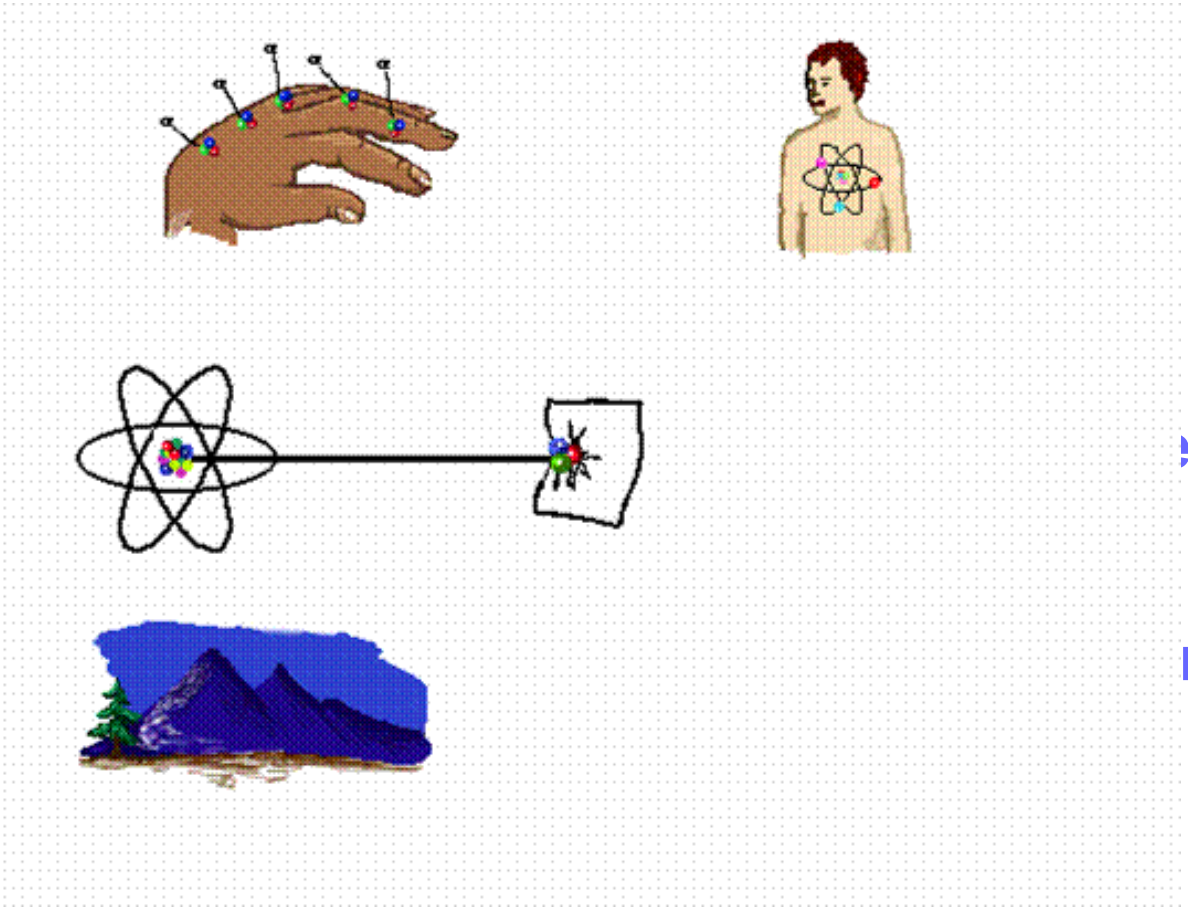
fallout < 1 mrem

*

Alpha Radiation

Only a hazard when inside your body (internal hazard)

can't penetrat



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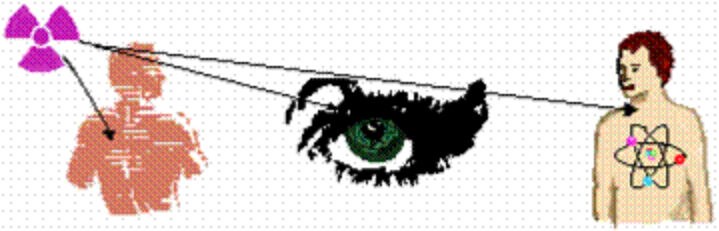
Beta Radiation Hazards

skin, eye and internal hazard



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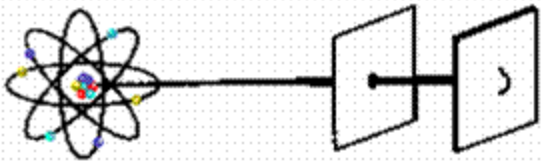
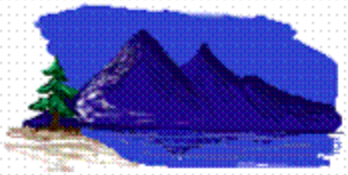
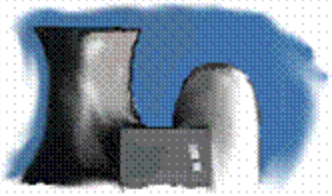






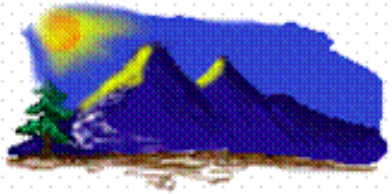
found in natural food, air and water

*

X Ray and gamma Ray radiation

Penetrating and external hazard

stopp

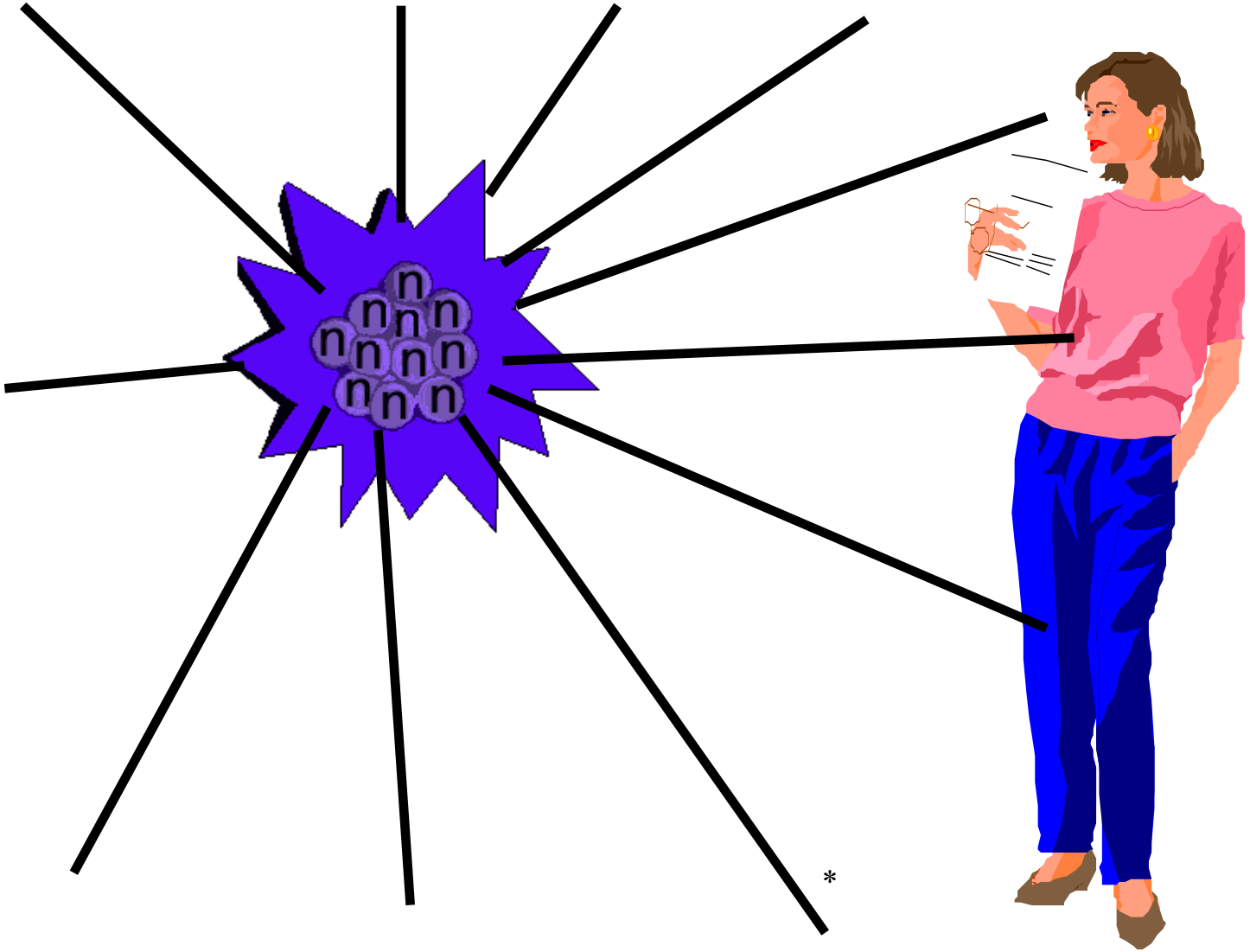


naturally prese
cosmic radiation

found in medical
uses

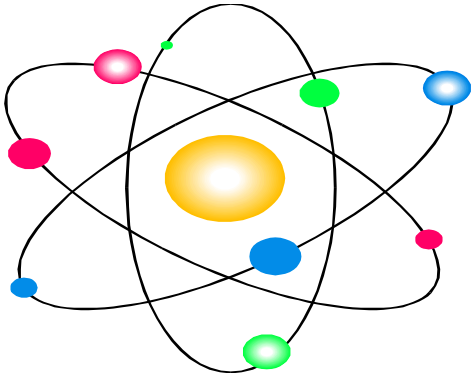
*

Neutron particles have no charge penetrate deep into the body

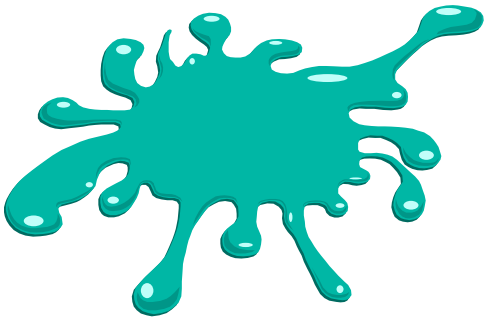


Radiation Versus Radioactive Contamination

- Radiation: particles or waves of energy emitted from unstable atoms.

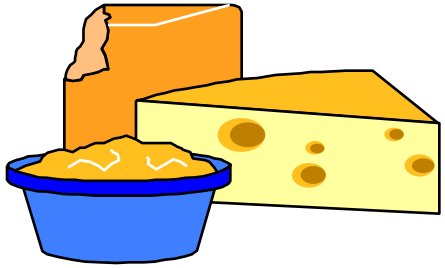


Radioactive Contamination: radioactive material usually in any location you do not want it. *

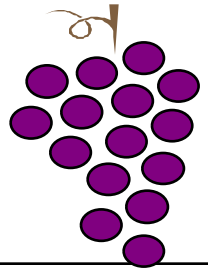


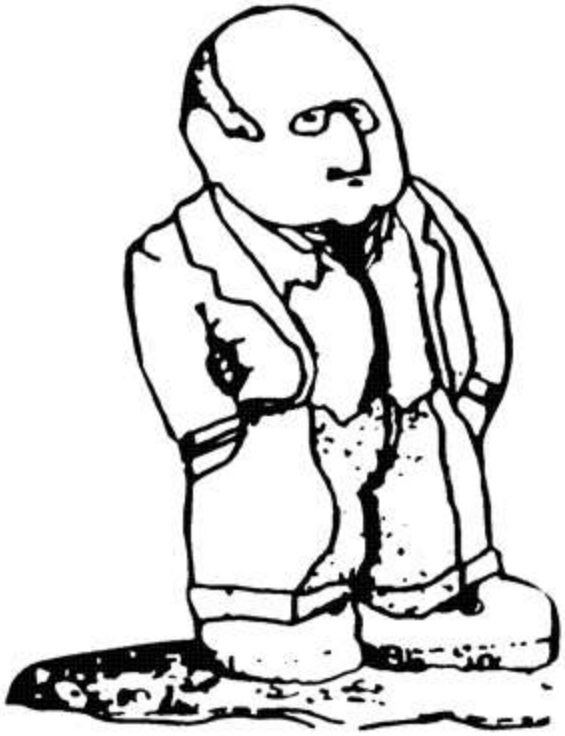
Background / Manufactured Radiation In the U.S. -- 360 mrem per Year

cosmic - 28

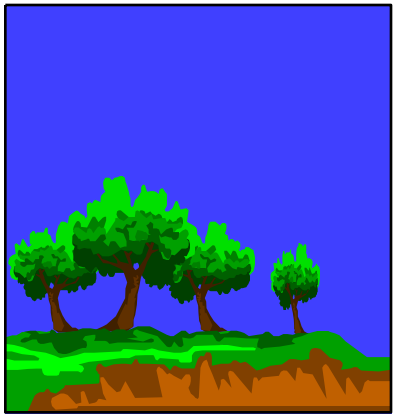


diet - 40





on - 200



terrestrial - 28

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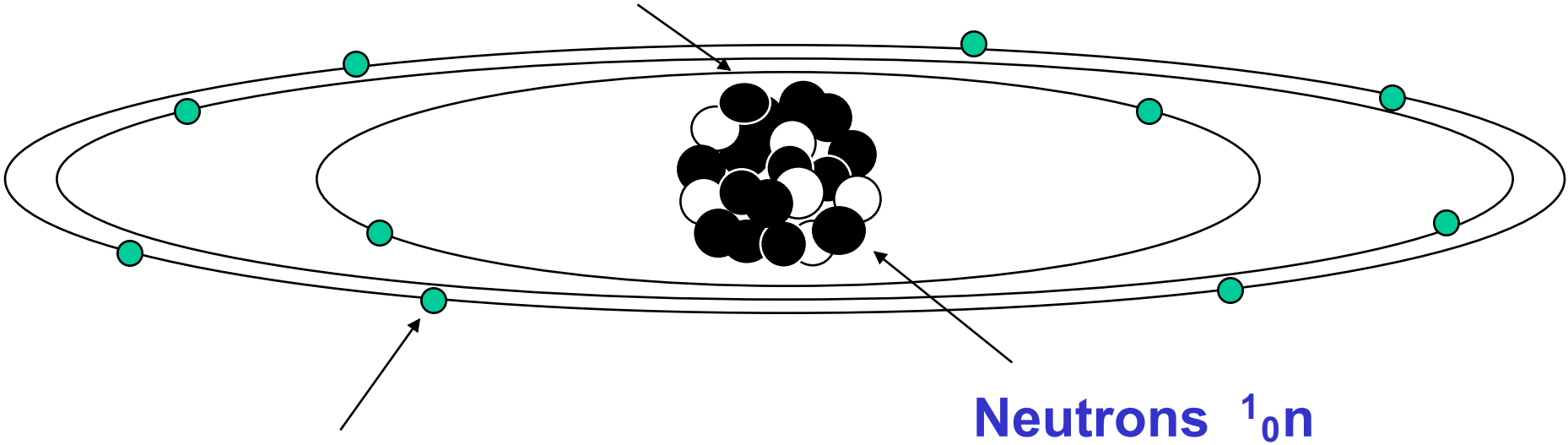
The Atom

Protons $^{1}_{1}p$
(1.007276 amu)



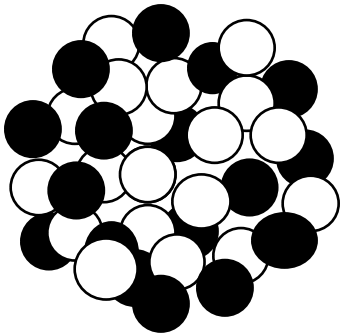
Neutrons $^{1}_{0}n$
(1.008665 amu)

Electrons
(0.0005486 amu)

Neon-20 $^{20}_{10}Ne$
(19.992434 amu)

*

Alpha Decay



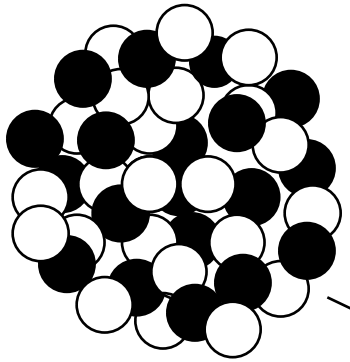
Daughter Nucleus

Np-237

Th-234

Ra-228

Rn-222



Parent Nucleus

Am-241

U-238

Th-232

Ra-226

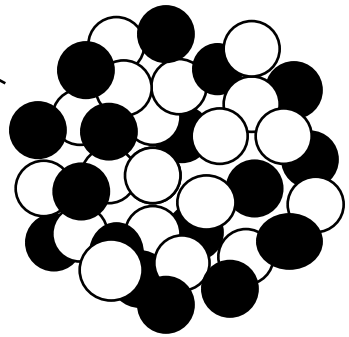
*

$^{4}_{2}\alpha^{++}$

Alpha Particle (Helium Nucleus) (4.00147 amu)

Beta (Negatron) Decay

Daughter Nucleus
Osmium-187
Calcium-40



$^{0}_{0}\nu$

Antineutrino

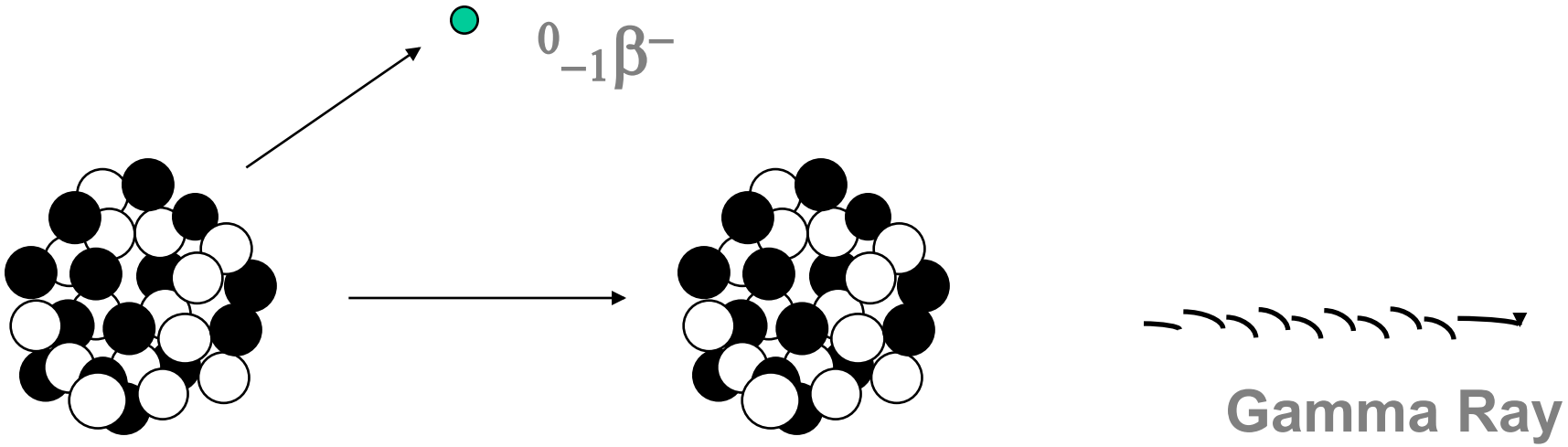
Parent Nucleus
Rhenium-187
Potassium-40

$^{0}_{-1}\beta^{-}$

Beta Particle (electron)

*

Gamma-Ray Emission



Parent Nucleus
Cesium-137
Molybdenum-99

Daughter Nucleus
Barium-137m
Technetium-99m

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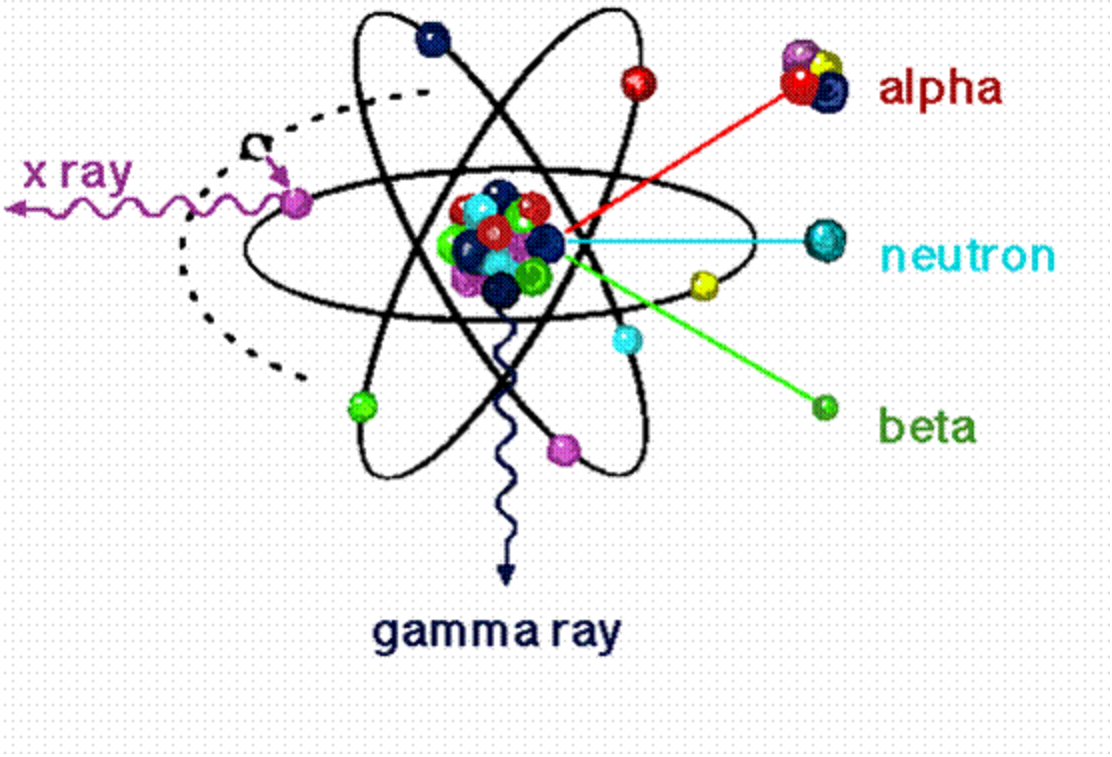
Ionizing Radiation -

can deposit energy in neighboring atoms resulting in the removal of electrons.



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