Islamic University / Najaf
College of Medical Technology
Department of Radiology Techniques

Radiation Protection 1

Stage 2

Lecture 4

By

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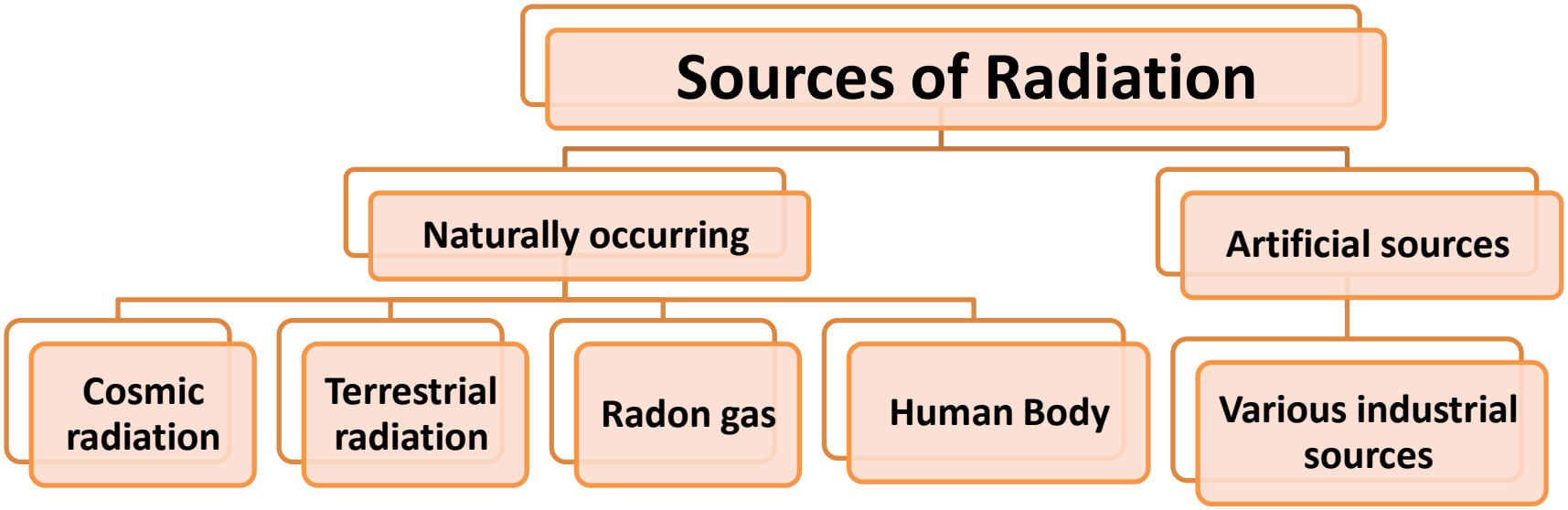
Sources of Radiation



Naturally occurring (background radiation)

It is naturally present in our environment since the birth of this planet. It includes:

A) Cosmic Radiation

The earth, and all living things on it, are exposed by radiation coming from space (sun and stars), this radiation interact with the Earth's atmosphere and magnetic field. The dose from cosmic radiation varies in different parts of the world due to differences in elevation and the effects of the earth's magnetic field.

This means that the increased the elevation above sea level, the greater is the dose rate received from cosmic rays.
About 90% of cosmic rays are protons, about 9% of them are alpha particles (that is, helium atom nuclei) and about 1% are beta particles (electrons).

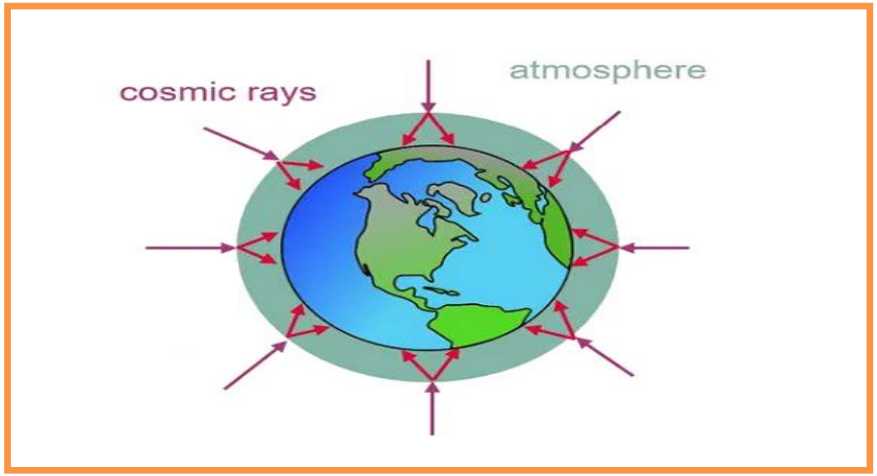


Figure (1)

B) Terrestrial Radiation

The main isotopes of terrestrial radiation are uranium and the decay products of uranium, such as thorium, radium. Low levels of these elements and their decay products are found everywhere, and ingested with food and water. The dose from terrestrial sources varies in different parts of the world. Locations with higher concentrations of uranium and thorium have the higher dose levels in their soil. The most important natural radionuclide of primary origin in the Earth's are U-238, with a half-life of $T_{½} = 4.49 \times 10^{9}$ years,

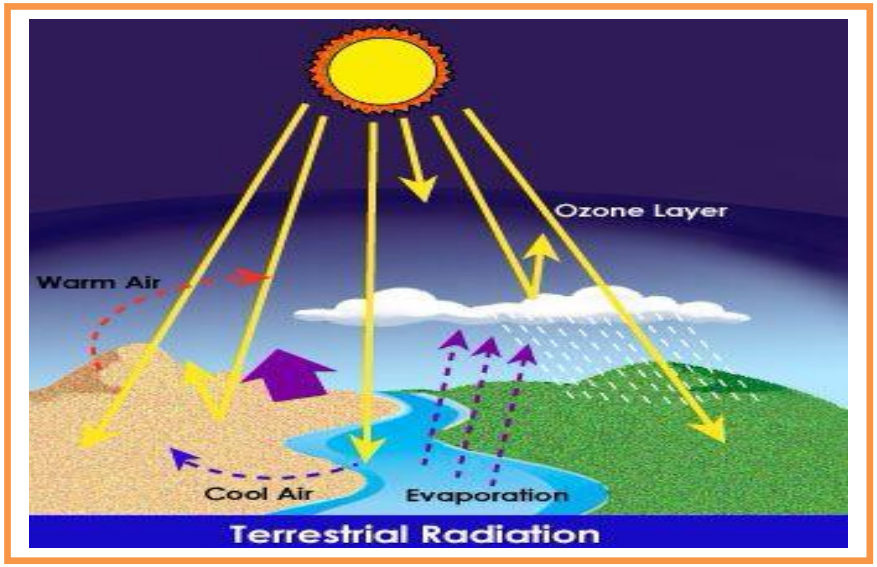


Figure (2)

U-235, with a half life of T½= 7.10×10^{8} years. Both of these isotopes of uranium are gradually transformed by (α) decay into a number of radionuclide of both uranium decay chains:

Uranium-238 Series

This series begins with U-238 nuclei (half-life $4.49\text{x}10^{9}$ y) and is gradually converted into Pb-206 stable nucleus through sequences of alpha and beta particles emission. The elements of this series arranged according to the mass number indicated in (4n+2) system.

Actinium-235 Series

This series begins with U-235 nuclei (half life $7.10\text{x}10^{8}$ y), which is the longest half life compared to other elements in this series and it ends with Pb-207,the elements of this series arranged according to the mass number indicated in (4n +3) system.

Thorium-232 Series

This series begins with Th-232 nuclei (half life $1.4\text{x}10^{10}$ y) and ends with Pb-208 stable isotope, the elements of this series arranged according to the mass number indicated in (4n) system.

Neptunium-237 Series

Np-237 has a half-life of $2.14\text{x}10^{6}$ y, which is much shorter than the geological age of the earth. Virtually all neptunium decayed within the first 50 millions of years after the earth was formed.

C) Radon Gas

It is the largest natural source of radiation exposure to humans, which exist on air, water and soil. Radon's pathway is from the earth, through the basements of houses and other buildings, and into inside air that people breathe. Radon exposures can vary depending on the soil and rock structure beneath buildings.

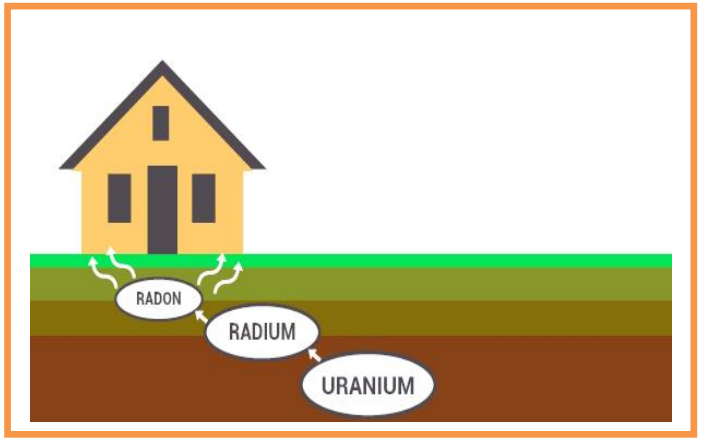


Figure (3)

D) Natural Internal Radiation in Human Body

It is the internal radiation comes from radioactive materials occur naturally in the human body. Potassium and Carbon are the primary sources of internal radiation exposures. The Potassium K-40 isotopes enter the human body through the food chain. Carbon C-14 enters the body both through the food chain and breathing.

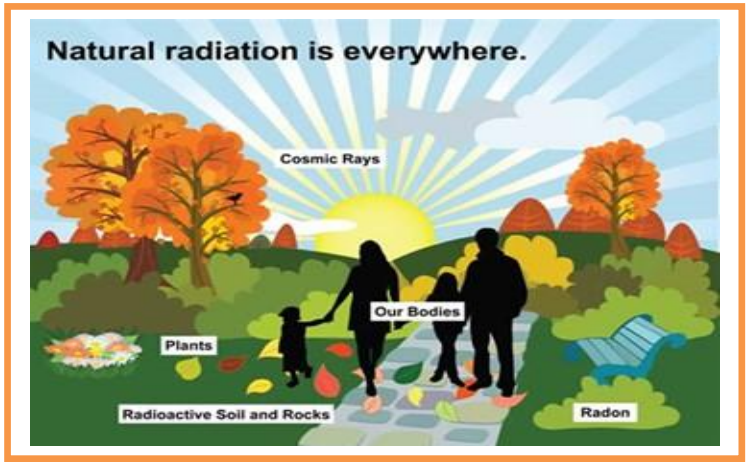


Figure (4)

2- Artificial Sources (Man-Made Radiation)

Artificial radiation sources are identical to the natural radiation in their nature and effect. The most important sources are:

A. Medical procedures: diagnostic X-rays, nuclear medicine, and radiation therapy.

B. Consumer products: tobacco (polonium-210), building materials, fuels (gas, coal, etc.)

C. Concern isotopes: cobalt (Co-60), cesium (Cs-137), others.

D. Radioactive Fallout: It includes nuclear explosions.

- The licensee's limit of exposure to manmade radiation it is (1mSv per years) for public exposure (individual members) and (50 mSv/year) for occupational exposure (working with radioactive material).