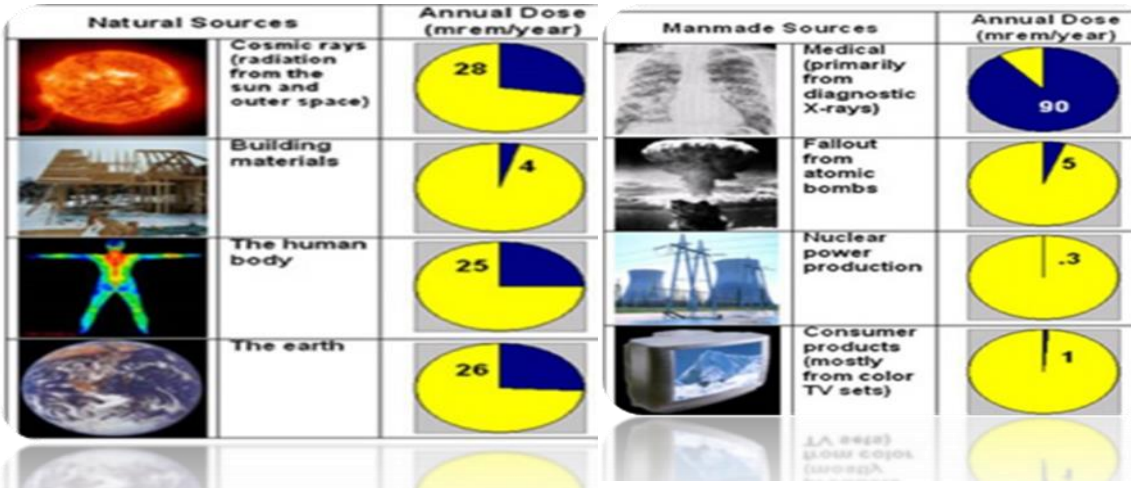
Radiation Protection

LECTURE THREE

Radiation Sources



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2025-2024

LECTURE THREE: Sources of Radiation

ONE: Natural Sources of Radiation

1- **Cosmic Rays**

2- **Terrestrial Radiation**

3- **Exposure Through Ingestion**

4- **Exposure Through Inhalation**

TWO : Manmade (Artificial) Sources of Radiation

1- **Diagnostic Radiology**

2- **Radiation Therapy**

3- **Nuclear Medicine**

4- **Nuclear Fuel Cycle (NPPs)**

LECTURE THREE: Sources of Radiation

❖ Introduction

- Radiation is around us, on earth, and in water and soil at all times.
- The human body contains some radioactive materials.
- **Cosmic radiation** from space also contributes to the background radiation around us.
- The source of **terrestrial radiation** (radiation sources in the **soil** and **water**) are uranium, potassium and thorium.
- The source of radiation is either natural or man-made.

❖ ONE: Natural Sources of Radiation

Radiation has always been present and is all around us in many forms. Life has evolved in a world with significant levels of ionizing radiation, and our bodies have adapted to it. Many natural sources produced during the formation of the solar system and through the interaction of cosmic rays with molecules in the atmosphere.

According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), there are four major sources of natural radiation: **(1) cosmic radiation, (2) terrestrial radiation, (3) exposure through ingestion,** and **(4) ingestion.**

1- Cosmic Rays

- Cosmic rays are found in **space** and created from various sources, including the **sun** and other **celestial events** in the universe.
- Cosmic rays are made up of **protons** but can be other **particles** or **wave energy**.
- Some cosmic rays reach the **Earth**, while others **interact with the atmosphere** to create different types of radiation.
- Some cosmic rays will penetrate the earth's atmosphere and become **absorbed by humans**.
- Radiation levels of cosmic rays **increase as you get closer to the source**

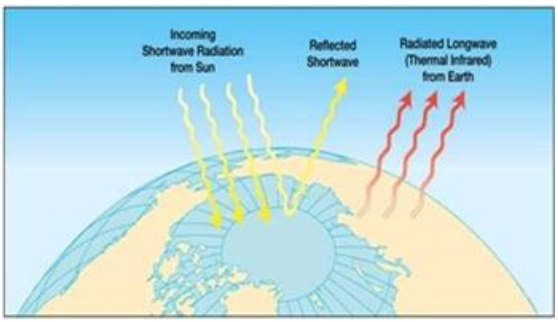
So the amount of cosmic radiation increases with the increase in the height above the earth's surface

Cosmic rays source is outside of the solar system

Cosmic rays source is the sun

2 - Terrestrial Radiation

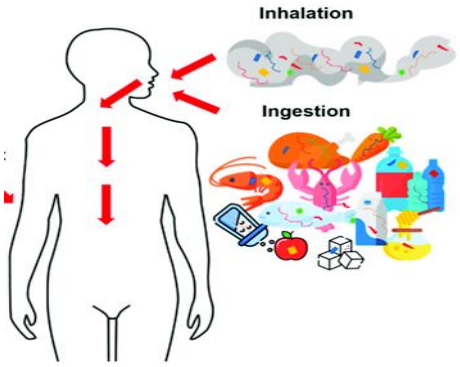
- The source of terrestrial radiation is the **Earth's crust** (**the hard outer layer of the Earth**).
- Earth's crust contains **deposits of Uranium, Potassium and Thorium** which, during the natural decay process, will release small amounts of ionizing radiation.



Terrestrial Radiation from soil

3 - Exposure Through Ingestion

- Exposure radiation occurs through **ingestion** (eating) of **food and drinking water.**
- The **food and water** contains amounts of **radioactive materials and radioactive isotopes** such as **potassium-40 and carbon-14,** which come from **groundwater**.



Exposure Through Ingestion & Inhalation

4 - Exposure Through Inhalation

- Exposure radiation through inhalation is achieved through **inhalation of radioactive gases** emitted from the **soil.**
- The radioactive gases emitted from soil are **Radon gas and Thoron gas** (^{238}U, ^{235}U, and ^{232}Th).
- **Radon** is produced by the **decay of Uranium**.
- **Thoron** is produced by the **decay of Thorium**.
- Radon gas and thoron gas **levels** differs depending location on the composition of soil due to the different composition of the soil.
- These gases are **non-dangerous** radioactive gases in the atmosphere, but inside the closed places become **dangerous**.

Uranium $\xrightarrow{\text{Decay}}$ Radon

Thorium $\xrightarrow{\text{Decay}}$ Thoron

❖ TWO : Man-made (Artificial) Sources of Radiation

The artificial (man-made) sources of ionizing radiation come from following:

1- Diagnostic Radiology

i) Plain Radiograph/X-ray

ii) Computed Tomography (CT)

iii) Fluoroscopy

iv) Mammography

v) Angiography

2- Radiation Therapy

Radiation therapy is a type of cancer treatment that uses beams of energy to kill cancer cells. This treatment is carried out using the following:

i) Linear accelerator treatment

ii) Proton beam therapy (Charged particles)

3- Nuclear Medicine

Nuclear medicine is a field of radiology that uses **very small amounts of radioactive materials** to examine organ function and structure.

4- Nuclear Fuel Cycle (NPPs)

Nuclear fuel cycle is the processes that use **uranium to produce a chain reaction that produces steam**, which in turn drives turbines to produce electricity.

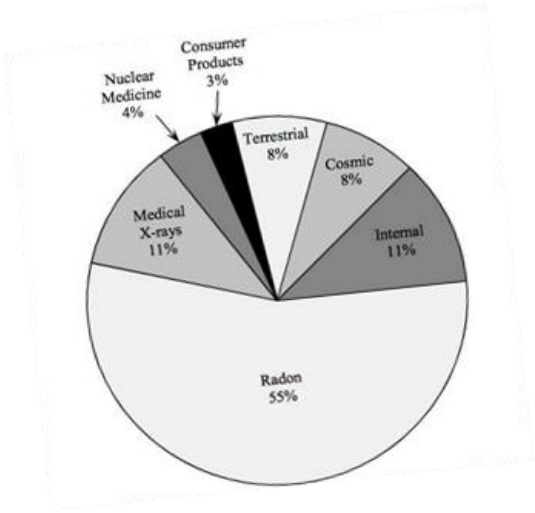


Diagram showing the proportions of radiation sources in nature

Bubble sheet questions

Q1- ---------- is made up of protons but can be other particles or wave energy

A- radiation therapy B- terrestrial radiation C- cosmic radiation D- radioactive gases E- radioactive materials

Q2- ---------- contains deposits of Uranium, Potassium and Thorium

A- radiation B- earth's crust C- cosmic radiation D- radioactive gases E- radioactive materials

Q3- The ---------- contains amounts of radioactive materials and radioactive isotopes

A-nuclear Fuel Cycle B- nuclear Medicine C- atmosphere D- cosmic radiation E- radioactive materials E- none of them

Q4- Radiation levels of cosmic rays increase as you get closer to the ---------

A- sun B- source C- celestial events D- none of them

Q5- Nuclear fuel cycle is the processes that use ---------- to produce a chain reaction that produces ----------

A- uranium - radon B- uranium - thoron C-uranium-steam D- thorium - amounts of radioactive materials E- all of them