**SNS COLLEGE OF ALLIED HEALTH SCIENCES**

SNS Kalvi Nagar, Coimbatore-35

Affiliated to The Dr.M.G.R Medical University, Chennai

# DEPARTMENT OF RADIOGRAPHY AND IMAGING TECHNOLOGY I YEAR

## COURSE NAME : GENERAL PHYSICS

## TOPIC : PRINCIPLES OF RADIATION PROTECTION AND REGULATIONS

# Introduction

The hazards of radiation were realized soon after the discovery of X-rays and gamma rays.

International Commission on Radiological Protection (ICRP) in 1950, defined radiation units and introduced the concepts of permissible dose.

In India, the radiation protection was conceived by the formation of Directorate Radiological Protection (DRP), Bhabha Atomic Research Centre, Mumbai. The Atomic Energy Act, 1962 and the Radiation Protection Rules, 1977 formed the basis of radiation safety in India.

Atomic Energy Regulatory Board (AERB), established in 1983 took over the regulatory affairs from DRP. The AERB is the competent authority, which control over the safe use of radiations both in medicine, industry and Nuclear installations in India

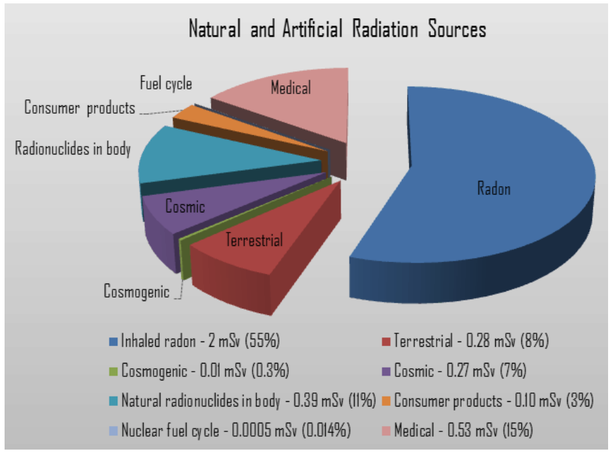
# SOURCES OF RADIATION

Everyday, we are exposed to radiation from various sources. The sources of radiation are,

classified into the following category:

- Natural radiation sources
- Enhanced natural sources
- Artificial radiation sources (manmade)
- Occupational exposures

The annual average per capita total effective dose equivalent is 3.0 mSv.

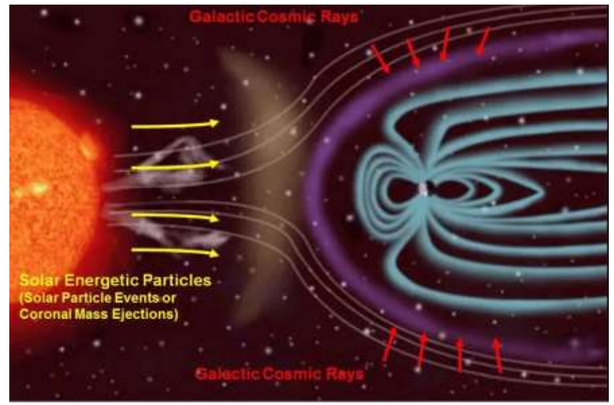


# Natural Radiation Sources

The natural radiation sources include the following:

Cosmic rays –

- Cosmic rays are outer world radiations comprising energetic protons and alpha particles
- The primary cosmic rays are protons (80%) collide with atmosphere, producing showers of secondary particles (electrons, muons) and electromagnetic radiations.
- An air traveller is exposed to increased level of cosmic rays.
- Traveling in a transcontinental flight may yield about 10 µSv per hour
- Structures provide some protection against cosmic rays, and hence, the indoor effective dose is 20% lesser than outdoor.



# Natural Radiation Sources

Terrestrial radionuclides from natural radioisotopes

- Terrestrial radionuclides have been present since the formation of earth.
- They mainly contribute in the form of external exposure, inhalation, and ingestion.
- K-40, U-238, and Th-232 are mainly responsible for external exposure.
- The biggest contributor of terrestrial radiation is Rn-222, of the order of 2 mSv per year.
- Radon is emitted by naturally occurring U-238 in the soil. Hence, inhalation exposure is due to Rn-222 (U-238) and its decay products.
- Radon daughters attach to aerosols and are deposited in the lungs. They may irradiate bronchial mucosa, and may induce bronchogenic cancer.

# Natural Radiation Sources

Internal radioisotopes – Internal radionuclide includes K-40 and C-14, which are present the in the human body.

The main contributor is K-40, which emits ß and y rays.

Enhanced Natural Sources –

Building Materials: Brick, concrete, granite (contain uranium, thorium, potassium).

Mining & Agriculture: Fertilizers with uranium, thorium decay products, and K-40.

Combustible Fuels: Coal, natural gas.

Consumer Products: Smoke alarms (americium-241), gas lantern mantles (thorium), dental prostheses, ceramics, optical lenses (uranium).

Radon Gas: Dissolved in domestic water supply.

# Artificial Radiation Sources

Medical Exposure:

The primary source of artificial radiation, accounting for approximately 79% of exposure.

This includes medical X-rays (fluoroscopy and computed tomography) and nuclear medicine, contributing an annual average effective dose equivalent of 540 µSv per year.

Consumer Products:

Items such as tobacco, domestic water supplies, building materials, smoke detectors, televisions, and computer screens contribute about 16% of artificial radiation exposure..

Nuclear Fallout:

Atmospheric testing of nuclear weapons releases radionuclides such as Carbon-14, H-3, Mn-54, Cs-136, Cs-137, Ba-140, Ce-144, plutonium, and trans-plutonium elements into the environment.

# Artificial Radiation Sources

Occupational Exposure: Arises from activities like uranium mining, nuclear power operations, medical diagnostics and therapy, aviation, non-uranium mining, and the application of phosphate fertilizers. This accounts for about 2% of artificial radiation exposure. Annual effective dose equivalents for specific occupations include:

Uranium miners: 12 mSv

Nuclear power operators: 6 mSv

Air crews: 1.7 mSv

X-ray technologists: 1.0 mSv

Radiologists: 0.7 mSv

Nuclear Power Production: Contributes about 1% of artificial radiation exposure, with carbon-14 being a significant contributors.