

Welcome To Radiation Safety Training

MODULE 1



OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES

OSU Radiation Safety Program

The OSU-CHS radiation safety program will be conducted in such a manner so that exposure to faculty, staff, students, the public, and the environment will be maintained as low as reasonably achievable and that no radiation exposure will be received without societal benefit. This will be accomplished without impeding legitimate research, or realistic teaching objectives in accord with State and Federal regulations.

Natural Sources



Cosmic

The sun and stars send a constant stream of cosmic radiation to Earth, much like a steady drizzle of rain. Differences in elevation, atmospheric conditions, and the Earth's magnetic field can change the amount (or dose) of cosmic radiation that we receive.

Terrestrial

The Earth itself is a source of terrestrial radiation. Radioactive materials (including uranium, thorium, and radium) exist naturally in soil and rock. Essentially all air contains radon, which is responsible for most of the dose that Americans receive each year from natural background sources. In addition, water contains small amounts of dissolved uranium and thorium, and all organic matter (both plant and animal) contains radioactive carbon and potassium. Some of these materials are ingested with food and water, while others (such as radon) are inhaled. The dose from terrestrial sources varies in different parts of the world, but locations with higher soil concentrations of uranium and thorium generally have higher doses.

Internal

All people have internal radiation, mainly from radioactive potassium-40 and carbon-14 inside their bodies from birth and, therefore, are sources of exposure to others. The variation in dose from one person to another is not as great as that associated with cosmic and terrestrial sources.

[Source](#)

Source: Inhaled Radiation

Primarily Radon (Rn-222) and its 'daughters':

- Rn-222 is released from the soil as Radium-226 decays
- Radium is part of the Uranium-238 decay chain
- Levels vary widely from area to area
- May be enhanced by poor ventilation or the use of Uranium containing building materials

Source	Dose (mSv/year)
Radon (U.S. average)	~1.3
Total natural background (U.S.)	~3.0
Total average radiation dose (natural + man-made, U.S.)	~6.2

Internal Radiation

Radiation from radioactive materials incorporated in the human body (the source of radiation is *inside* the body rather than external):

- Primarily Carbon-14 (C-14) and
- Potassium-40 (K-40)



Overview of C-14 and K-40 in the Human Body:

Isotope	Origin	Type of Radiation	Half-life	Average Body Content
Carbon-14	Cosmogenic (formed in the atmosphere, enters food chain)	Beta (β^-)	~5,730 years	Trace (approx. 1 nanogram)
Potassium-40	Natural isotope of potassium (0.012% of all K)	Beta (β^-) and Gamma (γ)	~1.25 billion years	~17 mg in average adult

Man-Made Sources

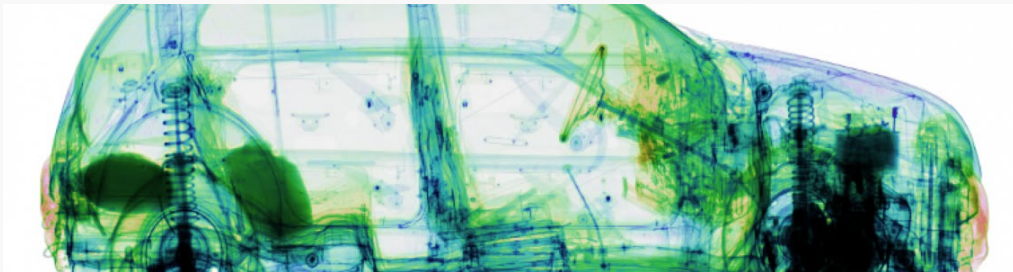


Medical Uses



Consumers Products

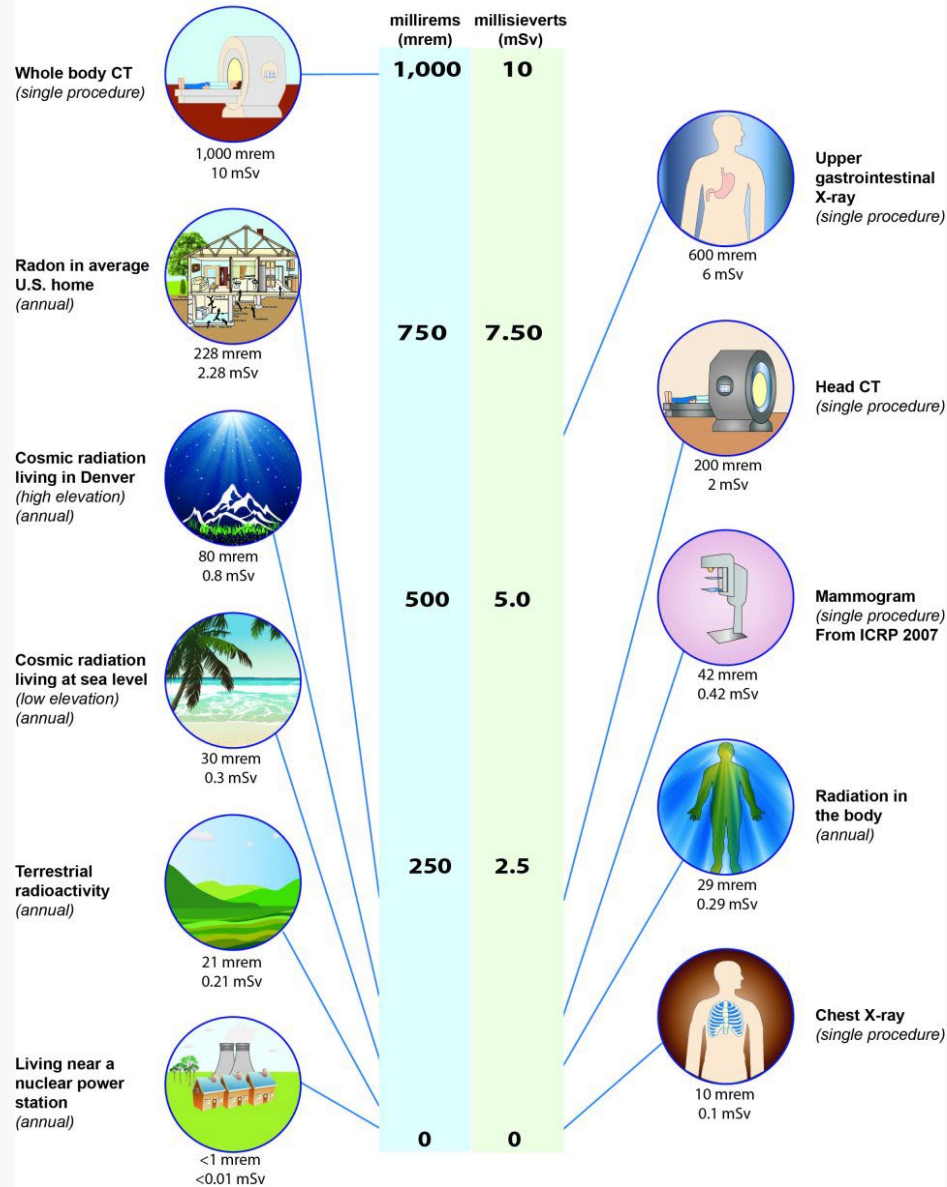
Industrial Uses



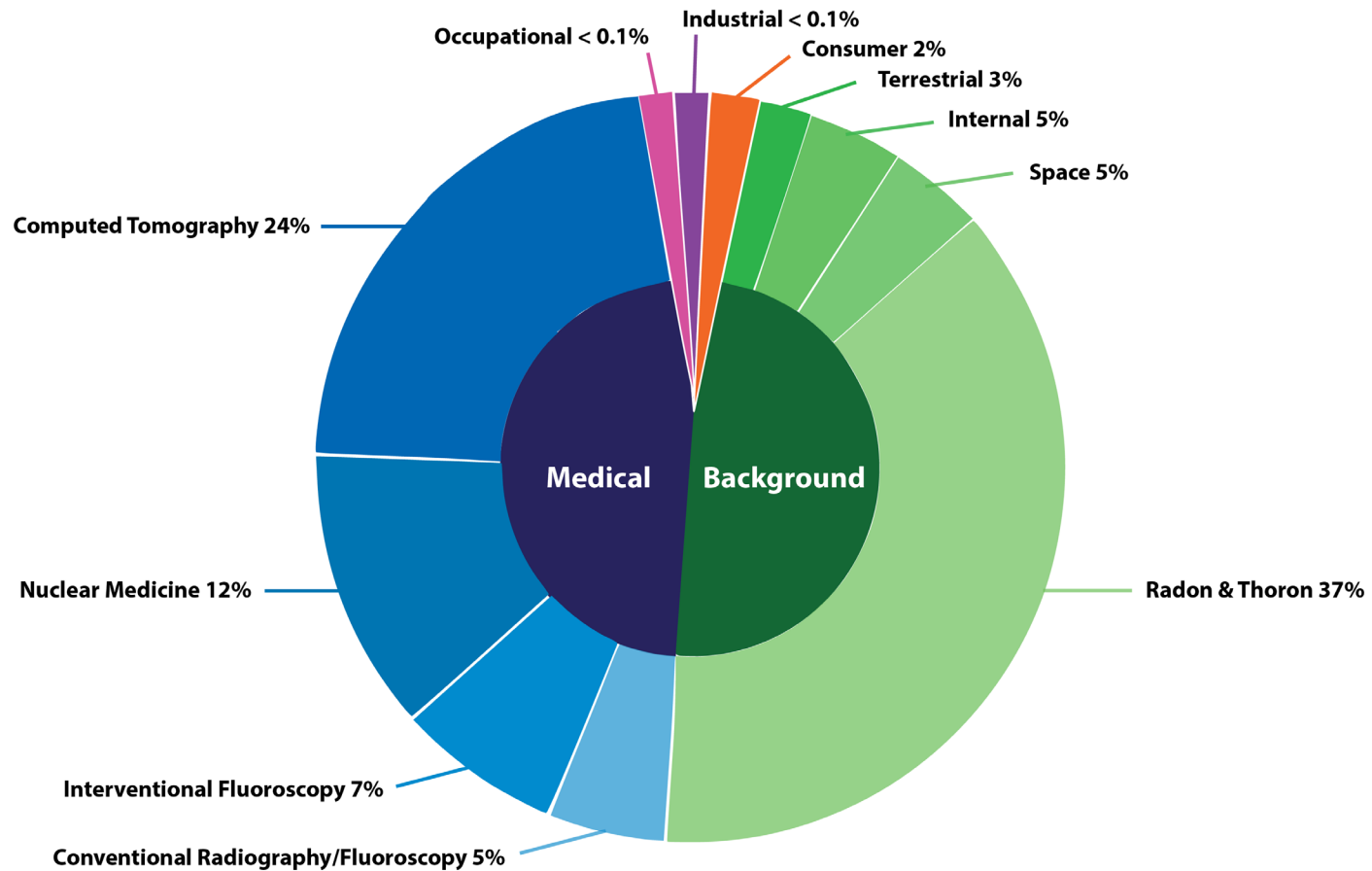
Nuclear Power

RELATIVE DOSES FROM RADIATION SOURCES

All doses from the National Council on Radiation Protection & Measurements, Report No. 160 (unless otherwise denoted)



Sources of Radiation Exposure



Average Annual Radiation Dose

Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
Units											
mrem (United States)	228 mrem	147 mrem	77 mrem	43 mrem	33 mrem	33 mrem	29 mrem	21 mrem	13 mrem	0.5 mrem	0.3 mrem
mSv (International)	2.28 mSv	1.47 mSv	0.77 mSv	0.43 mSv	0.33 mSv	0.33mSv	0.29 mSv	0.21 mSv	0.13 mSv	0.005 mSv	0.003 mSv

(Source: National Council on Radiation Protection & Measurements, Report No. 160)

Medical Sources

Diagnostic X-ray

General Radiography

Dental Radiography

Fluoroscopy

CT

*30-40 mrem/yr – U.S.
average*

Nuclear Medicine

Imaging using I-131, Tc-99m, Tl-201

Therapy using I-131

77 mrem/yr – U.S. average

Radiation Therapy

Use of external beams and sealed sources for treatment of cancers

*50 to 70 rem/yr or 50–70 Sv/yr– U.S.
average*

Industrial Sources

Industrial Radiography

- Use of X-rays or sealed gamma-ray sources for imaging structures and components

Level Gauges

- Use of sealed sources to check the level of materials in a tank or vat.

Well Logging

- Use of sealed sources to measure soil porosity, soil density, or underground structure & composition

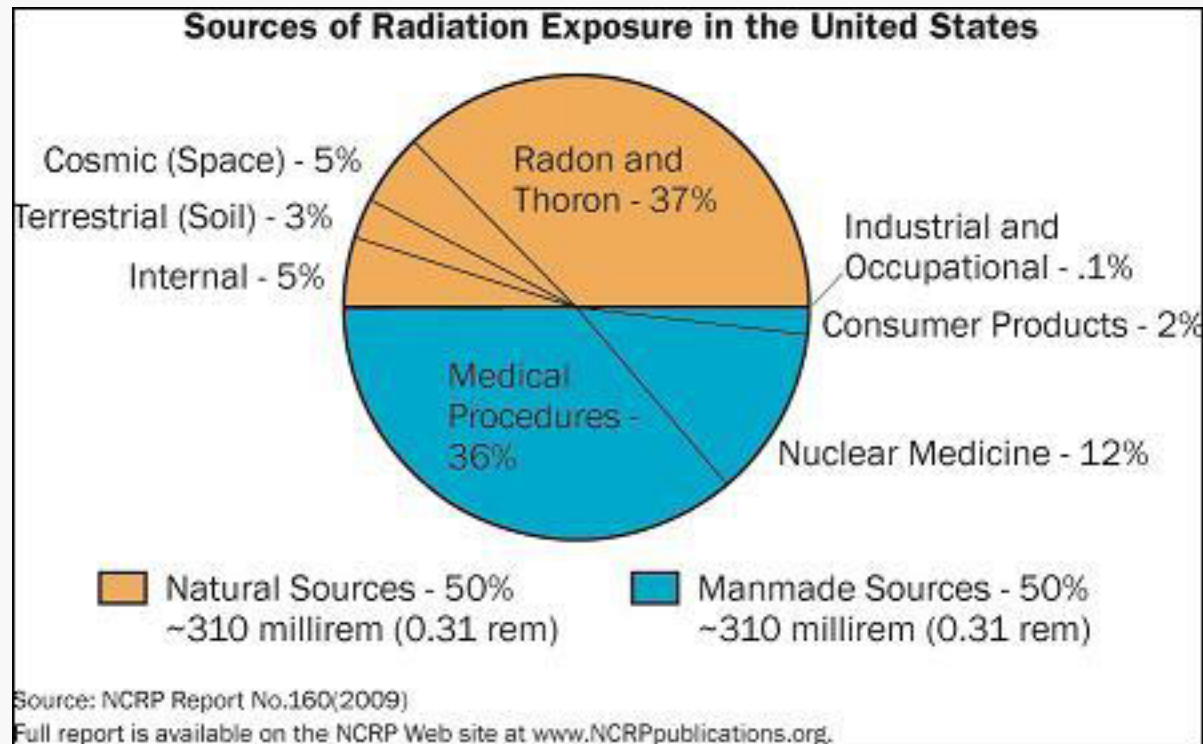
Static Elimination

- Use of radiation to remove static electricity

Consumer Products

- **Americium Smoke Detectors** (Am-241)
- **Clocks and watches:** some luminous watches and clocks contain a small quantity of hydrogen-3 (tritium) or promethium-147. Older watches and clocks (made before 1970) may contain radium-226 paint on dials and numbers to make them visible in the dark
- **Sun lamps and tanning salons:** the ultraviolet rays from sun lamps and tanning salons are as damaging to skin as the ultraviolet rays of the sun. In fact, warning labels are required which begin "DANGER—Ultraviolet radiation".
- **EXIT signs:** Some EXIT signs contain the radioactive gas called tritium, allowing them to glow in the dark without electricity or batteries. The tritium used in EXIT signs gives off low-level beta radiation, causing a light-emitting compound to glow.

Contributions to the Public Dose*



SOURCE