



SNS COLLEGE OF ALLIED HEALTH SCIENCES
SNS Kalvi Nagar, Coimbatore-35
Affiliated to The Dr.M.G.R Medical University, Chennai

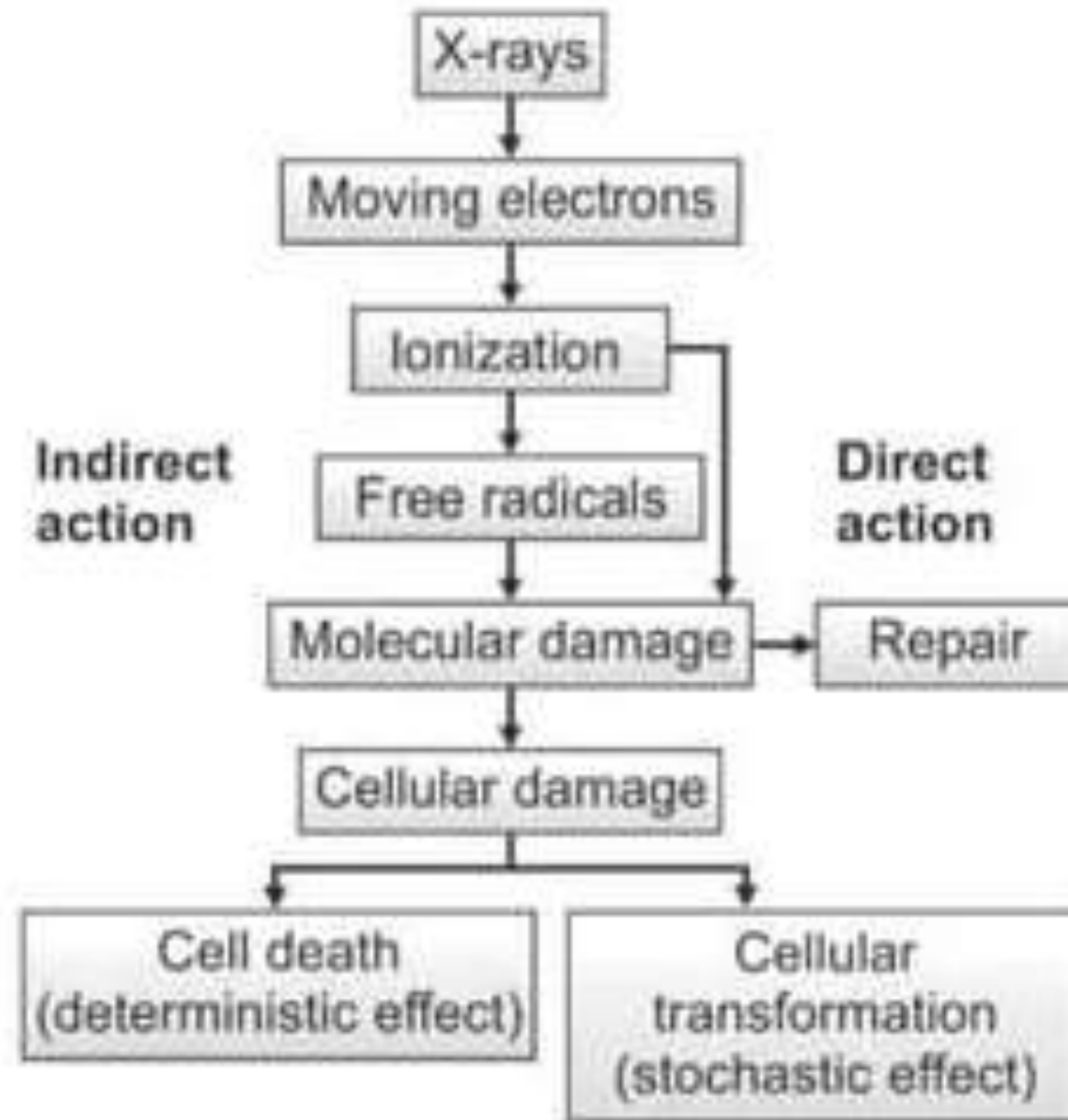


**DEPARTMENT OF RADIOGRAPHY AND IMAGING
TECHNOLOGY I YEAR**

COURSE NAME : GENERAL PHYSICS

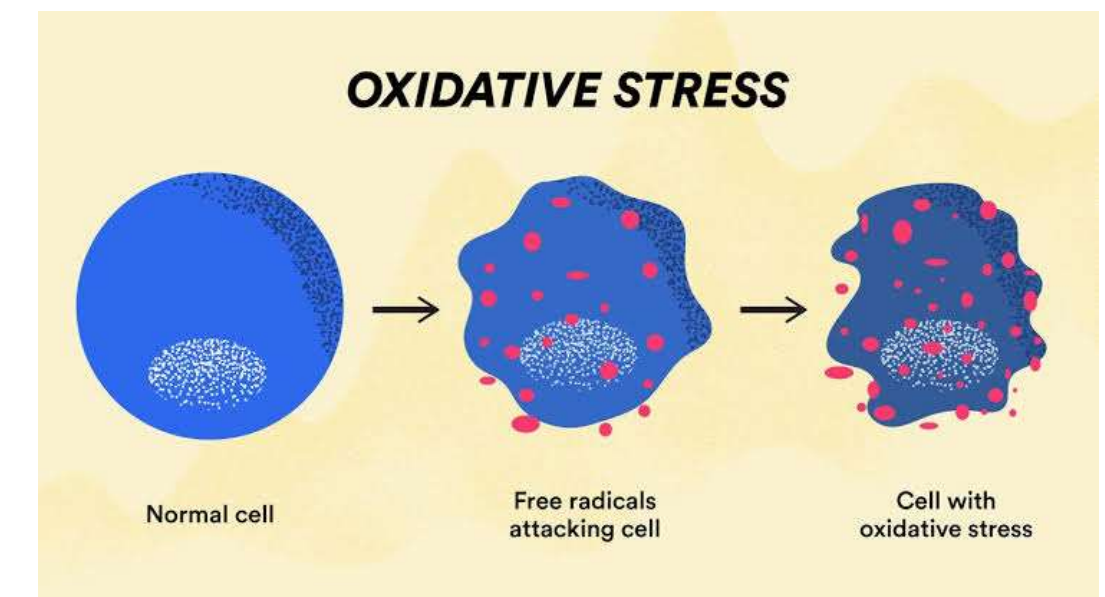
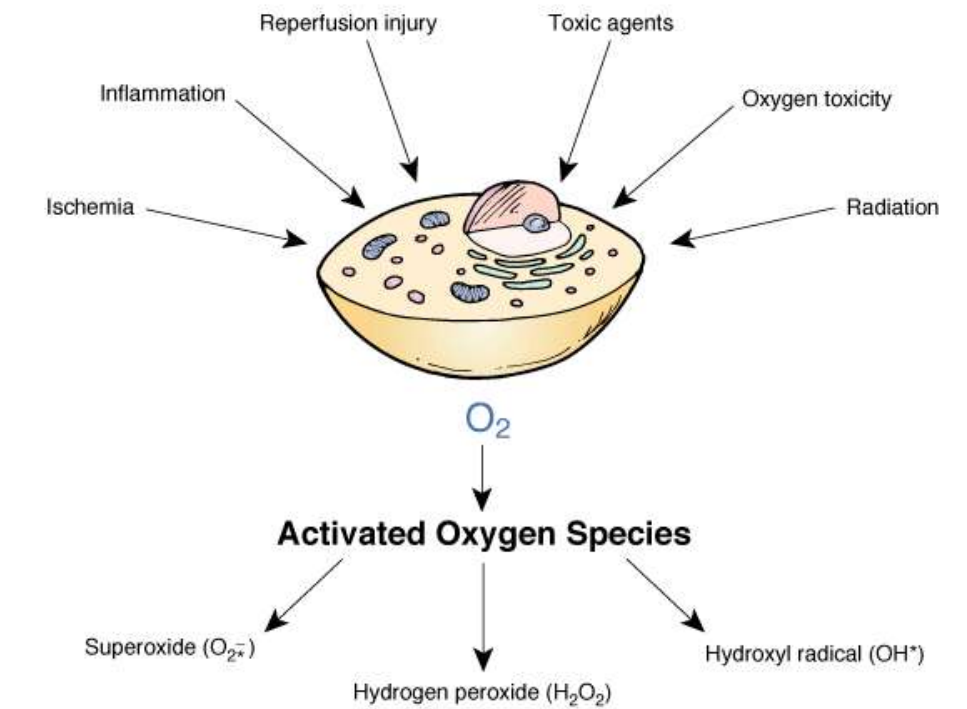
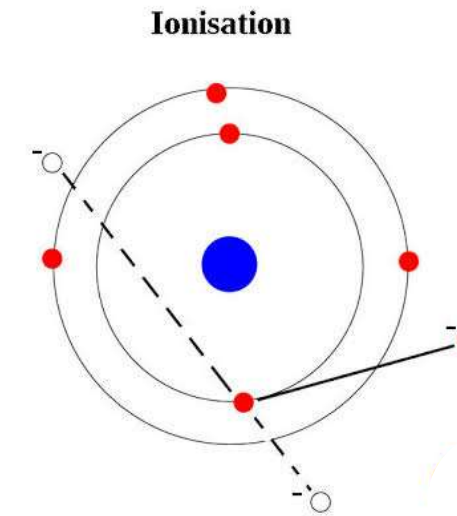
**TOPIC : PRINCIPLES OF RADIATION PROTECTION AND
REGULATIONS**

BIOLOGICAL EFFECTS OF RADIATION



BIOLOGICAL EFFECTS OF RADIATION

- Cellular Damage by Radiation
- **DNA Damage** : Energy deposition can damage DNA molecules.
- May cause chromosome **breaks and aberrations**.
- Impairs normal cell functions.
- Can result in **genetic or somatic damage**, affecting future generations.
- Highly Radiosensitive Cells: Lymphoid tissue, spermatids, bone marrow stem cells.
- Least Radiosensitive Cells: Nerve cells.
- Mechanisms: Direct damage to cells or indirect damage via free radicals.





BIOLOGICAL EFFECTS OF RADIATION

- Physical and chemical changes: **Microseconds**.
- Biological changes: **Minutes to years for manifestation**.

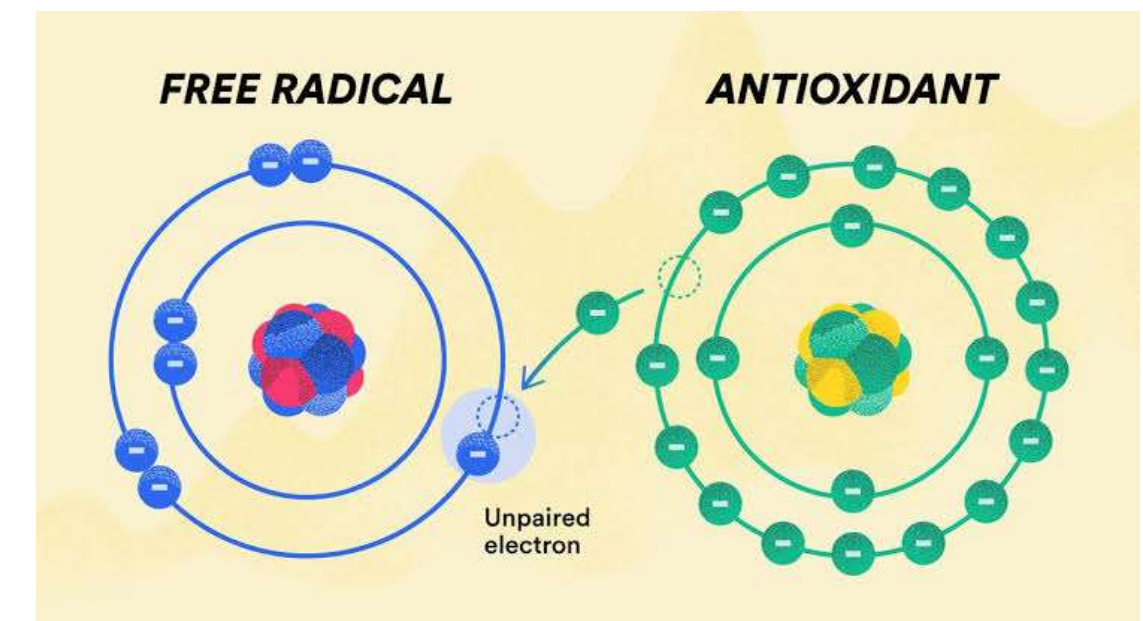
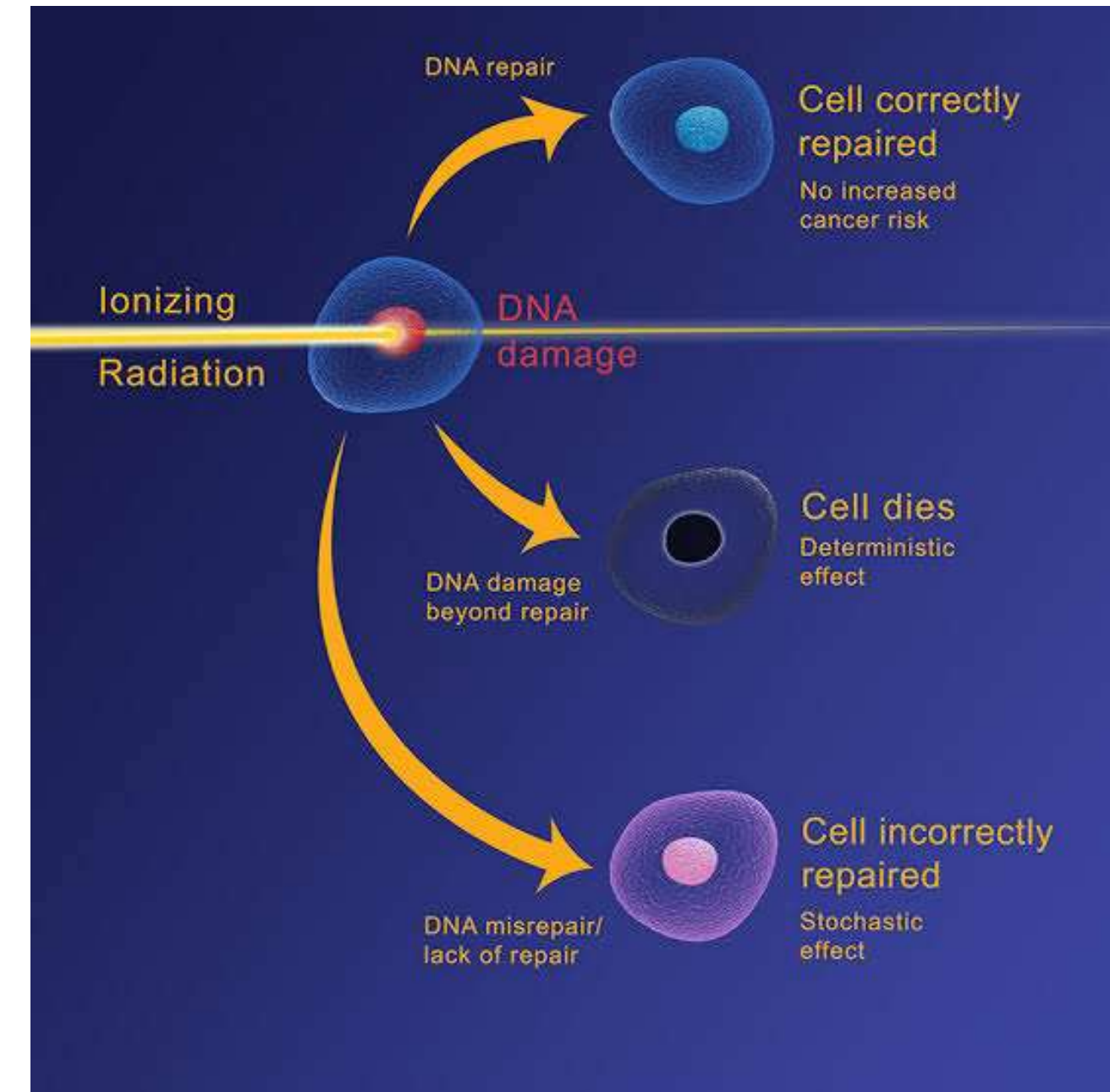
Factors Influencing Radiation Effects

- Type of radiation.
- Dose and dose rate.
- Dose fractionation and cell cycle stage.
- Presence of radioprotectors and radiosensitizers.

Acute : Short time exposure, more harmful, **Chronic** : Long time exposure, less harmful.

Early Effects: Manifest soon after irradiation.

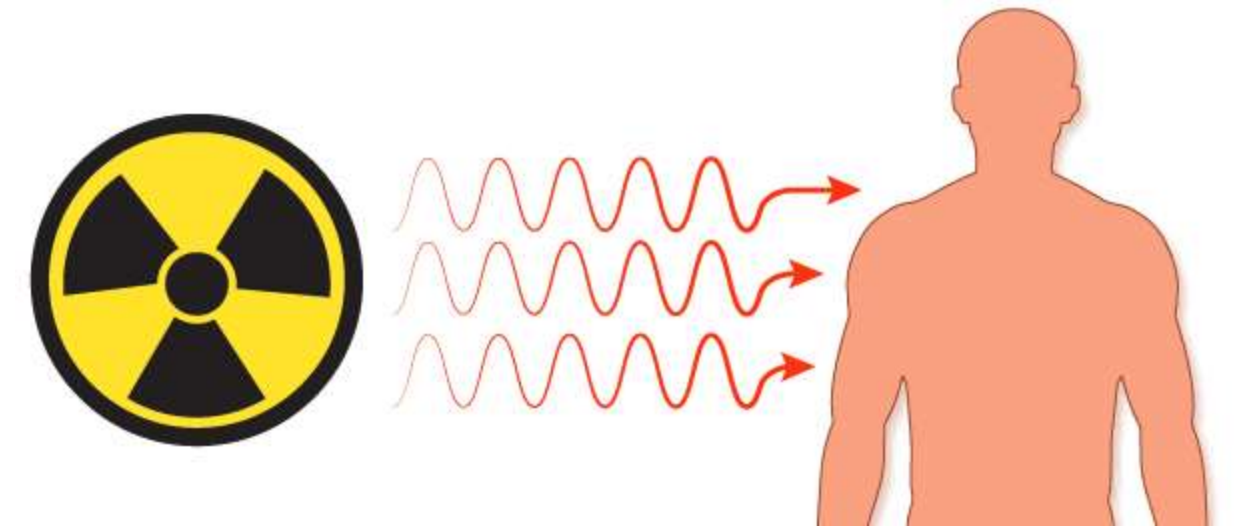
Late Effects: Manifest after a period of time.



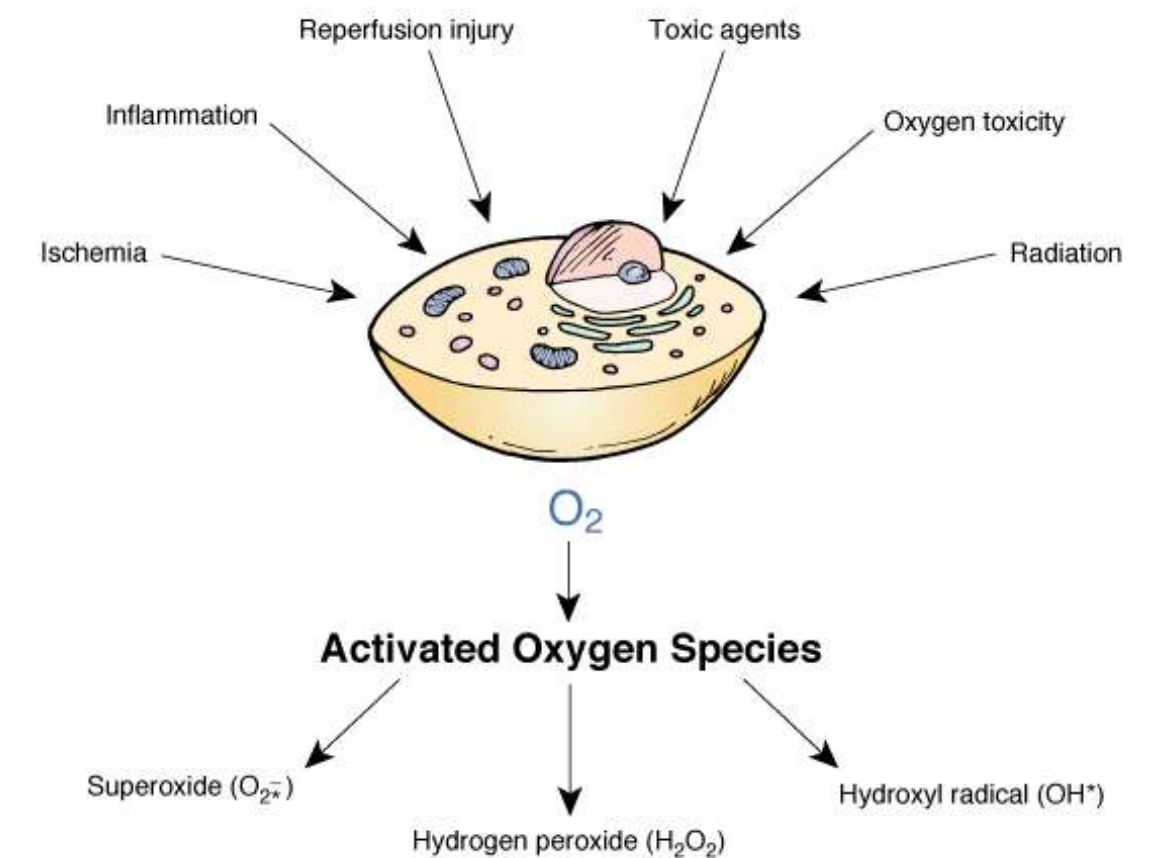


Effect of Radiation on Cells

Cell Structure & Radiation Interaction



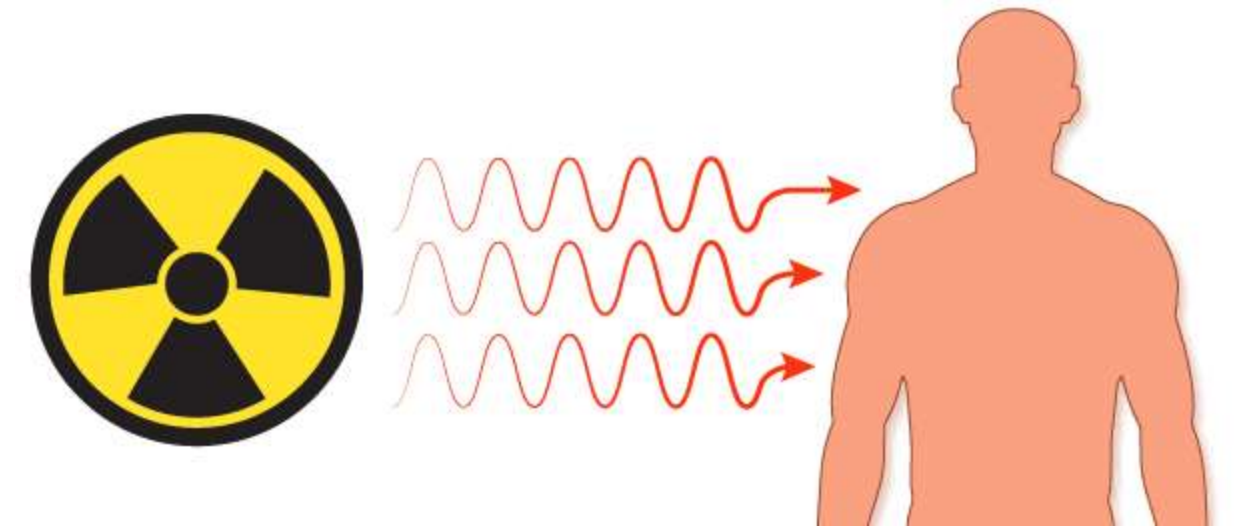
- The cell is the fundamental unit of life, containing a nucleus with chromosomes made of DNA and proteins.
- **Somatic cells** form body tissues and organs (46 chromosomes in 23 pairs).
- **Germ cells** are involved in reproduction (23 chromosomes in sperm & ova).
- **Radiation Impact on Cells**
- Water (80%) in cells interacts with ionizing radiation, producing free radicals (OH , H , e^-).
- **DNA is highly radiosensitive, and damage can lead to:**
 - Inhibition of cell division → Affects tissue & organ function.
 - Chromosome aberrations → Breaks leading to dicentric & ring formations.
 - Gene mutations → Alters genetic information, causing hereditary effects.
- Cell death → Reduces tissue viability





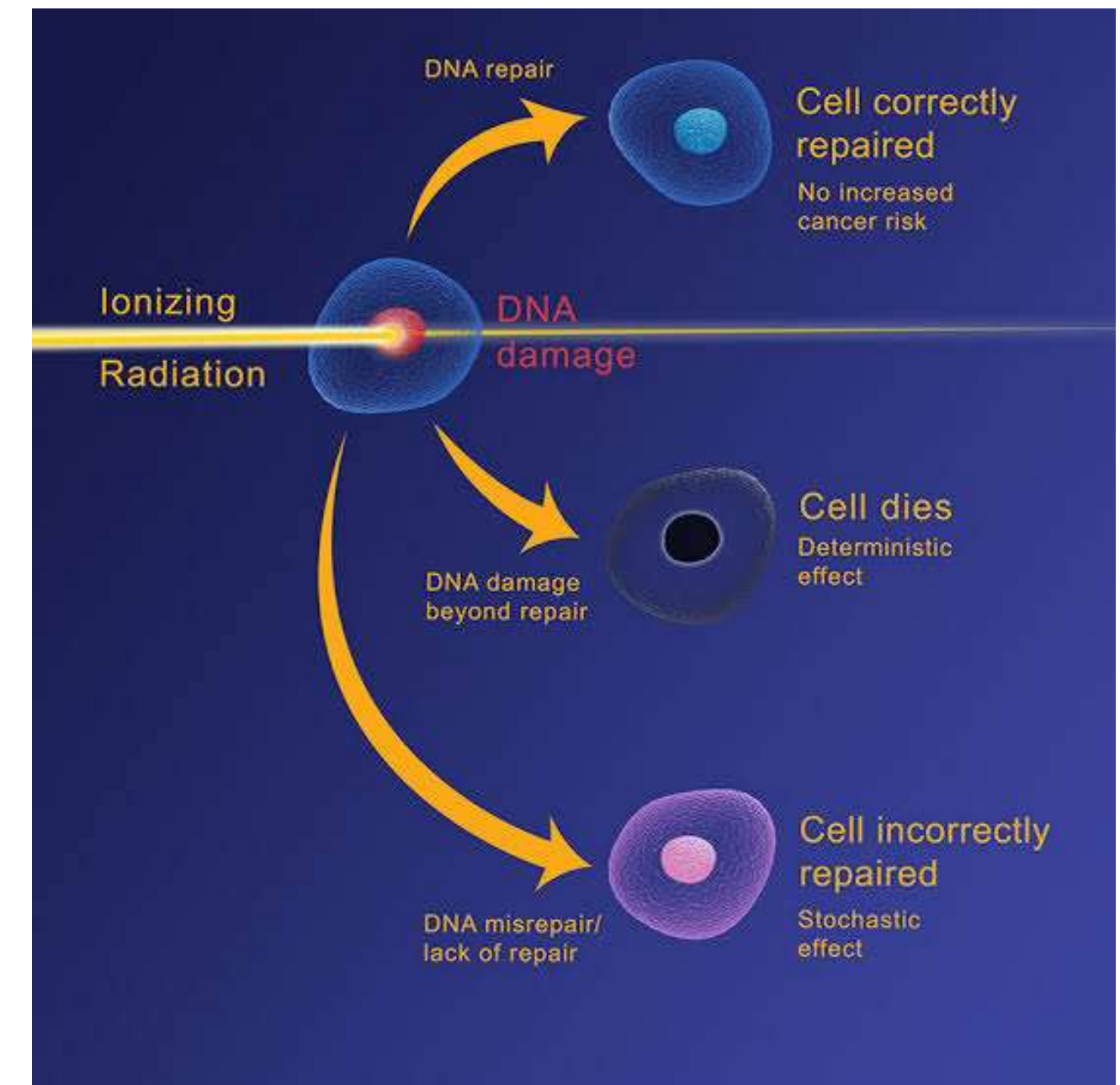
Effect of Radiation on Cells

Cell Structure & Radiation Interaction



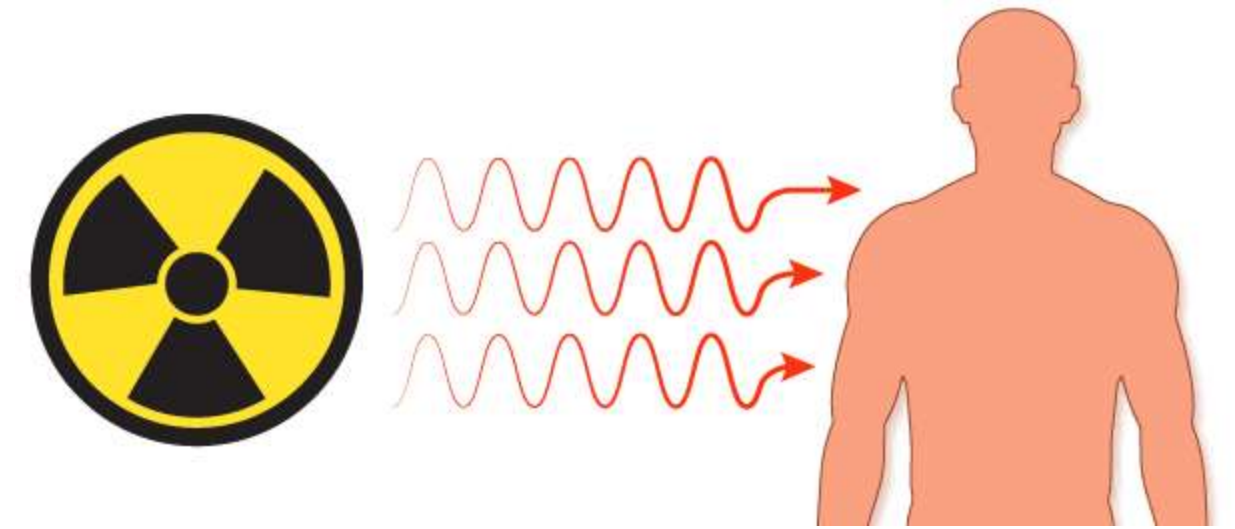
Justification & Biological Significance

- DNA damage leads to cell dysfunction or death, affecting organ systems.
- Chromosome aberrations can be used as biological dosimeters to estimate radiation exposure.
- Survival curves show that low LET radiation allows for some cellular repair, but high doses overwhelm repair mechanisms.
- Acute exposure at high doses leads to systemic failure, depending on the absorbed dose.

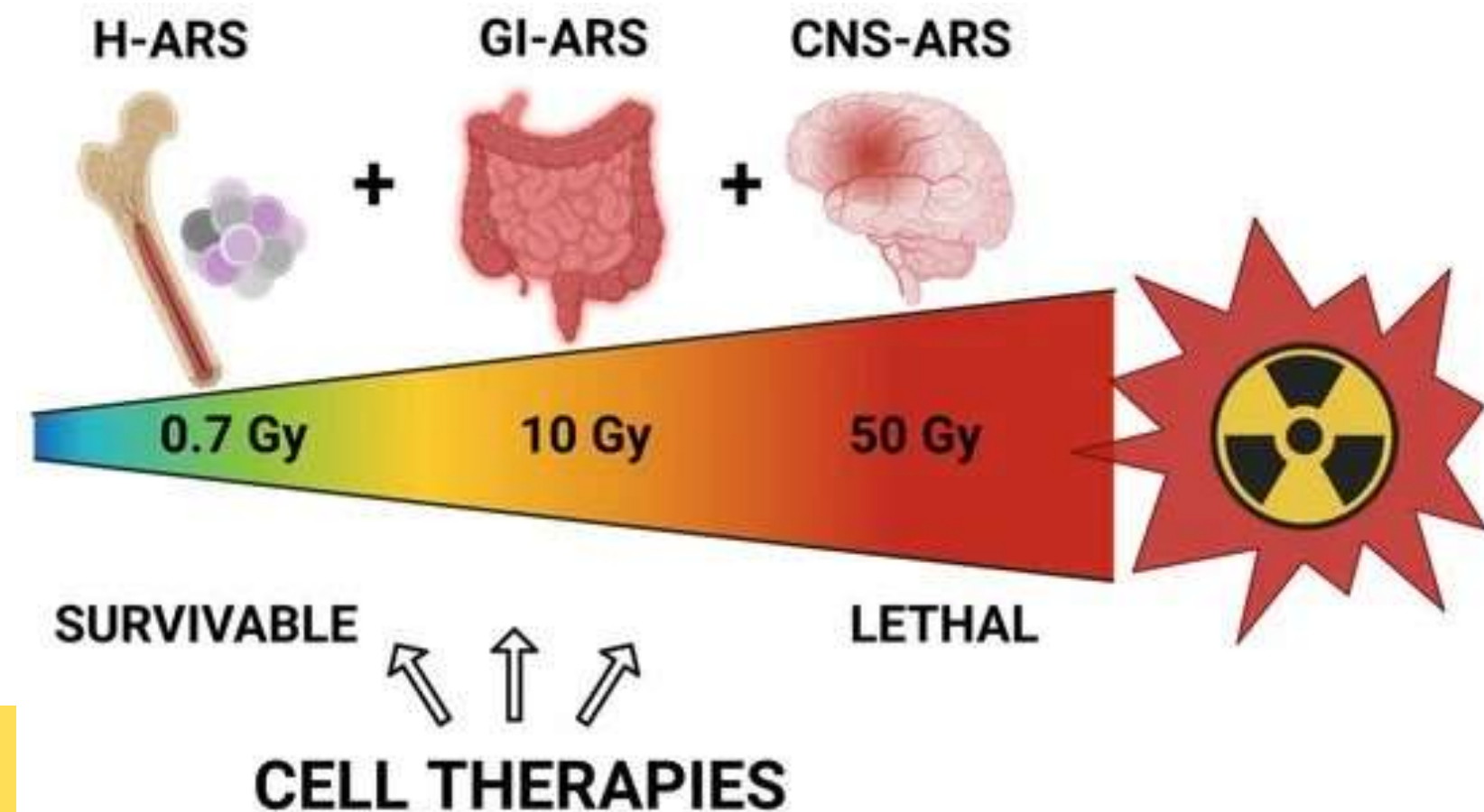




Acute Effects of Radiation



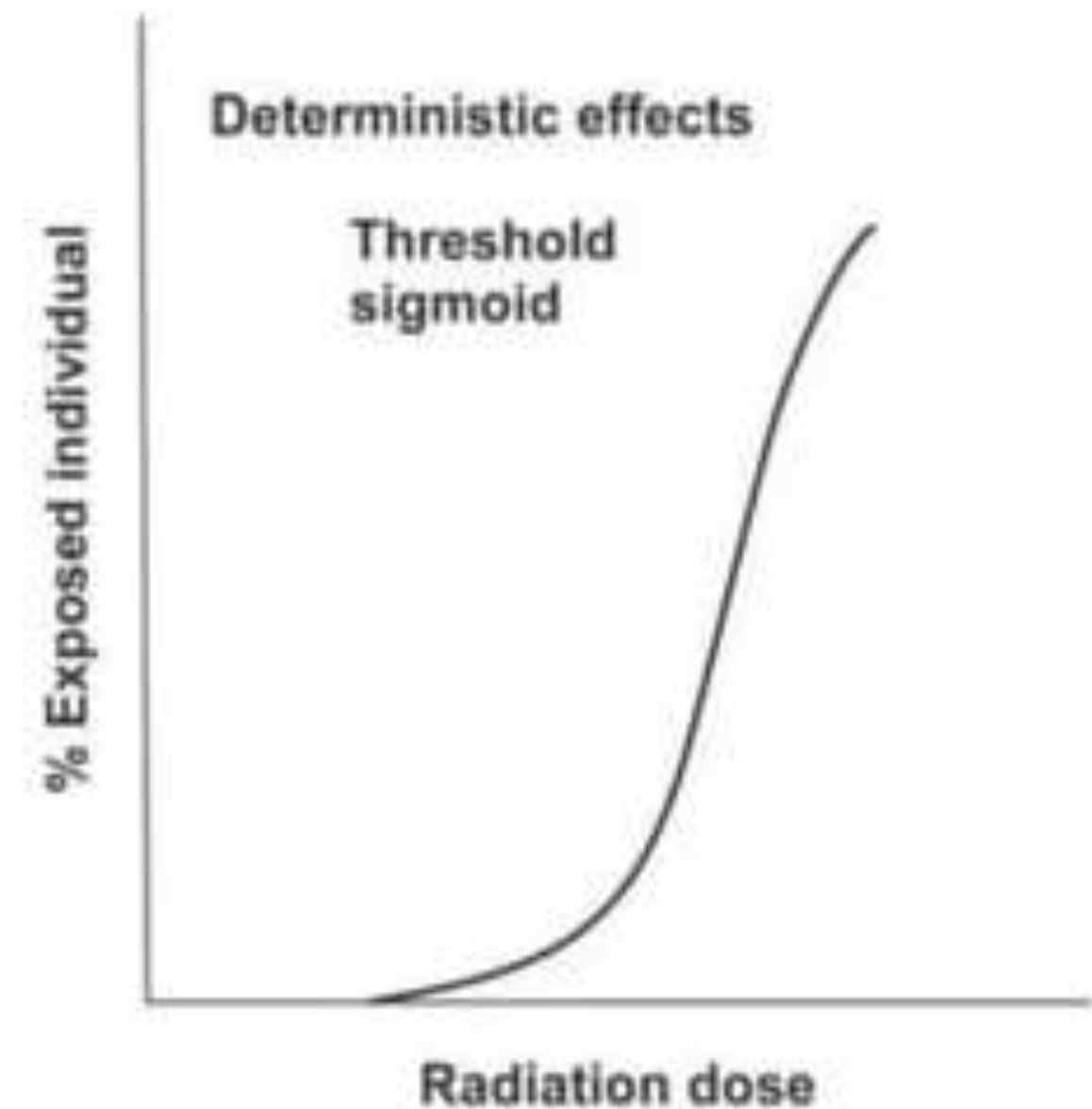
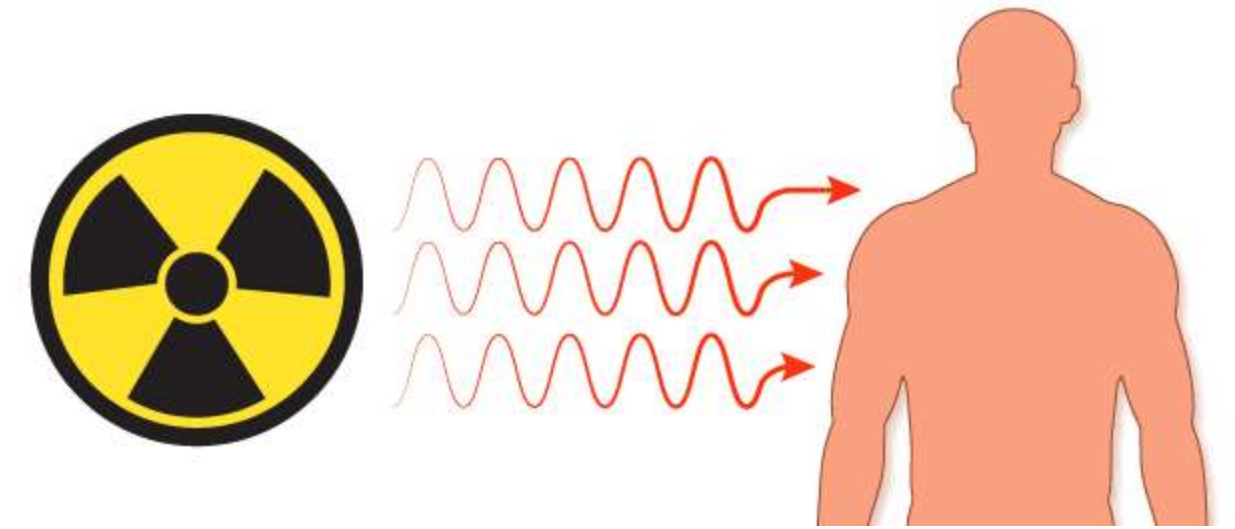
- High intensity whole body irradiation delivered in short interval may cause acute radiation effects
- 1–2 Gy → **Acute Radiation Syndrome** (ARS) with nausea, vomiting, diarrhoea.
- 2.5–5 Gy → **Hematopoietic Syndrome** (death in weeks/months).
- 5–12 Gy → **Gastrointestinal Syndrome** (death in days).
- >100 Gy → **Cerebrovascular Syndrome** (death in 24-48 hours).
- LD₅₀ (**Lethal Dose** for 50% mortality in 60 days) = 4 Gy for humans.





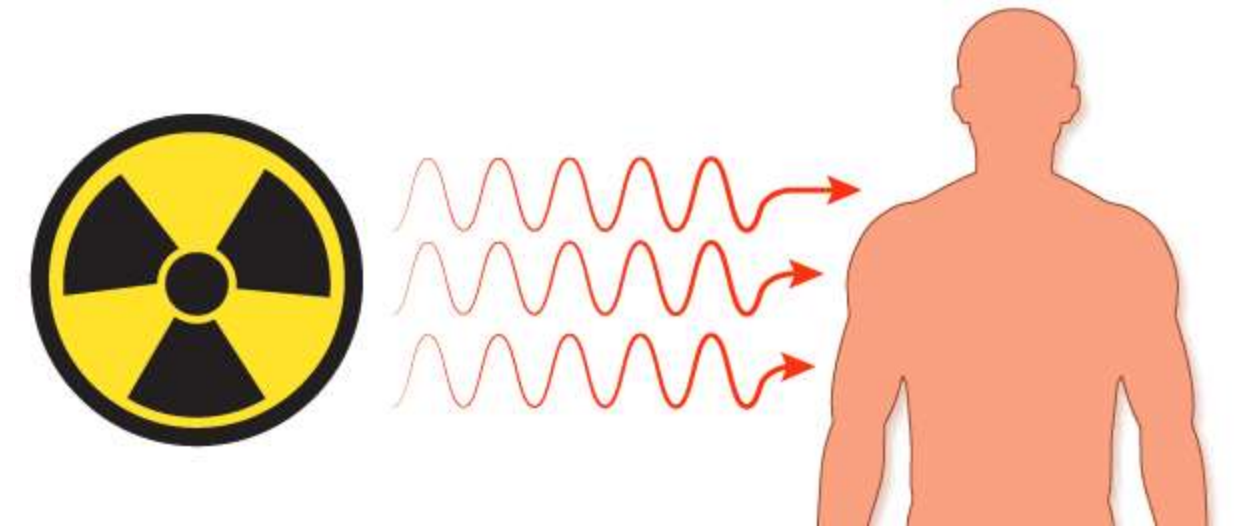
Deterministic Effects

- Threshold-based, “severity of harm increases with increasing absorbed dose”
- Occur above a **threshold dose** (>0.5 Gy), Caused by massive cell death.
- **Examples:**
 - Cataracts (≥ 2 Gy acute, ≥ 5 Gy chronic)
 - Skin erythema
 - Hair loss (epilation)
 - Organ atrophy & fibrosis
 - Blood cell reduction (<1 Gy)
 - Sterility (3-4 Gy in women, 5-6 Gy in men)
 - Preventable by radiation safety measures.





Stochastic Effects



- No Threshold, "probability of occurrence increases with increasing absorbed dose rather than its severity"
- Random occurrence, Can happen at low doses (<0.5 Gy).
- Examples:
 - Cancer (Leukemia, Thyroid, Breast, Lung, Bone, Skin)
 - Genetic mutations (hereditary effects)
- Latent period: Effects appear years after exposure.
- Follow ALARA principle (As Low As Reasonably Achievable) to reduce risk

