SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Approved by AICTE & Affiliated to Anna University

Accredited by NBA & Accrediated by NAAC with 'A++' Grade,

Recognized by UGC saravanampatti (post), Coimbatore-641035.

Department of Biomedical Engineering

Vision Tit 2 Vision Title 3

Course Name: 19BME301 – Medical Physics

III Year : V Semester

Unit V – BASIC RADIATION QUANTITIES

BIOLOGICAL EFFECTS OF RADIATION

Definition :-

The harmful effects caused to human being and other living beings due to their exposure to radiation is called as biological effects of radiation.

CELL

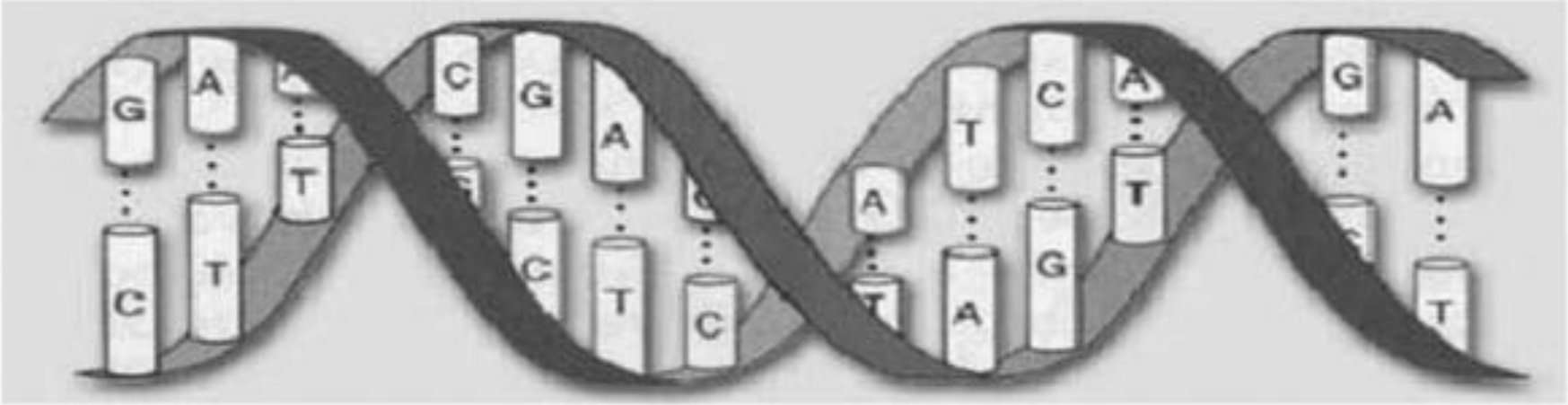
- The smallest unit of body is called a cell.
- Cells of different organs have different shapes sizes & functions.
- The most sensitive part of the cell is the NUCLEUS.

CELL

- Nucleus contains 46 thread like structures which are called CHROMOSOMES
- Each chromosome contains one very complex sensitive molecule called DEOXYRIBONUCLEIC ACID (DNA)
- DNA contains very specialised coded language made up of 4 molecules, A,T, G & C which are arranged in very specific order.

DNA structure

- Cell nucleus- Chromosomes- DNA
- Constitute the genetic material of the cells
- Target molecule for the induction of radiation damage



Interaction of radiation with the cell

Mechananisms of induction of radiation damage

MECHANISM OF INDUCTION OF DAMAGE

DIRECT EFFECT-

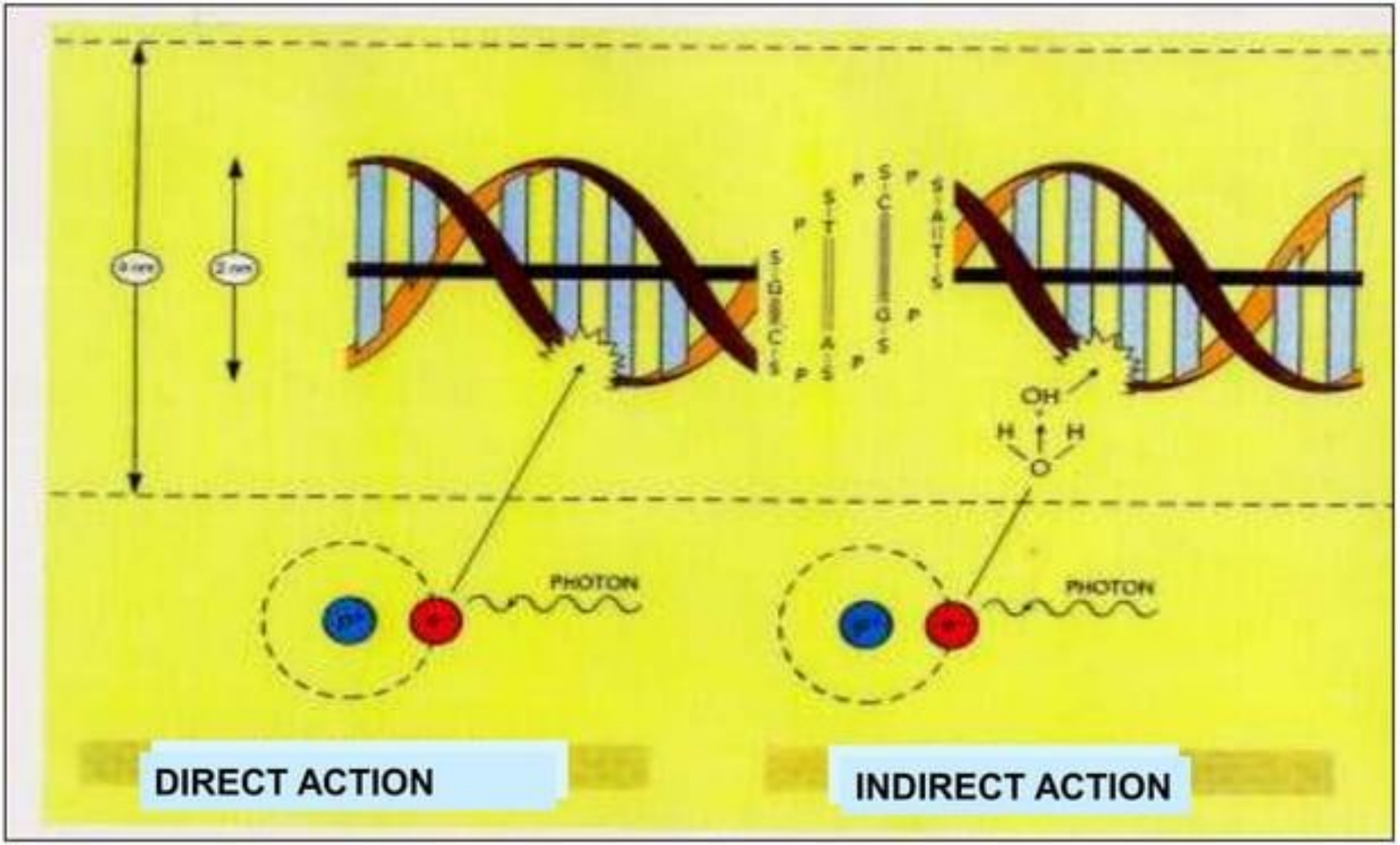
- Due to direct deposition of energy in THE TARGET MOLECULE (Deoxyribonucleic Acid-DNA).
- Direct action is predominant with high LET radiation, e.g. alpha particles and neutrons
- **Proportion of Direct Effect≈ 30%**

MECHANISM OF INDUCTION OF DAMAGE

INDIRECT EFFECT-

- Due to deposition of energy in the surrounding water & reaction of free radical formed in the water with the Target Molecule-DNA
- Indirect action is predominant with low LET radiation, e.g. X and gamma rays
- **Proportion of Indirect Effect ≈70%**

The target in the cell: DNA



CELLULAR LEVEL EFFECTS

Gene mutation- DNA sequence of A,T, G,C changes

Chromosome aberrations - Abnormal structures of chromosomes

Inhibition of division- cell division inhibited

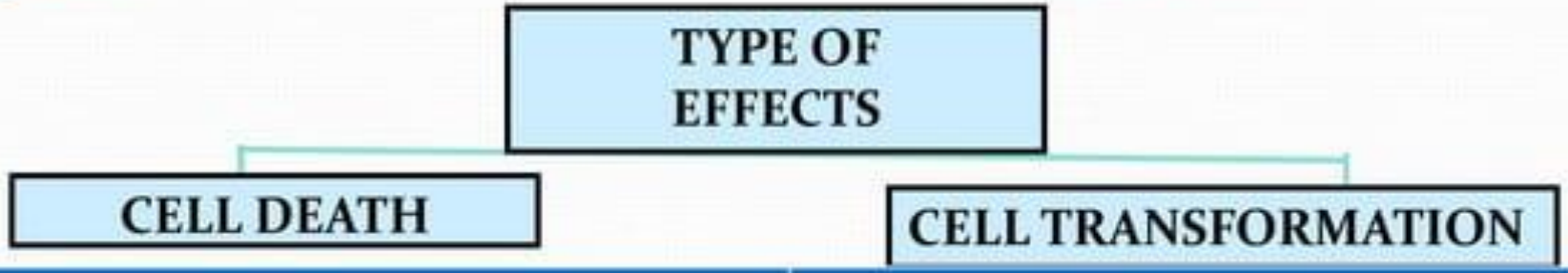
Cell Killing/cell death - cells stop dividing / functioning

RADIATION EFFECTS ON CELLS

Basically, there are three things that can happen:

- 1.The radiation may pass through the cell without doing any damage to cell.
- 2. The radiation may damage the cell so that the cell not only form to repair itself but reproduces itself in the damaged form – Biological Response.
- 3. The radiation may cause so much damage, cells dies.

DETERMINISTIC vs STOCHASTIC EFFECTS



DETERMINISTIC EFFECTS	STOCHASTIC EFFECTS
All body syndromes & partial body effects with thresholds	Genetic effects like cancer & heredity
. Occurs due to cell killing	occurs due to cell modification
No threshold dose	Threshold dose exist
. Definite to occur in all individuals beyond threshold doses	Probabilistic in nature (occurs by chance in some individuals)
Severity of symptoms chance increases with dose.	. Probability/risk or increases with dose

BIOLOGICAL EFFECTS OF ACUTE EXPOSURE TO RADIATIONS

Dose Range (Gy)	Immediate Biological Effect
< 0.1	No detectable biological effect
0.1 - 0.5	Detectable increase Chromosome aberration
0.5 – 1.0	Chromosome aberration plus transient reduction in WBC,
1.0	Temporary sterility in males
1.0 – 2.0	nausea, vomiting, diarrhea (NVD), recovery probable
2.0 – 3.0	Threshold for induction of cancer Radiation sickness in most exposed individuals. Death of small percentage of individuals (10 - 30%)
3.0 – 5.0	$LD_{50/60}$ for human beings Sever hemorrhage,
5.0 – 10.0	Severity of the above effects increases, almost 100% deaths (at higher doses)

Thank You