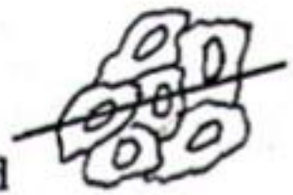
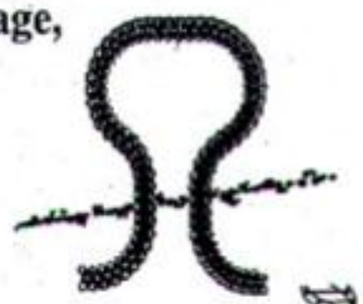
DISTANCE SCALE	ORGANIZATION LEVEL	HIGH-LET TRACK
100 μm		
	A. Tissue	Adjacent cells damaged 
10 μm	B. Cell Nucleus	Large insult, or none 
1 μm	C. Chromosomes	Correlated damage in separate chromosomes 
100 nm	D. Chromatin	Correlated damage, fragments 
10 nm	E. Nucleosome	
	F. DNA	Clustered damage, complexity 
1 nm	G. Chemical reactions	Recombination; biradical reactions OH• R•
0.1 nm		

High-LET and low-LET radiations are different at <u>all</u> these levels.
Which level(s) dominate the biological effectiveness?

Radiation track structure is important at all levels of organisation,
from molecules to tissue, from sub-nanometres to 100s of micrometres

The DNA level (nanometres) is particularly important.

- This slide presents an elegant framework for understanding the relationships between various categories of DNA damage and radiation, specifically, how the track structure of ionizing radiation can manifest biologic effects. Differences in track structure and ionization density become more obvious when put into this perspective.
- For example, the creation of free radicals is depicted on the nanometer scale, which is the predominant form of indirect effects of ionizing radiation. Double strand breaks can occur in the 5nm range and deletions at the 100nm range, which can be visualized as a function of the organization of chromatin loops. By a track creating DSBs in two strands of DNA in a loop and with inappropriate repair, a deletion could occur. The mechanism by which a track can create a translocation can occur is shown in the one micrometer range.
- The illustration raises the question of which organizational level dominates the biological effects of radiation. Due to the clustered nature of ionizations resulting from radiation track structures, the most important level for biologic effects is at the DNA scale (nanometers) and even the larger scale phenomena, such as deletions or translocations, are dependent on the changes occurring at the DNA level. Approximately half of double strand breaks that occur with low LET radiation are associated with additional breaks or base damages whereas with high LET radiation, such as alpha particles, approximately 90% of such foci are associated with additional clusters of breaks and damaged bases.
- This illustration depicts damages that can occur in the DNA molecule as a function of track structure and scale. I chose this slide because the perspective provided by this image is very useful when learning the mechanisms whereby radiation can cause DNA disturbances.