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PHARMACEUTICAL BIOTECHNOLOGY

UNIT 4

TOPIC :

- **b) Genetic organization of Eukaryotes and Prokaryotes**



Genetic Organization of Prokaryotes and Eukaryotes

- Genetic organization refers to the arrangement, packaging, and management of genetic material (DNA) inside a cell. The organization of DNA differs significantly between prokaryotic and eukaryotic cells due to differences in cellular structure and complexity.

Prokaryotes

- Prokaryotes are organisms that possess prokaryotic cells. These cells are simple, small, and lack a true nucleus and membrane-bound organelles. Their genetic material is present freely in the cytoplasm in a region called the nucleoid.

Examples

- Bacteria
- Cyanobacteria

Genetic Organization in Prokaryotes

1. Single Circular DNA

Prokaryotes generally contain a single circular chromosome.

- DNA is double-stranded.
- The chromosome is circular in shape.
- It is not enclosed within a nuclear membrane.

2. Nucleoid Region

The genetic material is present in a specialized region called the nucleoid.

- The nucleoid is not surrounded by a membrane.
- DNA remains directly exposed to the cytoplasm.

3. Absence of Histone Proteins

Most prokaryotes do not possess histone proteins.

- DNA is not tightly packed into chromatin.
- Some archaea possess histone-like proteins.

4. Presence of Plasmids

Plasmids are small circular DNA molecules present outside the main chromosome.

- They replicate independently.
- Often carry genes for antibiotic resistance.
- Can be transferred between bacteria.

5. Less Non-Coding DNA

Most prokaryotic DNA is coding DNA.

- Genes are closely packed.
- Introns are generally absent.
- Very little non-coding DNA is present.

6. Haploid Nature

Prokaryotic cells usually contain only one copy of each gene.

- Only one chromosome is present.
- Therefore, they are considered haploid organisms.

Eukaryotes

- Eukaryotes are organisms that possess eukaryotic cells. These cells are larger and more complex and contain a true nucleus along with membrane-bound organelles.

Examples

- Plants
- Animals
- Fungi
- Protists

Genetic Organization in Eukaryotes

1. Multiple Linear Chromosomes

Eukaryotic cells contain multiple chromosomes.

- Chromosomes are linear in shape.
- Located inside the nucleus.
- The number of chromosomes varies among species.

2. Nuclear Envelope

The genetic material is enclosed within a double-layered membrane called the nuclear envelope.

- Separates DNA from the cytoplasm.
- Protects genetic material.
- Controls movement of substances through nuclear pores.

3. Presence of Histone Proteins

Histone proteins help in the packaging and organization of DNA.

- DNA wraps around histones.
- Forms nucleosomes.
- Nucleosomes further condense into chromatin and chromosomes.

4. Presence of Introns and Exons

Eukaryotic genes contain:

Exons

- Coding regions of DNA.
- Expressed in proteins.

Introns

- Non-coding regions of DNA.
- Removed during RNA processing.

5. Large Amount of Non-Coding DNA

A significant portion of eukaryotic DNA is non-coding.

- Includes introns.
- Regulatory sequences.
- Repetitive DNA elements.

6. Diploid Nature

Most eukaryotic organisms are diploid.

- Possess two copies of each chromosome.
- One chromosome inherited from each parent.

DNA Packaging In Eukaryotes

DNA packaging occurs in several levels:

1. DNA double helix
2. DNA wrapped around histones
3. Formation of nucleosomes
4. Chromatin fibers
5. Condensed chromosomes

This packaging allows a large amount of DNA to fit inside the nucleus.