Molecular Biology

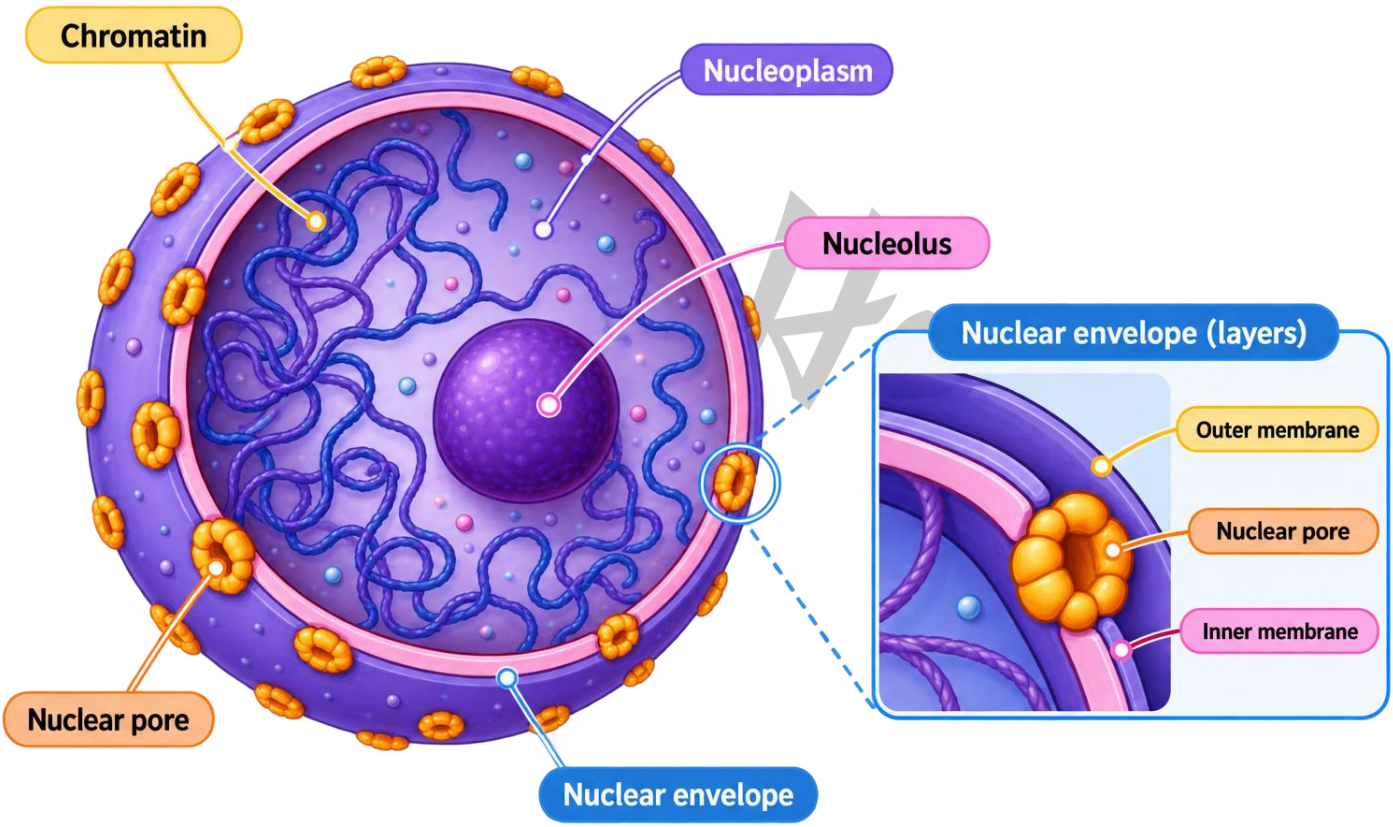
Structure of Nucleus

- The nucleus is a very important part of a cell. It acts like the control center because it stores genetic material (DNA) and controls cell activities such as growth, metabolism, and reproduction.

Basic Features of the Nucleus

- Usually spherical or oval in shape.
- Present in eukaryotic cells (plants, animals, fungi).
- Contains genetic material (DNA) organized into chromosomes.

Main Parts of the Nucleus



A. Nuclear Envelope (Nuclear Membrane)

- It is a double-layered membrane that surrounds the nucleus.
- It separates the nucleus from the rest of the cell (cytoplasm).
- **It has two layers:**
  - Outer membrane (connected to endoplasmic reticulum)
  - Inner membrane
- It contains **nuclear pores**.

B. Nuclear Pores

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- Tiny openings in the nuclear membrane.
- Allow movement of substances like RNA and proteins in and out of the nucleus.
- They are highly selective (not everything can pass freely).

C. Nucleoplasm

- A semi-liquid substance inside the nucleus.
- Similar to cytoplasm but inside the nucleus.
- It contains enzymes, nucleotides, and other molecules needed for DNA replication and transcription.

D. Nucleolus

- A dense, round structure inside the nucleus.
- It is not surrounded by a membrane.
- Its main function is to produce **ribosomal RNA (rRNA)** and assemble ribosomes.

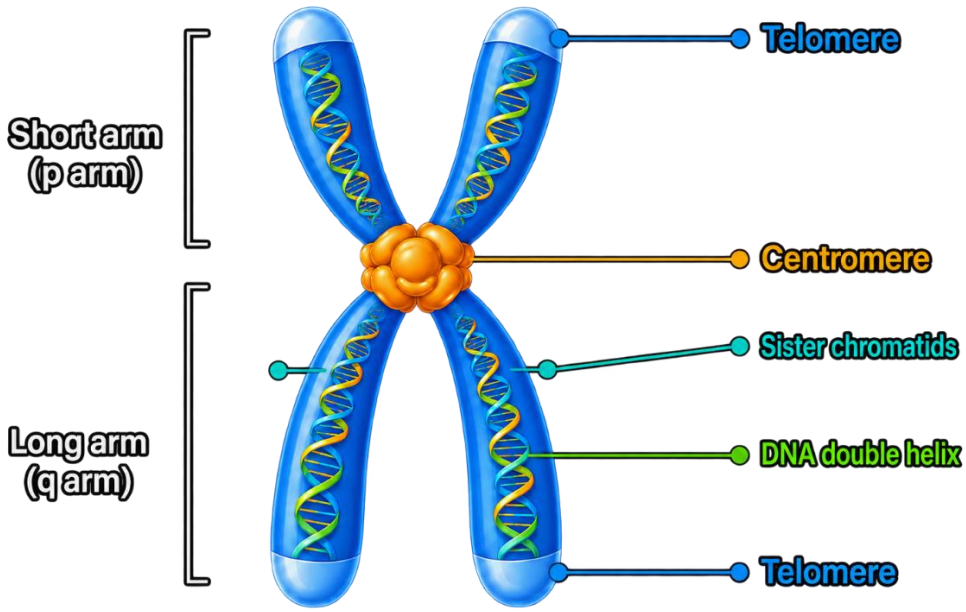
E. Chromatin

- A thread-like structure made of DNA and proteins (mainly histones).
- It appears loose and uncoiled when the cell is not dividing.
- During cell division, chromatin condenses to form chromosomes.

First Hope

Structure of Chromosome

- A **chromosome** is a tightly packed form of DNA found inside the nucleus.
- It carries genetic information (genes).



Basic Components of a Chromosome

A. DNA (Deoxyribonucleic Acid)

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- The main genetic material.
- It contains instructions for building proteins.

B. Histone Proteins

- DNA wraps around these proteins.
- Help in packaging DNA into a compact structure.

Levels of Chromosome Organization

A. Nucleosome

- The basic unit of chromosome structure.
- DNA wraps around a group of histone proteins.
- Looks like "beads on a string".

B. Chromatin Fiber

- Nucleosomes coil further to form a thicker fiber.

C. Looped Domains

- Chromatin fibers form loops attached to a protein scaffold.

D. Fully Condensed Chromosome

- During cell division, chromatin becomes highly condensed and visible under a microscope.

First Hope

Organization of DNA in Chromosome

- **DNA is very long, so it is packed efficiently:**
  - DNA wraps around proteins called histones.
  - This forms a structure called a nucleosome (bead-like structure).
  - Nucleosomes coil further to form chromatin fibers.
  - During cell division, chromatin condenses into chromosomes.

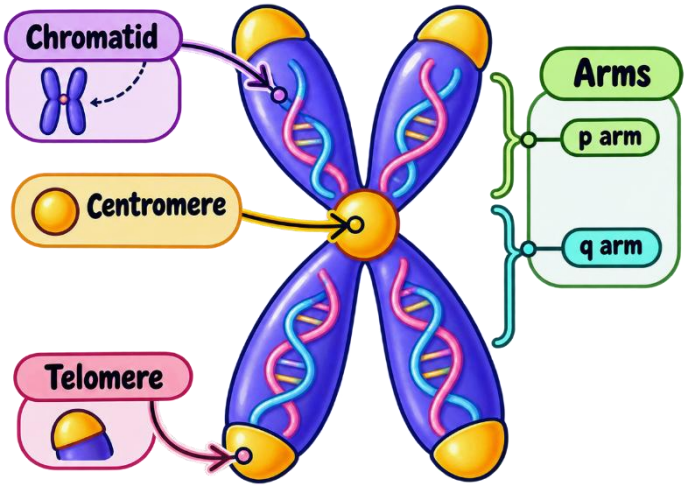
Parts of a Chromosome

A. Chromatid

- Each chromosome has two identical halves called sister chromatids (after DNA replication).
- They are joined together.

B. Centromere

- The region where two chromatids are attached.



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- Important for movement during cell division.

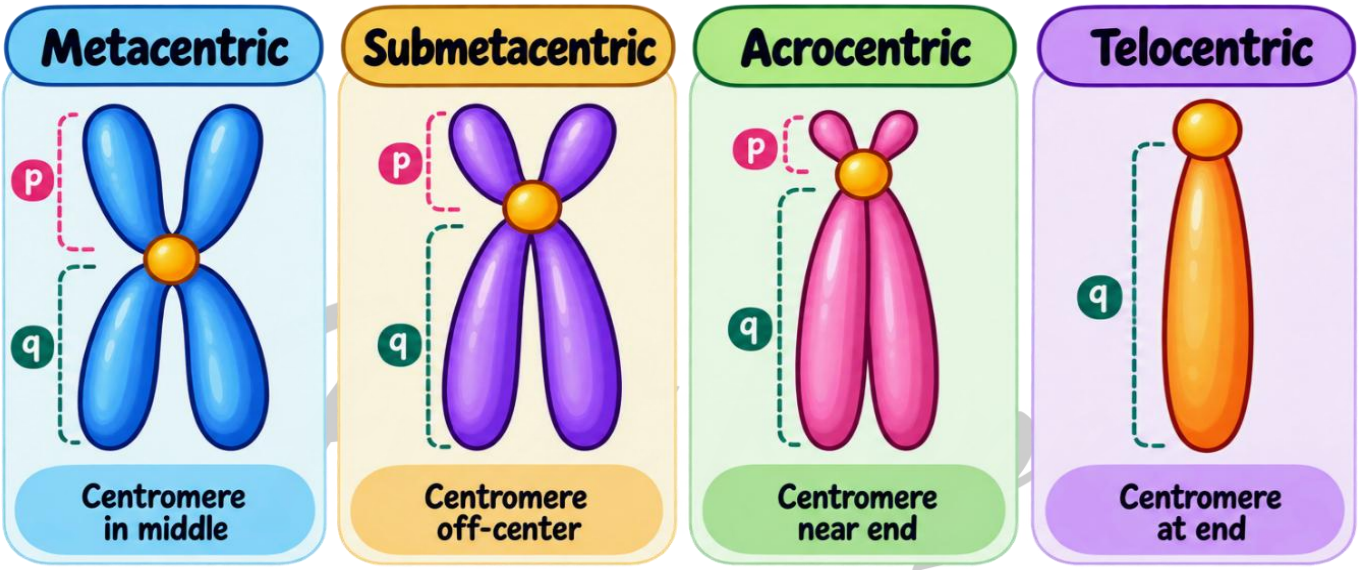
C. Telomere

- The end of the chromosome.
- Protect DNA from damage and prevent shortening during replication.

D. Arms of Chromosome

- **Divided into:**
  - p arm (short arm)
  - q arm (long arm)

Types of Chromosomes (Based on Centromere Position)



1. Metacentric

- Centromere in the middle.
- Arms are equal in length.

2. Submetacentric

- Centromere slightly off-center.
- One arm is longer than the other.

3. Acrocentric

- Centromere near one end.
- One very short arm and one long arm.

4. Telocentric

- Centromere at the extreme end.
- Only one visible arm.

Functions of Chromosomes

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- Carry genetic information (genes).
- Control inheritance from parents to offspring.
- Help in proper distribution of DNA during cell division.
- Regulate protein synthesis indirectly through genes.

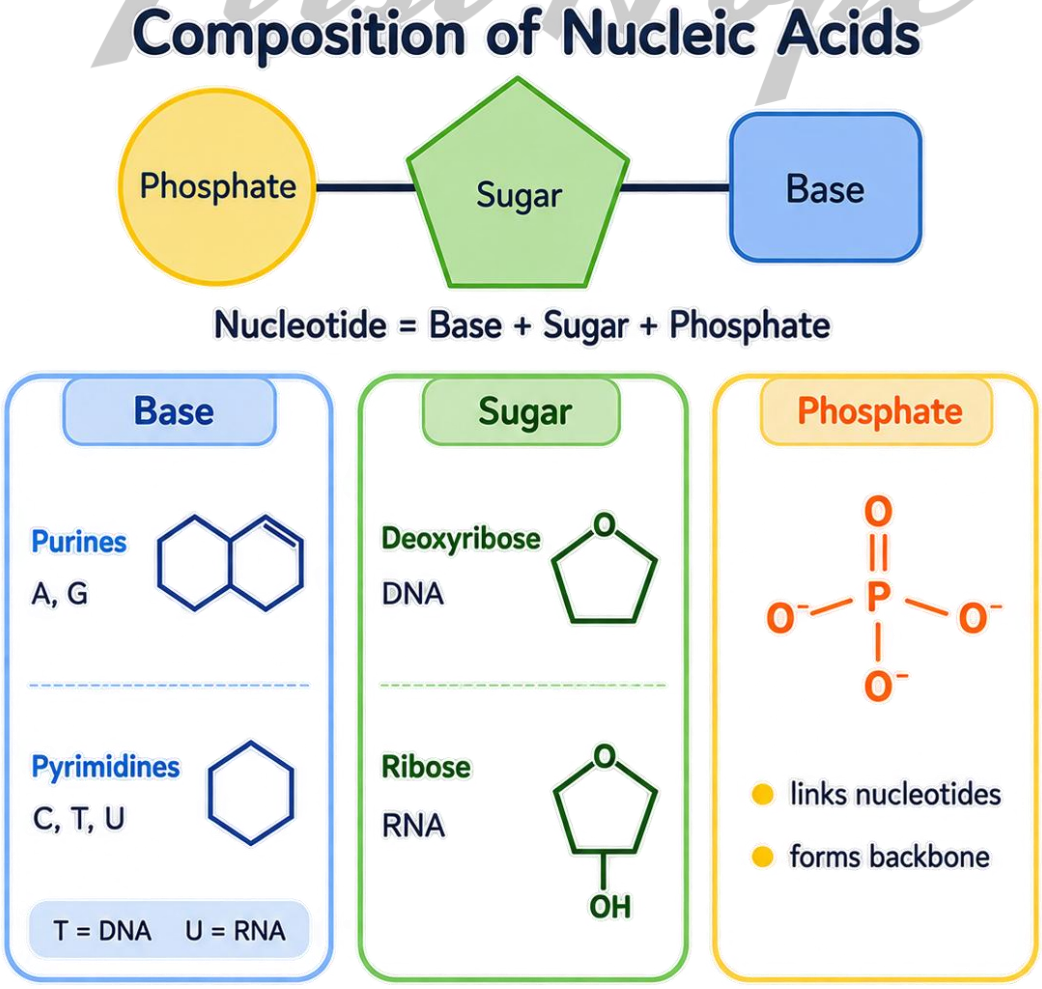
Nucleic Acids

What are Nucleic Acids?

- **Nucleic acids** are very important biological molecules that store and transfer genetic information in living organisms.
- They are essential for the growth, development, and reproduction of cells.
- **There are two main types of nucleic acids:**
  - DNA (Deoxyribonucleic Acid)
  - RNA (Ribonucleic Acid)

Composition of Nucleic Acids

- Nucleic acids are made up of smaller units called **nucleotides**.
- **Each Nucleotide has Three Parts:**



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