INTRODUCTION TO MOLECULAR BIOLOGY

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Molecular Biology

Semester I

Week 1

10-07-2025

Outline

- Introduction to Molecular Biology
- Interdisciplinary Connections
- History of Molecular Biology
- Core Genetic Concepts
- Proteins and Gene Expression
- Gene Structure

Objectives

- Define molecular biology and explain its role in studying life at the molecular level.
- Describe the relationship between molecular biology and other fields such as biochemistry, genetics, biotechnology, cell biology, and microbiology.
- Discuss the historical development and significance of molecular biology in modern medicine.
- Differentiate among key genetic concepts: genome, chromosome, and gene.
- Identify the main regions of a gene (introns and exons) and understand the concepts of alleles and loci.

Weekly Lecture Schedule (13 Lectures)

Weeks	Topics
1	Introduction to Molecular Biology: Central Dogma, historical experiments (Griffith, Avery, Hershey–Chase), overview of course.
2	Chemical Nature of Genetic Material: DNA/RNA structure, nucleotides, base pairing, sugar–phosphate backbone, denaturation.
3	The Human Nuclear Genome, Origin of term , Overview, Types, Comparison of different genome type, What are the difference and similarities between prokaryote and eukaryote of the genome
4	Primary structure of DNA , DNA methylation , polynucleotide strand , RNA structure, types of RNA
5	DNA Replication in Prokaryotic and Eukaryotic Cells, definition,.Mechanism of DNA replication, Difference between prokaryote and eukaryote in DNA replication
6	Gene definition, structural gene, regulatory gene, promoter, operator , repressor protein in gene regulation function
7	Midterm Exam
8	Gene expression , Central dogma in molecular biology Transcription
9	Steps of DNA transcription , Initiation , Elongation , and Termination
10	Difference between prokaryote and eukaryote, Posttranscriptional modification
11	Structure of tRNA , mRNA , rRNA , ribosome and site of mRNA binding , ribosome in prokaryote and eukaryote
12	Genetic code , General feature, The 64 codon , The reading frame, The almost universal genetic code
13	Protein synthesis , translation , Definition , Steps of translation, Initiation , elongation, Termination
14	Protein synthesis , translation , Definition , Steps of translation, Initiation , elongation, Termination
15	Final Exam

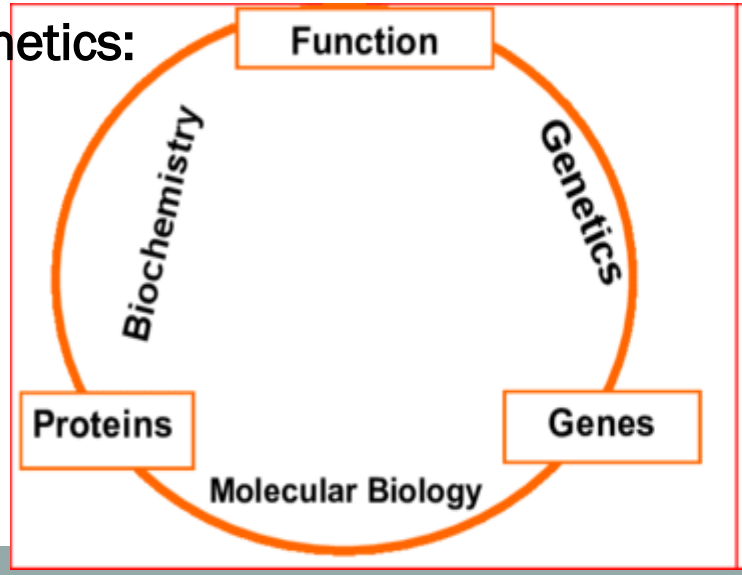
Introduction to Molecular Biology

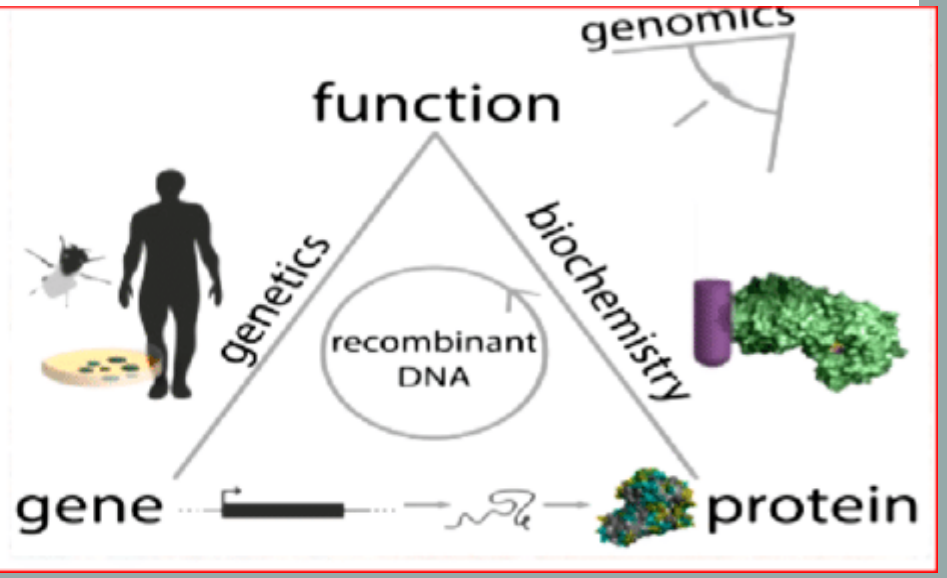
- **Molecular biology** is a science that deal with the study of biology at a molecular level.
- **Molecular biology** the study of gene structure and functions at a molecular level to understand the molecular basis of heredity , genetics variation and the expression of gene.
- **The molecular biology** is the branch of biology and its one of the most rapidly growing areas of biology this concerned with the molecules of biological systems of cell.

Introduction to Molecular Biology

- **Molecular biology was interaction with other sciences:**
  - Biochemistry
  - Genetics
  - Biotechnology
  - Cell biology
  - Microbiology

What Is The Relationship Between Molecular Biology, Biochemistry And Genetics:





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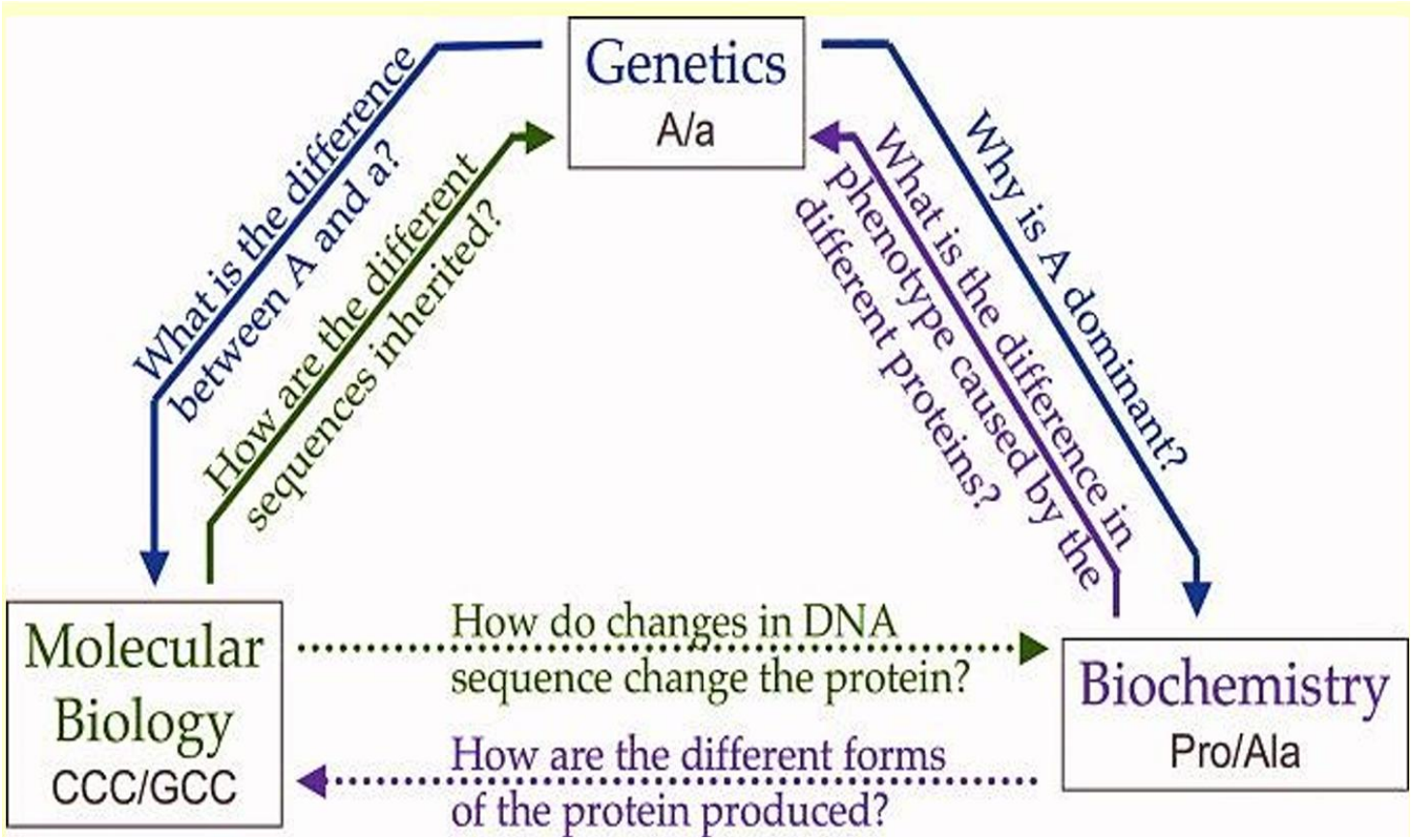

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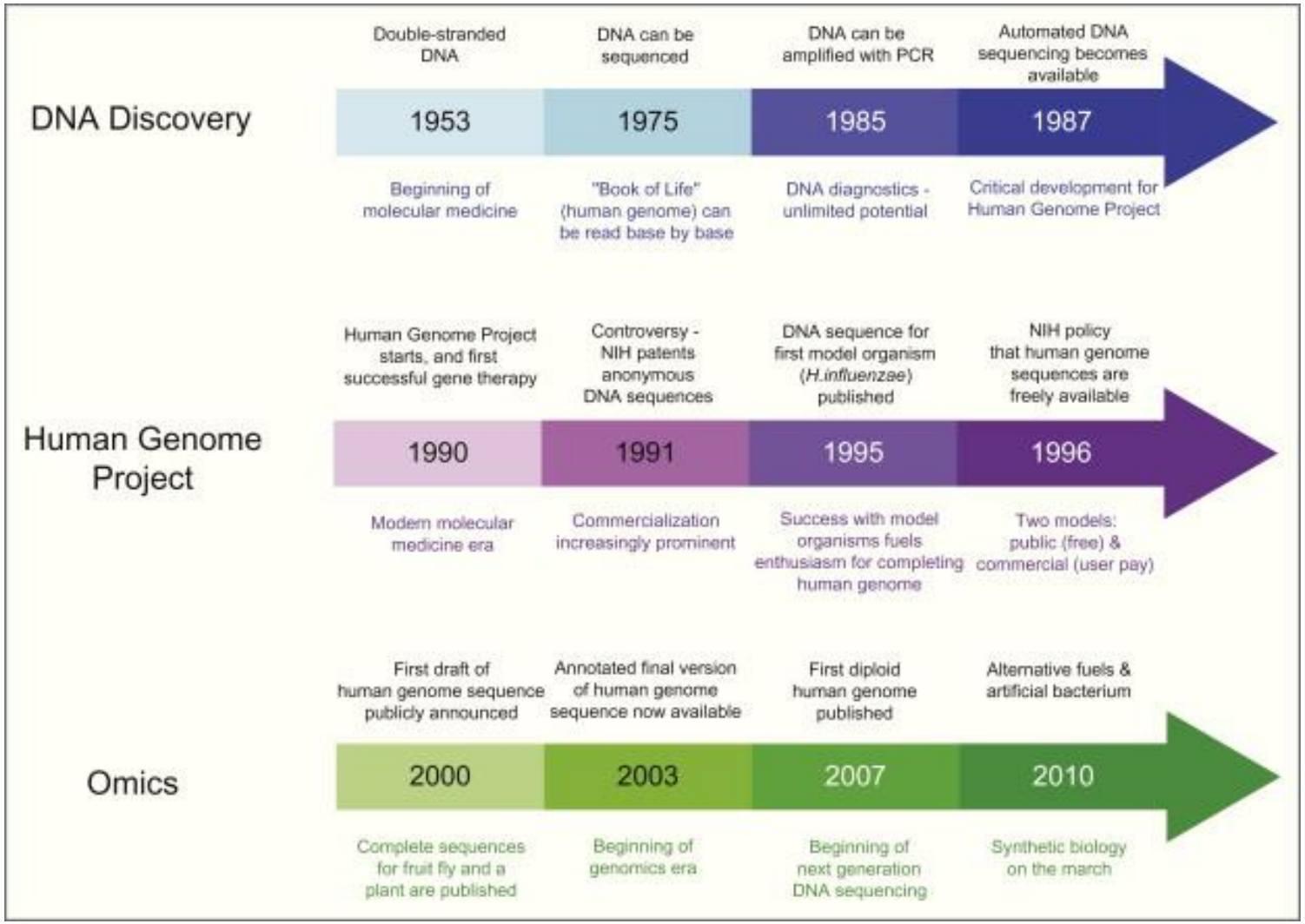
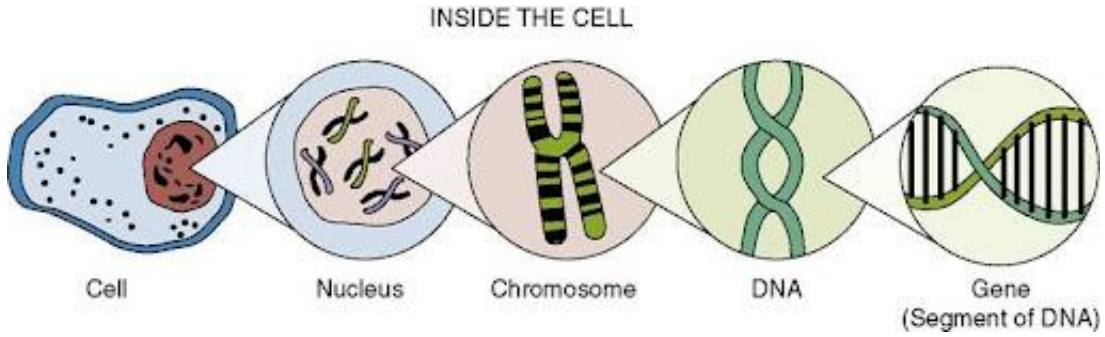
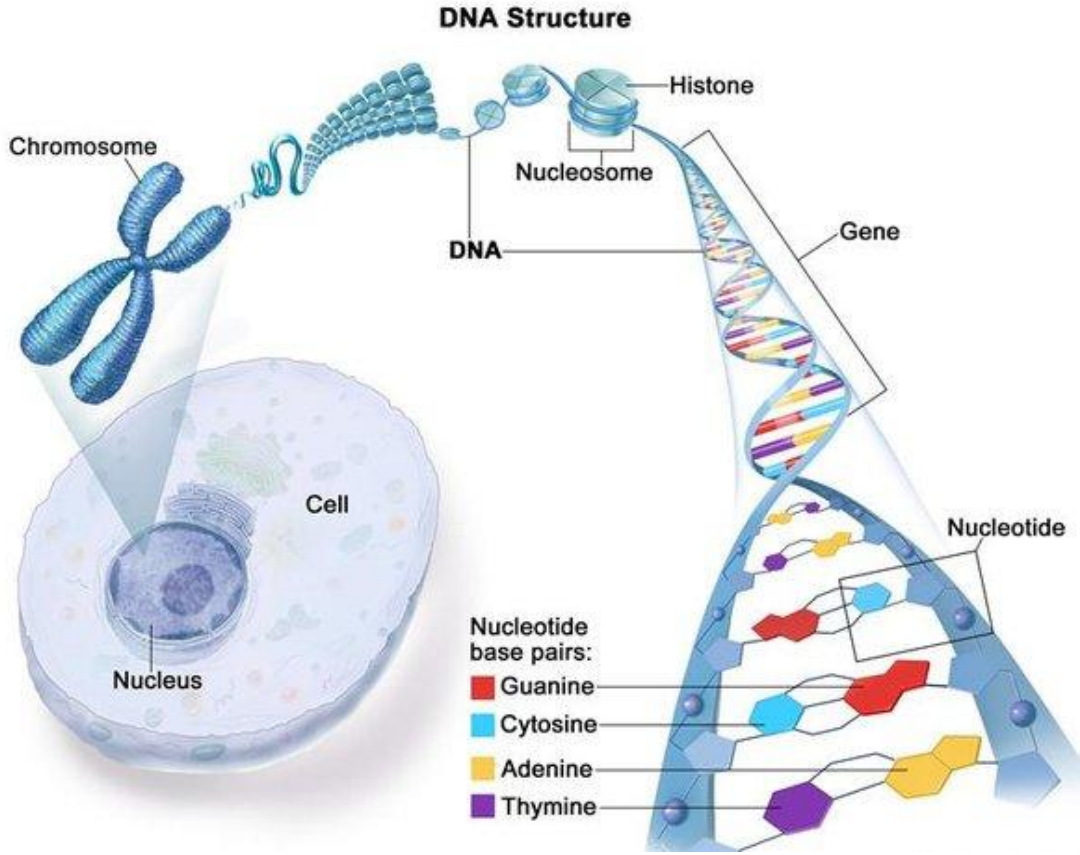
History of Molecular Biology/Medicine



What Is The Difference Between Genome, Chromosome, Gene?





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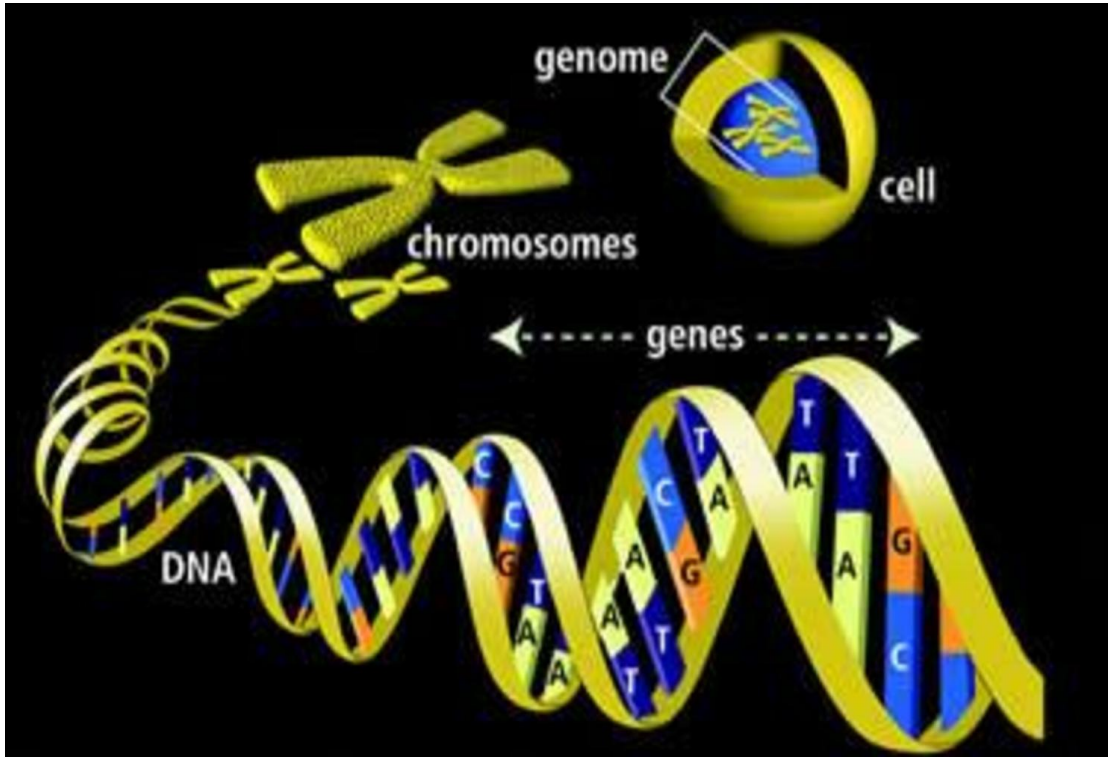
Genome:

- Genome is a total amount of genetic materials of any individual , and it is differ for one to another.
- Genome of the typical human cells are divided into 23 chromosomes.



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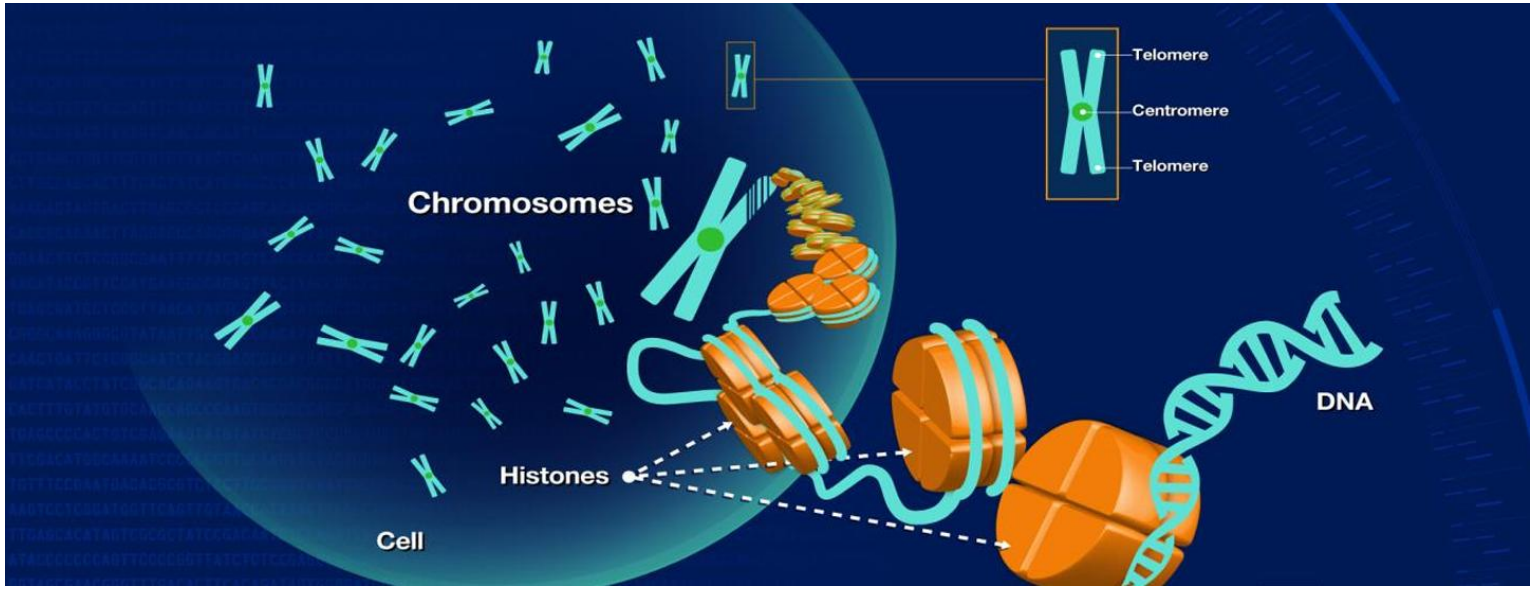
Chromosome:

- The chromosomes of a cell are in the cell nucleus.
- They carry the genetic information.

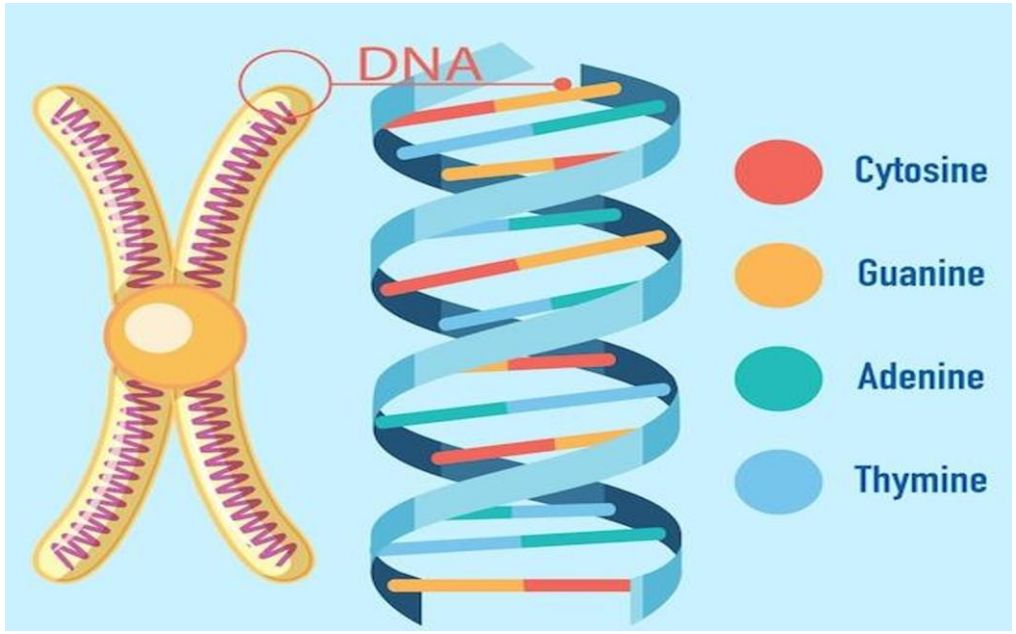
Chromosomes are made up of DNA and protein combined as chromatin.

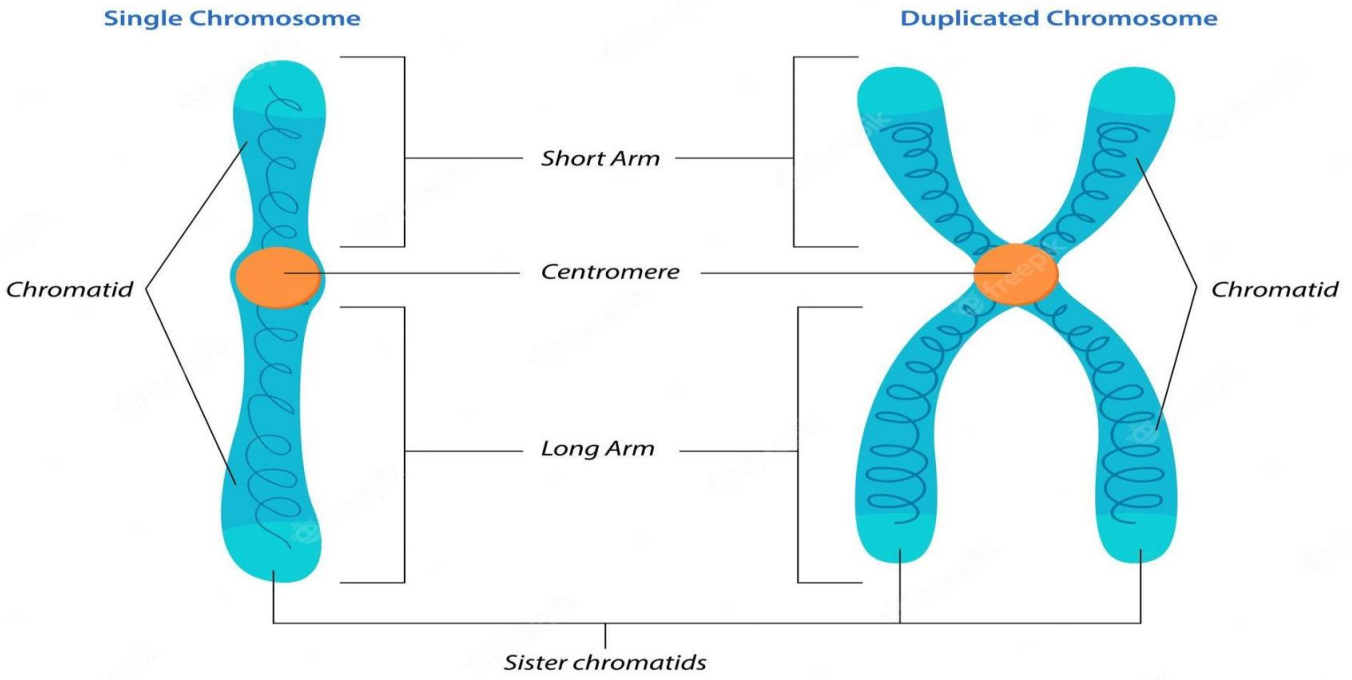
- Each chromosome contains many genes.

Chromosomes come in pairs



Chromosome:

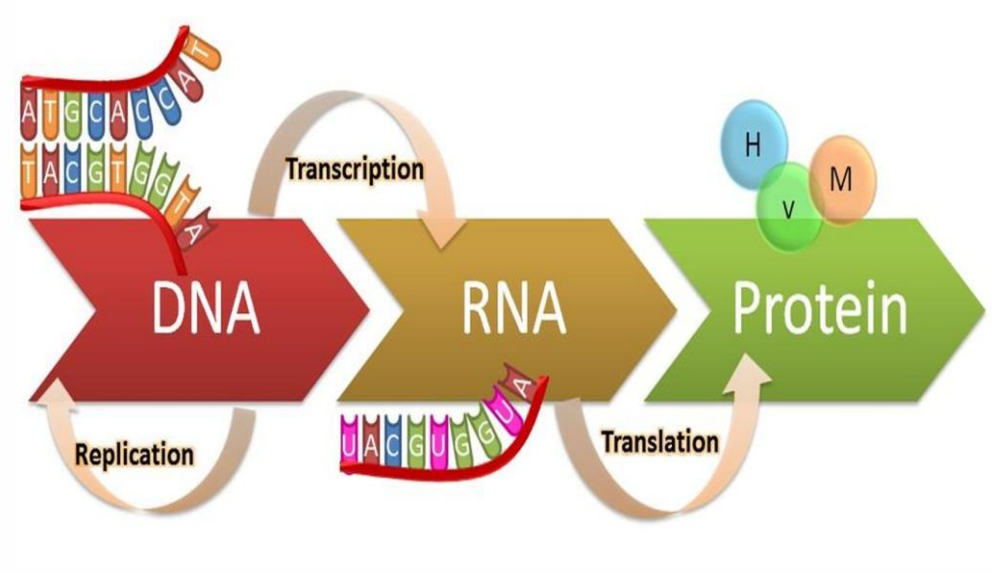

DNA
Cytosine
Guanine
Adenine
Thymine

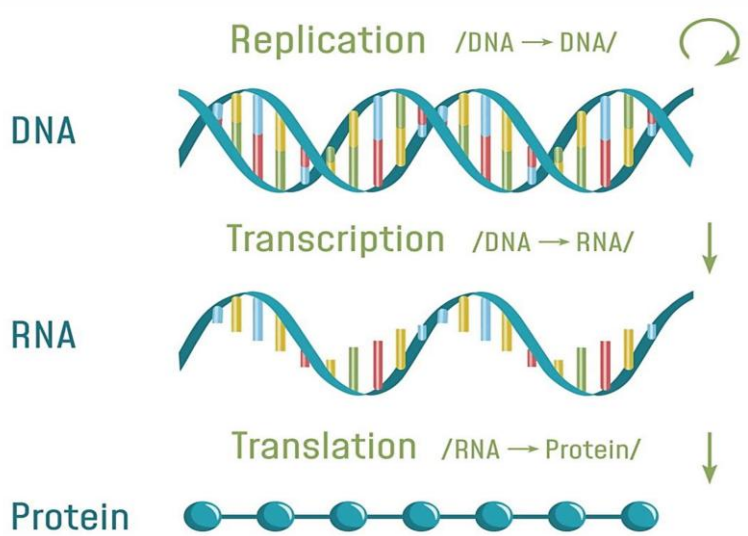

Single Chromosome
Duplicated Chromosome
Short Arm
Centromere
Long Arm
Chromatid
Chromatid
Sister chromatids

Introduction to Molecular Biology

Proteins:

- Proteins are polymers of amino acids, these amino acids were linked together by peptide bonds to form peptides and later these peptides are modified to form proteins.
- Proteins are widely used in cells to serve diverse functions. Some proteins provide the structural support for cells while others act as enzymes to catalyze certain reactions. Protein synthesis requires two steps: transcription and translation.





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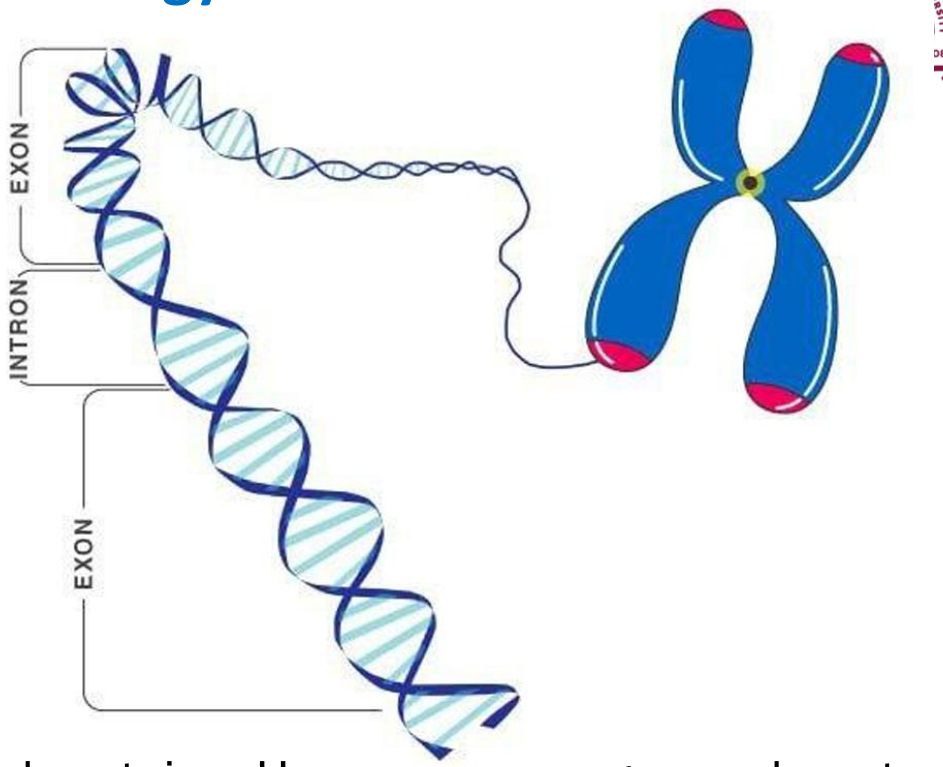


Gene:

- Gene is the basic unit of inheritance , it contained in chromosomes.
- Gene is a region of DNA that produce functional
- RNA molecules . the gene size are various among living individual.
- Genes are made up of DNA.
- Some genes act as instructions to make molecules called proteins. However, many genes do not code for proteins.
- It is a segment within a very long strand of DNA with specific instruction for the production of one specific protein.
- Located on chromosome on it's place or locus.
- Allele: A variant of the DNA sequence at a given locus. Each allele inherited from a different parent.

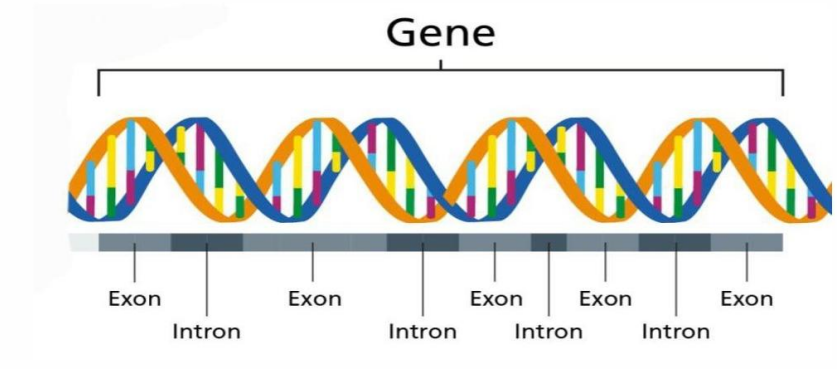
Introduction to Molecular Biology

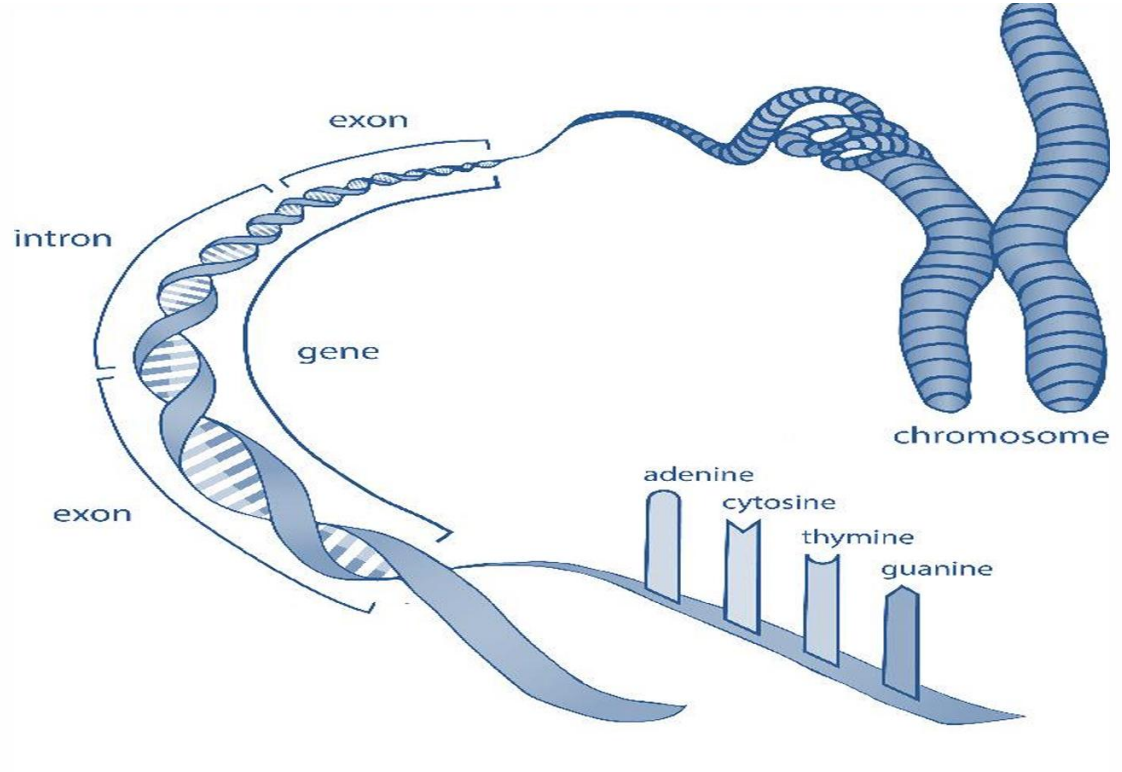
Gene Regions :

The gene have two type of region:

A. Introns (Non-coding regions) it forms a majority of the nucleotide sequences of genes.

B. Exons (Coding regions) expression sequences make up a minority of the nucleotide sequences of genes.





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- Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular Biology of the Cell (7th ed.). W. W. Norton & Company.
- Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. (2019). Biochemistry (9th ed.). W. H. Freeman and Company.