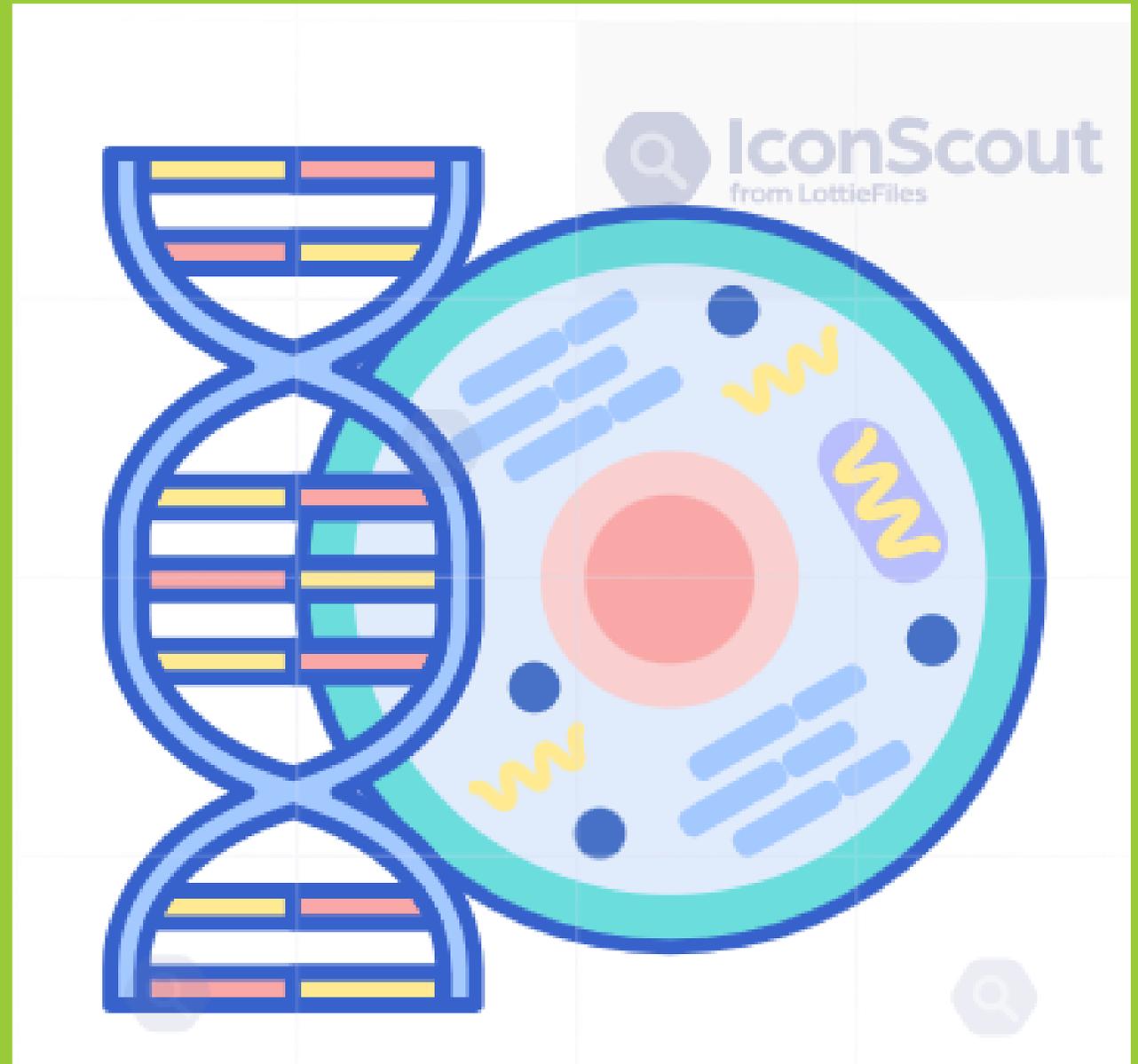


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MOLECULAR BIOLOGY– Cell Components



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AUTHORS DISCLOSURE



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This presentation is directed to the students registered on the 'Pharmaceutical Biotechnology' course at the School of Pharmaceutical Sciences, the Hashemite University, Jordan. Academic year 2024/2025.

LEARNING OBJECTIVES



By the end of this presentation, students will be able to:

1. Describe the major components of eukaryotic cells, including the nucleus, nucleic acids, mitochondria, ribosomes, and cell membrane.
2. Explain the functions of each cell component and their relevance to cellular processes and Biopharmaceutical applications.
3. Differentiate between the various types of RNA (mRNA, rRNA, tRNA, miRNA, siRNA, and lncRNA) and their specific roles in gene expression and regulation, and their relevance to Biopharmaceutical applications.
4. Provide examples of how understanding cell components informs the design and application of biopharmaceuticals (e.g., monoclonal antibodies, gene therapies).

رح يكون تركيزنا على ... basic components

اول جزء واهم جزء ال nucleus لانه بيحتوي على ال (DNA) genetic material

DNA مهم ندرسها لانه بنقدر نشتغل عليها ل gene therapy, gene editing
complement DNA for protein production

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ANIMAL CELL ELEMENTS

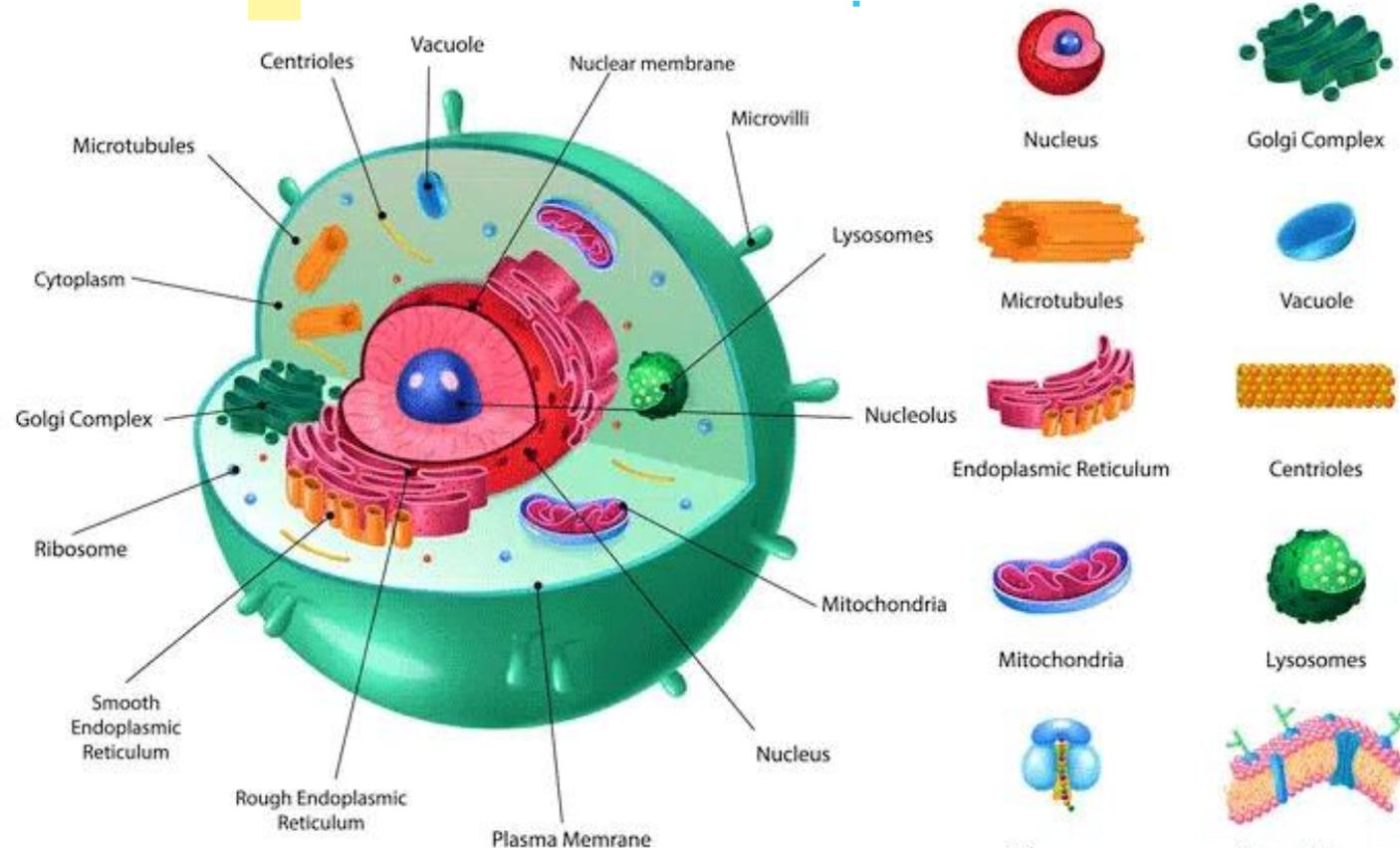


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اكيد بنحكي عن ال
animal cell
وليس ال
bacterial

ANIMAL CELL DIAGRAM



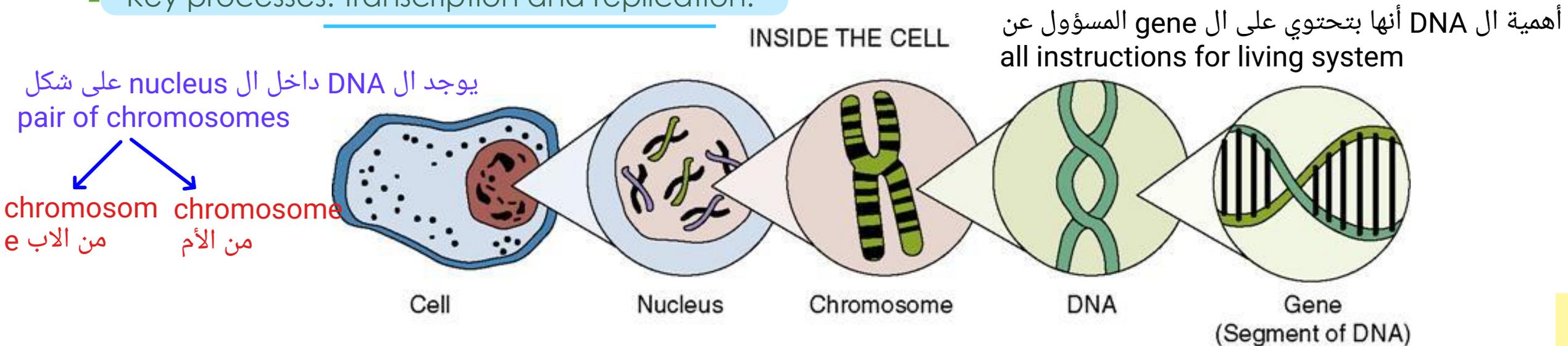
CELL NUCLEUS – Site Of Genetic Manipulation (Gene Therapy)



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- Contains the genetic material (DNA), where the instructions for making proteins are stored
- is the site of gene expression and regulation.
- In biotechnology, manipulating DNA for gene therapy or recombinant protein production often starts here.
- Key processes: transcription and replication.



CHROMOSOMES

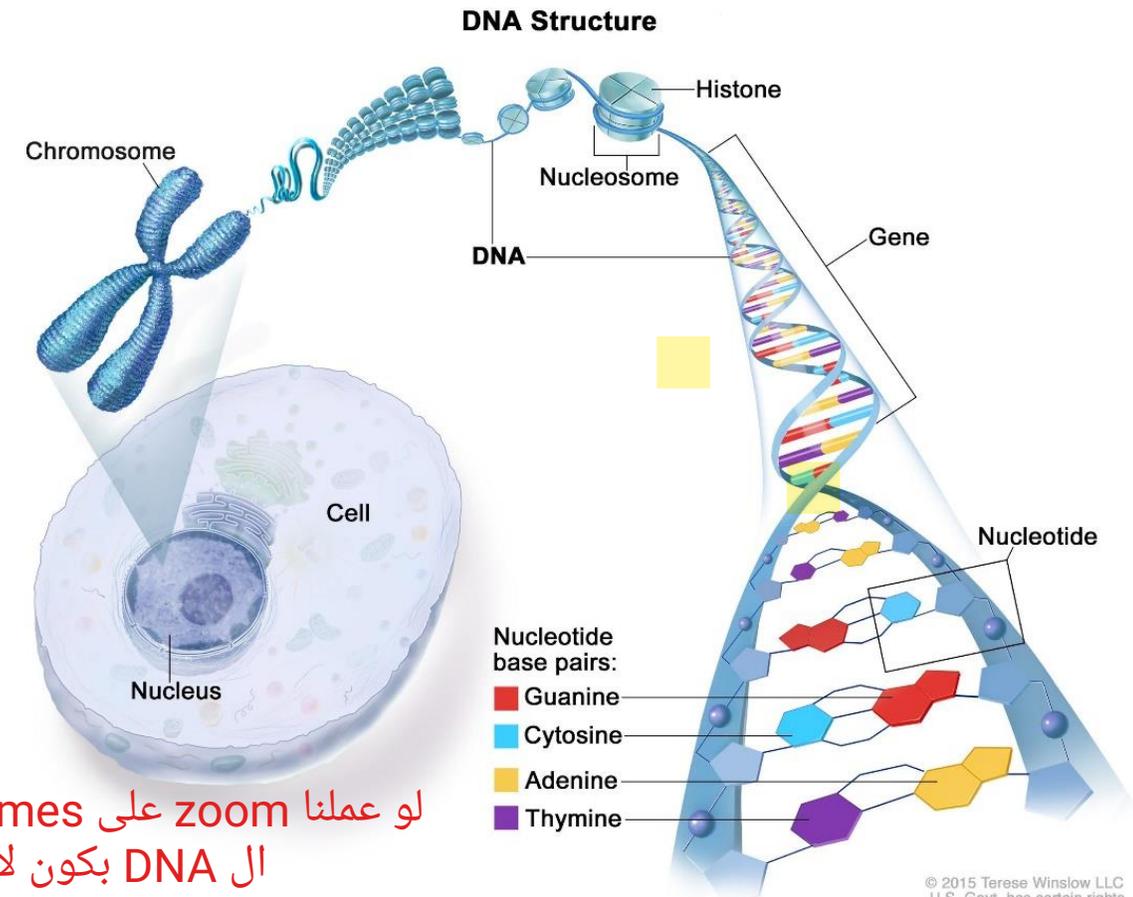


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يشبه شكل الخيط

- Chromosomes are **thread-like** structures present in the nucleus.
- are DNA tightly coiled around a protein called **histone**. (just like a thread wound around a cardboard tube).
- Notice how the DNA is coiled around histone and then many such histones are packed together to form a chromosome.
- Chromosomes exist in **pairs**. Human cells contain **23 such pairs** or **46 chromosomes**.
- Each chromosome is comprised of one super-long DNA molecule.



لو عملنا zoom على chromosomes رح نلاقي مرتب على شكل histone
ال DNA يكون لاف على هدول ال ال histone زي لفة الصوف

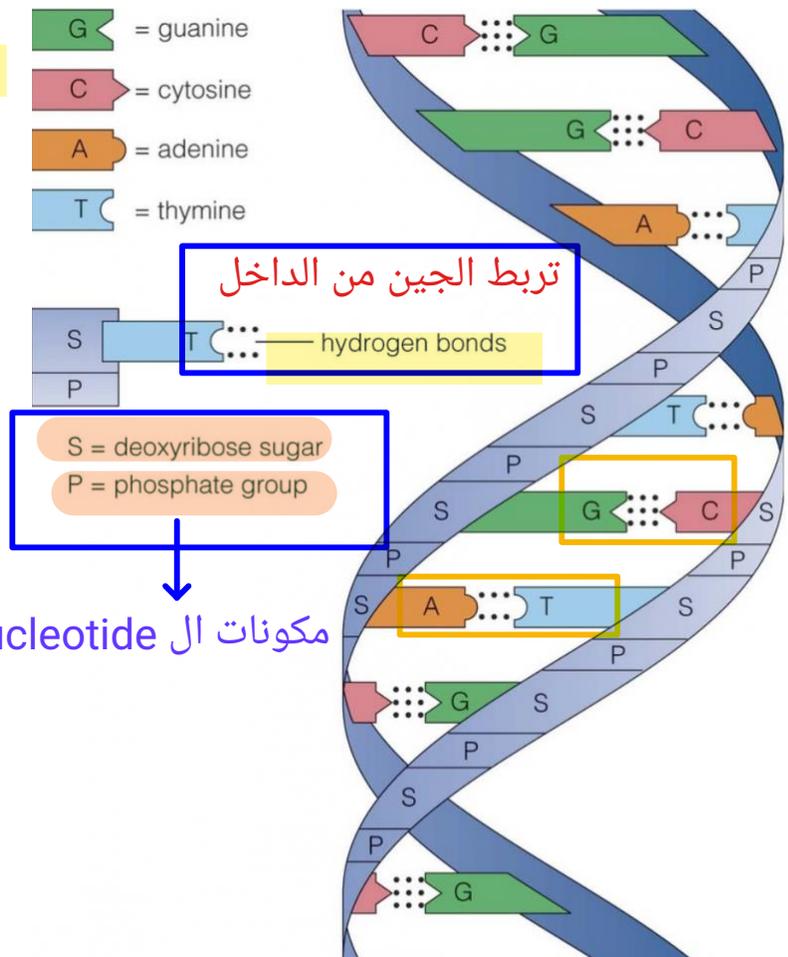
DEOXYRIBONUCLEIC ACID (DNA)



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- The famous **Double Helix** model for the structure of DNA as shown in the above image is one of the most well-known models.
- It is a twisting structure made up of 2 polymer chains. The 'backbone' of each chain is constituted of sugar-phosphate and connecting ladders of nitrogenous bases project inside. In the figure - shows the backbone marked with 'S' and 'P' indicating alternating sugar and phosphates.
- The polymer chain comprises of smaller monomers called **nucleotides**. → **basic building block for DNA**
- Each nucleotide has **3 parts** – a **sugar(ribose)**, a **phosphate molecule** and a **nitrogenous base**.
- There are 4 kinds of Nitrogenous Bases – **Adenine(A)**, **Thymine(T)**, **Guanine(G)** and **Cytosine(C)**. These bases are complementary. A attaches with T and C attaches with G to form complementary pairs that make up the connecting attachments of the double helix model.



DEOXYRIBONUCLEIC ACID (DNA)



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- **DNA** is called the **blueprint of life** because it contains the genetic code which are instructions needed for an organism to grow, develop, survive and reproduce.
- DNA does this by controlling protein synthesis, a process we will explain later.
- Proteins are the most important material in our body !
- protein synthesis is responsible for all activities carried on by the body and it is controlled by the genes.
- Many would associate them with muscles but they also aid the production of enzymes which are responsible for conducting all chemical processes and reactions within the body.

GENES and ALLELES



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الجينات تحمل الصفات الوراثية

- Genes, as we know, are hereditary markers from which we derive various characteristics like skin color, height, etc. الجين الواحد يمثل صفة معينة ويتكون من two allele
- More technically, each DNA molecule consists of sequences of Genes. Each gene is a particular set of instructions for specific functions. Eg. globin gene would aid the production of hemoglobin, another gene would do so for insulin, so on and so forth. Each gene naturally consists of a sequence of nucleotides and base pairs.
- A genome refers to the entire set of genetic material (DNA or RNA in some viruses) within an organism.

genetic material كل

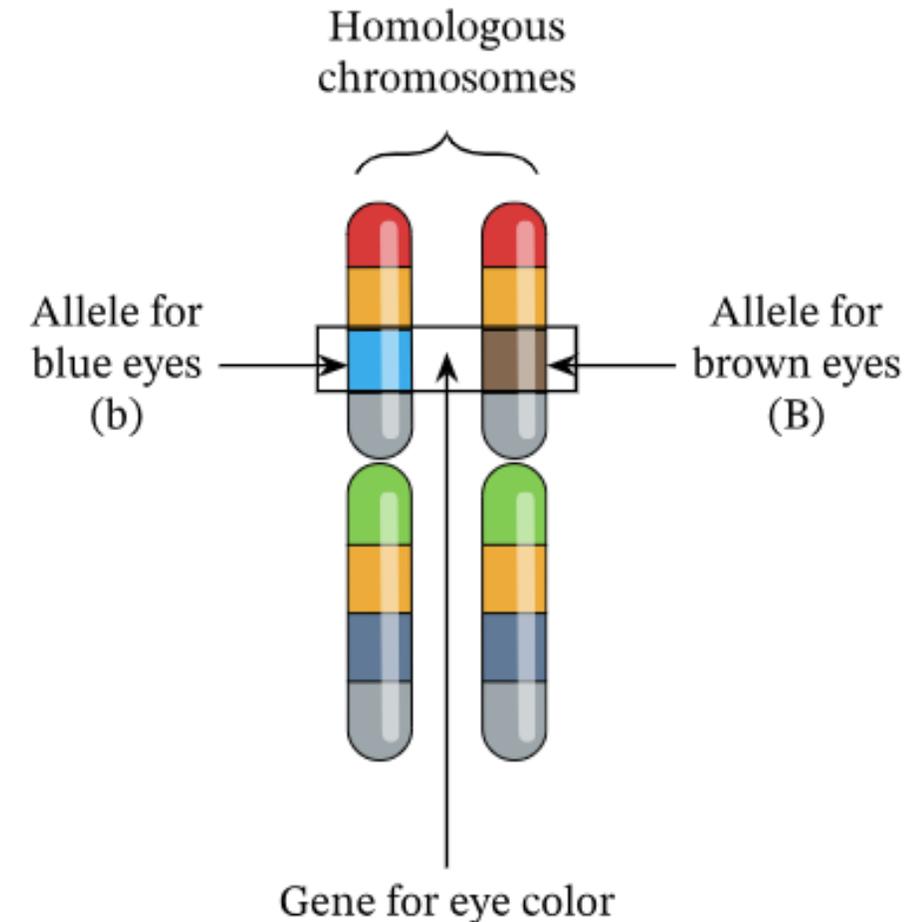
GENES and ALLELES



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- An allele is one of two or more versions of DNA sequence (a single base or a segment of bases) at a given genomic location (locus).
- An individual inherits two alleles, one from each parent, for any given genomic location where such variation exists. If the two alleles are the same, the individual is homozygous for that allele.
- **Dominant** Alleles (**Capital** Letter) and **Recessive** Alleles (**Small** Letter).
- While an allele refers to a variant form of a gene, a gene is a broader term that refers to a unit of heredity in general. A gene is a sequence of DNA that contains the information to produce a specific protein or set of proteins, whereas alleles are the different forms this gene might take.



GENES and ALLELES

مهم نعرف شو همة ال genes و ال alleles لانه
لو بدنا نعمل intervention
ال intervention بكون على مستوى ال gene
عن طريق ال genes therapy بنعمل
replacement for gene



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- **Gene:** Determines a specific trait (e.g., eye color).
- **Alleles:** Different forms of that gene (e.g., brown eyes vs. blue eyes).
- For example, in the case of blood type, the **ABO gene** has three main alleles: **A**, **B**, and **O**. The combination of these alleles inherited from parents determines an individual's blood type (A, B, AB, or O).
- **The ABO gene indirectly encodes the ABO blood group antigens.**
The ABO locus has three main allelic forms: A, B, and O. The A and B alleles each encode a glycosyltransferase that catalyzes the final step in the synthesis of the A and B antigen, respectively. The A/B polymorphism arises from several SNPs in the ABO gene, which result in A and B transferases that differ by four amino acids. The O allele encodes an inactive glycosyltransferase that leaves the ABO antigen precursor (the H antigen) unmodified.
- Certain diseases are caused by mutations in alleles (e.g., cystic fibrosis, sickle cell anemia).
- Using CRISPR technology, scientists can edit or correct harmful alleles to treat genetic disorders by replacing them with normal versions of the gene.
 - Example: CRISPR has been used experimentally to target the beta-globin allele responsible for sickle cell disease, replacing it with a functional copy to produce healthy red blood cells

كلهم related لبعض بس همة مو نفس الاشيا

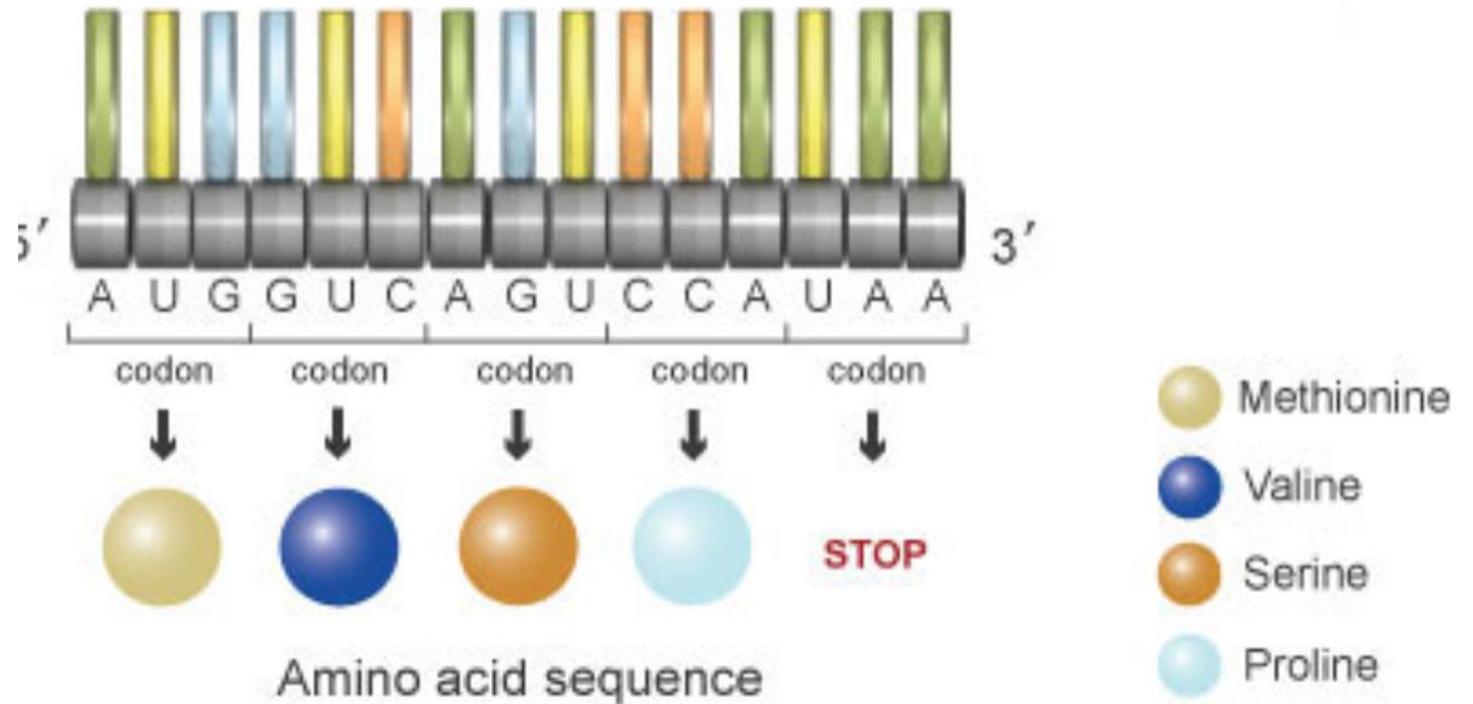
CODONS, AMINO ACIDS, PEPTIDES & PROTEINS



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- While describing DNA, we said that it helps with Protein Synthesis, a very fundamental process to sustain life.
- The concept of codons helps establish the link between Genes and protein synthesis reactions.
- Each Gene can be represented as a sequence of codons where codons are a sequence of base triplets – meaning 3 bases combine together to form a Codon.



CODONS, AMINO ACIDS, PEPTIDES & PROTEINS



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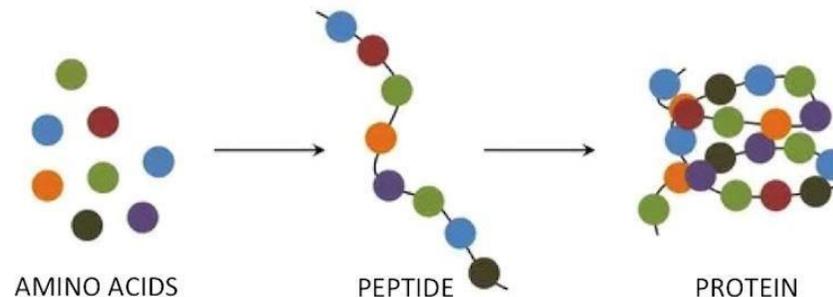
- Each codon corresponds to a specific Amino acid. Eg. AUG codon corresponds to the Amino acid Methionine.
- Amino Acids combine together to form a particular peptide chain. The peptide chains undergo a structural transformation to form 3-Dimensional molecules called **proteins.**
- A peptide is a short chain of amino acids (typically 2 to 50) linked by chemical bonds (called peptide bonds). A longer chain of linked amino acids (51 or more) is a polypeptide. The proteins manufactured inside cells are made from one or more polypeptides.

coding system

protein synthesis مهم في عملية ال

عملية ال translation from mRNA to protein

HOW YOUR BODY USES AMINO ACIDS
AS BUILDING BLOCKS



TYPES OF PROTEINS IN A HUMAN BODY



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S No.	PROTEIN	FUNCTION	EXAMPLES
1	Enzymes	Facilitate biochemical reactions	اي اشبي آخره ase Lactase, Pepsin
2	Hormonal	Messenger proteins that help to coordinate bodily activities	Insulin, Oxytocin
3	Structural	Provide support	Keratin, Collagen
4	Contractile	Responsible for movement	Actin, Myosin
5	Transport	Move molecules from one place to another	Haemoglobin, Cytochromes

GENOTYPE AND PHENOTYPE

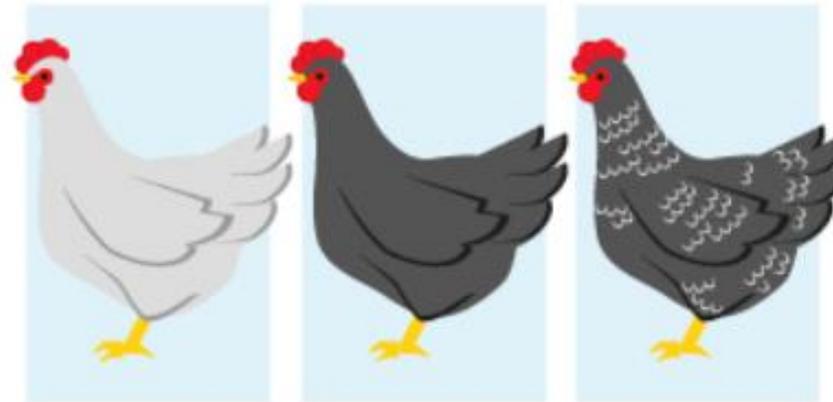


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- Genotype is the genetic makeup of a cell, an organism or an individual with reference to a particular trait.
- It refers to the pairing of alleles and is not concerned with the expression of that trait
- Phenotype refers to the organism's expressed physical trait. It depends both on the genetic makeup (genotype) and the environment.

الفرق بين ال genotype وال phenotype
ال genotype : هي الجينات المسؤولة عن هاي الصفة
أما ال phenotype هي الصورة النهائية اللي بنشوفها



Phenotype

WHITE

BLACK

SPECKLED

RIBONUCLEIC ACID (RNA)

اهم نوع ل RNA
هو mRNA



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أهمية ال RNA

- The bridge between DNA and protein synthesis is RNA.
RNA is chemically similar to DNA, except that it contains ribose as its sugar and substitutes the nitrogenous base uracil for thymine.
- It is single-stranded rather than a double helix.
- To get from DNA, written in one chemical language, to protein, written in another, requires two major stages, **transcription** and **translation**.
- The process from DNA to RNA is known as **Transcription**. During transcription, a DNA strand provides a template for the synthesis of a complementary RNA strand. Transcription of a gene produces a messenger RNA (mRNA) molecule.

