CBSE Class 12 Biology Notes Chapter 6: These notes are important for students preparing for their CBSE Class 12 Biology board exams particularly for Chapter 6 *Molecular Basis of Inheritance*. This chapter talks about the fundamental processes that govern genetic inheritance, such as DNA replication, transcription and translation. The notes break down complex topics like the structure of DNA, the role of RNA, and the regulation of gene expression into simpler concepts, making them easier to understand.

By studying these notes, students can gain a detailed understanding of molecular genetics, build a solid foundation for future studies in biology and contribute to advancements in fields like medicine and biotechnology.

CBSE Class 12 Biology Notes Chapter 6 Molecular Basis of Inheritance Overview

These notes for CBSE Class 12 Biology Chapter 6 Molecular Basis of Inheritance have been prepared by subject experts of Physics Wallah.

By using these notes students can improve their understanding of molecular genetics and prepare well for their board exams.

CBSE Class 12 Biology Notes Chapter 6 Molecular Basis of Inheritance PDF

The PDF link for the CBSE Class 12 Biology Notes on Chapter 6, Molecular Basis of Inheritance, is available below.

These notes are written in simple language, making it easier for students to grasp complex ideas. Download the PDF to enhance your preparation and strengthen your understanding of molecular genetics for the board exams.

CBSE Class 12 Biology Notes Chapter 6 Molecular Basis of Inheritance PDF

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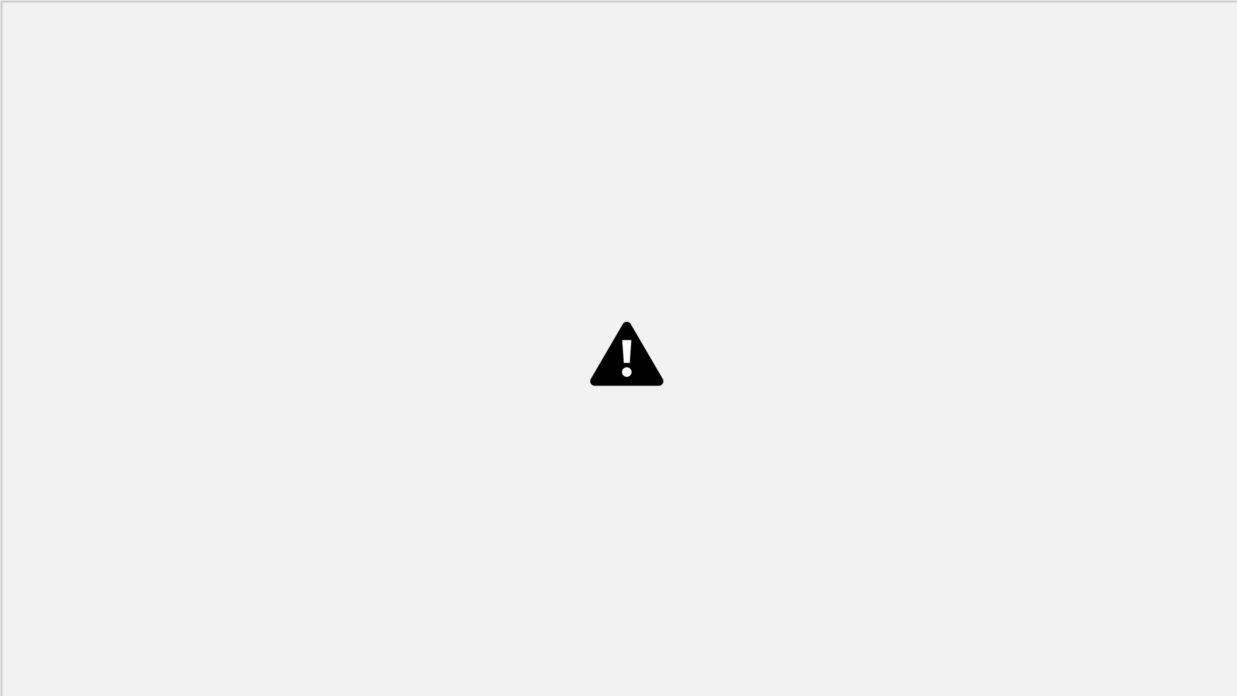
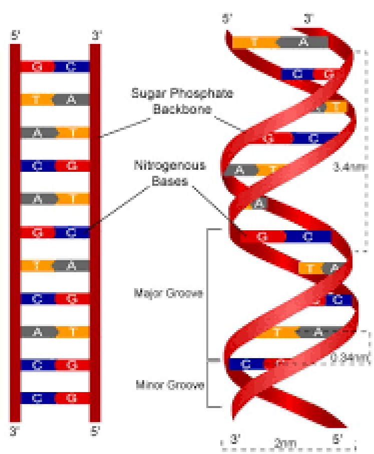
Here we have provided CBSE Class 12 Biology Notes Chapter 6 Molecular Basis of Inheritance-

What is DNA?



DNA, or Deoxyribonucleic Acid, is the molecule responsible for carrying genetic information in all living organisms. It is a long chain made up of deoxyribonucleotides, and its length is determined by the number of nucleotide base pairs.

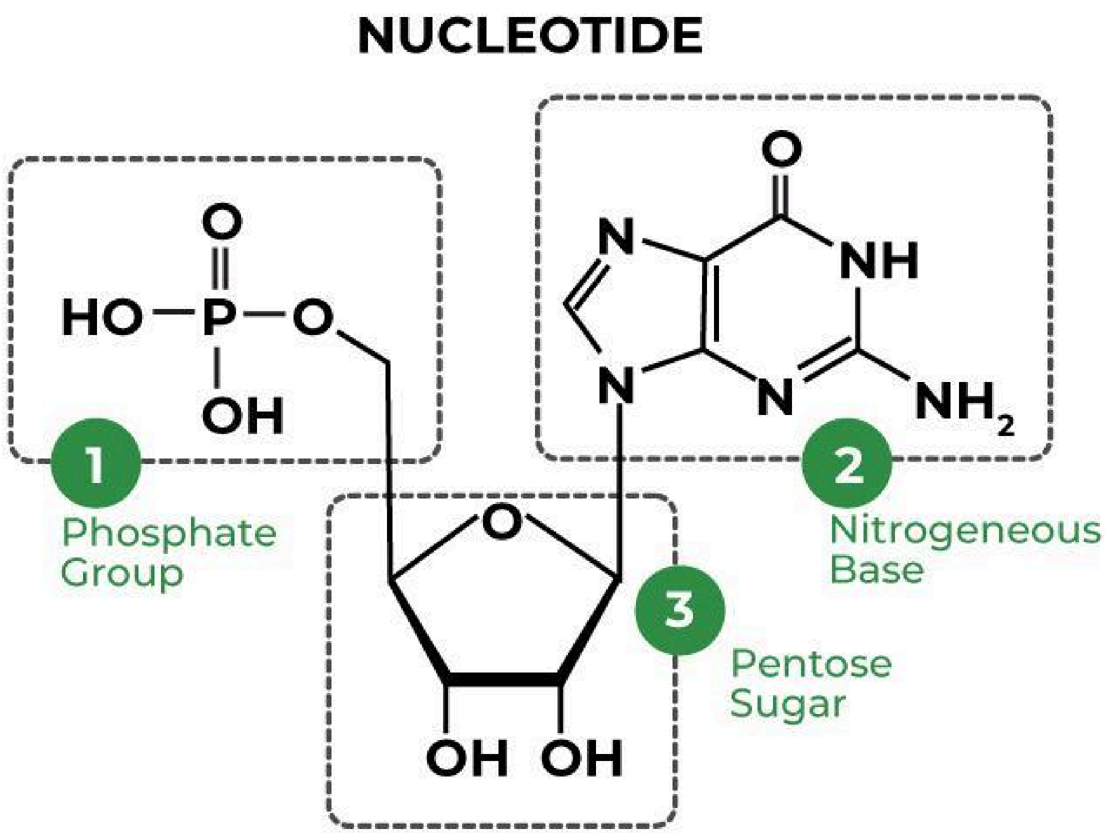
DNA Structure



Watson and Crick were the first scientists to propose the double-helix model of DNA, using X-ray crystallography. Each strand of DNA is a polymer of nucleotides. Each nucleotide consists of three components: a deoxyribose sugar, a nitrogenous base, and a phosphate group. DNA follows the central dogma of molecular biology, where genetic information flows from DNA to RNA, and then to protein.

The structure of DNA resembles a twisted ladder. The two strands are held together by weak hydrogen bonds between paired nitrogenous bases. In this pairing, a purine base (adenine or guanine) always pairs with a pyrimidine base (thymine or cytosine). Specifically, adenine (A) pairs with thymine (T), and guanine (G) pairs with cytosine (C).

Structure of Polynucleotide



A polynucleotide is a long chain made up of repeating units called nucleotides, which are the building blocks of DNA and RNA.

Nucleotide Structure

Each nucleotide consists of three components:

Nitrogenous Base: These are classified into two types:

- **Purines**: Adenine (A) and Guanine (G)
- **Pyrimidines**: Cytosine (C) and Thymine (T) in DNA (or Uracil (U) in RNA)

Sugar: The sugar is a pentose, which differs between DNA and RNA:

- **Deoxyribose** in DNA
- **Ribose** in RNA

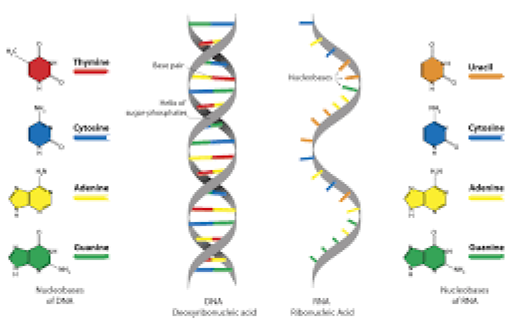
Phosphate Group: The phosphate group connects the nucleotides together by linking the sugar of one nucleotide to the phosphate of the next, forming the sugar-phosphate backbone of the polynucleotide chain.

The combination of a sugar and a nitrogenous base forms a **nucleoside**, while a nucleoside with an added phosphate group becomes a **nucleotide**. These nucleotides link together to form the polynucleotide chain that makes up DNA or RNA.

What Is a Gene?

A gene is the functional unit of inheritance, responsible for transmitting genetic information from one generation to the next. In eukaryotic organisms, DNA is composed of both coding and non-coding sequences of nucleotides. The **coding sequences** are called **exons**, and they are the parts that code for proteins. The **non-coding sequences**, known as **introns**, do not code for proteins. While exons are included in the mature RNA after processing, introns are removed.

RNA (Ribonucleic Acid)



RNA is a single-stranded nucleic acid found in all living cells. It acts as a messenger, carrying instructions from DNA to help control the process of protein synthesis. There are three main types of RNA:

1. **Messenger RNA (mRNA)**: Carries the genetic code from DNA to the ribosomes, where proteins are synthesized.
2. **Transfer RNA (tRNA)**: Brings the correct amino acids to the ribosomes during protein synthesis.
3. **Ribosomal RNA (rRNA)**: Combines with proteins to form ribosomes, the site of protein synthesis.

Packaging DNA Helix

In **prokaryotes**, DNA is organized as a large loop in the nucleoid region. Here, the negatively charged DNA is tightly held by positively charged proteins. In contrast, **eukaryotic** DNA is arranged in a more complex structure within chromosomes.

In eukaryotes, DNA is wrapped around a core of histone proteins to form structures called **nucleosomes**. A **nucleosome** consists of DNA wound around a histone octamer, which is made up of 8 histone proteins. These histones are rich in basic amino acids like lysine and arginine, which give them a positive charge. There are five types of histone proteins: **H1, H2A, H2B, H3, and H4**, with the histone octamer containing two molecules each of H2A, H2B, H3, and H4. This packaging helps regulate gene expression.

A nucleosome prevents DNA from becoming tangled and contains about **200 base pairs (bp)** of DNA. The further organization of chromatin (DNA and protein complex) is aided by **Non-histone chromosomal (NHC) proteins**.

- **Euchromatin**: These are transcriptionally active regions of DNA where chromatin is loosely packed and appear lightly stained.
- **Heterochromatin**: These are transcriptionally inactive regions where chromatin is densely packed, taking up a darker stain.

RNA World

RNA is believed to have been the first genetic material, with substantial evidence suggesting that essential life processes evolved around RNA. It serves dual roles, acting both as genetic material and as a catalyst. However, RNA's highly reactive nature made it unstable as a catalyst. This instability led to the evolution of DNA from RNA, with chemical modifications that enhanced its stability.

Replication

Watson and Crick proposed that DNA replication is **semiconservative**, meaning that each new DNA molecule consists of one original strand and one newly synthesized strand. This was experimentally confirmed by Meselson and Stahl in 1958. Taylor et al. conducted experiments using radioactive thymidine in faba beans (Vicia faba) to further demonstrate that DNA replication is indeed semiconservative.

The enzyme **DNA polymerase** plays a crucial role in DNA replication, catalyzing the process. It can only add nucleotides in the 5’ to 3’ direction. This results in two different replication processes:

1. **Leading Strand**: Replication is continuous along this strand, where the template strand runs in the 3’ to 5’ direction.
2. **Lagging Strand**: Replication is discontinuous here because the template strand runs in the 5’ to 3’ direction. This strand is synthesized in short segments known as **Okazaki fragments** that are later joined together.

Transcription

Transcription is the process through which genetic information in DNA is copied into RNA, specifically focusing on one segment of DNA at a time. During this process, adenine (A) pairs with uracil (U) instead of thymine (T) as seen in DNA. Transcription involves three key regions:

1. **Structural Gene**: This part contains the actual coding sequence for the RNA.
2. **Promoter**: This region is where RNA polymerase binds to initiate transcription.
3. **Terminator**: This signals the end of transcription.

The enzyme **RNA polymerase** catalyzes the transcription process. The direction of transcription mirrors that of DNA replication, proceeding in the 5' to 3' direction. The strand of DNA that serves as a template for RNA synthesis is called the **antisense strand**, which has a 3' to 5' polarity. Conversely, the **coding strand** has a 5' to 3' polarity and is referred to as the **sense strand**. The coding strand contains the structural gene, along with the promoter and terminator regions, and includes both exons (coding sequences) and introns (non-coding sequences).

Genetic Code

The genetic code refers to the sequences of bases in messenger RNA (mRNA) that specify the order of amino acids in protein synthesis. Each code consists of three nucleotides, forming what are known as **codons** or **triplets**. There are a total of 64 possible codons; 61 of these codons correspond to specific amino acids, while the remaining three are known as **stop codons** because they do not code for any amino acid. The codon **AUG** serves as both the start codon and codes for the amino acid **methionine**, marking the beginning of protein synthesis. This code is essential for translating the genetic information from mRNA into functional proteins, which are vital for the structure and function of cells.

Mutations and Genetic Code

Mutations involve changes in the genetic sequence, and one common type is a **point mutation**, where a single base pair is altered. A well-known example is **sickle cell anemia**, caused by a mutation in the gene coding for the β-globin chain of hemoglobin. In this case, the amino acid **glutamate** is replaced by **valine**, leading to the sickling of red blood cells.

Another type of mutation is the **frameshift mutation**, which occurs when there is a loss or gain of one or two base pairs in the DNA sequence. This changes the reading frame from the point of mutation, altering the entire sequence of amino acids downstream. Frameshift mutations can have significant impacts on the resulting protein, often leading to nonfunctional proteins or severe genetic disorders.

Translation

Translation is the process through which amino acids are linked together to form proteins, facilitated by **peptide bonds**. During this process, all three types of RNA **messenger RNA (mRNA)**, **transfer RNA (tRNA)**, and **ribosomal RNA (rRNA)** play distinct roles. The first step in translation is the **aminoacylation of tRNA**, where tRNA molecules are charged with their respective amino acids. Ribosomes act as the site of protein synthesis, functioning as catalysts for the formation of peptide bonds. Translation proceeds in the 5' to 3' direction, and the large subunit of the ribosome contains two sites that accommodate tRNAs carrying amino acids, bringing them close enough together to facilitate peptide bond formation.

Regulation of Gene Expression

Gene expression, the process by which genes are converted into polypeptides, can be regulated at various levels in eukaryotes, including:

1. During the formation of the primary transcript (transcription).
2. During the processing or splicing of the mRNA.
3. When transporting mRNA from the nucleus to the cytosol.
4. During protein synthesis (translation).

Gene expression is influenced by environmental, physiological, and metabolic conditions. In the development and differentiation of an embryo, the coordinated regulation and expression of multiple genes are crucial.

In prokaryotes, gene expression primarily occurs at the initiation of transcription. The activity of **RNA polymerase** at the start site is controlled by regulatory proteins that can act as repressors or activators. The accessibility of the promoter region is influenced by an **operator sequence** located adjacent to it, which binds specific proteins, typically repressors. This regulatory mechanism ensures that gene expression can be finely tuned according to the cell's needs.

Benefits of CBSE Class 12 Biology Notes Chapter 6 Molecular Basis of Inheritance

- **Structured Learning**: The notes provide a well-organized structure that aligns with the CBSE syllabus, helping students to systematically cover all important topics and concepts needed for the exam.
- **Focused Content**: They highlight key concepts such as DNA structure, replication, transcription, translation and gene regulation, allowing students to concentrate their study efforts on the most relevant material.
- **Conceptual Clarity**: By simplifying complex ideas into understandable terms, the notes enhance students conceptual clarity, which is important for answering application-based questions in exams.
- **Quick Reference**: The notes are a quick reference guide during last-minute revisions, making it easier for students to recall important facts and processes.

- **Practice Preparation**: The notes prepare students for various types of questions, including theoretical, application-based and diagrammatic questions, ensuring they are well-equipped for different exam formats.
- **Confidence Boost**: By providing a detailed overview of the chapter, the notes help boost students confidence in their knowledge and preparedness for the exam.
- **Time Management**: With clearly organized content, students can manage their study time more effectively ensuring they cover all necessary topics before the exam date.