

Chapter 6: Molecular Basis of Inheritance

DNA as Genetic Material:

Established through experiments by Griffith, Avery, MacLeod & McCarty, and Hershey & Chase.

DNA is a long polymer with a deoxyribose (pentose) sugar, phosphate group, and nitrogenous bases (Adenine, Thymine, Cytosine, Guanine).

Structure of DNA:

Double helix model proposed by Watson and Crick.

Antiparallel strands held together by hydrogen bonds between complementary

base pairs (**A-T and G-**

C). Replication of DNA:

Semi-conservative replication model.

DNA helicase unwinds the helix, DNA polymerase facilitates the addition of new nucleotides.

RNA World:

RNA believed to be the first genetic material .

Types of RNA: mRNA (Messenger), tRNA (Transfer), rRNA (Ribosomal).

Transcription:

Process of synthesizing RNA from DNA template.

In eukaryotes, primary transcript (hnRNA) undergoes splicing, capping, and tailing to form mature mRNA.

Genetic Code:

Triplet code, codon specific to amino acids.

64 possible codons, 61 code for amino acids, and 3 are stop codons.

Universal in nature with few exceptions.

Translation:

Process of protein synthesis from mRNA template.

tRNA acts as an adapter, carrying specific amino acids to ribosomes where polypeptide synthesis occurs.

Regulation of Gene Expression:

Not all genes are active at all times.

In prokaryotes: Operon model (e.g., Lac operon).

In eukaryotes: Multiple levels of regulation (chromatin level, transcriptional, post-transcriptional, translational, and post-translational).

Human Genome Project:

Aims to sequence the entire human genome and identify all genes.

Outcomes: Identified ~20,500 protein-coding genes; understanding of molecular basis of diseases; drug design.

DNA Fingerprinting:

Technique to identify individuals based on DNA patterns.

Uses Short Tandem Repeats (STRs) for identification.

Applications: Forensics, paternity testing, biodiversity studies..

