Chapter 12: DNA

Class	Biology

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12.1 — Identifying the Substance of Genes

Bacterial Transformation

Frederick Griffith → studied how bacteria made people sick

- **Transformation:** the process of a chemical compound containing information to change harmless bacteria into disease-causing bacteria
    - Griffith concluded that the compound was a gene since it was passed down

The Hershey-Chase Experiment

- Tested to see if the protein coat or DNA core entered the bacterium
    - Found the entering gene was the DNA core

> The scientists concluded that **DNA is genetic material found in all living cells**.

The Role of DNA

- Storing, copying, and transmitting genetic information in a cell

Storing Information

The main function of DNA is to **STORE GENETIC MATERIAL**.

- Controls *patterns of development*

Copying Information

Cells must copy DNA before dividing.

- Requires specific structures

Transmitting Information

> Genes are transmitted from one generation to the next.

- Must be transmitted correctly to prevent errors

12.2 — The Structure of DNA

The Components of DNA

DNA (Deoxyribose Nucleic Acid): long, slightly acidic molecules originally identified in cell nuclei

Nucleic Acids & Nucleotides

Nucleic Acids: long, slightly acidic molecules originally identified in cell nuclei

- Made up of smaller subunits (*nucleotides*)

A nucleotide is made up of ...

- A 5-carbon sugar (deoxyribose)
- A Phosphate Group
- A Nitrogen Base

Nitrogenous Bases & Covalent Bonds

Nitrogenous Bases: bases that contain nitrogen

- Four Types: adenine (A), thymine (T), cytosine (C), guanine (G)

Nucleotides in DNA strands are joined by **covalent bonds**.

- Between the sugar of one nucleotide and the phosphate group of the next

Nucleotides can be **joined together** is any order, but only **connect with their opposite**.

Solving the Structure of DNA

Chargaff's Rule

Erwin Chargaff → adenine & thymine had equal amounts, cytosine & guanine had equal amounts

- [A] = [T] and [G] = [C]

Rosalind Franklin

- Used X-ray diffraction to understand the structure of DNA
    1. Purification of DNA
    2. Stretching of DNA fibers
    3. X-ray beam aimed at DNA samples

Franklin's pictures showed a **helix** shape with two strands.

Watson and Crick

James Watson → American biologist

Francis Crick → British physicist

Watson and Crick understood what they were missing after seeing **Rosalind Franklin's DNA pictures**.

- Double helix structures with two strands of nucleotide sequences

The Double-Helix Model

- Looks like a twisted ladder
    - Two strands twist around one another

Chargaff’s rule → explains how the two strands of DNA are held together

Antiparallel Strands

The two strands of DNA run in opposite directions.

- The nitrogenous bases come into contact at the center of DNA

Hydrogen Bonding

Hydrogen bonding held the nucleotides together.

- DNA needs to be held by weak bonds for it to be separated easily

Base Pairing

Base Pairing: matching of A-T and C-G

- Explained Chargaff’s rule

12.3 — DNA Replication

Copying the Code

> Each base on the nucleotide strand corresponds with only one other base.

- Explains DNA replication (one strand can serve as a template for the other)

The Process of DNA Replication

Replication: the copying of the DNA and duplication for two resulting cells to each have a complete DNA molecule

- During the S phase of the cell cycle

One strand serves as the template for the complementary strand.

The Role of Enzymes

Enzymes “unzip” DNA into two strands.

- Done by breaking the hydorgen bonds

DNA Polymerase: an enzyme that joins nucleotides to synthesize a new, complementary strand of DNA from one strand

- “Proofreads” each DNA strand

Telomeres

Telomeres: the tips of eukaryotic chromosomes

- **Telomerase** → replicates the ends of the DNA (prevents genetic information from being lost)

Replication in Living Cells

- Occurs during S phase of the cell cycle

The DNA and histone molecules form **nucleosomes**.

- **Histones:** proteins around which chromatin is tightly coiled

Prokaryotic DNA Replication

- Starts from a single point and proceeds in two directions until the chromosome is copied

Eukaryotic DNA Replication

- Begins at multiple places at the DNA molecule and proceed in both directions at each place

There can be errors in DNA replication.

- Even after checks by multiple proteins