Nucleic Acids- The Information Molecules

- Examples: DNA and RNA

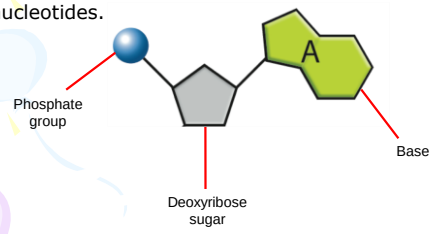
Nucleotides

Monomer = nucleotide

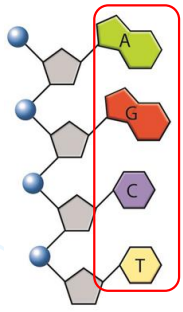
- Three parts of a nucleotide
  1. phosphate group
  2. Sugar
     - Deoxyribose
     - Ribose
  3. nitrogen base
     - A (adenine)
     - T (thymine)
     - C (cytosine)
     - G (guanine)
     - U (uracil)

Nucleotide Structure

- DNA is made up of nucleotides joined into long strands or chains by covalent bonds.
- Nucleic acids are made up of building blocks called nucleotides.



Nitrogenous Bases



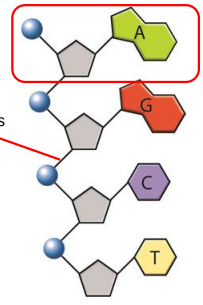
Adenine

Guanine

Cytosine

Thymine

Nucleic Acid Structure

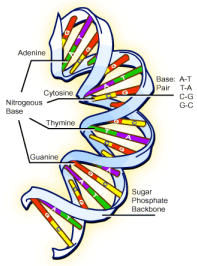


One nucleotide

Covalent bond between nucleotides

Structure and Function of DNA

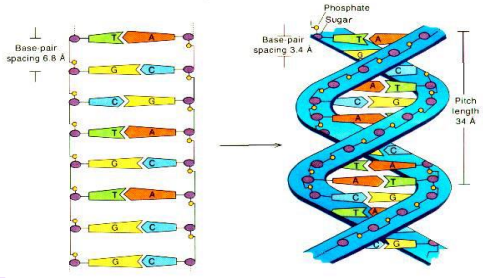
DNA= Deoxyribonucleic Acid



Function

1. DNA stores and transfers all of the GENETIC information of a cell.
2. DNA is the code for ALL proteins in the cells.
3. DNA→ mRNA→ amino acid order→ protein shape → protein function

Information in Order of Bases



Location

Prokaryotic Cells

- Bacteria → no nucleus
- DNA is stored in ONE CIRCULAR chromosome in the middle of the cytoplasm

Eukaryotic Cells

- Plant and animal cells → have nucleus
- DNA ALWAYS STORED INSIDE OF THE NUCLEAR MEMBRANE.
- Linear chromosome

Determining the Structure

- 1952 Hershey and Chase
  - determined DNA was genetic material
- 1953 James Watson and Francis Crick
  - Determined 3-d structure of DNA
  - Based on work by Rosalind Franklin
  - Won Nobel Prize in 1962

Franklin's X-rays

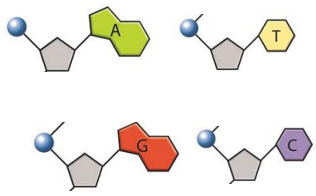
- DNA is a helix.
- Likely two strands to the molecule
- Nitrogenous bases near the center of the molecule

The Work of Watson and Crick

DNA is a double helix, in which two strands of nucleotide sequences are wound around each other.

Chargaff's Rule

[A] = [T] and [C] = [G]
Complementary Base Pairing



Structure

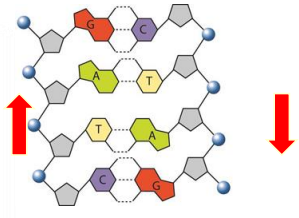
1. Polymer made of repeating nucleotides.
2. DNA has a DOUBLE HELIX shape
   - Spiral
   - Twisted ladder
3. One side of ladder is upside down compared to other

Structure

4. Two strands of nucleotides bonded together in the middle.
5. Bases follow the complementary base pairing rules
   - A ↔ T
   - C ↔ G

The Double Helix: Antiparallel Strands

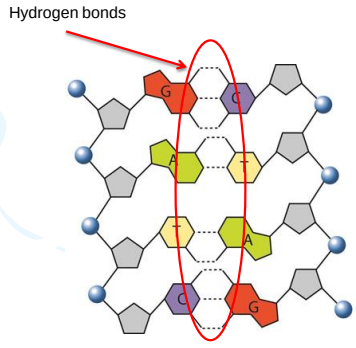
The two strands in a DNA molecule run in opposite directions.



Bonding

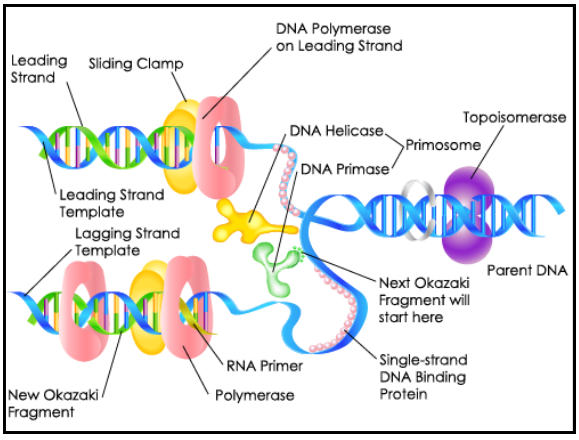
1. Strong **covalent** bonds hold together the sugar-phosphate backbone.
2. Weak **hydrogen** bonds hold together the complementary base pairs in the middle of the molecule.

The Double Helix: Hydrogen Bonding



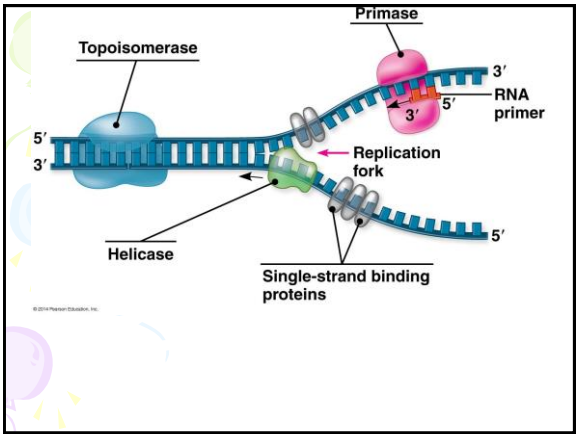
Replication of DNA

- Replica = copy
- DNA replication - process of copying the DNA
  - Enzymes



The Enzymes

- DNA polymerase (I and III): elongates new strands
- Helicase: Separates strands
- Primase: starts process of elongation (RNA)
- Ligase: Joins pieces together
- Single strand binding proteins: keeps strands from rejoining.
- Topoisomerase: prevents supercoiling

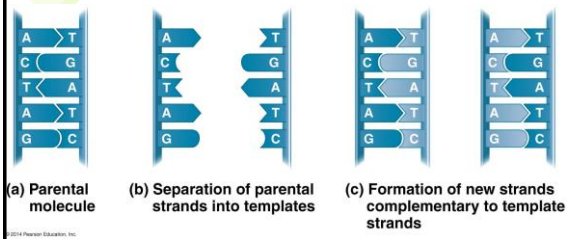


Process

1. Helicase separates the strands
2. SSBP keep strands from rejoining
3. Primase adds primer to start process
4. DNA polymerase III reads each strand, making complementary base pairs.
5. DNA polymerase I replaces primer
6. Ligase joins ends of pieces

Semi-Conservative

- each new double-strand has ONE NEW strand and ONE OLD strand of nucleotides



Replication

- How do the two new pieces of DNA compare to each other?
  - identical
- How do they compare to the original piece?
  - identical