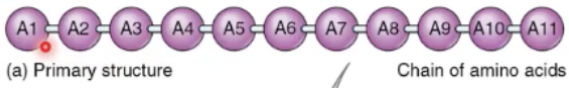
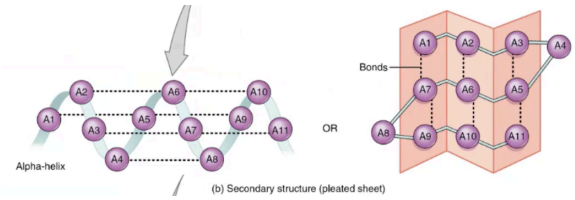
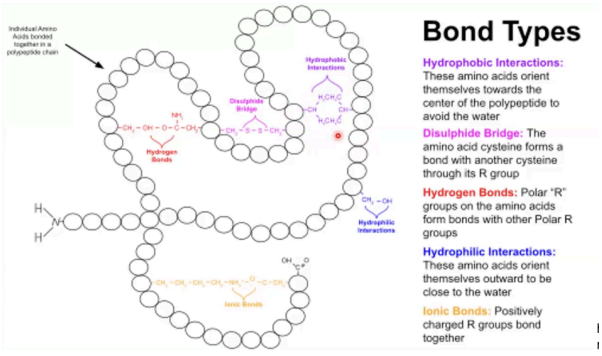
Families of Amino Acids

Acidic • Negative charges
Basic • Positive charges
Uncharged Polar • Can form Hydrogen bonds with water
Nonpolar • Do not interact with water • Tend to be proteins inside

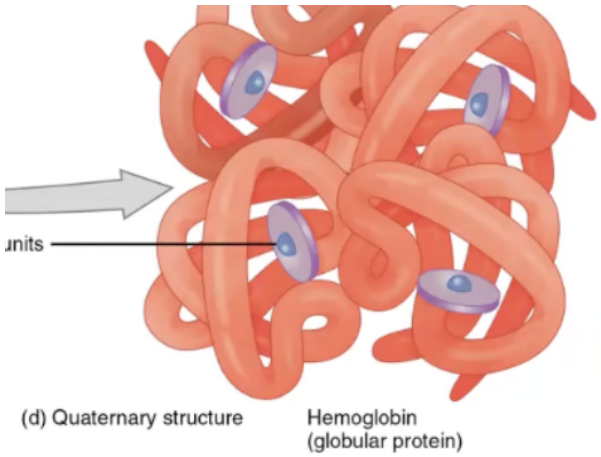
- describe the characteristics, structures and functions of amino acids, peptides and proteins
- understand the relationship between protein sequence, structure and function

Structure of Protein

Primary  	• Amino acid sequence
Secondary  	**Alpha Helix** • Spiral shape **Beta Sheet** • Folded sheet • Come from H-bonds in the backbone

Tertiary
 
 	
	Overall 3D shape of 1 polypeptide chain
	• Caused by side chains
	  ○ H-bonds
	  ○ Ionics bonds
	  ○ Hydrophobic interactions
	  ○ Hydrophilic interactions
	  ○ Disulfide Bridge

Quaternary	**Occurs when multiple polypeptide chains join together** E.g. **Hemoglobin** ● 4 polypeptide chains ● Carries oxygen in blood ● **Multiple polypeptides forming one protein**



Function of Proteins

1. As protein catalysts: **enzymes**
2. Stores of amino acids
3. Communication: serving as chemical signals (Hormones and cytokines)
4. Communication: specific receivers (receptors) for specific signals → initiate responses when the signaling molecule binds to the receptor
5. Movements of organs & movement of cells
6. Transport within an organism (**carriers**) & transporting in and out of cells (**channels and transporters**)
7. Fighting infectious diseases: the **immunoglobulins**

Enzymes

Metabolism

- The total of all chemical reactions that occur in the organism

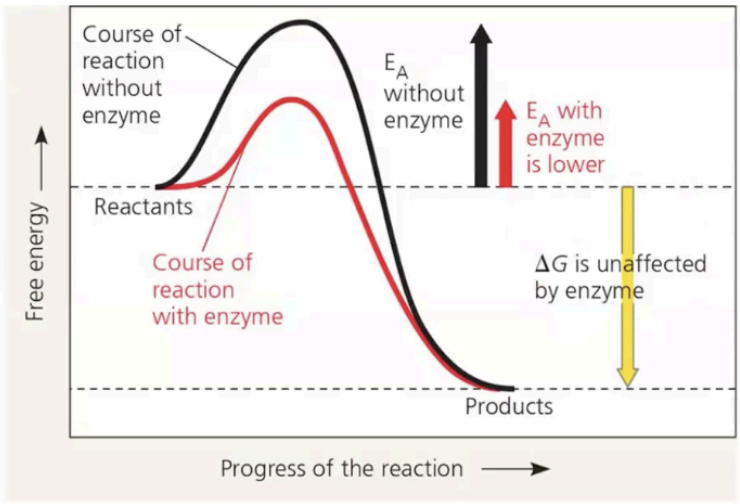
Anabolic (endo)	Catabolic (exo)
Small molecules are assembled into large ones **Energy required**	Large molecules are broken down into small ones **Energy is released**

Activation Energy

- Reactants must enter an unstable state (**transition state**)
- Energy required to get reactants to the transition state (**Activation Energy)**
    - Breaks bonds
    - Increases collisions between reactants

Enzymes Function

- Catalyst increase the speed of reaction without being consumed
- The catalytic action of enzymes is achieved by lowering the activation energy



Lecture 7 (Nucleic Acids & DNA)

Structure of Nucleic Acids (DNA & RNA)

- DNA & RNA are nucleic acids made up of a **linear** array of monomers called nucleotides

Difference between DNA & RNA

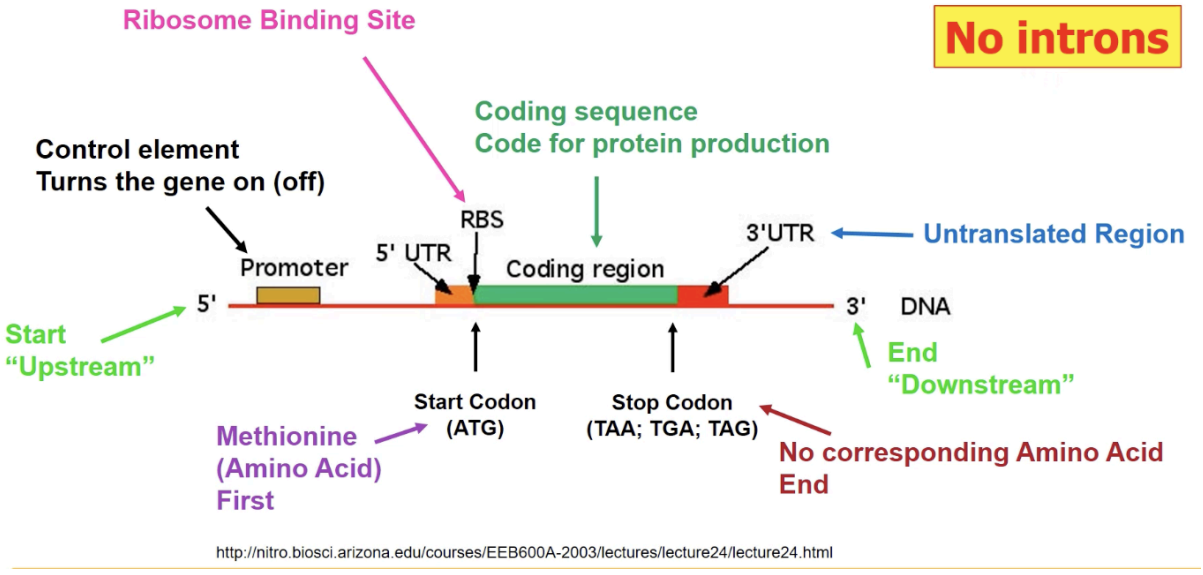
The presence of the OH on the 2 (2') position of the pentose sugar.

What is a Nucleotide

- Composed of: phosphate group, a nitrogen-containing base, and a five-carbon sugar

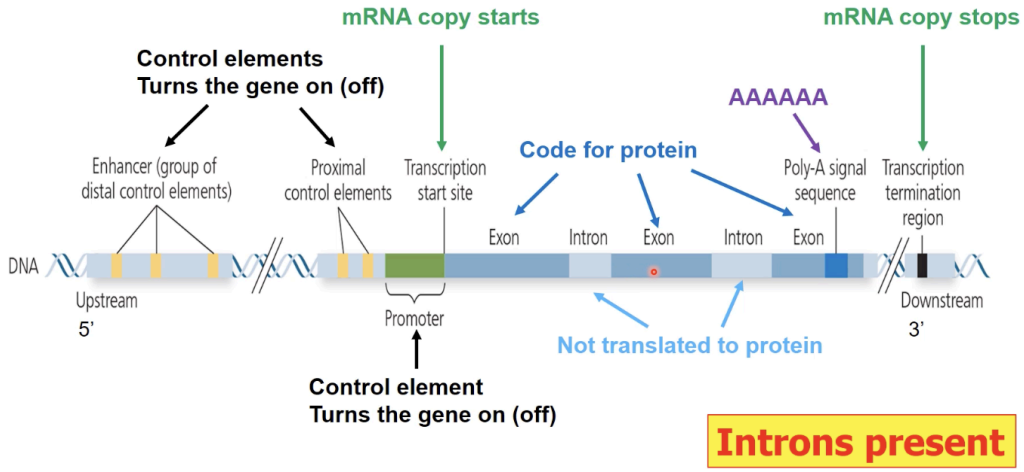
Structure of a Gene → Prokaryotes

A prokaryotic gene has a promoter to turn it on, a ribosome binding site to help the ribosome attach, a start codon to begin translation, a coding sequence that makes the protein, and a stop codon to end translation. Prokaryotic genes usually **have no introns, so the coding region is continuous.**

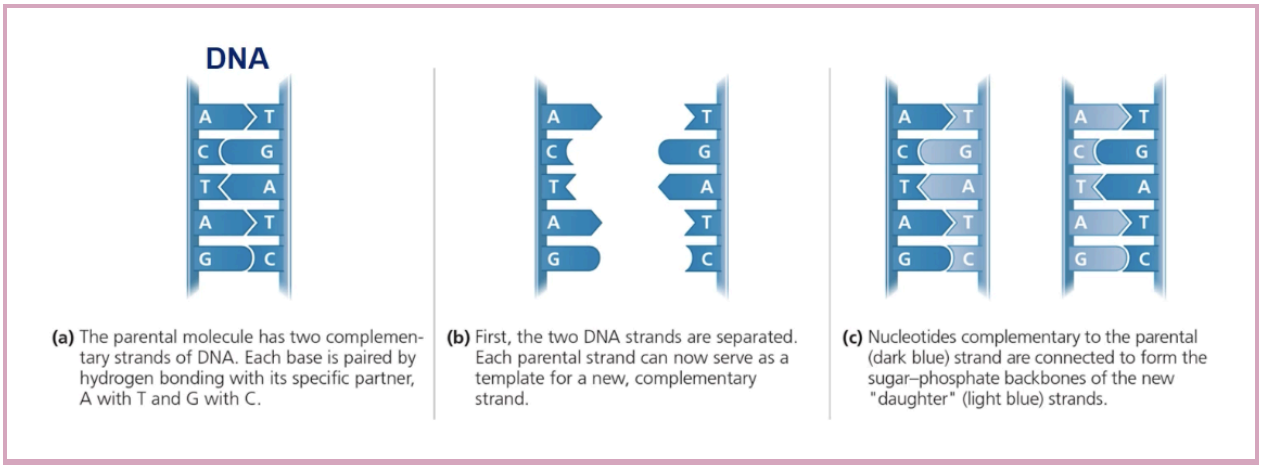


Structure of a Gene → Eukaryotes

Eukaryotic genes contain promoters, regulatory control elements, exons and introns. During RNA processing, introns are removed by splicing and exons are joined together to form mature mRNA, which is then translated into a protein.



DNA Replication



- DNA only synthesised only in the 5' to 3' direction
- Replication based on complemetarity of bases
  - New strand complementary to parent strand
  - ANti-parallel
- DNA replication = semi conservative
  - New daughter strand stays bound to parent template
  - One old strand with one new strand

DNA Replication → Escherichia coli

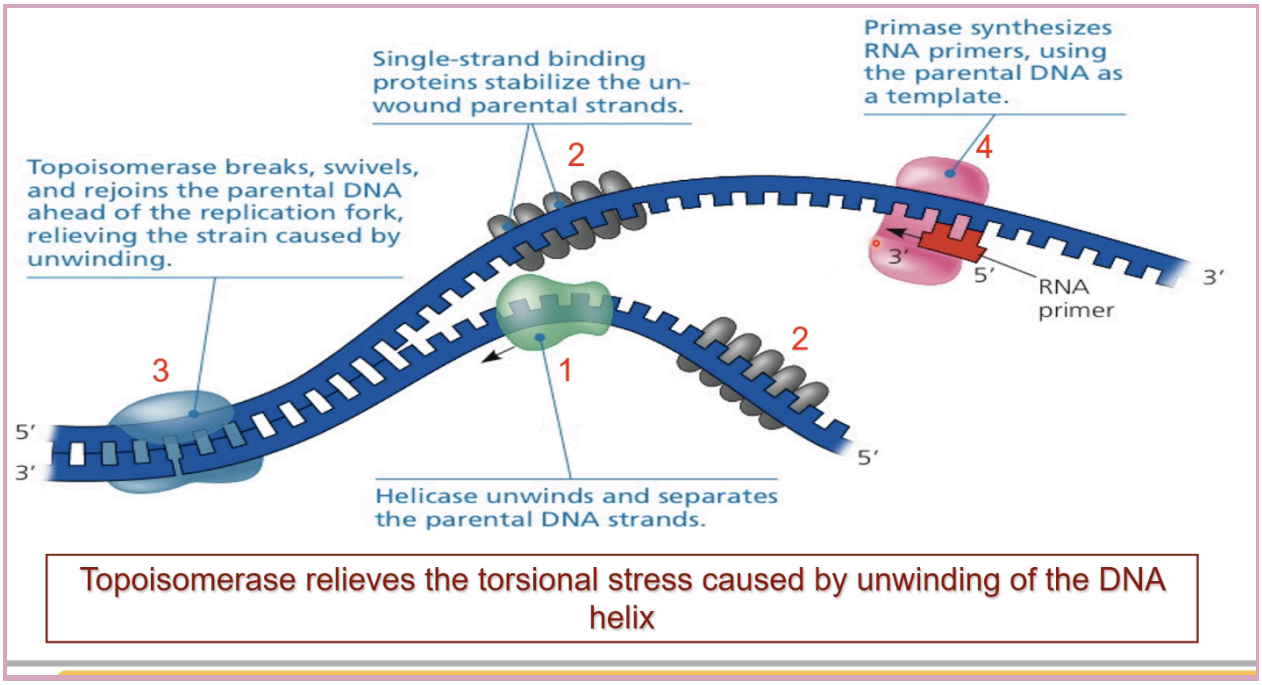
In prokaryotes such as *E. coli*, DNA replication begins at the origin of replication (oriC). A replication bubble forms and two replication forks move bidirectionally around the circular chromosome. Replication ends at the terminus (Ter), producing two identical DNA molecules by semi-conservative replication, where each daughter DNA contains one parental strand and one newly synthesised strand.

Quick Memory Trick

oriC → Bubble → Forks → Ter → Two DNA molecules

(Start → Open → Copy → Stop → Finish)

First Stage of DNA Replication



During DNA replication, **helicase** unwinds and separates the DNA strands by breaking hydrogen bonds. **Single-strand binding proteins** stabilise the separated strands and prevent them from rejoining. **Topoisomerase** relieves torsional strain caused by unwinding by temporarily cutting and rejoining DNA. **Primase** synthesises short RNA primers that provide a starting point for DNA polymerase to begin DNA synthesis.