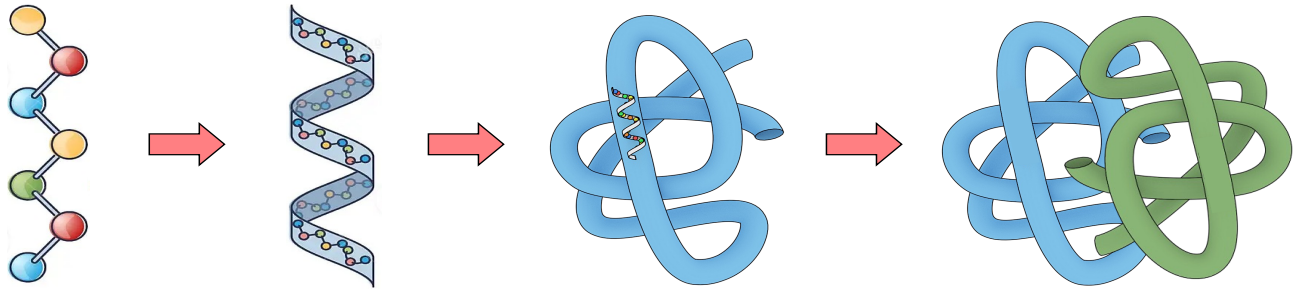
Visualising Protein Structure

Introduction

Proteins are formed of chains of amino acids that subsequently fold into a functional conformation. There are four levels of folding involved in protein structure, with each level building on the previous.

- *Primary Structure:* The order of amino acids in a polypeptide chain (held together by peptide bonds)
- *Secondary Structure:* Folding of the chain into regular and repeating arrangement by hydrogen bonds
- *Tertiary Structure:* The overall 3-D shape of the polypeptide chain (due to bonding between R groups)
- *Quaternary Structure:* The interaction of multiple (>1) polypeptide chains to form a functional protein

Levels of Protein Structure



PRIMARY SECONDARY TERTIARY QUATERNARY

Materials

Go to the BioNinja site and access the Molecular Visualisation page (Course → Practical Work):

- Link: https://ib.bioninja.com.au/Molecular-Visualisation.html

Methodology

- Click on the links for the following proteins: keratin, lysozyme, aquaporin, GFP, haemoglobin
- To manipulate the molecule, move the cursor over the molecule and press: *control + click*
  - To change the model format (wireframe, ball and stick, etc.) select: *Style → Scheme*
  - To show hydrogen bonds, select: *Style → Hydrogen Bonds → On*
  - To colour certain components, select: *Colour → By Scheme → Choose a component*
  - To show polarity, select: *Surface → Molecular Electrostatic Potential (range -0.1 to 0.1)*

PART 1: Keratin

Keratin forms the outer layer of the skin, nails, hair and feathers. It is an example of a fibrous protein.

1. Describe the general purpose and properties of a fibrous protein

PART 2: Lysozyme

Lysozyme acts as an antimicrobial agent by hydrolysing bacterial cell walls. It is a globular protein.

2. Describe the general purpose and properties of a globular protein

PART 3: Aquaporin vs GFP

Aquaporins are transmembrane water channels and GFP is a cytosolic protein that fluoresces green.

3. Compare the secondary and quaternary structures of these two globular proteins

PART 4: Haemoglobin

Haemoglobin is responsible for the binding of oxygen within red blood cells for transport to the cells.

4. Explain what is meant by the statement: 'Haemoglobin is a conjugated protein'

5. List an advantage and disadvantage of using molecular visualisation software to model protein structure