

# Biochemistry

## Diversity of Protein Structure and Function

- Polypeptide chains
- Approximately 20 amino acids
- Extended arrays
- Final shape is determined by amino acid sequence
- Mediate between unfolded and folded
- Primary -> Secondary -> Tertiary -> Quaternary
- Primary
  - Sequence of amino acids
- Secondary
  - Folding of amino acids
  - Alpha helices
  - Beta sheets
  - Random coils
- Tertiary
  - Folding of secondary structure
  - Mixture of secondary structures
  - Maximise secondary bonding
  - Formation to minimise hydrophobic groups exposure to water
    - Myoglobin is just alpha helices
    - Staphylococcal nuclease has beta sheet and 3 alpha helices
    - GFP beta barrel has alpha helices on top and bottom
  - Can be multicoloured
- Quaternary
  - Polypeptide chains associate
  - More than one polypeptide
  - Final protein form
- All amino acids have same structure, except Proline
- In neutral solutions, amino acids are zwitterions
- N terminal has a free  $\text{NH}_3^+$  group
- C terminal has a free carbonyl group  $\text{COO}^-$
- Linked by peptide bonds
  - Notional loss of water
  - Polypeptidation

## Amino Acids

- Hydrophobic or hydrophilic
- Charge, reactivity and hydrogen bonding capacity
- Hydrogen Bonding
  - $\text{OH} \cdots \text{O}$

- OH-----H<sup>-</sup>
- OH-----N
- NH-----O
- N<sup>+</sup>H-----O
- NH-----N
- Cult of Hydrophobic amino acids
  - Glycine
  - Valine
  - Leucine
  - Alanine
  - Isoleucine
  - Proline
    - Merges with amino group on backbone
    - Turns into Imino
    - Forbids rotation
- Acidic Acids
  - Glutamic Acid
  - Aspartic Acid
- Basic Acids
  - Lysine
  - Histidine
  - Arginine
- Hydroxyl Acids
  - Serine
  - Threonine
- Aromatic Acids
  - Phenylalanine
  - Tryptophan
  - Tyrosine
- Sulphur Acids
  - Cysteine
    - Can form disulphide bonds
  - Methionine
  - Selenocysteine
- Amine Acids
  - Asparagine
  - Glutamine

## Ionisation of Amino Acids

- Amino terminal and carboxyl terminal
- Uncharged at pH 7.4
- Overall charge is sum of + and -
  - Depends on amino acids with acidic and basic side chains
- Aspartic acid and glutamic acid have PK<sub>a</sub> of 4