Four Levels of Protein Structure

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1. Primary structure~
   - unique sequence of amino acids
   - determined by genes
   - slight change can affect conformation and function
   - ex.: sickle~cell anemia~substitution of 1 amino acid: valine for glutamic acid at position #6 of the 146 amino acid polypeptide

2. Secondary structure~
   - regular, repeated coiling and folding of polypeptide backbone
   - stabilized by hydrogen bonding between amino acids
   - 2 major types:
   - alpha~helix (identified first)
     - spiral helix
     - H~bonding between every 4th peptide bond
     - Found in fibrous proteins : keratin, collagen
     - Hair, nails, and throughout parts of globular proteins
   - Beta~pleated sheet
     - Folded plane (pleated skirt)
     - Dense core of globular proteins and some fibrous proteins

3. Tertiary structure~
   - irregular contortions of proteins due to bonding between side chains (R's)

- bonding via covalent linkages and weak interactions
- Weak interactions:
  - H-bonding
  - Ionic bonding
  - Hydrophobic interactions
  - Nonpolar R groups tend to clump towards the middle of molecule
  - Van der Waals interactions
- Covalent linkages:

2 cysteine molecules come in contact-the S's tend to covalently bond, forming a disulfide bridge, S-S
- very strong bond
- changes entire conformation
- globular proteins typically have shape
- dominated by tertiary structure

4. Quaternary structure-

- structure that results from interactions between several polypeptides in a single protein
- collagen (fibrous, 2) 3 helical polypeptides
  - gives connective tissue its strength

- hemoglobin (globular, 3)
  4 subunits 2 alpha and 2 beta chains

What determines protein conformation?
1. Polypeptide chain of given amino acids will spontaneously arrange itself into a 3-D shape because of interactions between the amino acids.

- H-bonds
- ionic
- hydrophobic interactions
- disulfide bridges
  van der Waals interactions

2. Physical and chemical conditions of protein's environment

- pH, salt concentration, temperature change (heat), change of environment (polar nonpolar), (water organic solvent)
- all can cause denaturation-change in shape/native state
  - form fits function: change in form, no longer carry out function