Proteins

-- proteins comprise many STRUCTURAL and FUNCTIONAL components of living things:

A. STRUCTURAL PROTEINS:

i. Keratin – prominent in hair and finger/toenails

ii. Collagen -- found in connective tissue (eg. ligaments, tendons, cartilage, bone) and skin

iii. Actin and Myosin -- structural components of muscle tissue

iv. Tubulin – main component of cellular cytoskeleton

B. FUNCTIONAL PROTEINS:

i. Enzymes -- regulate biochemical reactions in the body.

ii. Hormones – chemical messengers (travel in blood) that influence metabolism in many ways (eg. insulin, Growth Hormone etc.)

iii. Antibodies -- provide an immune response in our blood by recognizing (and indirectly destroying) anything foreign and harmful

iv. Neurotransmitters -- allow nerve cells to communicate with other nerve cells, muscle cells, or glands (eg. norepinephrine, acetylcholine, dopamine)

v. Hemoglobin -- transports oxygen, carbon dioxide, and acts as a blood buffer by transporting hydrogen ions.

vi. Fibrin -- a protein that aids in the clotting of blood.

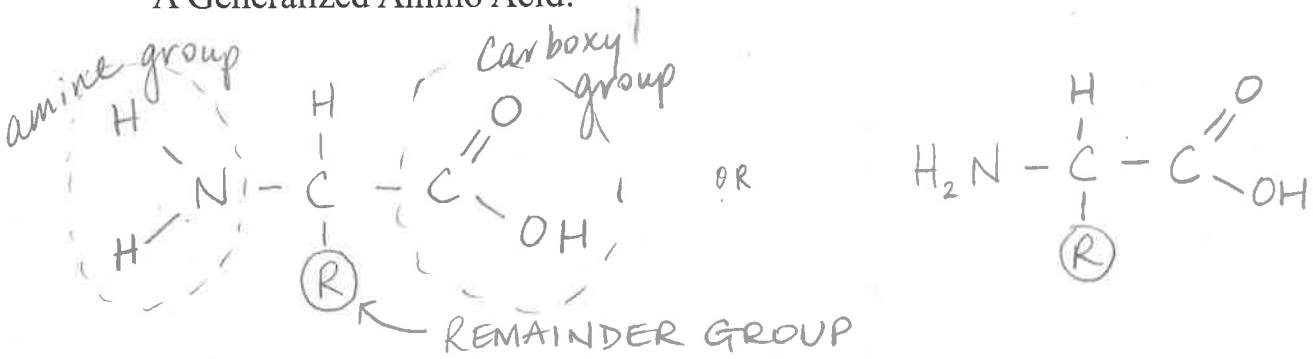
Protein Structure

-- composed of monomers called AMINO ACIDS.

-- there are 20 amino acids in nature.

-- each of these 20 amino acids contain an identical *conserved* structure and differing Remainder Groups (R-Groups).

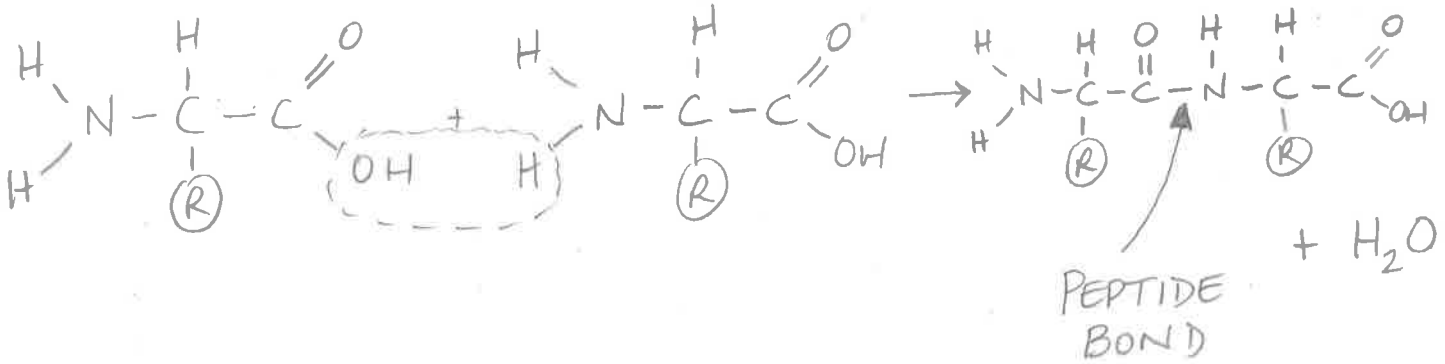
A Generalized Amino Acid:



Linking Amino Acid Monomers

-- amino acids are joined by dehydration synthesis to form a polypeptide chain or a protein molecule (this occurs during the process of Protein Synthesis, hosted by a ribosome(s)).

-- a covalent bond called a PEPTIDE BOND forms between the amino group of one amino acid and the carboxyl group of another, again through the process of dehydration synthesis.



-- a chain of 2-75 amino acids is a referred to as a peptide chain or a POLYPEPTIDE.

-- a chain of >75 amino acids is considered to be a PROTEIN.

Note: amino acids' conserved structures possess slightly polar tendencies, meaning that amino acids can form hydrogen bonds between themselves (Note: R-Groups can be polar or non-polar).

Protein Structure -- Levels of Organization

-- proteins commonly have three levels of organization, and some have a fourth level:

I. Level One -- PRIMARY STRUCTURE:

-- refers to the simple linear sequence of amino acids held together by peptide bonds.

-- every protein has a unique sequence of amino acids.

II. Level Two -- SECONDARY STRUCTURE:

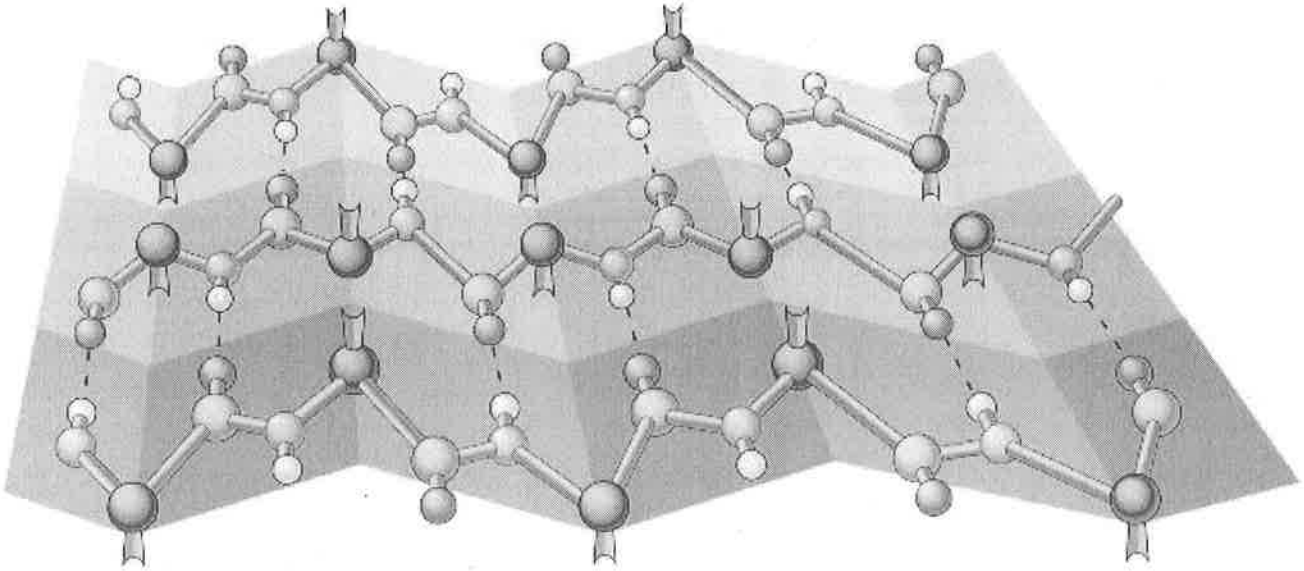
-- refers to the polypeptide/protein chain adopting an ***alpha-helix*** (right-handed coil) shape (the majority of proteins adopt this structure, relative to the other type of secondary structure described below) (see fig. 2.27 p. 39).

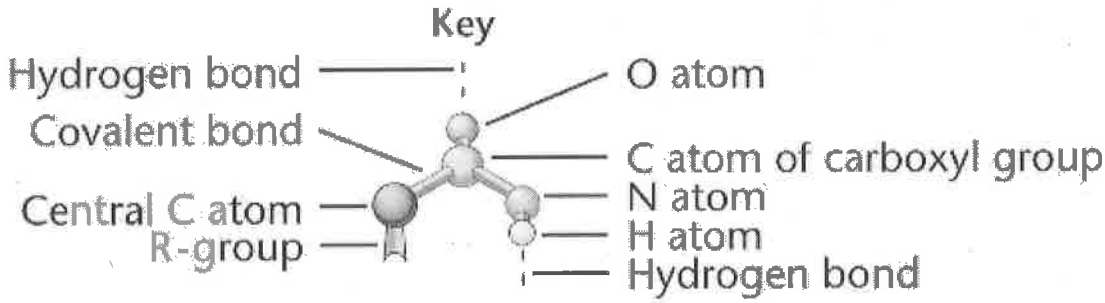
-- hydrogen bonds between every fourth amino acid (H to O, or H to N) initiate the formation of the helix and stabilize it once it's formed.

-- amino acids might also form less common ***beta-pleated sheets*** where amino acids are connected laterally with hydrogen bonds.

-- these beta sheets are more evident in structural-style proteins (globular proteins) or in fibrous proteins (fibrin (blood clotting)).

-- see diagram next page.





III. Level Three -- TERTIARY STRUCTURE:

-- refers to the 'twisting and turning' of the alpha-helix into a structure that looks less 'strand-like' but more 'knot-like'.

-- promoted by attractions (Ionic, Covalent, H-bonds) and repulsions between the various R-groups involved in the protein.

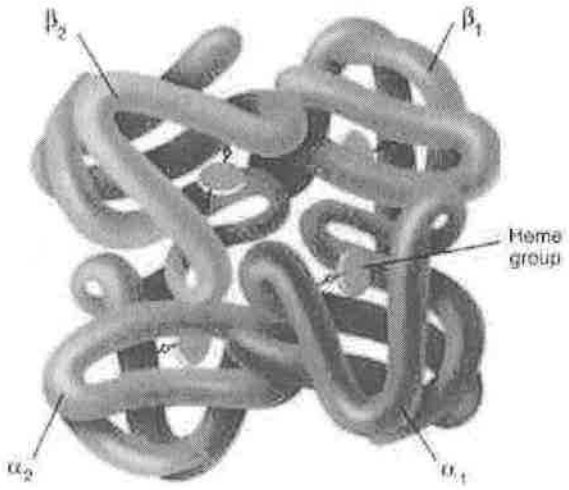
-- each protein-type possesses its own, unique tertiary structure.

IV. Level Four -- QUATERNARY STRUCTURE:

-- not all proteins possess a quaternary structure.

-- occurs when separate, tertiary-structured proteins join together to form a more 'complex' protein.

-- eg. Hemoglobin (see diagram on next page)



* the final shape of a protein is essential in determining how the protein functions (see p.30) *discussed heavily in the Enzyme Unit.

Protein Denaturation (read intro on p.38)

-- a protein is said to be *denatured* when its tertiary shape is altered, due to the normal bonding between R-groups being inhibited/disturbed.
-- this destroys the functionality of the protein
-- may be caused by:
    -- large temperature increase (eg. egg whites)
    -- exposure to heavy metals (eg. Pb, Hg, U, etc...)
    -- changes in pH