Proteins

The building blocks of life

Hair and Nails

A protein called alpha-keratin forms your hair and fingernails,and also is the major component of feathers, wool, claws, scales, horns, and hooves.

Blood

The hemoglobin protein carries oxygen in your blood to every part of your body.

Muscles

Muscle proteins called actin and myosin enable all muscular movement—from blinking to breathing to rollerblading.

Brain and Nerves

Ion channel proteins control brain signaling by allowing small molecules into and out of nerve cells.

Cellular Messengers

Receptor proteins stud the outside of your cells and transmit signals to partner proteins on the inside of the cells.

Enzymes

Enzymes in your saliva, stomach, and small intestine are proteins that help you digest food.

Antibodies

Antibodies are proteins that help defend your body against foreign invaders, such as bacteria and viruses.

Cellular Construction Workers

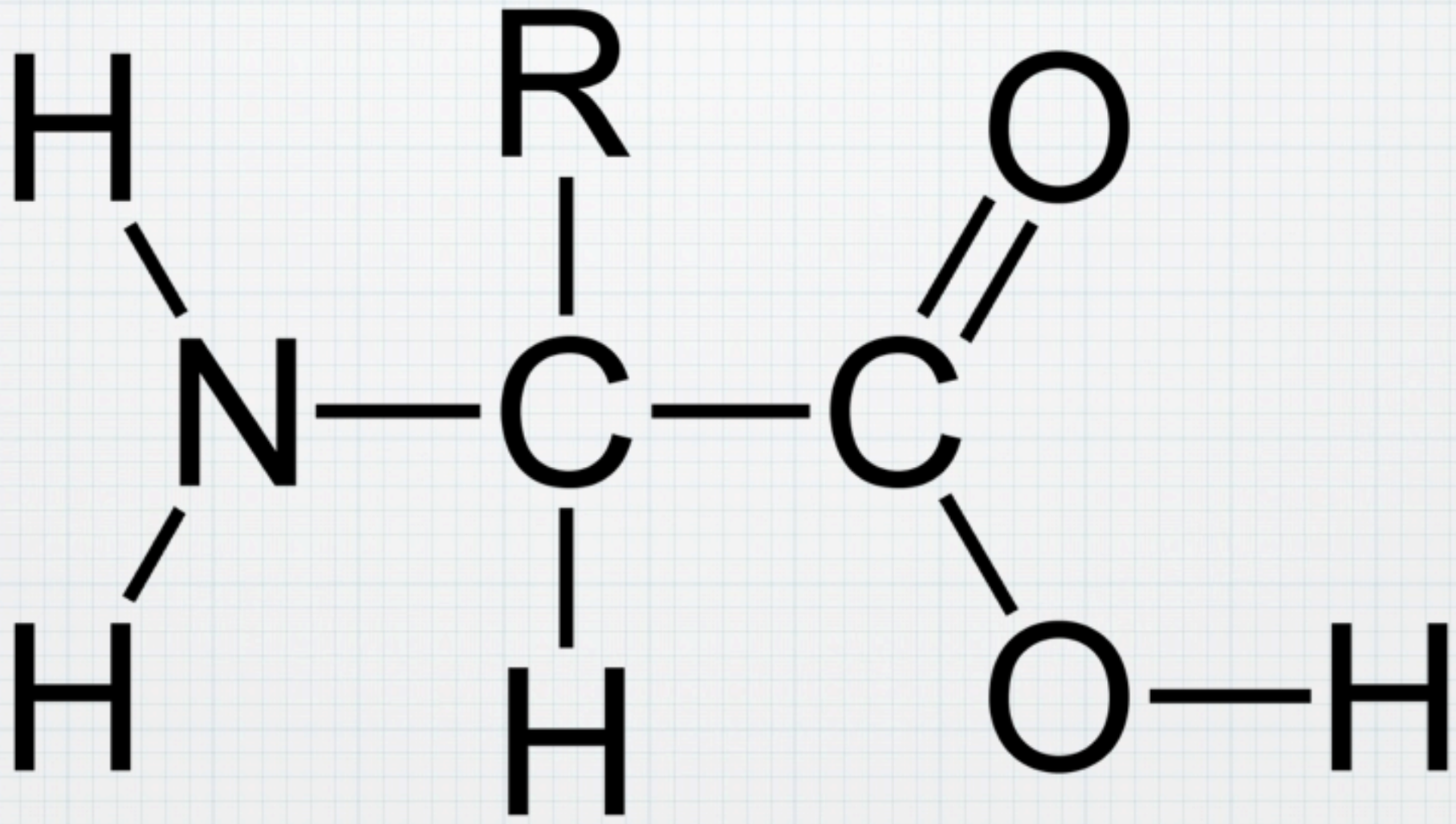
Huge clusters of proteins form molecular machines that do your cells' heavy work, such as copying genes during cell division and making new proteins.

* Proteins are considered to be macromolecules.
    * Monomers: Amino Acids

Amino Acids

* There are 20 amino acids
  * 11 non-essential
  * 9 essential
    * Obtained from 'complete proteins'

Amino Acids

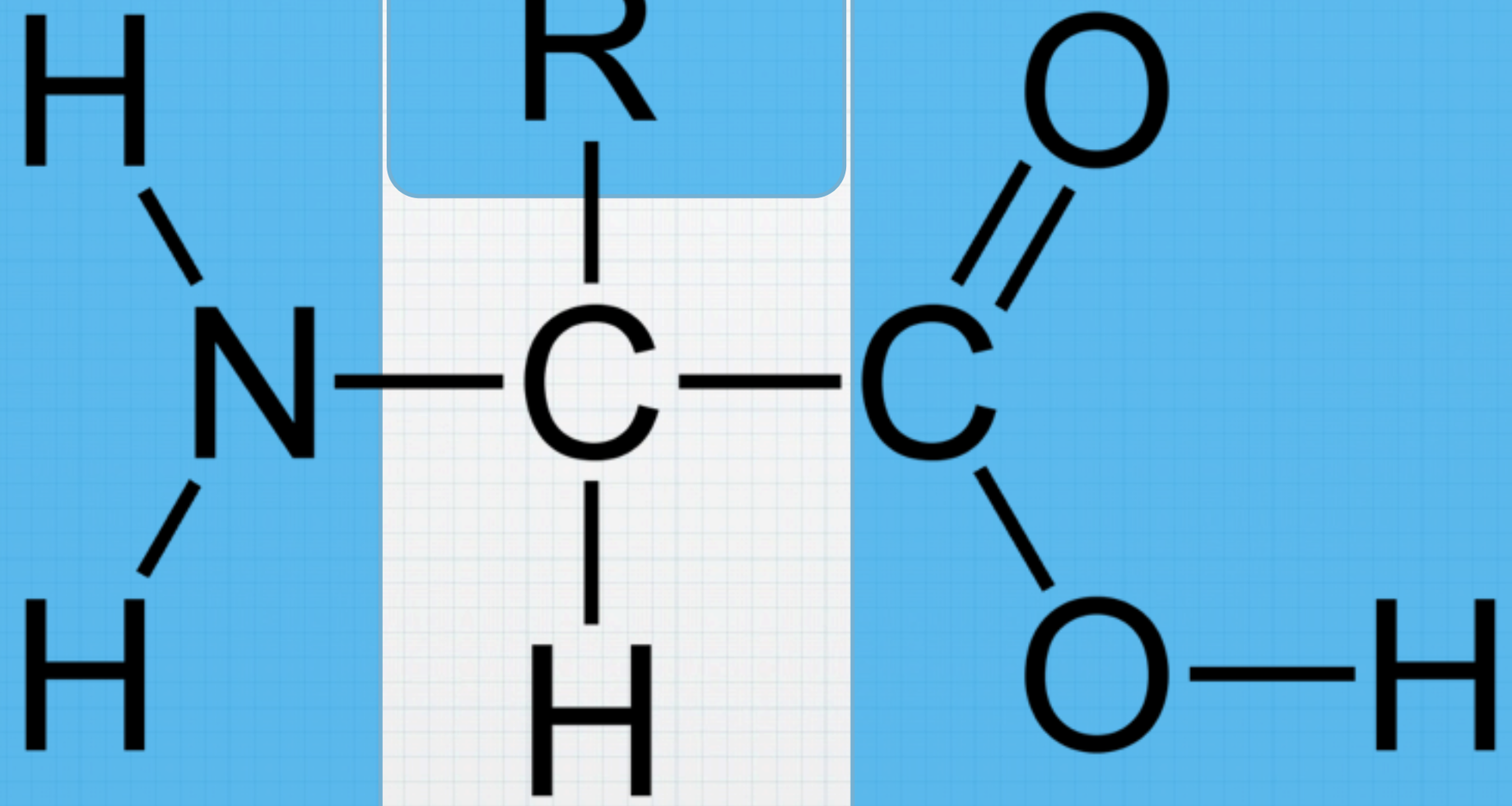


Amino Acids

Amino Group

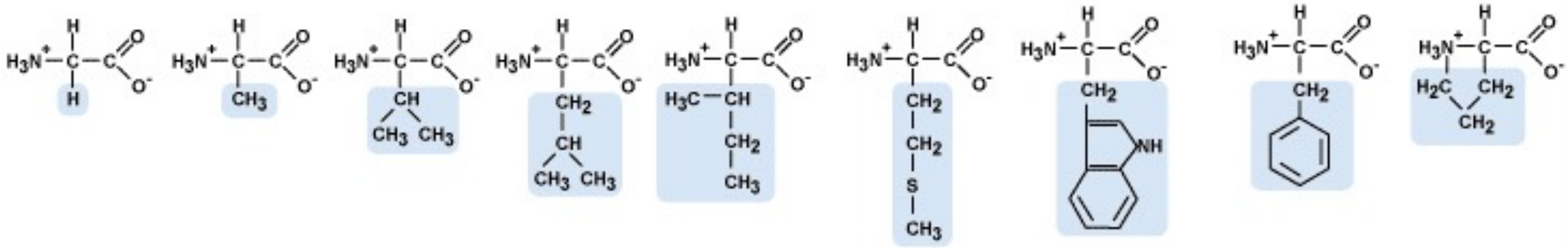
R Group

Carboxyl Group



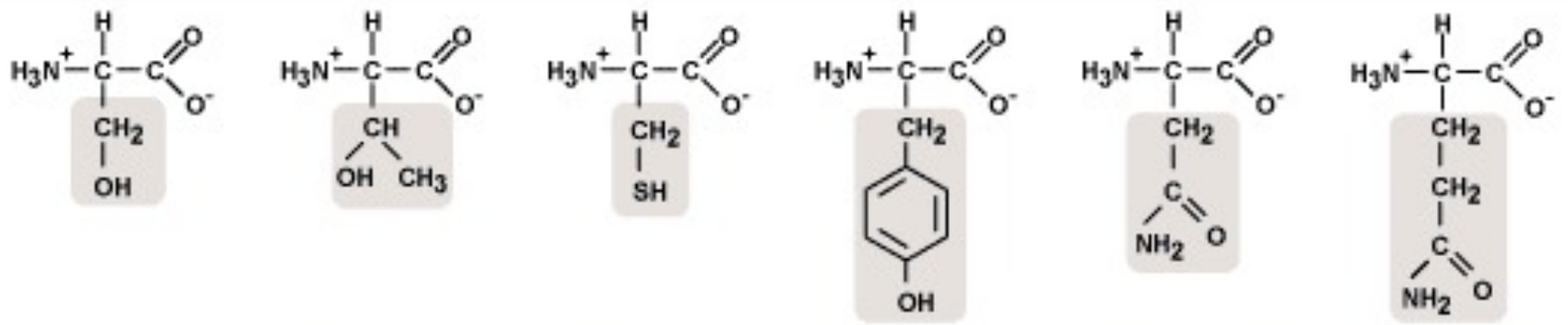
R-Group

NONPOLAR



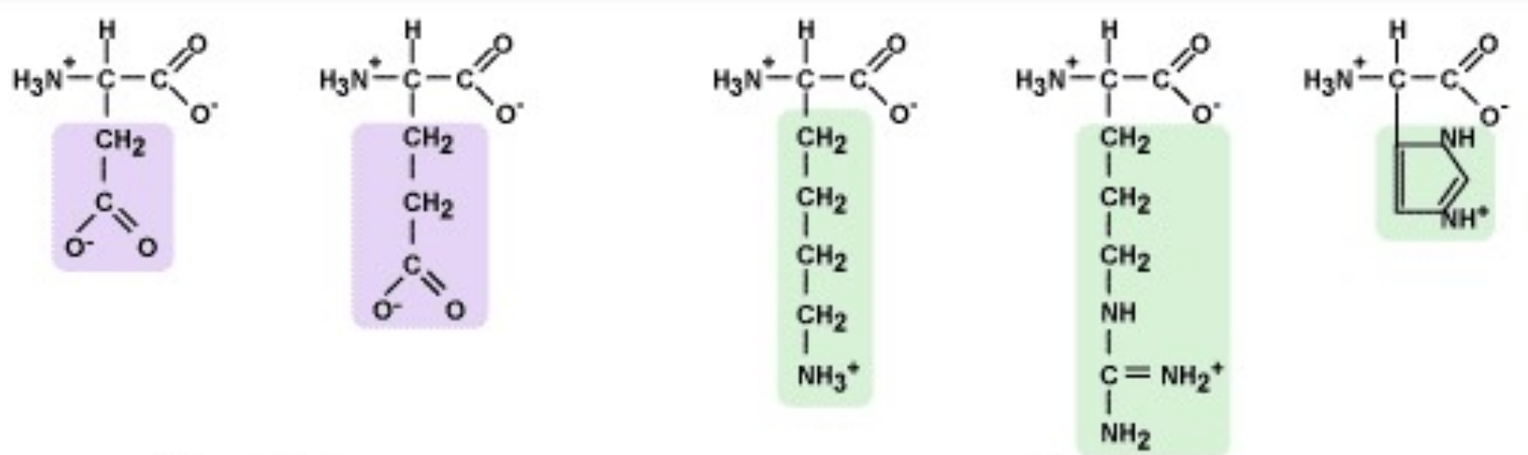
Glycine (Gly) Alanine (Ala) Valine (Val) Leucine (Leu) Isoleucine (Ile) Methionine (Met) Tryptophan (Trp) Phenylalanine (Phe) Proline (Pro)

POLAR



Serine (Ser) Threonine (Thr) Cysteine (Cys) Tyrosine (Tyr) Asparagine (Asn) Glutamine (Gln)

Electrically Charged



Acidic

Aspartic Acid (Asp) Glutamic Acid (Glu)

Lysine (Lys)

Basic

Arginine (Arg) Histidine (His)

Structure

* Proteins are held together by peptide bonds.
  * Peptide: 2 amino acids
  * Oligopeptide: <10 amino acids
  * Polypeptide: >10 amino acids

What do they do?

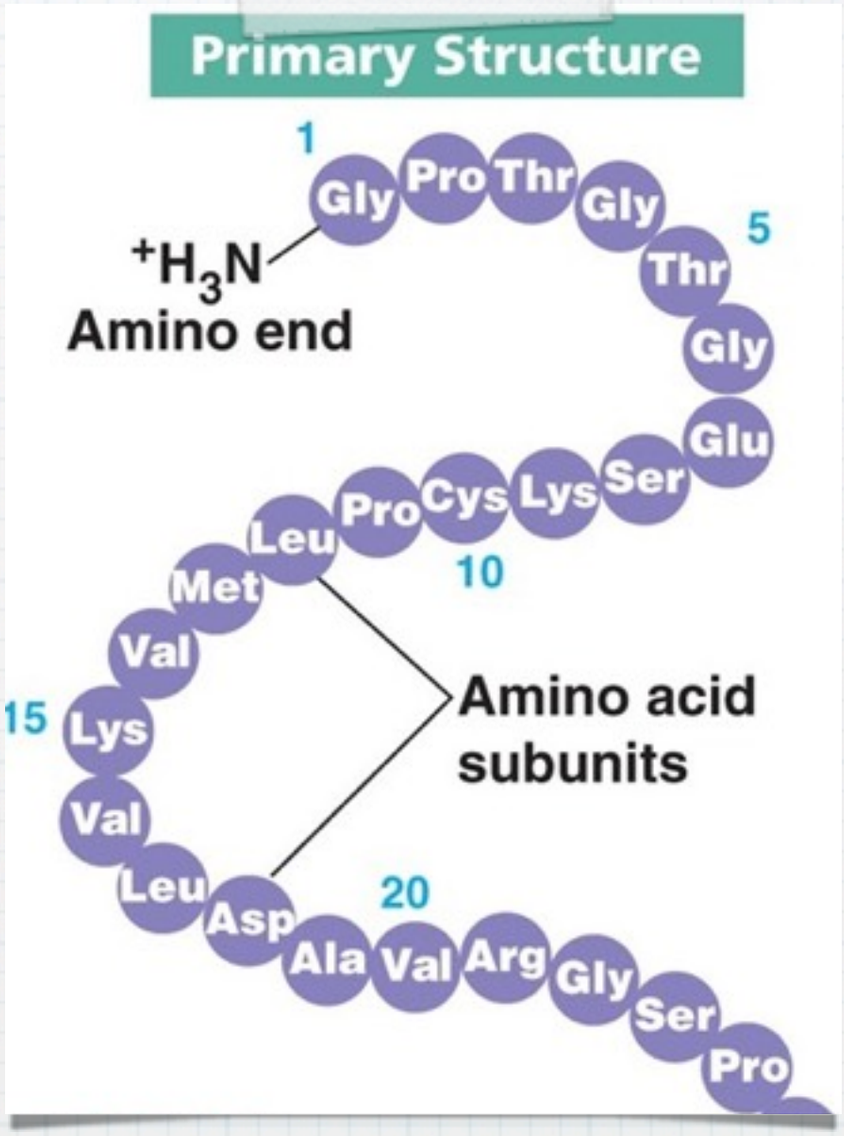
* Enzymes
* Hormones
* Structural Proteins (keratin collagen, elastin)
* Antibodies
* Transport Proteins
* Contractile Proteins (actin, myosin)

Protein Structure

* There are four levels to protein structure.
* The shape of a protein determines it's function.

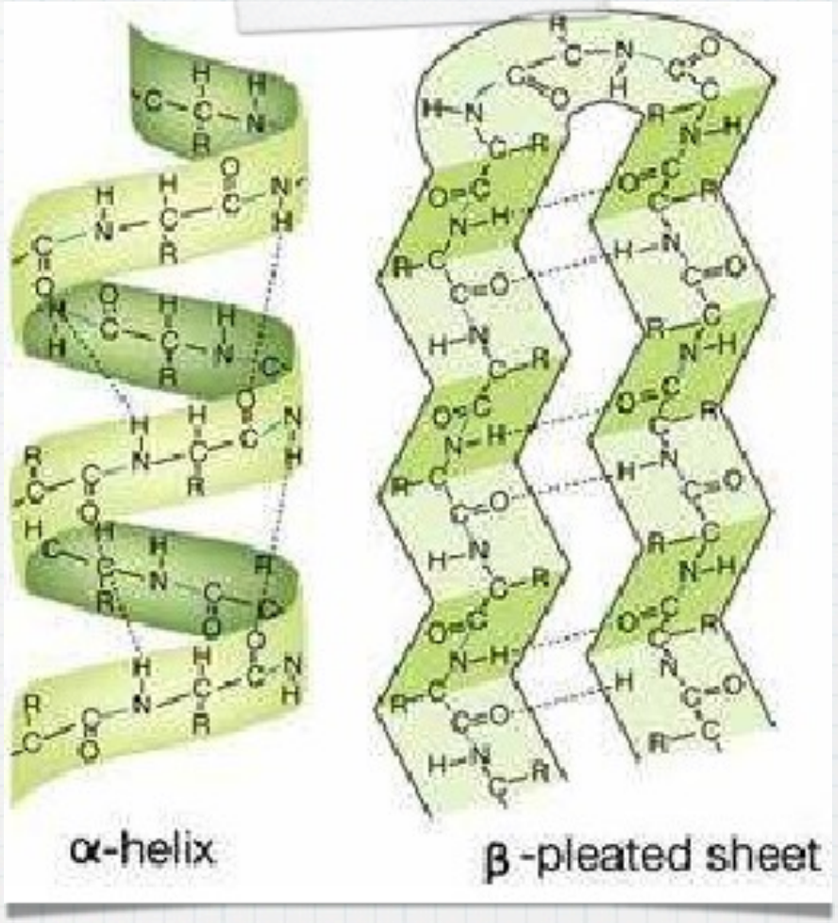
Protein Structure

* Primary Structure
* Describes the sequence of the amino acids in a chain.

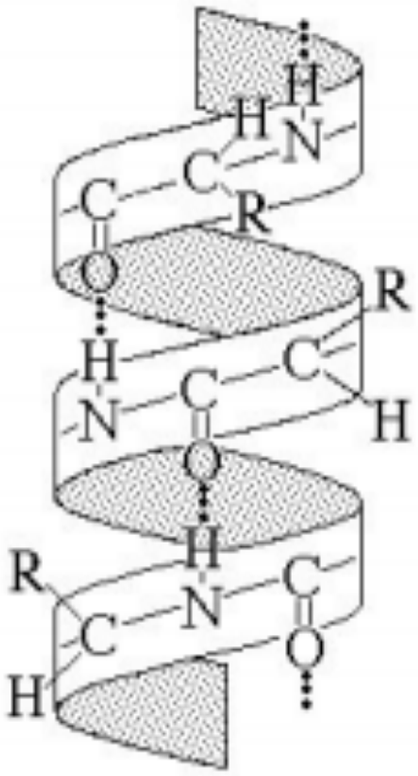


Protein Structure

* Secondary Structure
  * Coils (alpha helix) of folds (beta pleated sheets)
  * Occurs because of hydrogen bonding between C-O of one amino group and the N-H of another.



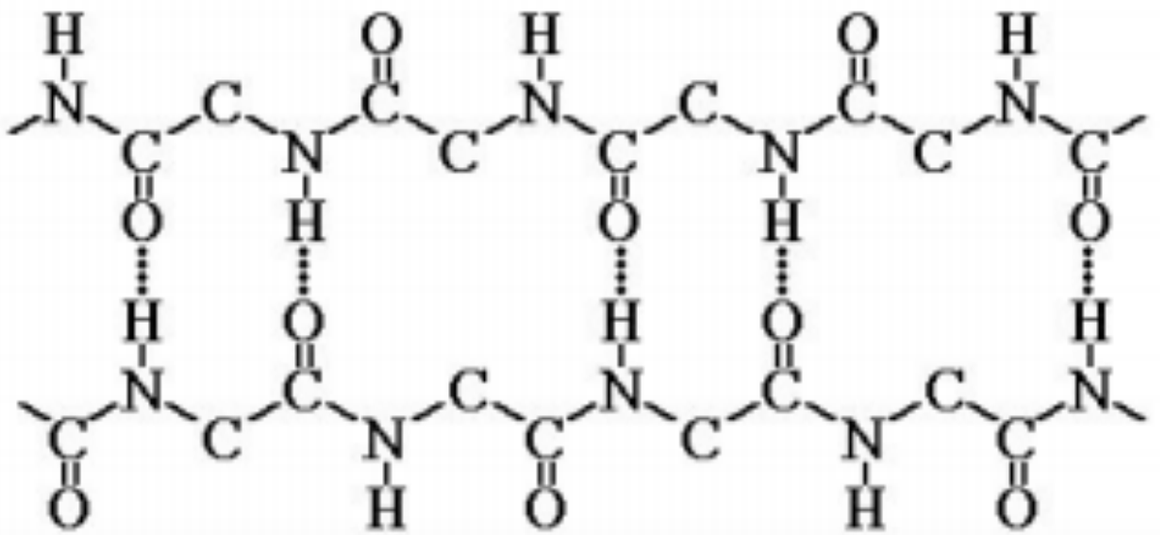
α-helix



The telephone cord shape of the α-helix is held in place by Hydrogen bonds between every N-H group and the oxygen of a C=O group in the next turn of the helix, four amino acids down the chain. The typical α-helix is about 11 amino acids long.

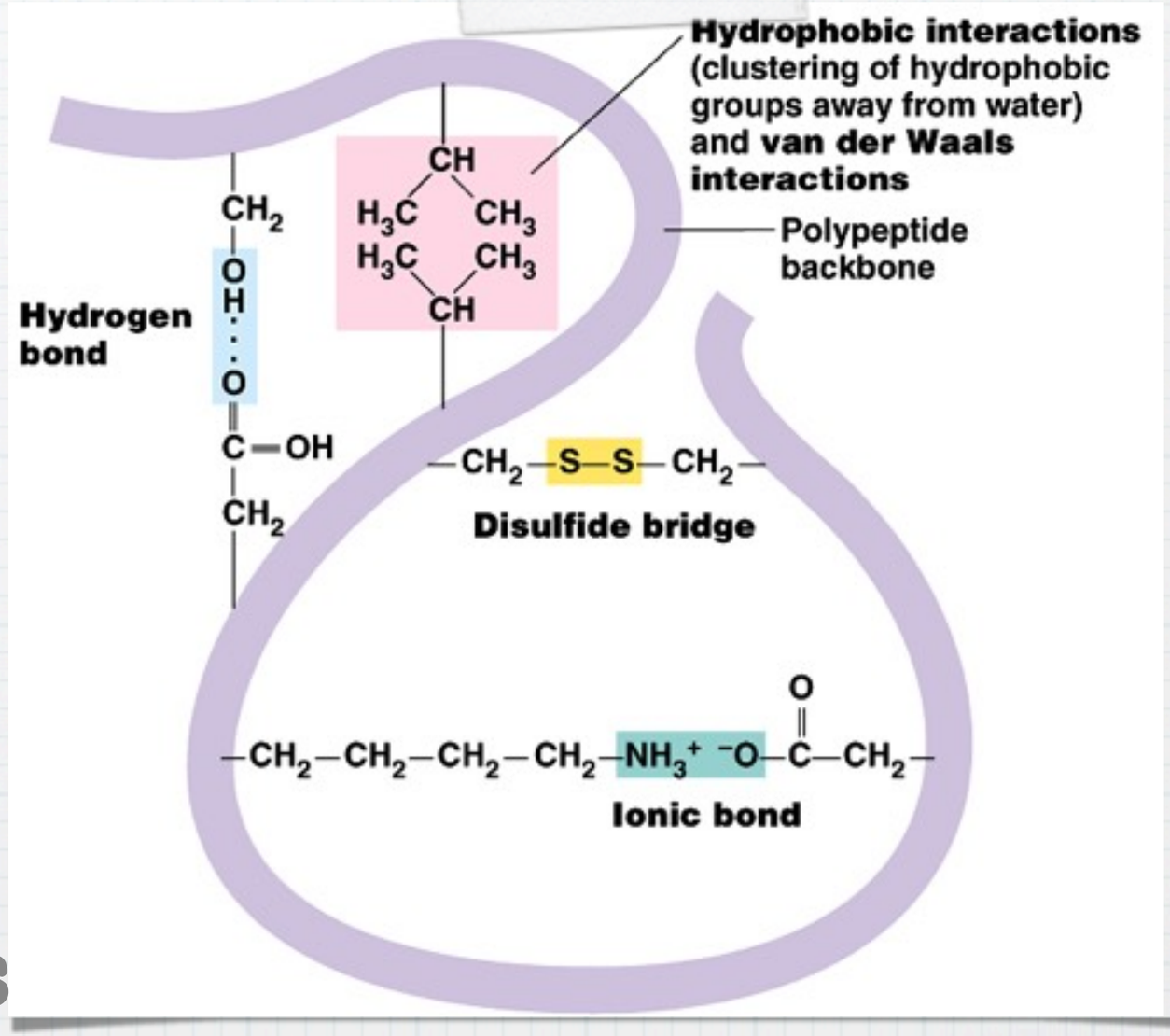
β-sheet

The pleated sheet structure of the β-sheet is held together by Hydrogen bonds between the amide groups of linear polypeptide chains. The average number of amino acid residues in a typical β-sheet is six with an average of six strands bonding together.

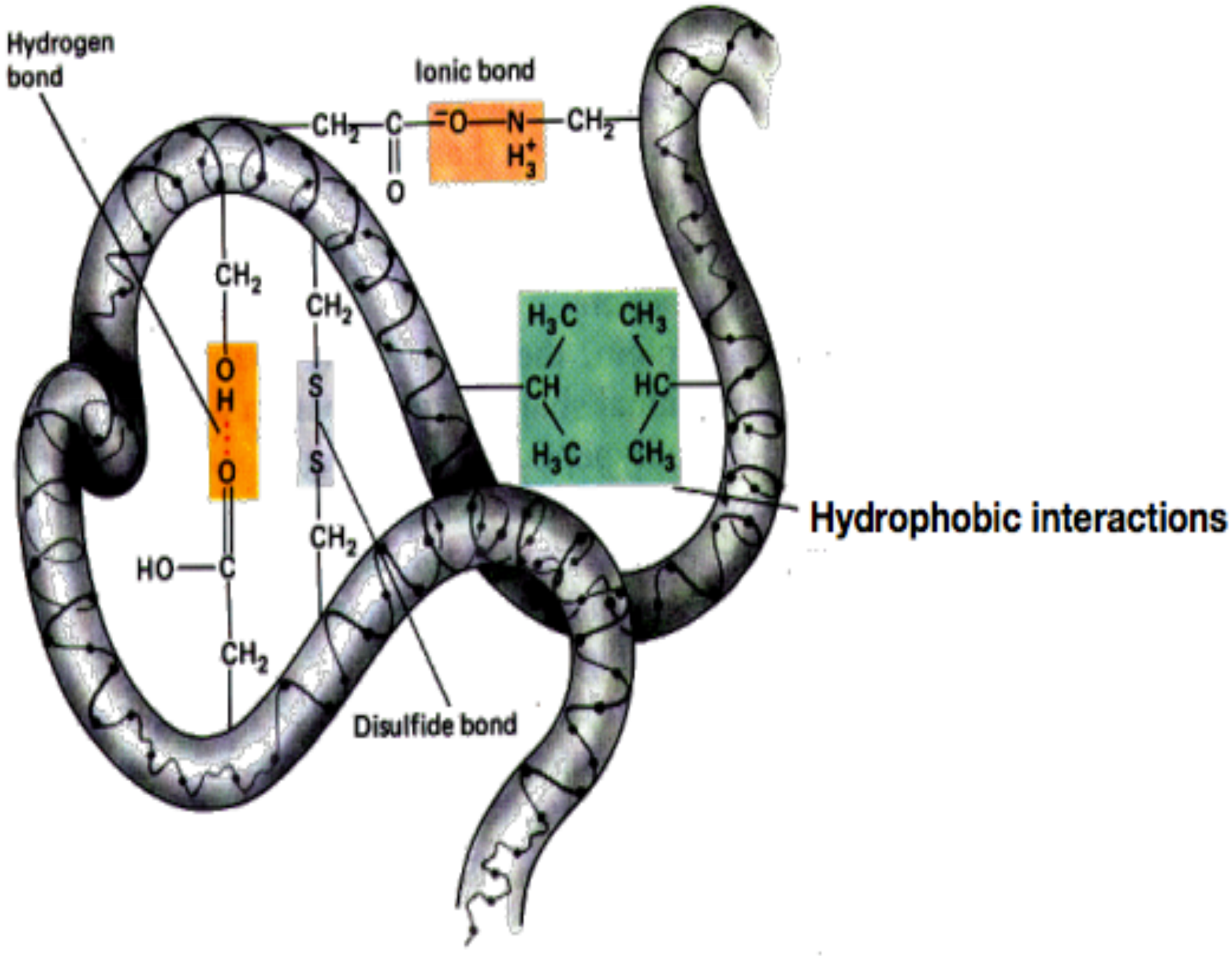


Protein Structure

* Tertiary Structure
  * Caused by bonds between R groups.
    * i) hydrogen bonds
    * ii) ionic bonds
    * iii) Disulfide bridges
    * iv) non-polar interactions

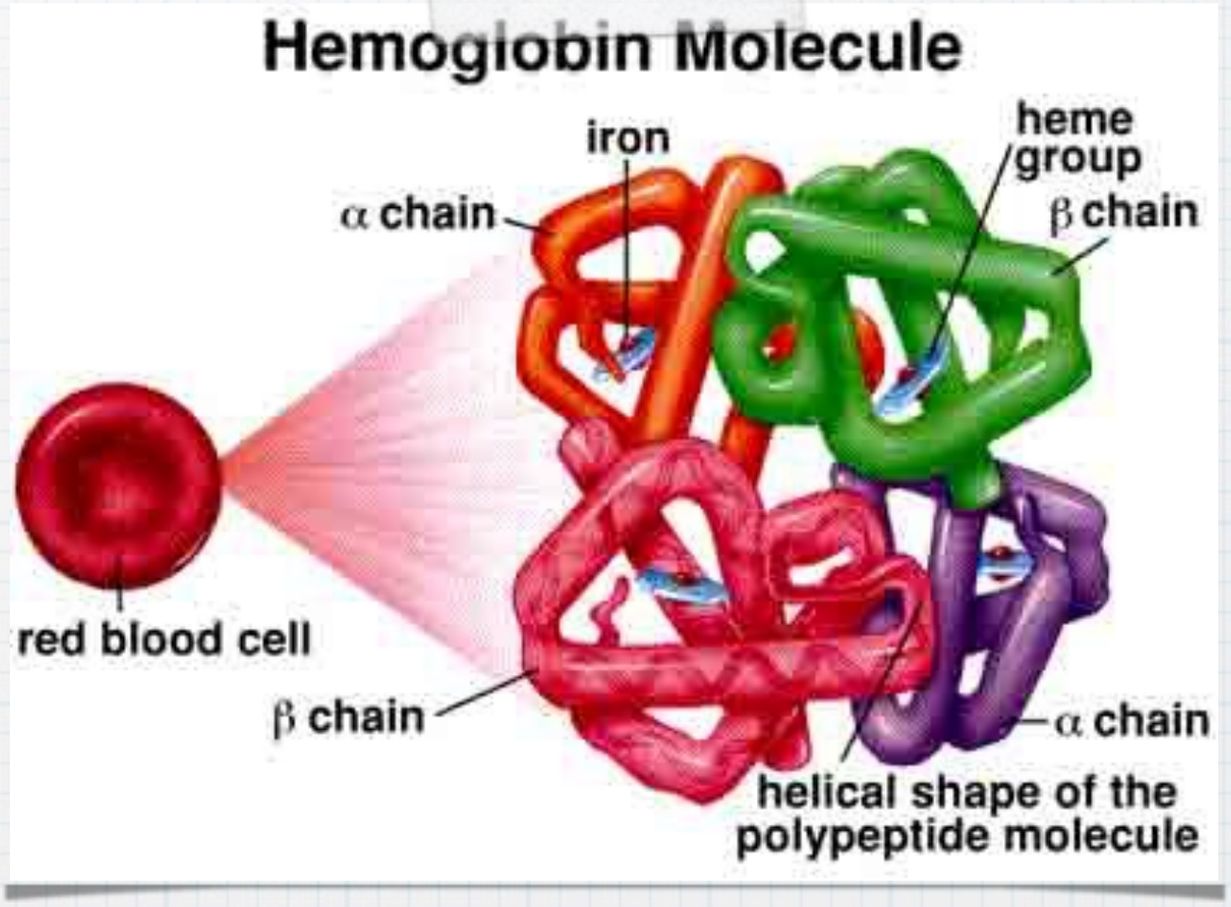


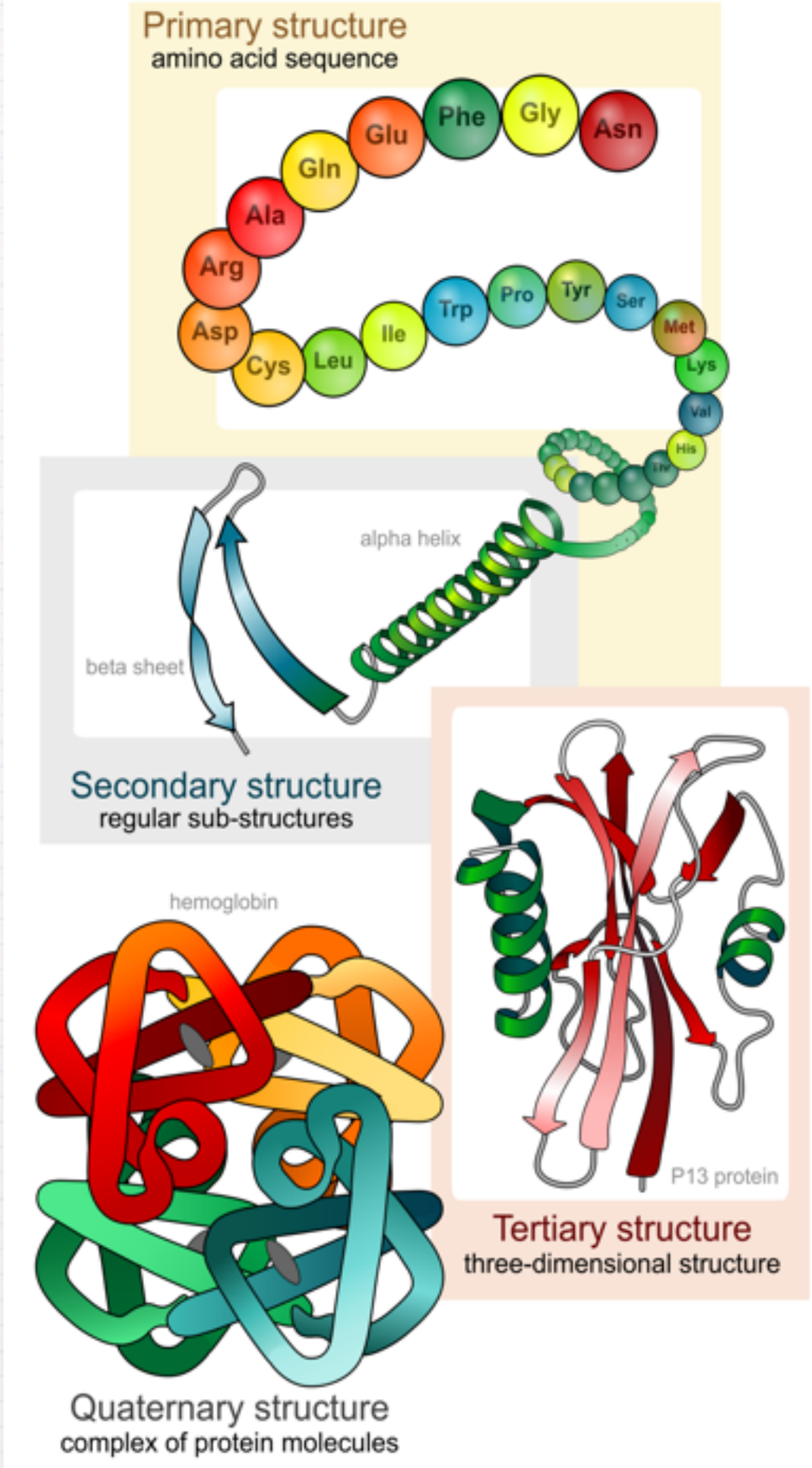
Bonds that cause polypeptides to fold



Protein Structure

* Quaternary Structure
  * The incorporation of more than one folded polypeptide chain.




Primary structure
amino acid sequence
Glu
Phe
Gly
Asn
Gln
Ala
Arg
Asp
Cys
Leu
Ile
Trp
Pro
Tyr
Ser
Met
Lys
Val
His
alpha helix
beta sheet
Secondary structure
regular sub-structures
hemoglobin
Quaternary structure
complex of protein molecules
P13 protein
Tertiary structure
three-dimensional structure

Structure = Function

* Denaturation: The loss of protein structure, this also causes loss of function.
* This can be caused by changing temperature or pH