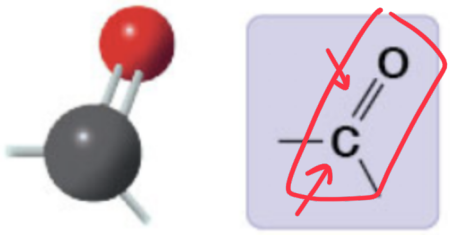
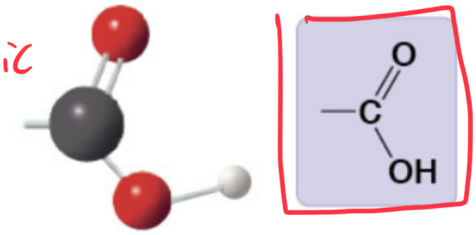
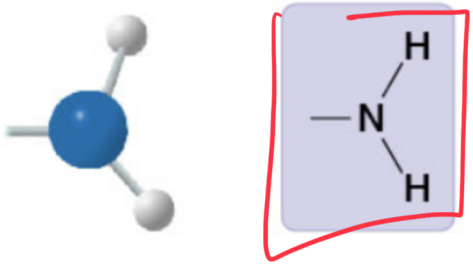
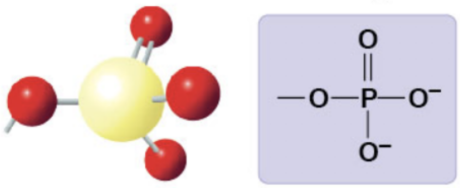
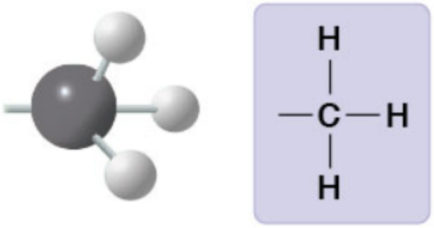
Macromolecules

Name	Structure	Polarity	Links	Other
Hydroxyl		Polar	Sugars	Accounts for sweetness.
Carbonyl		Polar	Fats	Head group of fats.
Carboxyl		Polar	Amino acids	Found in every amino acid.
Amino		Polar	Amino acids	Found in every amino acid.
Sulfhydryl		Polar	Antigens	Smells awful.

DNA deoxyribonucleic acid
RNA

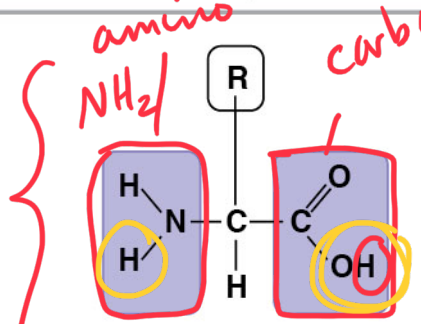
Phosphate		Polar	DNA	Releases energy in ATP.
Methyl		Nonpolar	none	A primary component in gas.

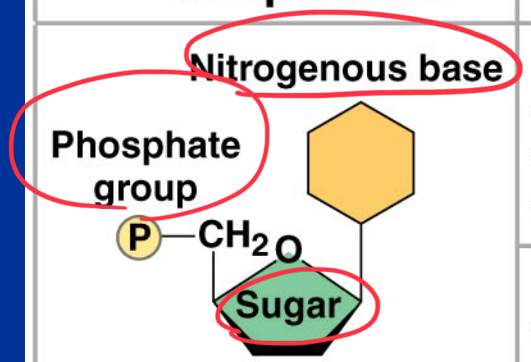
link nucleic acid

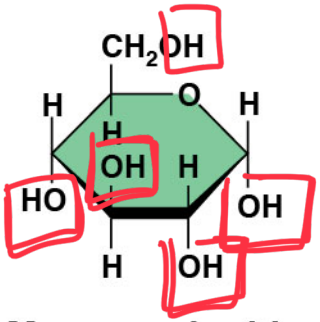
nucleic acid

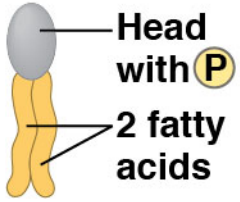
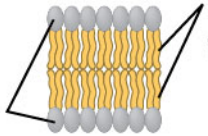
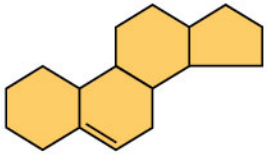
is one oxygen

found in fats

Components	Examples	Functions
 Amino acid monomer (20 types)	• Enzymes • Structural proteins • Storage proteins • Transport proteins • Hormones • Receptor proteins • Motor proteins • Defensive proteins	• Catalyze chemical reactions • Provide structural support • Store amino acids • Transport substances • Coordinate organismal responses • Receive signals from outside cell • Function in cell movement • Protect against disease

Components	Examples	Functions
 Nucleotide monomer	DNA:  • Sugar = deoxyribose • Nitrogenous bases = C, G, A, T • Usually double-stranded	Stores hereditary information
	RNA:  • Sugar = ribose • Nitrogenous bases = C, G, A, U • Usually single-stranded	Various functions in gene expression, including carrying instructions from DNA to ribosomes

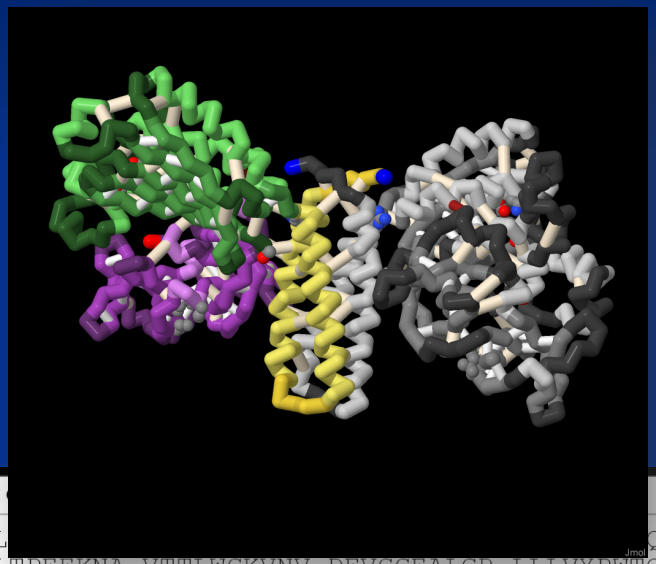
Components	Examples	Functions
 Monosaccharide monomer	Monosaccharides: glucose, fructose	Fuel; carbon sources that can be converted to other molecules or combined into polymers
	Disaccharides: lactose, sucrose	
	Polysaccharides: • Cellulose (plants) • Starch (plants) • Glycogen (animals) • Chitin (animals and fungi)	• Strengthens plant cell walls • Stores glucose for energy • Stores glucose for energy • Strengthens exoskeletons and fungal cell walls

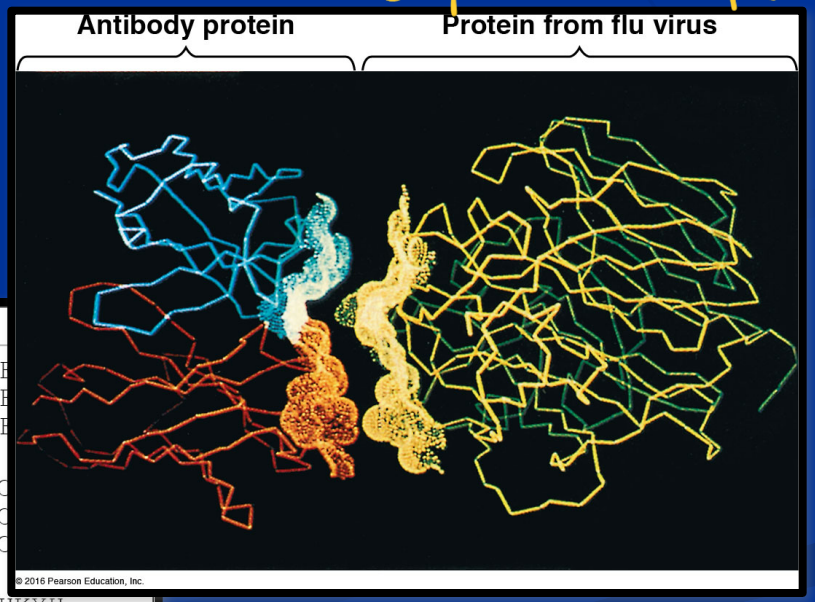
Components	Examples	Functions
Glycerol  Fats/Lipids	Triacylglycerols (fats or oils): glycerol + three fatty acids	Important energy source 
 	Phospholipids: glycerol + phosphate group + two fatty acids	Lipid bilayers of membranes 
 Steroid backbone	Steroids: four fused rings with attached chemical groups	• Component of cell membranes (cholesterol) • Signaling molecules that travel through the body (hormones)

Proteomics: Analysis of proteins and sequences

genes → protein

catalyze reactin (speeds it up)





Species	Alignment
Human	1 VHL … QR FF
Monkey	1 VHLTPEEKNA VTTLWGKVNV DEVGGEALGR LLLVYPWTQR FF
Gibbon	1 VHLTPEEKSA VTALWGKVNV DEVGGEALGR LLVVYPWTQR FF
Human	51 PDAVMGNPKV KAHGKKVLGA FSDGLAHLDN LKGTFATLSE LH
Monkey	51 PDAVMGNPKV KAHGKKVLGA FSDGLNHLDN LKGTFAQLSE LH
Gibbon	51 PDAVMGNPKV KAHGKKVLGA FSDGLAHLDN LKGTFAQLSE LH
Human	101 ENFRLLGNVL VCVLAHHFGK EFTPPVQAAY QKVVAGVANA LAHKYH
Monkey	101 ENFKLLGNVL VCVLAHHFGK EFTPQVQAAY QKVVAGVANA LAHKYH
Gibbon	101 ENFRLLGNVL VCVLAHHFGK EFTPQVQAAY QKVVAGVANA LAHKYH

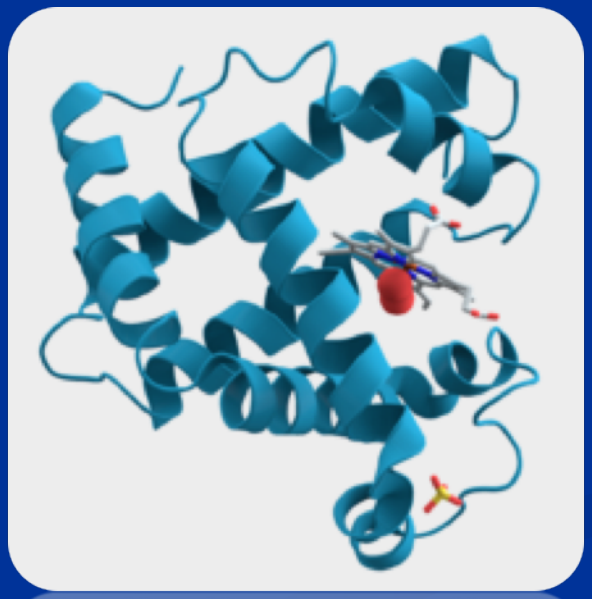
Data from Human: http://www.ncbi.nlm.nih.gov/protein/AAA21113.1; rhesus monkey: http://www.ncbi.nlm.nih.gov/ protein/122634; gibbon: http://www.ncbi.nlm.nih.gov/protein/122616

I. Proteins

Proto → first

- "Proteios" = first or primary
- 50% dry weight of cells
- Contains: C, H, O, N, S

amino



Myoglobin protein

Protein Functions (+ examples)

- Enzymes (lactase)
- Defense (antibodies)
- Storage (milk protein = casein)
- Transport (hemoglobin)
- Hormones (insulin)
- Receptors
- Movement (motor proteins)
- Structure (keratin)

→ speeds up a reaction

typical enzyme in body

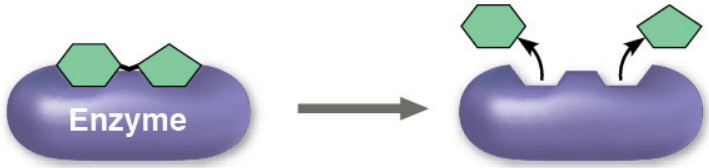
enzyme catalyzes millions of reactions per second.

Overview of protein functions

Enzymatic proteins

Function: Selective acceleration of chemical reactions

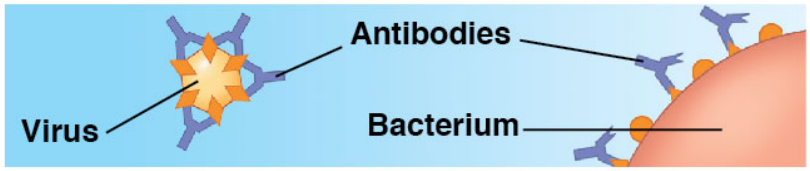
Example: Digestive enzymes catalyze the hydrolysis of bonds in food molecules.



Defensive proteins

Function: Protection against disease

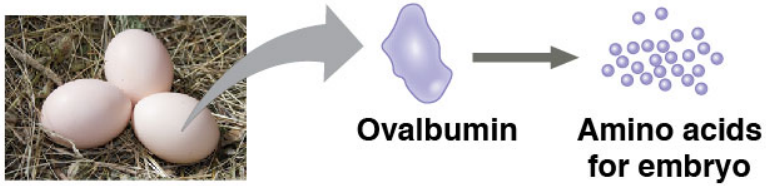
Example: Antibodies inactivate and help destroy viruses and bacteria.



Storage proteins

Function: Storage of amino acids

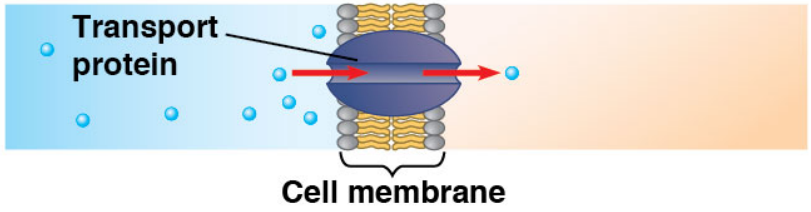
Examples: Casein, the protein of milk, is the major source of amino acids for baby mammals. Plants have storage proteins in their seeds. Ovalbumin is the protein of egg white, used as an amino acid source for the developing embryo.



Transport proteins

Function: Transport of substances

Examples: Hemoglobin, the iron-containing protein of vertebrate blood, transports oxygen from the lungs to other parts of the body. Other proteins transport molecules across membranes, as shown here.

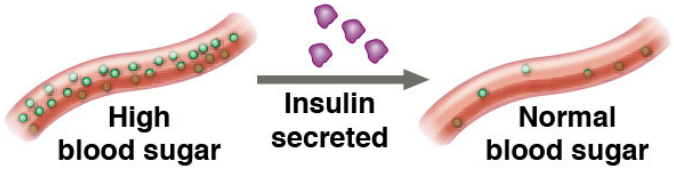


Overview of protein functions

Hormonal proteins

Function: Coordination of an organism's activities

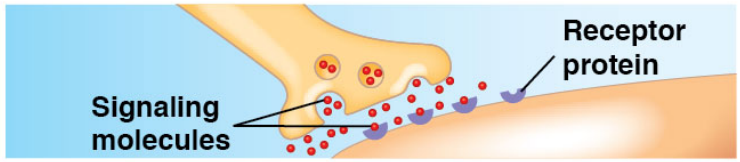
Example: Insulin, a hormone secreted by the pancreas, causes other tissues to take up glucose, thus regulating blood sugar concentration.



Receptor proteins

Function: Response of cell to chemical stimuli

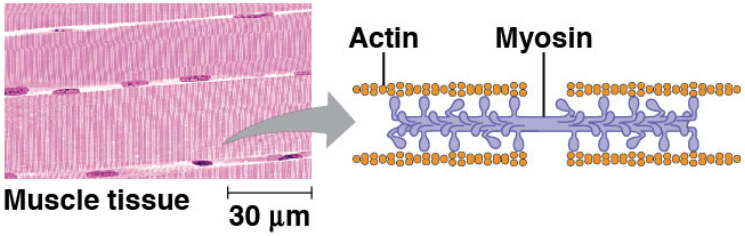
Example: Receptors built into the membrane of a nerve cell detect signaling molecules released by other nerve cells.



Contractile and motor proteins

Function: Movement

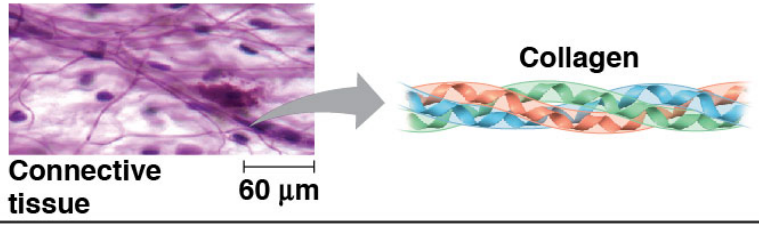
Examples: Motor proteins are responsible for the undulations of cilia and flagella. Actin and myosin proteins are responsible for the contraction of muscles.



Structural proteins

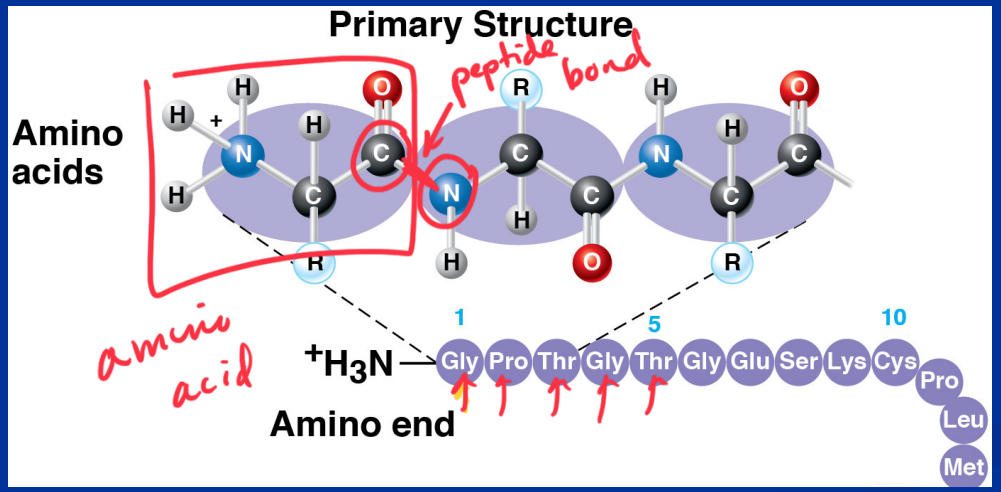
Function: Support

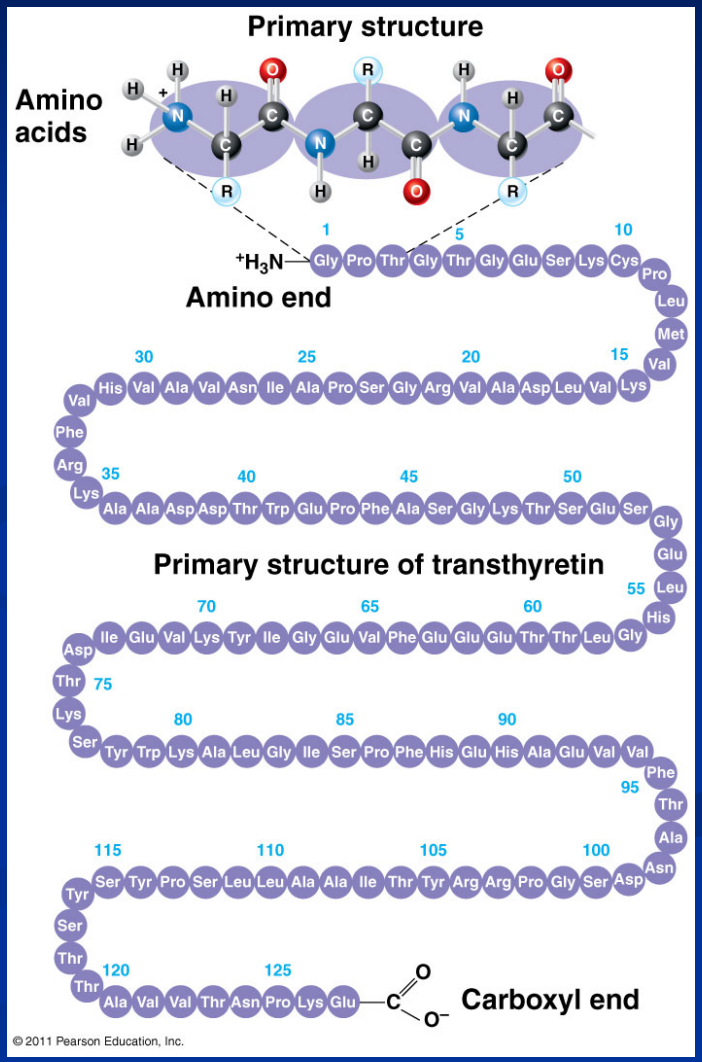
Examples: Keratin is the protein of hair, horns, feathers, and other skin appendages. Insects and spiders use silk fibers to make their cocoons and webs, respectively. Collagen and elastin proteins provide a fibrous framework in animal connective tissues.



Four Levels of Protein Structure

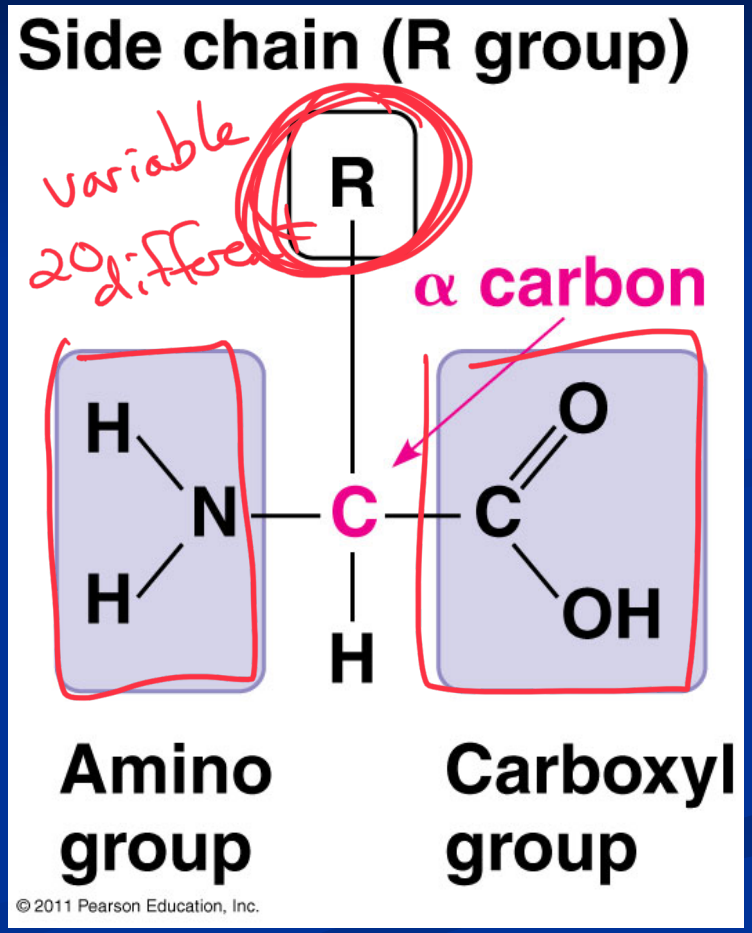
1. **Primary** music notes
   - **Amino acid** (AA) sequence
   - 20 different AA's
   - **peptide bonds** link AA's

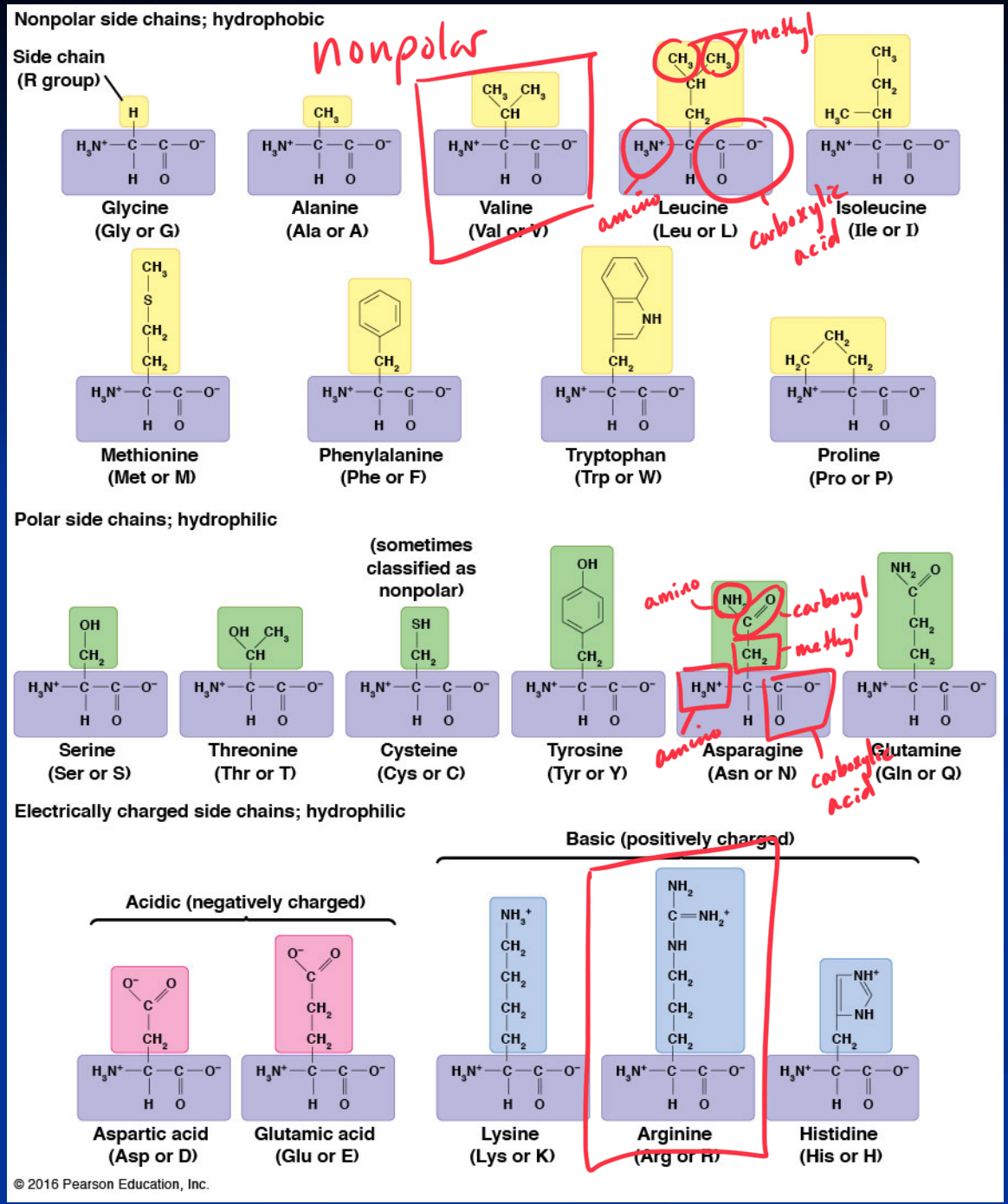


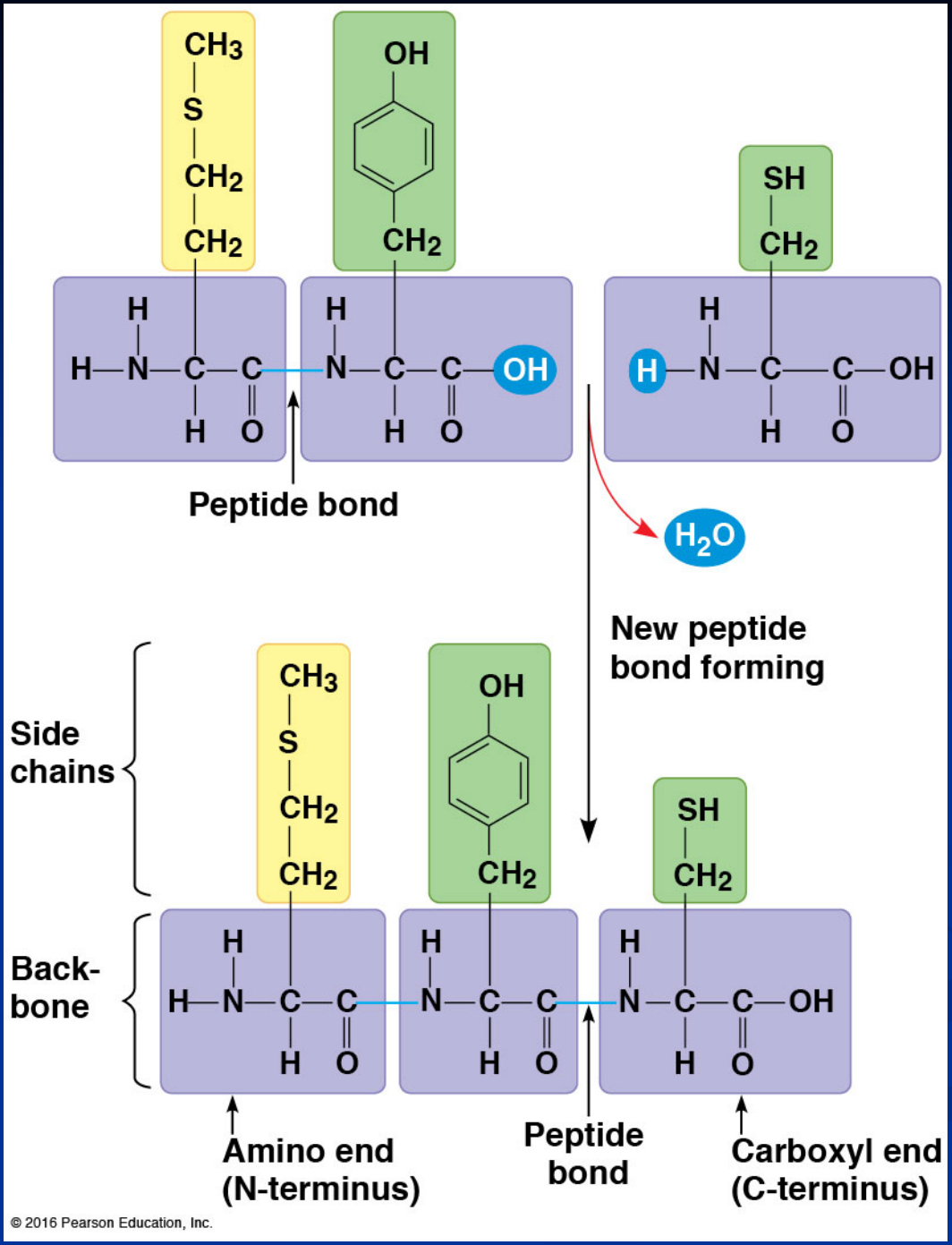


Amino Acid

- **R group** = side chains
- Properties:
  - hydrophobic
  - hydrophilic
  - ionic (acids & bases)
- "amino" : $-NH_2$
- "acid" : -COOH







Peptide Bonds