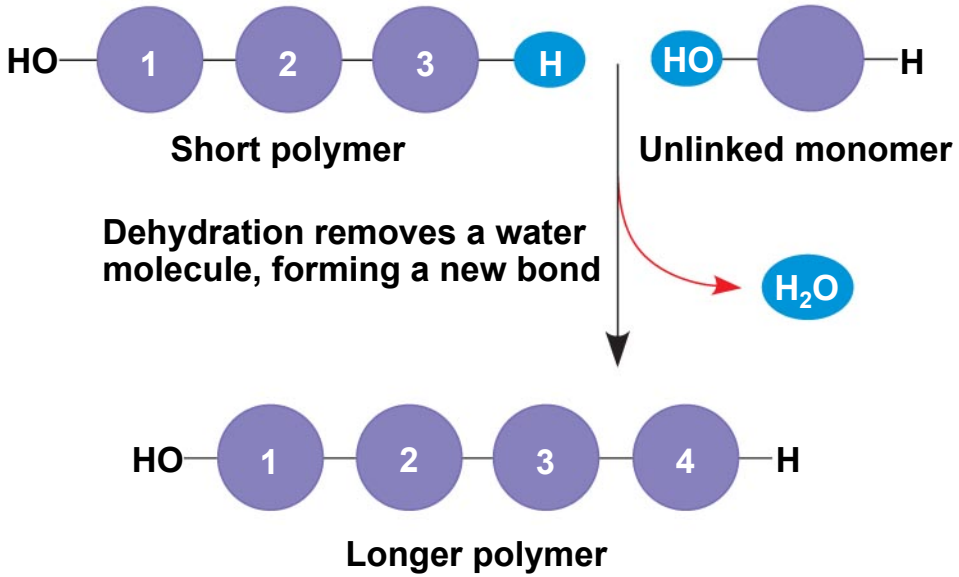
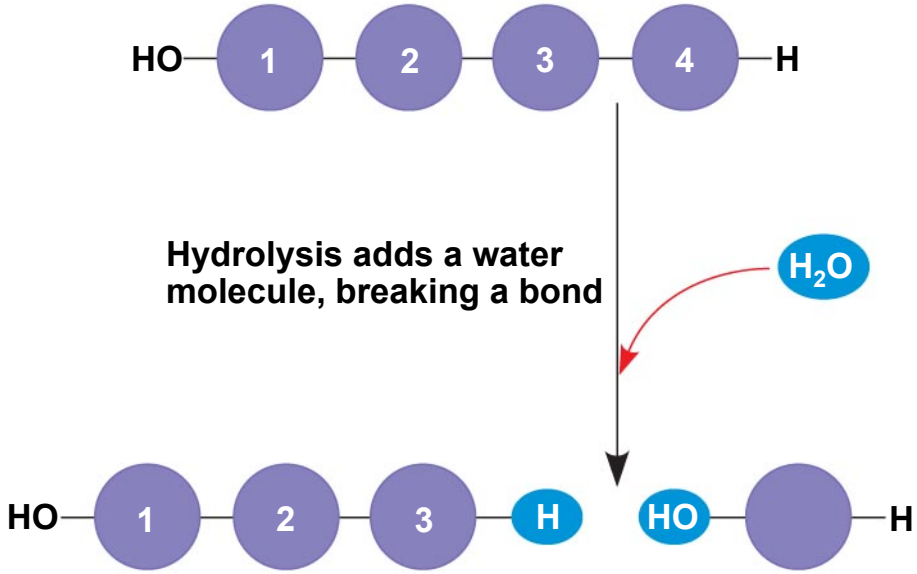
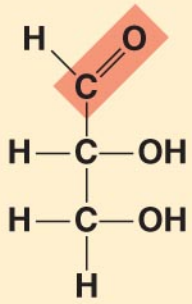
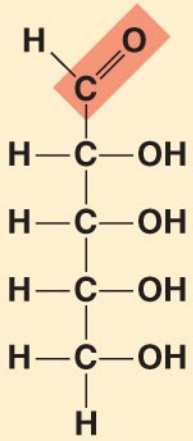
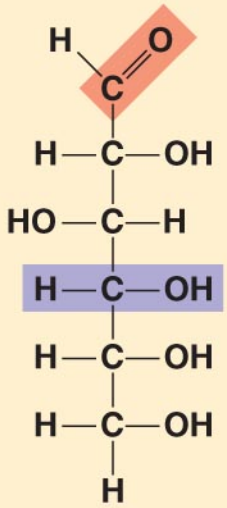
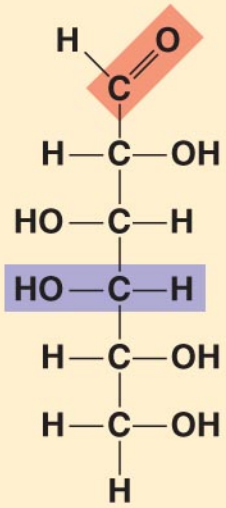
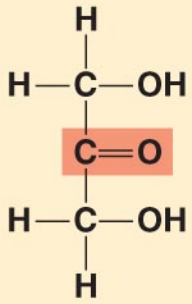
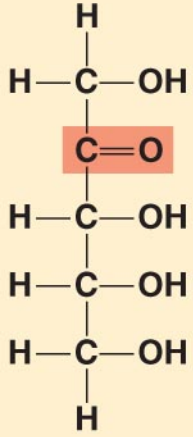
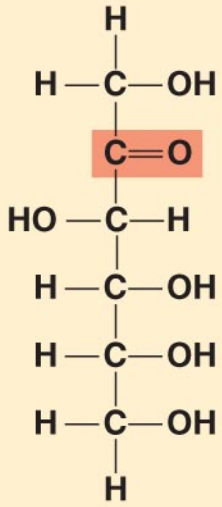
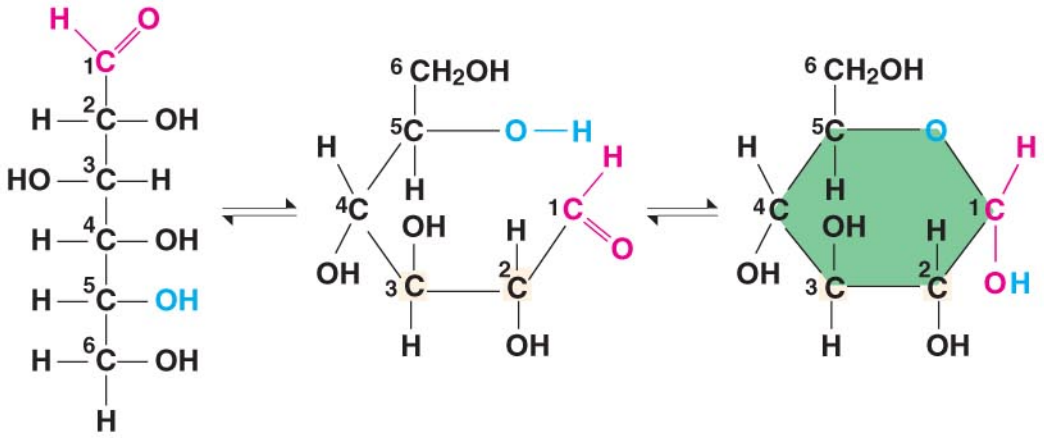


(a) Dehydration reaction in the synthesis of a polymer

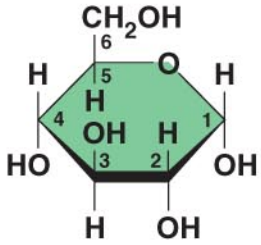


(b) Hydrolysis of a polymer

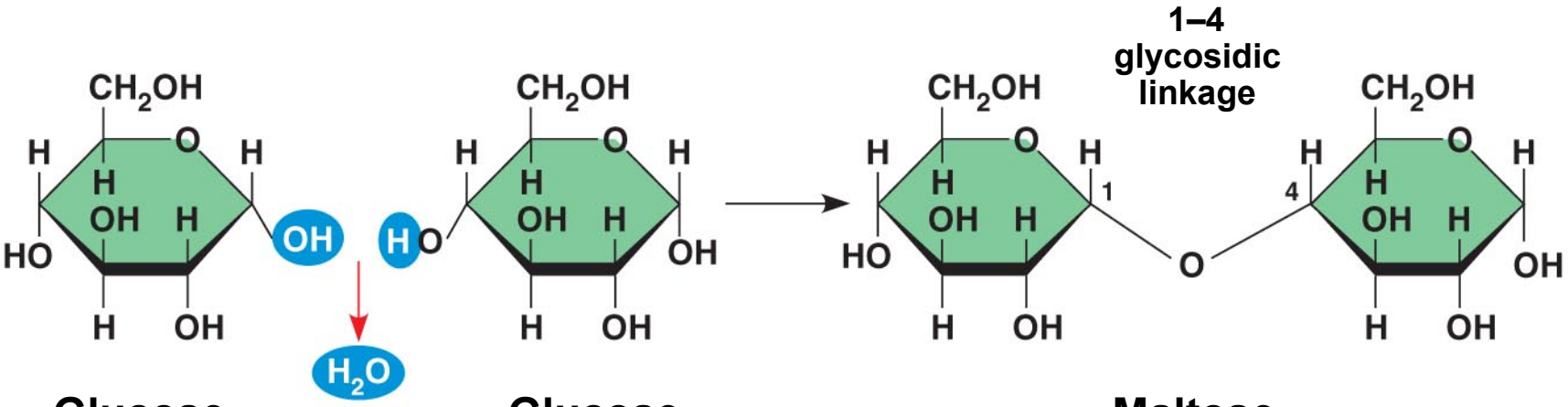
	Trioses ($C_3H_6O_3$)	Pentoses ($C_5H_{10}O_5$)	Hexoses ($C_6H_{12}O_6$)	
Aldoses	 Glyceraldehyde	 Ribose	 Glucose	 Galactose
Ketoses	 Dihydroxyacetone	 Ribulose	 Fructose	



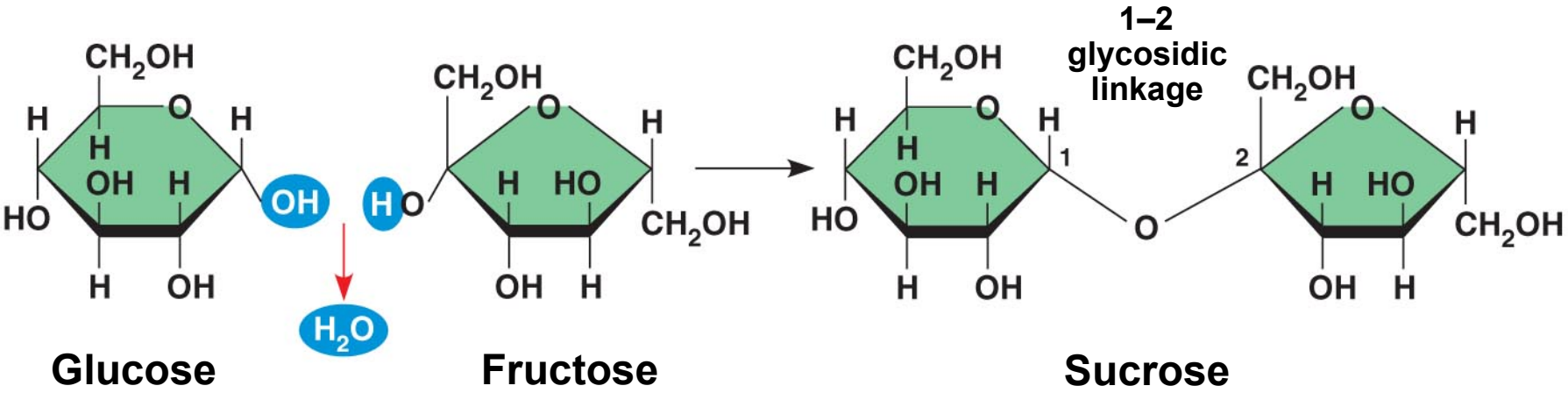
(a) Linear and ring forms



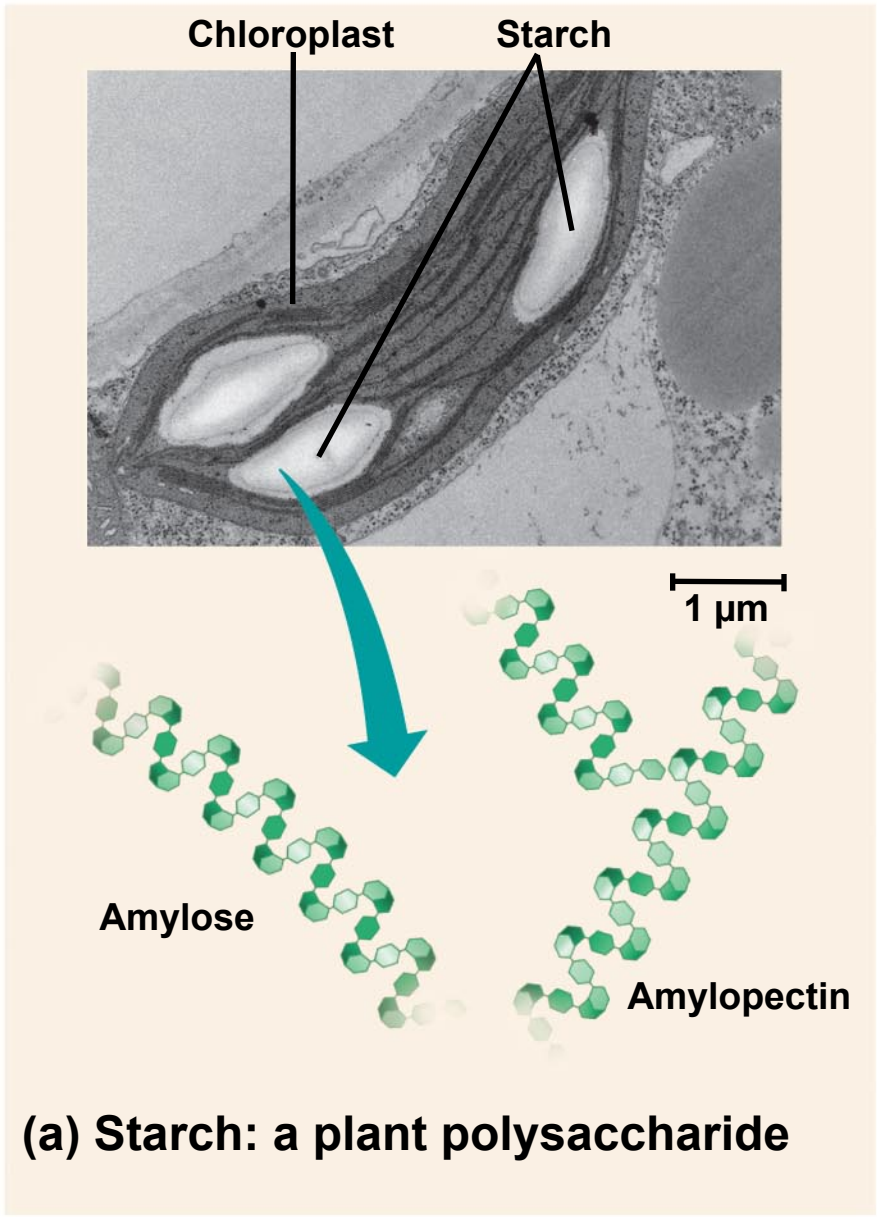
(b) Abbreviated ring structure



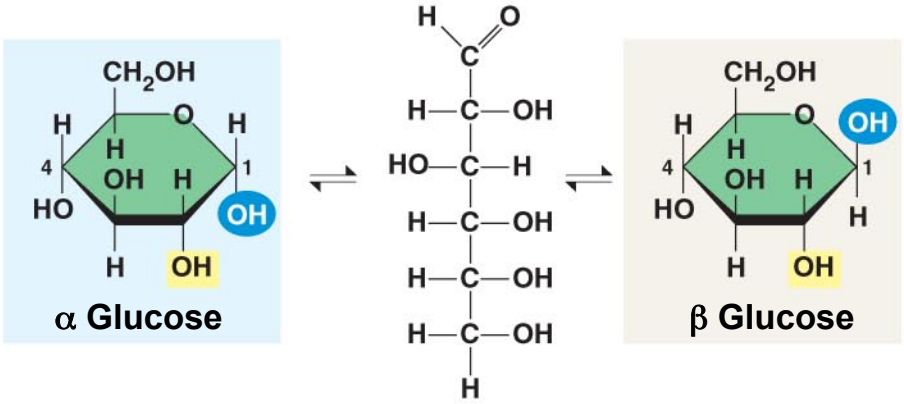
(a) Dehydration reaction in the synthesis of maltose

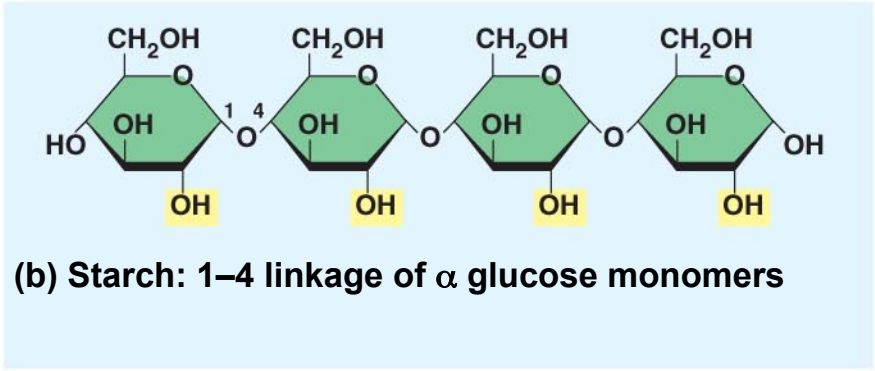


(b) Dehydration reaction in the synthesis of sucrose

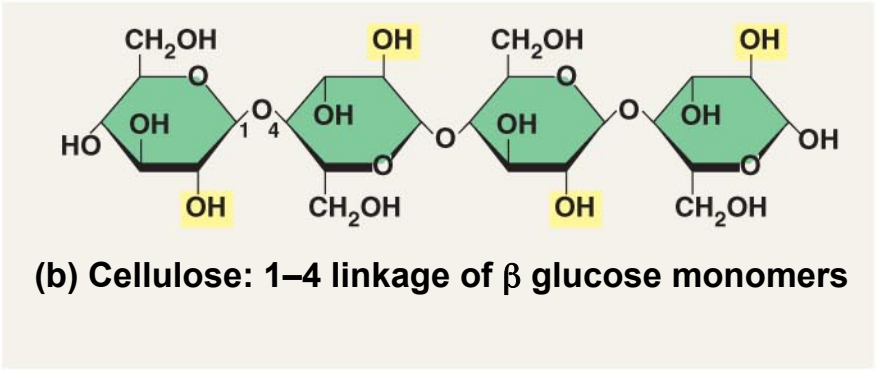


(a) α and β glucose ring structures

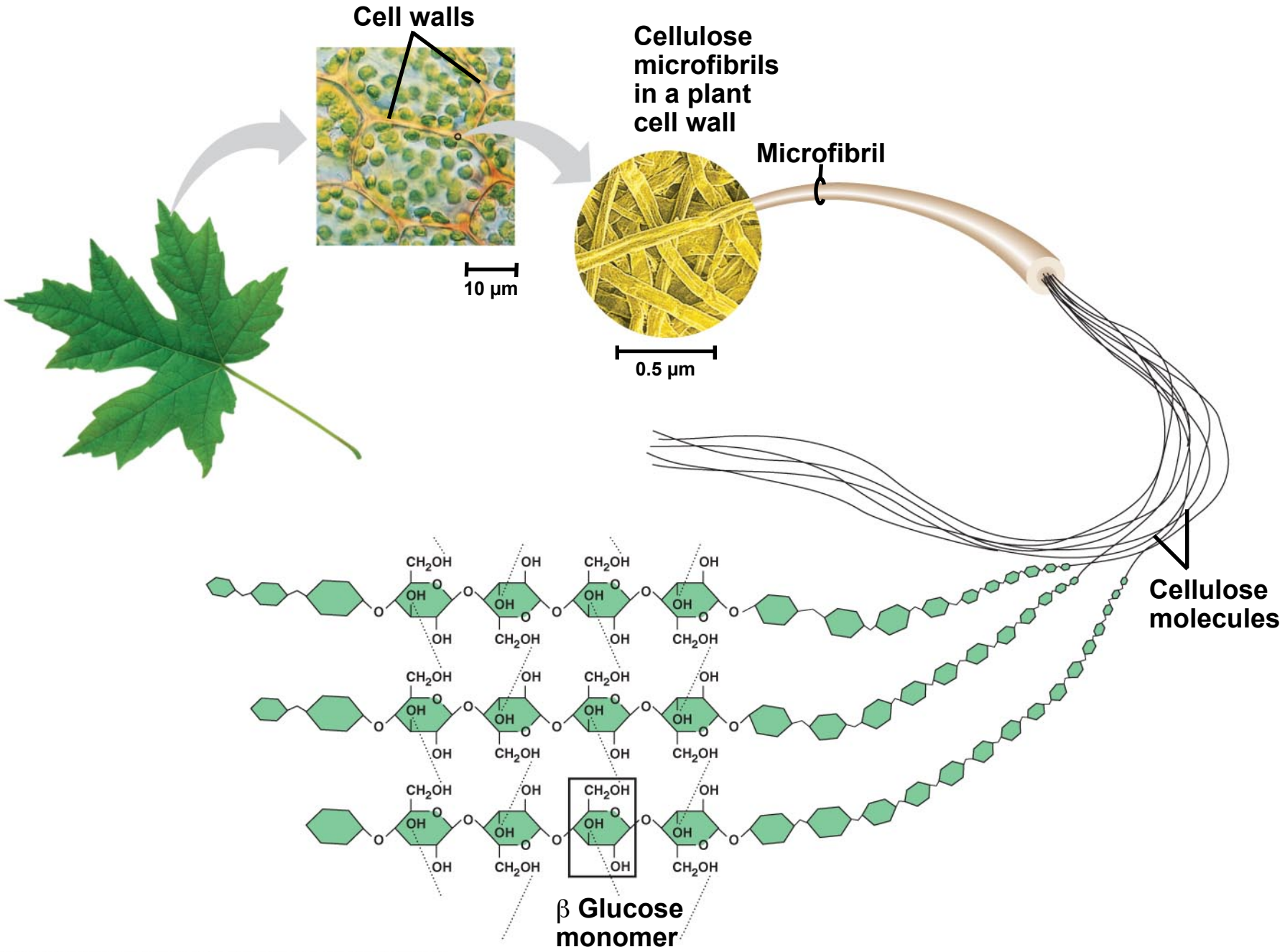


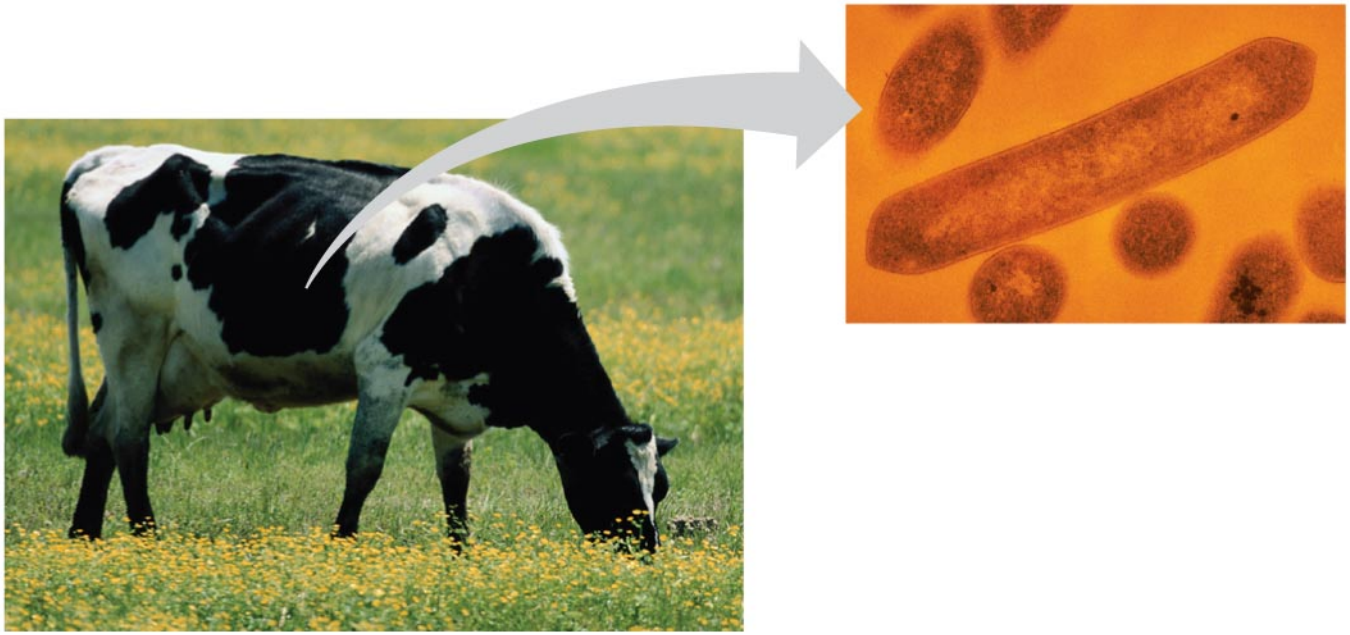


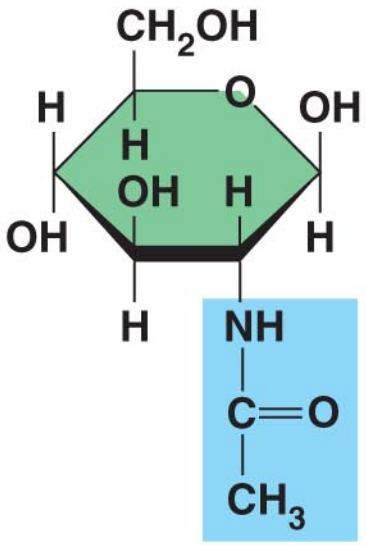
(b) Starch: 1–4 linkage of α glucose monomers



(b) Cellulose: 1–4 linkage of β glucose monomers

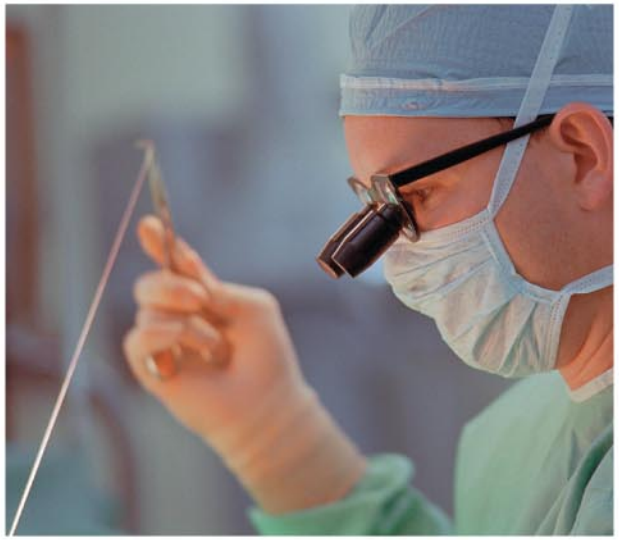




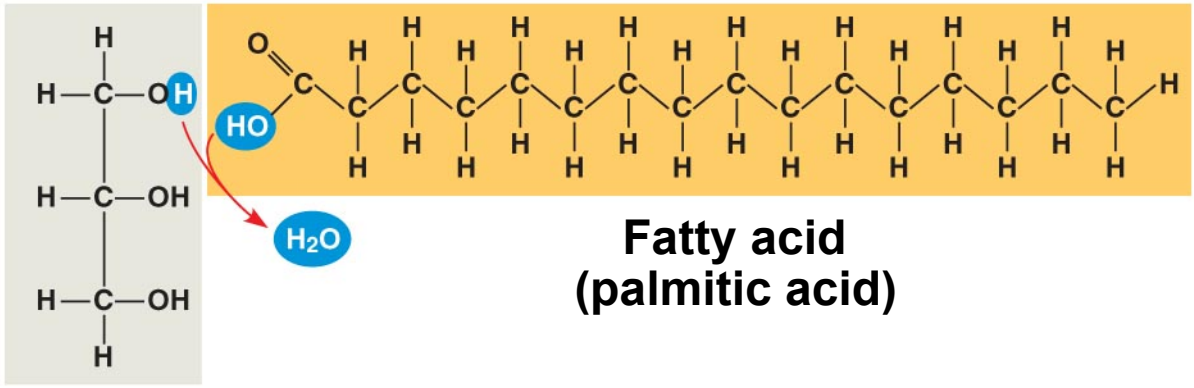


(a) The structure of the chitin monomer.

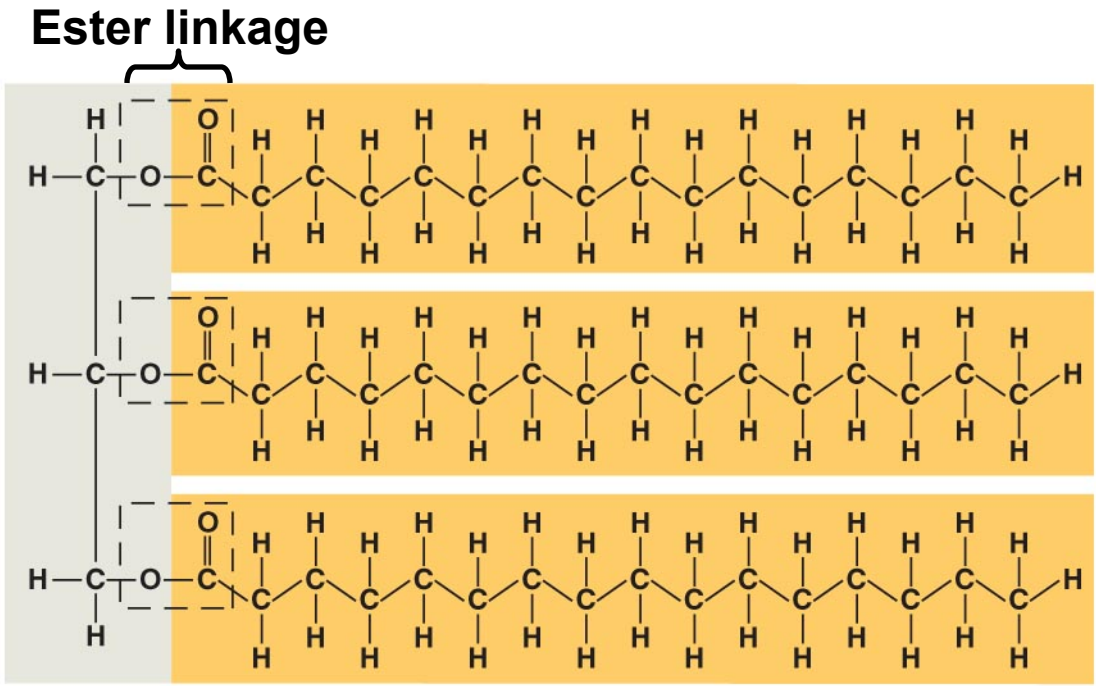
(b) Chitin forms the exoskeleton of arthropods.



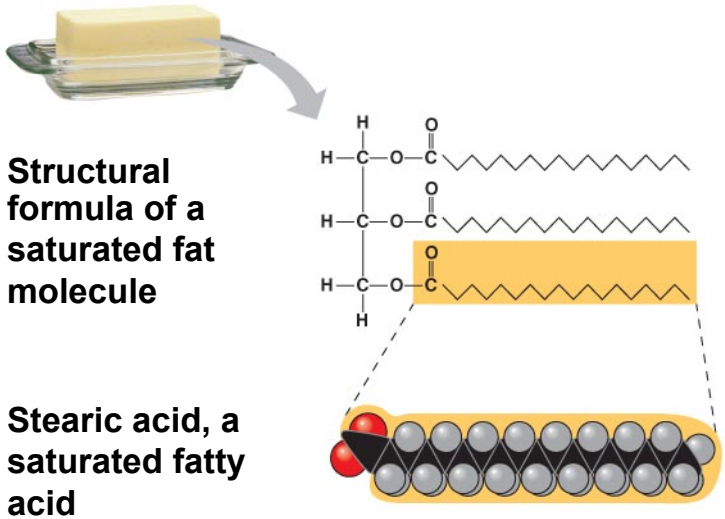
(c) Chitin is used to make a strong and flexible surgical thread.

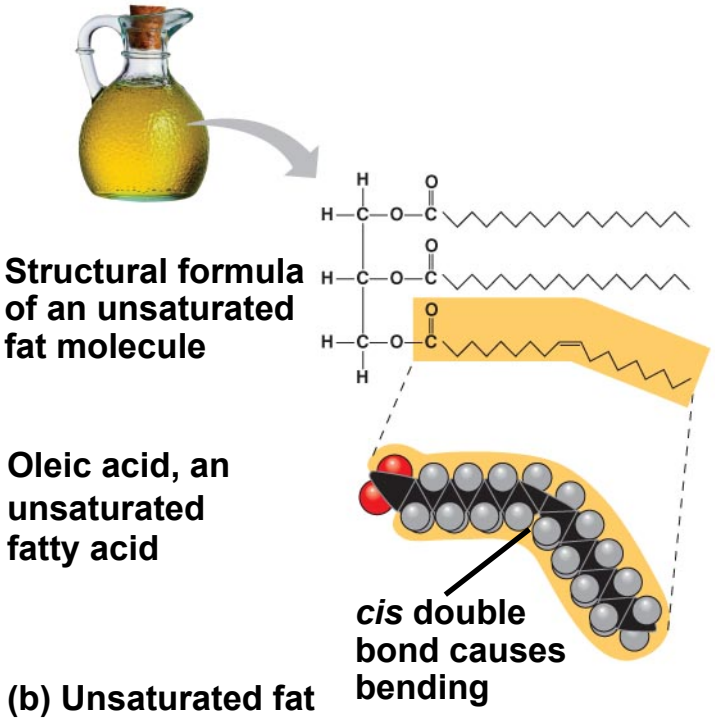


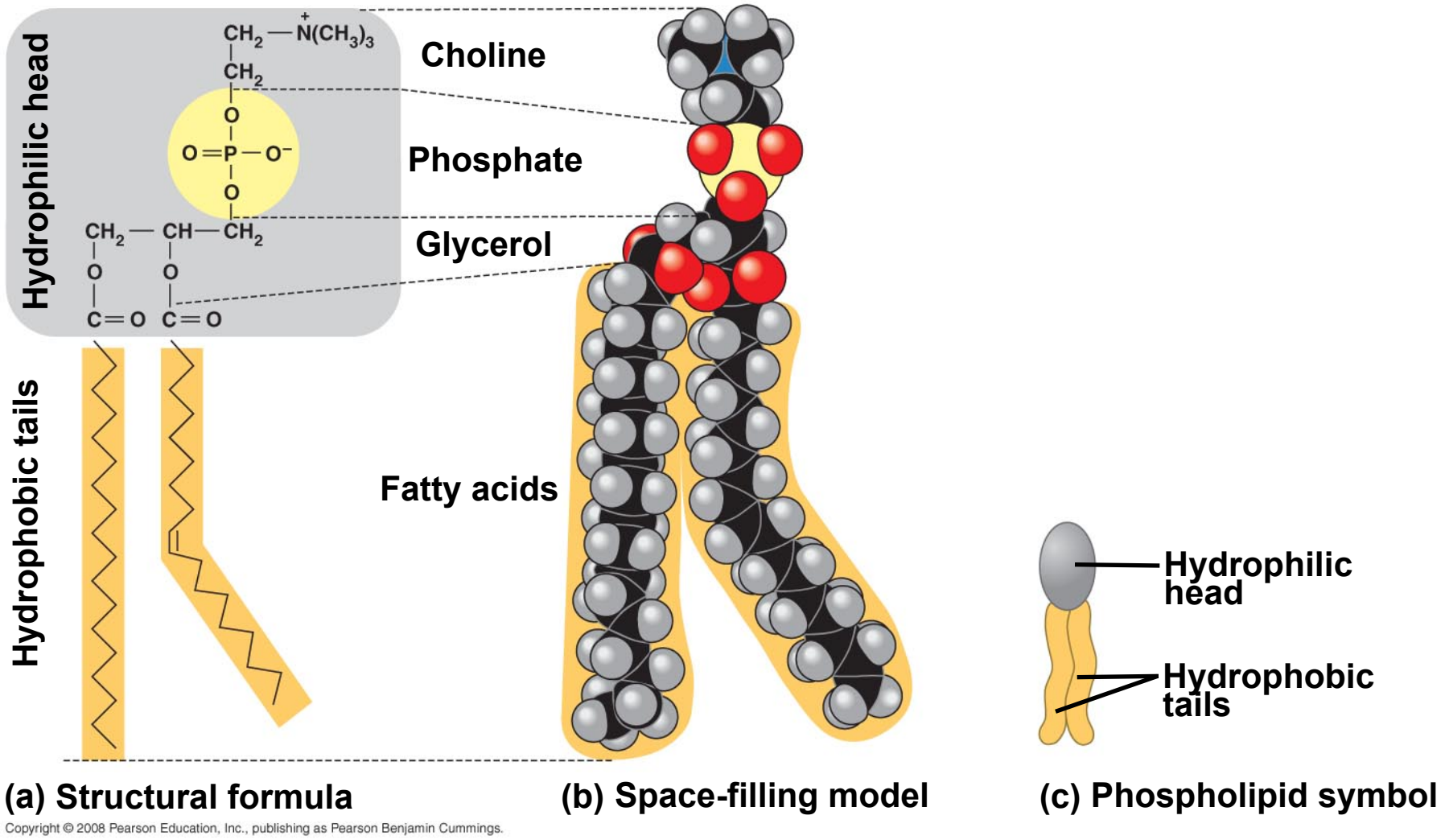
(a) Dehydration reaction in the synthesis of a fat

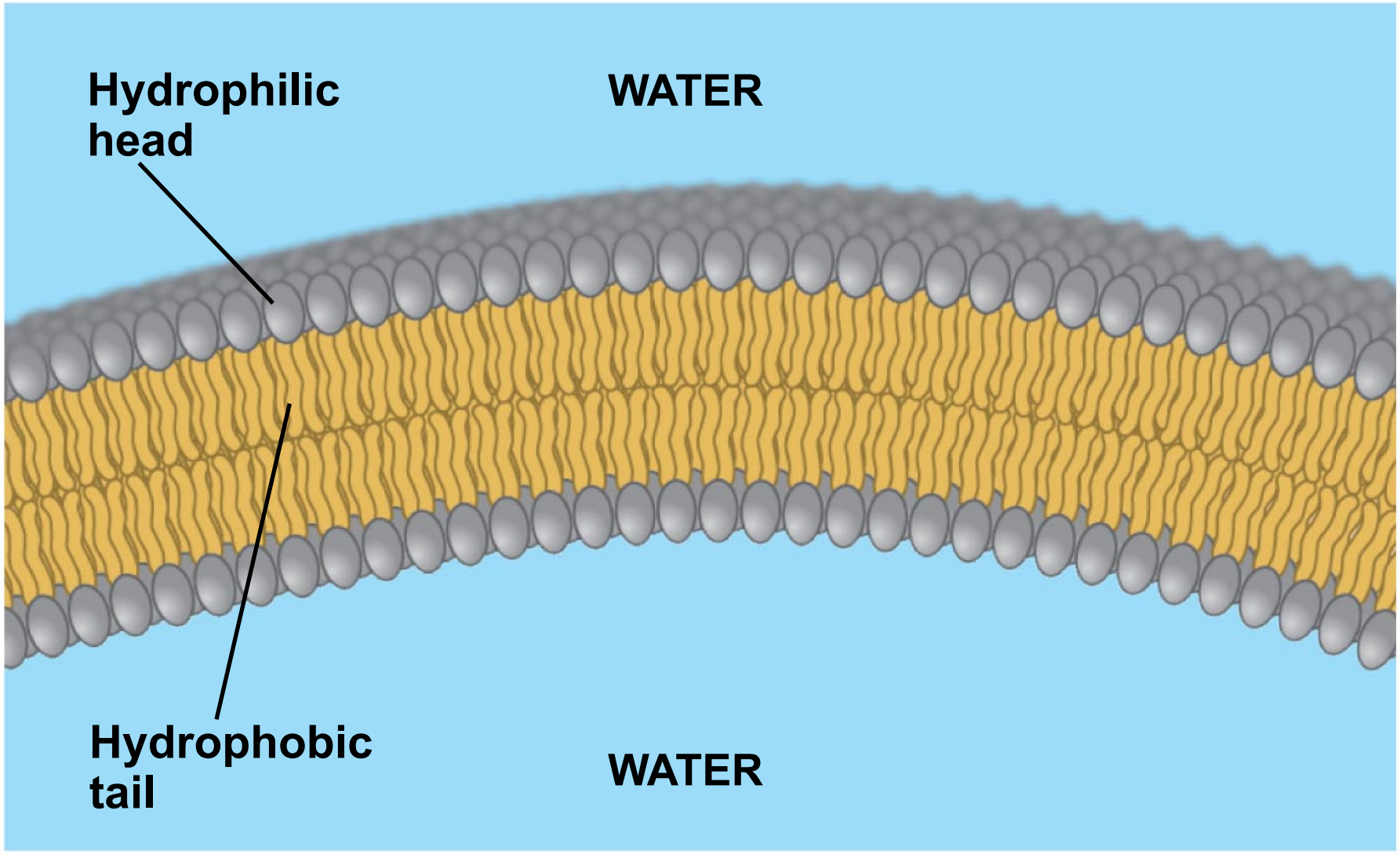


(b) Fat molecule (triacylglycerol)









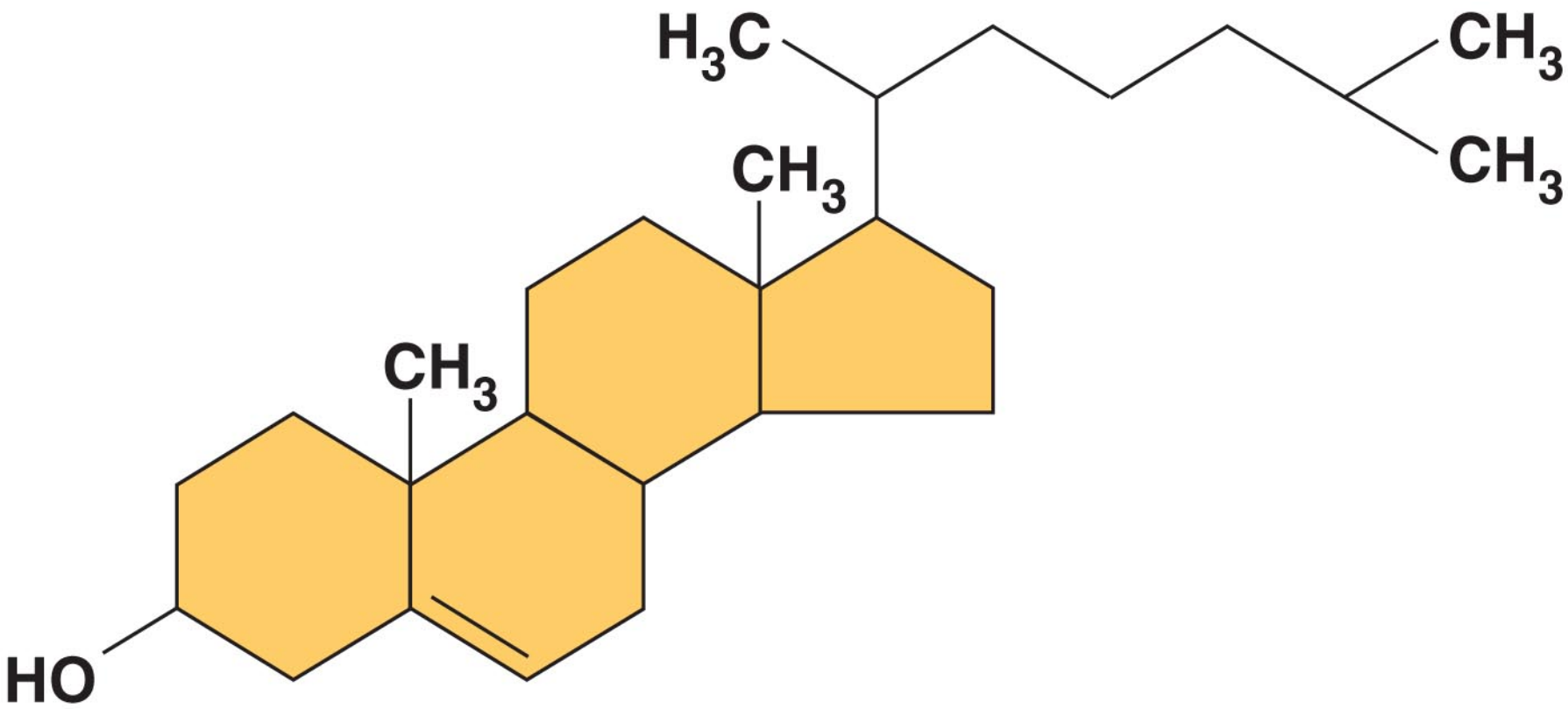
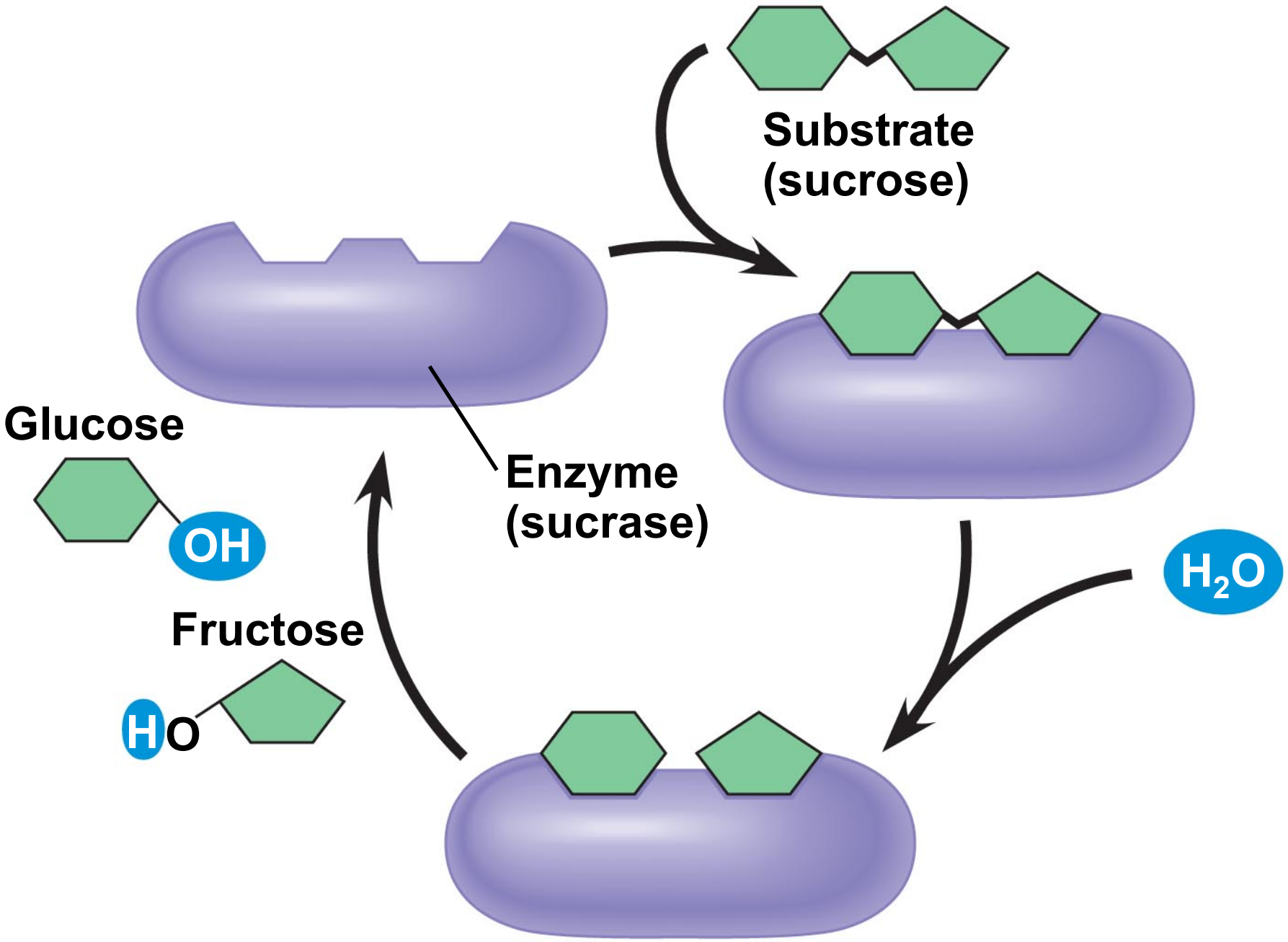
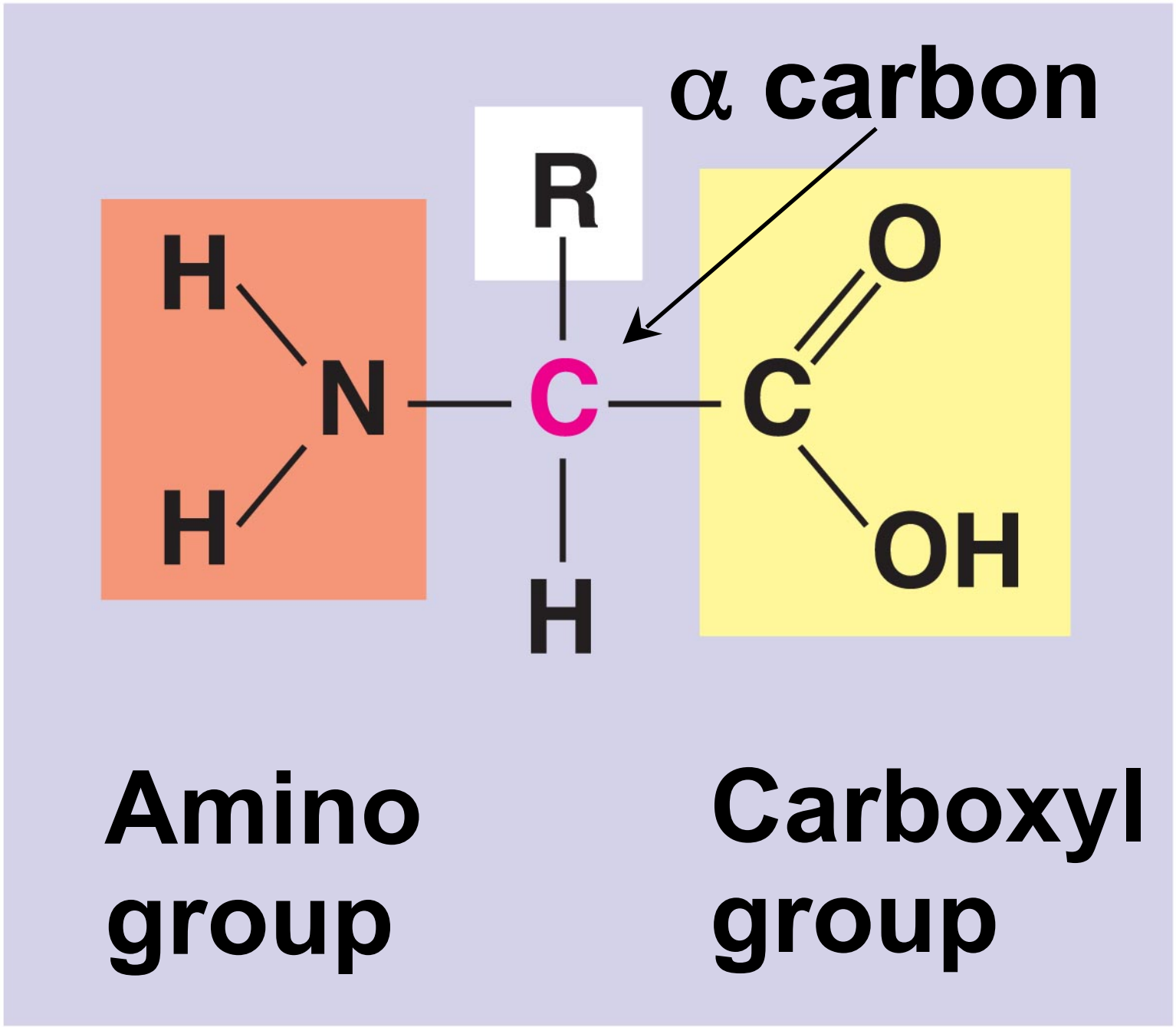
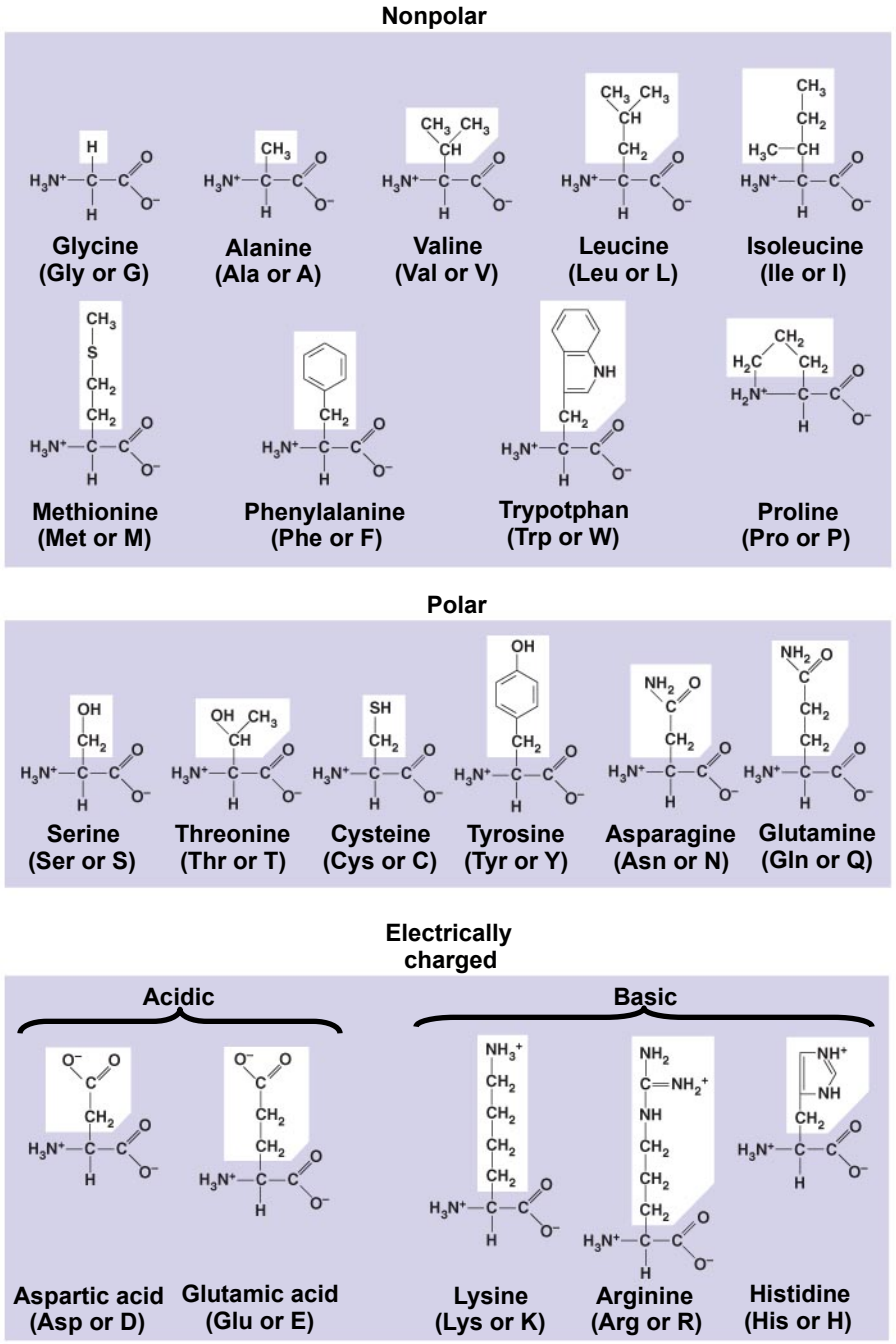


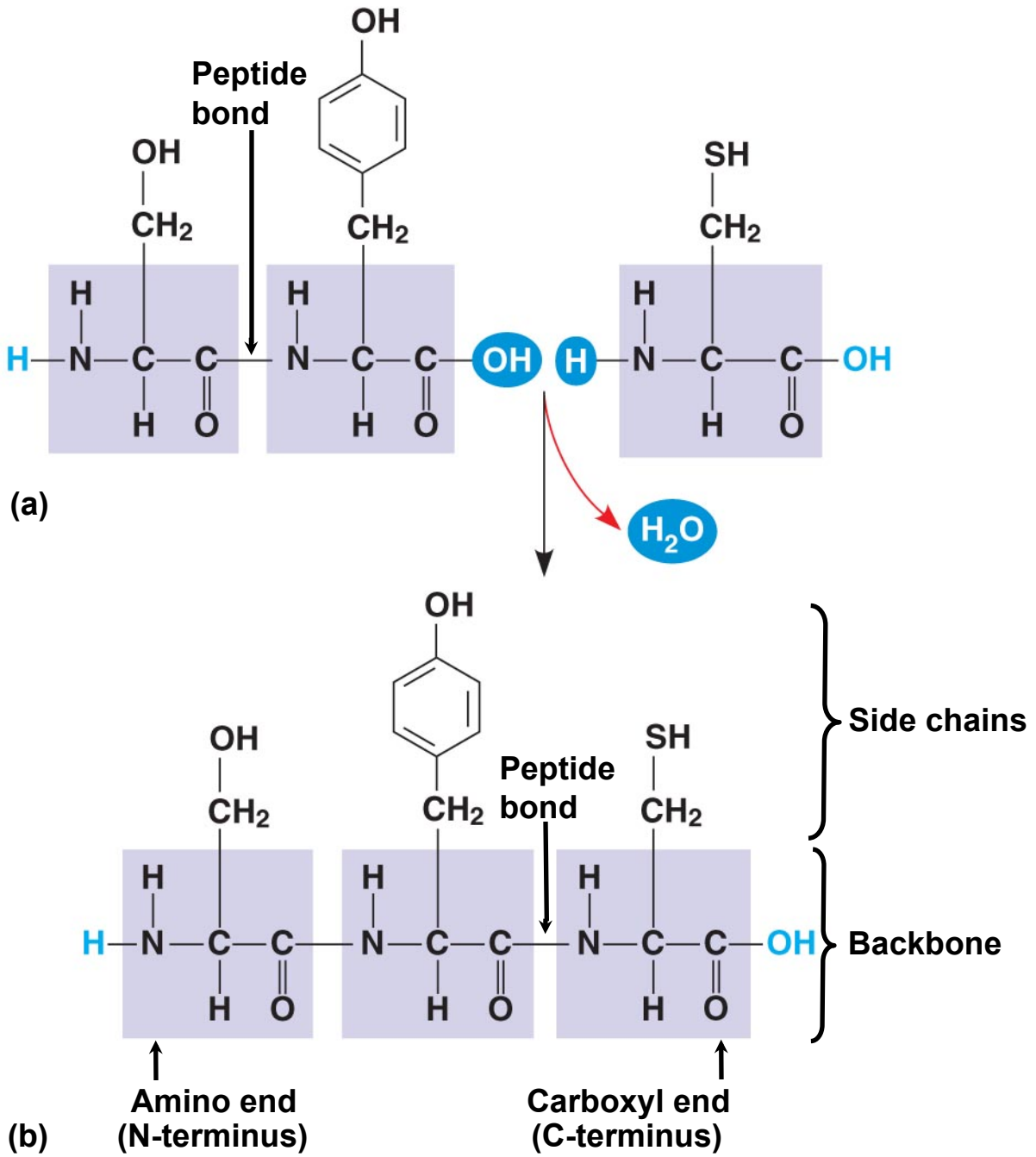
Table 5.1 An Overview of Protein Functions

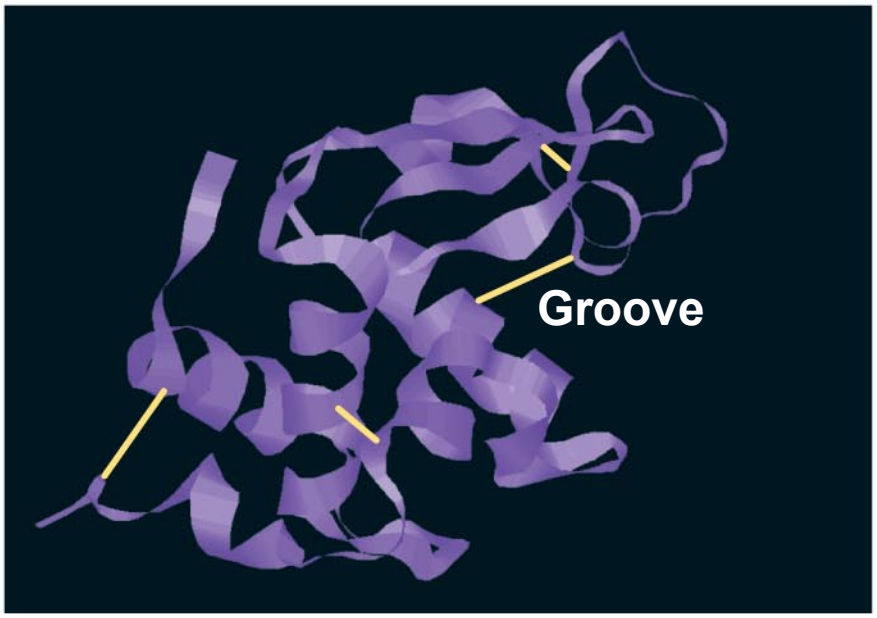
Type of Protein	Function	Examples
Enzymatic proteins	Selective acceleration of chemical reactions	Digestive enzymes
Structural proteins	Support	Silk fibers; collagen and elastin in animal connective tissues; keratin in hair, horns, feathers, and other skin appendages
Storage proteins	Storage of amino acids	Ovalbumin in egg white; casein, the protein of milk; storage proteins in plant seeds
Transport proteins	Transport of other substances	Hemoglobin, transport proteins
Hormonal proteins	Coordination of an organism's activities	Insulin, a hormone secreted by the pancreas
Receptor proteins	Response of cell to chemical stimuli	Receptors in nerve cell membranes
Contractile and motor proteins	Movement	Actin and myosin in muscles, proteins in cilia and flagella
Defensive proteins	Protection against disease	Antibodies combat bacteria and viruses.



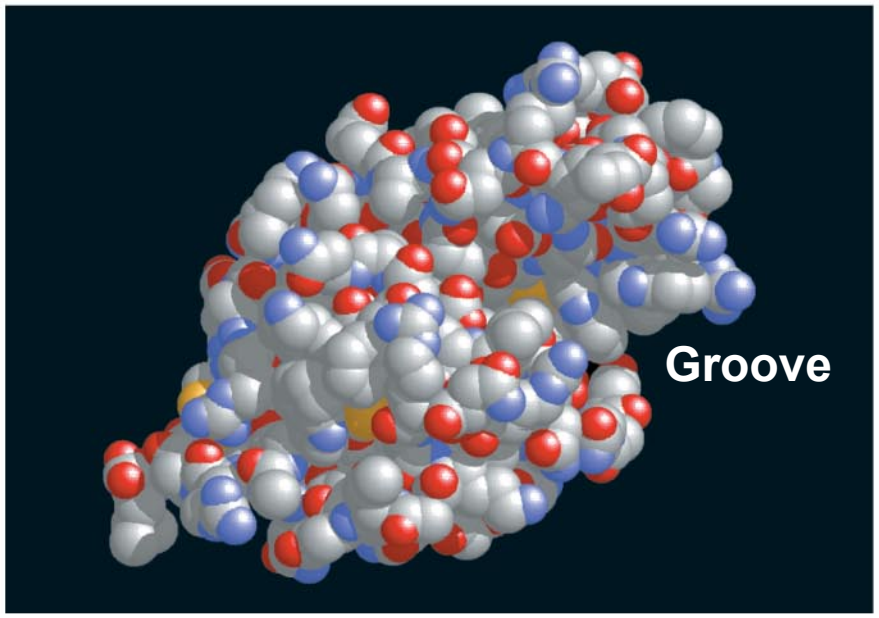




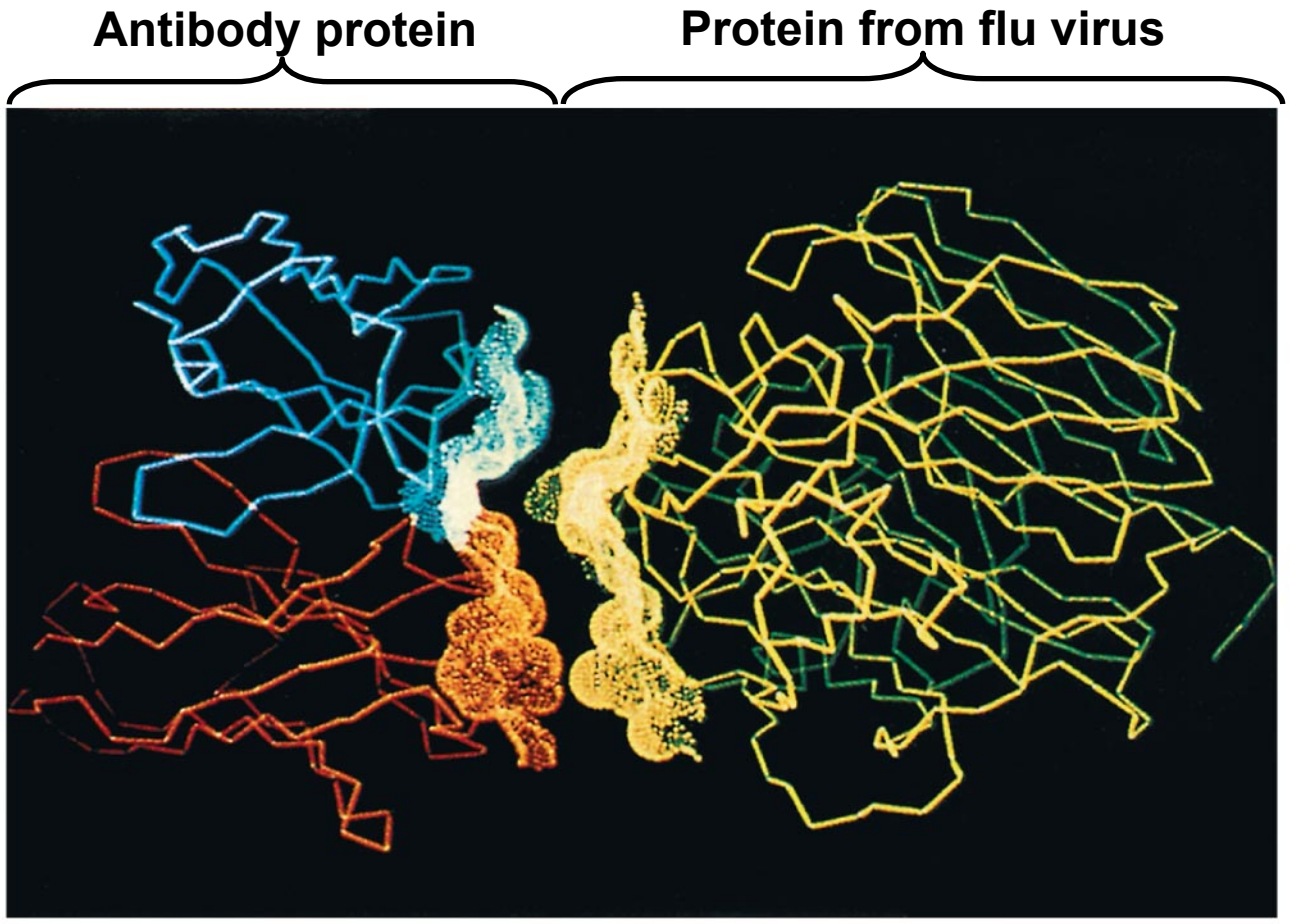


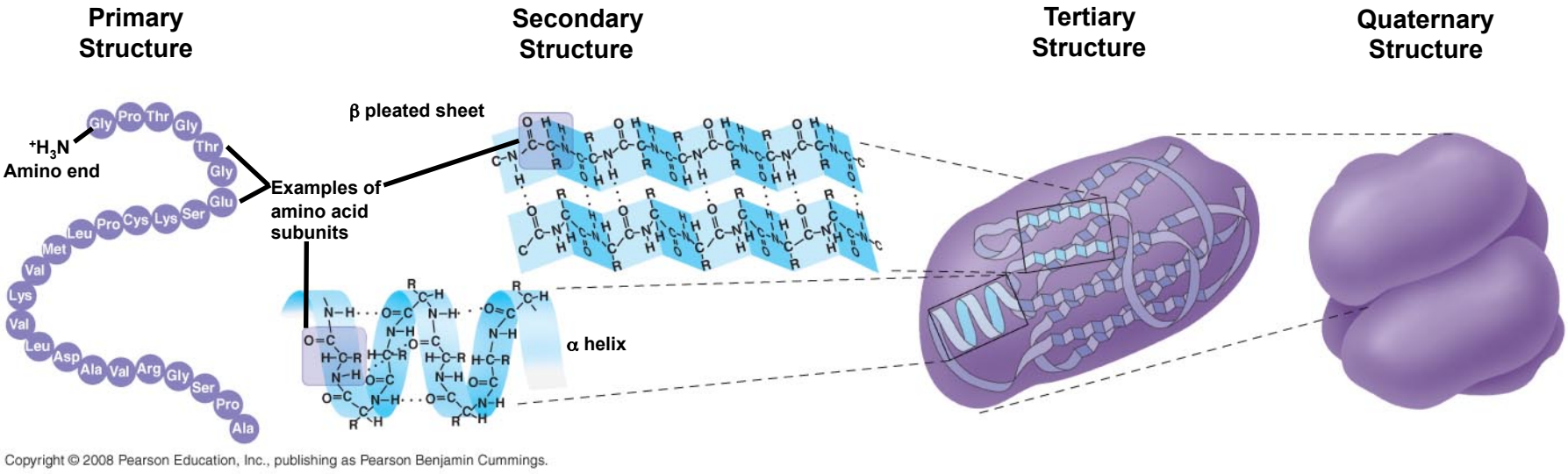


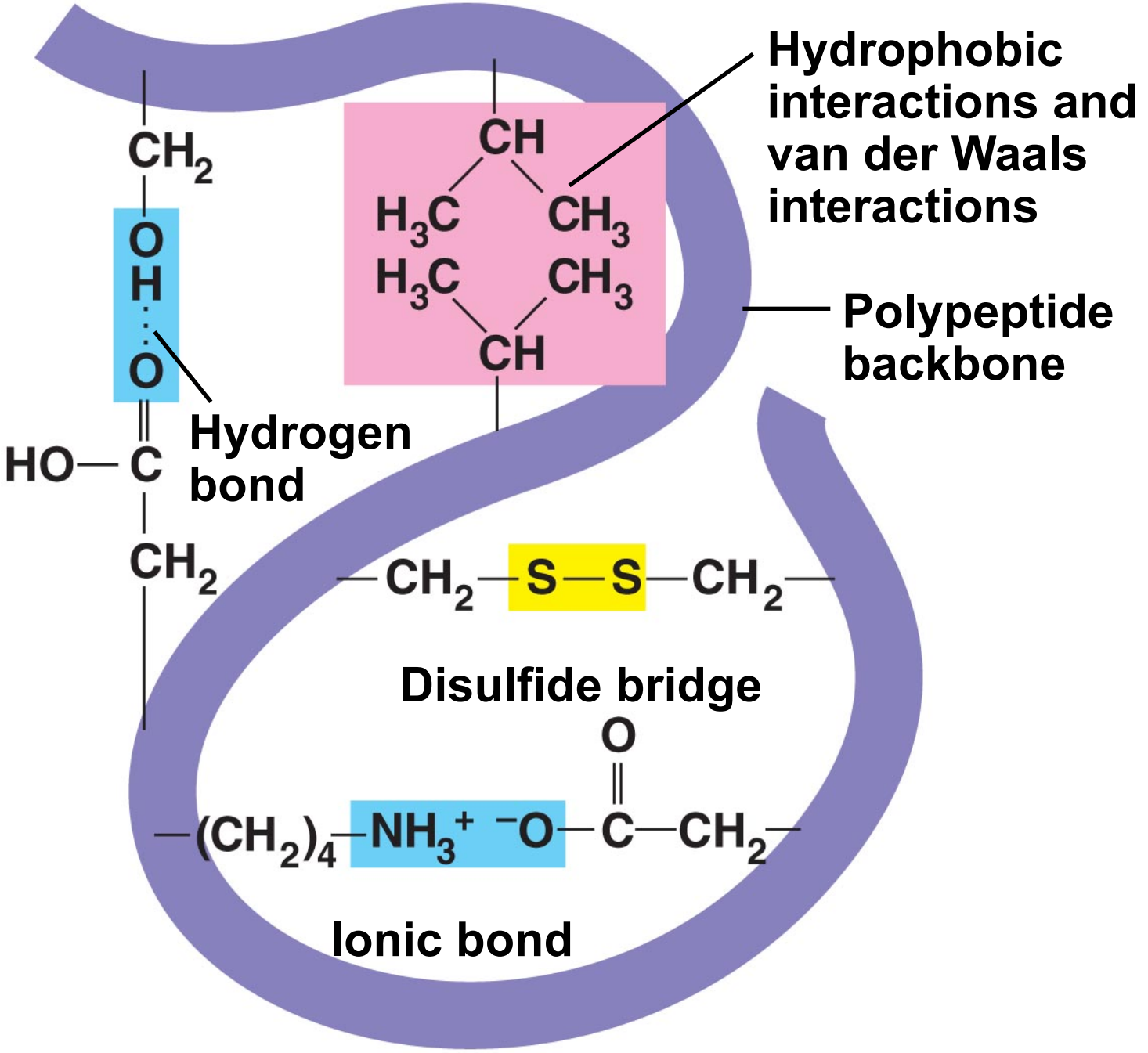
(a) A ribbon model of lysozyme

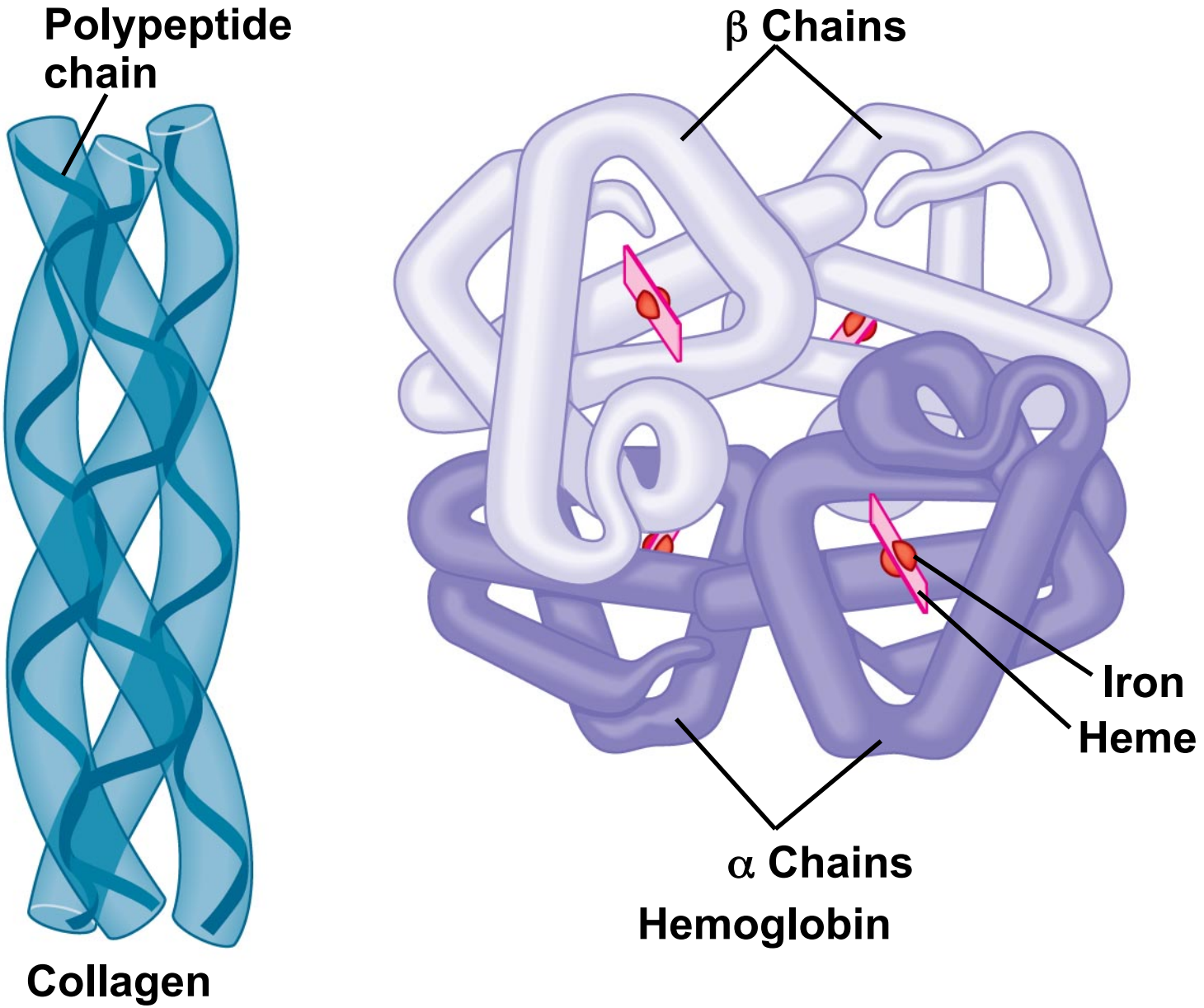


(b) A space-filling model of lysozyme







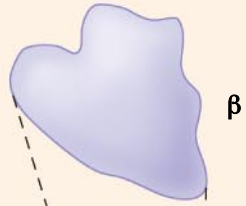


Normal hemoglobin

Primary structure

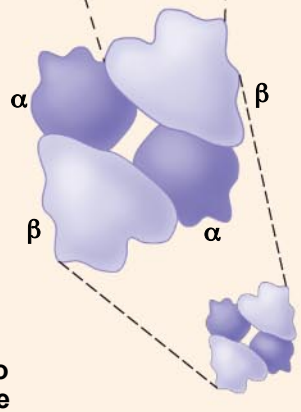
Val His Leu Thr Pro Glu Glu
1 2 3 4 5 6 7

Secondary and tertiary structures



Quaternary structure

Normal hemoglobin (top view)

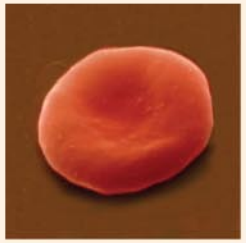


Function

Molecules do not associate with one another; each carries oxygen.

Red blood cell shape

Normal red blood cells are full of individual hemoglobin moledules, each carrying oxygen.



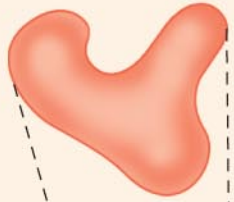
Sickle-cell hemoglobin

Primary structure

Val His Leu Thr Pro Val Glu
1 2 3 4 5 6 7

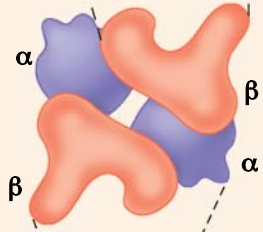
Secondary and tertiary structures

Exposed hydrophobic region



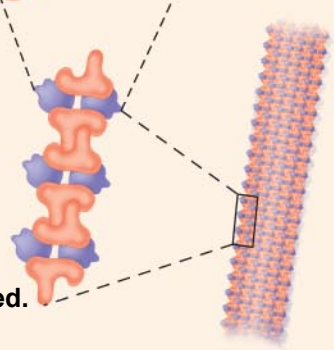
Quaternary structure

Sickle-cell hemoglobin



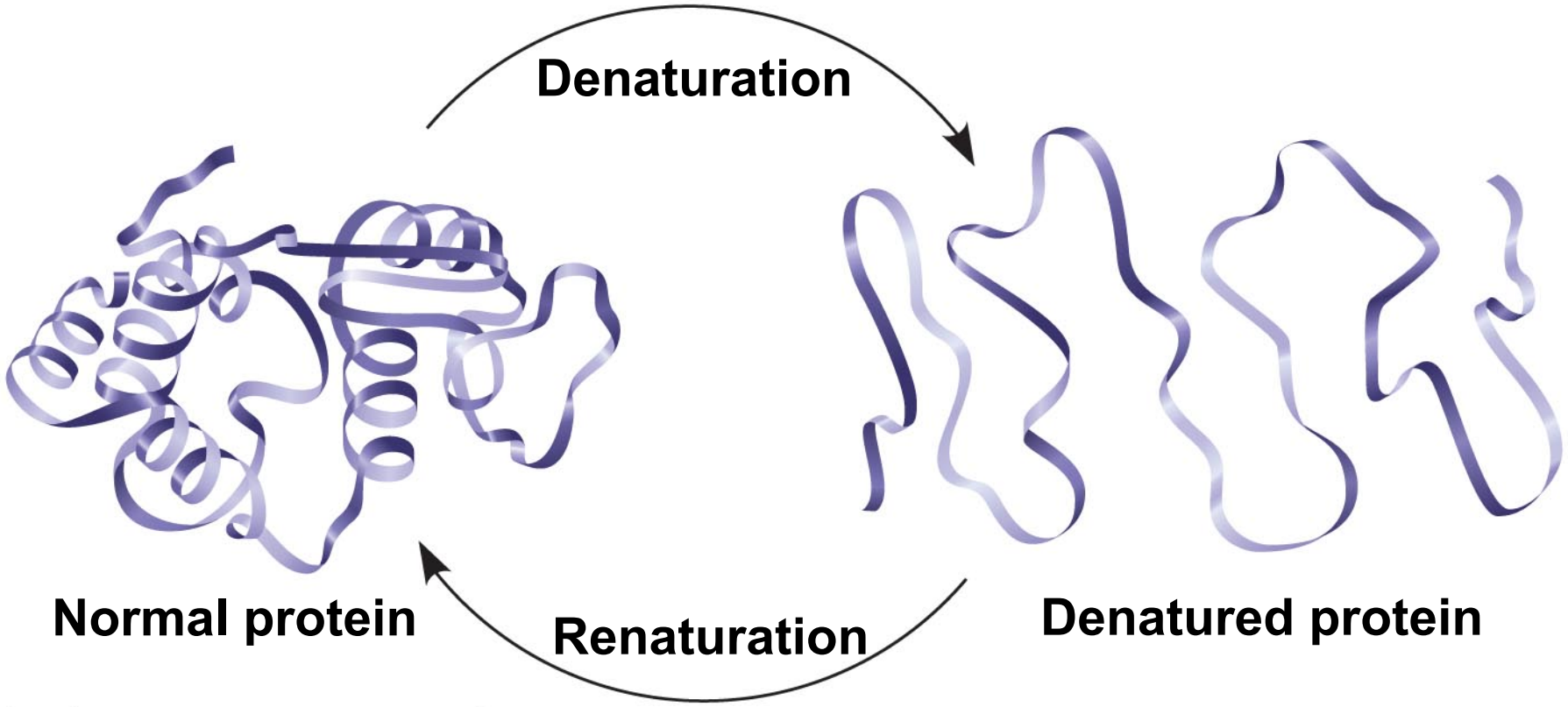
Function

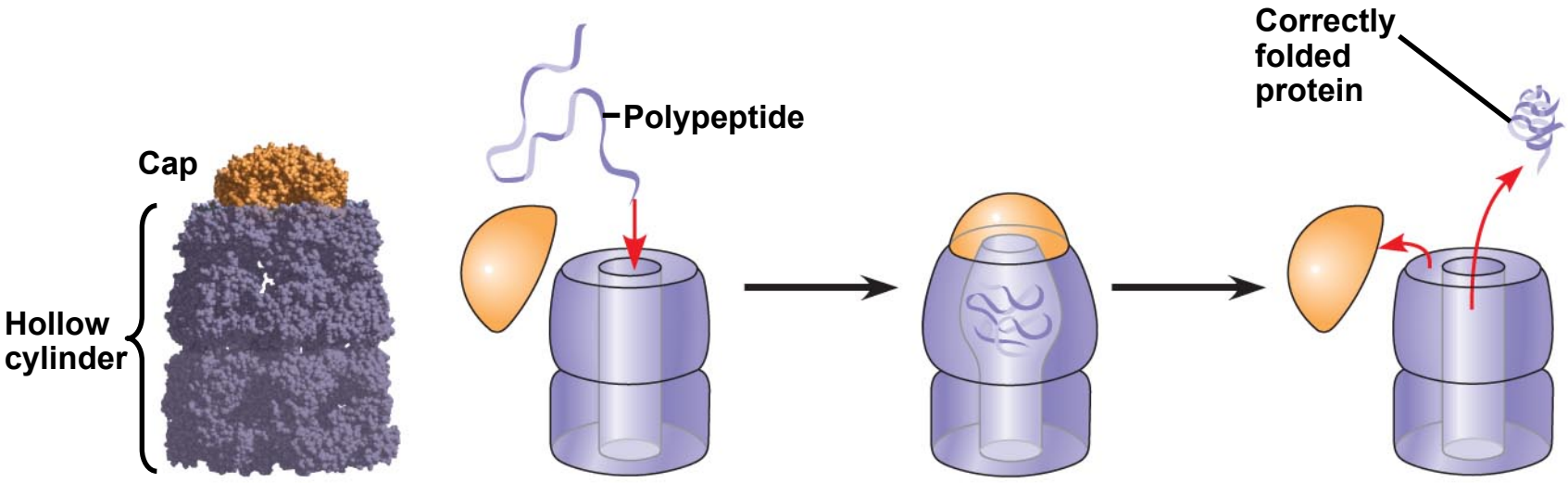
Molecules interact with one another and crystallize into a fiber; capacity to carry oxygen is greatly reduced.

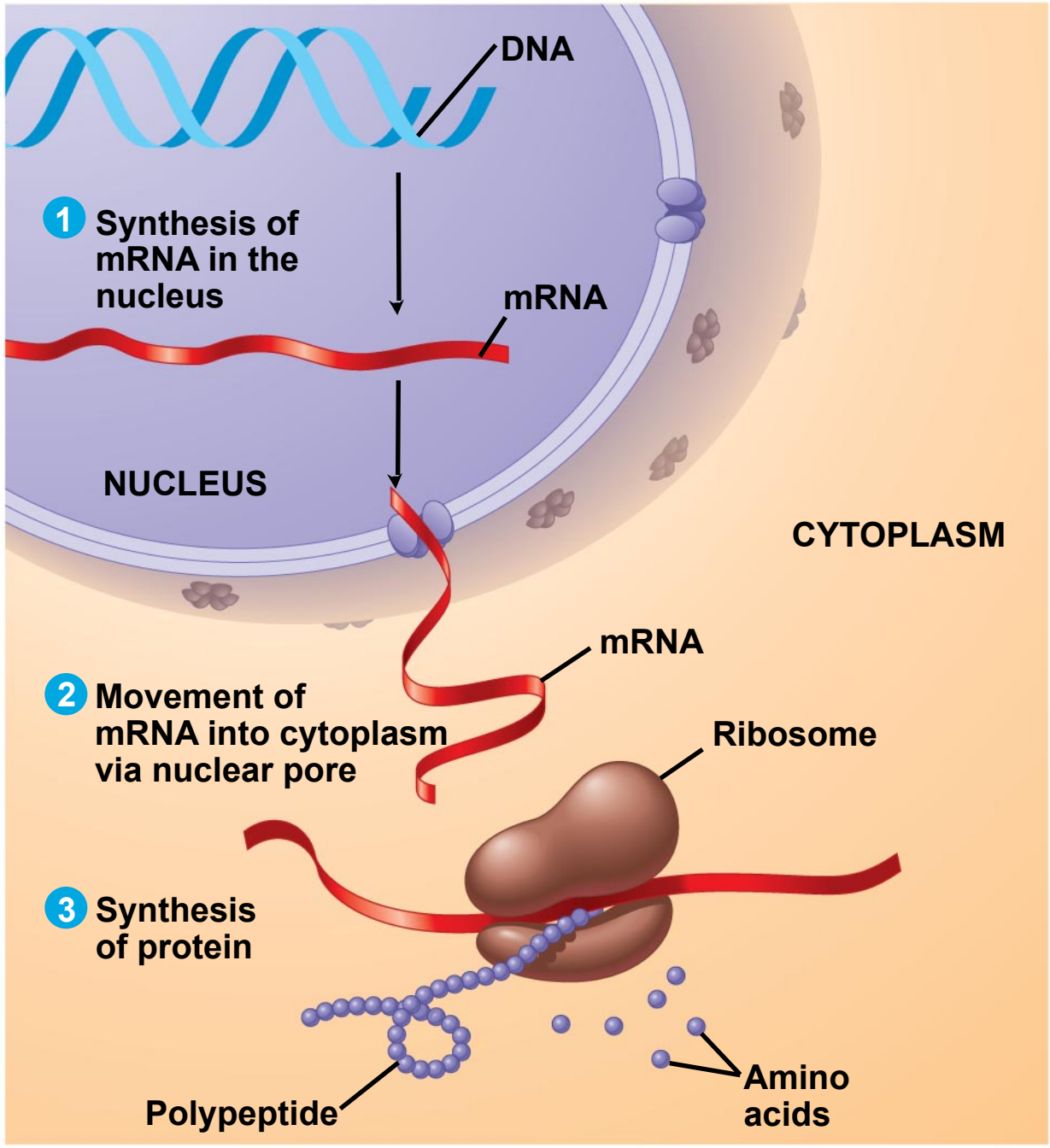


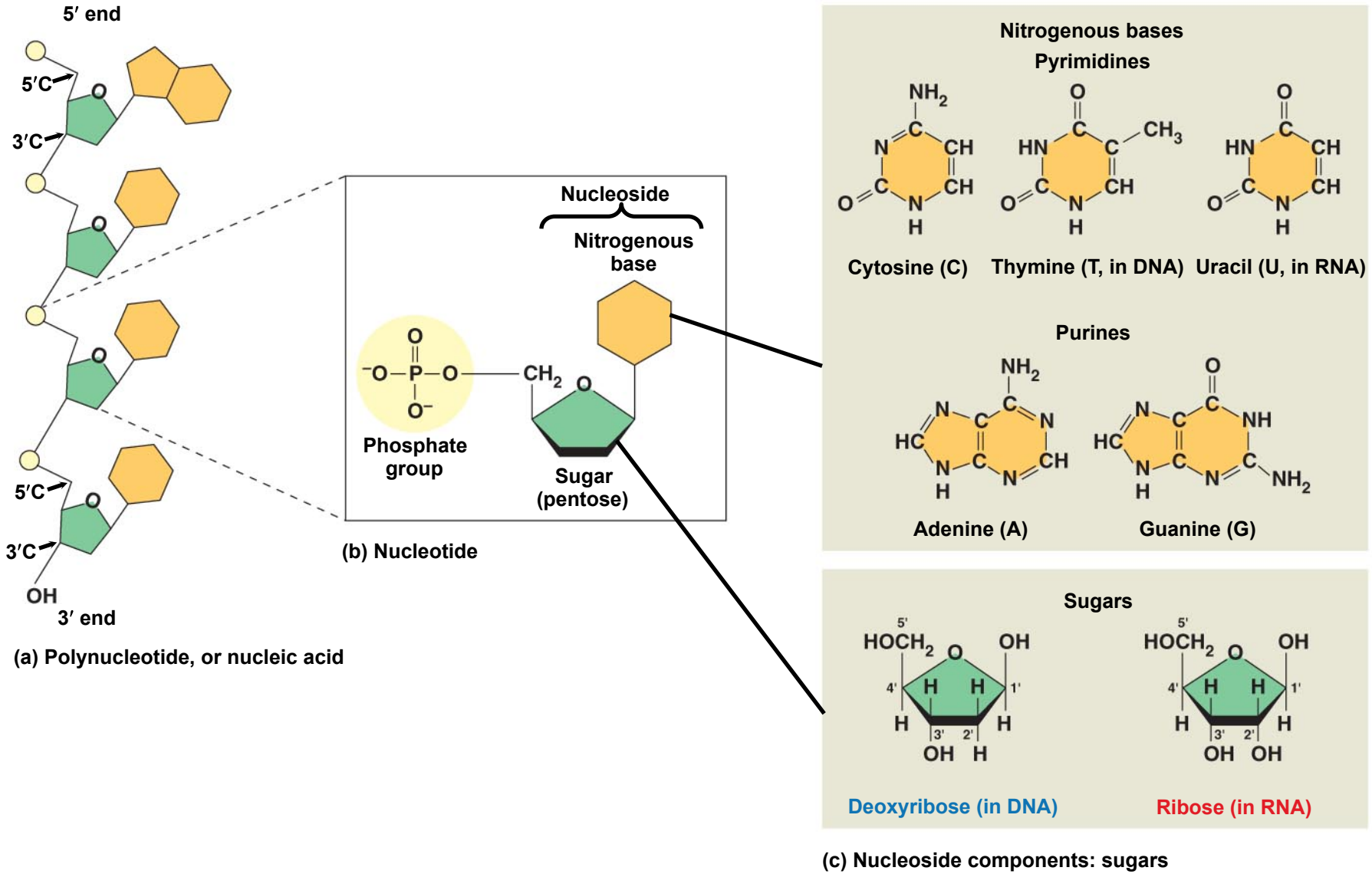
Red blood cell shape

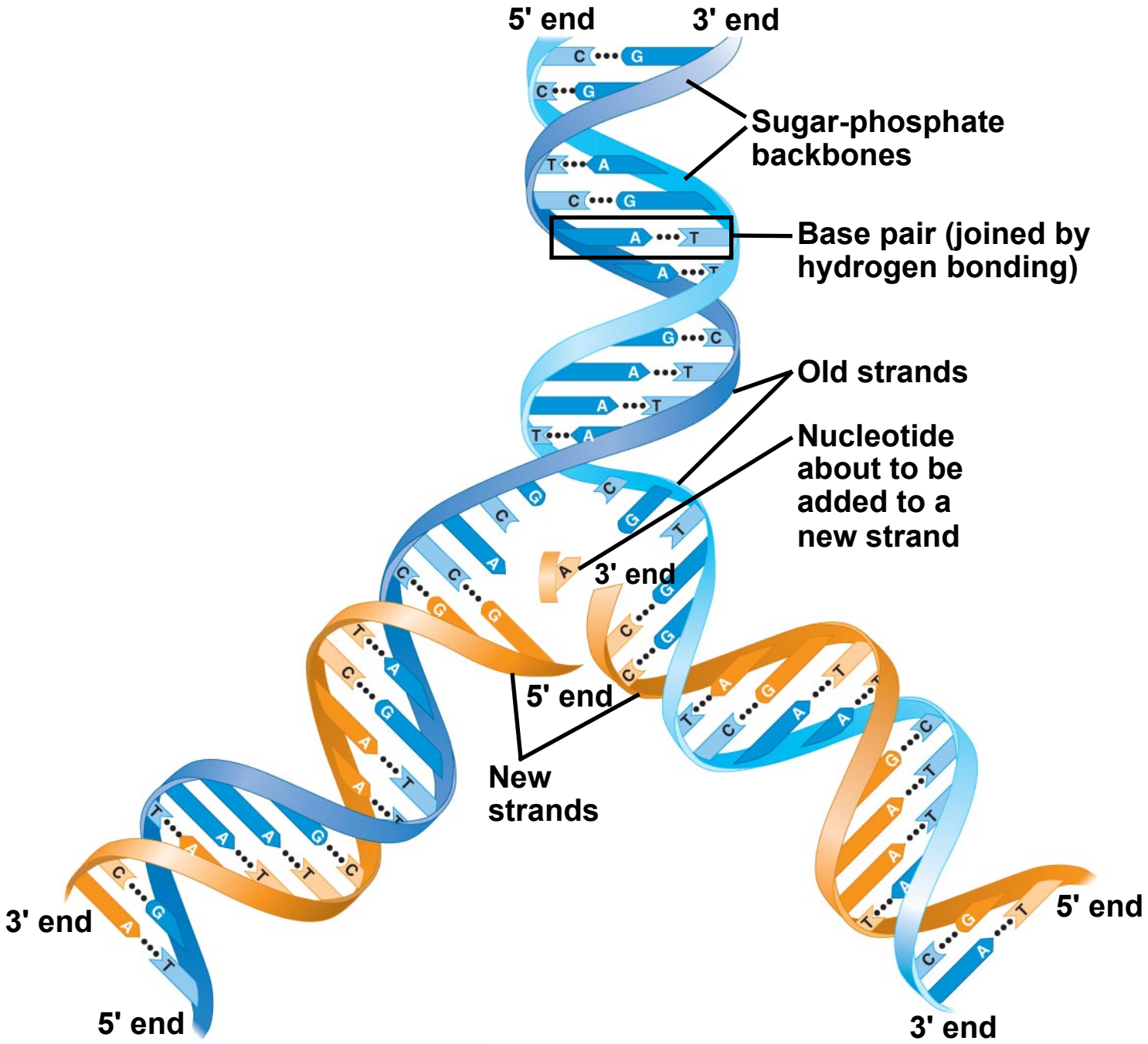
Fibers of abnormal hemoglobin deform red blood cell into sickle shape.

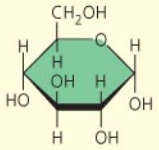
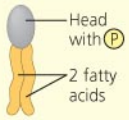
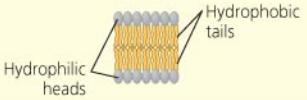
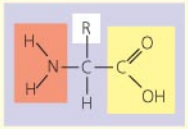
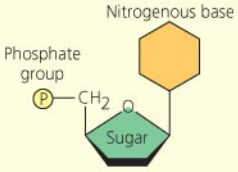










Large Biological Molecules	Components	Examples	Functions
Concept 5.2 **Carbohydrates** serve as fuel and building material	 Monosaccharide monomer	Monosaccharides: glucose, fructose	Fuel; carbon sources that can be converted to other molecules or combined into polymers
		Disaccharides: lactose, sucrose	
		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
Concept 5.3 **Lipids** are a diverse group of hydrophobic molecules and are not macromolecules		Triacylglycerols (fats or oils): glycerol + 3 fatty acids	Important energy source 
		Phospholipids: phosphate group + 2 fatty acids	Lipid bilayers of membranes 
	 Steroid backbone	Steroids: four fused rings with attached chemical groups	• Component of cell membranes (cholesterol) • Signals that travel through the body (hormones)
Concept 5.4 **Proteins** have many structures, resulting in a wide range of 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
Concept 5.5 Nucleic acids store and transmit hereditary information	 Nucleotide monomer	DNA:  • Sugar = deoxyribose • Nitrogenous bases = C, G, A, T • Usually double-stranded	Stores all hereditary information
		RNA:  • Sugar = ribose • Nitrogenous bases = C, G, A, U • Usually single-stranded	Carries protein-coding instructions from DNA to protein-synthesizing machinery