Objective: You will be able to describe the types of properties found in each monomer.

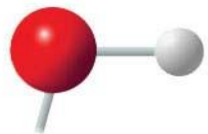
Do now:

- Relate polar, nonpolar molecules with the concepts of hydrophobic and hydrophilic

Functional Groups

- A chemical group with specific properties that impacts chemical reactions and the overall property of a molecule
  - Hydroxyl group
  - Carboxyl group
  - Amino group
  - Phosphate group

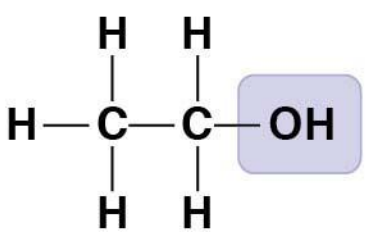
Hydroxyl group (—OH)



—OH

(may be written HO—)

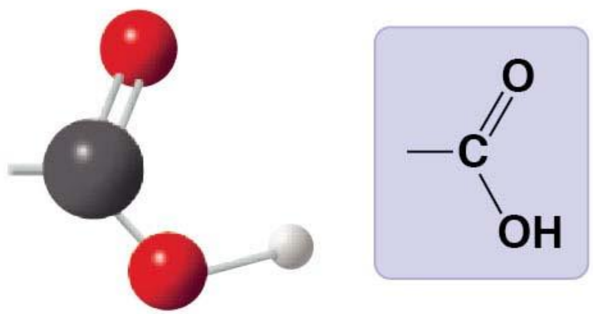
Alcohol
(The specific name usually ends in -*ol*.)



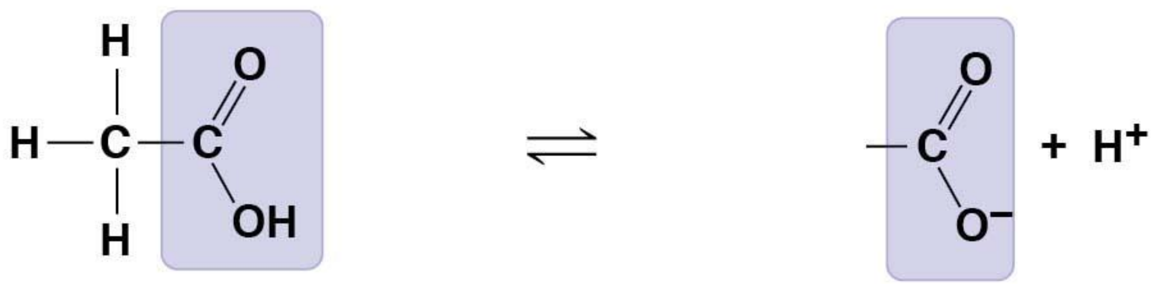
Ethanol, the alcohol present in alcoholic beverages

Figure 3.6-1c

Carboxyl group (—COOH)



Carboxylic acid, or organic acid

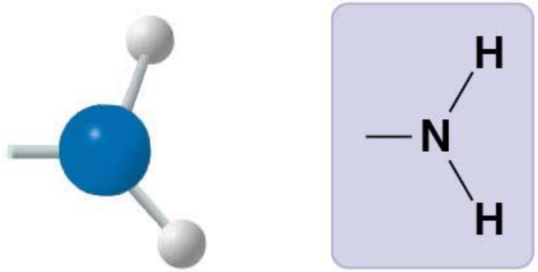


Acetic acid, which gives vinegar its sour taste

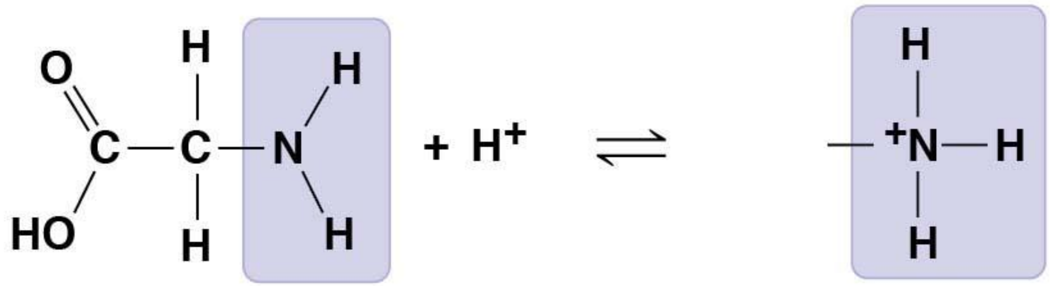
Ionized form of —COOH (carboxylate ion), found in cells

Figure 3.6-1d

Amino group ($—NH_2$)



Amine

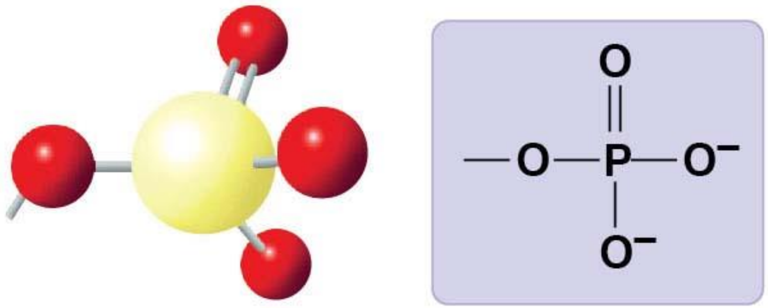


Glycine, an amino acid (note its carboxyl group)

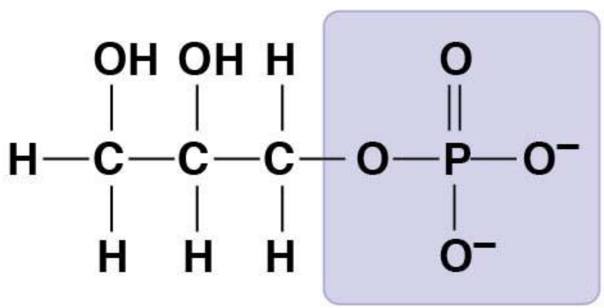
Ionized form of $—NH_2$, found in cells

Figure 3.6-2b

Phosphate group ($—OPO_3^{2-}$)

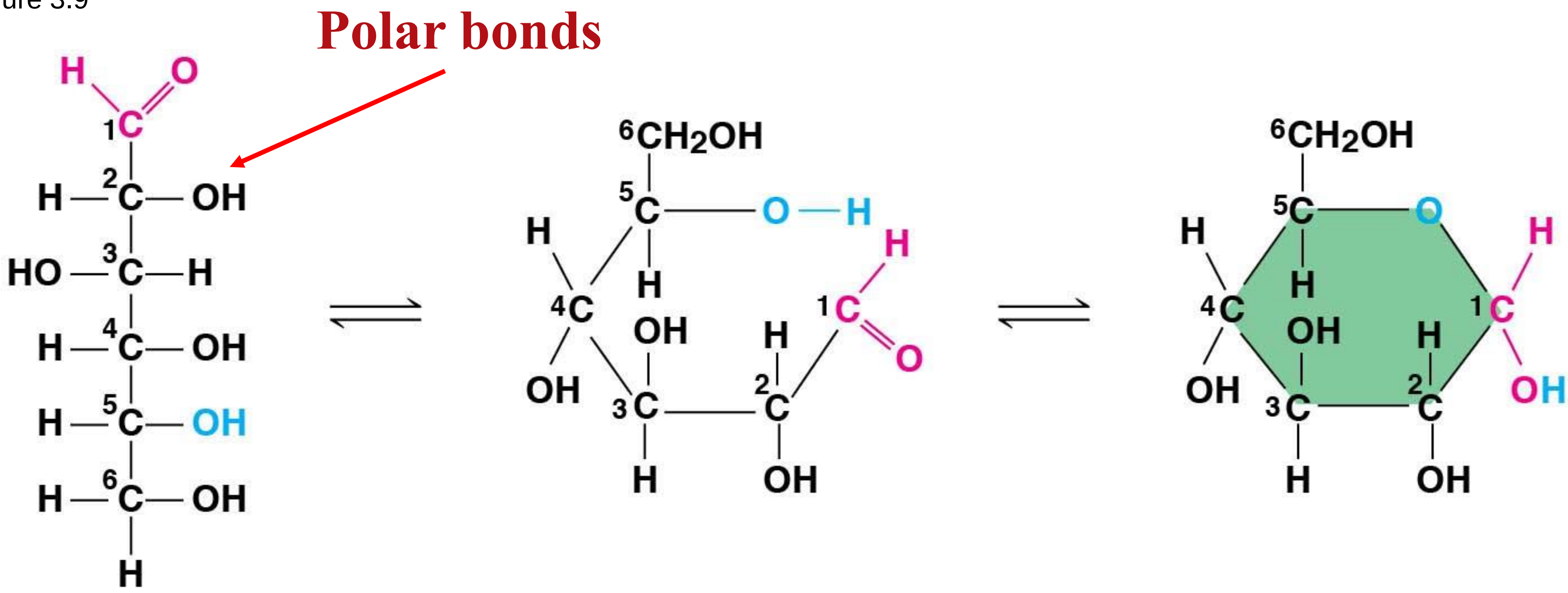


Organic phosphate



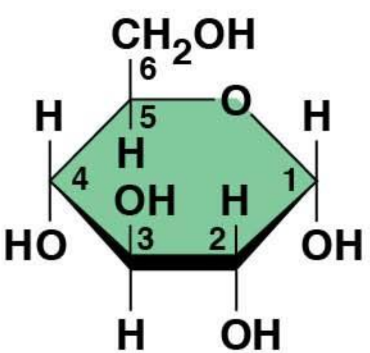
Glycerol phosphate, which takes part in many important chemical reactions in cells

Figure 3.9



(a) Linear and ring forms

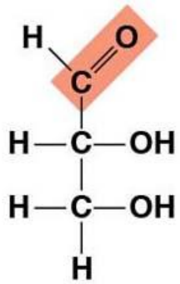
Monosaccharides



(b) Abbreviated ring structure

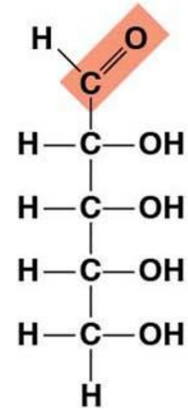
Figure 3.8

Triose: three-carbon sugar ($C_3H_6O_3$)



Glyceraldehyde
An initial breakdown product of glucose in cells

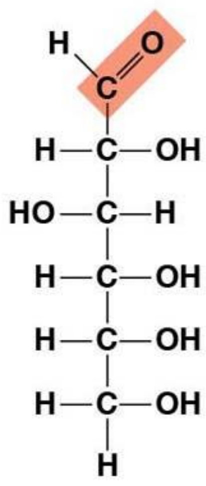
Pentose: five-carbon sugar ($C_5H_{10}O_5$)



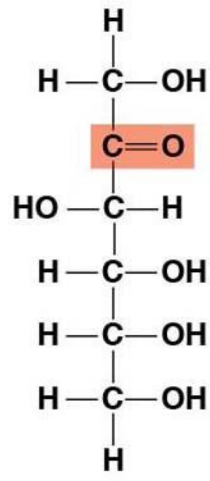
Ribose
A component of RNA

Hexoses: six-carbon sugars ($C_6H_{12}O_6$)

How do you know that these are monosaccharides?



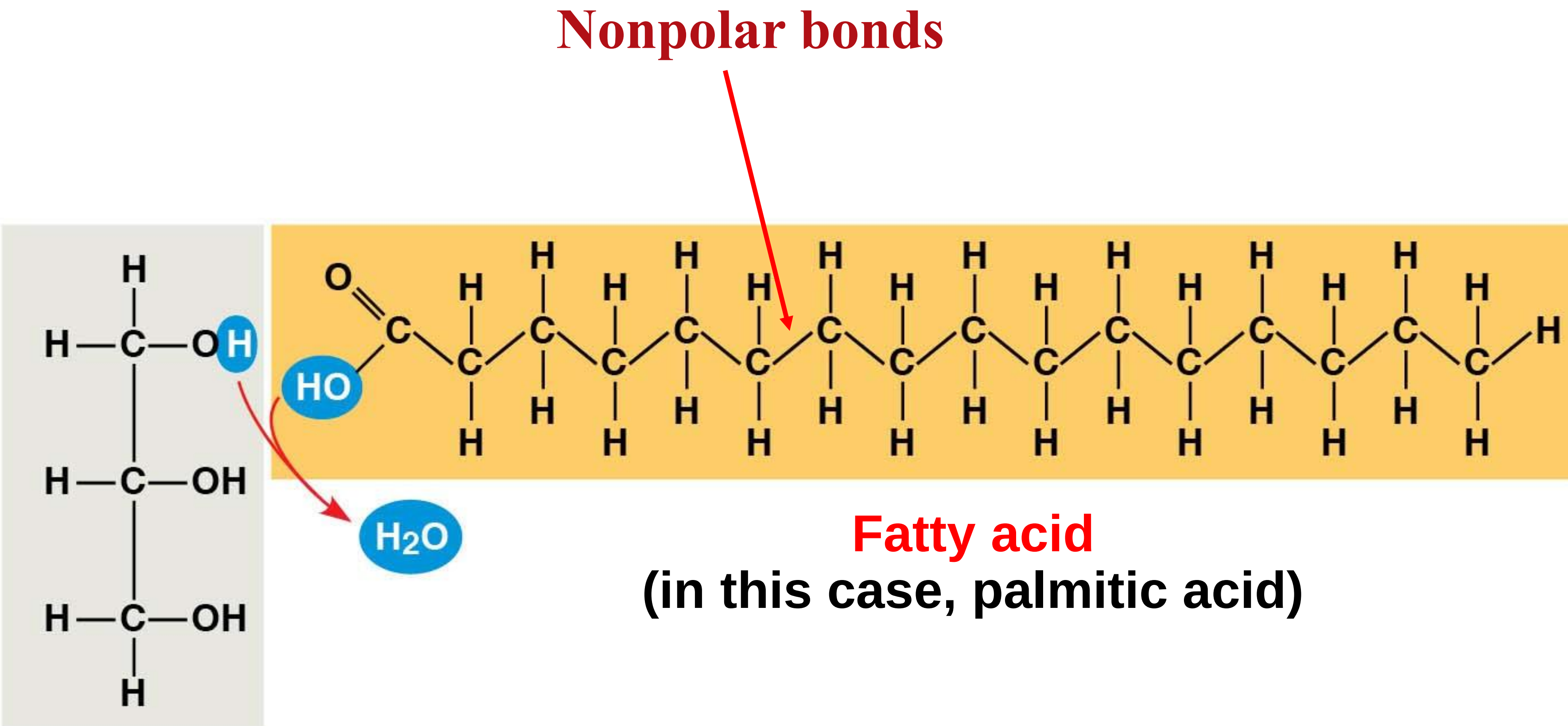
Glucose



Fructose

Energy sources for organisms

Figure 3.13-1



Glycerol

(a) One of three dehydration reactions in the synthesis of a fat

How do you know that these are fatty acids?

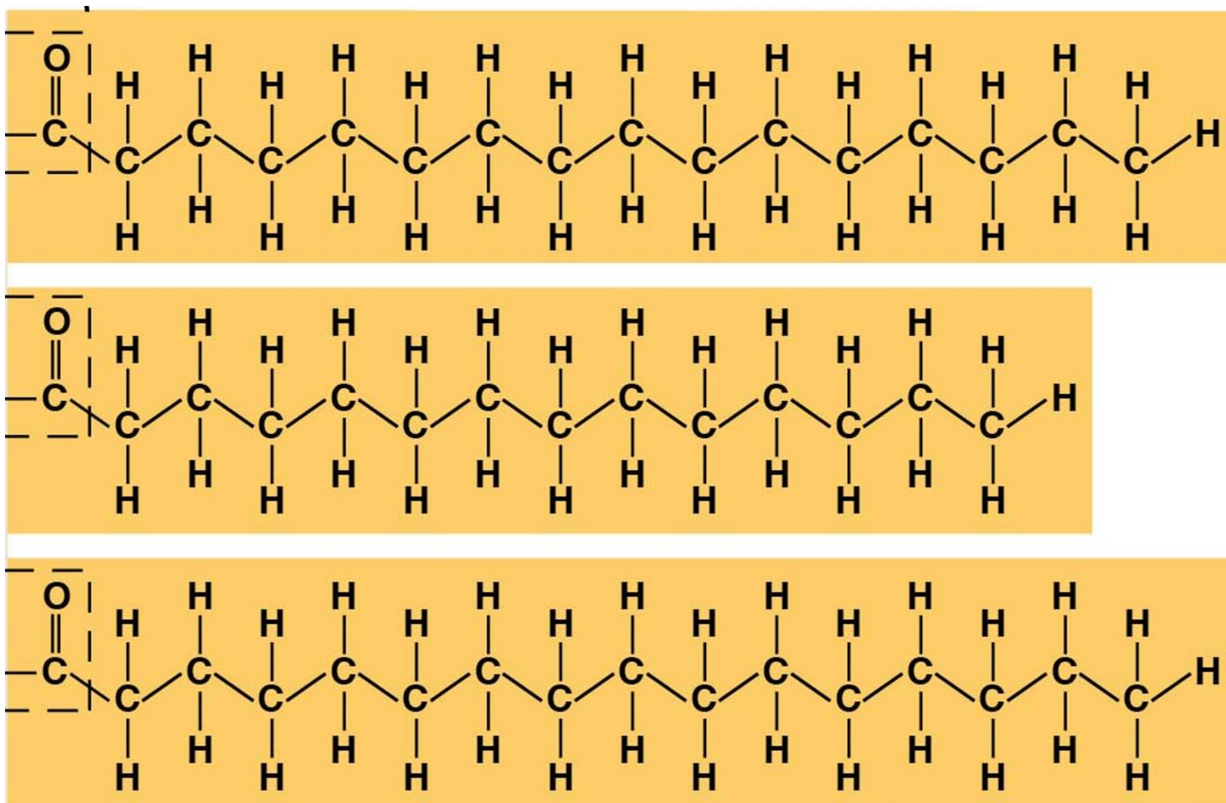


Figure 3.UN06

Amino Acids

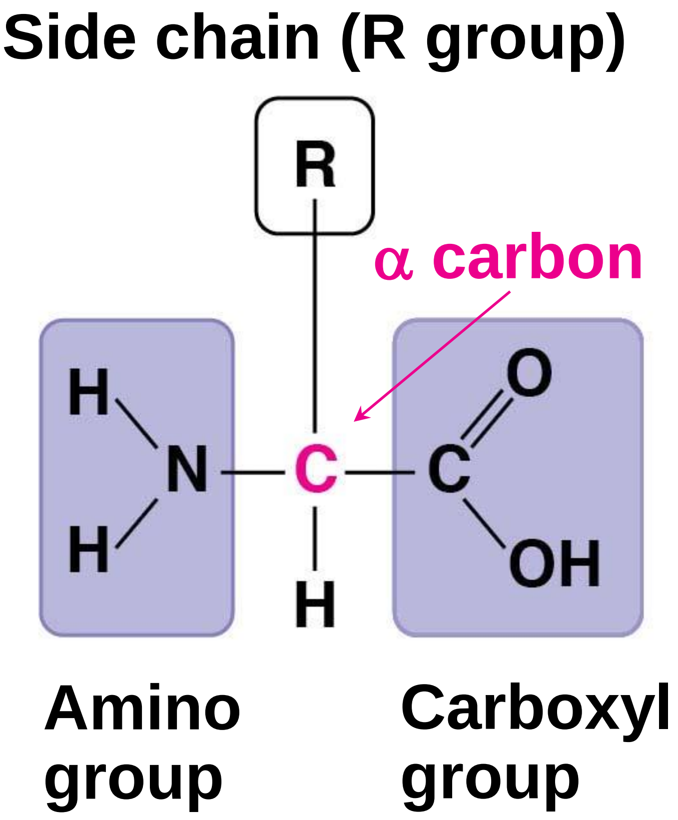
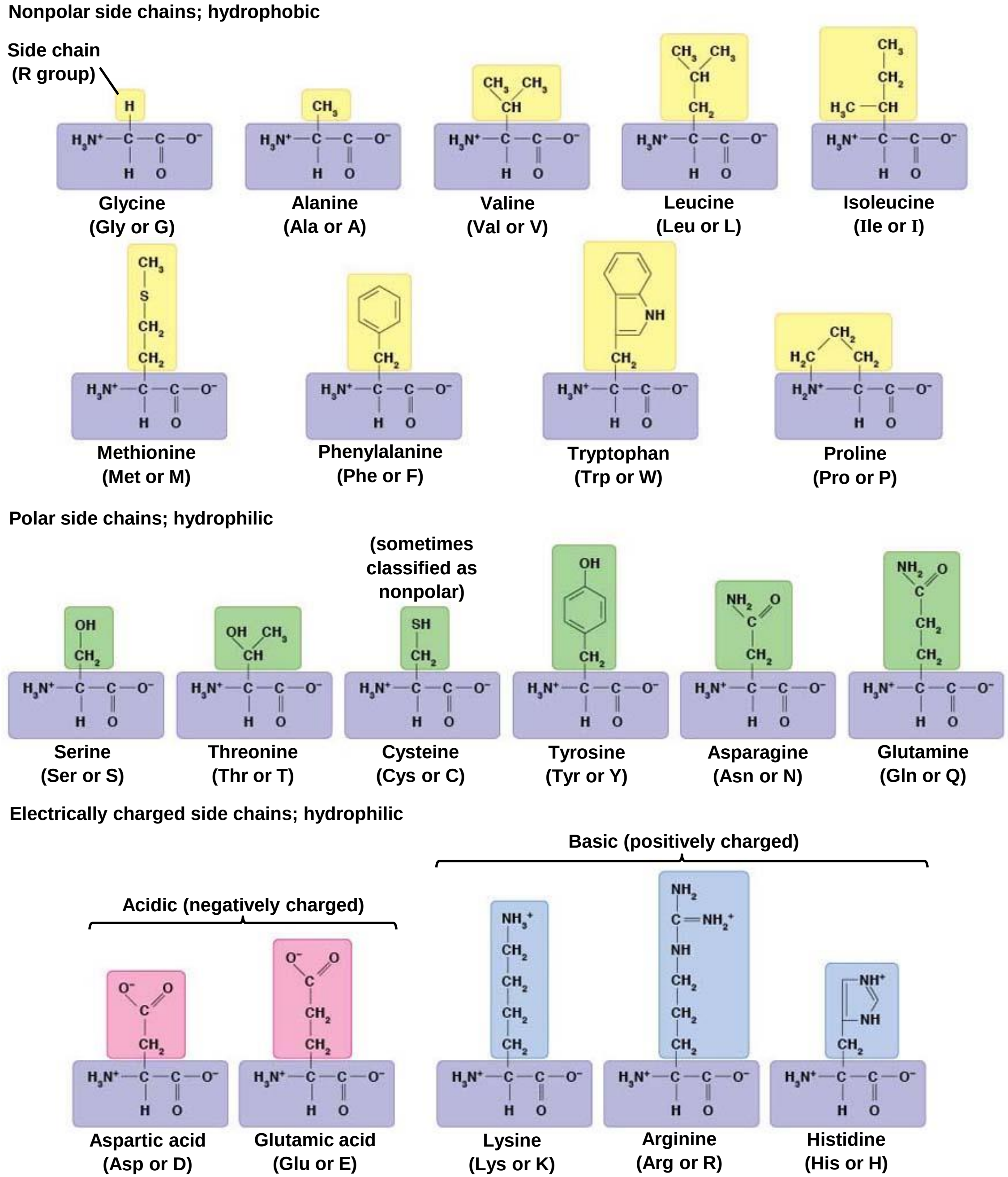
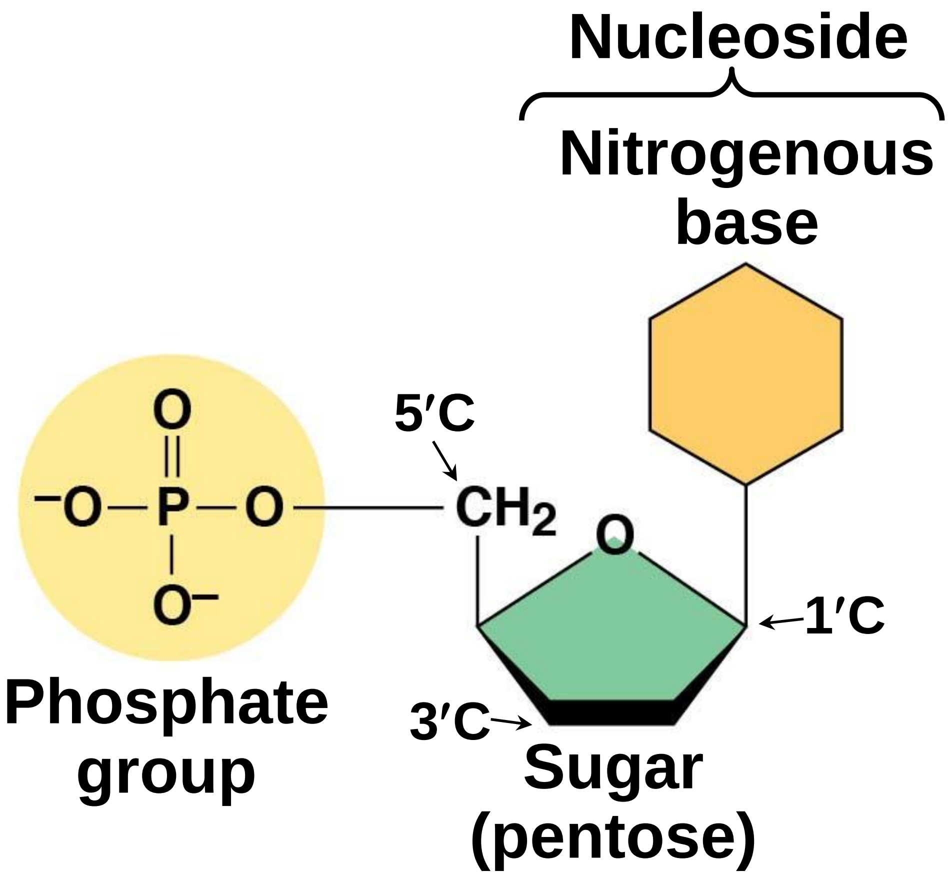


Figure 3.18

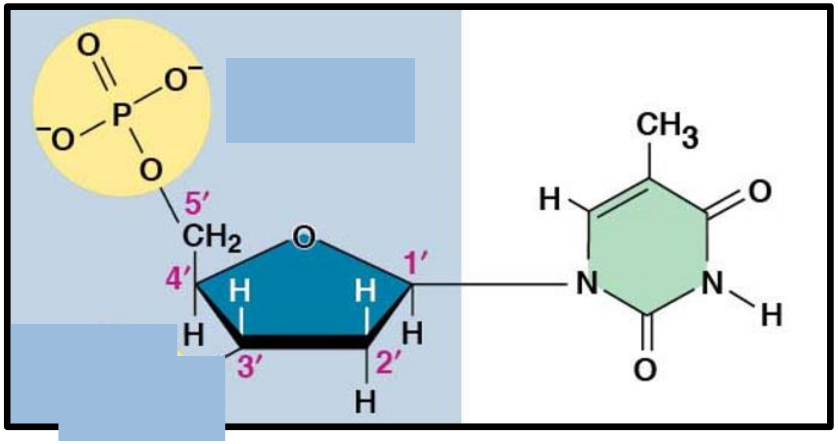
Amino Acids

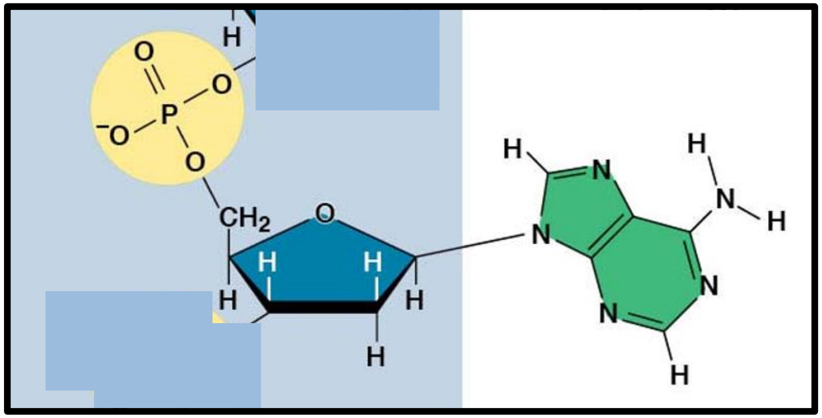




(b) Nucleotide

How do you know that these are nucleotides?



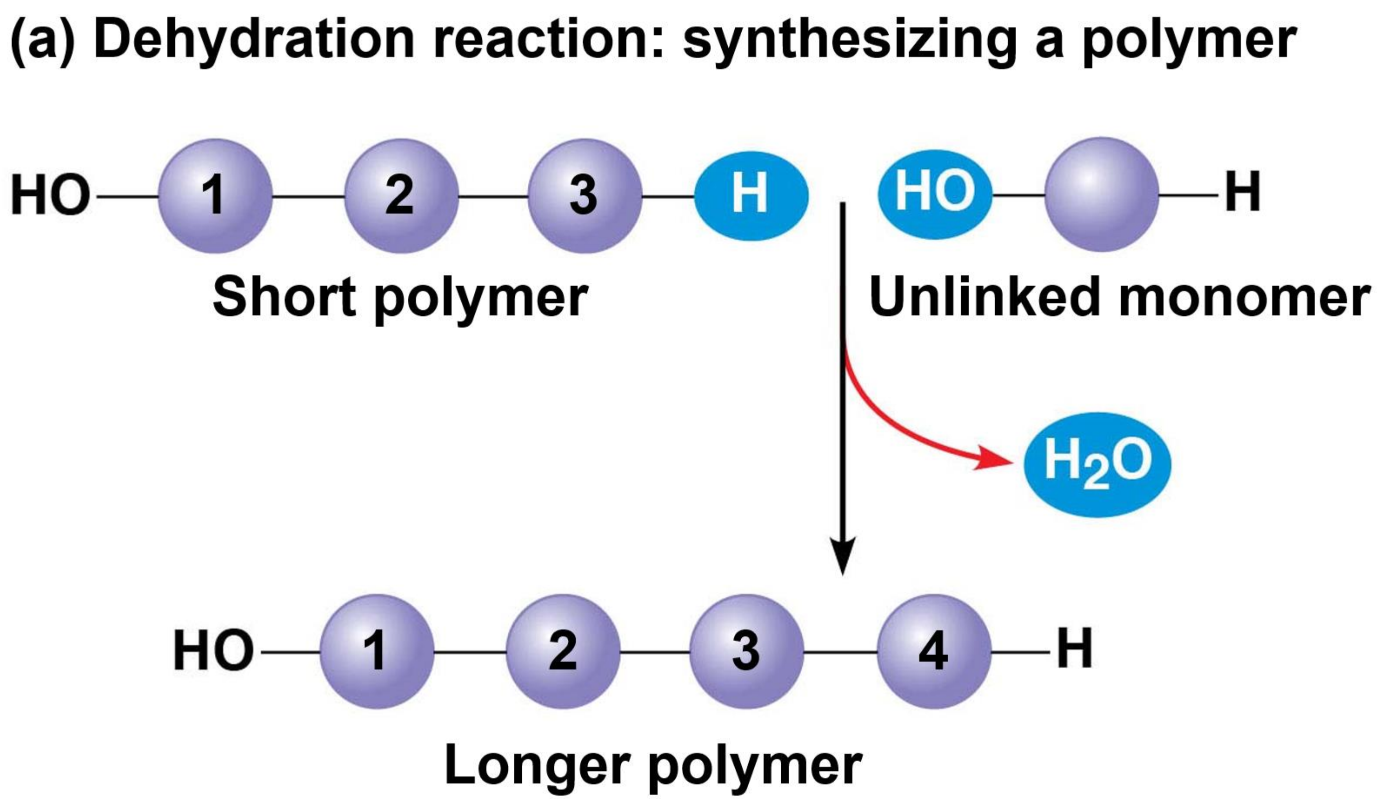


Objective: You will be able to describe the types of bonds that connect monomers to form polymers.

Do now:

- Using context clues, speculate on the meaning of these two terms:
  - Dehydration Synthesis
  - Hydrolysis

Dehydration synthesis forms covalent bonds between monomers to form polymers



Hydrolysis breaks covalent bonds in polymers to form monomers

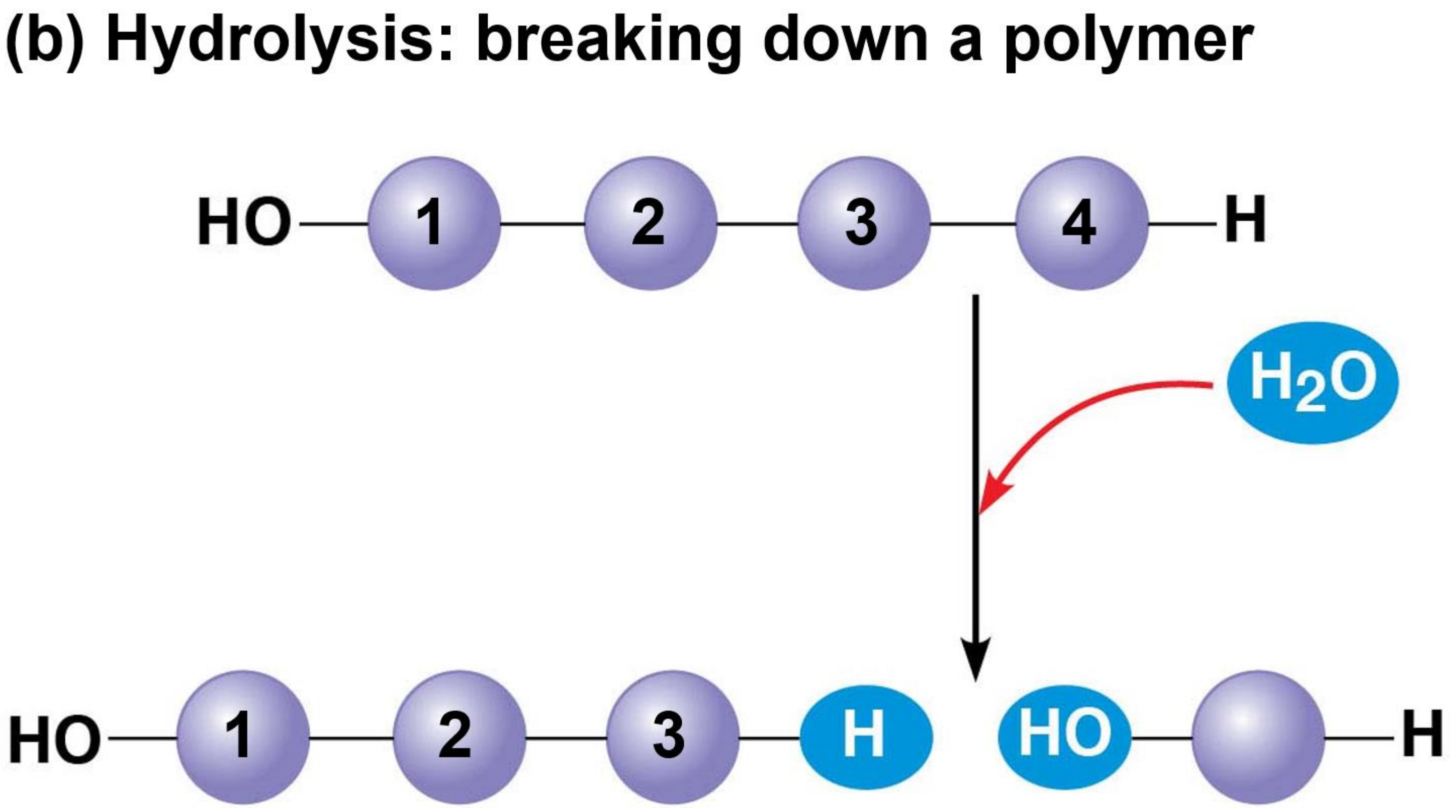
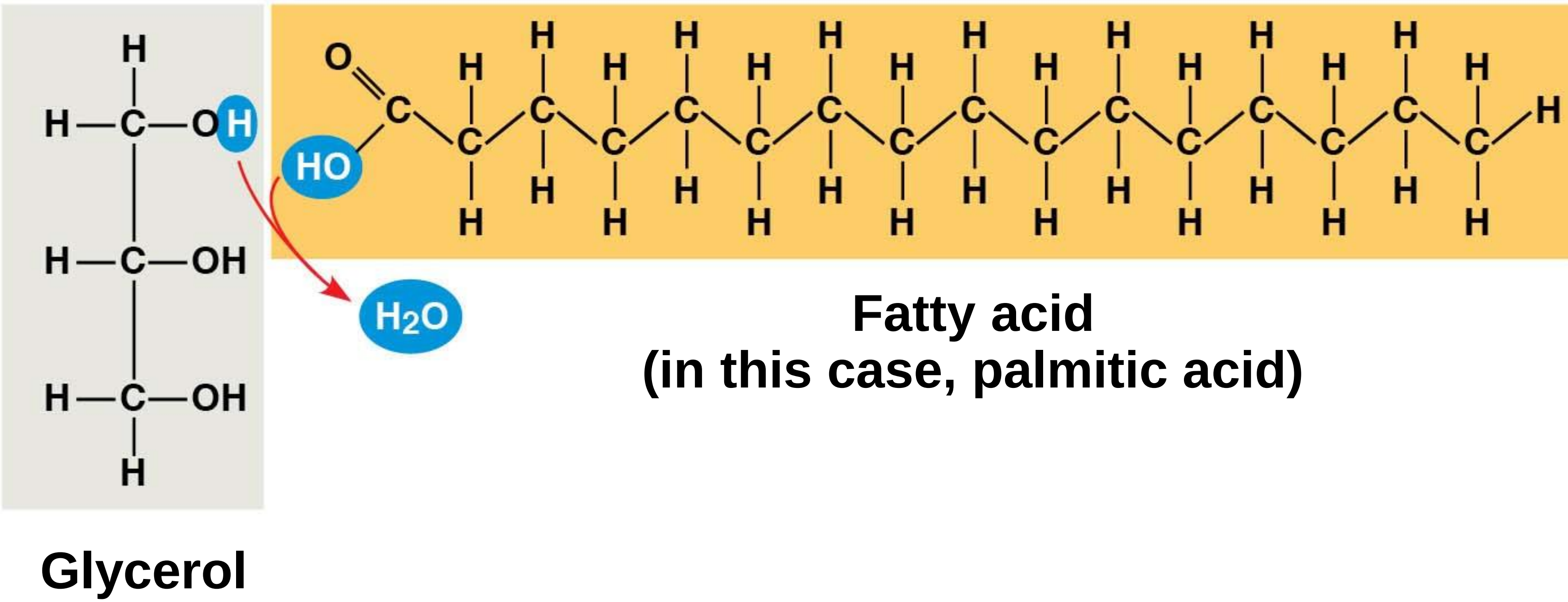
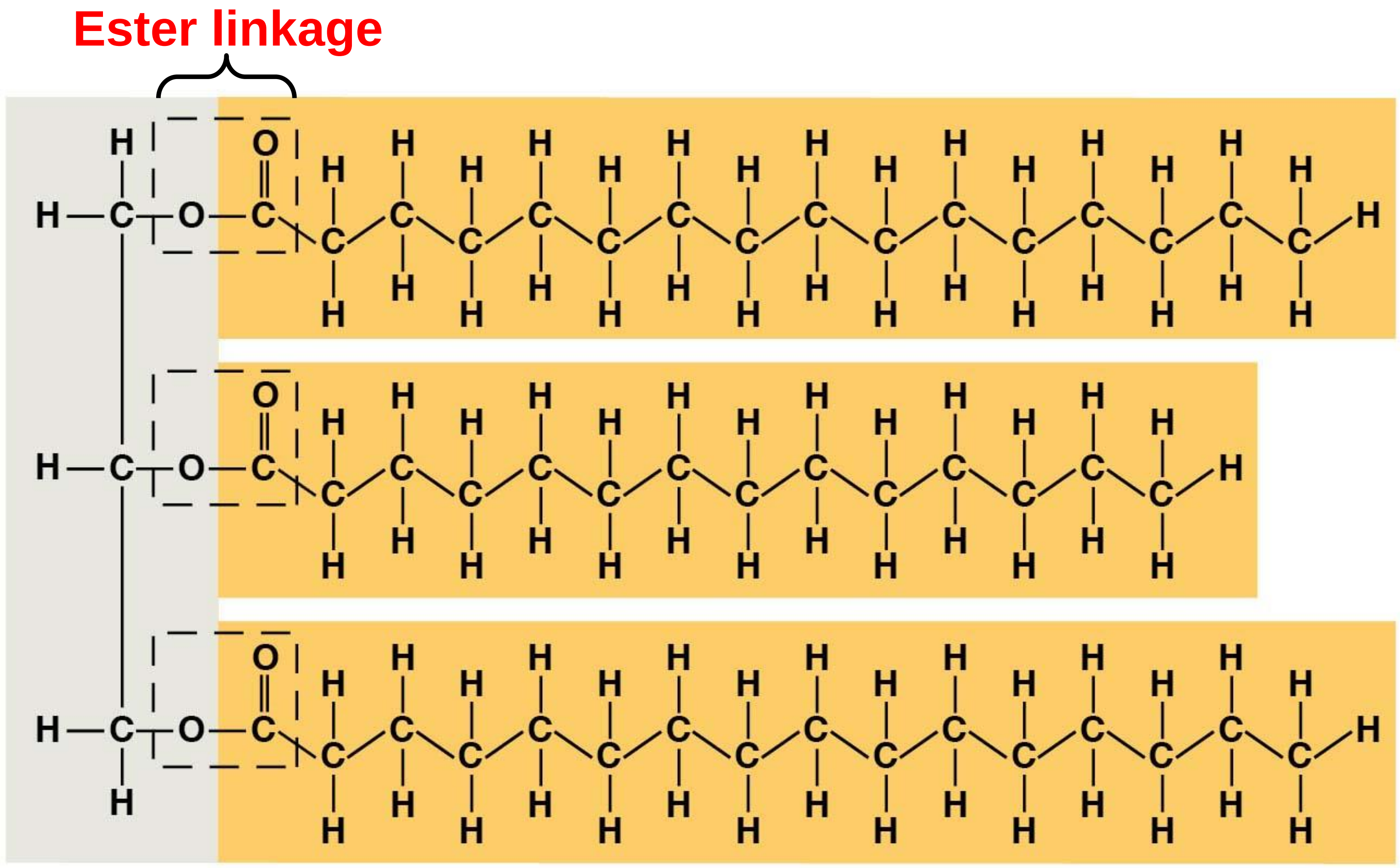


Figure 3.13-1



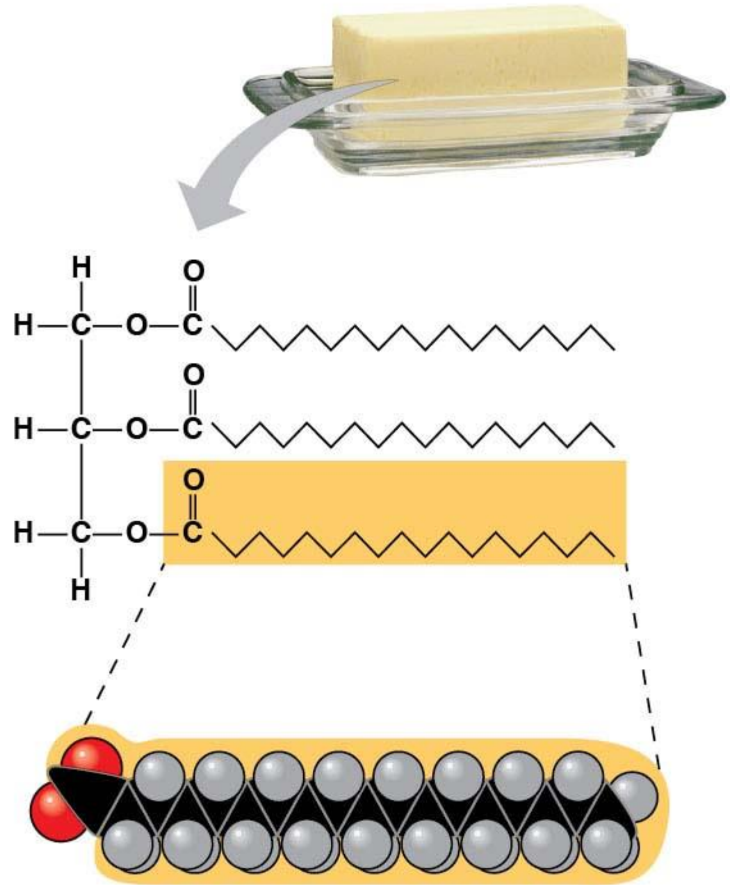
(a) One of three dehydration reactions in the synthesis of a fat

Figure 3.13-2



(b) Fat molecule (triacylglycerol)

(a) Saturated fat



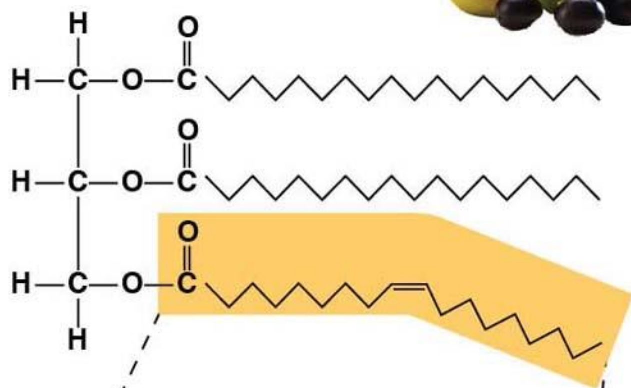
Structural formula of a saturated fat molecule

Space-filling model of stearic acid, a saturated fatty acid

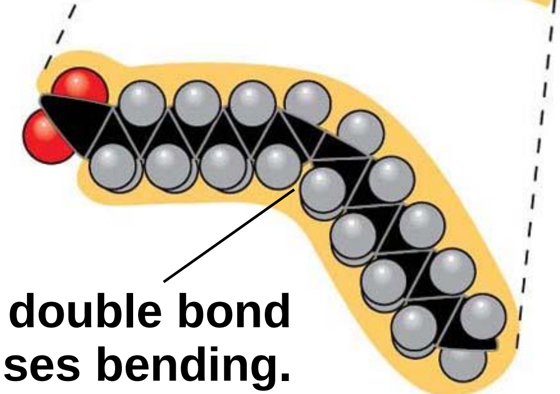
Figure 3.14-2

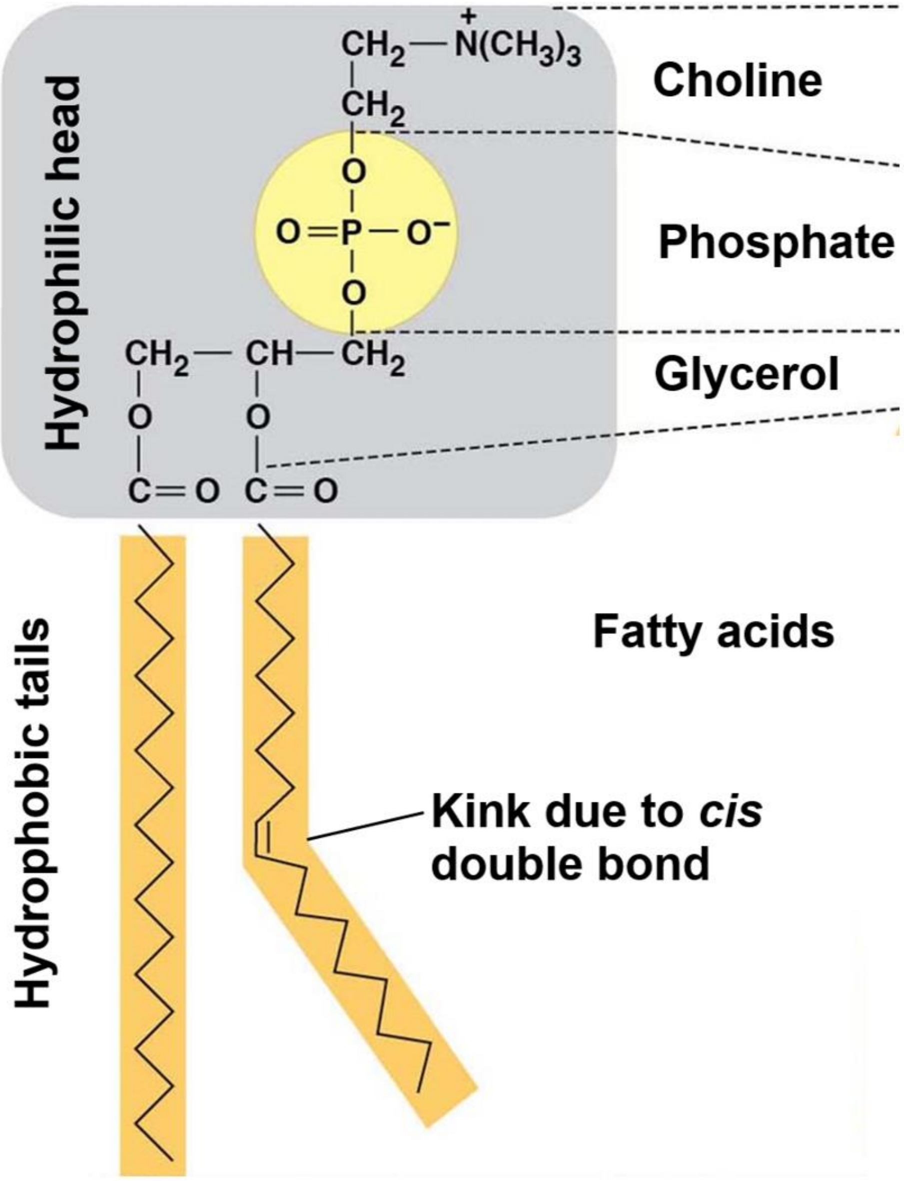
(b) Unsaturated fat

Structural formula of an unsaturated fat molecule



Space-filling model of oleic acid, an unsaturated fatty acid

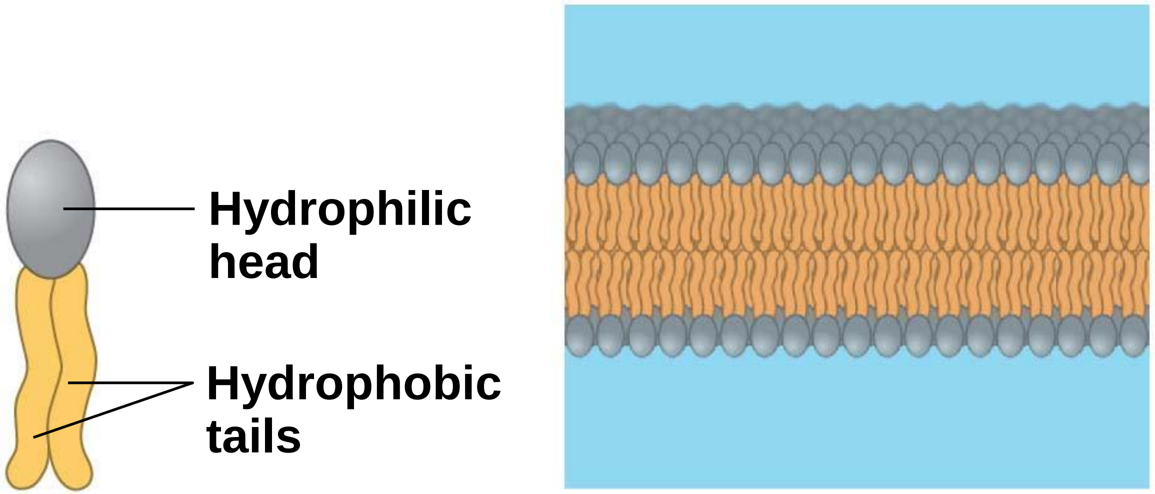




This is a phospholipid, how is it similar to a fat?

How is it different?

Figure 3.15-2



(c) Phospholipid symbol

(d) Phospholipid bilayer

Figure 3.16

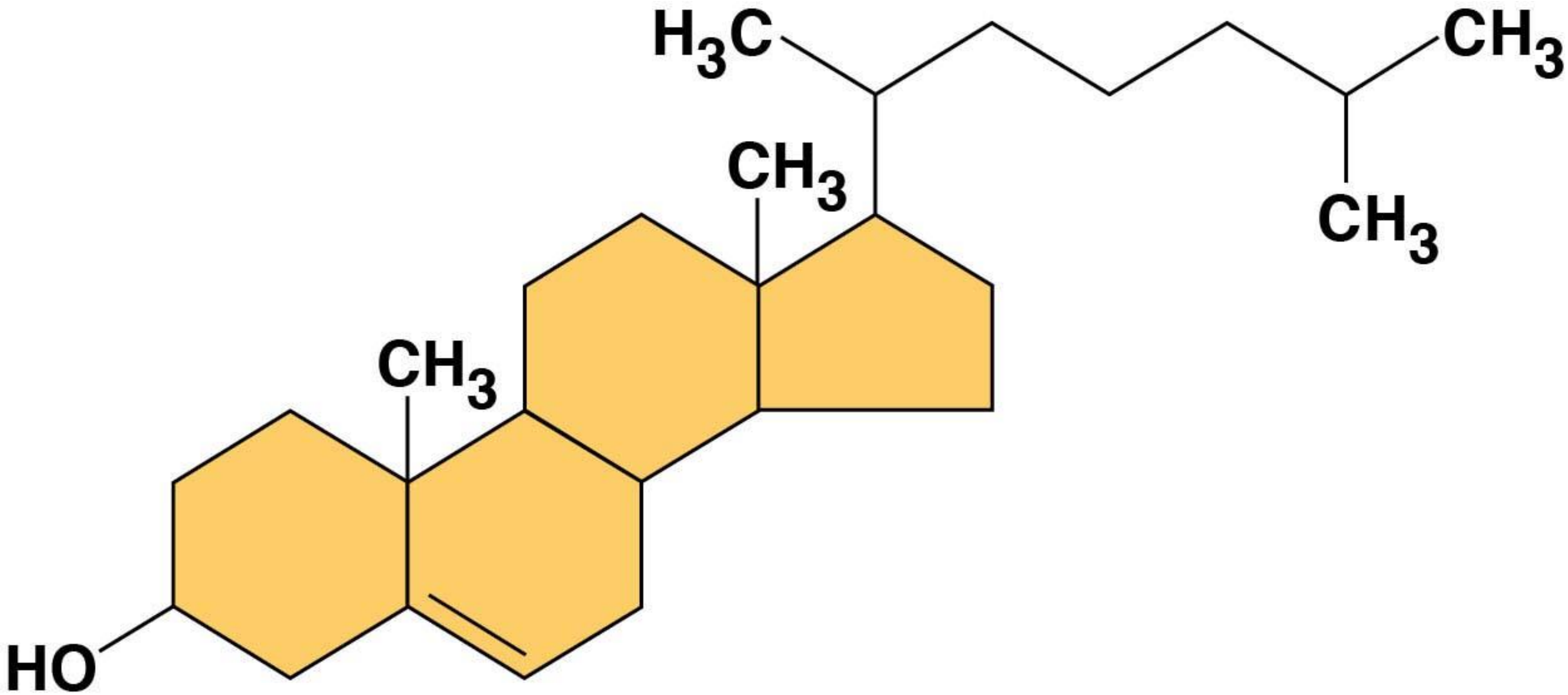
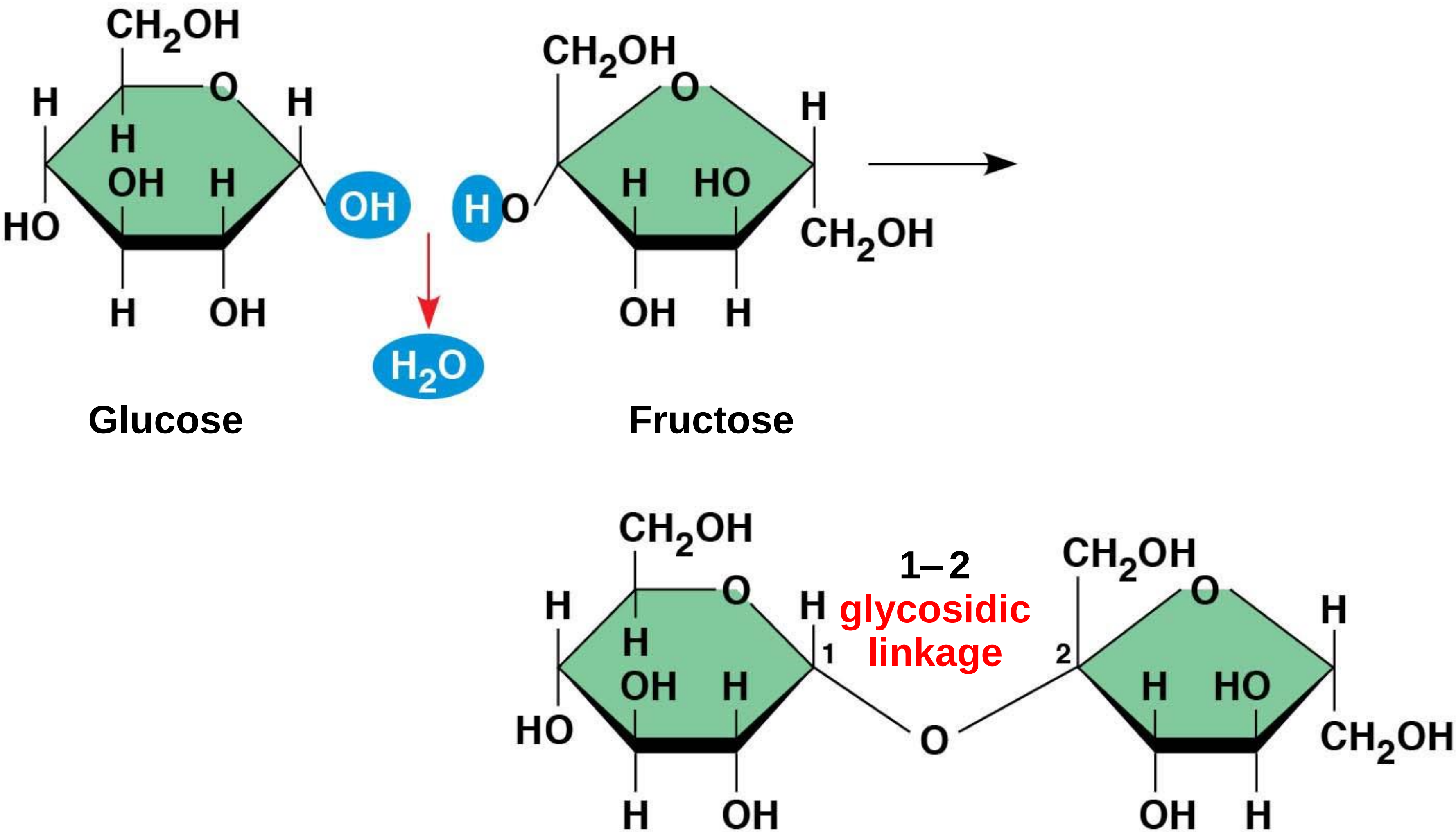
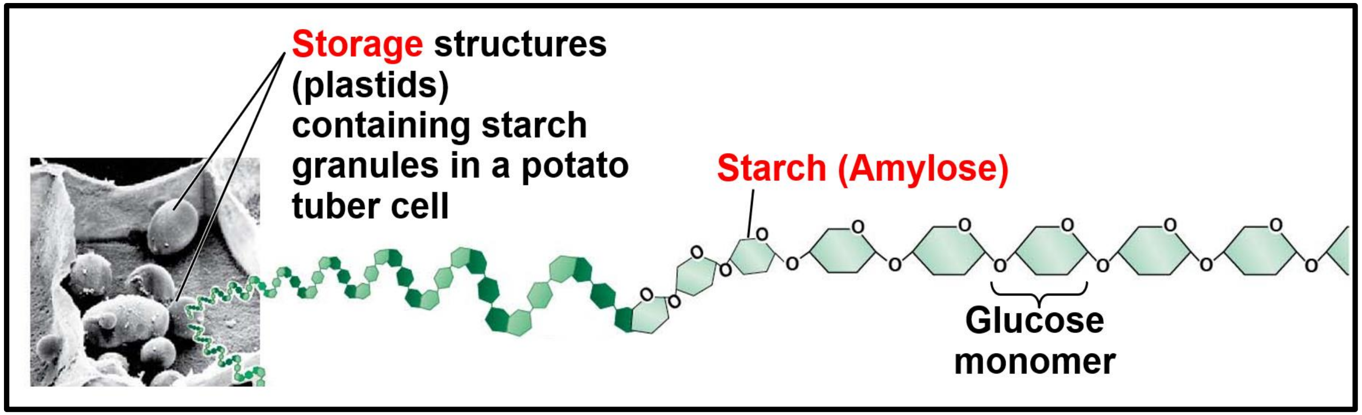
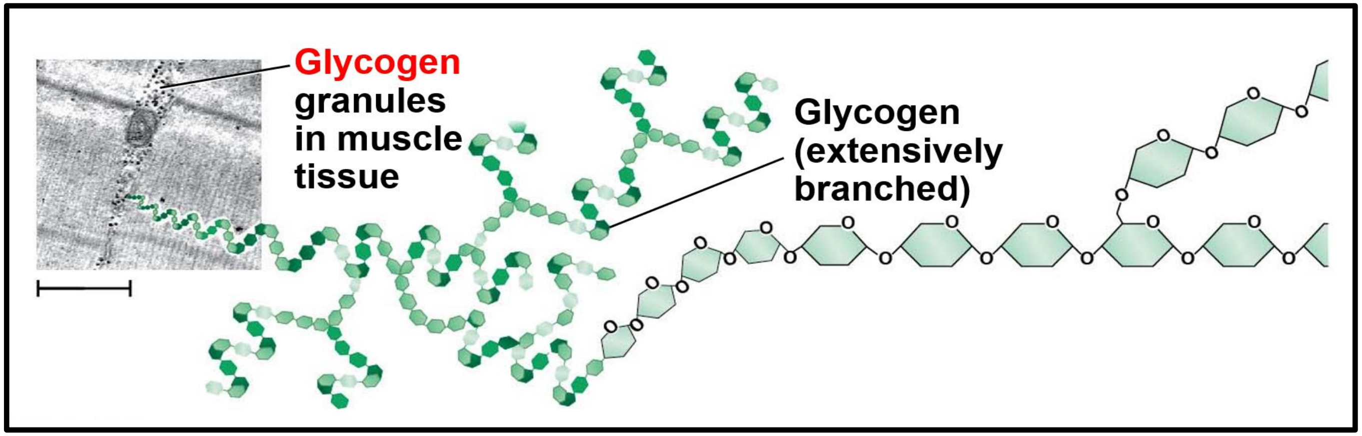


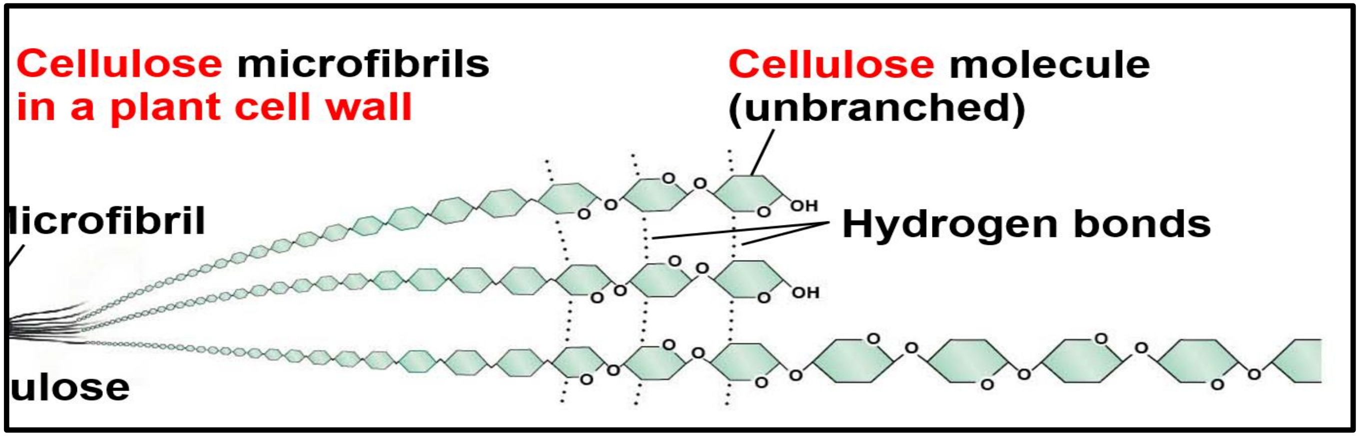
Figure 3.10-s2



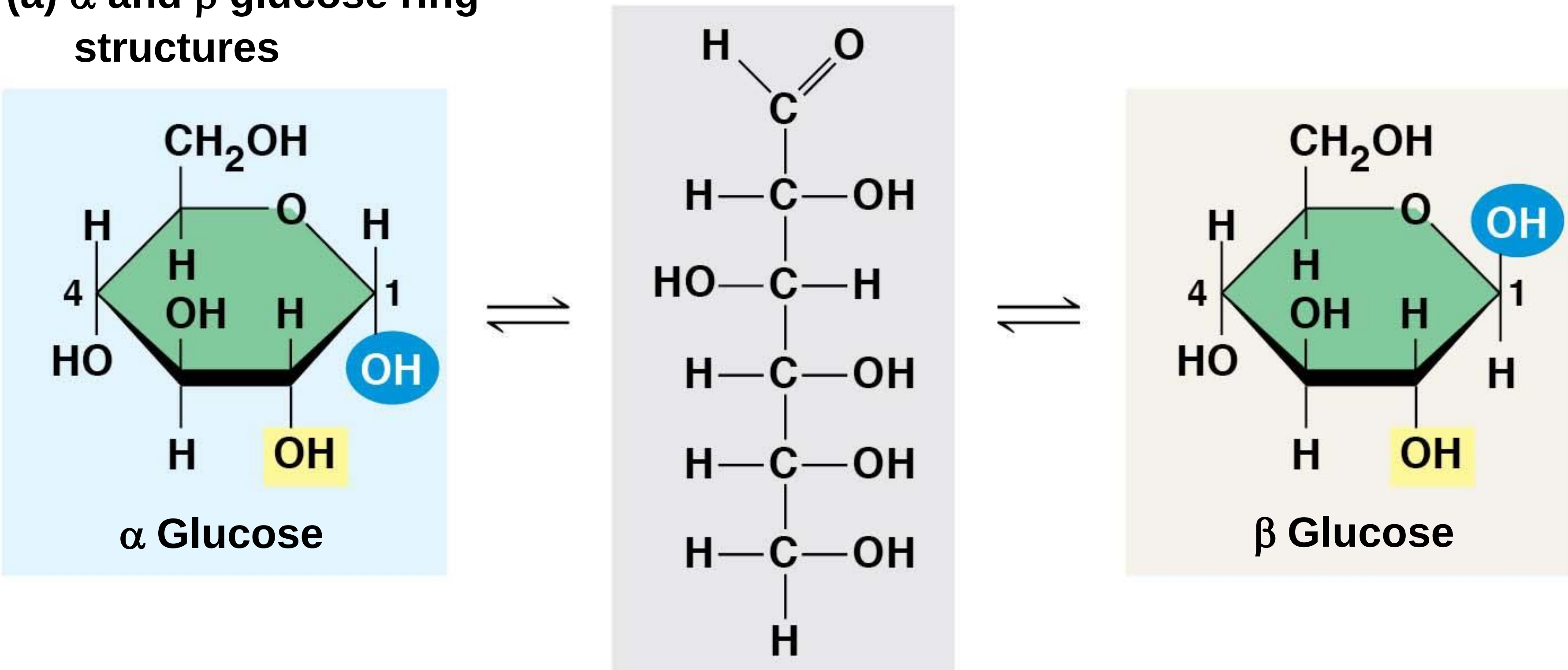
Sucrose


Storage structures (plastids) containing starch granules in a potato tuber cell
Starch (Amylose)
Glucose monomer


Glycogen granules in muscle tissue
Glycogen (extensively branched)

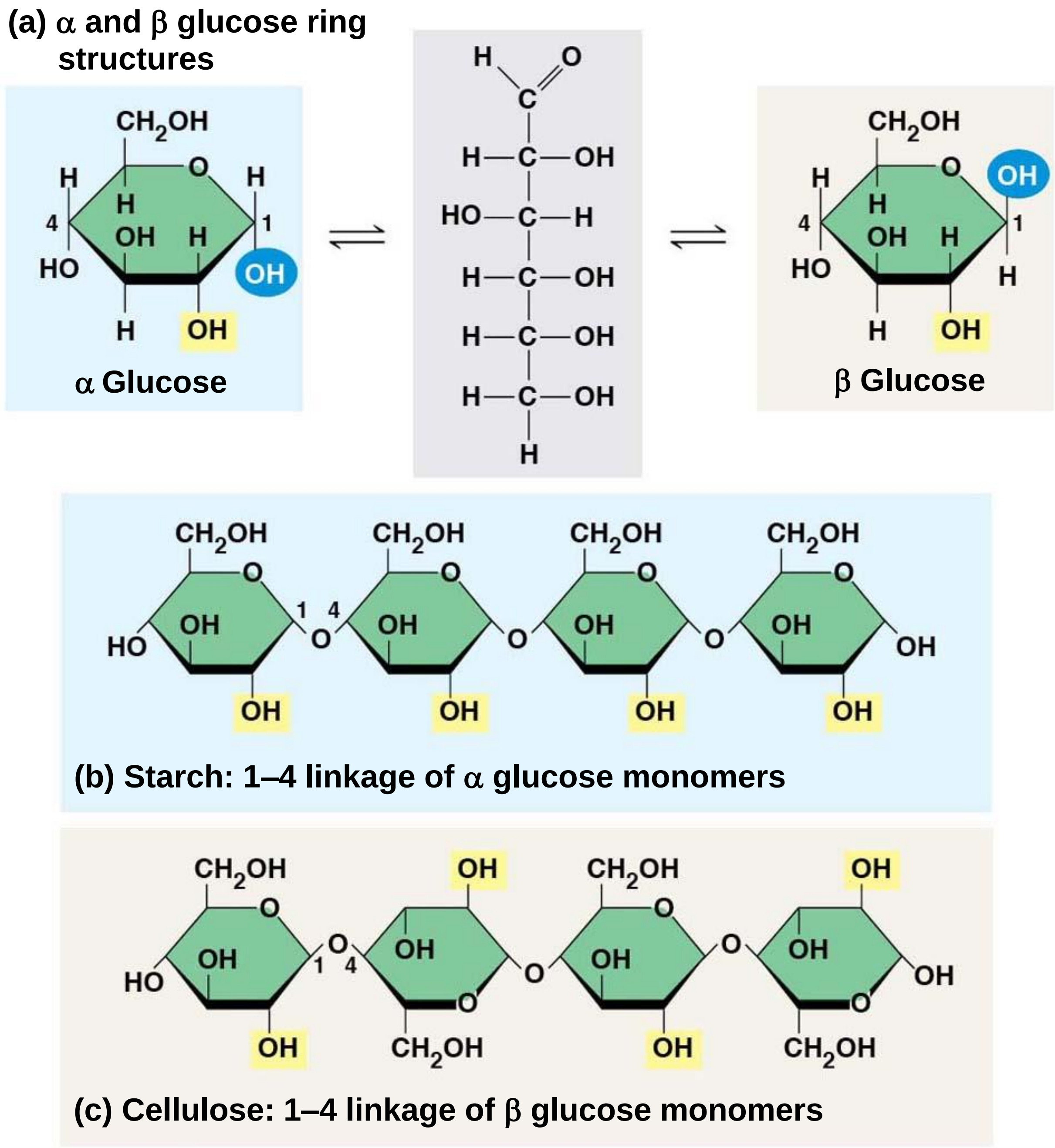

Cellulose microfibrils in a plant cell wall
Cellulose molecule (unbranched)
licrofibril
Hydrogen bonds
OH
OH
ulose

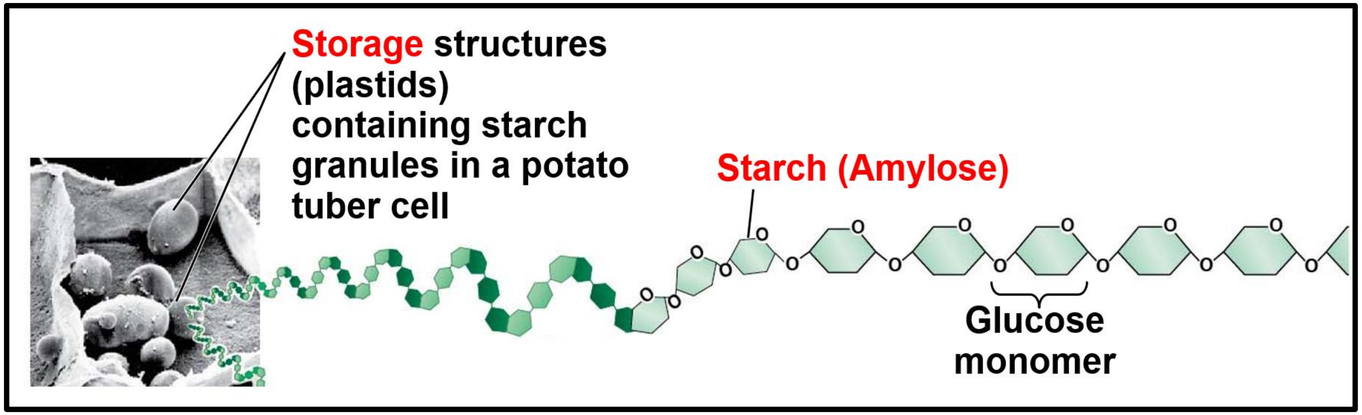
(a) α and β glucose ring structures



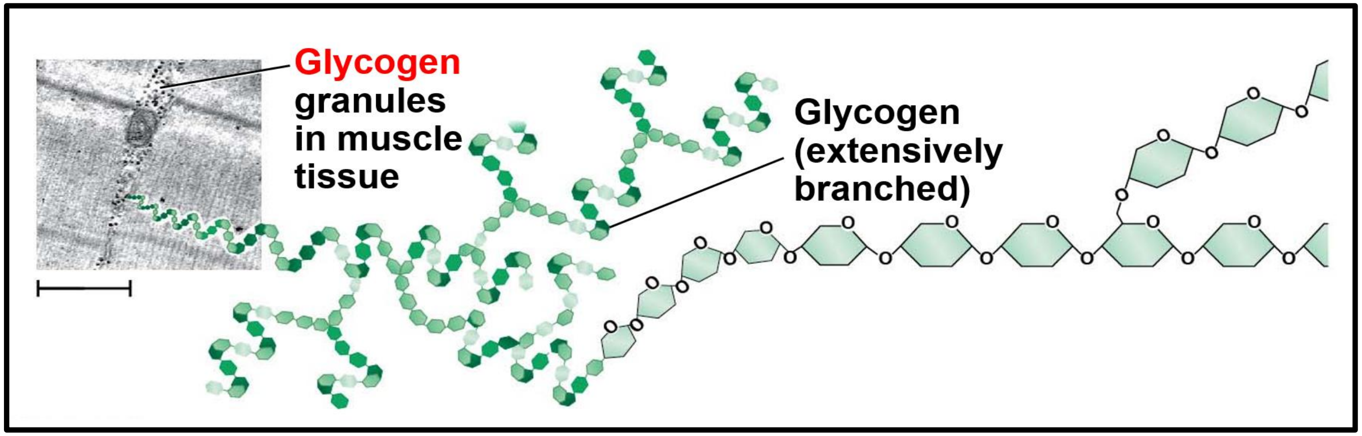
- Keep your polysaccharide intact
- Find 2 alpha (α) glucose and 2 beta (β) glucose molecules
- Combine the monosaccharides in this order **α - β - α – β**
- Compare the two polysaccharides

Figure 3.12

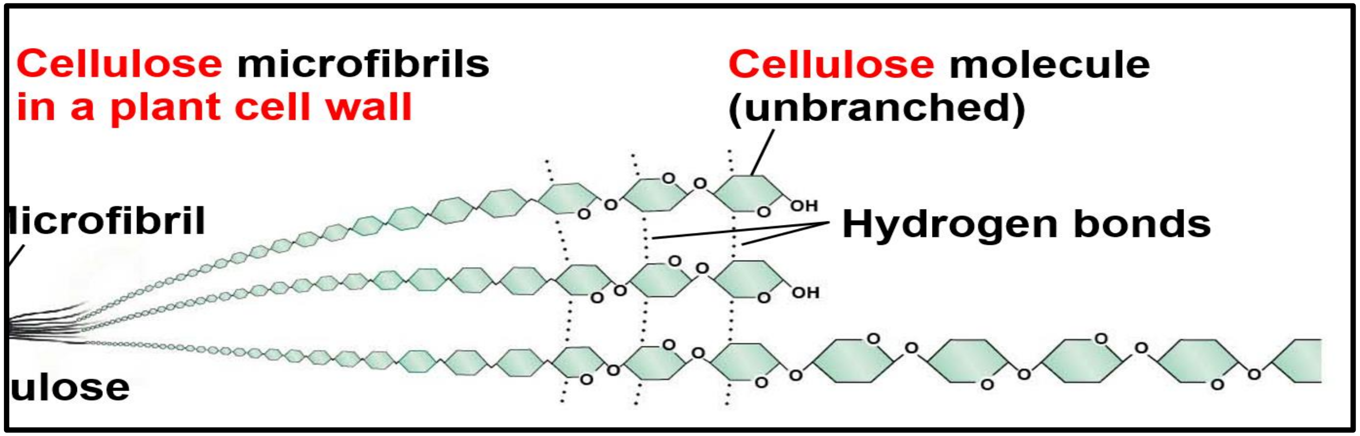

(a) α and β glucose ring structures
α Glucose
β Glucose
(b) Starch: 1–4 linkage of α glucose monomers
(c) Cellulose: 1–4 linkage of β glucose monomers



Storage structures (plastids) containing starch granules in a potato tuber cell
Starch (Amylose)
Glucose monomer



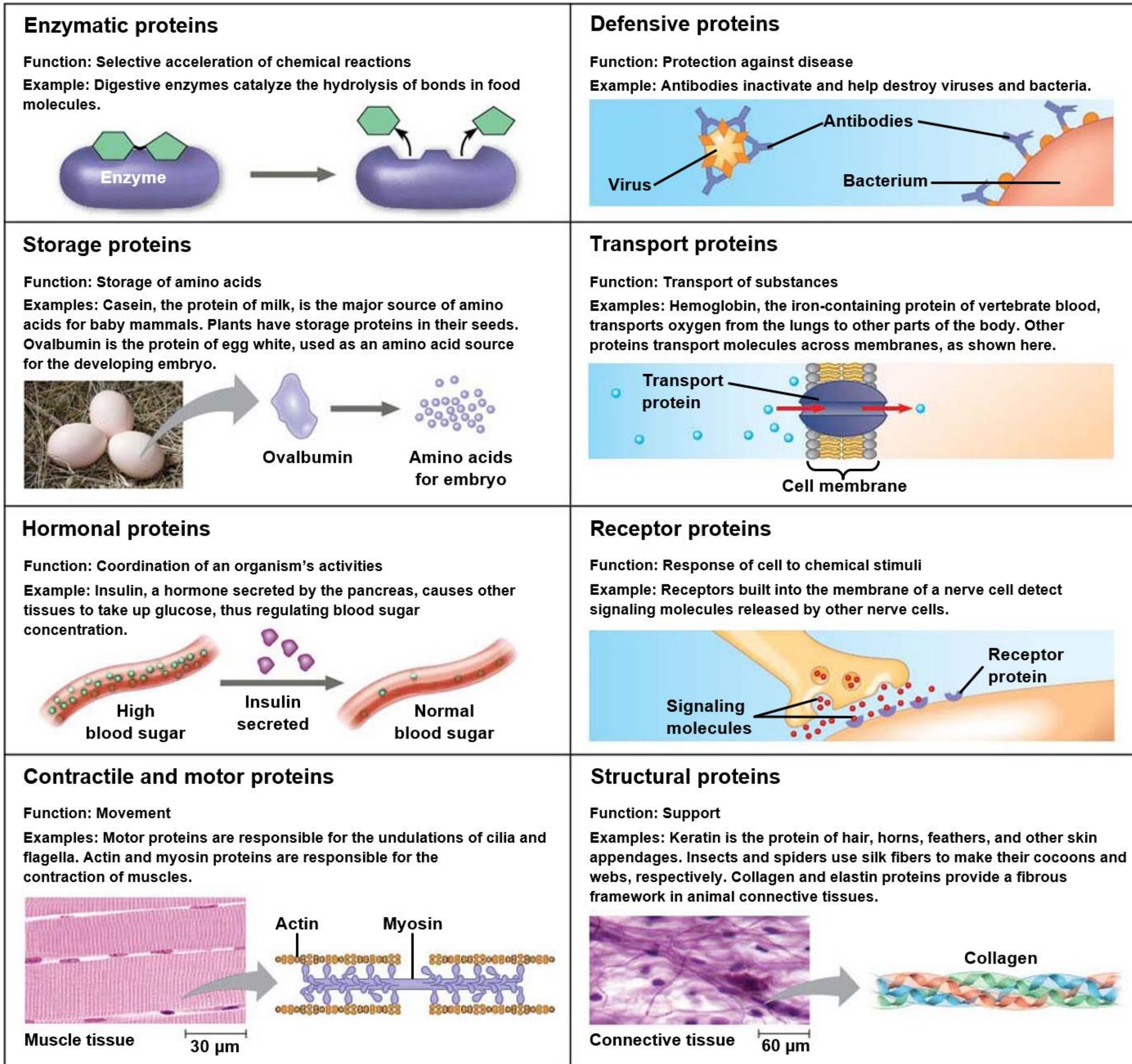
Glycogen granules in muscle tissue
Glycogen (extensively branched)



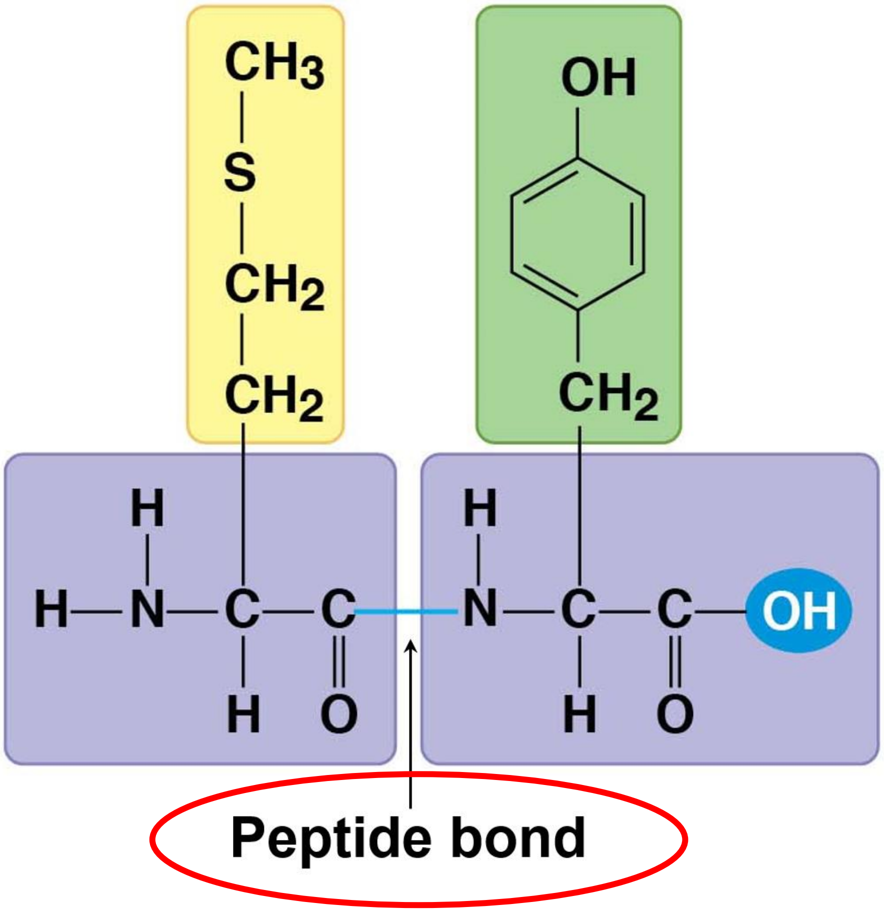
Cellulose microfibrils in a plant cell wall
Cellulose molecule (unbranched)
Microfibril
Hydrogen bonds
ulose

Objective: You will be able to describe the molecular structure of a protein.

Do now:



Dipeptide



- Combine the rest of your amino acids
  - To do this, you must connect the amino group end of the newly joining amino acid to the carboxyl group end of the dipeptide *(remove water)*

- **You created the macromolecule know as a polypeptide or protein**
  - Once the water is removed, notice how you are left with an **N-C-C backbone**

- Compare the **sequence** of your polypeptide with that of your neighbors.
  - This sequence is called its **primary structure**.

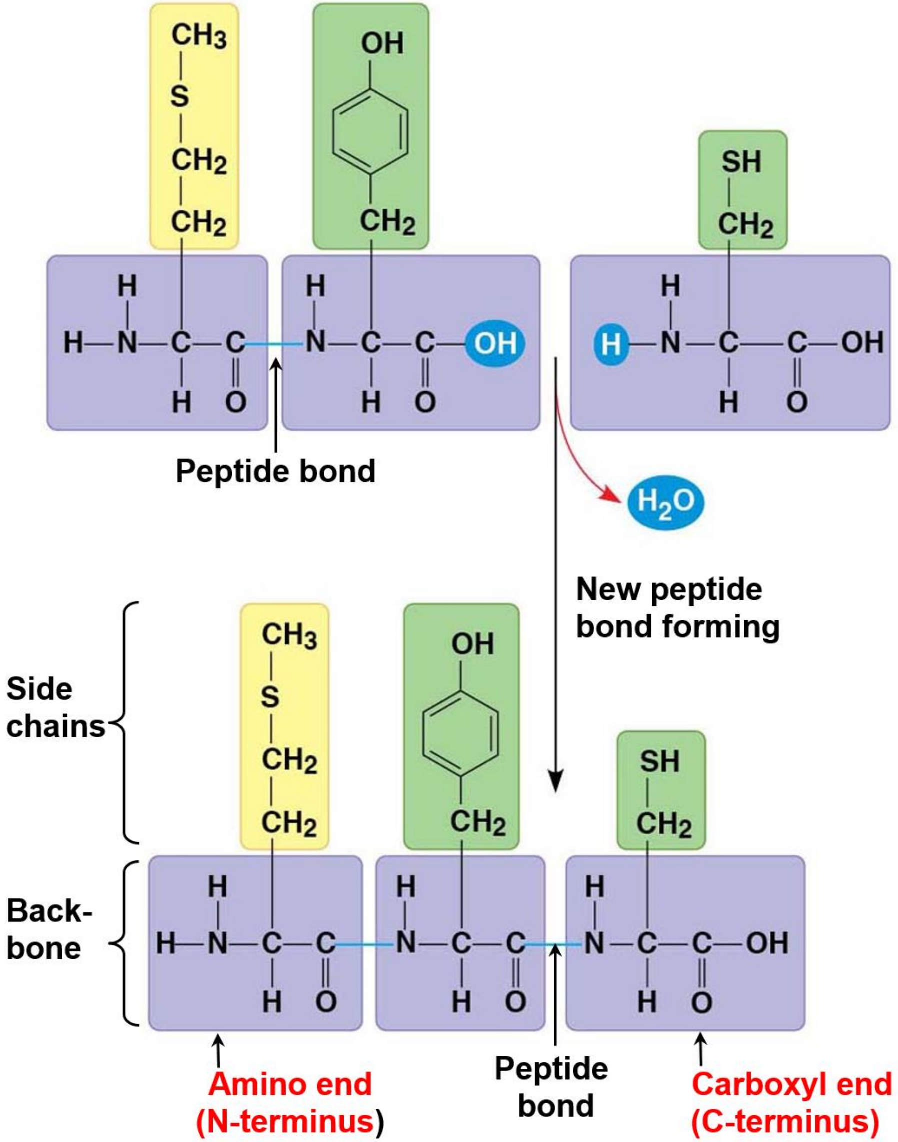


Figure 3.22-1a

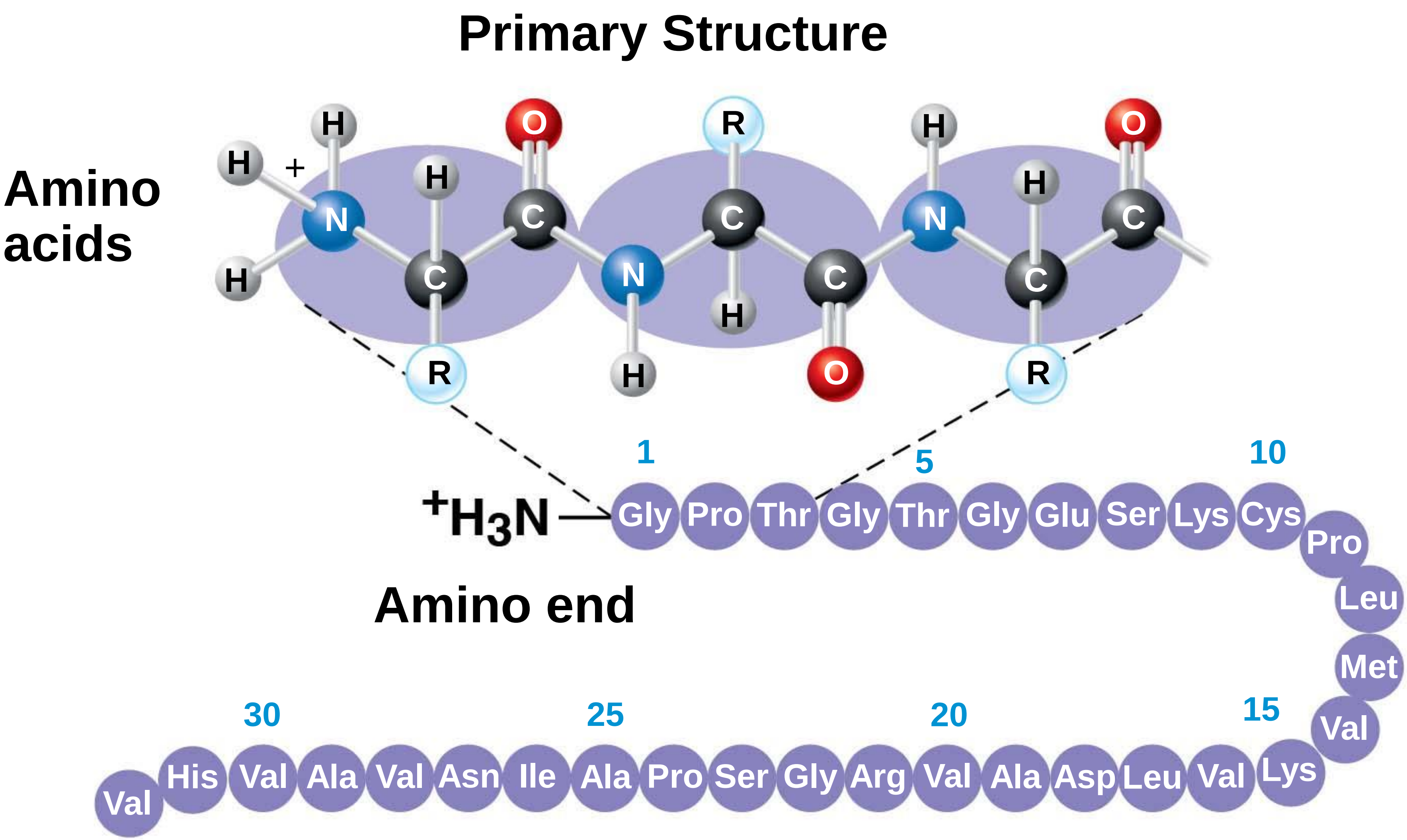
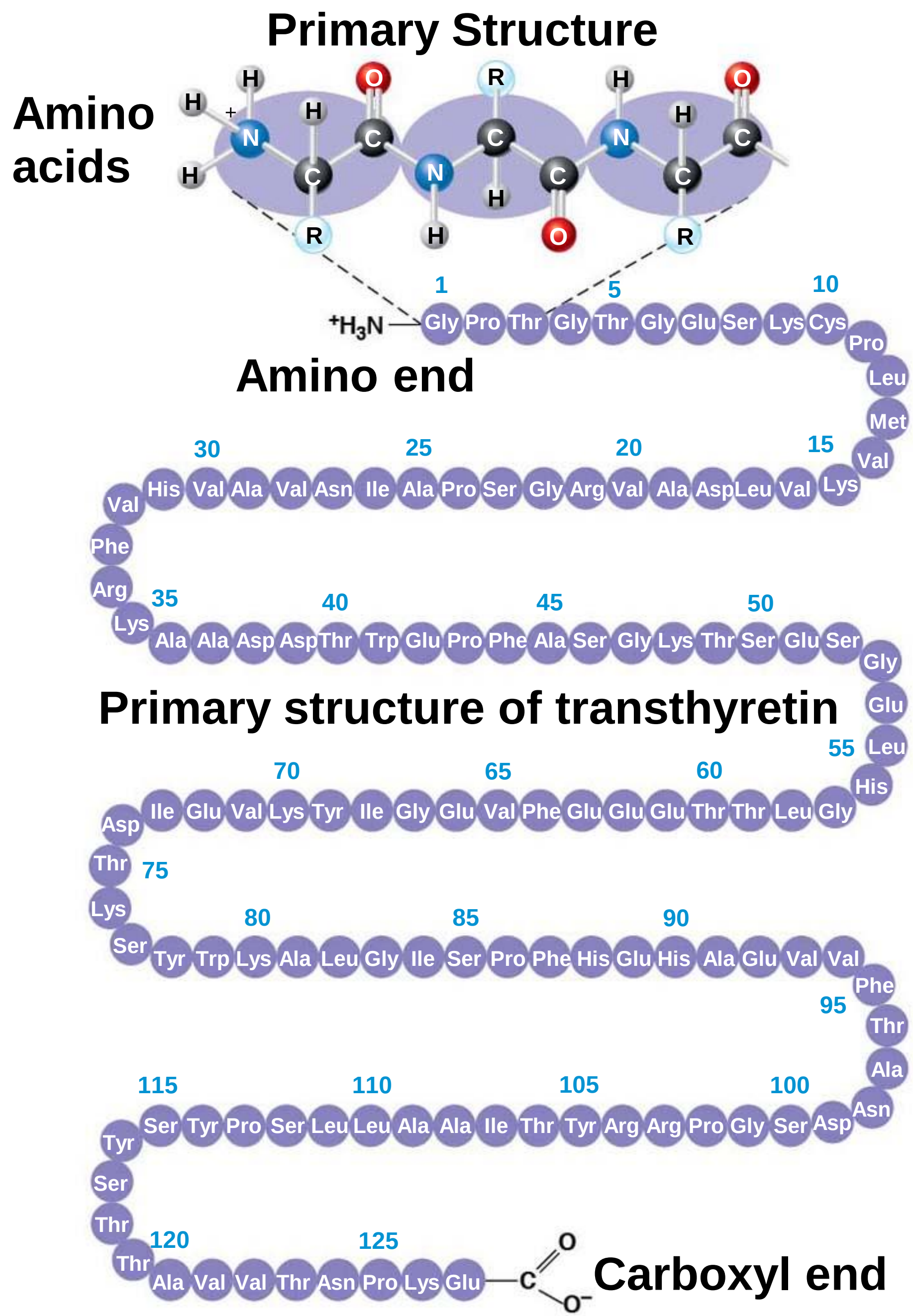
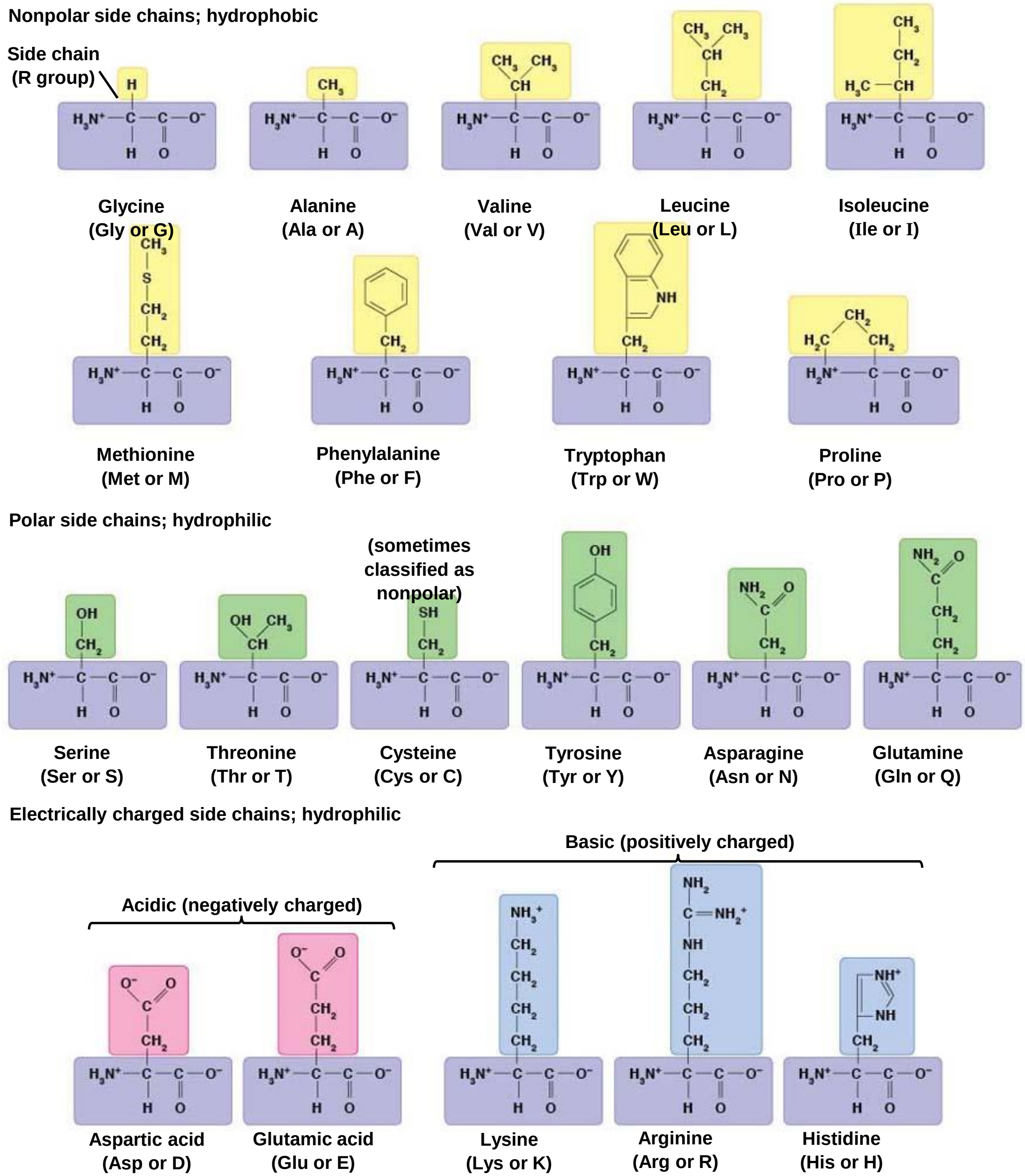


Figure 3.22-1



Primary Structure
Amino acids
Amino end
Primary structure of transthyretin
Carboxyl end
^+H_3N
1 Gly Pro Thr Gly 5 Thr Gly Glu Ser Lys 10 Cys Pro Leu Met Val 15 Lys Val Leu Asp Ala Val 20 Arg Gly Ser Pro 25 Ala Ile Asn Val Ala 30 Val His Val Phe Arg Lys 35 Ala Ala Asp Asp 40 Thr Trp Glu Pro Phe 45 Ala Ser Gly Lys Thr 50 Ser Glu Ser Gly Glu 55 Leu His Gly Leu Thr 60 Thr Glu Glu Glu Phe 65 Val Glu Gly Ile Tyr 70 Lys Val Glu Ile Asp Thr 75 Lys Ser Tyr Trp 80 Lys Ala Leu Gly Ile 85 Ser Pro Phe His Glu 90 His Ala Glu Val Val Phe 95 Thr Ala Asn Asp 100 Ser Gly Pro Arg Arg 105 Tyr Thr Ile Ala Ala 110 Leu Leu Ser Pro Tyr 115 Ser Tyr Ser Thr Thr 120 Ala Val Val Thr Asn 125 Pro Lys Glu

Figure 3.18


Nonpolar side chains; hydrophobic
Side chain (R group)
Glycine (Gly or G)
Alanine (Ala or A)
Valine (Val or V)
Leucine (Leu or L)
Isoleucine (Ile or I)
Methionine (Met or M)
Phenylalanine (Phe or F)
Tryptophan (Trp or W)
Proline (Pro or P)
Polar side chains; hydrophilic
(sometimes classified as nonpolar)
Serine (Ser or S)
Threonine (Thr or T)
Cysteine (Cys or C)
Tyrosine (Tyr or Y)
Asparagine (Asn or N)
Glutamine (Gln or Q)
Electrically charged side chains; hydrophilic
Basic (positively charged)
Acidic (negatively charged)
Aspartic acid (Asp or D)
Glutamic acid (Glu or E)
Lysine (Lys or K)
Arginine (Arg or R)
Histidine (His or H)

Protein Conformation

- A protein's 3-D shape, conformation, is ultimately determined by the primary structure (sequence of bases).

- The function of a protein is completely dependent on its structure.

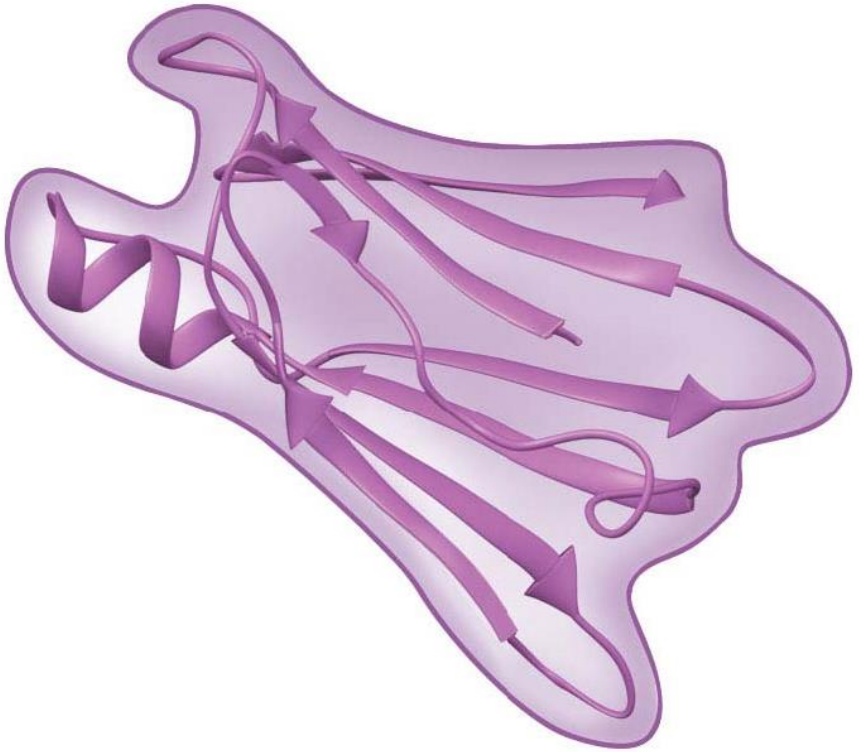
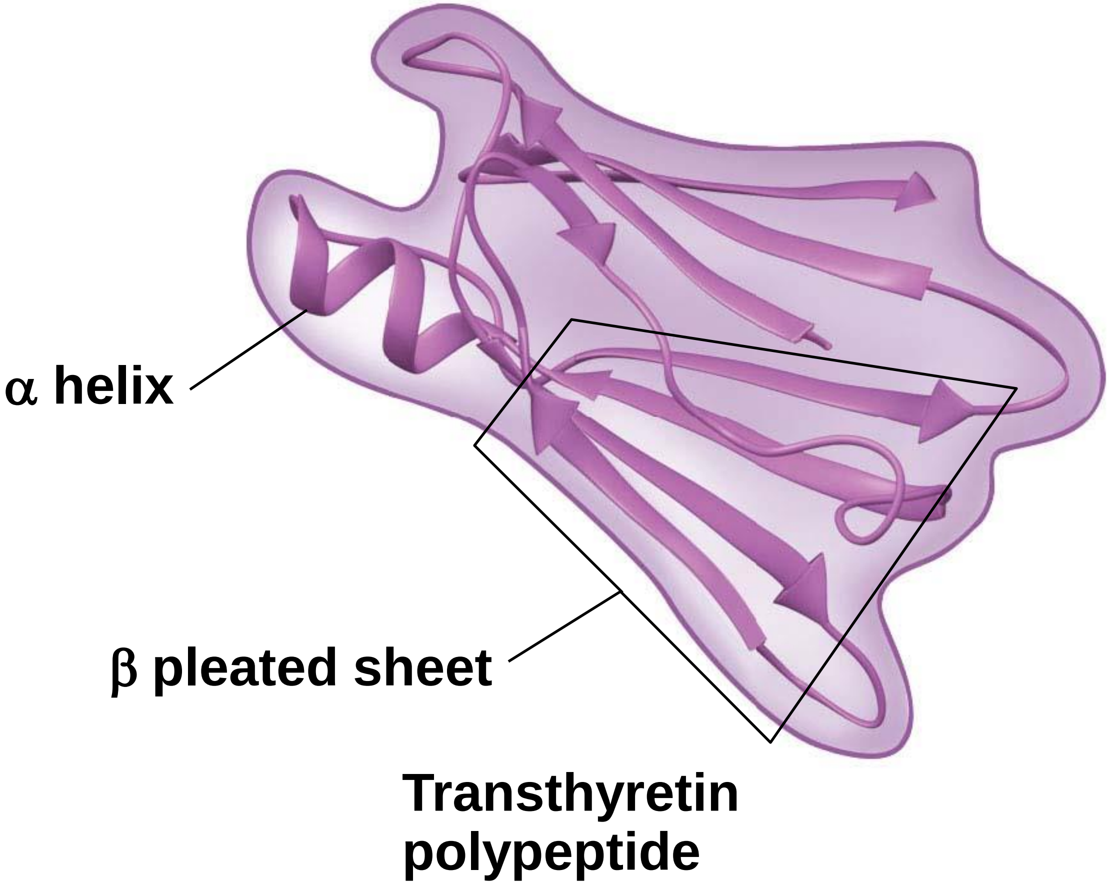
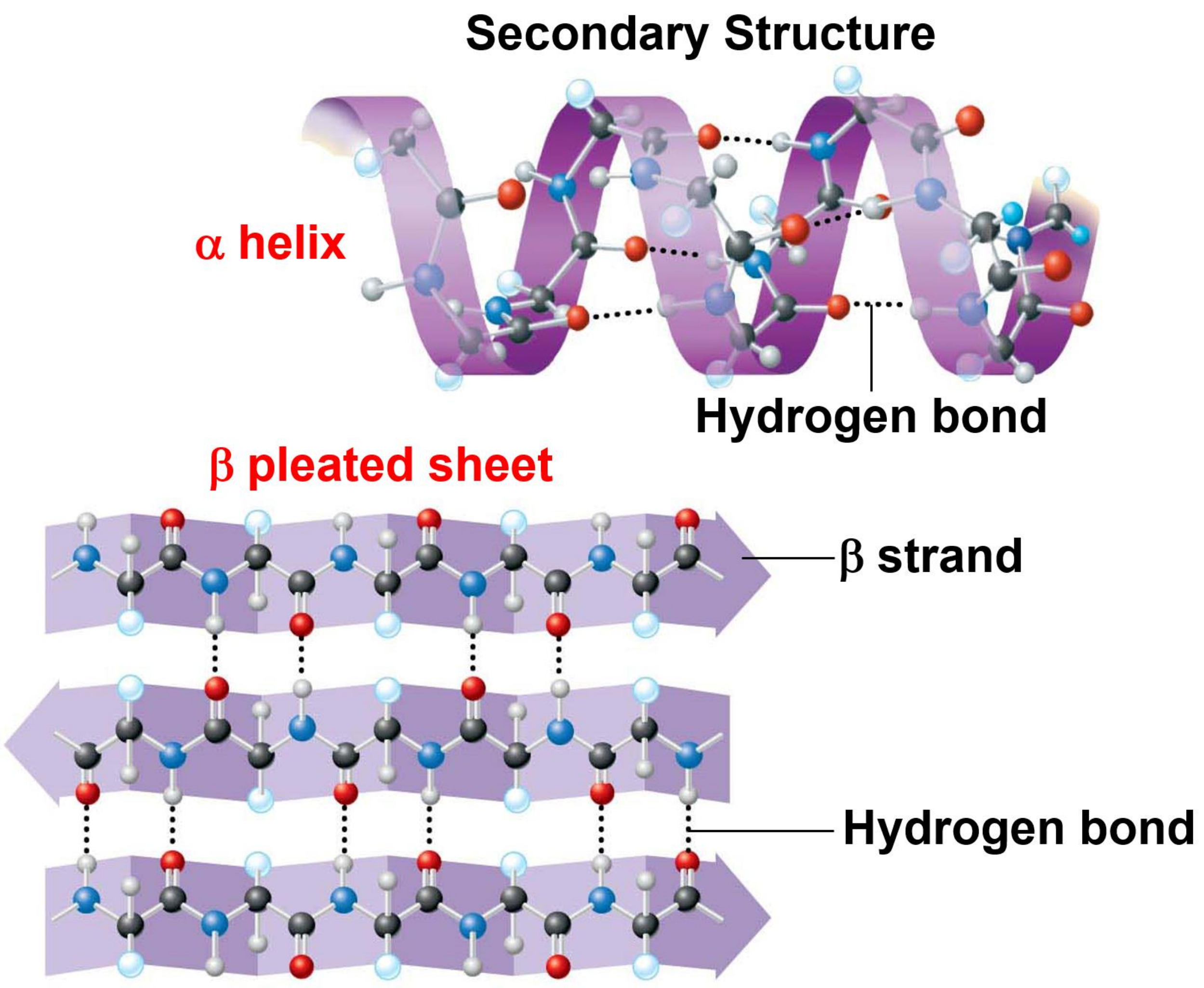


Figure 3.22-3

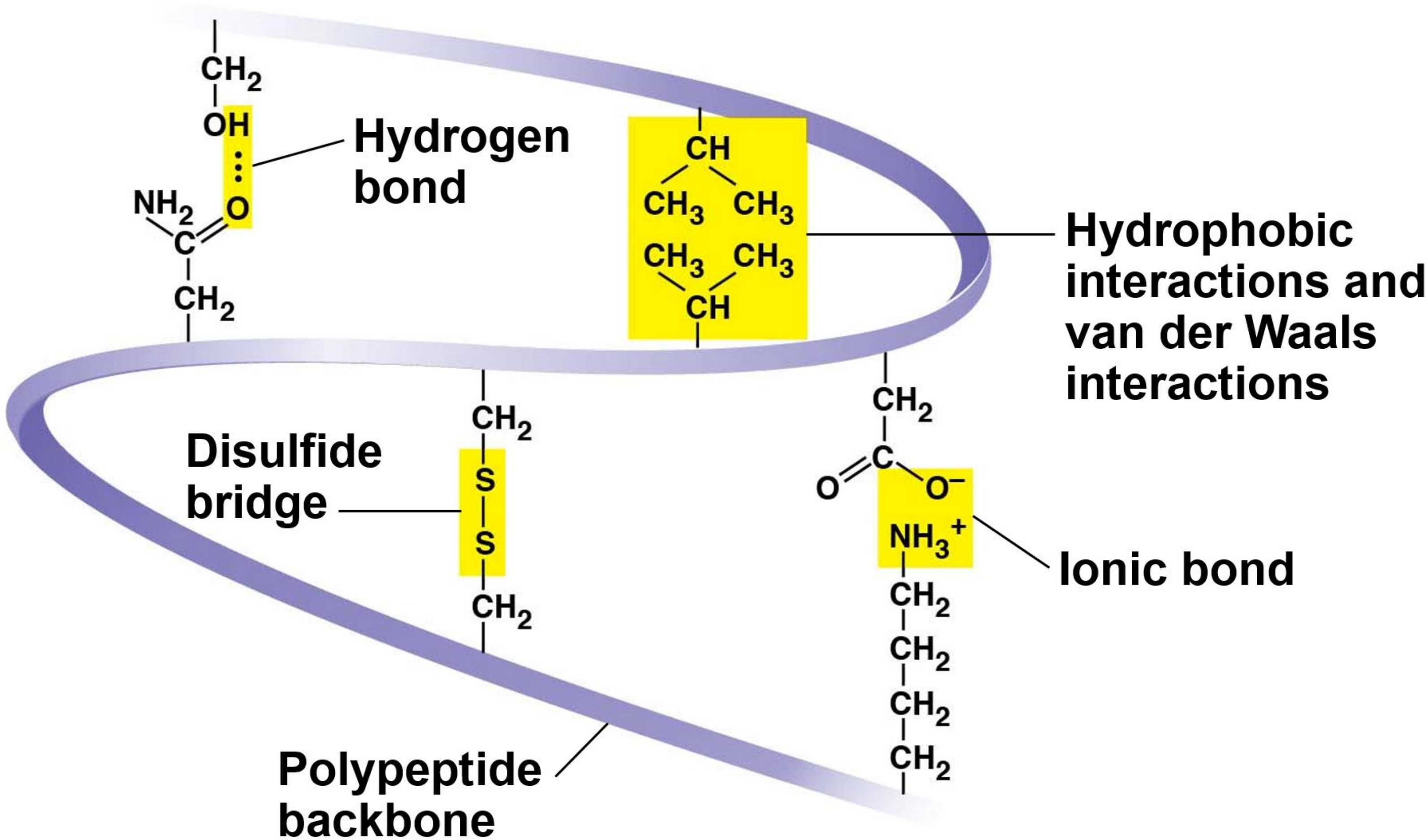
Polypeptide Shape





Primary structure determines the protein's conformation because it "puts" the amino acids in the specific sequence to cause the helixes and sheets to form.

Tertiary Structure



Primary structure determines the protein's conformation because it "puts" the amino acids in the specific sequence to cause the interactions between side chains.

Figure 3.22-3

Polypeptide Shape

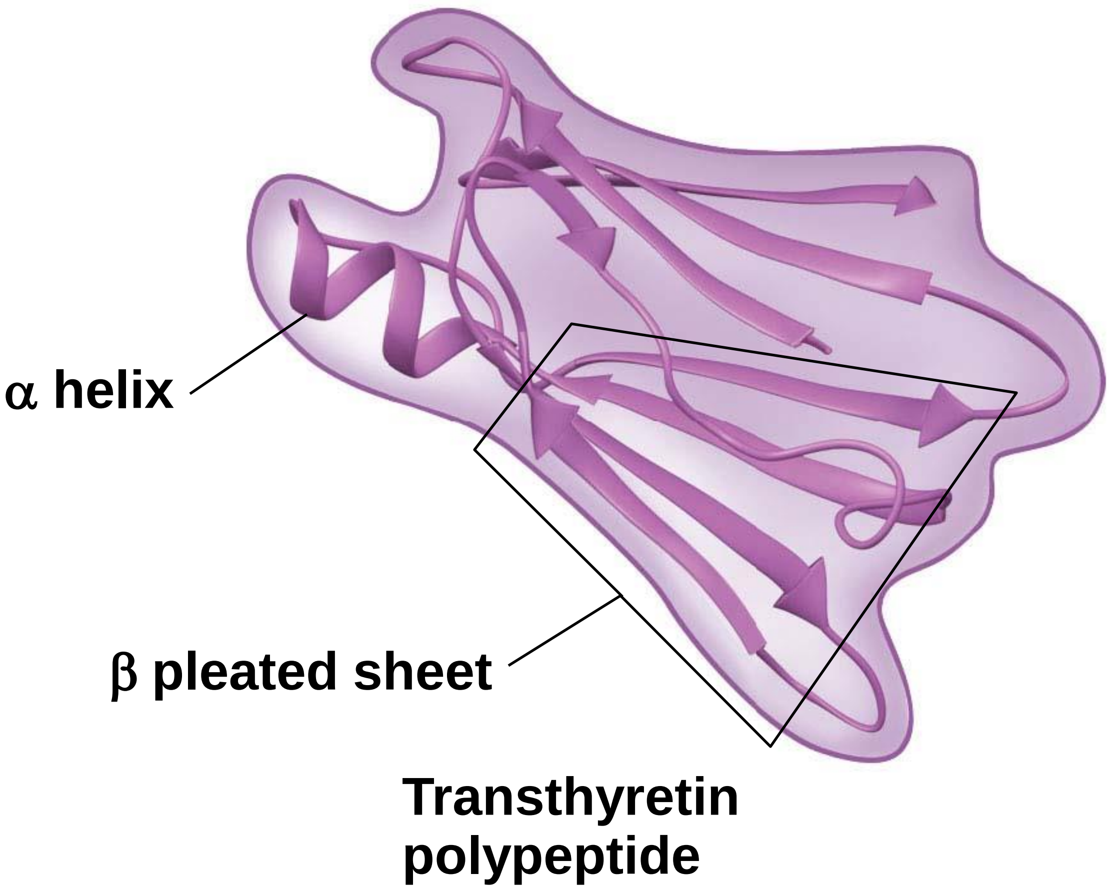
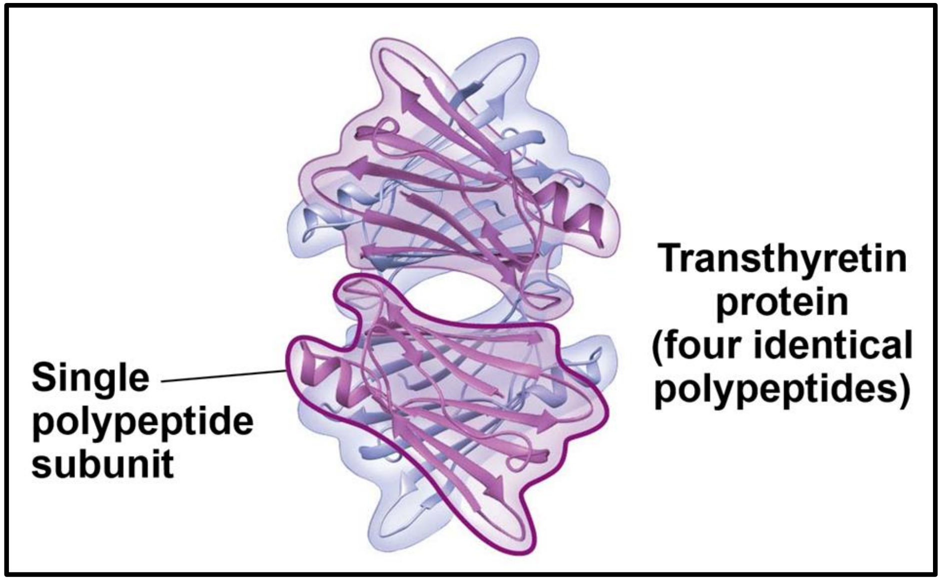
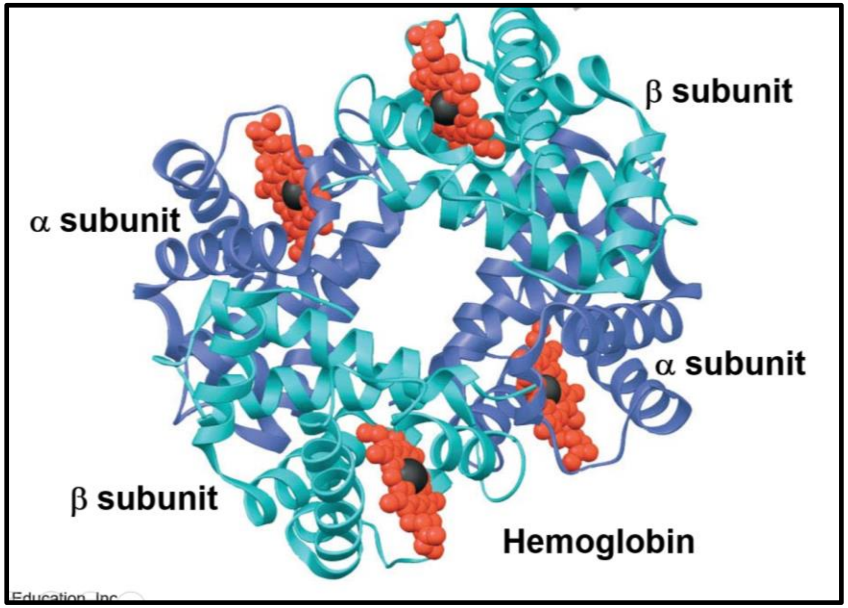
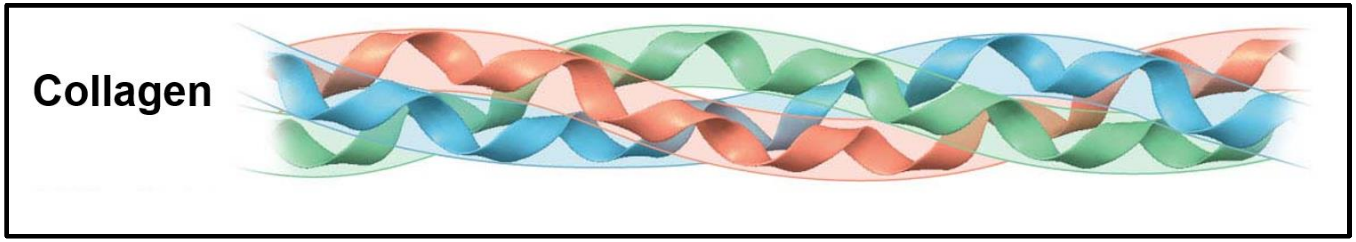


Figure 3.22-4

Quaternary structure







These proteins all have a specific shape to perform a specific function.

Impact of changing the primary structure…

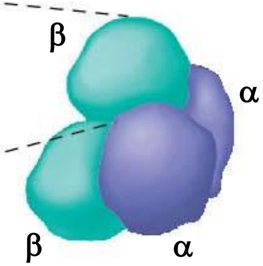
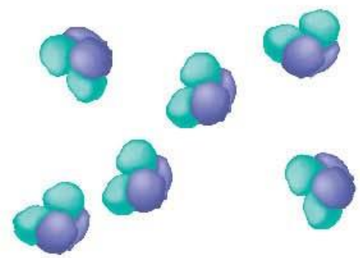
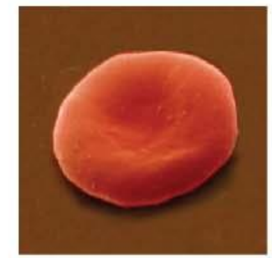
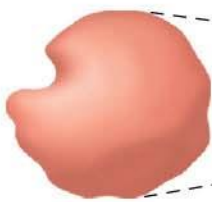
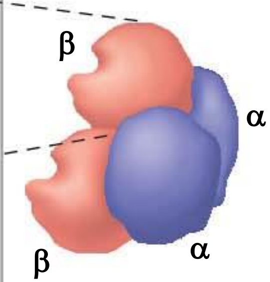
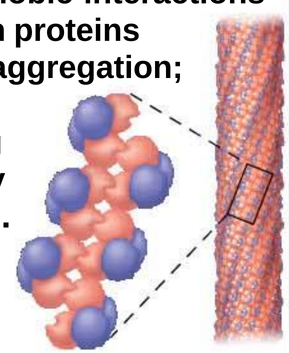
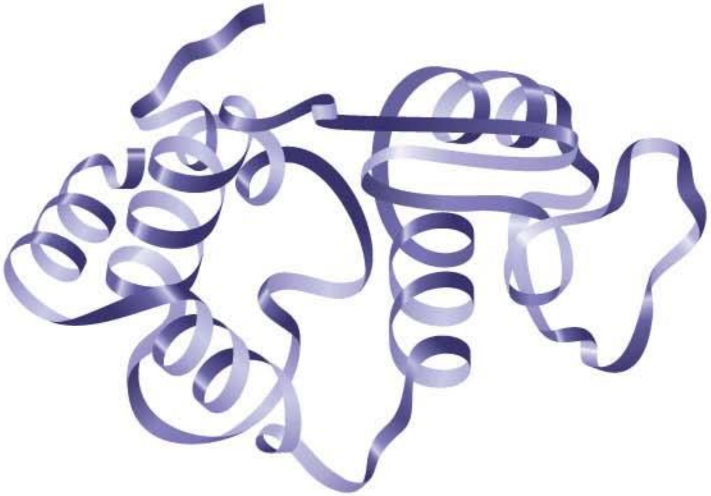
	Primary Structure	Secondary and Tertiary Structures	Quaternary Structure	Function	Red Blood Cell Shape
Normal	1 Val 2 His 3 Leu 4 Thr 5 Pro 6 Glu 7 Glu	Normal β subunit 	Normal hemoglobin  	Proteins do not associate; each carries oxygen. 	Normal red blood cells are full of individual hemoglobin proteins. 
Sickle-cell	1 Val 2 His 3 Leu 4 Thr 5 Pro 6 Val 7 Glu	Sickle-cell β subunit 	Sickle-cell hemoglobin  	Hydrophobic interactions between proteins lead to aggregation; oxygen carrying capacity reduced. 	Fibers of abnormal hemoglobin deform red blood cell into sickle shape. 

Figure 3.24-s1



Normal protein

Figure 3.24-s2

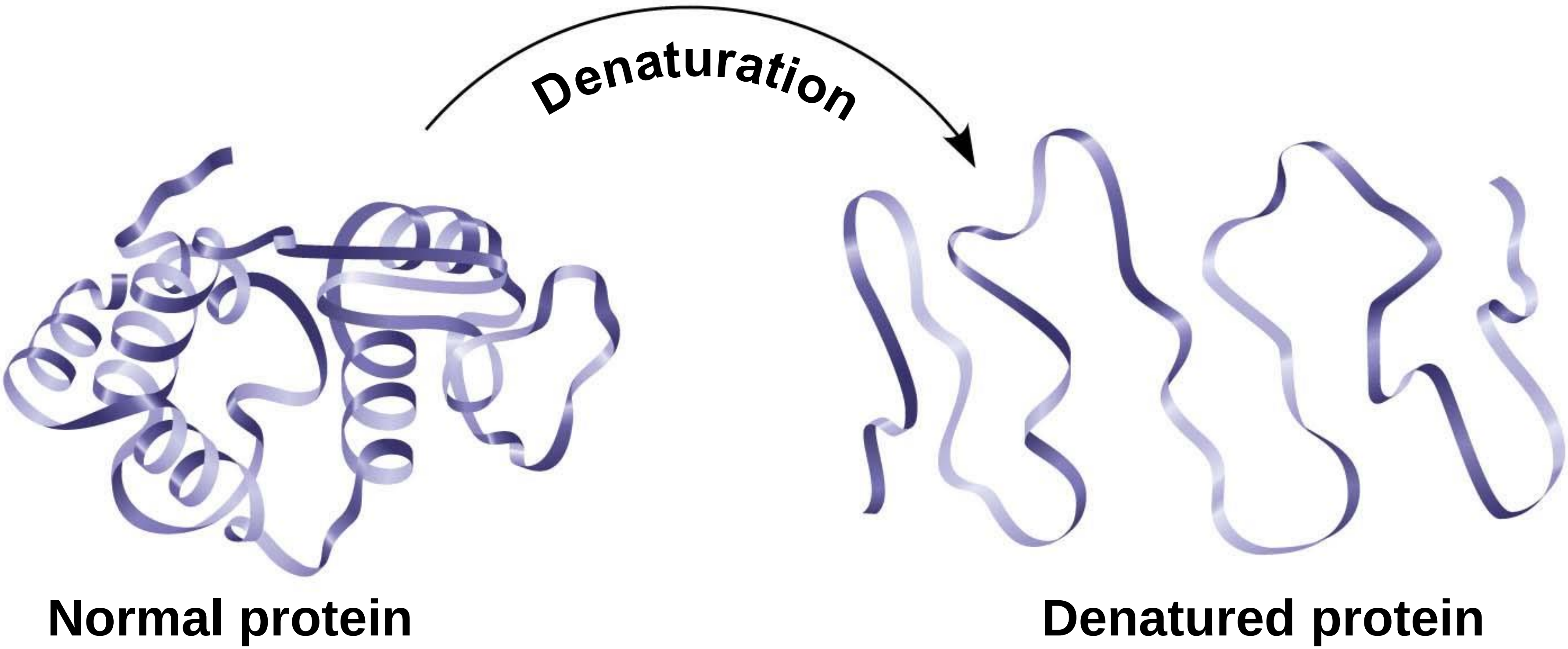
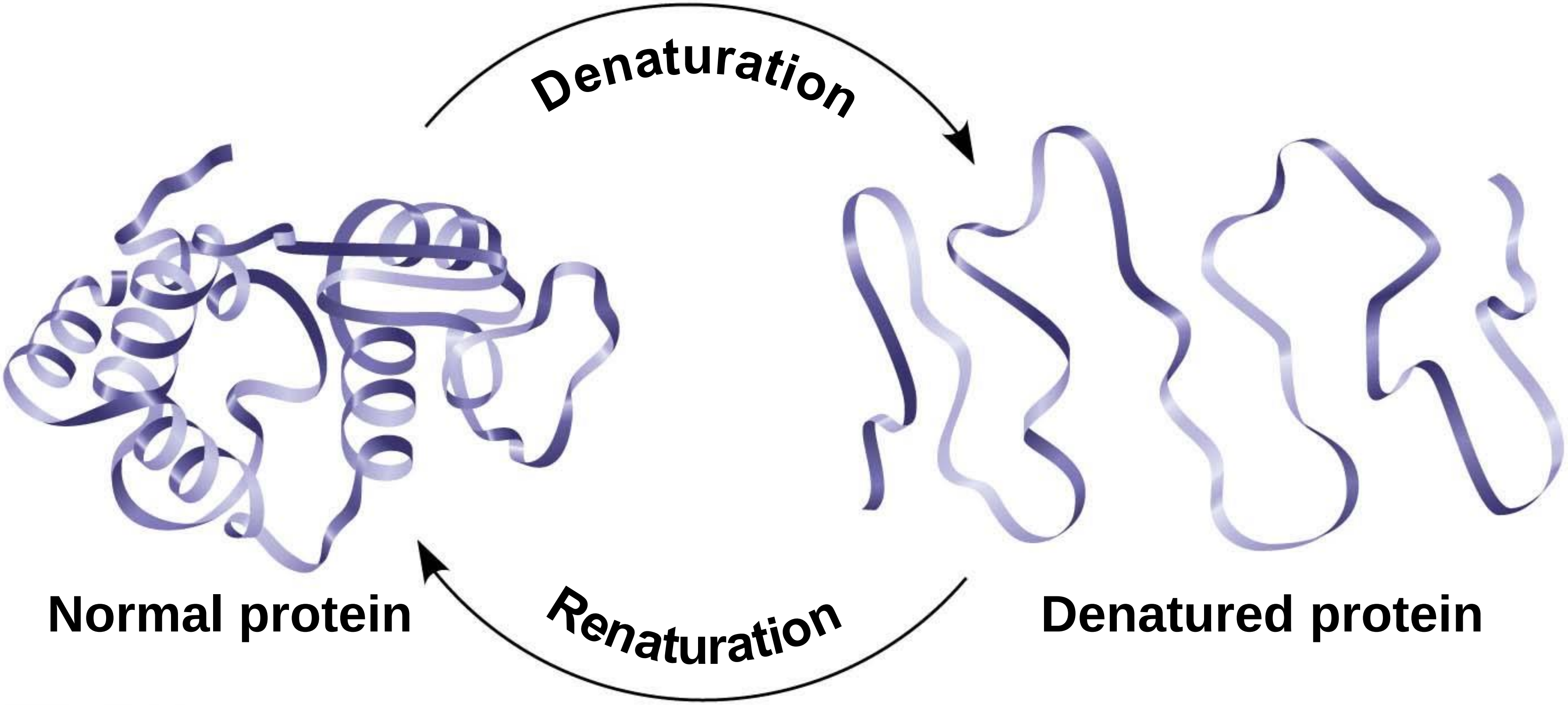


Figure 3.24-s3

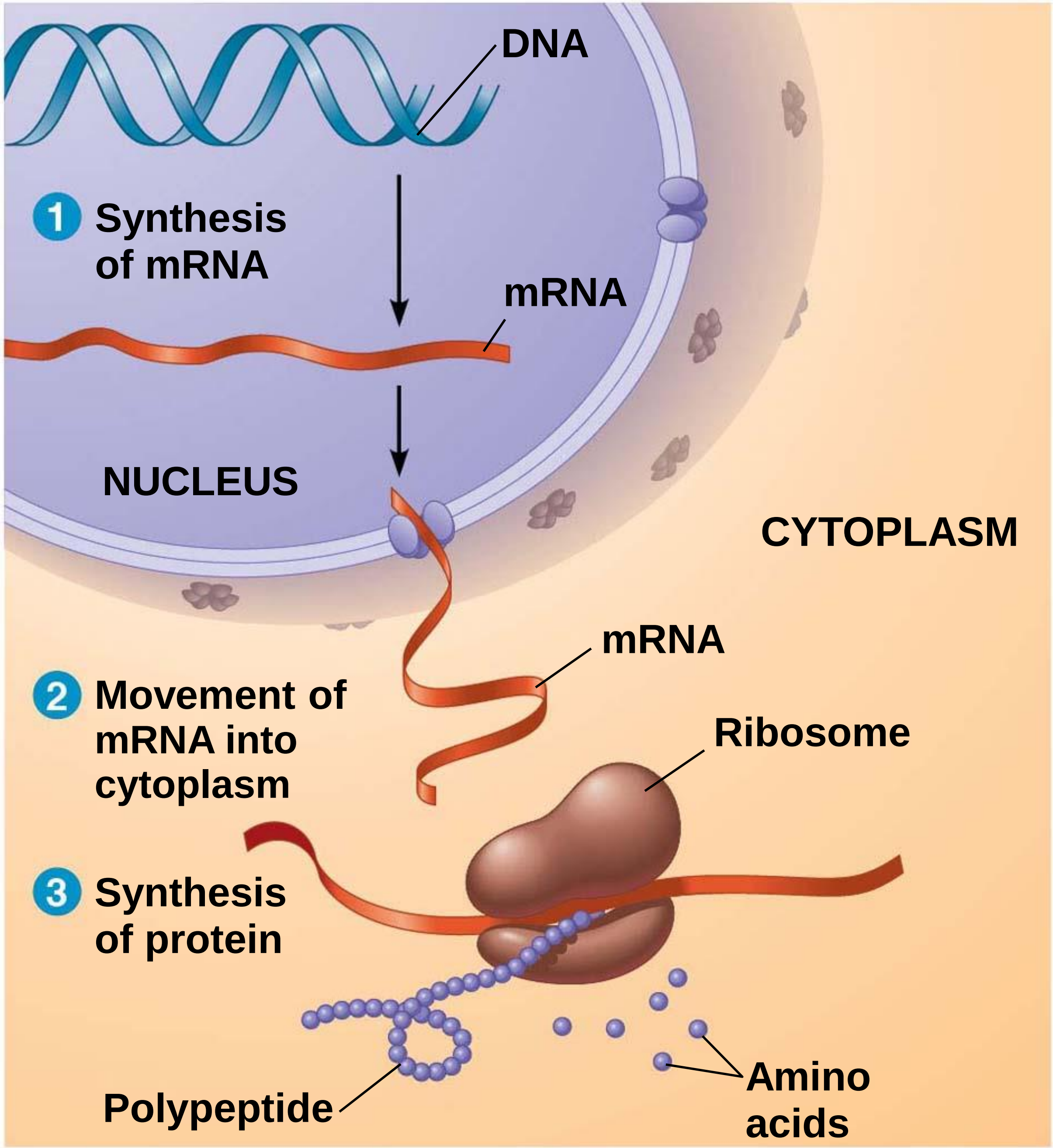


Objective: You will be able to describe the molecular structure of nucleic acids.

Do now:

- In nucleic acids, biological information is encoded in the sequences of nucleotide monomers.

Figure 3.26-s3



The monomer of nucleic acids are called nucleotides

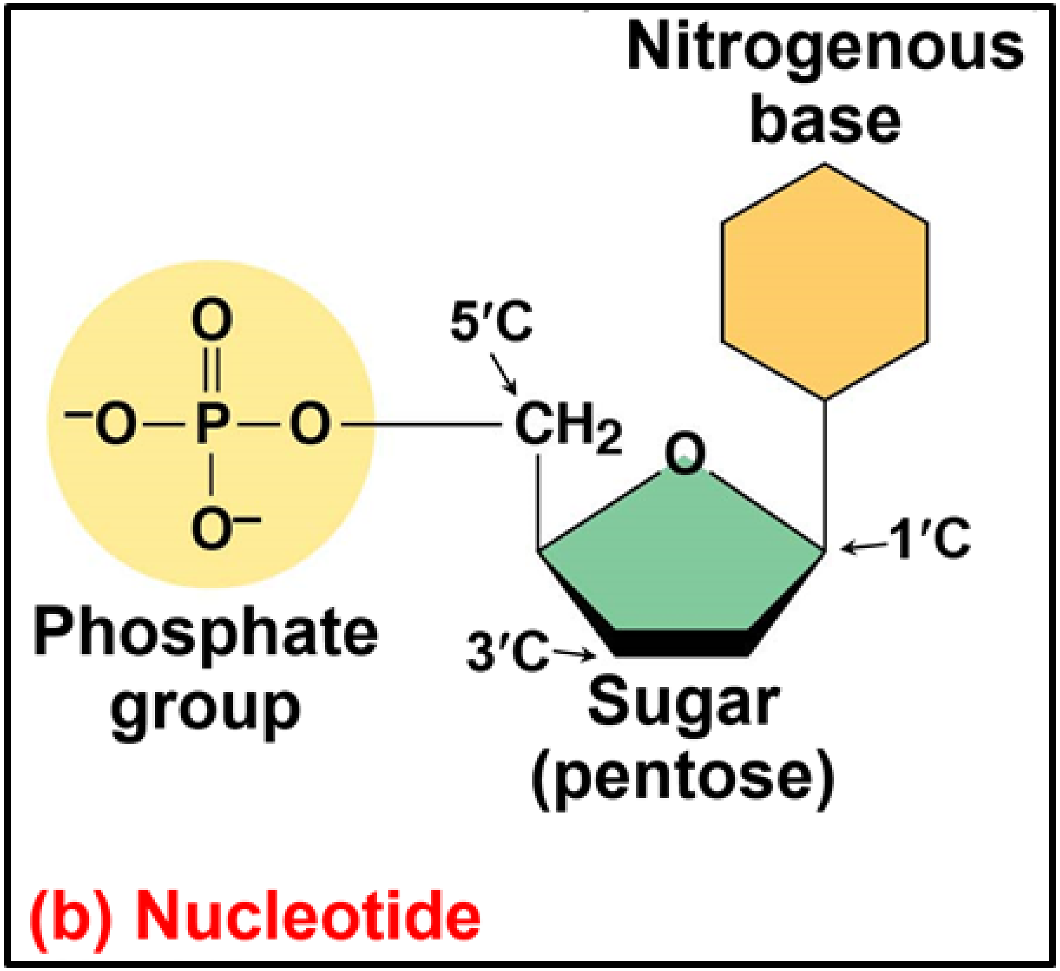
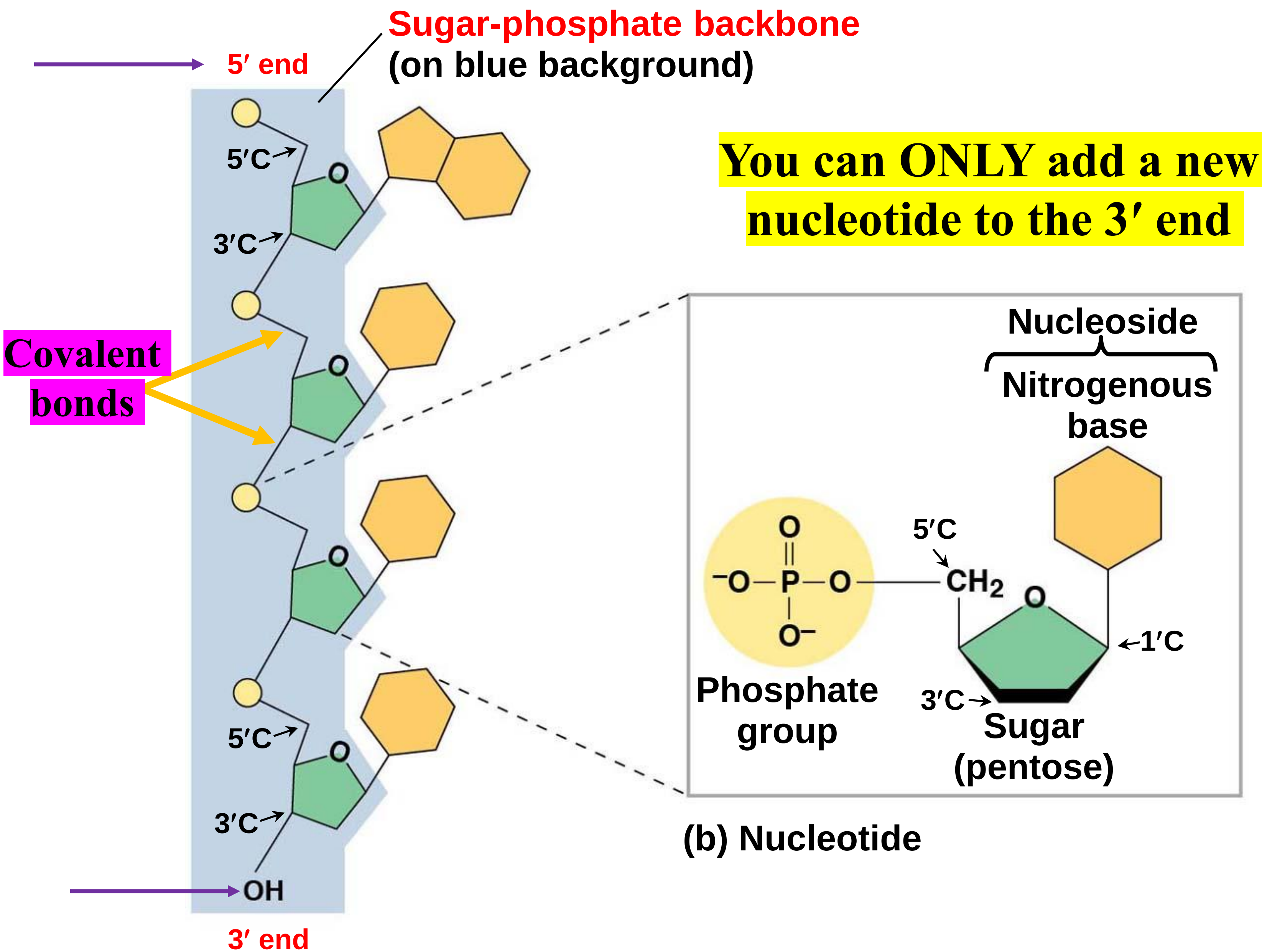


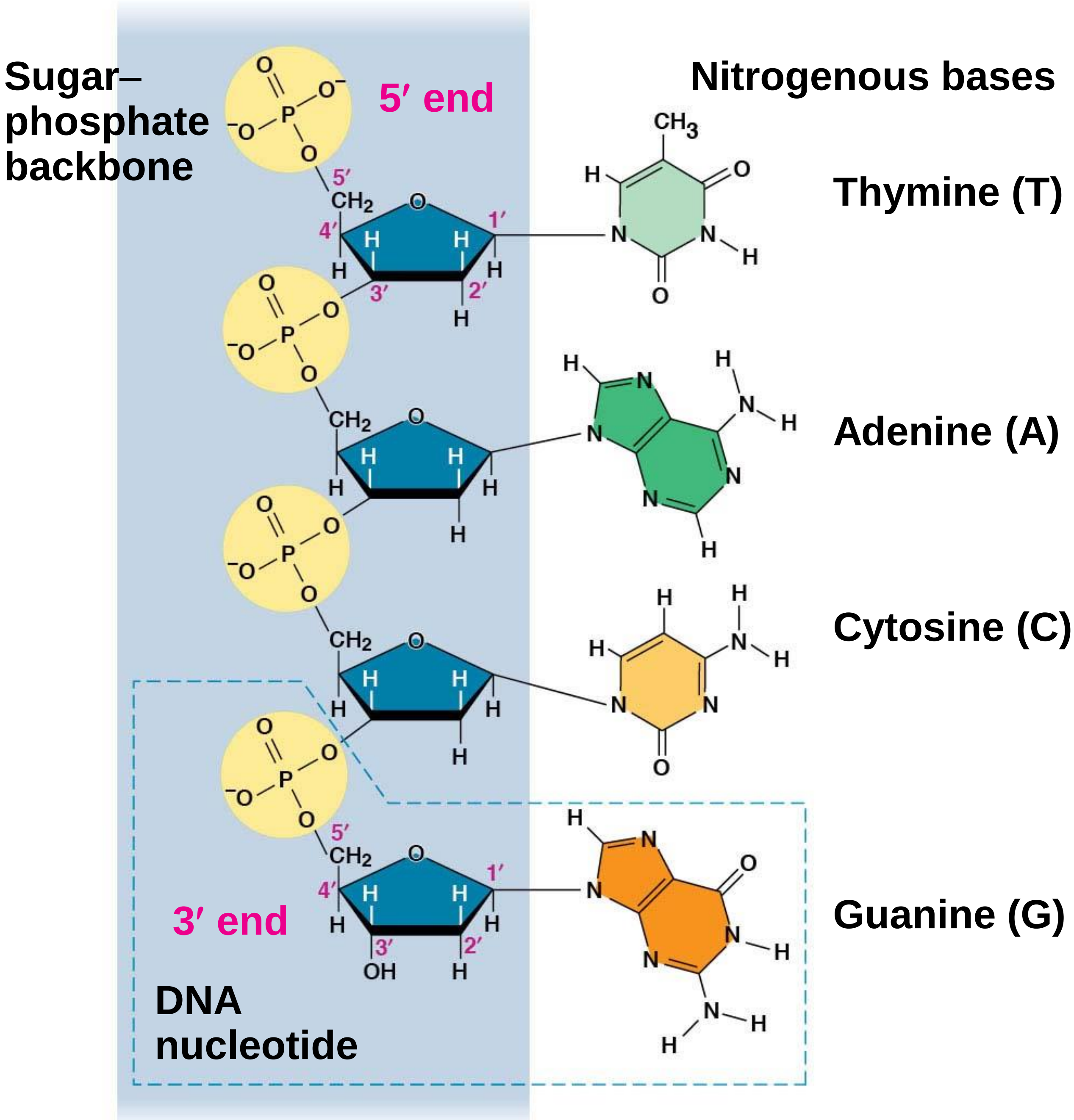
Figure 3.27-1



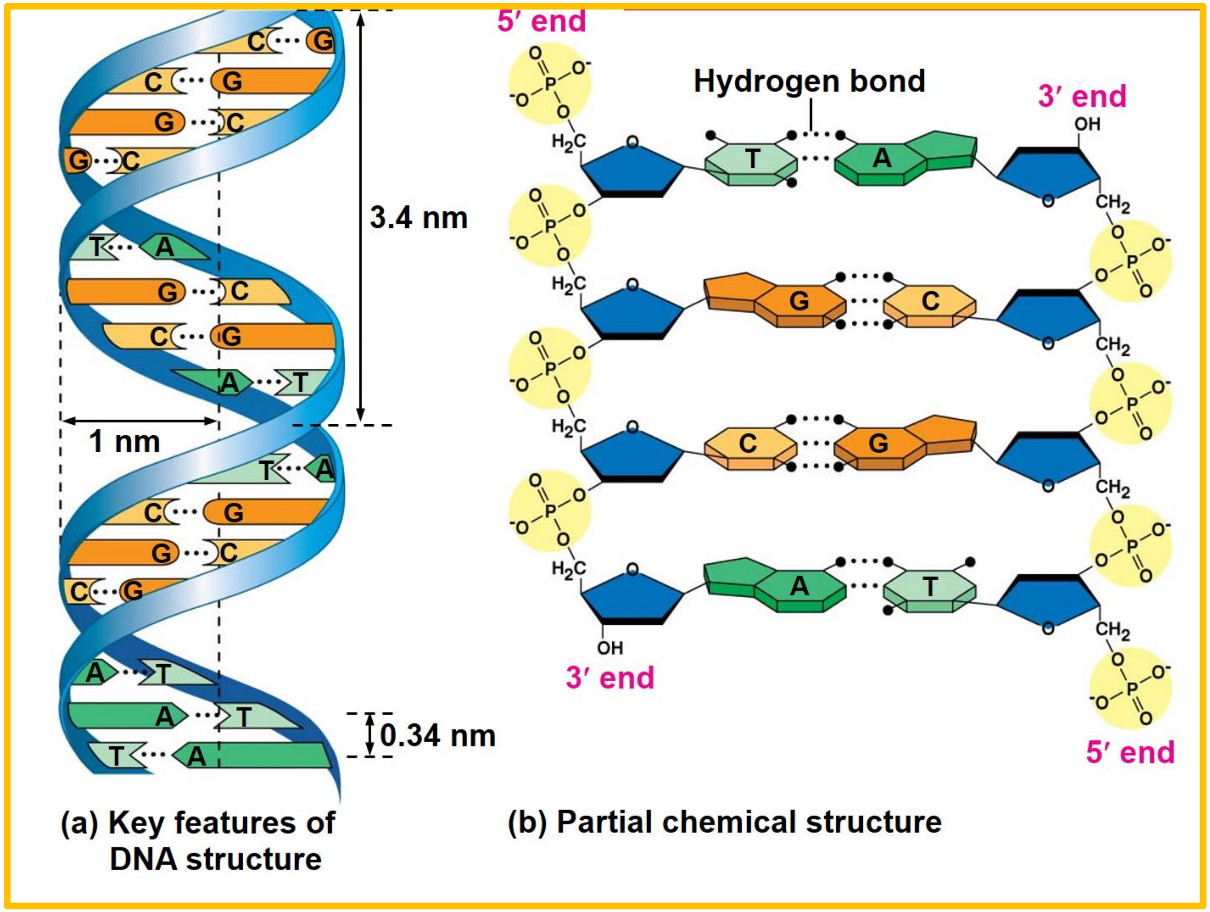
(b) Nucleotide

(a) Polynucleotide, or nucleic acid

Figure 13.6


Sugar–phosphate backbone
5′ end
Nitrogenous bases
Thymine (T)
Adenine (A)
Cytosine (C)
Guanine (G)
3′ end
DNA nucleotide
CH3
CH2
OH
5′
4′
3′
2′
1′

- DNA is double stranded with 2 anti-parallel strands



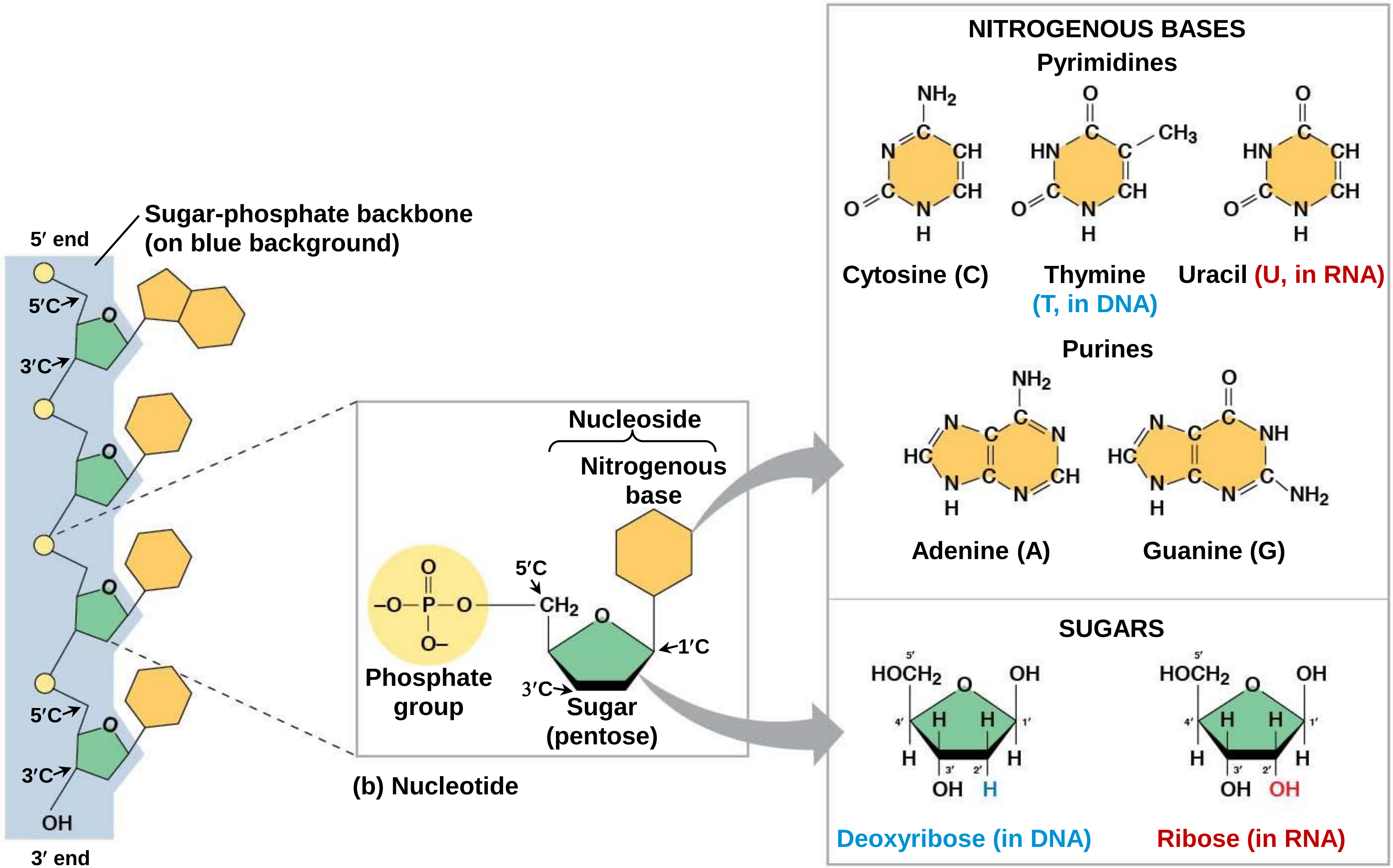
- Information is stored within the DNA molecule <u>due to the sequence of bases</u>.

Objective: You will be able to describe the molecular structure of DNA and RNA.

Do now:

- List what you can remember about the structure of DNA

Figure 3.27



(a) Polynucleotide, or nucleic acid

(b) Nucleotide

(c) Nucleoside components

Figure 3.26-s3

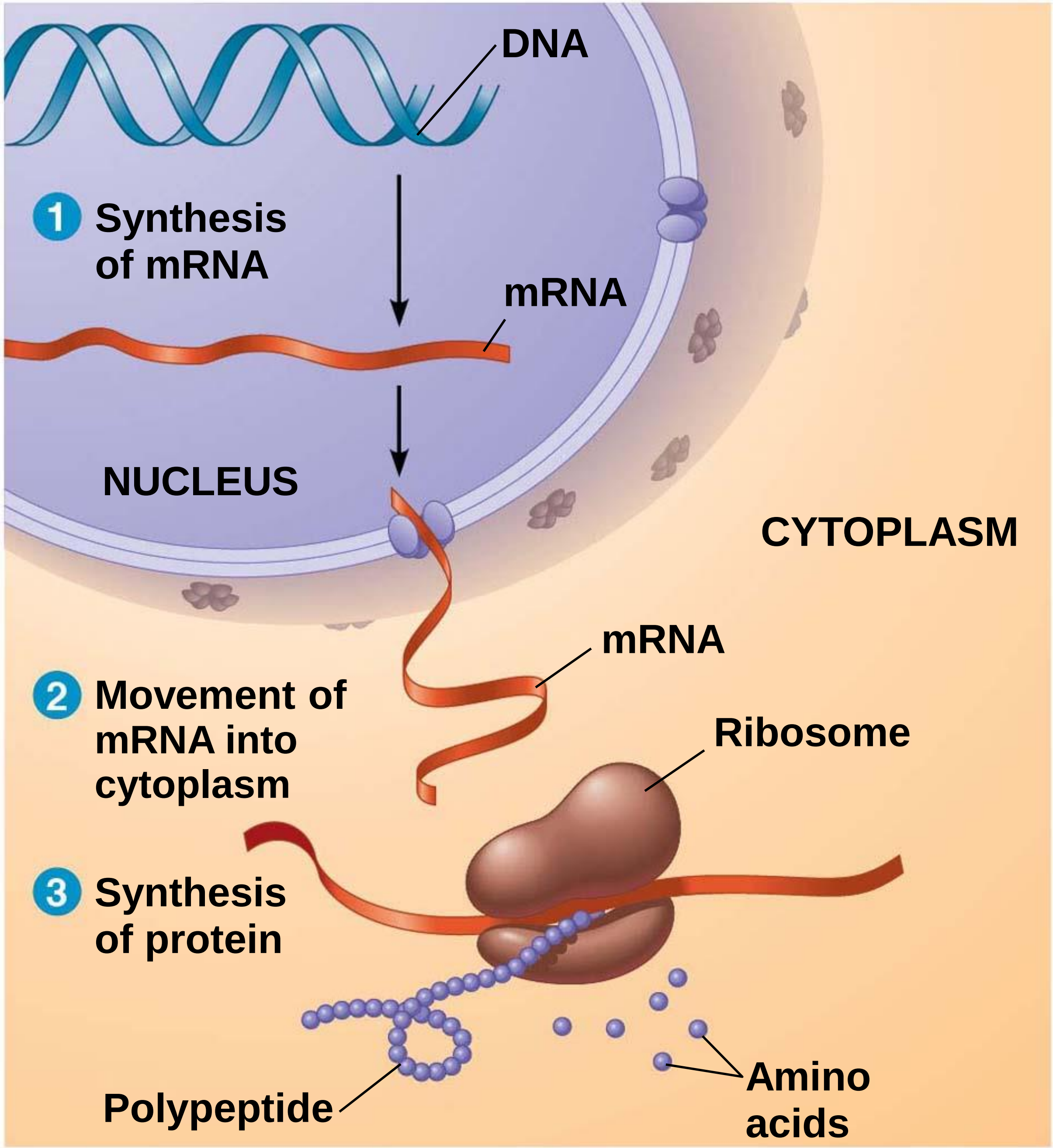


Figure 3.UN08

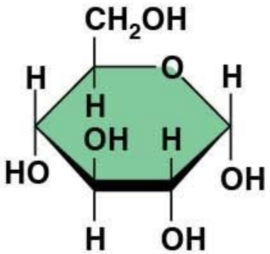
Components	Examples	Functions
 Monosaccharide monomer	Monosaccharides: glucose, fructose	Fuel; carbon sources that can be converted to other molecules or combined into polymers
	Disaccharides: lactose, sucrose	
	Polysaccharides: • Cellulose (plants) • Starch (plants) • Glycogen (animals) • Chitin (animals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

Figure 3.UN09

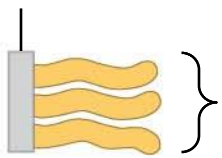
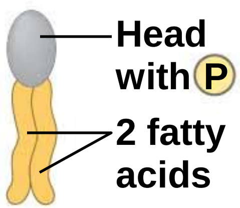
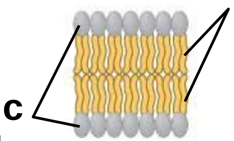
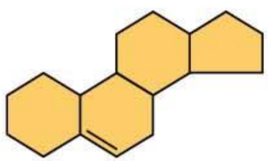
Components	Examples	Functions
	Triacylglycerols (fats or oils): glycerol + three fatty acids	Important energy source 
	Phospholipids: glycerol + phosphate group + two fatty acids	Lipid bilayers of membranes 
	Steroids: four fused rings with attached chemical groups	• Component of cell membranes (cholesterol)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

Figure 3.UN10

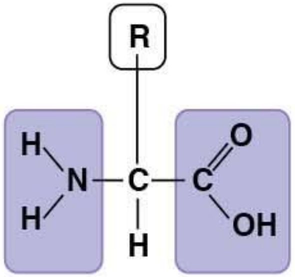
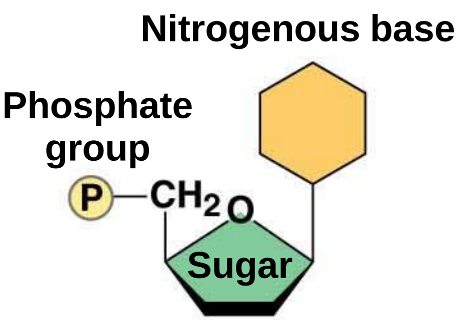
Components	Examples	Functions
 Amino acid monomer (20 types)	• Enzymes • Structural proteins • Storage proteins • Transport proteins • Hormones • Receptor proteins • Motor proteins • Defensive proteins	• Catalyze chemical reactions • Provide structural support • Store amino acids • Transport substances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

Figure 3.UN11

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