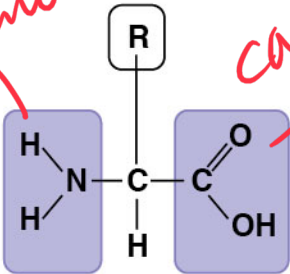
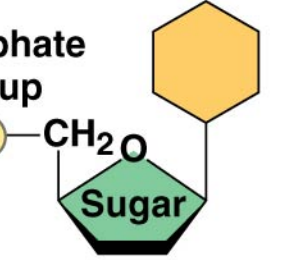


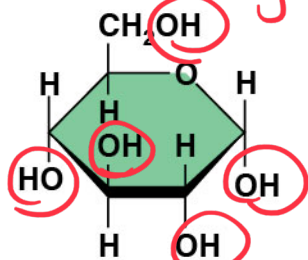


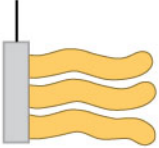

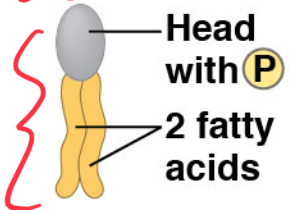
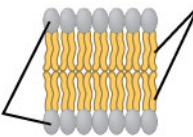
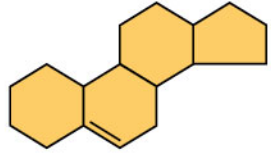
Components	Examples	Functions
<p><i>amino</i></p>  <p><i>carboxylic acid</i></p> <p>Amino acid monomer (20 types)</p>	<ul style="list-style-type: none"> • Enzymes • Structural proteins • Storage proteins • Transport proteins • Hormones • Receptor proteins • Motor proteins • Defensive proteins 	<ul style="list-style-type: none"> • 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

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Components	Examples	Functions
<p>Nitrogenous base</p>  <p>Phosphate group</p> <p>Nucleotide monomer</p>	<p>DNA: </p> <ul style="list-style-type: none"> • Sugar = deoxyribose • Nitrogenous bases = C, G, A, T • Usually double-stranded <p>RNA: </p> <ul style="list-style-type: none"> • Sugar = ribose • Nitrogenous bases = C, G, A, U • Usually single-stranded 	<p>Stores hereditary information</p> <p>Various functions in gene expression, including carrying instructions from DNA to ribosomes</p>


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Components	Examples	Functions
<p><i>sugar - carbohydrate</i></p>  <p>Monosaccharide monomer</p>	<p>Monosaccharides: <u>glucose, fructose</u></p>	<p>Fuel; carbon sources that can be converted to other molecules or combined into polymers</p>
	<p>Disaccharides: lactose, sucrose</p>	
	<p>Polysaccharides:</p> <ul style="list-style-type: none"> • Cellulose (plants) • Starch (plants) • Glycogen (animals) • Chitin (animals and fungi) 	<ul style="list-style-type: none"> • Strengthens plant cell walls • Stores glucose for energy • Stores glucose for energy • Strengthens exoskeletons and fungal cell walls

Components	Examples	Functions
<p>Glycerol <i>Fats</i></p>  <p><i>triacylglycerols</i></p>	<p>Triacylglycerols (fats or oils): glycerol + three fatty acids</p> <p><i>nonpolar</i></p>	<p>Important energy source</p> 
<p>3</p> 	<p>Phospholipids: glycerol + phosphate group + two fatty acids</p> <p><i>phospholipid</i></p>	<p>Lipid bilayers of membranes</p> 
 <p><i>Steroid backbone</i></p>	<p>Steroids: four fused rings with attached chemical groups</p>	<ul style="list-style-type: none"> • Component of cell membranes (cholesterol) • Signaling molecules that travel through the body (hormones)

II. Nucleic Acids

Function: store hereditary info

DNA <i>A, G, C, T</i>	RNA <i>A, G, C, U</i>
<ul style="list-style-type: none">• <u>Double-stranded helix</u>• N-bases: <u>A</u>, <u>G</u>, <u>C</u>, <u>Thymine</u>• <u>Stores hereditary info</u>• <u>Longer/larger</u> <i>millions of</i>• Sugar: <u>deoxyribose</u> <i>bases</i> <p><i>more DNA</i></p> 	<ul style="list-style-type: none">• <u>Single-stranded</u>• N-bases: <u>A</u>, <u>G</u>, <u>C</u>, <u>Uracil</u>• Carry info from DNA to ribosomes <i>transfers info.</i>• <u>tRNA</u>, <u>rRNA</u>, <u>mRNA</u>, <u>RNAi</u>• Sugar: ribose

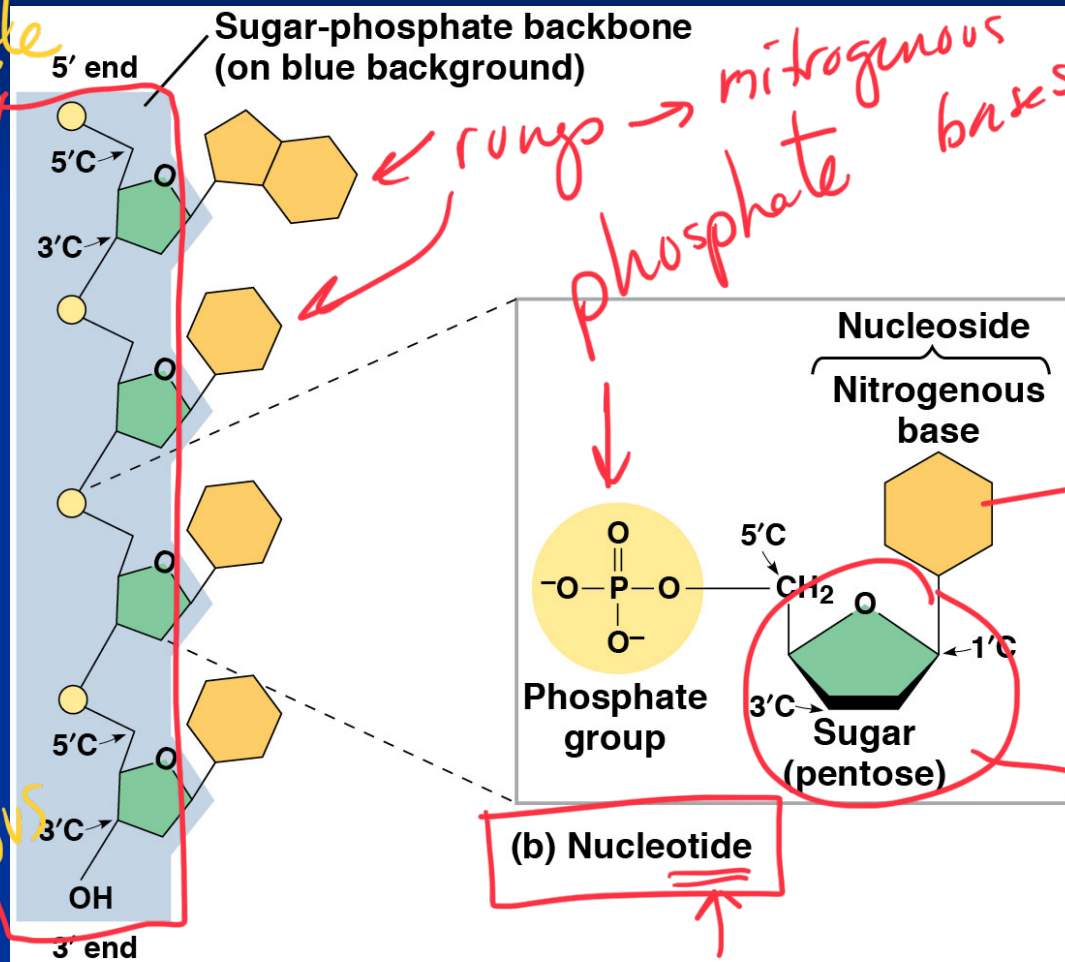
codes for proteins/enzymes "genes"

RNA is template of DNA

Nucleotides: monomer of DNA/RNA

Nucleotide = Sugar + Phosphate + Nitrogen Base

macromolecule
sugar + phosphate
backbone
rungs
nitrogenous base



(a) Polynucleotide, or nucleic acid

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(b) Nucleotide

rungs → nitrogenous bases
phosphate

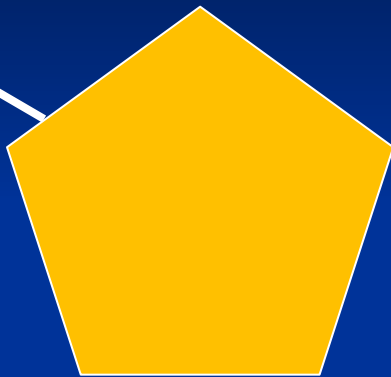
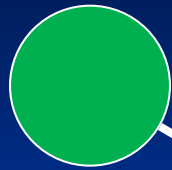
linked "N" through nitrogen

nitrogenous base

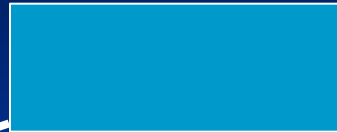
sugar - OHs hydroxyls

Nucleotide

phosphate

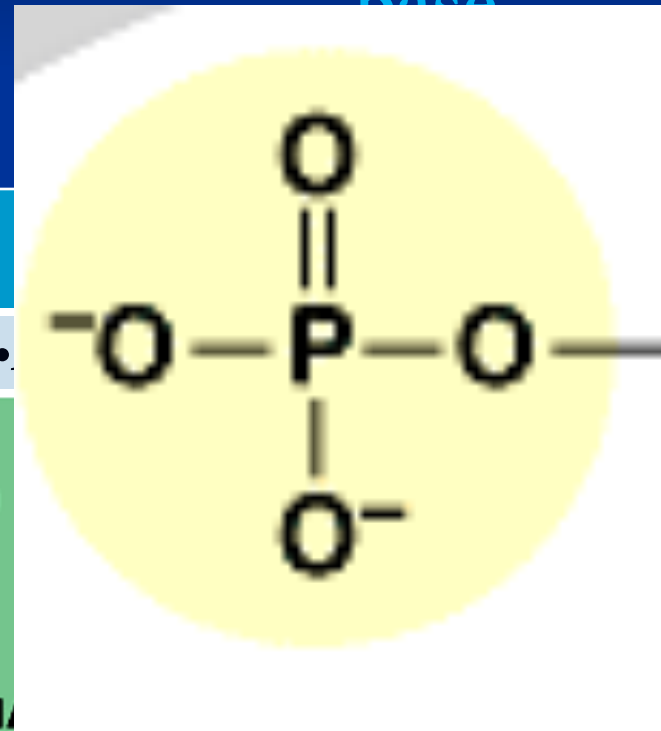


5-C sugar



Nitrogen
base

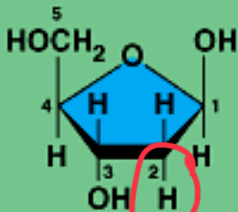
{ A - T
G - C



dines

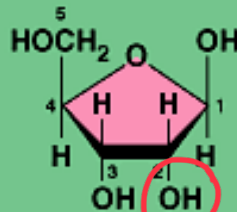
(DNA)
(RNA)

g



Deoxyribose (in DNA)

DNA



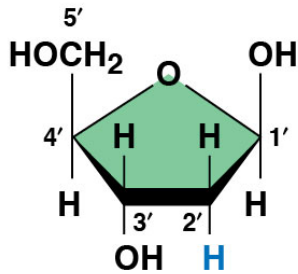
Ribose (in RNA)

RNA

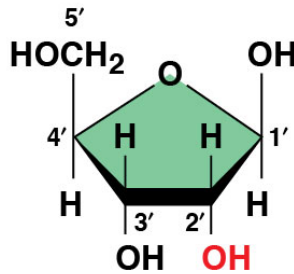
major structural difference
is presence of oxygen

Pyrimidines C/T/U single
CUT the Py

SUGARS



Deoxyribose (in DNA)



Ribose (in RNA)

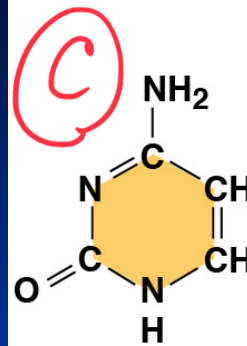
(c) Nucleoside components

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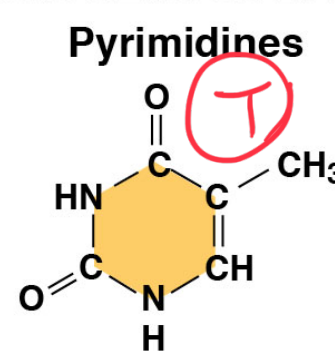
Purines
Pure As Gold

NITROGENOUS BASES

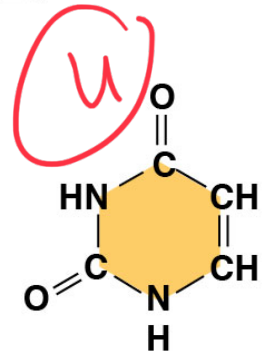
Pyrimidines



Cytosine (C)

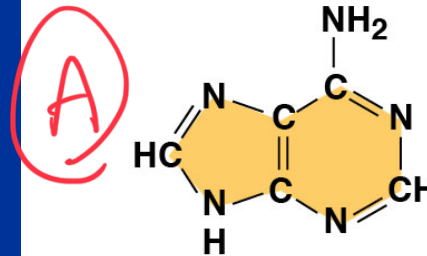


Thymine
(T, in DNA)

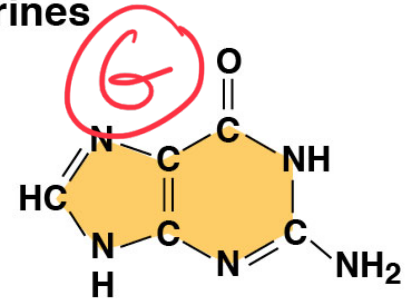


Uracil (U, in RNA)

Purines



Adenine (A)



Guanine (G)

(c) Nucleoside components

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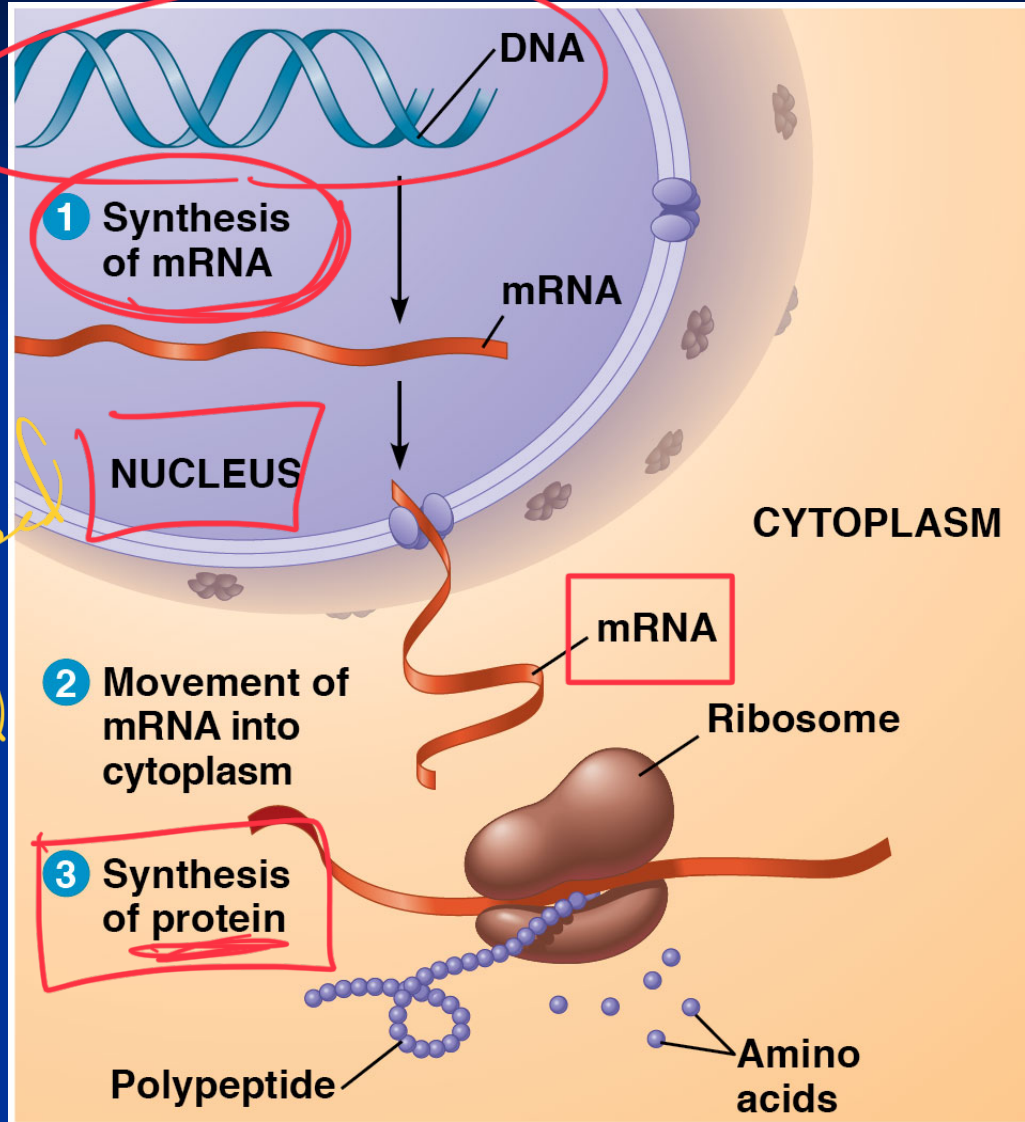
heterocycles

Information flow in a cell:

DNA → RNA → protein

Central
Dogma
of Biology

DNA
↓ transcribed
RNA
↓ translated
protein



one way
flow of
information

Retroviruses

HIV
RNA
↓
DNA

III. Carbohydrates

Macromolecule
carbohydrate = sugar

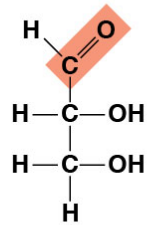
- **Fuel** and **building material**
- Include simple sugars (fructose) and polymers (starch)
- Ratio of 1 carbon: 2 hydrogen: 1 oxygen or CH_2O
one cycle
- *1 sugar* monosaccharide \rightarrow *2 sugars* disaccharide \rightarrow *many sugars* polysaccharide
- Monosaccharides = monomers (eg. glucose, ribose)
- Polysaccharides:
 - Storage (plants-starch, animals-glycogen)
 - Structure (plant-cellulose, arthropod-chitin)

} Differ in
position &
orientation of
glycosidic
linkage

Carbohydrate $1\text{C} : 2\text{H} : 1\text{O}$

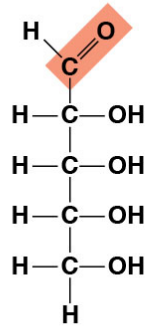
$\text{C}_6\text{H}_{12}\text{O}_6$ Glucose $\text{C}_6\text{H}_{12}\text{O}_6$ $6(\text{CH}_2\text{O})$

Triose: three-carbon sugar ($C_3H_6O_3$)



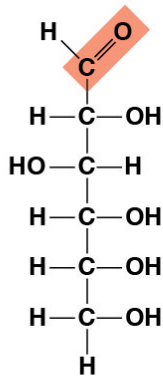
Glyceraldehyde
An initial breakdown
product of glucose in cells

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

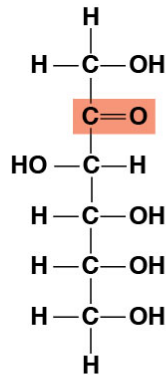


Ribose
A component of RNA

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



Glucose
Energy sources for organisms

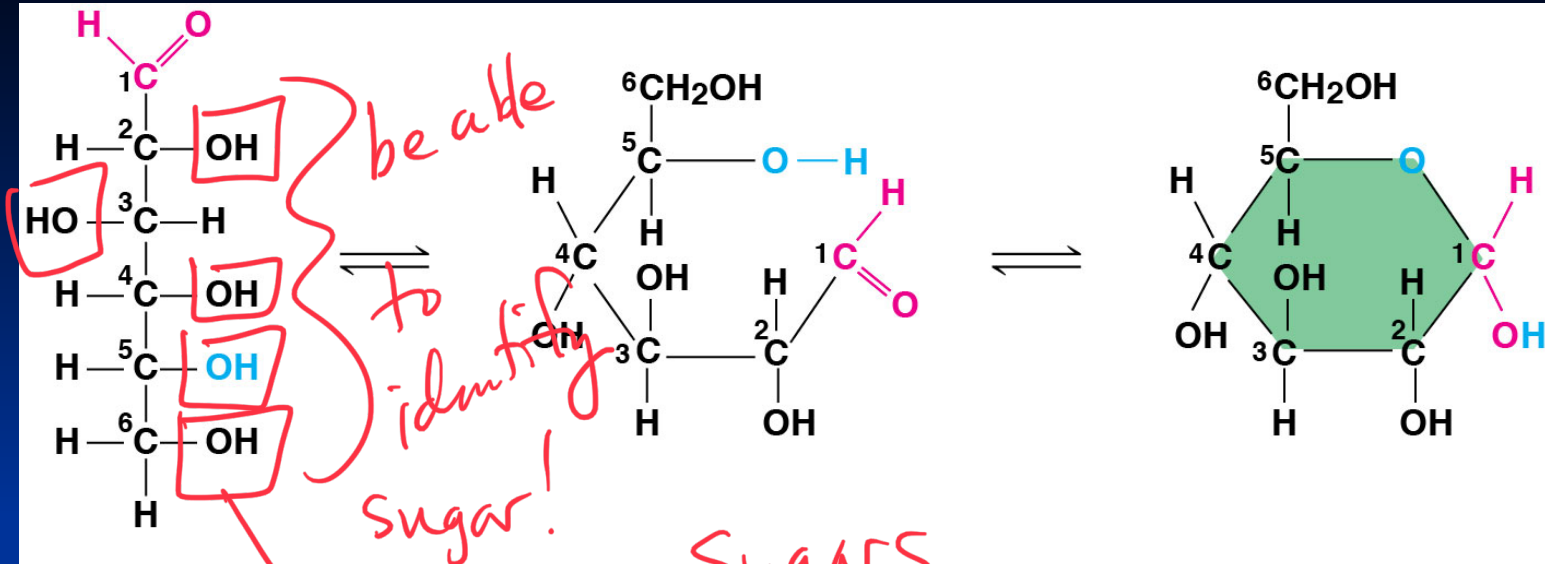


Fructose

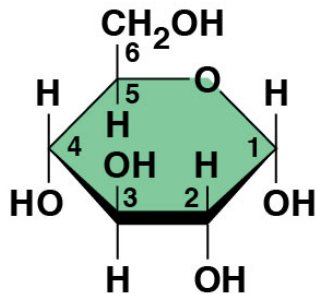
aldose
Don't worry

ketose

The structure and
classification of
some
monosaccharides



(a) Linear and ring forms

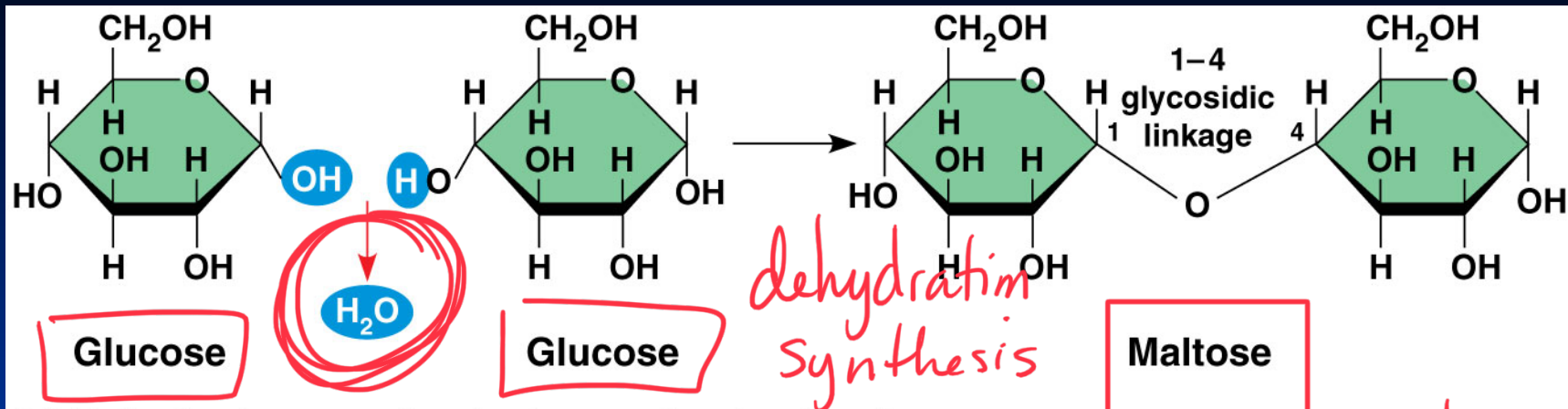


(b) Abbreviated ring structure

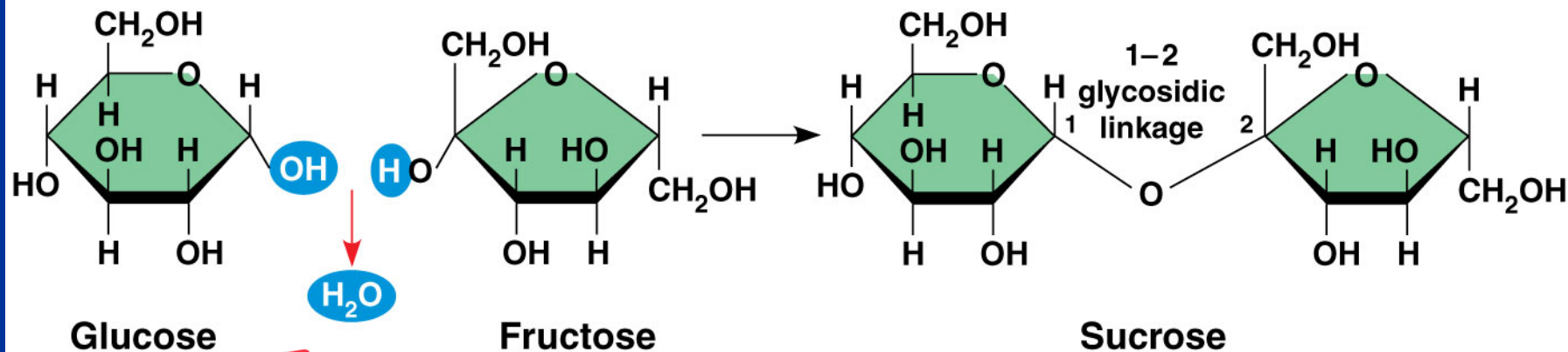
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sweetness
polar
Linear → cyclized

Linear and ring forms of glucose



(a) Dehydration reaction in the synthesis of maltose
monosaccharide + monosaccharide → disaccharide



(b) Dehydration reaction in the synthesis of sucrose

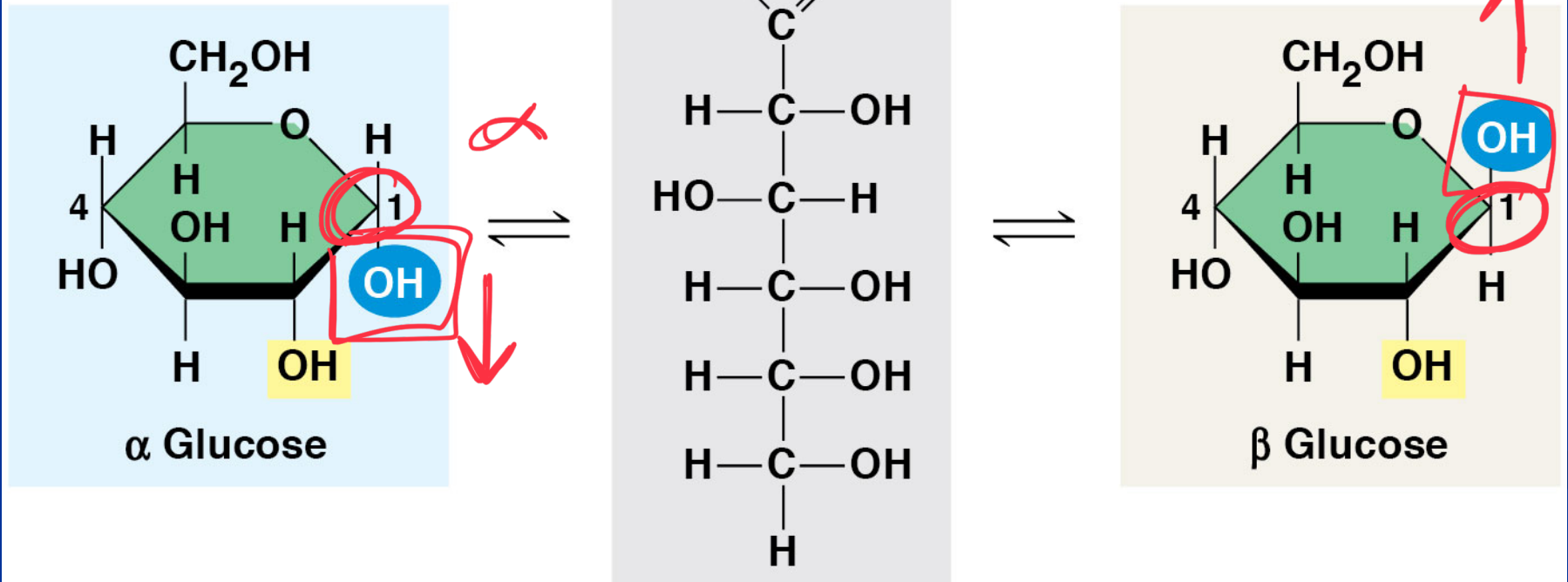
© 2011 Pearson Education, Inc.

Carbohydrate synthesis

Cellulose vs. Starch

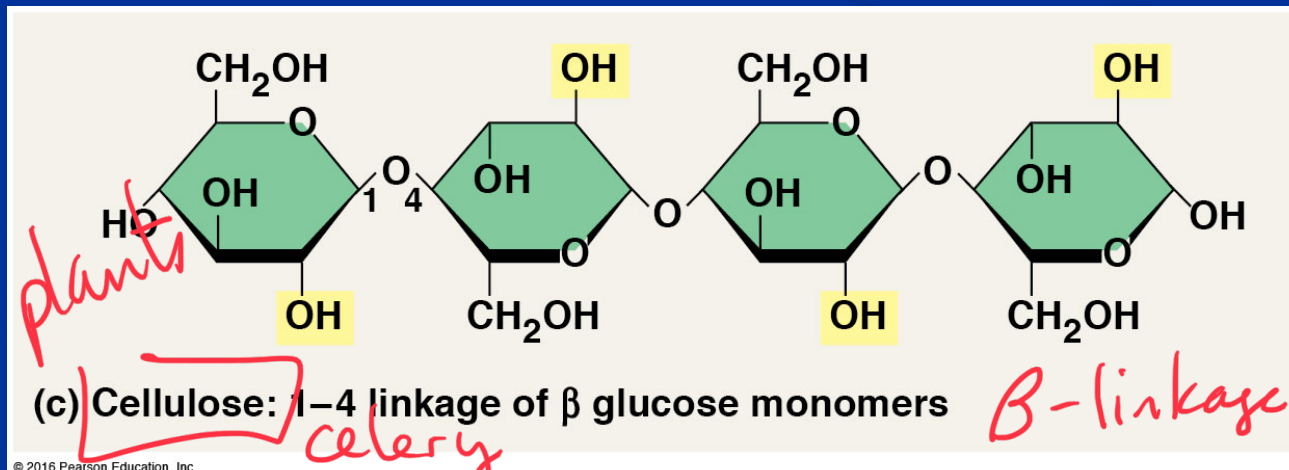
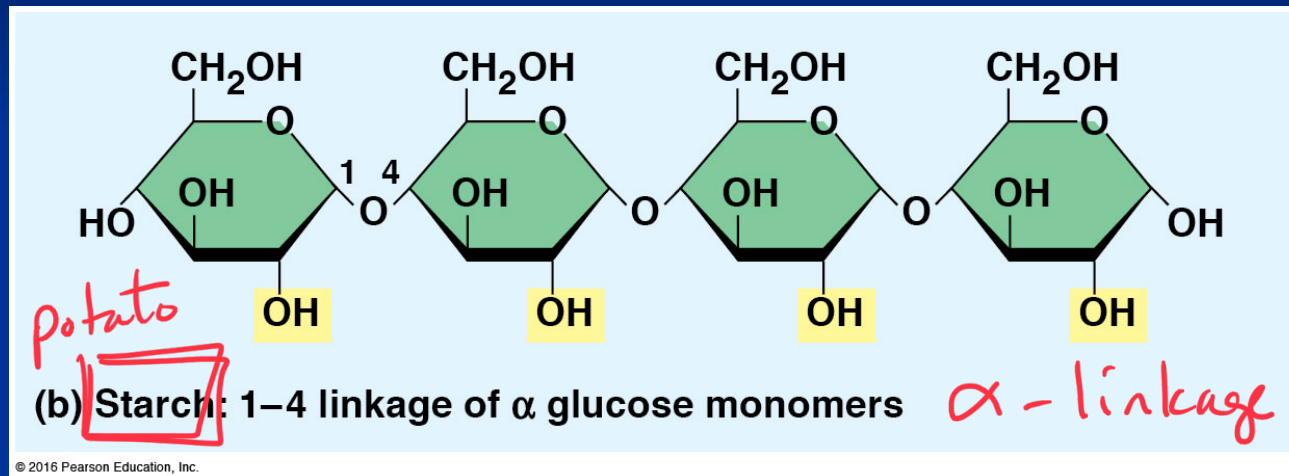
Two Forms of Glucose: α glucose & β glucose

(a) α and β glucose ring structures



Cellulose vs. Starch

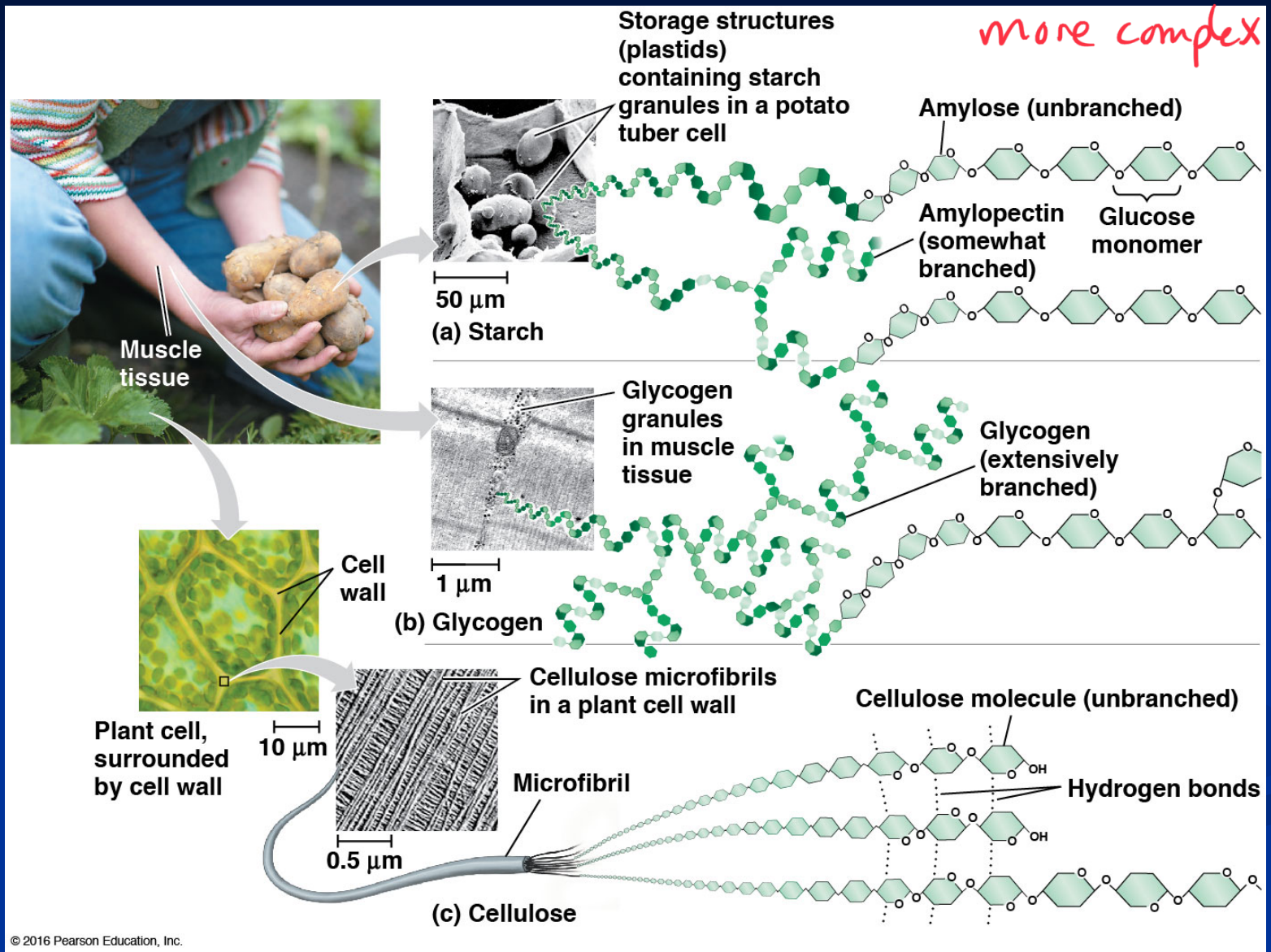
- Starch = α glucose monomers
- Cellulose = β glucose monomers

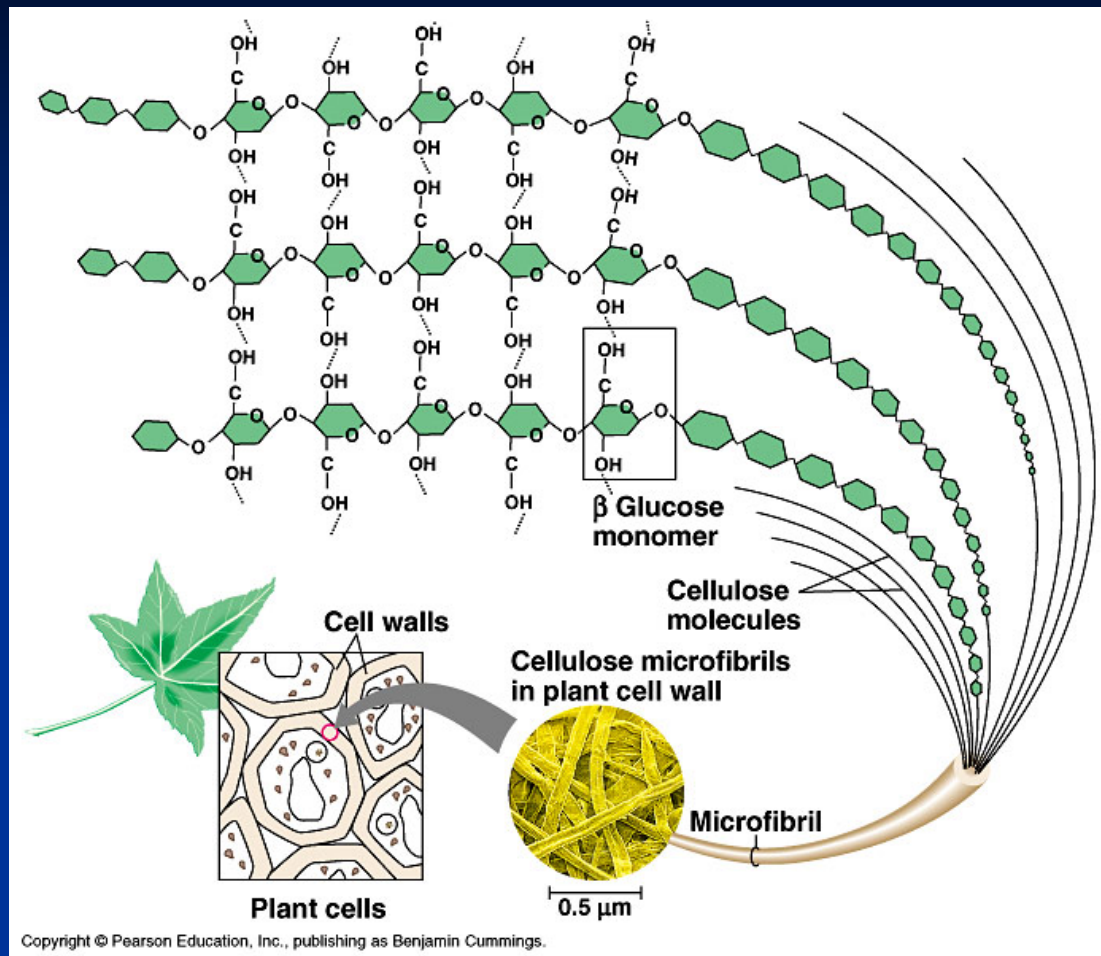


only difference
between
potato
&
celery
is the
linkage

Storage polysaccharides of plants (starch) and animals (glycogen)

most lives → also in muscles





▲ Chitin forms the exoskeleton of arthropods.

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Structural polysaccharides: cellulose & chitin (exoskeleton)

IV. Lipids

solution property: nonpolar

A. Fats (triglyceride): store energy

- Glycerol + 3 Fatty Acids
- saturated, unsaturated, polyunsaturated

B. Steroids: cholesterol and hormones

C. Phospholipids: lipid bilayer of cell membrane

- hydrophilic head, hydrophobic tails

1 sugar



32 ATP

1 fatty acid



120 ATP

since phospholipids
have both polar
and nonpolar
regions: amphipathic



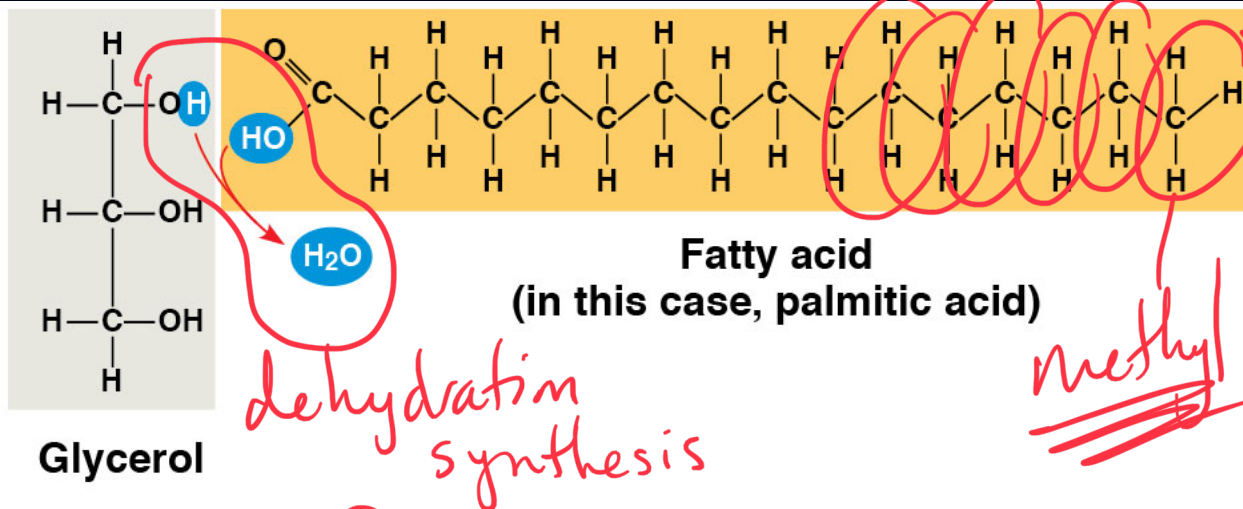
Hydrophilic head

polar

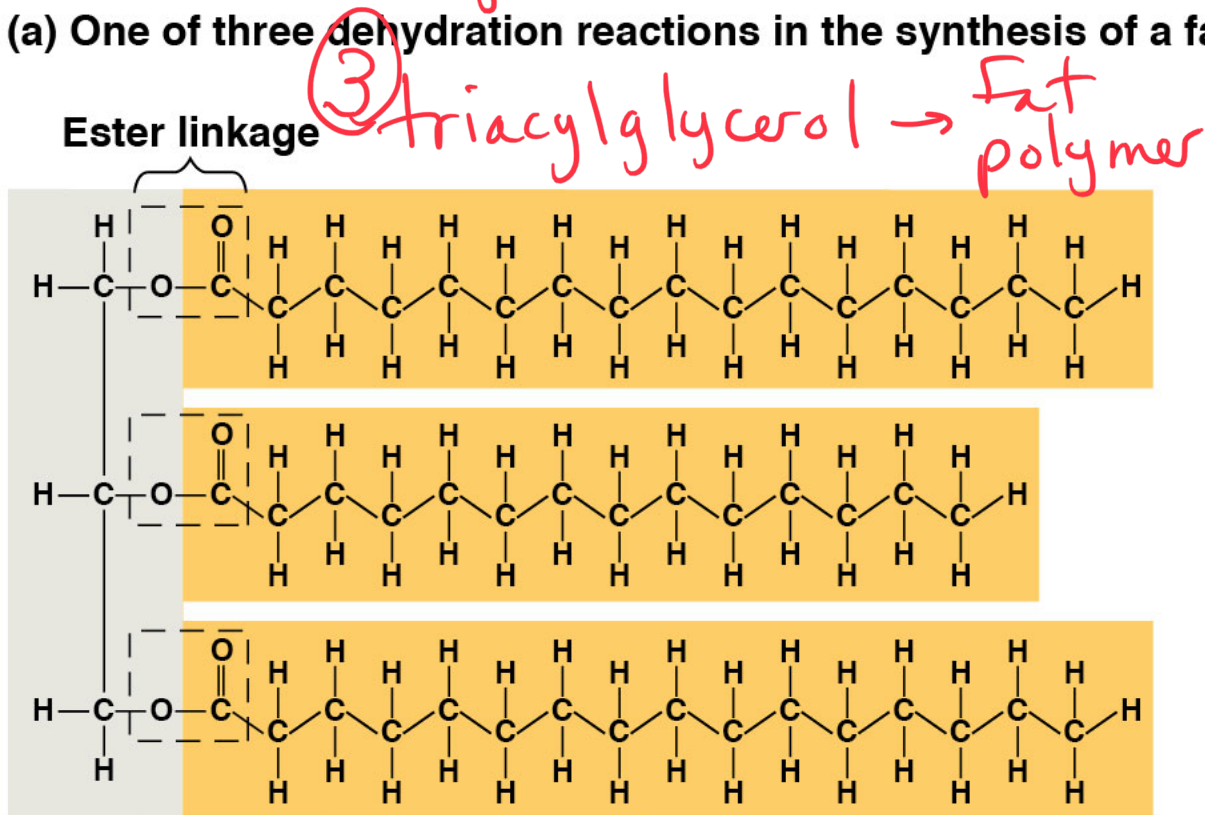


Hydrophobic tail

nonpolar



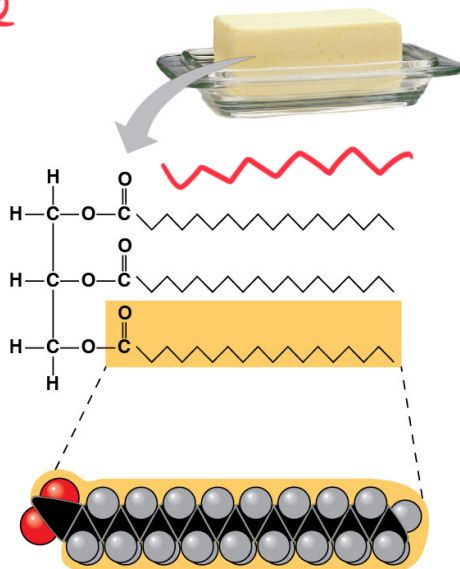
(a) One of three dehydration reactions in the synthesis of a fat



(b) Fat molecule (triacylglycerol)

(a) Saturated fat

no double bonds



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(b) Unsaturated fat

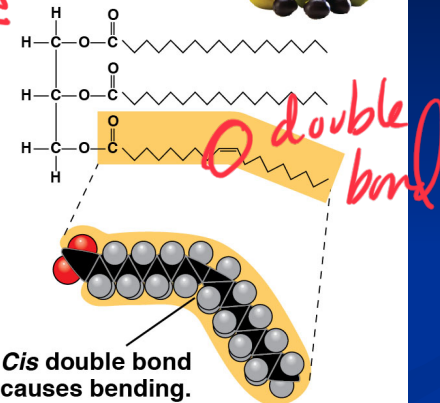
has at least one double bond

healthier

Structural formula of an unsaturated fat molecule

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

Cis double bond causes bending.



Saturated

Unsaturated

Polyunsaturated

“saturated” with H

Have some C=C, result in kinks

In animals

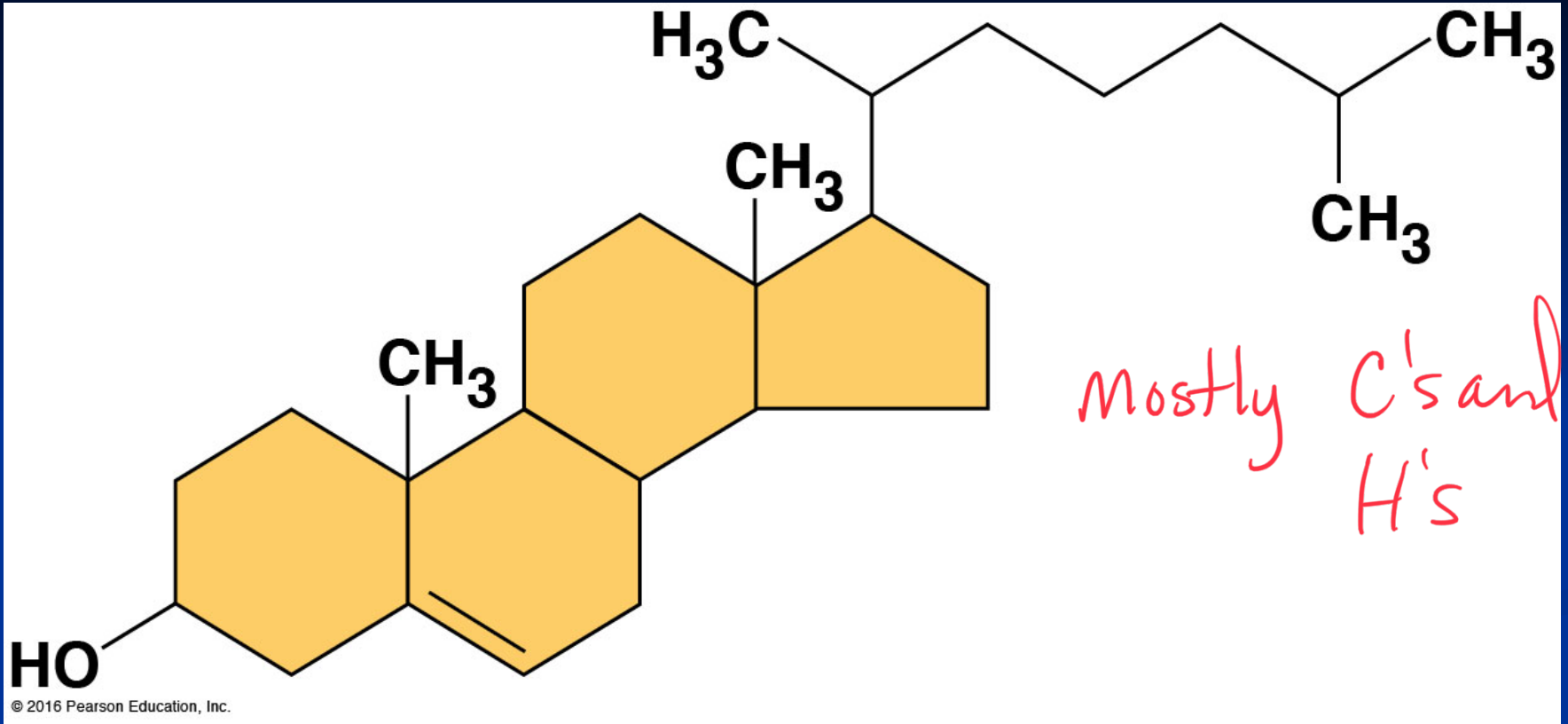
In plants

Solid at room temp.

Liquid at room temp.

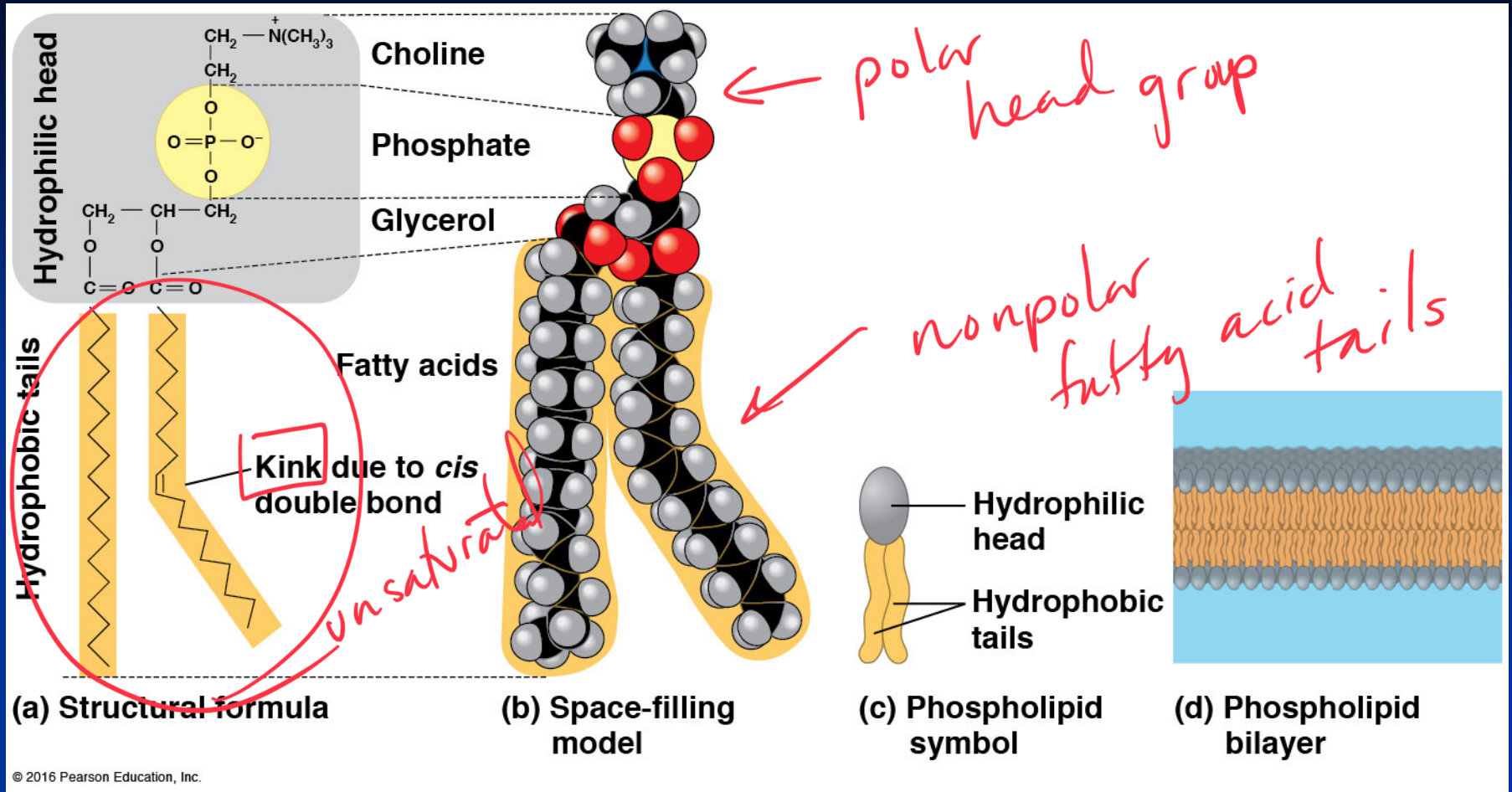
Eg. butter, lard

Eg. corn oil, olive oil



Cholesterol, a steroid

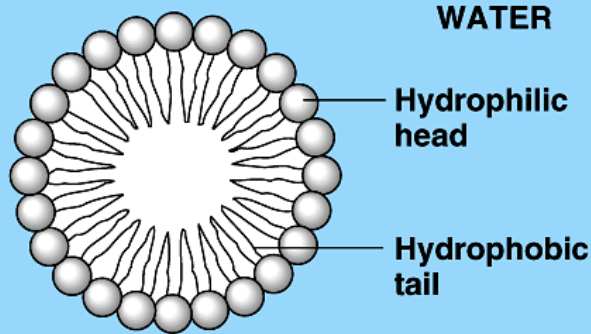
in cell membrane
cholesterol - temperature and fluidity buffer
in the cell.



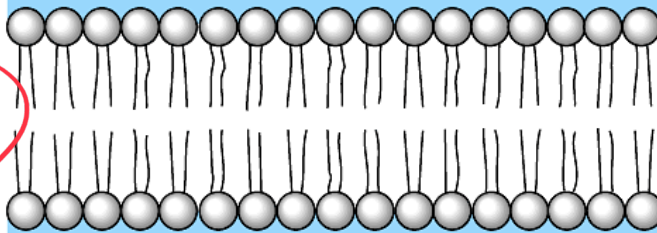
The structure of a **phospholipid**

Hydrophobic/hydrophilic interactions make a **phospholipid bilayer**

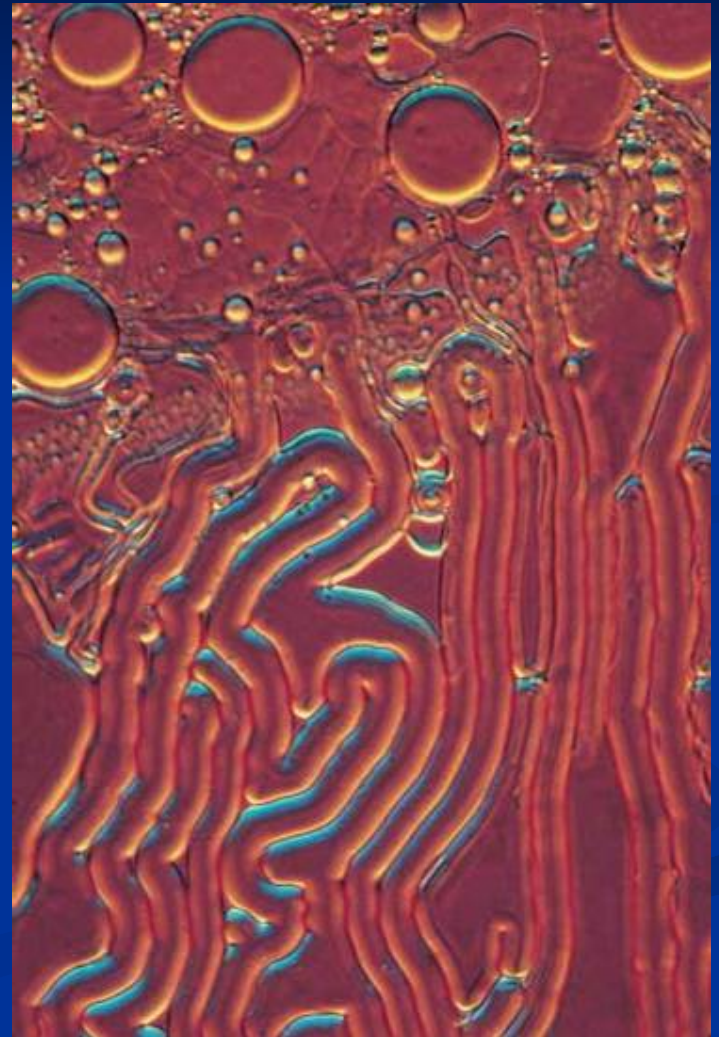
(a) Micelle

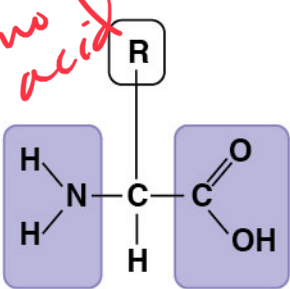


(b) Phospholipid bilayer

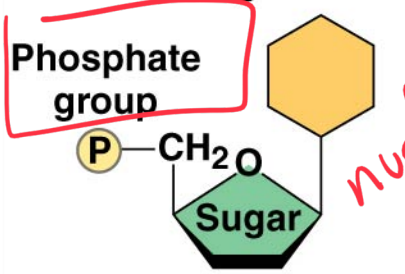




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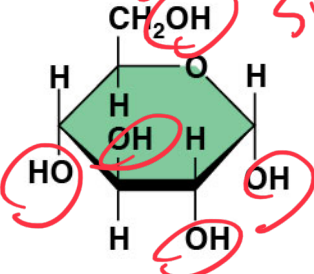


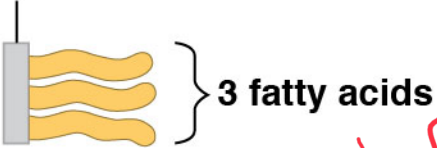

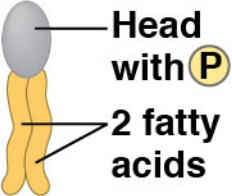
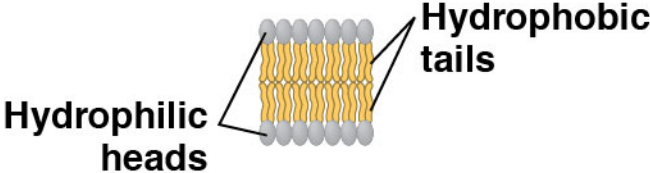
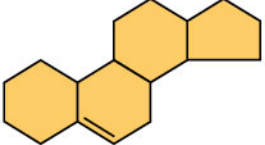
Components	Examples	Functions
<p><i>amino acid</i></p>  <p>Amino acid monomer (20 types)</p>	<ul style="list-style-type: none"> • Enzymes • Structural proteins • Storage proteins • Transport proteins • Hormones • Receptor proteins • Motor proteins • Defensive proteins 	<ul style="list-style-type: none"> • 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

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Components	Examples	Functions
<p>Nitrogenous base</p> <p><i>nucleotide</i></p>  <p>Phosphate group</p> <p>Sugar</p> <p>Nucleotide monomer</p>	<p>DNA: </p> <ul style="list-style-type: none"> • Sugar = deoxyribose • Nitrogenous bases = C, G, A, T • Usually double-stranded <p>RNA: </p> <ul style="list-style-type: none"> • Sugar = ribose • Nitrogenous bases = C, G, A, U • Usually single-stranded 	<p>Stores hereditary information</p> <p>Various functions in gene expression, including carrying instructions from DNA to ribosomes</p>

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Components	Examples	Functions
<p><i>carbohydrate - sugar</i></p>  <p>Monosaccharide monomer</p>	<p>Monosaccharides: glucose, fructose</p>	<p>Fuel; carbon sources that can be converted to other molecules or combined into polymers</p>
	<p>Disaccharides: lactose, sucrose</p>	
	<p>Polysaccharides:</p> <ul style="list-style-type: none"> • Cellulose (plants) • Starch (plants) • Glycogen (animals) • Chitin (animals and fungi) 	<ul style="list-style-type: none"> • Strengthens plant cell walls • Stores glucose for energy • Stores glucose for energy • Strengthens exoskeletons and fungal cell walls

Components	Examples	Functions
<p>Glycerol</p>  <p><i>ch's fatty acids / lipids</i></p>	<p>Triacylglycerols (fats or oils): glycerol + three fatty acids</p>	<p>Important energy source</p> 
	<p>Phospholipids: glycerol + phosphate group + two fatty acids</p>	<p>Lipid bilayers of membranes</p> 
 <p>Steroid backbone</p>	<p>Steroids: four fused rings with attached chemical groups</p>	<ul style="list-style-type: none"> • Component of cell membranes (cholesterol) • Signaling molecules that travel through the body (hormones)