International Baccalaureate Higher Level Biology:

1. Google Classroom Code: 6ew2r75
2. Pacing (2 years)
3. Summer assignments:
    a. Reading and understanding will help you, as this class is an extremely fast pace class
        I. Read Topics 1.1, 1.2 and 1.3 in the IB books
        II. Read Topic 2, 3, 4 and 5 in the AP book (much easier to follow, although more pages)
        III. Be able to draw and identify the following molecules:

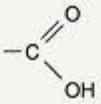
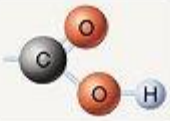
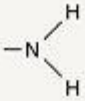
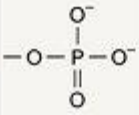
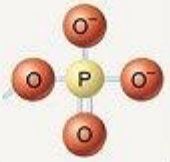
a. Alpha glucose
b. Beta Glucose
c. Ribose
d. Deoxyribose
e. glycerol
f. saturated fatty acid
g. monounsaturated fatty acid
h. Polyunsaturated fatty acid
i. ATP
j. Functional Groups
    1. Hydroxyl
    2. Amine (amino)
    3. Carboxyl
    4. Phophate
    5. Carbonyl

h. What two monosaccharides make up the following disaccharides
    1. Maltose
    2. Lactose
    3. Sucrose

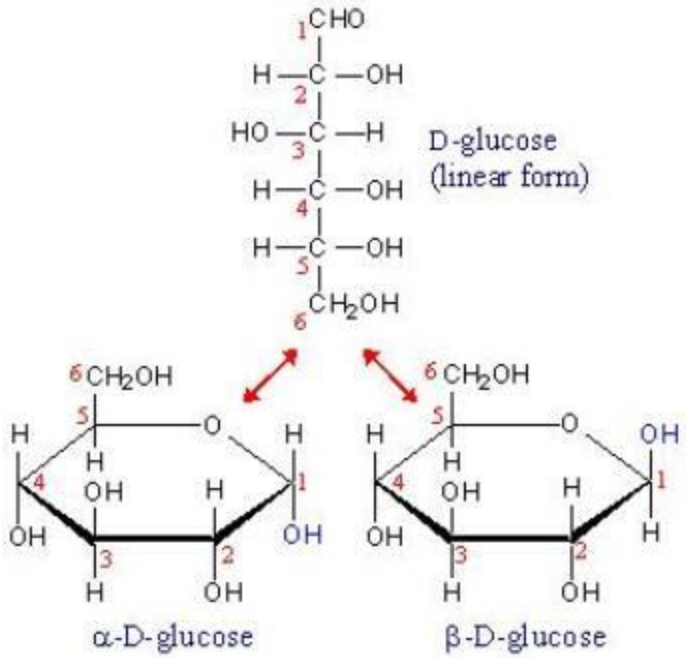
i. Draw, label and explain a single amino acid
j. Difference between a condensation reaction (dehydration synthesis) and Hydrolysis
k. Draw the formation of a dipeptide
l. Draw the formation of a triglyceride
m. Draw the formation of a dinucleotide
o. Draw a nucleotide
p. Identify the two purines
q. Identify the three pyrimidines

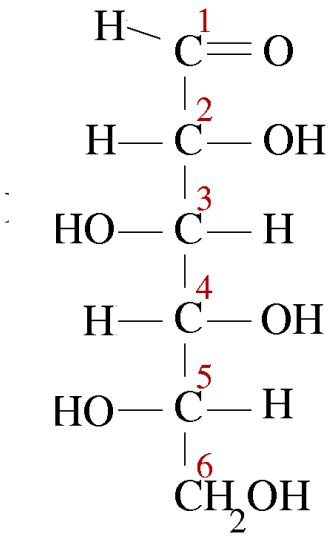
***** By doing this over the summer, it will tremendously help you eventually understand the material come your ENTIRE time in HL Biology. There is not a test or anything to turn in the first day of class, but usually there will be a test the second week of class!

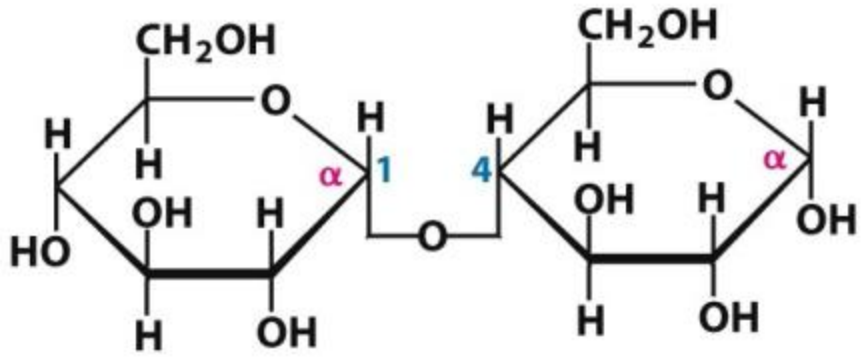
Below are some diagrams that may help you!

Group	Structural Formula	Ball-and-Stick Model	Found In
Hydroxyl	—OH		Carbohydrates
Carbonyl			Lipids
Carboxyl			Proteins
Amino			Proteins
Phosphate			DNA, ATP

0

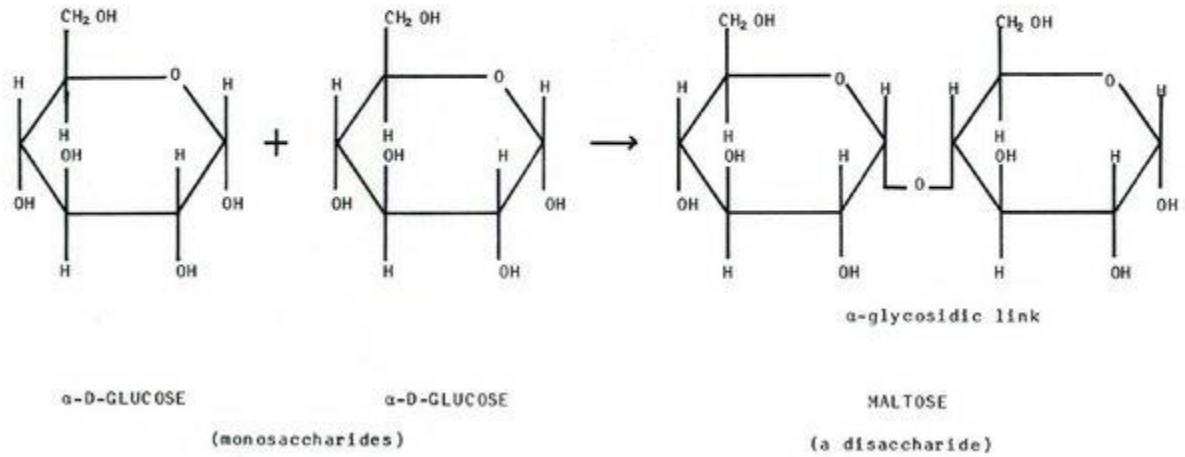

D-glucose
(linear form)
α-D-glucose
β-D-glucose

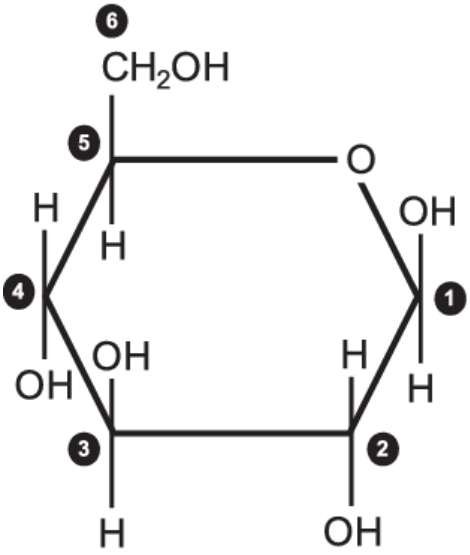




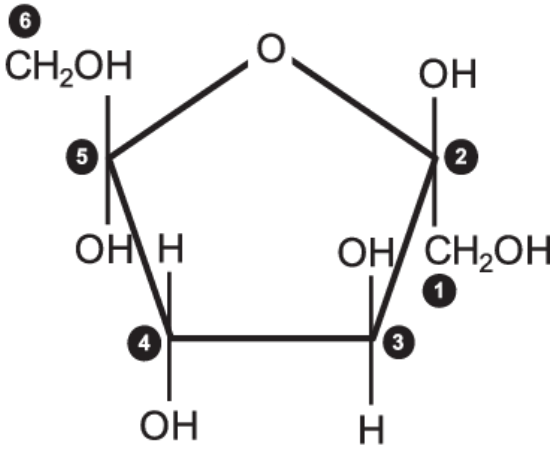
Maltose
(α-D-Glucopyranosyl-(1→ 4)-α-D-glucopyranose

FIC. 25.4. Formation of the glycosidic link

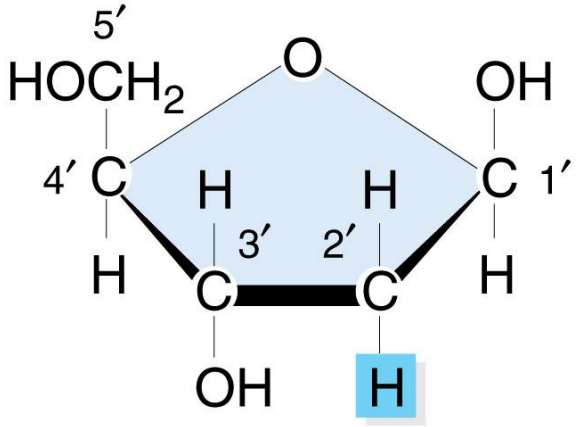




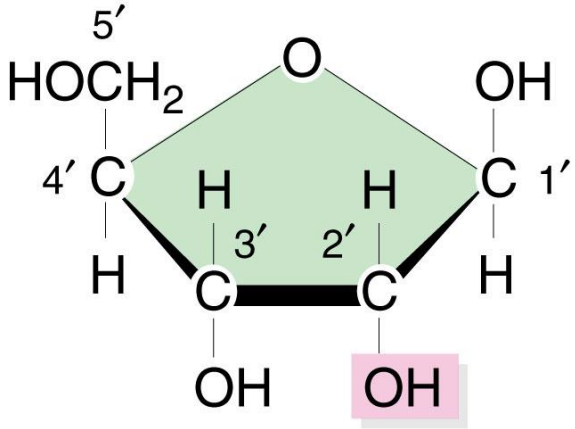
glucose



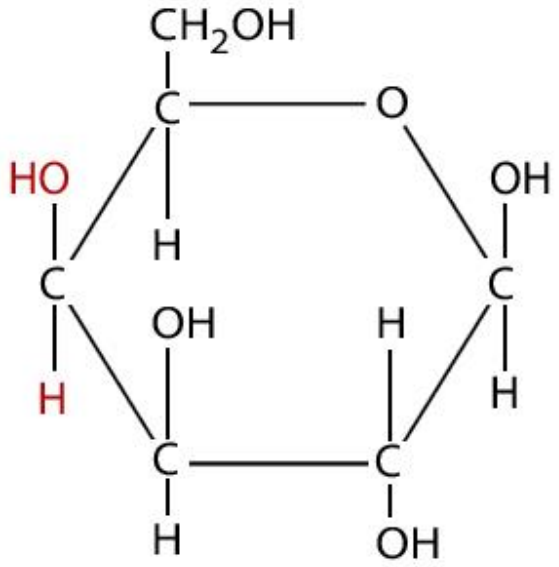
fructose



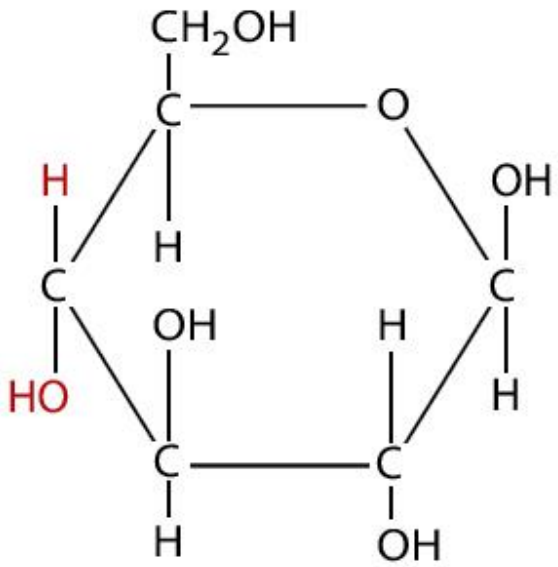
Deoxyribose



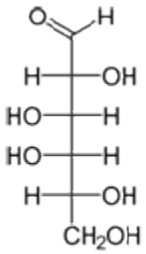
Ribose



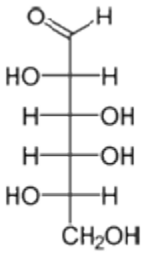
Galactose



Glucose

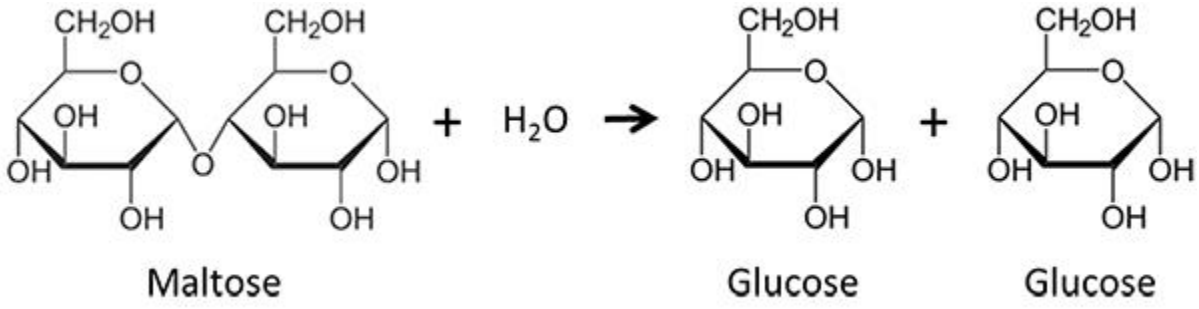


D-Galactose

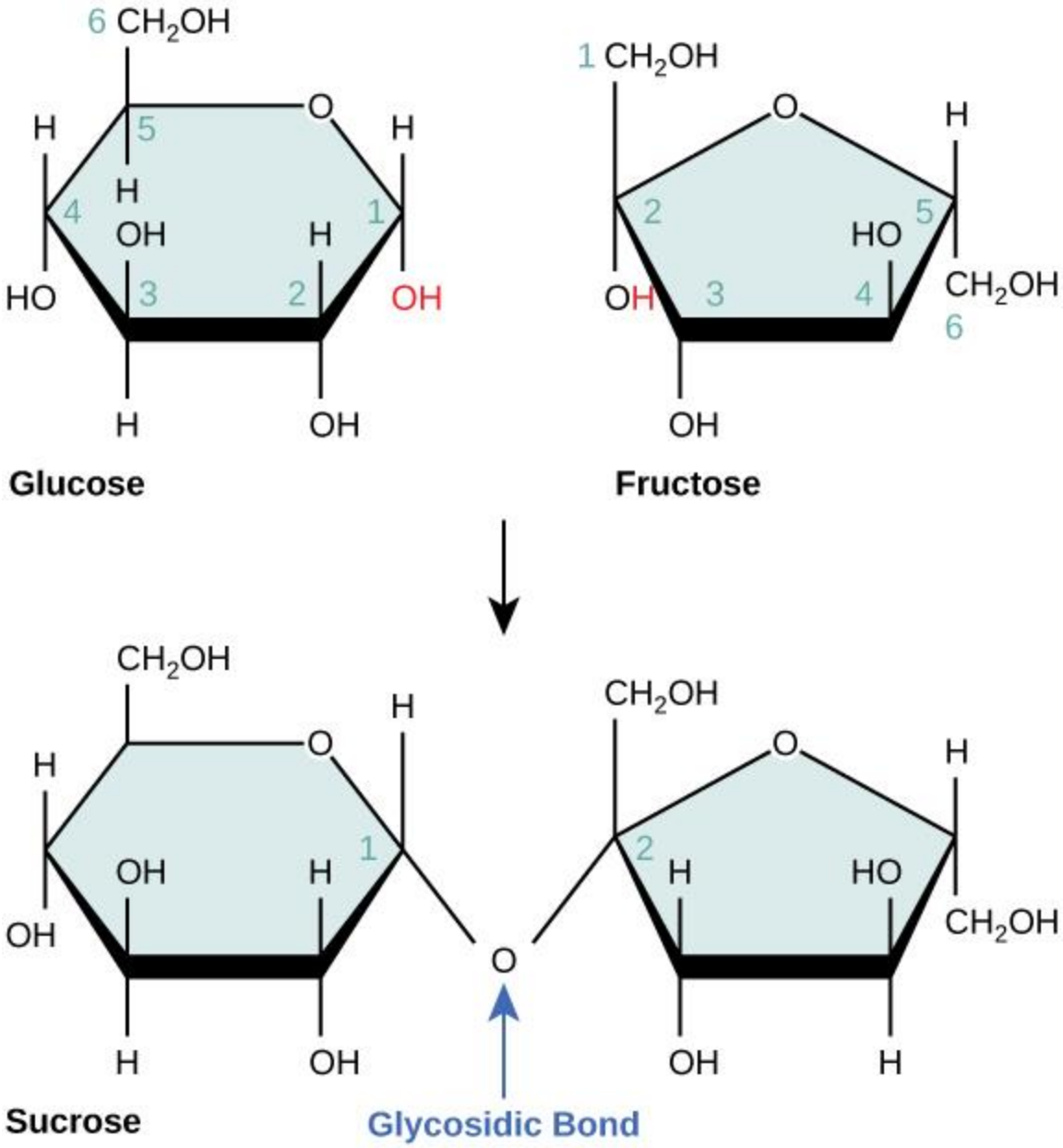


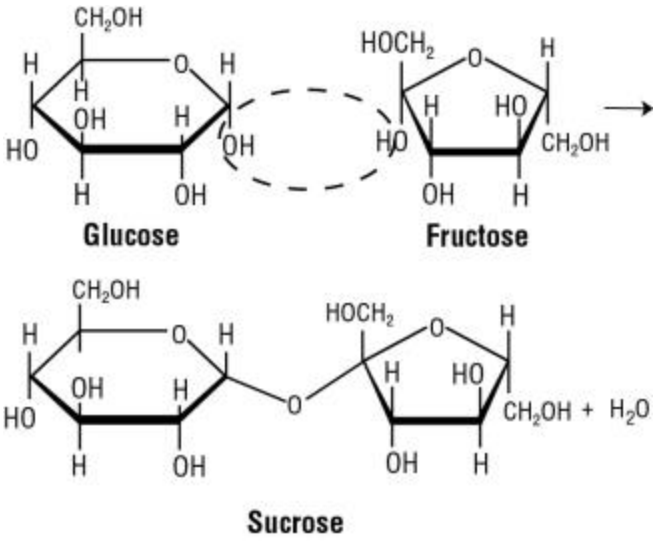
L-Galactose

Hydrolysis of maltose



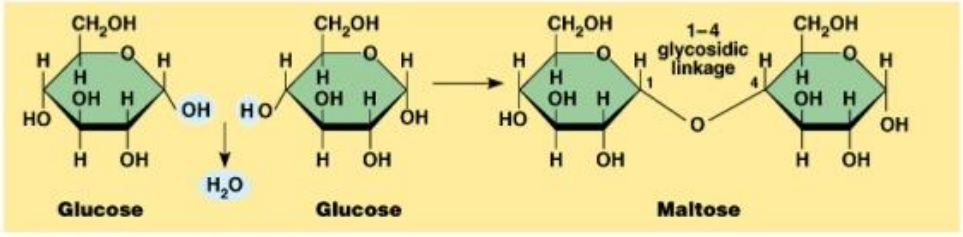
Maltose Glucose Glucose


6 CH2OH
H
5
O
H
H
4
1
OH
H
HO
3
2
OH
H
OH
Glucose
1 CH2OH
O
H
2
5
HO
OH
3
4
CH2OH
6
OH
Fructose
CH2OH
H
O
H
OH
1
H
OH
H
O
CH2OH
O
H
2
H
HO
CH2OH
OH
H
OH
OH
H
Sucrose
Glycosidic Bond

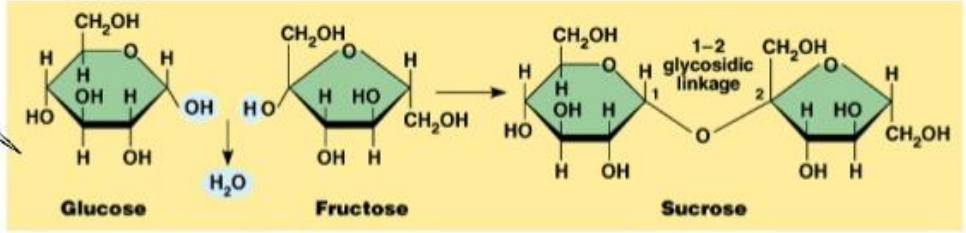


Disaccharide Formation and Structure

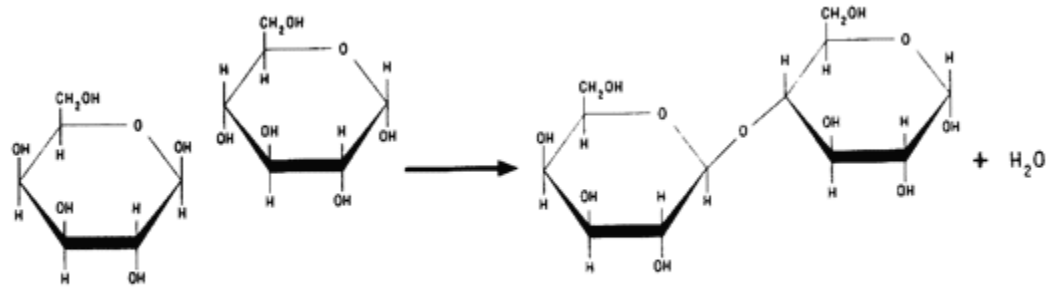
- Disaccharides are formed when two monosaccharides are joined by dehydration synthesis reaction.



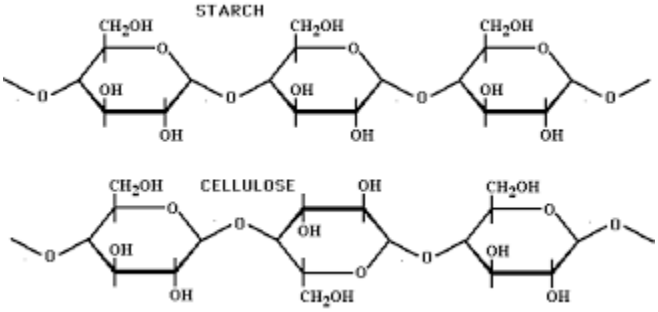
(a) Dehydration synthesis of maltose

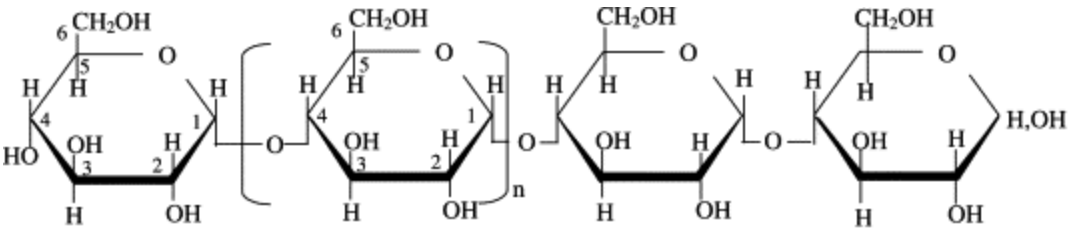


(b) Dehydration synthesis of sucrose

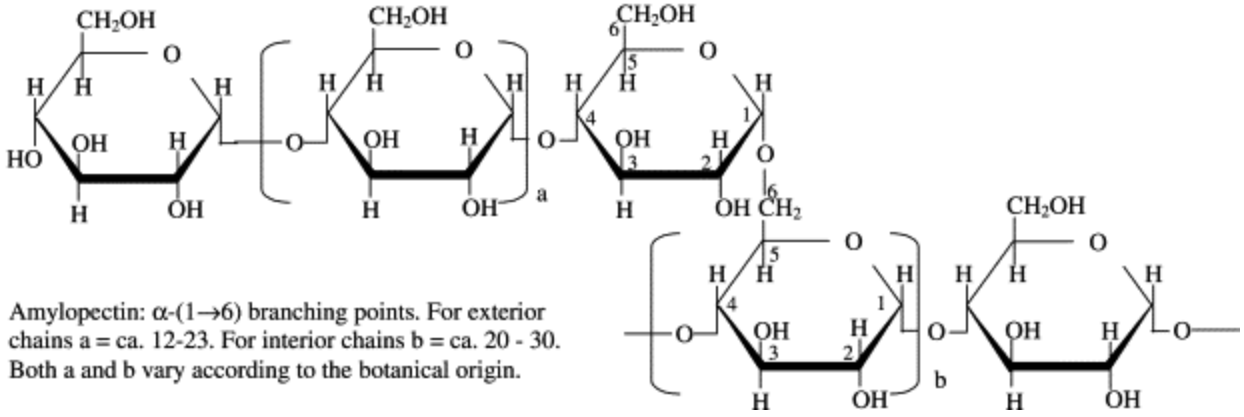


Galactose + Glucose = Lactose + Water





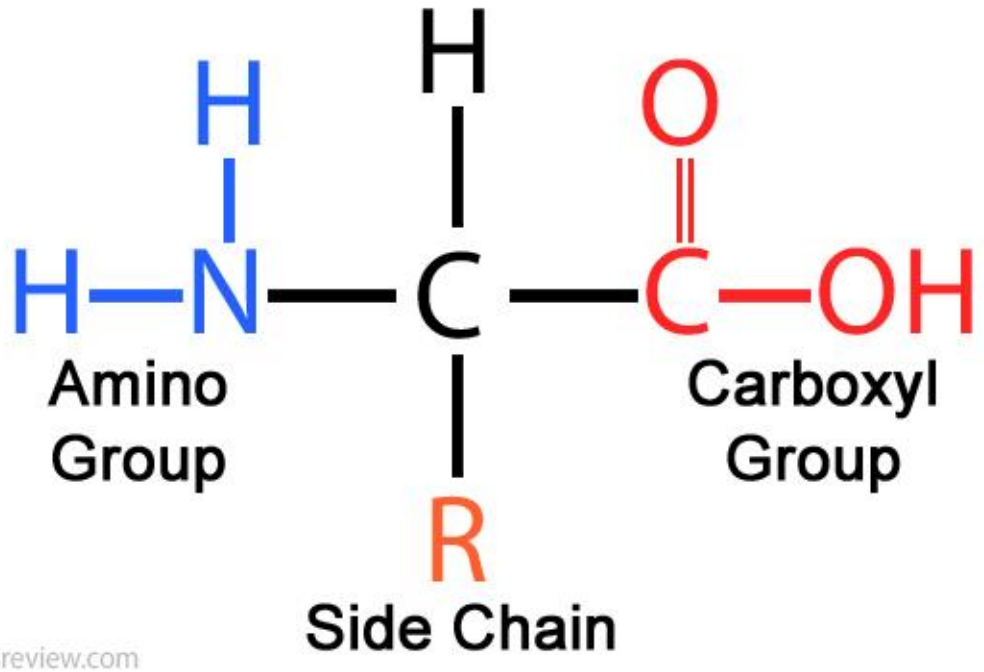
Amylose: α-(1→4)-glucan; average n = ca. 1000. The linear molecule may carry a few occasional moderately long chains linked α-(1→6).

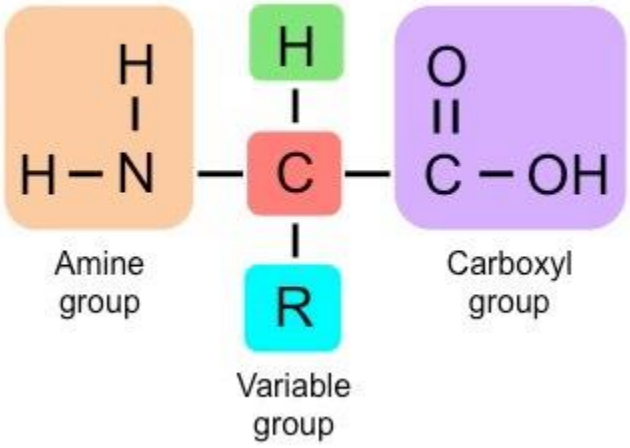


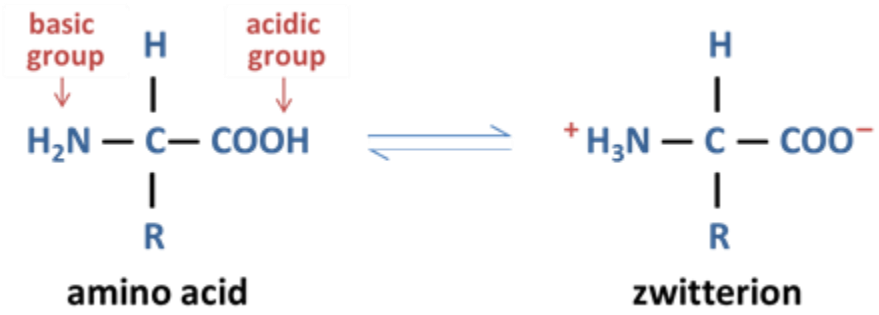
Amylopectin: α-(1→6) branching points. For exterior chains a = ca. 12-23. For interior chains b = ca. 20 - 30. Both a and b vary according to the botanical origin.

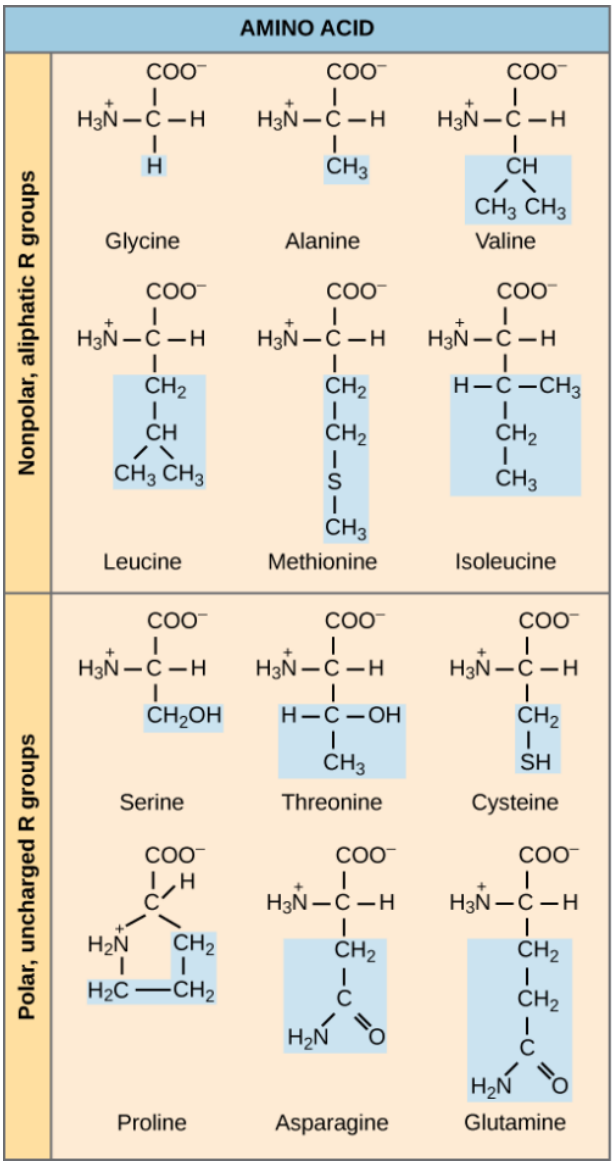
Amino Acid

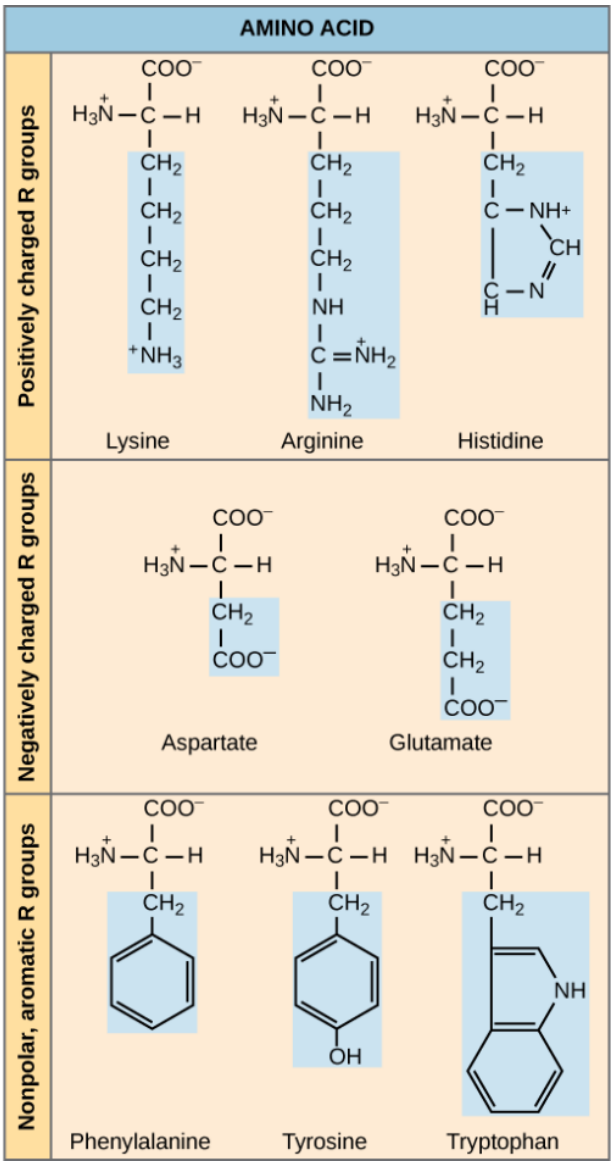
Amino Acid Structure

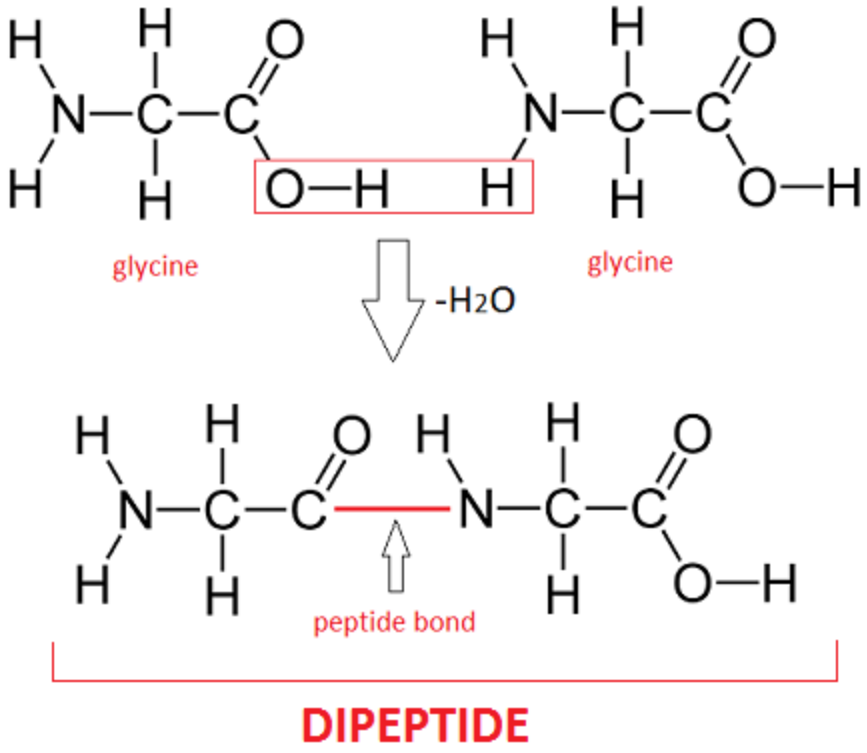




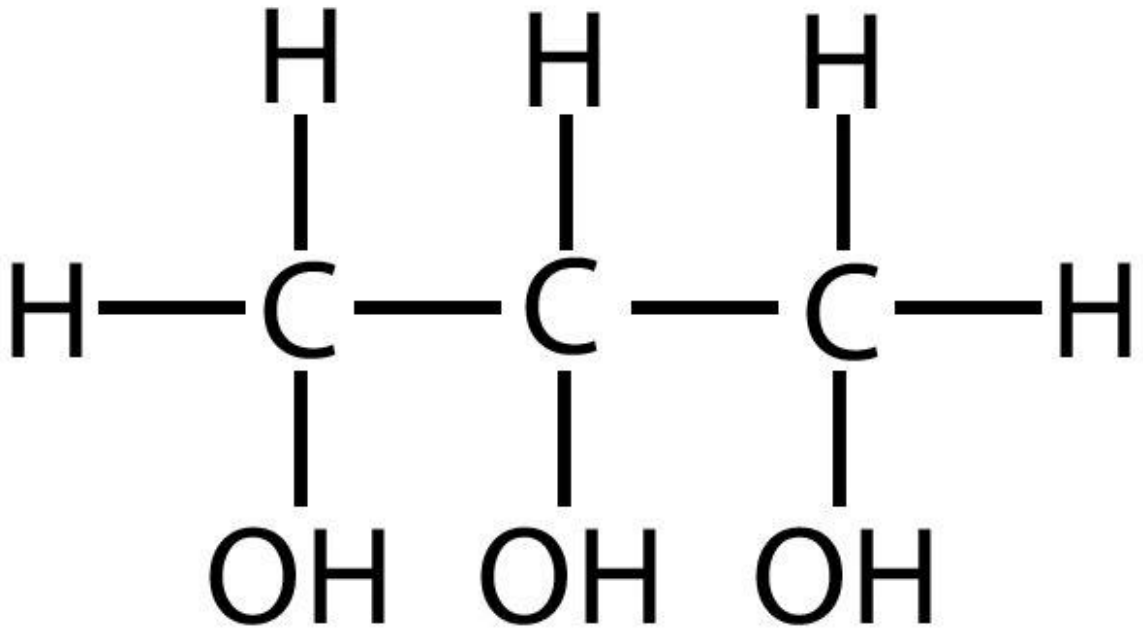

basic group
acidic group
amino acid
zwitterion

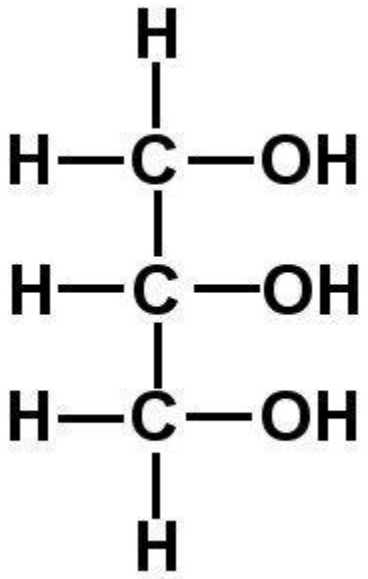

AMINO ACID
Nonpolar, aliphatic R groups
Glycine
Alanine
Valine
Leucine
Methionine
Isoleucine
Polar, uncharged R groups
Serine
Threonine
Cysteine
Proline
Asparagine
Glutamine

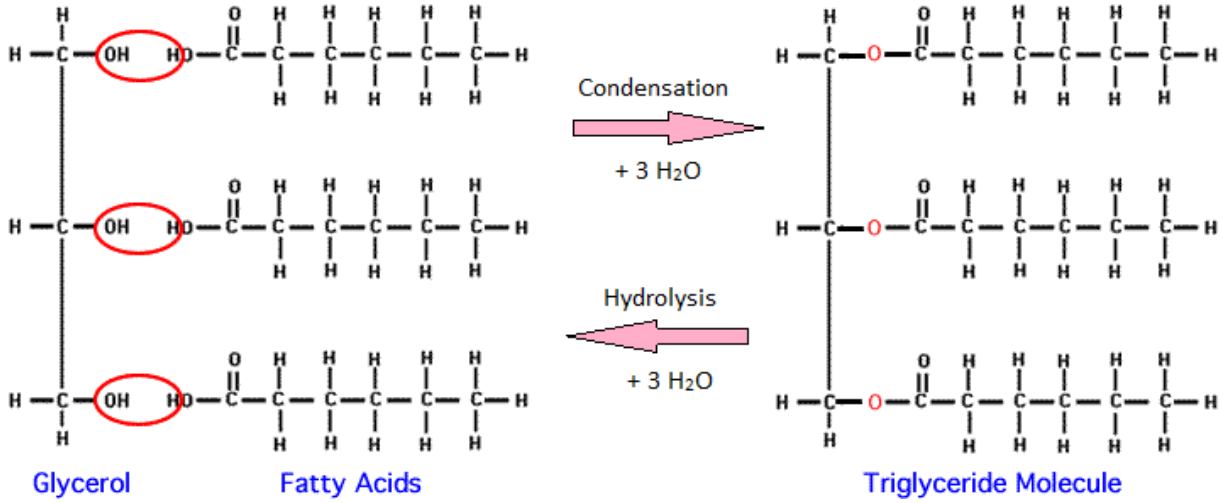

AMINO ACID
Positively charged R groups
Lysine
Arginine
Histidine
Negatively charged R groups
Aspartate
Glutamate
Nonpolar, aromatic R groups
Phenylalanine
Tyrosine
Tryptophan

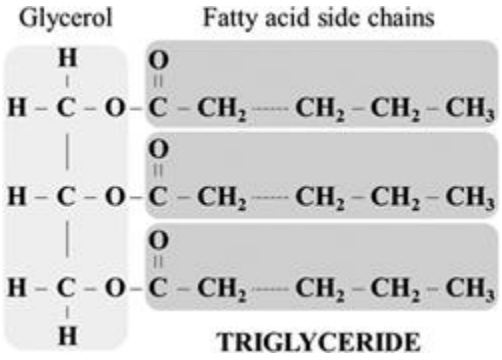


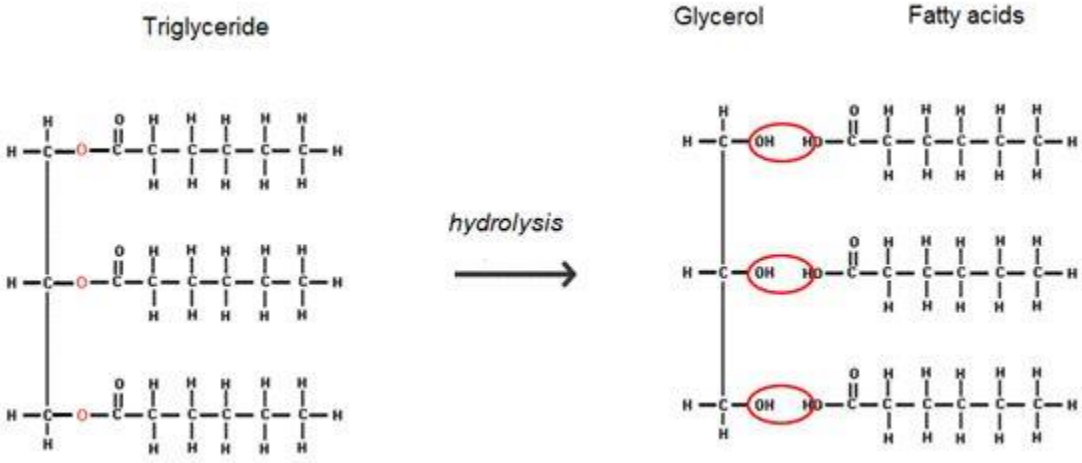
Lipids


H H H
H C C C H
OH OH OH


H
H C OH
H C OH
H C OH
H

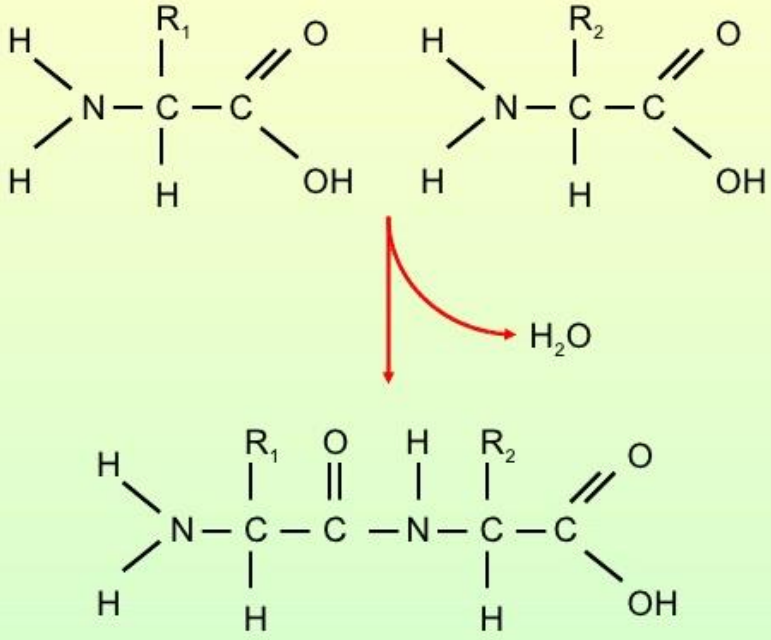

Condensation
+ 3 H2O
Hydrolysis
+ 3 H2O
Glycerol
Fatty Acids
Triglyceride Molecule


Glycerol
Fatty acid side chains
TRIGLYCERIDE

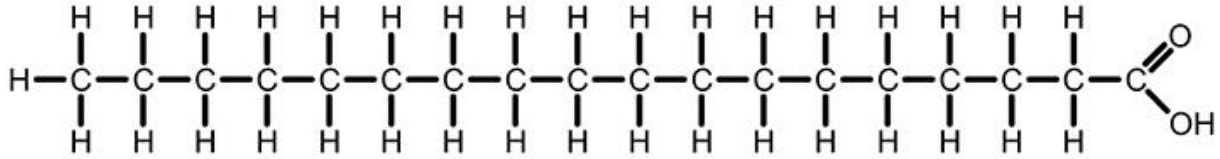

Triglyceride
hydrolysis
Glycerol
Fatty acids

Formation of a dipeptide produces a molecule of water, therefore…

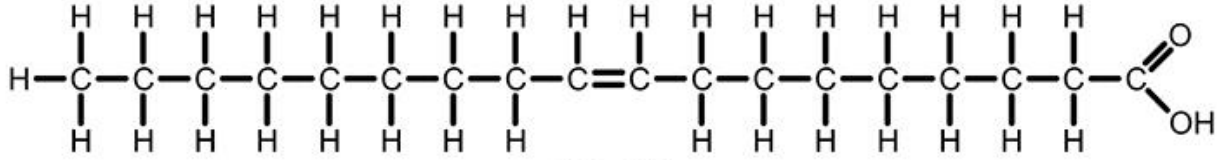
…this is a <u>condensation reaction</u>



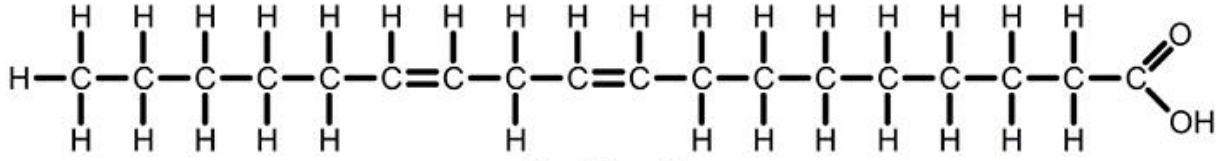
2 amino acids → dipeptide + water



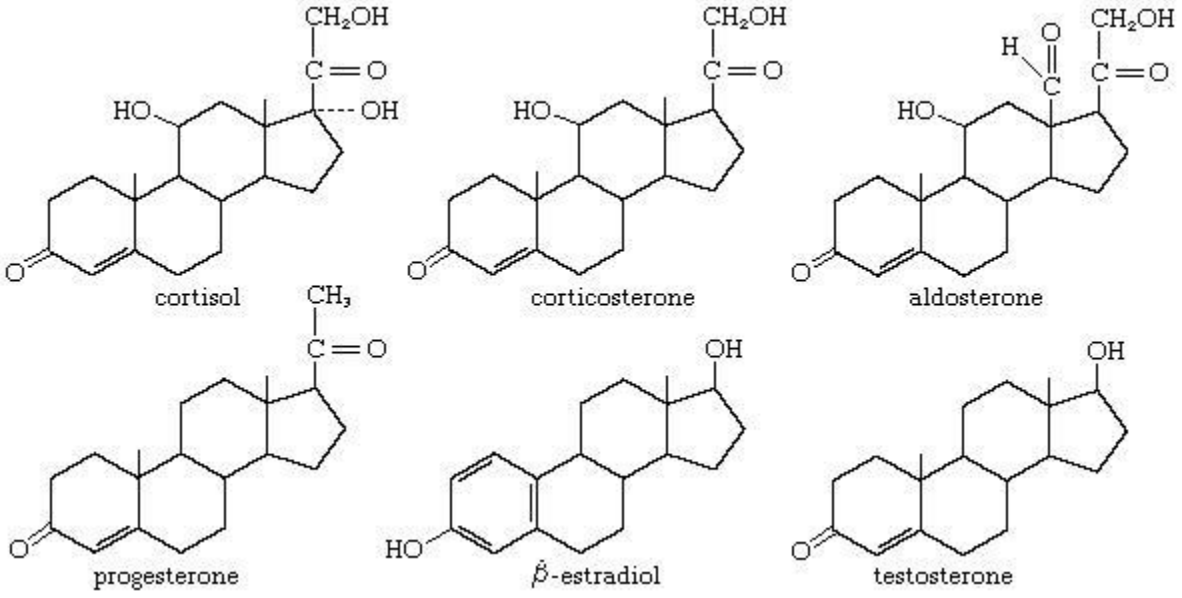
stearic acid
(saturated fatty acid)

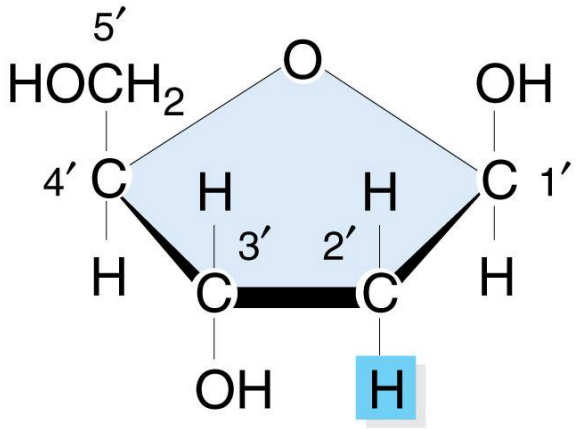


oleic acid
(monounsaturated fatty acid)

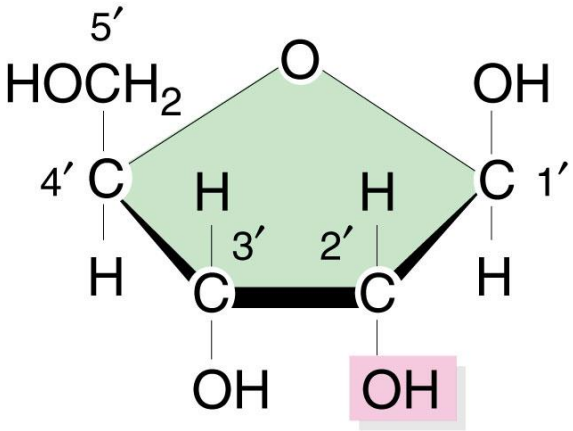


linoleic acid
(polyunsaturated fatty acid)

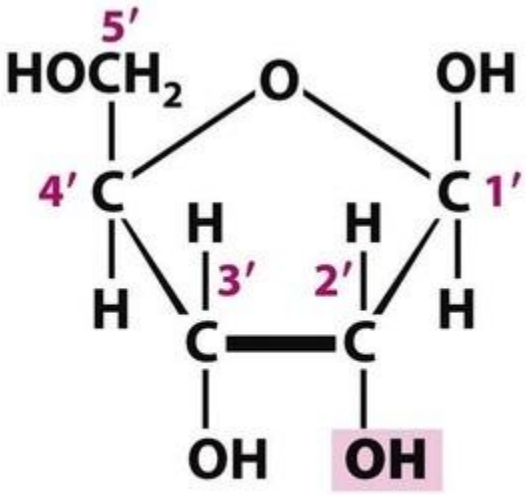




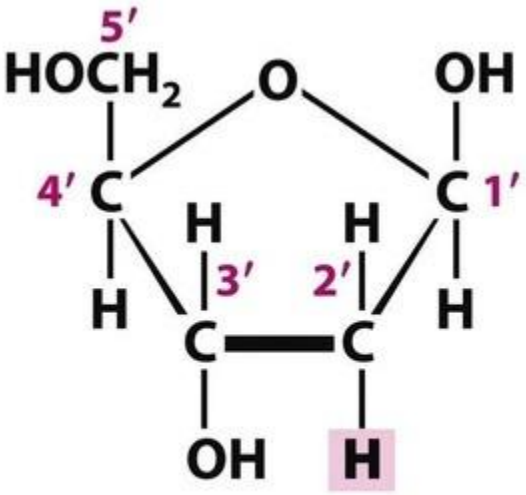
Deoxyribose



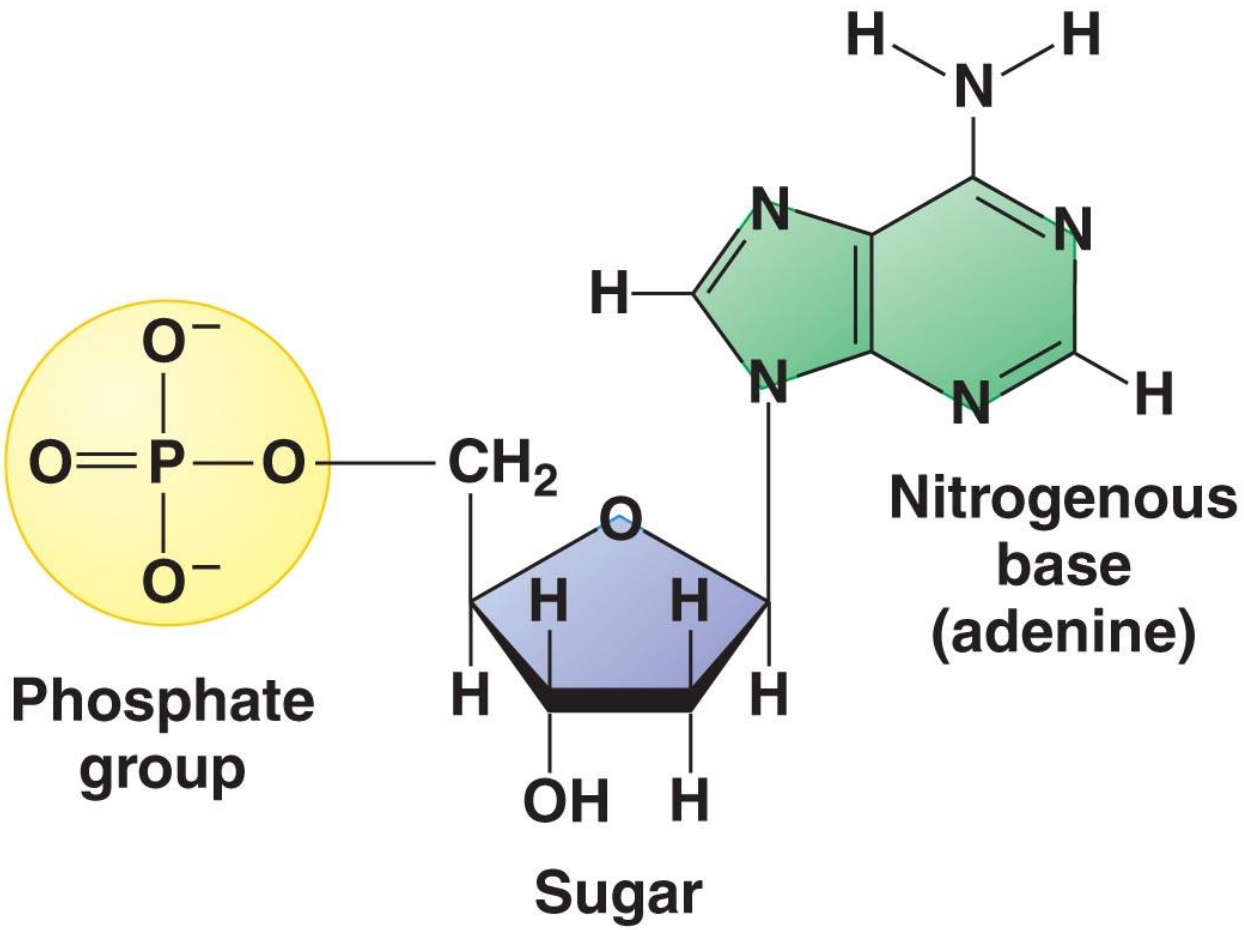
Ribose

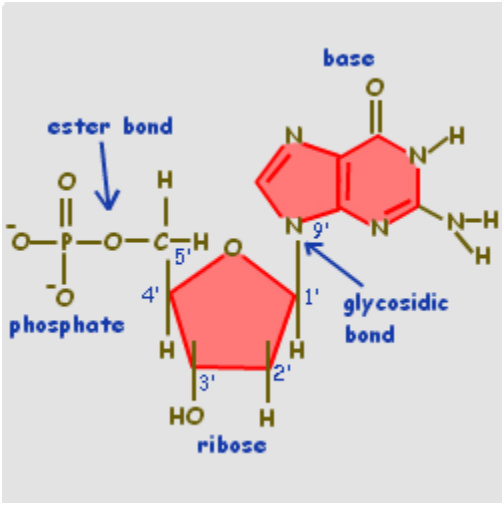


Ribose

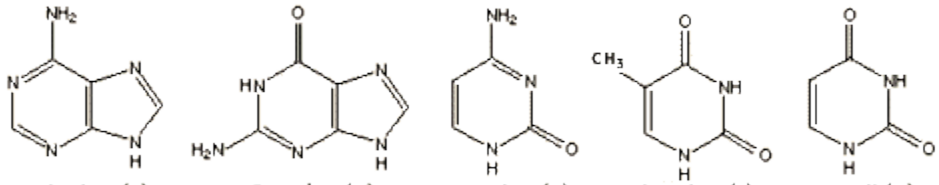


Deoxyribose





Purines **Pyrimidines**

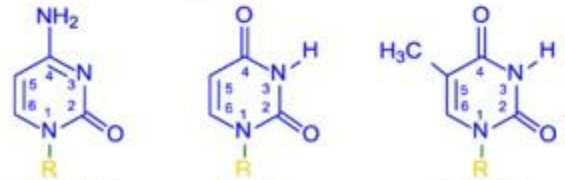


Adenine (A) (DNA and RNA) | Guanine (G) (DNA and RNA) | Cytosine (C) (DNA and RNA) | Thymine (T) (DNA only) | Uracil (U) (RNA only)

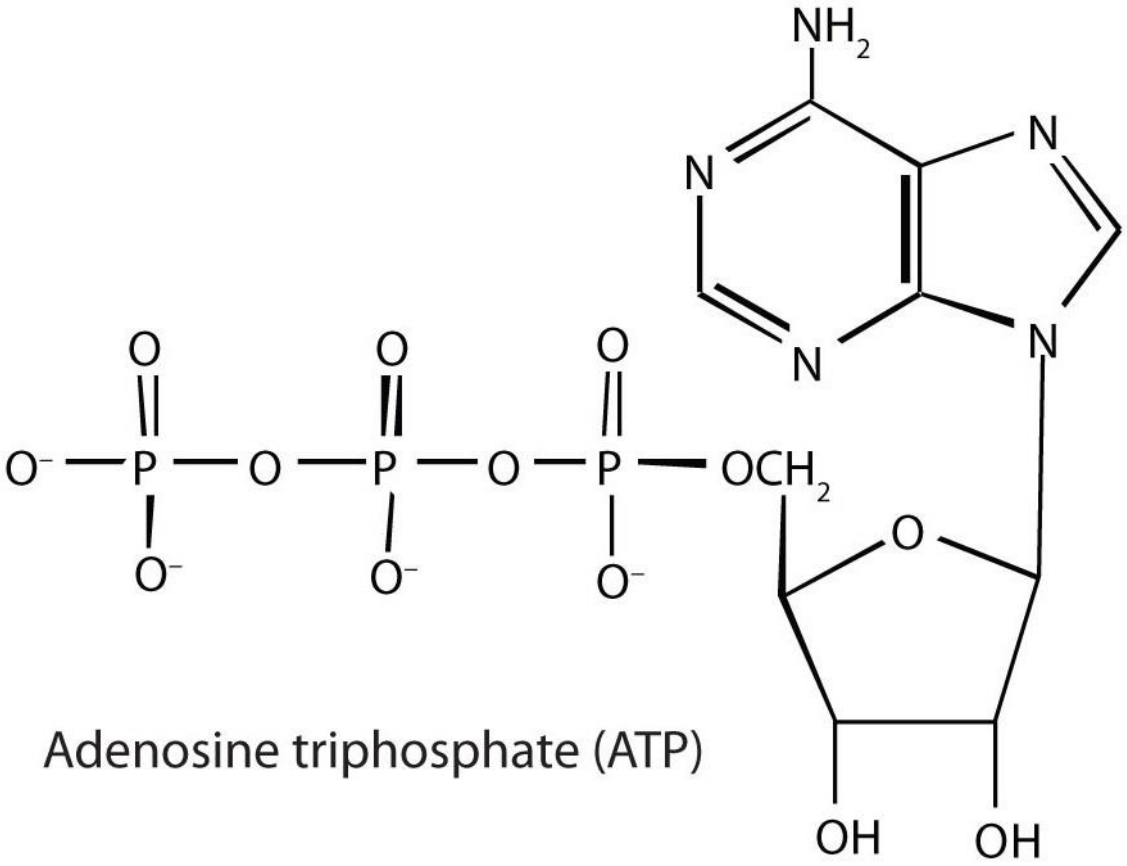
Purines

Adenine Guanine

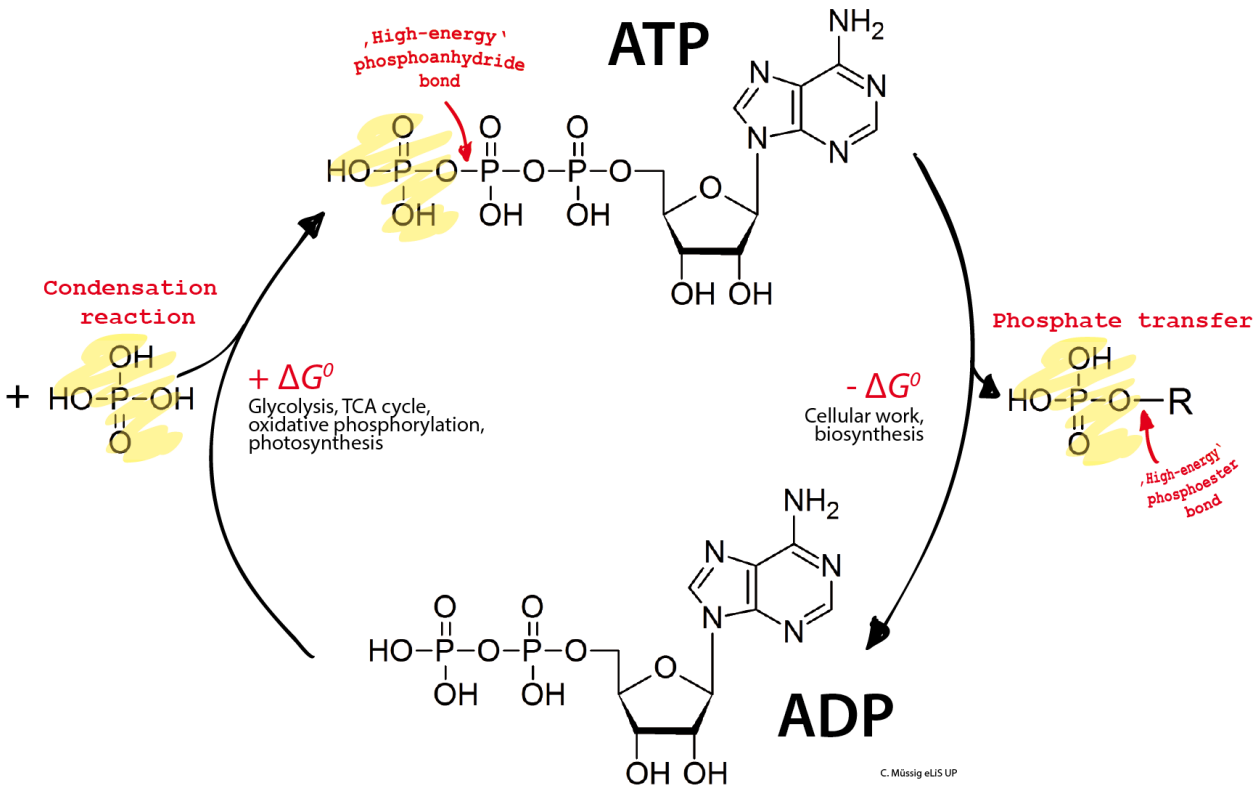
Pyrimidines

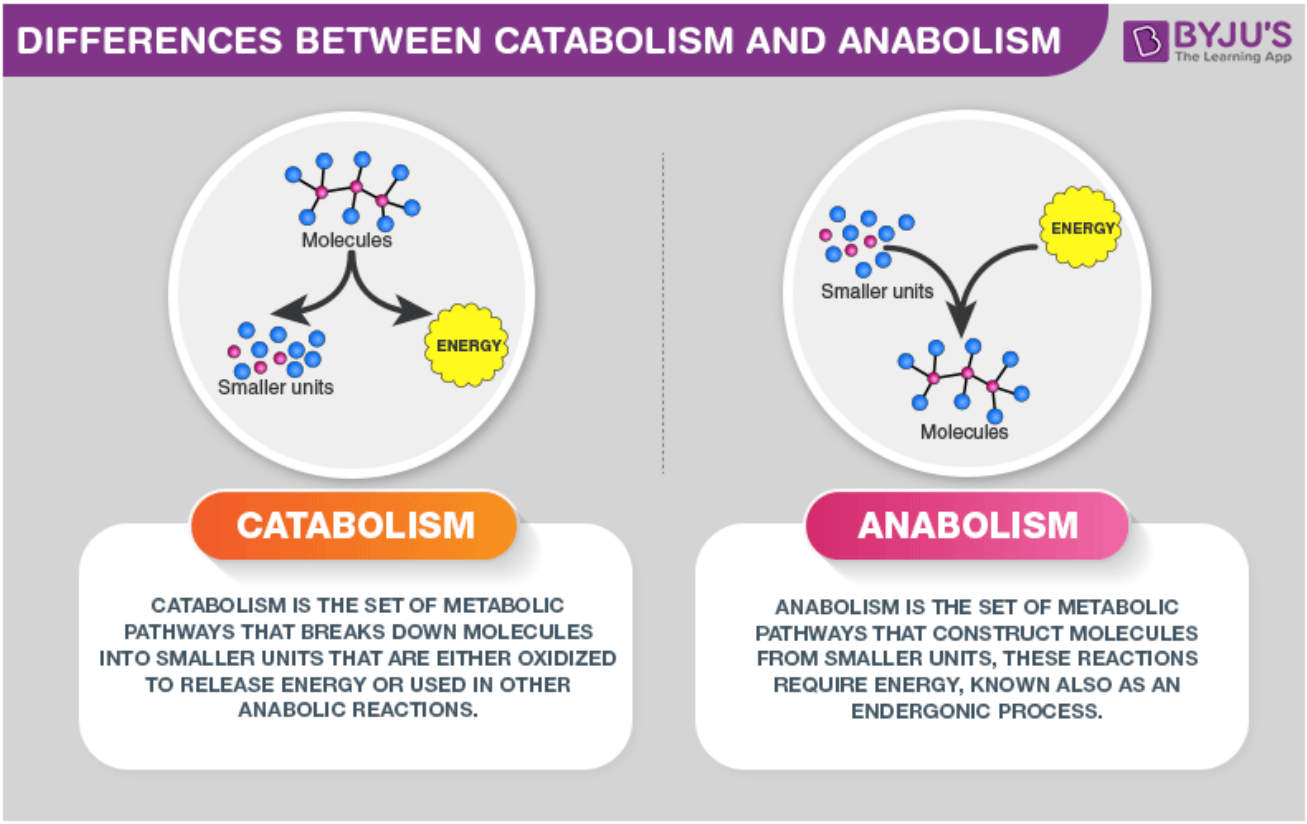


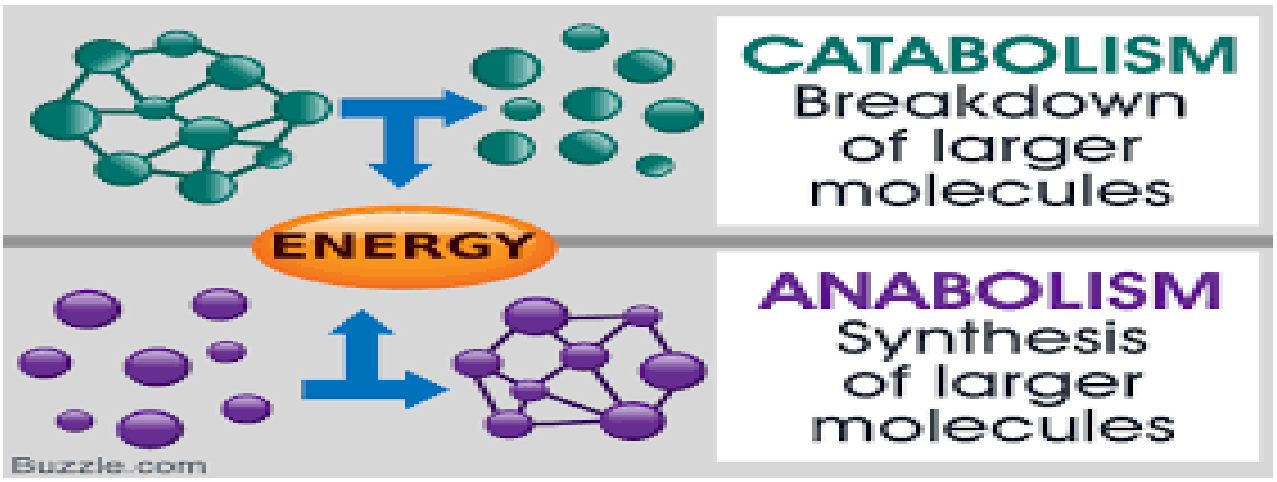
Cytosine Uracil Thymine



Adenosine triphosphate (ATP)


ATP
'High-energy' phosphoanhydride bond
Condensation reaction
+ ΔG⁰
Glycolysis, TCA cycle, oxidative phosphorylation, photosynthesis
- ΔG⁰
Cellular work, biosynthesis
Phosphate transfer
'High-energy' phosphoester bond
ADP
C. Müssig eLiS UP





Anabolic examples

DNA synthesis

Protein Synthesis

Formation of a larger sugar (mono to di or poly)

Steroids

PHOTOSYNTHESIS

Formation of a dipeptide

ATP Synthesis

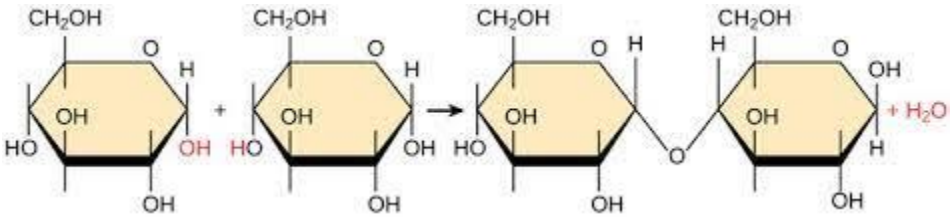
Carbon Fixation (light independent) CO_2 to first stable sugar molecule

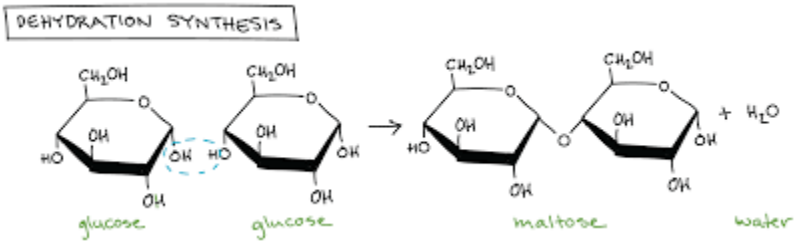
Catabolic

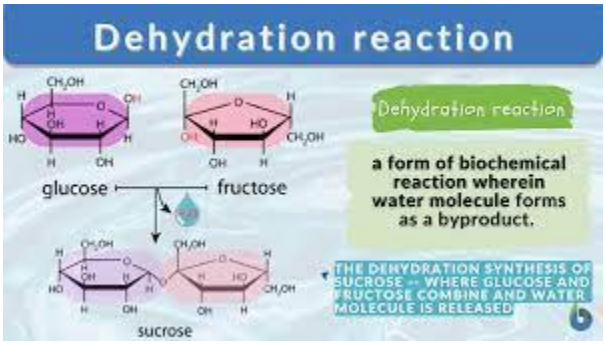
Digestive system

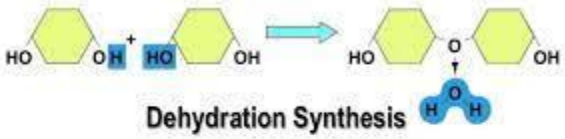
ANABOLISM VERSUS CATABOLISM

ANABOLISM	CATABOLISM
Anabolism is the metabolic process where simple substances are synthesized into complex molecules	Catabolism is the metabolic process which breaks down large molecules into smaller molecules
Constructive phase of metabolism	Destructive phase of metabolism
Requires ATP energy	Releases ATP energy
Endergonic reaction	Exergonic reaction
Estrogen, testosterone, growth hormone, insulin, etc. are involved	Adrenaline, cortisol, glucagon, cytokines, etc. are involved
Does not utilize oxygen	Utilizes oxygen
Functional at resting or sleeping	Functional at body activities
Kinetic energy is converted into potential energy	Potential energy is converted into kinetic energy
Occurs during photosynthesis in plants, protein synthesis, glycogen synthesis and assimilation in animals	Occurs during cellular respiration, digestion, and excretion

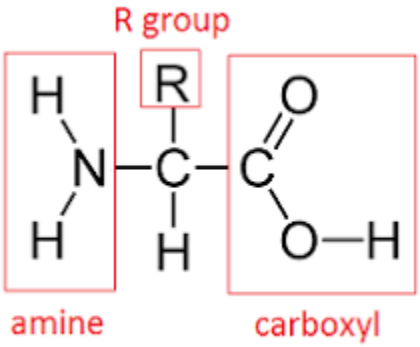

CH2OH
O
H
OH
HO
+ H2O

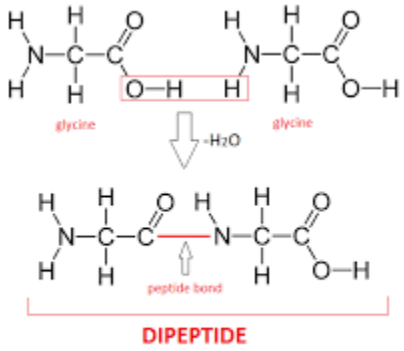

DEHYDRATION SYNTHESIS
glucose
glucose
maltose
water

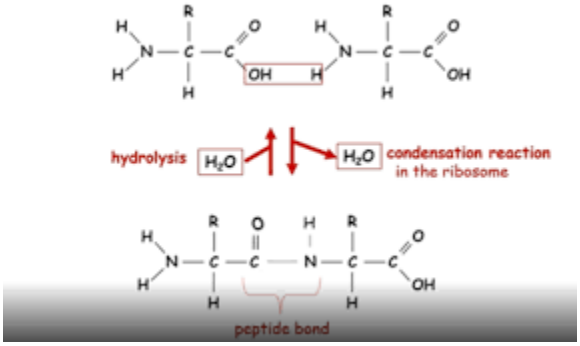

Dehydration reaction
glucose
fructose
sucrose
Dehydration reaction
a form of biochemical reaction wherein water molecule forms as a byproduct.
THE DEHYDRATION SYNTHESIS OF SUCROSE -- WHERE GLUCOSE AND FRUCTOSE COMBINE AND WATER MOLECULE IS RELEASED

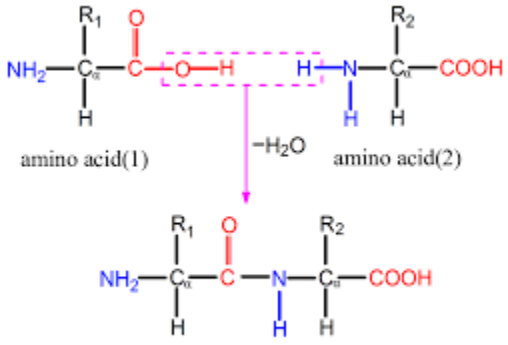

Dehydration Synthesis

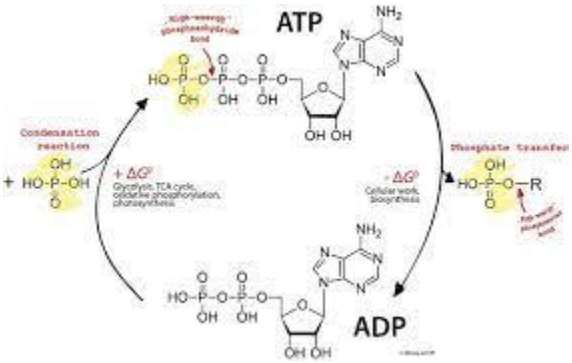

Hydrolysis (Digestion)


R group
amine
carboxyl


glycine
glycine
-H2O
peptide bond
DIPEPTIDE


hydrolysis
H2O
H2O
condensation reaction
in the ribosome
peptide bond





Carbohydrates

General molecular formula: $C_n H_{2n} O_n$

1 : 2 : 1

When we say macromolecules what does that mean?

It means huge molecular mass (hundreds or thousands of units joined together to form one huge molecule)

What is a Monomer?

Is the individual unit of a long chain, that keeps repeating

e.g.: glucose

What is a Polymer?

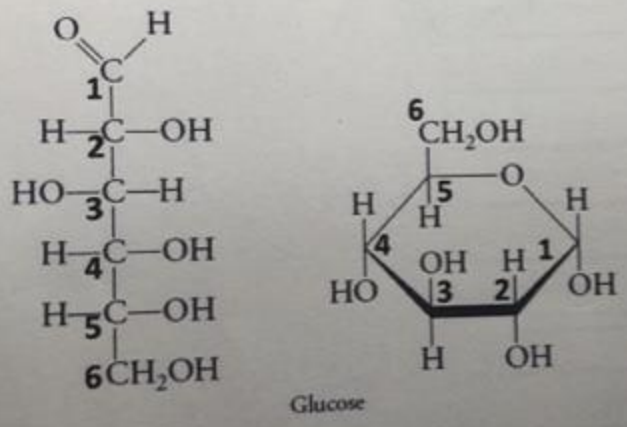
Is a long chain of repeated units (monomers)

e.g.: Amylose

3. Simple carbohydrates (monosaccharides) have the general formula $(CH_2O)_n$ (hydrates of carbons). Glucose has the formula $C_6H_{12}O_6$ and the Fischer projection (open chain form) and Haworth projection (cyclic, hemiacetal form in solution) are shown below.

a. Propose a mechanism (draw arrows) for the formation of the hemiacetal form (right) of glucose from the open chain form (left).

b. Identify the new chiral center formed in the Haworth projection (right structure).

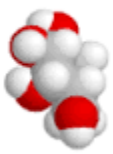


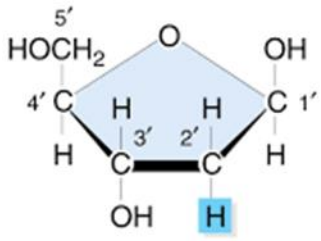
Glucose

Definition - Carbohydrates are sugar polymers
Carbohydrate = Carbon + Water

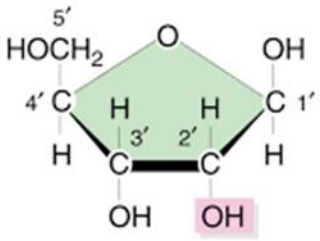
$C_n(H_2O)_n$

or $C_6H_{12}O_6$

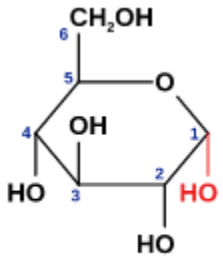




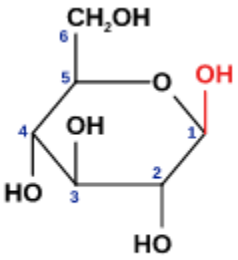
Deoxyribose



Ribose



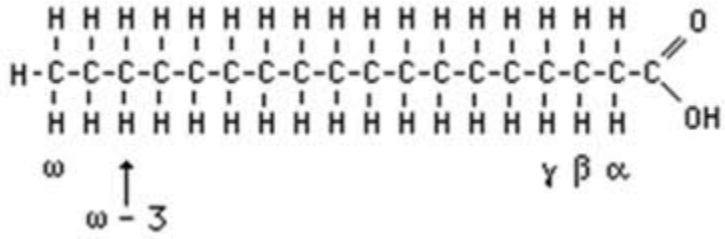
Alpha-(α) Glucose

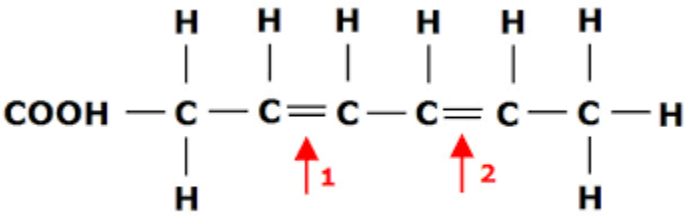


Beta-(β) Glucose

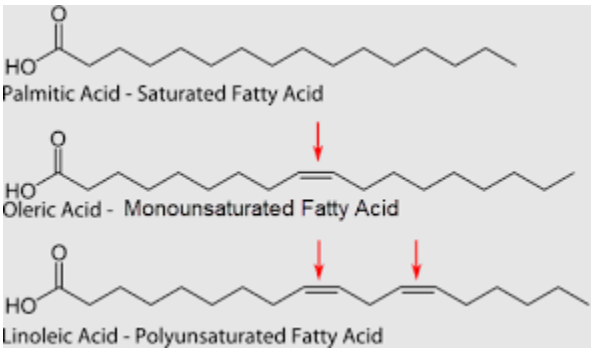
Fatty acids

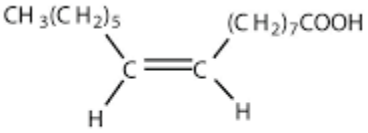
- They all have a carboxyl group (-COOH) at one end and a methyl group (CH_3-) at the other end.
- A fatty acid has the general formula: ***CH_3-$(CH_2)_n$-COOH*** where n is typically an even number between 12 and 22
- If no double bonds are present the molecule is called a **saturated fatty acid**.
- If a chain contains double bonds, it is called an **unsaturated fatty acid.**



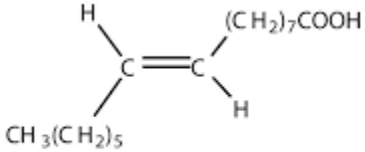


Polyunsaturated Fat





cis fatty acid



trans fatty acid