Organic Chemistry and Biomolecules

TEKS

- B.9A compare the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids

Vocabulary

Organic Chemistry

- Organic
- Valence Electron
- Monomer
- Polymer
- Dehydration Synthesis
- Hydrolysis

Biomolecules

- Carbohydrate
- Protein
- Nucleic Acid
- Lipid
- Saturated
- Unsaturated
- Monosaccharide
- Polysaccharide
- Amino Acid
- Nucleotide
- Nitrogenous Base
- Phosphate group

Prerequisite Questions

- What is a covalent bond?
- What are valence electrons?
- Why do scientists say that life on Earth is carbon based?

Essential Question

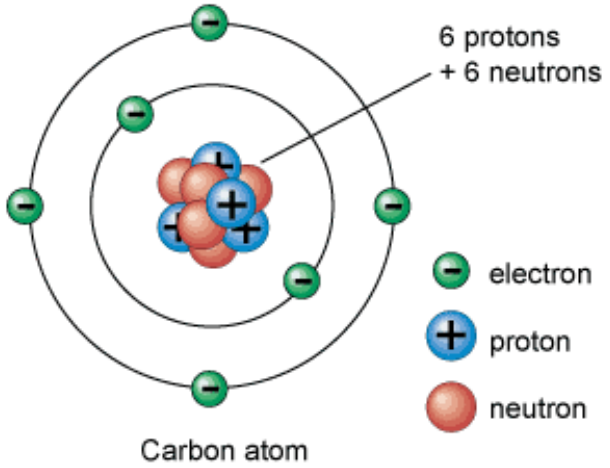
- How are structure and function connected in the 4 biomolecules?

Organic Chemistry

- Organic chemistry is study of molecules that contain **Carbon**.

- Valence electrons are the outer most electrons used in bonding.

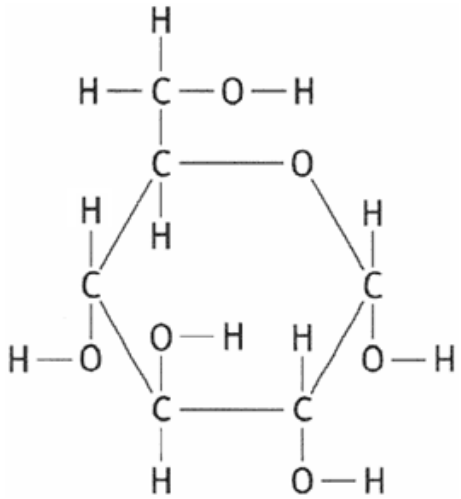
- Carbon is very versatile.
  - It has 4 valence electrons,
    so it can form 4 covalent bonds



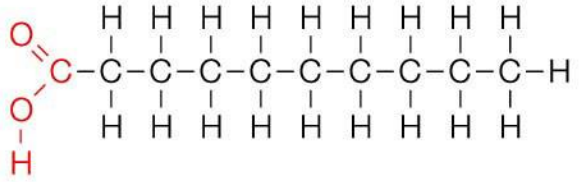
Organic Chemistry

- Carbon can form long chains by covalently bonding to itself.
- Carbon readily bonds with other elements like H, O, N, P and S

Glucose



Saturated



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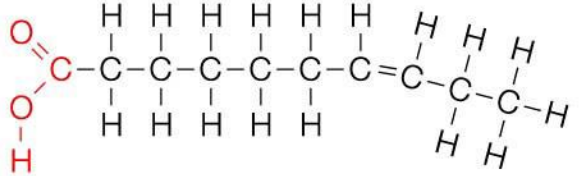
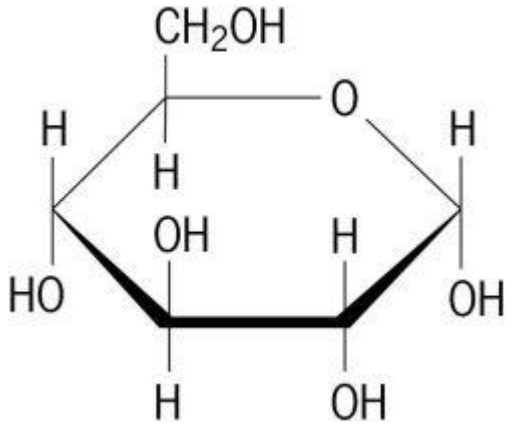


Organic Chemistry - **Monomers**

- A Monomer is a small molecule that is repeated over and over in a larger molecule

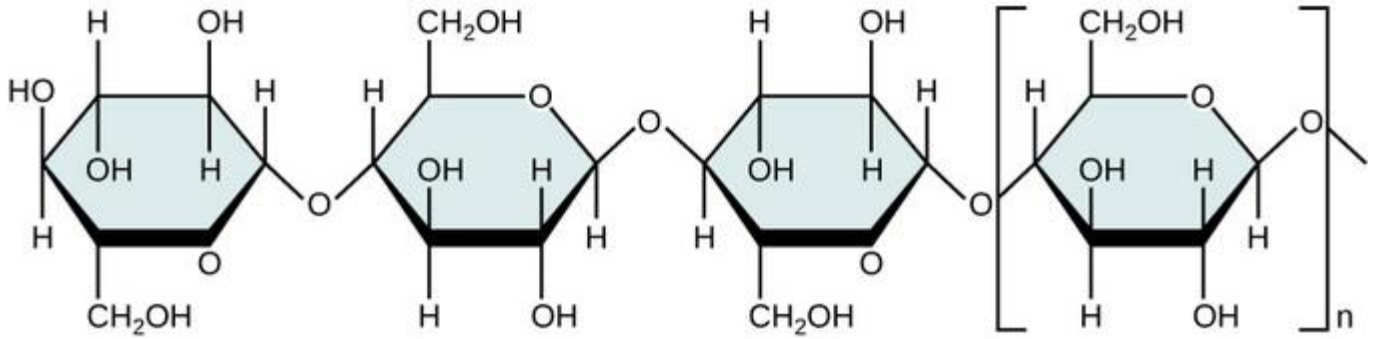
- Carbohydrates, Proteins and Nucleic Acids have monomers

- Ex: Monosaccharide (Glucose)



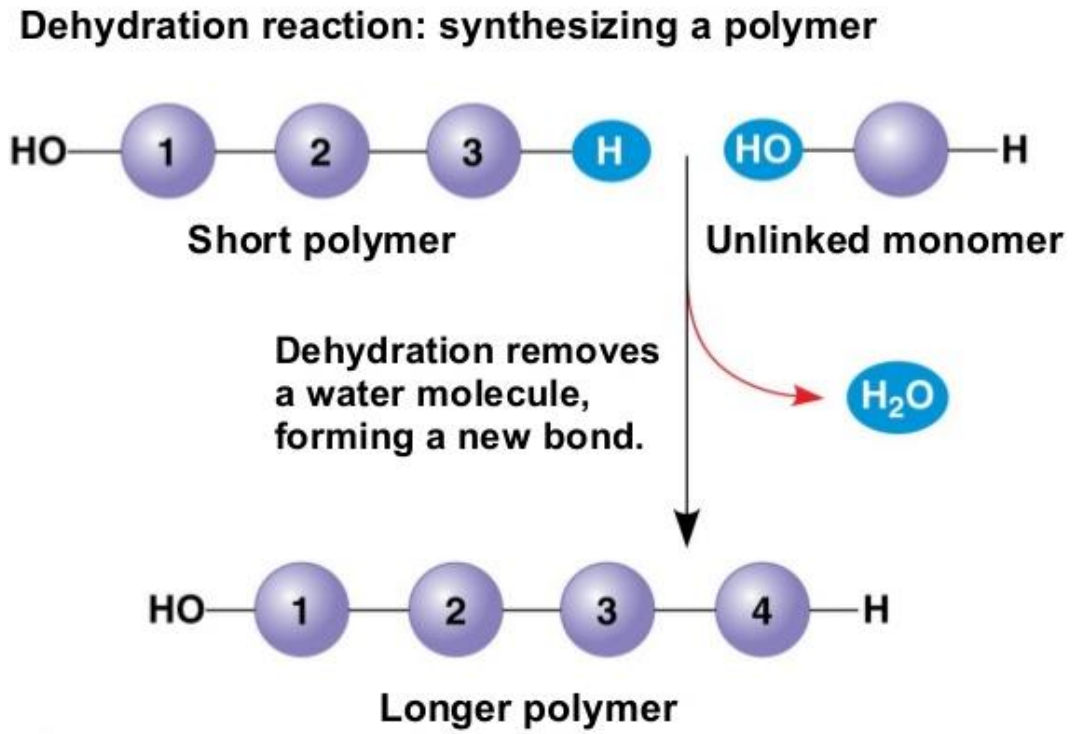
Organic Chemistry - **Polymers**

- A Polymer is a large molecule made up of many smaller monomers.
- Carbohydrates, Proteins and Nucleic Acids also have a polymer structure that is made up of their monomers.
- Ex: Polysaccharide (Cellulose)



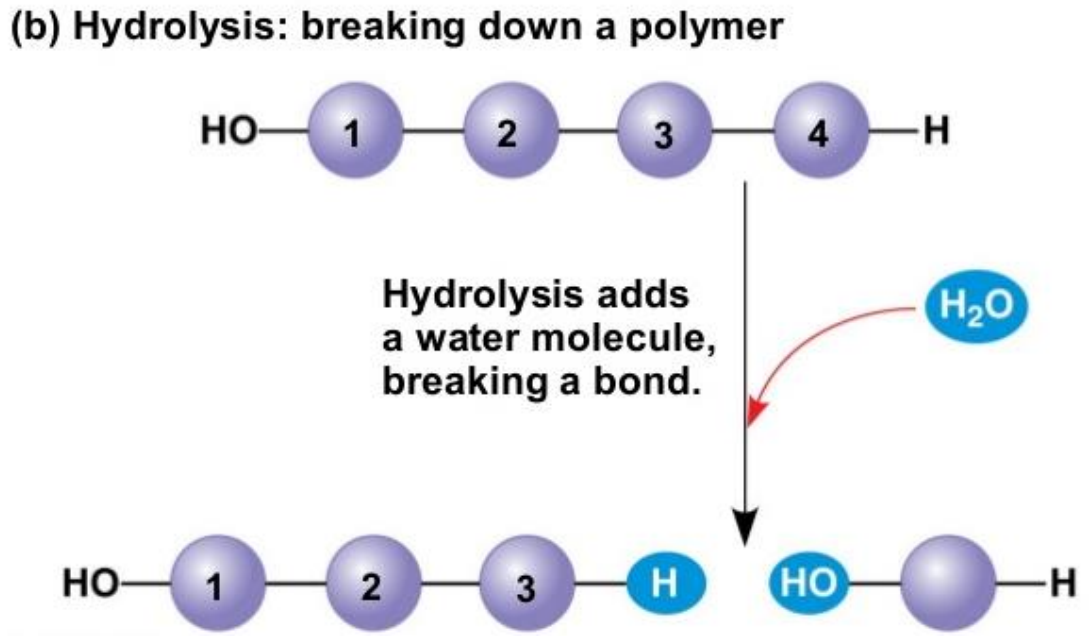
Organic Chemistry – Dehydration Synthesis

- The process of **Dehydration Synthesis** connects monomers together to make polymers and gives off a water molecule in the process.



Organic Chemistry – Hydrolysis

- The process of **Hydrolysis** separates monomers from polymers and breaks up a water molecule in the process.

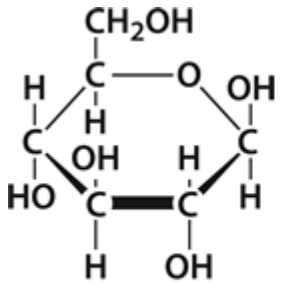


Carbohydrates

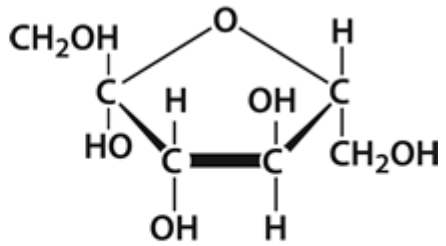
Elements:	**Major biological use:**
C, H, O (C:O ratio is very close to 1:1)	Short term (quick) energy [4 Kcal/gram] ***Other biological uses***: Structural, Cell identification
Does it have Monomer/Polymer structure:	**Examples:**
Yes Monomer name – Monosaccharide Polymer name – Polysaccharide	*Monosaccharides*: Glucose, Fructose, Maltose, Galactose *Polysaccharides*: Sucrose, Cellulose, Glycogen, Chitin (HELPFUL TIP: carbohydrates often end in –**ose**)

Carbohydrate Images

Monosaccharide (Ex: Glucose and Fructose)



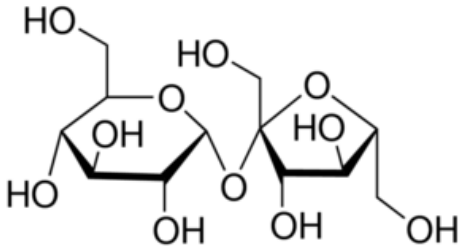
glucose

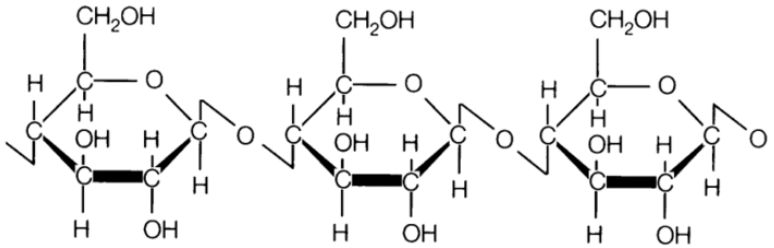


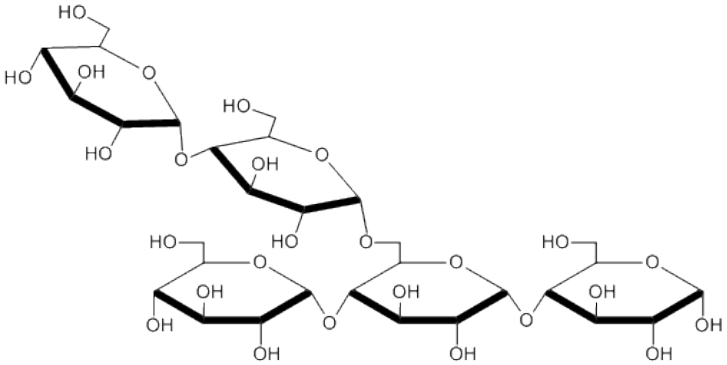
fructose

Polysaccharide

(Ex: Sucrose, Cellulose and Glygocen)





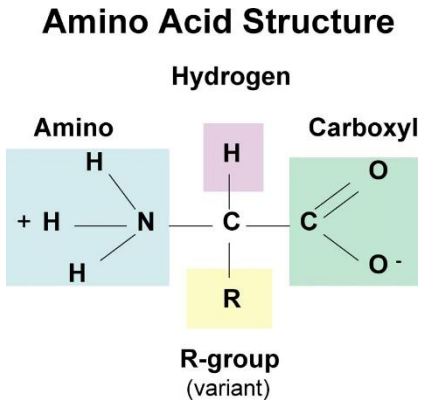


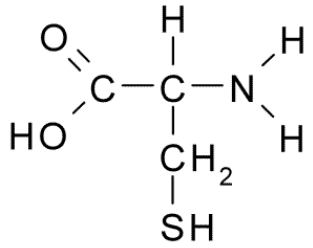
Proteins

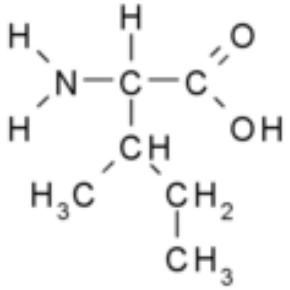
Elements:	**Major biological use:**
C, H, O , N	Enzymes ***Other biological uses***: Structural, Cell identification
Does it have Monomer/Polymer structure: **Yes** Monomer name – Amino Acid (20 different) Polymer name – Polypeptide/Protein	**Examples:** Enzymes (*Sucrase, Amylase, Lactase*), Protein channels, Antibodies, Insulin, Actin, Myosin, Tubulin (HELPFUL TIP: enzymes often end in –**ase**)

Protein Images

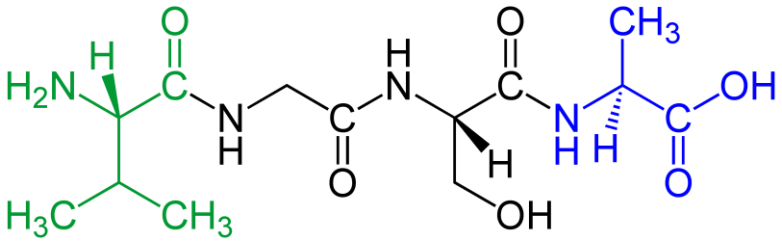
Amino Acid (Ex: general Cystine and Isoleucine)

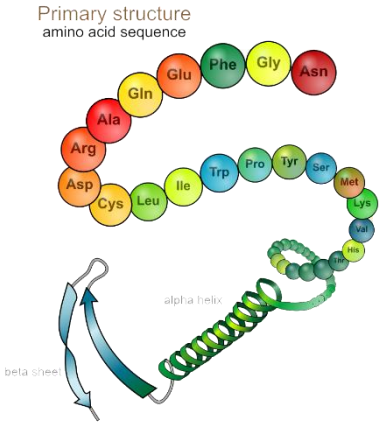


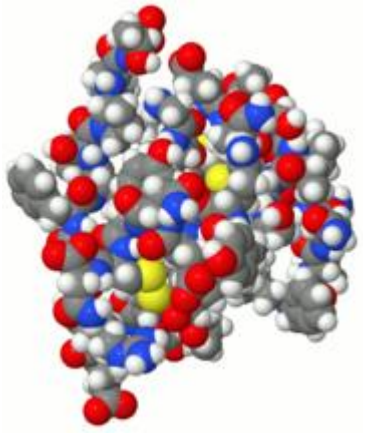




Polypeptide/Protein (Ex: Polypeptide General and Insulin)







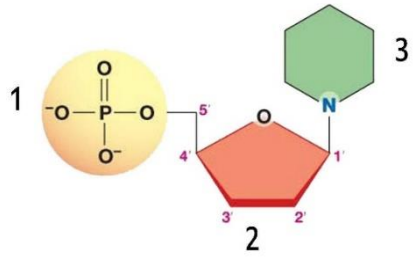
Nucleic Acids

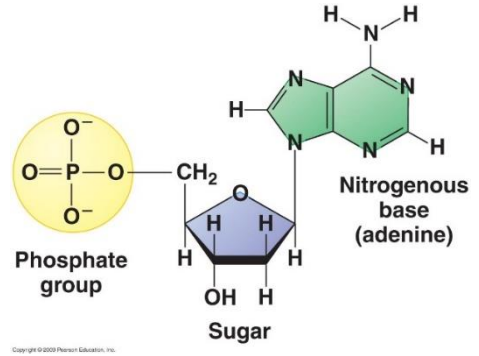
Elements:	**Major biological use:**
C, H, O , N, P	Storing Genetic Information ***Other biological uses***: Building proteins
Does it have Monomer/Polymer structure: **Yes** Monomer name – Nucleotide Polymer name – Nucleic Acid/Polynucleotide	**Examples:** DNA (Double Stranded, contains A, C, G and T) RNA (Single Stranded, contains A, C, G and U)

Nucleic Acid Images

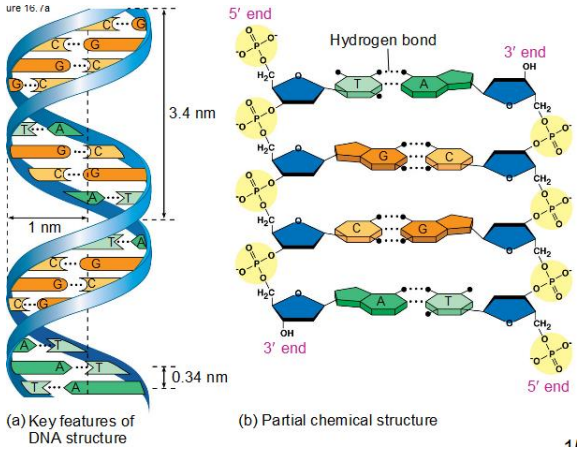
Nucleotide (Ex: General and Adenosine)

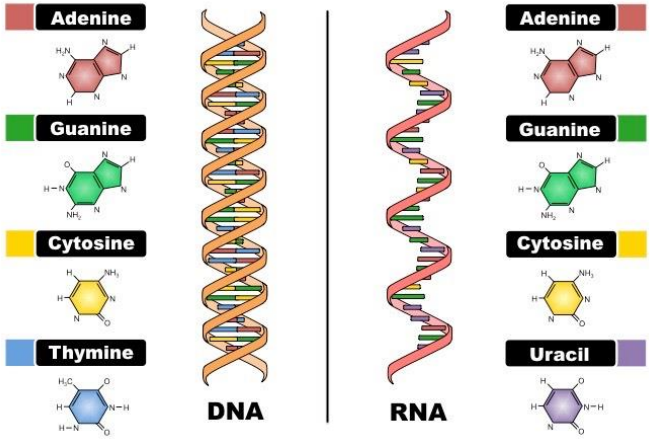
1 – Phosphate group
2 – Sugar
3 – Nitrogenous Base





Polynucleotide/Nucleic Acid (Ex: DNA and RNA)



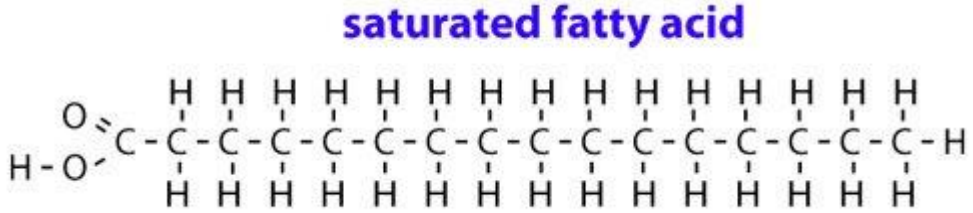


Lipids

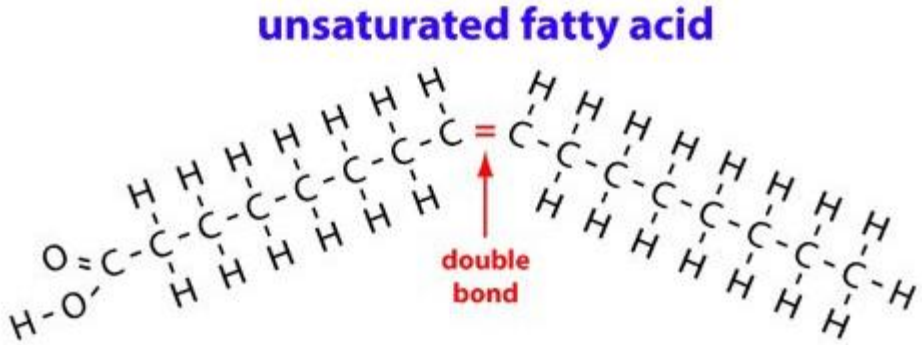
Elements:	**Major biological use:**
C, H and sometimes O (C:O ratio is NOT close to 1:1)	Long term (slow) energy [9 Kcal/gram] ***Other biological uses***: Insulation, Lubrication, Cell boundaries, Signals
Does it have Monomer/Polymer structure:	**Examples:**
NO!	Saturated Fats, Unsaturated Fats, Steroids, Phospholipids

Saturated vs. Unsaturated Fats

- **Saturated Fats** have all single bonds between the carbons.
- The carbons are saturated with hydrogens.

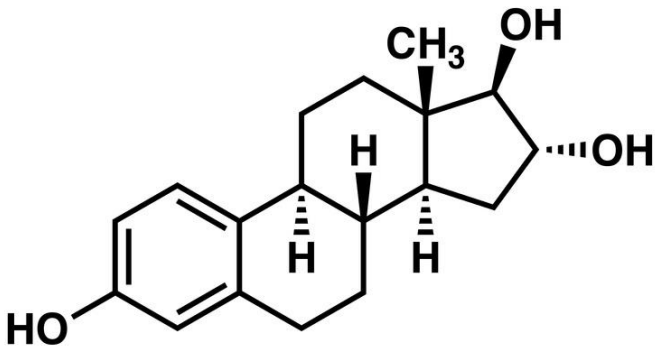


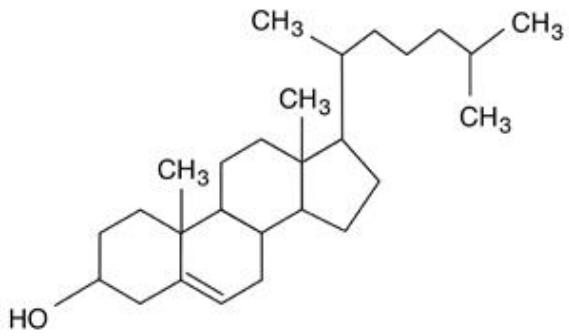
- **Unsaturated Fats** have at least one double bond between carbons.
- Hydrogens have to be removed to make the double bonds



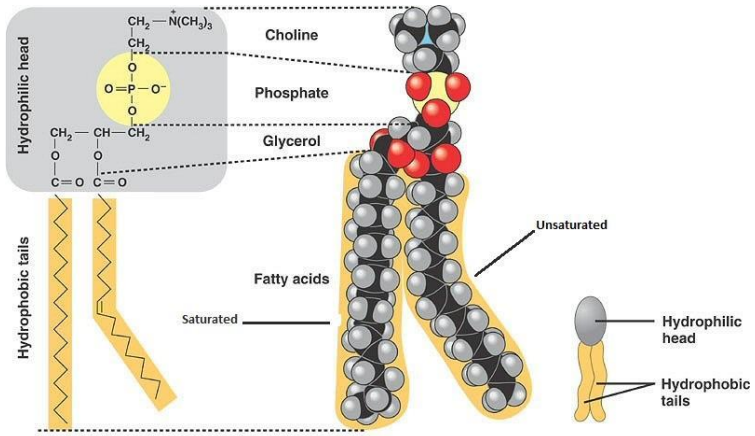
Lipid Images

Steroids/Sterols (Ex: Estrogen and Cholesterol)

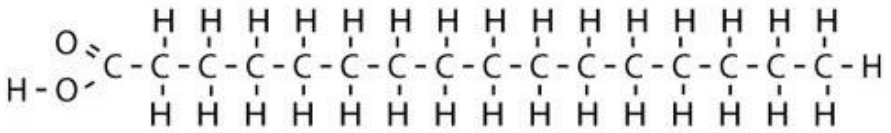




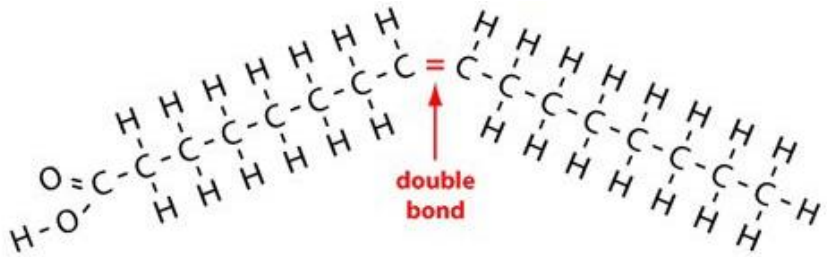
Phospholipid



Saturated Fat



Unsaturated Fat



Concept Mastery Questions

- How does dehydration synthesis create new molecules?
- What molecule is released when a polymer is created with dehydration synthesis?
- How are lipids different from the other 3 biomolecules?
- What biomolecules are a good source of energy? Explain…