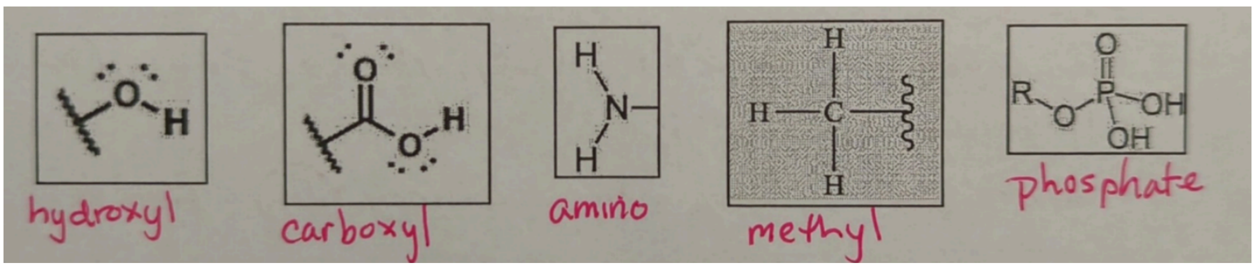
Name: KEY

Unit 1b: Organic Chemistry Study Guide

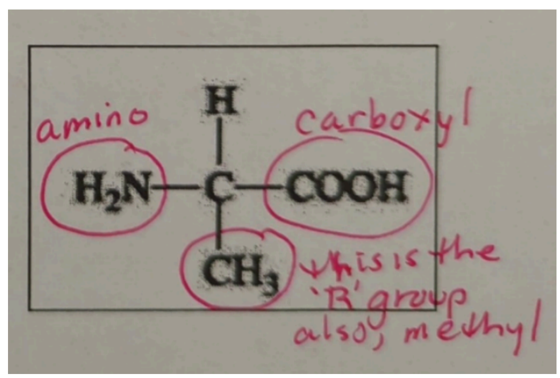
Topic 1.2: Elements of Life

Learning Objective	**ENE-1.A** Describe the composition of macromolecules required by living organisms.
I can…	☐ I can identify carbon as the atom used to build the backbone of all organic molecules. ☐ I can identify nitrogen as an element needed to build proteins and nucleic acids. ☐ I can identify phosphorus as an element needed to build nucleic acids and some lipids.

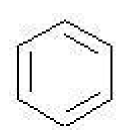
1. Identify the functional groups below. (word bank: hydroxyl, amino, carboxyl, methyl, phosphate). Which one is nonpolar/hydrophobic?



2. The following structure has three functional groups that you identified above, but they were written with a different shorthand. Identify all three functional groups, then identify the molecule, if you can.

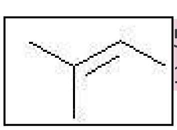


3. How many carbons are in the following drawing? How many hydrogens?

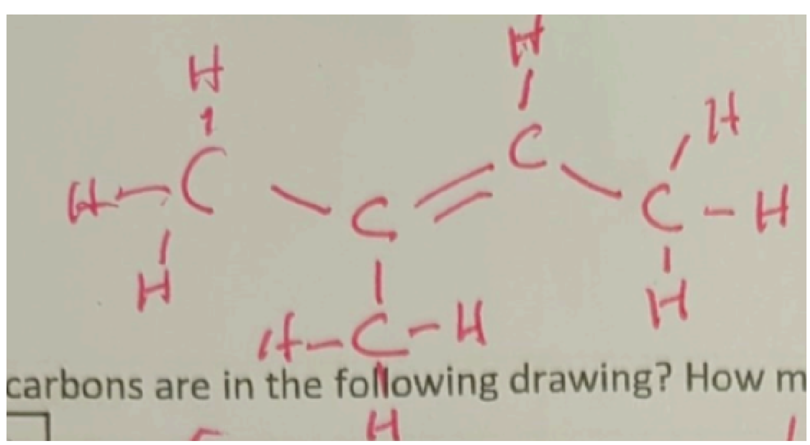


6 and 6

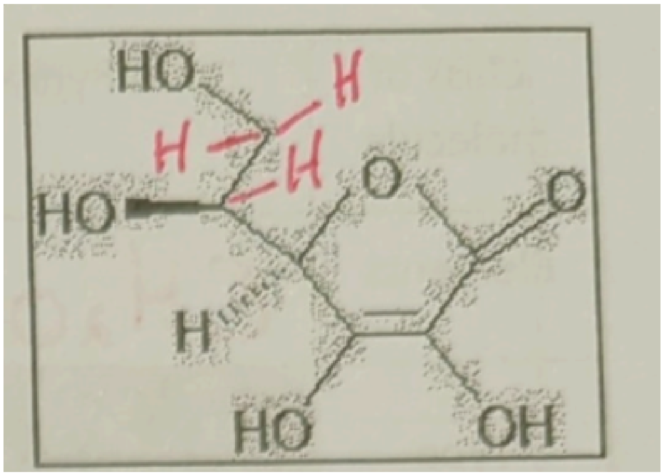
4. How many carbons are in the following drawing? How many hydrogens?

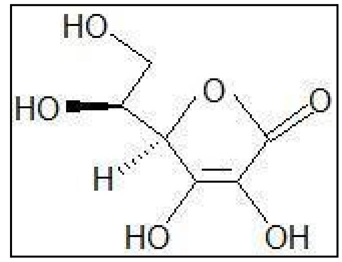


5 carbons and 10 hydrogens



5. Look at the following molecule of vitamin A and draw in the hidden hydrogens.





Topic 7.13: Origins of Life on Earth

Learning Objective	SYI-3.E Describe the scientific evidence that provides support for models of the origin of life on Earth.
I can…	☐ Explain the geological evidence that supports the hypothesis that life originated on Earth. (The earliest fossil evidence for life dates to 3.5 bya) ☐ Explain the model about the origin of life on Earth that primitive earth provided inorganic precursors from which organic molecules could have been synthesized because of the presence of available free energy and the absence of a significant quantity of atmospheric oxygen (O_2). ☐ Explain the model about the origin of life on Earth that organic molecules could have been transported to Earth by a meteorite or other celestial event.

1. People have long puzzled over the origin of life. What can we know and what can we never know, scientifically, about the origin of life?

We can know how life might have started, and the precursors and elements that would need to be present, but we can NOT know how life actually started.

2. What kinds of questions are scientifically testable? What kinds are not?

Testable questions can be proven wrong. (Hypothesis and null hypothesis).

If we can't falsify, it's not science. (So that's why religion and philosophy are not science).

3. In what way was the atmosphere our Earth different before life began, 3.8 billion years ago?

There was no atmospheric oxygen (O_2). This is important!!

Oxygen developed over time due to producers (thank you, cyanobacteria!!)

4. What did Stanley Miller's experiment show and what did it not show?

It showed how life **might** have started. It doesn't prove how life did start.

5. New data about the composition of the early atmosphere shows that the early atmosphere was a little bit different than what Miller had assumed for his experiment. How must scientists modify their models when new data becomes available showing the original assumptions were just a bit off? How must scientists modify their models when new data shows that the original assumptions were drastically off?

We need to modify our model a little bit and retest. Example: Try his experiment again, but with a different combination of gasses in the chamber.

If it is drastically different, then toss it! Like if we thought that the Earth was the center of the universe, then we would have to toss that model when evidence showed us that we are no where near the center of the universe.

6. If scientists are interested in the presence of life on another planet or asteroid, what do they look for when they analyze materials taken from these planets? In other words, what do we think is required for life, as we know it?

Water and carbon compounds.

7. Which radioisotope(s) (^{14}C, ^{35}S, ^{15}N, ^{32}P) would be most appropriate for following the path of each macromolecule through an organism, experiment, or ecosystem?
    a. Carbohydrate C14
    b. Lipid C14 (or if we are looking at a phospholipid, then maybe P32)
    c. Protein N15 or S 35
    d. Nucleic Acid P32 or N15

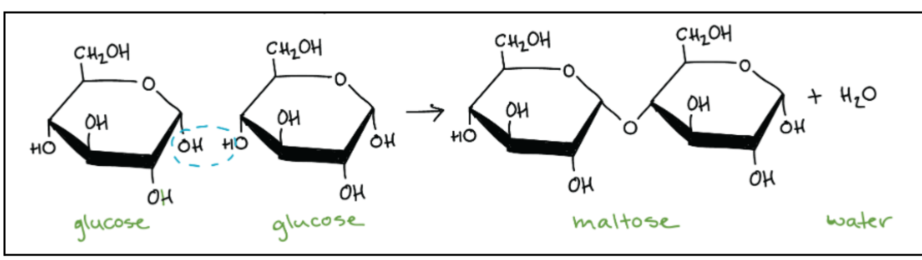
You don't need to know the number of the isotope, just the element.

Topic 1.3: Introduction to Biological Macromolecules

Learning Objective	**SYI-1.B** Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.
I can…	□ Identify the process of hydrolysis and dehydration synthesis, which are used to cleave and form covalent bonds between monomers

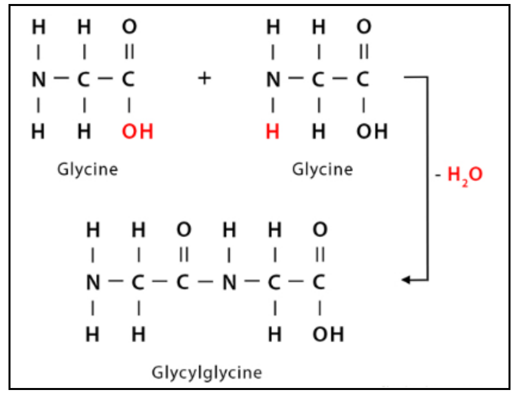
NOTE: Just answer the dehydration synthesis vs hydrolysis questions first, then come back to answer the types at the end of the unit.

1. Does the following equation depict dehydration synthesis or hydrolysis? What type of molecules are involved? (Carb/lipid/protein/nucleic acid – you may need to come back to this)

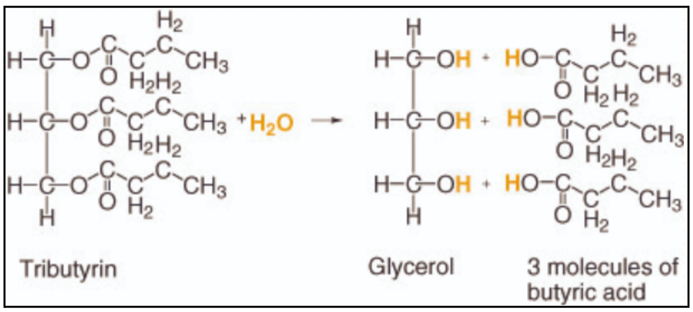


These are monosaccharides going together to make a disaccharide.

2. Does the following equation depict dehydration synthesis or hydrolysis? What type of molecules are involved? (Carb/lipid/protein/nucleic acid – you may need to come back to this)



These are amino acids going together to make a dipeptide.



3. Does the equation on the left depict dehydration synthesis or hydrolysis? What type of molecules are involved? (Carb/lipid/protein/nucleic acid – you may need to come back to this)

A triglyceride is broken down into glycerol and three fatty acids.

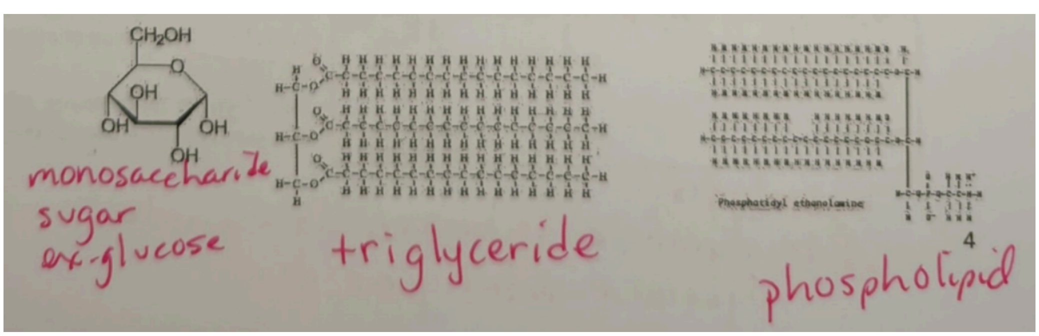
4. Distinguish between positive feedback and negative feedback.

Negative feedback is much more common. Changes away from a set point trigger changes in the opposite direction.

Positive feedback - changes away from the set point causes changes in the same direction.

Organic Molecules Chart AP bio

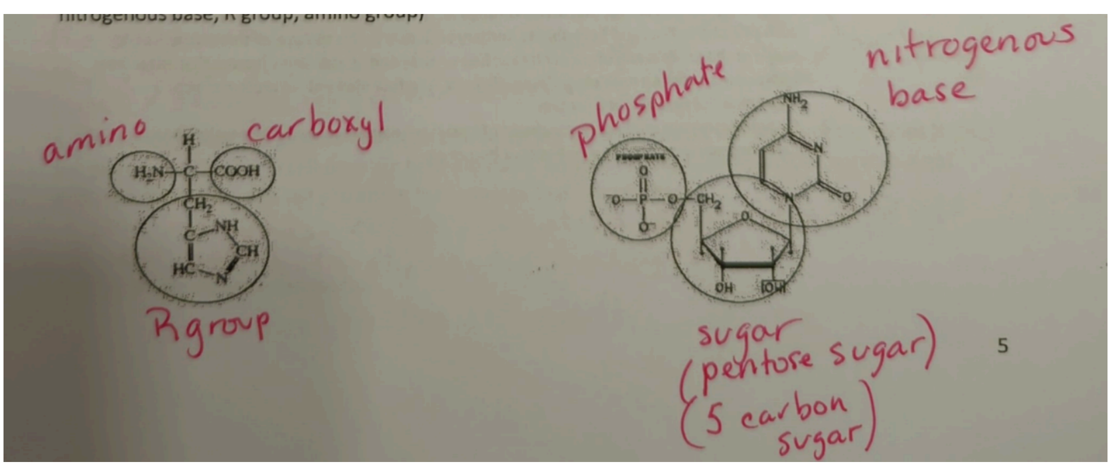
Class of molecule	Carbohydrate	Lipid			
Elements	CH_2O	CH and a little bit of O			
Type		triglyceride	phospholipid	steroid	wax
Monomer/ Building block	monosaccharide	Glycerol and 3 fatty acids	Glycerol and 2 fatty acids and a hydrophilic head	4 fused rings (of hydrocarbon)	2 fatty acids joined by a bond
Other Name	sugar				
Function	Monomer function quick energy	triglyceride function store energy long term	Phospholipid function cell membrane	Steroid function hormones and cholesterol	Wax function water repellent
Polymer Name	polysaccharide				
Polymer Examples	Energy storage in animals glycogen Energy storage in plants starch Structure in plants (found in cell walls) cellulose Exoskeleton and fungi cell walls chitin	What property do all lipids have in common? they are all hydrophobic			



	Proteins	Nucleic Acids		
Elements	CHONS	CHONP		
Monomer	amino acids	nucleotides		
Polymer	polypeptide		DNA	RNA
Polymer Structure Polymer Function(s)	Bond type in primary structure: **covalent** (peptide is between the amino acids) Bond type that holds secondary structure in alpha helices or beta pleated sheets: **Hydrogen bonds** (found between N and H in the backbone of the polypeptide) Bonds or interactions that hold the 3D shape of a protein in tertiary or quaternary structure **all of them**: hydrogen bonds, hydrophobic interactions, ionic bonds, covalent (disulfide) bonds between different R groups of amino acids in the polypeptide for tertiary structure but between different polypeptide chains for the quaternary structure. List a few specific functions enzymes, hormones, receptors, antibodies, structures	Sugar Bases (letters) Number of strands typical	Deoxyribose ATCG 2	Ribose AUCG 1

Identify the monomer: amino acid

Identify the monomer: nucleotide



Topic 1.4: Properties of Biological Macromolecules

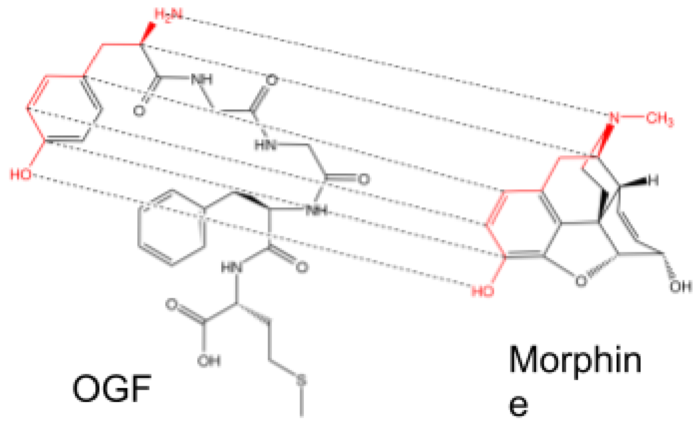
Learning Objective	**SYI-1.B Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules**.
I can…	◻ Explain why and how the structure and function of polymers are derived from the way their monomers are assembled. ◻ In nucleic acids, information is encoded in sequences of nucleotide monomers. ◻ Each nucleotide is made of a five-carbon sugar (deoxyribose or ribose), a phosphate, and a nitrogen base (adenine, thymine, guanine, cytosine, or uracil). ◻ DNA and RNA differ in structure and function. ◻ In proteins, the specific order of amino acids in a polypeptide (primary structure) determines the overall shape of the protein. ◻ Amino acids have directionality, with an amino (NH2) terminus and a carboxyl (COOH) terminus. The R group of an amino acid can be categorized by chemical properties (hydrophobic, hydrophilic, or ionic), and the interactions of these R groups determine structure and function of that region of the protein. ◻ Complex carbohydrates are made of sugar monomers whose structures determine the properties and functions of the molecules. ◻ Lipids are nonpolar macromolecules— ◻ Differences in saturation determine the structure and function of lipids. ◻ Phospholipids contain polar regions (that interact with other polar molecules, such as water) and nonpolar regions (that are often hydrophobic).

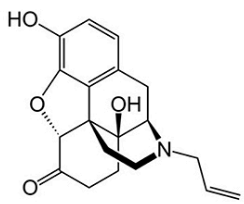
Topic 1.5: Structure and Function of Biological Macromolecules

Learning Objective	**SYI-1.B Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule.**
I can…	◻ Directionality of the subcomponents influences structure and function of the polymer— ◻ Nucleic acids have a linear sequence of nucleotides that have ends, defined by the 3' hydroxyl and 5' phosphates of the sugar in the nucleotide. During DNA and RNA synthesis, nucleotides are added to the 3' end of the growing strand, resulting in the formation of a covalent bond between nucleotides. ◻ DNA is structured as an antiparallel double helix, with each strand running in opposite 5' to 3' orientation. Adenine nucleotides pair with thymine nucleotides via two hydrogen bonds. Cytosine nucleotides pair with guanine nucleotides by three hydrogen bonds. ◻ Proteins are made of linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain. ◻ Proteins have primary structure determined by the sequence order of their constituent amino acids, secondary structure that arises through local folding of the amino acid chain into elements such as alpha-helices and beta-sheets, tertiary structure that is the overall three-dimensional shape of the protein and often minimizes free energy, and quaternary structure that arises from interactions between multiple polypeptide units. The four elements of protein structure determine the function of a protein. ◻ Carbohydrates are made of linear chains of sugar monomers connected by covalent bonds. Carbohydrate polymers may be linear or branched.

Structure and Function
The structure (or shape) of any tool is important for its correct functioning. Any change in structure may cause a functional change. This is very important in biology. Keep this in mind as you answer the following questions.

1) Opioid growth factor (OGF) is a naturally occurring, endogenous opioid that provides short term pain relief in humans. Morphine is a poppy plant derivative that has clinical, pain relief applications. These molecules have the ability to cross the blood brain barrier and bind with nervous system receptors along the indicated surface.



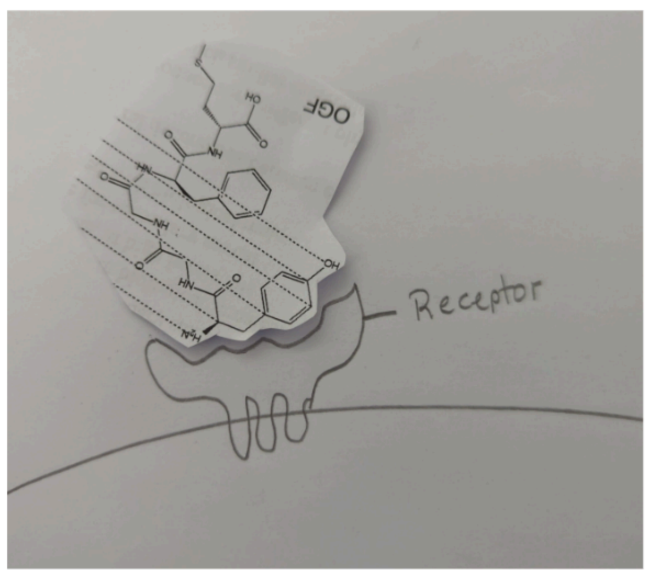


Naloxone

The abuse of morphine and opioid derivatives is linked to tens of thousands of deaths per year in the US. Narcan or Naloxone is a synthetic drug developed in a lab to combat opioid overdoses. Utilize the image of the Naloxone molecule on the left to propose an explanation for how this Naloxone would interact with the body.

“Opioid growth factor (OGF) is a naturally occurring, endogenous opioid” means that it is made in the body (endogenous). (We will study receptors, etc. more in unit 4). When OGF binds with its receptor, it starts a chain reaction that ends up decreasing pain. Do you see how well OGF fits with its receptor?

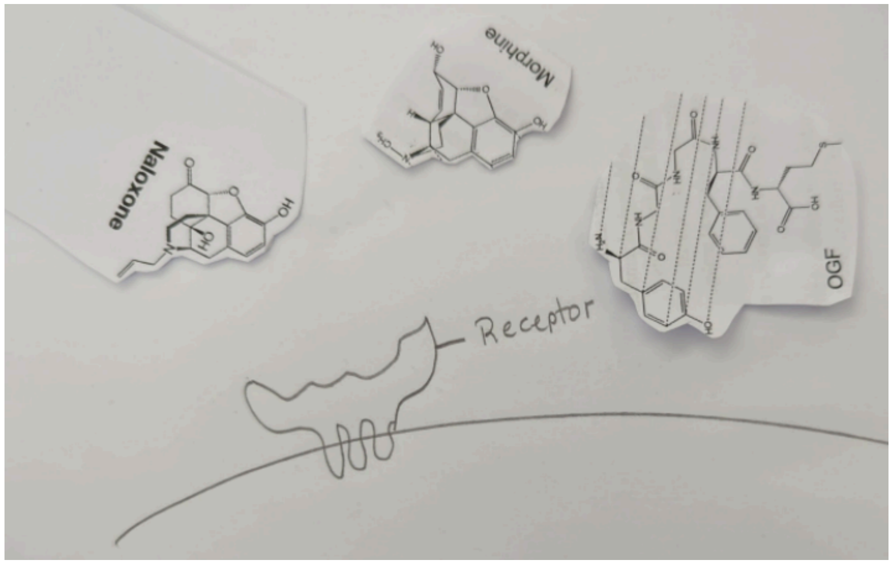
Another thing to know about signal molecules and their receptors is that these signal molecules are always bouncing on and off of their receptors. They are not permanently stuck on the receptor. If there are lots of OGF molecules around, they will be on the receptors more often than not.



Here are all three of the molecules in this question.

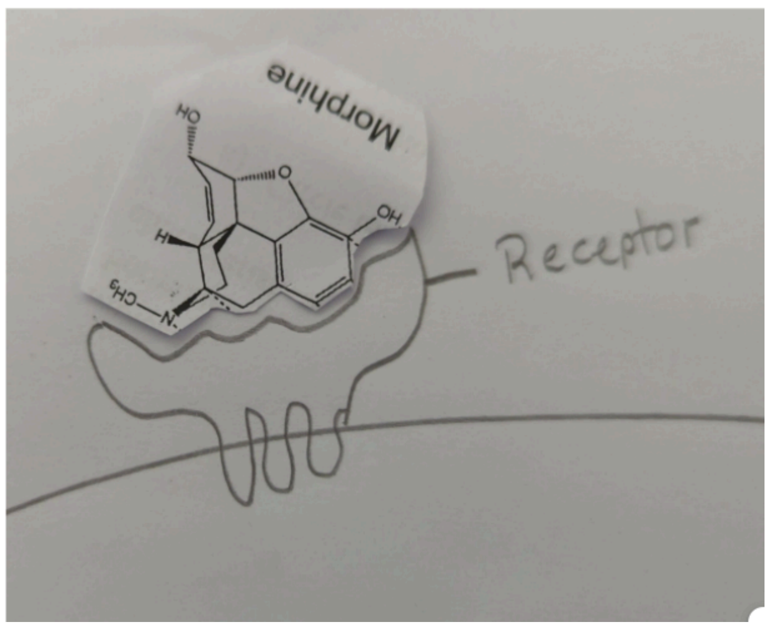
Do you see how each of these three molecules have a very similar shape on one side, which is able to bind with this same receptor?

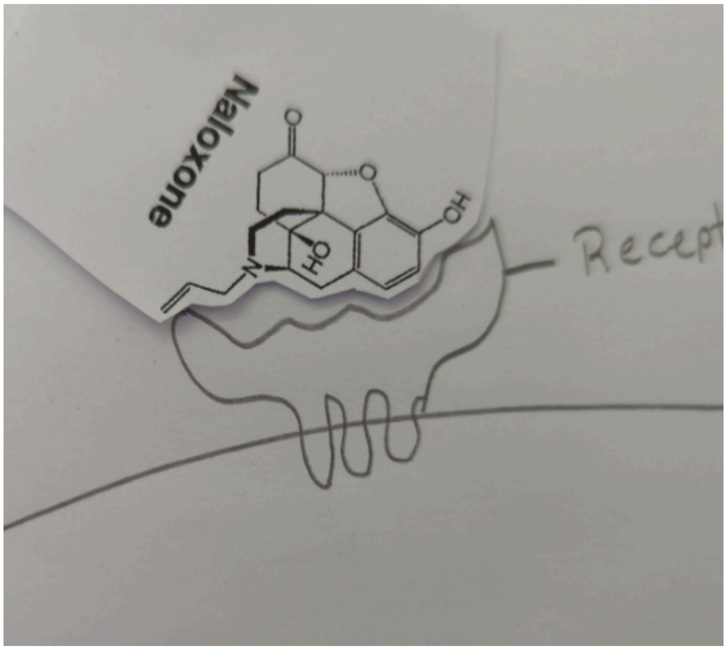
That structure affects function is a really important concept for this course.



Morphine is a type of opioid. It is a drug that fits well with OGF's receptor and triggers the same change in the cell as OGF. It is used for patients who experience a lot of pain. For example, a person may be given morphine after surgery or for pain management when terminally ill, etc.

People can become addicted to morphine, however.





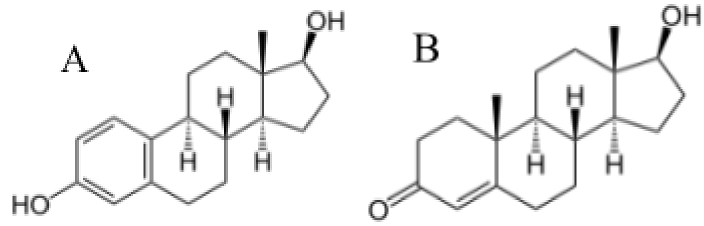
Naloxone is a drug that can rapidly reverse an opioid overdose.

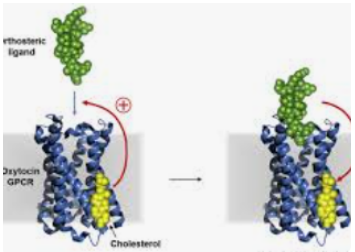
Naloxone fits with part of OGF's receptor. Naloxone has a high affinity for (ability to bind to) opioid receptors. It binds to these receptors better than morphine.

So as the morphine molecules bounce on and off of the receptors, naloxone bounces on but doesn't leave as much.

Naloxone blocks the receptor, but does not trigger the changes in the cell that morphine triggers.

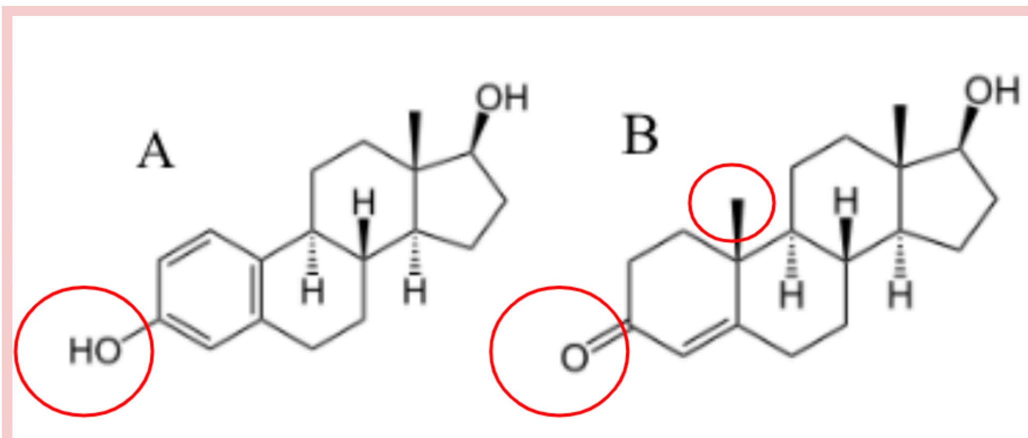
2) Molecule A is estradiol, at high levels this hormone is responsible for secondary sexual characteristics associated with biological females. Molecule B is testosterone, at high levels this hormone is responsible for secondary sexual characteristics associated with biological males.





Here is a diagram of a signaling molecule and its receptor.

a) Circle the structural differences between estradiol and testosterone on the diagrams.

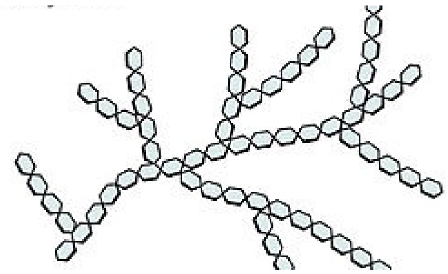


b) These hormones produce very different physiological responses in the human body. Propose an explanation for how such similar molecules can elicit different physiological responses.

They fit into different receptors, thus causing different responses. (More on this in unit 4).

Carbohydrate Practice

1. The diagram to the right is starch.
   a. Describe the synthesis of starch (what monomer(s) is it made from and what reaction produces it).

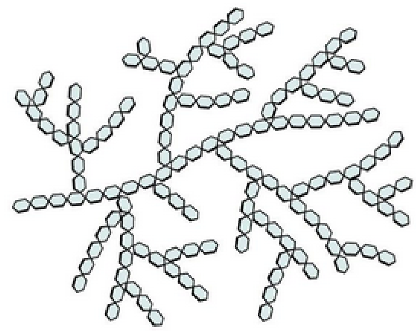


Glucose is put together by dehydration synthesis in plants. This process is also sometimes called polymerization.

   b. Describe the role of starch in a plant.

Energy storage. Plants can break it down to make glucose.

2. The diagram to the right is glycogen.
   a. Describe the synthesis of glycogen (what monomer(s) is it made from and what reaction produces it).



Glucose is put together by dehydration synthesis in animals. This process is also sometimes called polymerization.

   b. Describe glycogen's role in an animal.

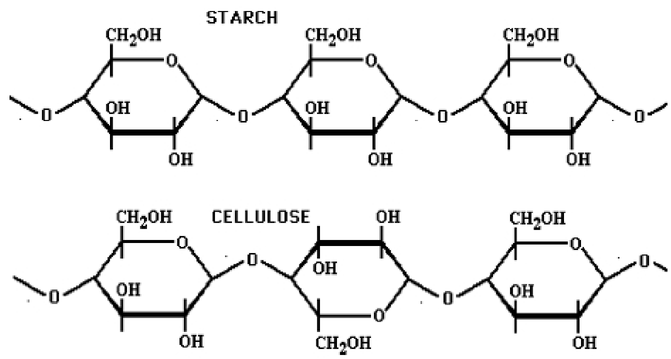
Energy storage. Animals can break it down to make glucose.

   c. Describe the role of insulin and glucagon in the formation and breakdown of glycogen.

When blood glucose levels are **high**, insulin (a hormone) is released into the blood and causes the production of glycogen (dehydration synthesis). This removes glucose from the blood, thus lowring blood glucose. Yay homeostasis.

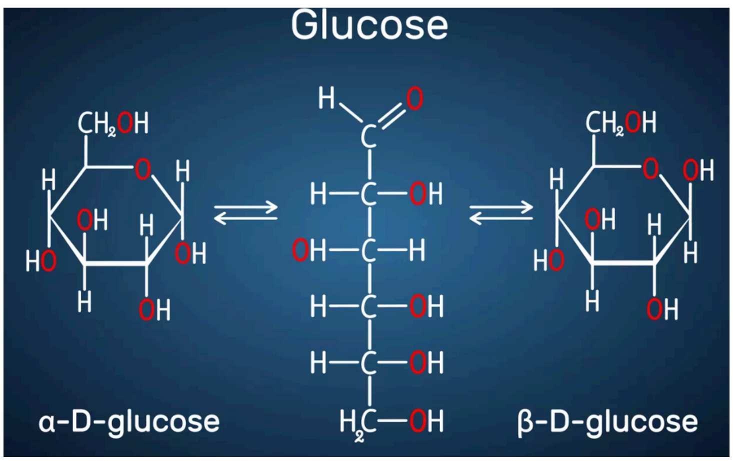
When glucose levels in the blood are **low,** glucagon (a hormone) is released into the blood and causes the breakdown (hydrolysis) of glycogen. This releases glucose into the blood, thus raising blood glucose. Yay homeostasis.

3. Starch and cellulose are both made of glucose monomers. Humans can digest starch, but not cellulose. Study the diagrams and determine the differences in the structures of these two polymers. Describe any differences that you see.



The glucose is all facing the same way in starch, but the glucose in cellulose alternate (each is upside down compared the the ones around it.

This is because starch is made of alpha D-glucose



where as cellulose is made of beta-D-glucose. See the picture below. As it turns out, cellulose is able to make more hydrogen bonds between its chains, so it can pack together more tightly, which makes it stronger and more stable.

We have enzymes that can break the linkages between starch (and glycogen) subunits, so we can get glucose out of them. We do NOT have enzymes that can break down the linkages between cellulose subunits, so we can NOT use cellulose for energy.

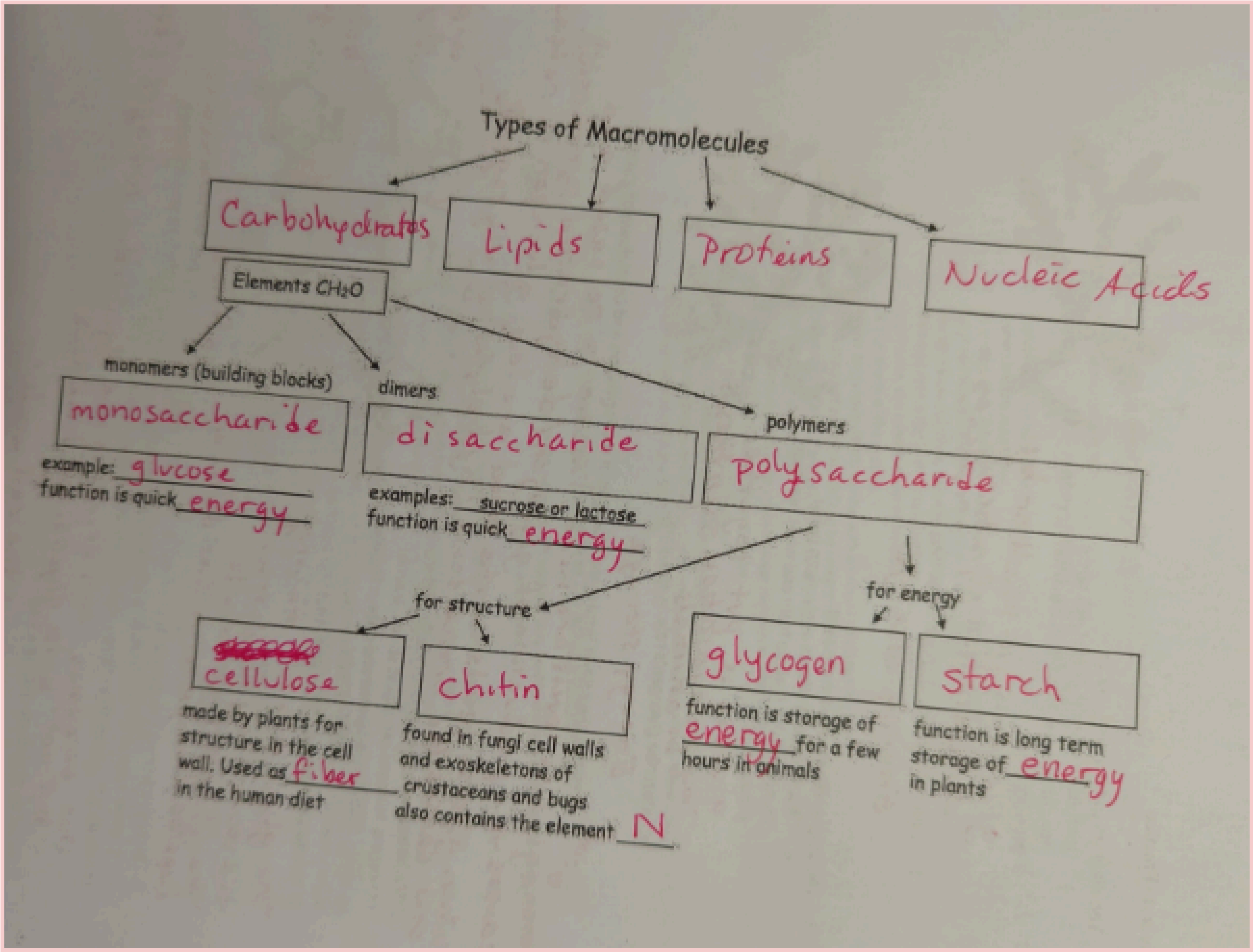
THis is all more than you need to know. What you actually need to know is that since their structure is different, their function is different.

4. The bonds joining the glucose monomers in starch are alpha-glycosidic linkages, but the bonds joining the glucose monomers in cellulose are beta-glycosidic linkages. Humans can hydrolyze starch but not cellulose. What does this tell you about the enzymes that humans have?

We have enzymes that can break the linkages between starch (and glycogen) subunits (alpha glycosidic linkages), so we can get glucose out of them.

We do NOT have enzymes that can break down the linkages between cellulose subunits (beta glycosidic linkages), so we can NOT use cellulose for energy.

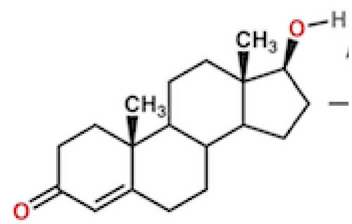
5. What do plants use cellulose for?
Structure in the cell wall.


Types of Macromolecules
Carbohydrates
Lipids
Proteins
Nucleic Acids
Elements CH_2O
monomers (building blocks)
monosaccharide
example: glucose
function is quick energy
dimers
disaccharide
examples: sucrose or lactose
function is quick energy
polymers
polysaccharide
for structure
cellulose
made by plants for structure in the cell wall. Used as fiber in the human diet
chitin
found in fungi cell walls and exoskeletons of crustaceans and bugs
also contains the element N
for energy
glycogen
function is storage of energy for a few hours in animals
starch
function is long term storage of energy in plants

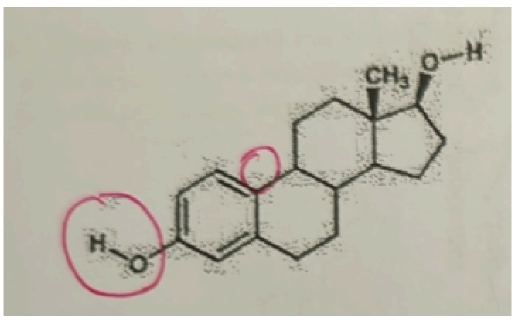
Lipid Practice

1. What type (or class) of molecule is this? How do you know? Is it mainly polar or mainly nonpolar?

It is a steroid because it is made of 4 fused hydrocarbon rings (A hydrocarbon is a molecule made of carbon and hydrogen).
It is mainly non-polar (hydrophobic) because it is mainly a hydrocarbon (carbons with some hydrogen attached).
The oxygen atom and the hydroxyl group (-OH) would be the only polar parts.

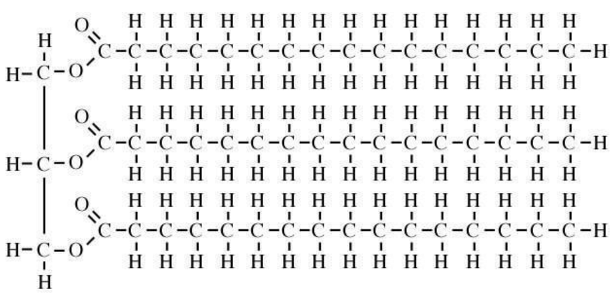


2. The molecule to the right is testosterone. The molecule below is estrogen. Circle any differences in their structures.



3. Why do these molecules appear so similar yet have such different effects in the body?

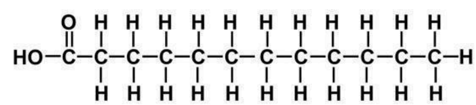
Their shapes must be just different enough that they stimulate different receptors. (Different receptors recognize each).

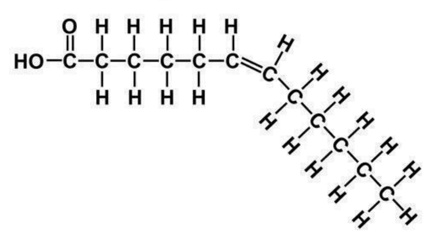


4. What type of molecule is this? What subcomponents make it?

This is a triglyceride. It is made of one glycerol molecule and three fatty acids.

5. Identify each structure to the right as a saturated or an unsaturated fatty acid. Which would be more common in the cell membrane of a tropical fish? …in the cell membrane of a cold water fish?





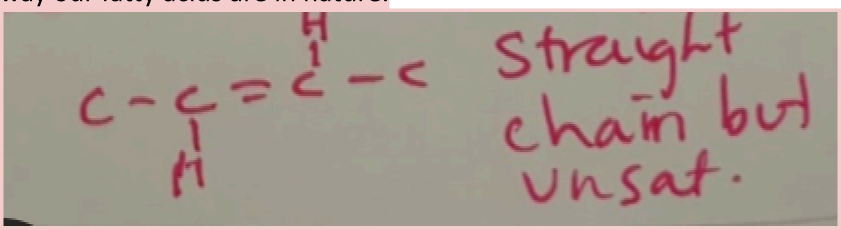
The top structure is a saturated fatty acid (it is all filled up with hydrogens). The bottom structure is an unsaturated fatty acid. (It does not have as many hydrogens, so it is not saturated with hydrogens).

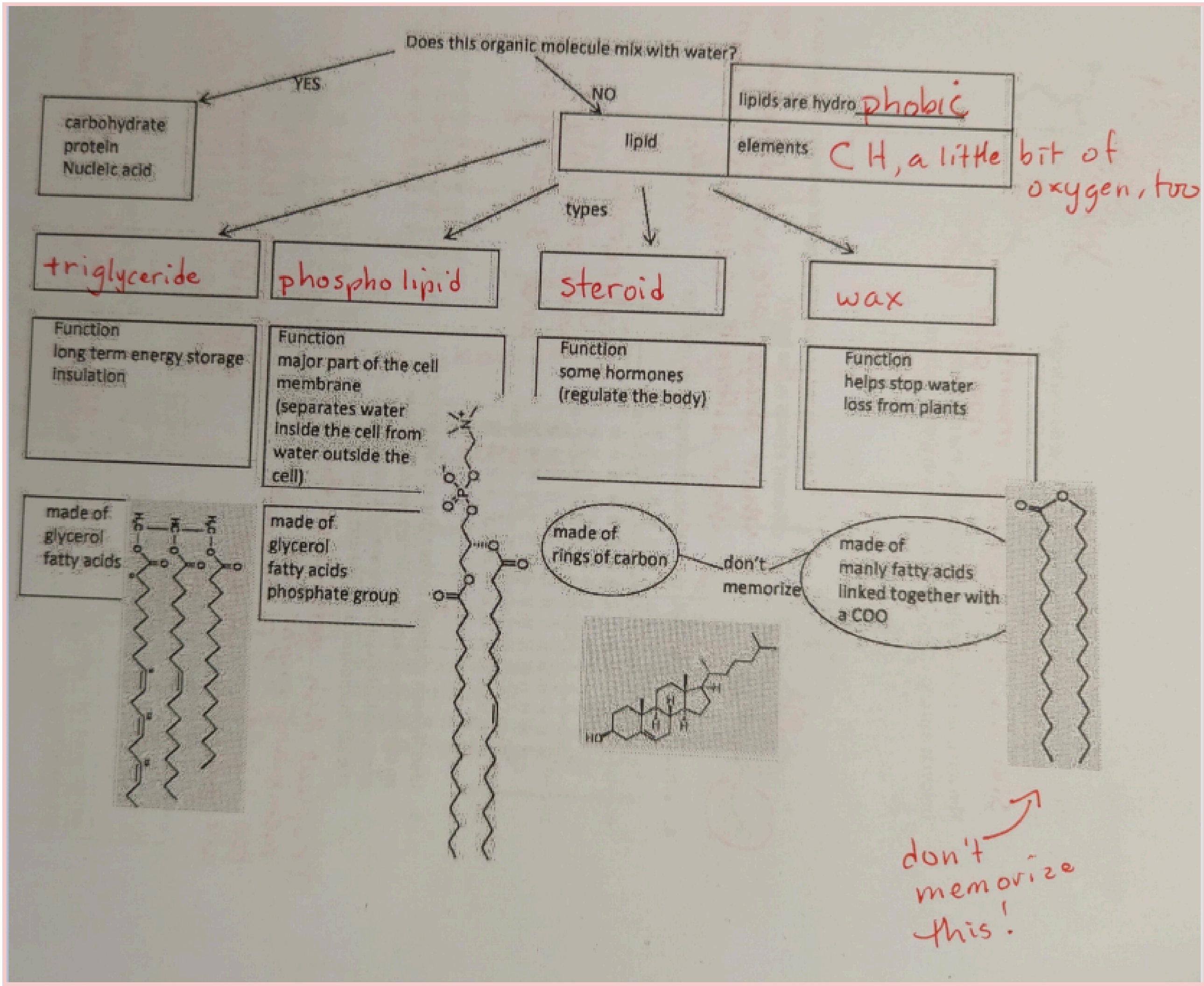
Tropical fish tend to have saturated fatty acids. It is hot, so the membrane would tend to get too liquidy (like when butter melts on a hot day). To work against this, the fatty acids are generally saturated.

Cold water fish tend to have unsaturated fatty acids. It is cold, so the membrane would tend to get too solid (like butter melts in the refrigerator). To work against this, the fatty acids are generally unsaturated.

	Double bonds between carbon atoms?	Bent or straight chains?	Solid or liquid at room temperature?	Generally more healthy or unhealthy?
unsaturated fatty acid	yes	bent	liquid	more healthy
saturated fatty acid	no	straight	solid	less healthy

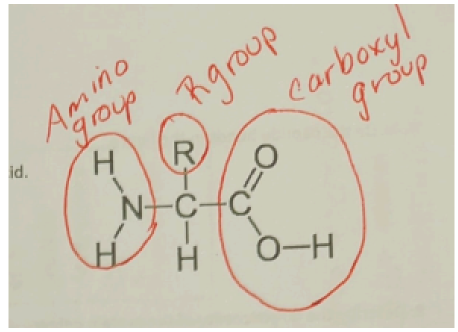
Please note that both are better than trans-fats!! Having the hydrogens on the opposite sides is not the way our fatty acids are in nature.




Does this organic molecule mix with water?
YES
NO
carbohydrate
protein
Nucleic acid
lipid
lipids are hydro phobic
elements C H, a little bit of oxygen, too
types
triglyceride
phospho lipid
steroid
wax
Function
long term energy storage
insulation
Function
major part of the cell membrane (separates water inside the cell from water outside the cell)
Function
some hormones (regulate the body)
Function
helps stop water loss from plants
made of
glycerol
fatty acids
made of
glycerol
fatty acids
phosphate group
made of
rings of carbon
don't memorize
made of
manly fatty acids linked together with a COO
don't memorize this!

Protein Practice

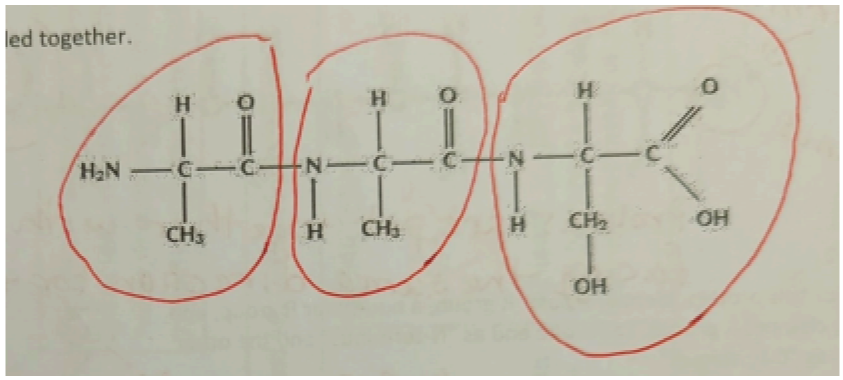
1. Circle and **label** the R group, carboxyl group, and amino group of this amino acid.



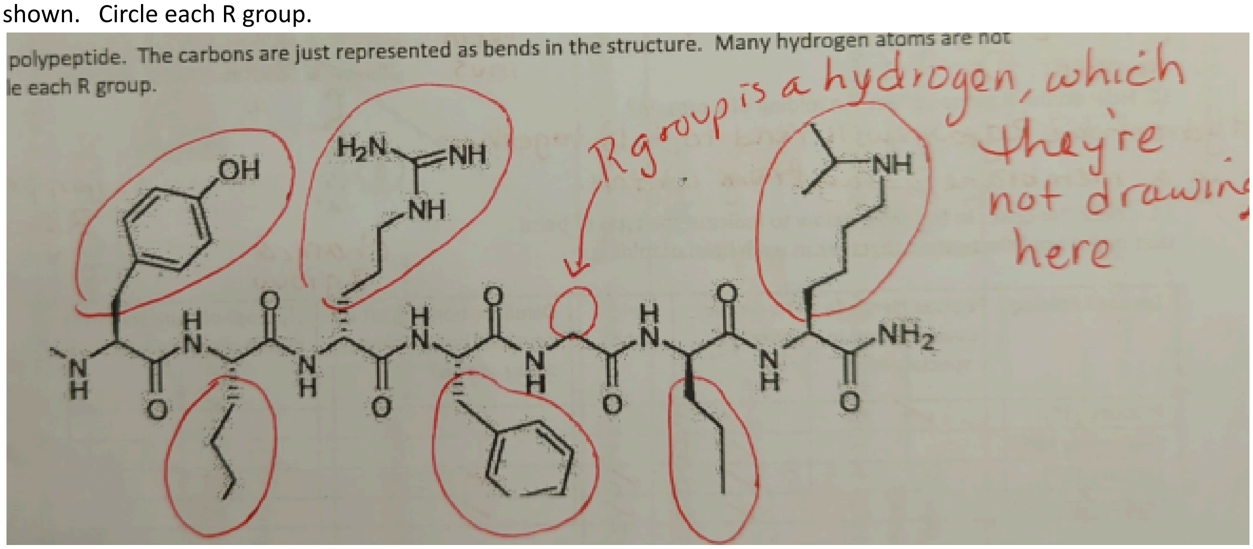
2. Below is a figure with several amino acids bonded together.

a. Circle each amino acid (there are 3).

b. Is this a polypeptide or a nucleic acid?



3. Below is a polypeptide. The carbons are just represented as bends in the structure. Many hydrogen atoms are not shown. Circle each R group.

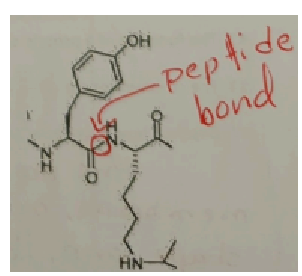


4. There are 20 amino acids. What makes each amino acid different?

R groups

5. There are gazillions of proteins. What makes each protein different, structurally?

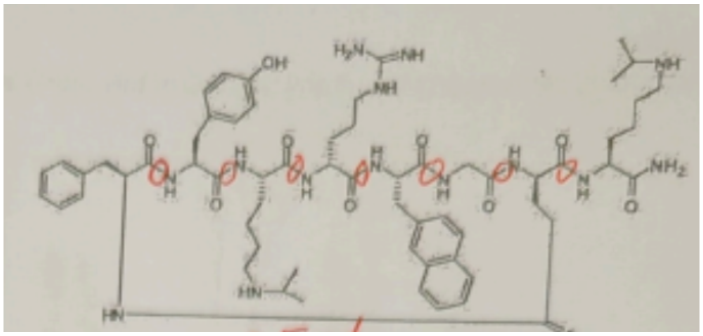
The order (or sequence) of amino acids. This order determines how the polypeptide will fold, affecting its shape, which affects its function.



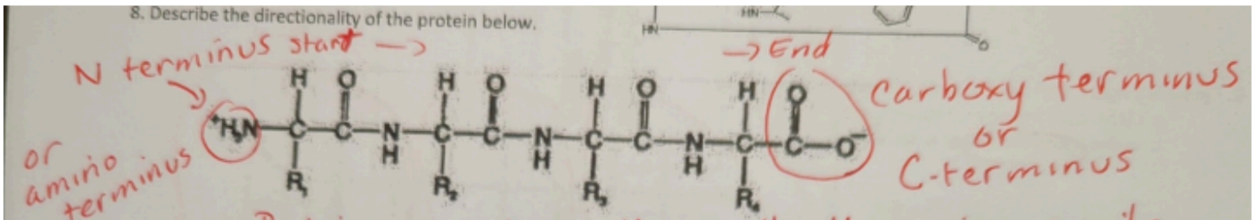
6. What's the special name given to the bond that joins amino acids together? Label it in the dipeptide shown to the right.

peptide bond (a covalent bond)

7. Circle the peptide bonds in the figure.



8. Describe the directionality of the protein below.



Proteins have directionality, meaning their amino acids are put together in a particular direction, with every single amino acid in the same orientation for the entire length of the polypeptide. So, if one side goes N, C, C with an O, the entire molecule repeats like that, in that order.

N, C, C with an O then N, C, C with an O then N, C, C with an O then N, C, C with an O then N, C, C with an O then N, C, C with an O

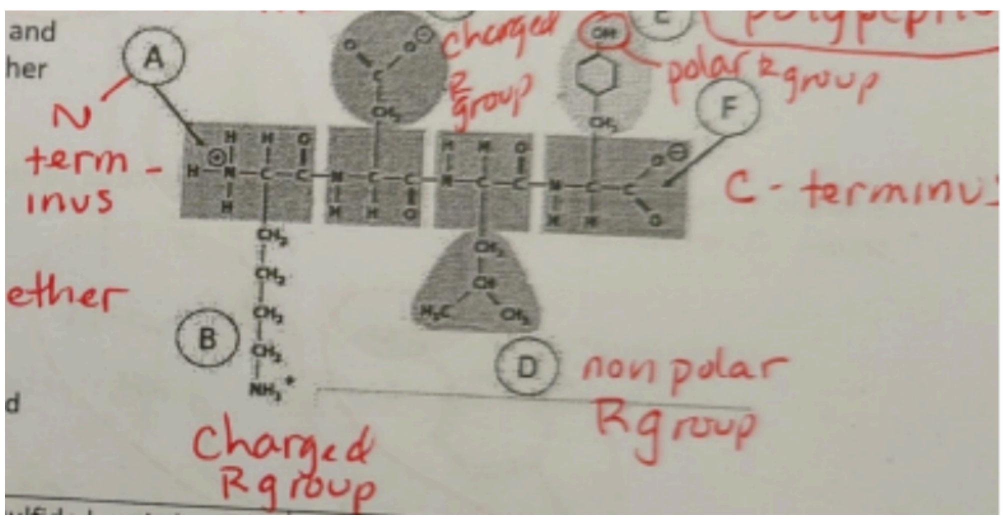
They can still fold in funky ways, and have special R group interactions, but the backbone (N, C, C with an O) is the same direction.

9. For this protein, identify a polar R group, a non-polar R group, and two charged R groups. Label one end as "N-terminus" and the other end as "C-terminus."

polar:E

nonpolar:D

charged: C,B



10. How do the R groups affect the folding of a protein?

Hydrophobic regions will tend to fold together (away from water at the surface of the protein) or in a membrane (the tails region of a phospholipid bilayer), away from water.

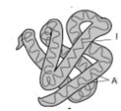
Charged R groups will attract oppositely charged R groups.

Polar R groups will attract water and/or oppositely partially charged polar R groups.

11. Check the boxes in the table below to indicate the type of bond that might hold the protein together at each level of folding.

Level of Folding	Peptide bonds (a c bond in a special place)	Hydrogen bonds	Ionic bonds	Disulfide bonds (just a covalent bond between sulfur atoms)	Hydrophobic Interactions dipole-dipole interactions
Primary (1st)	✔				
Secondary (2nd)		✔			
Tertiary (3rd)		✔	✔	✔	✔
Quaternary (4th)		✔	✔	✔	✔

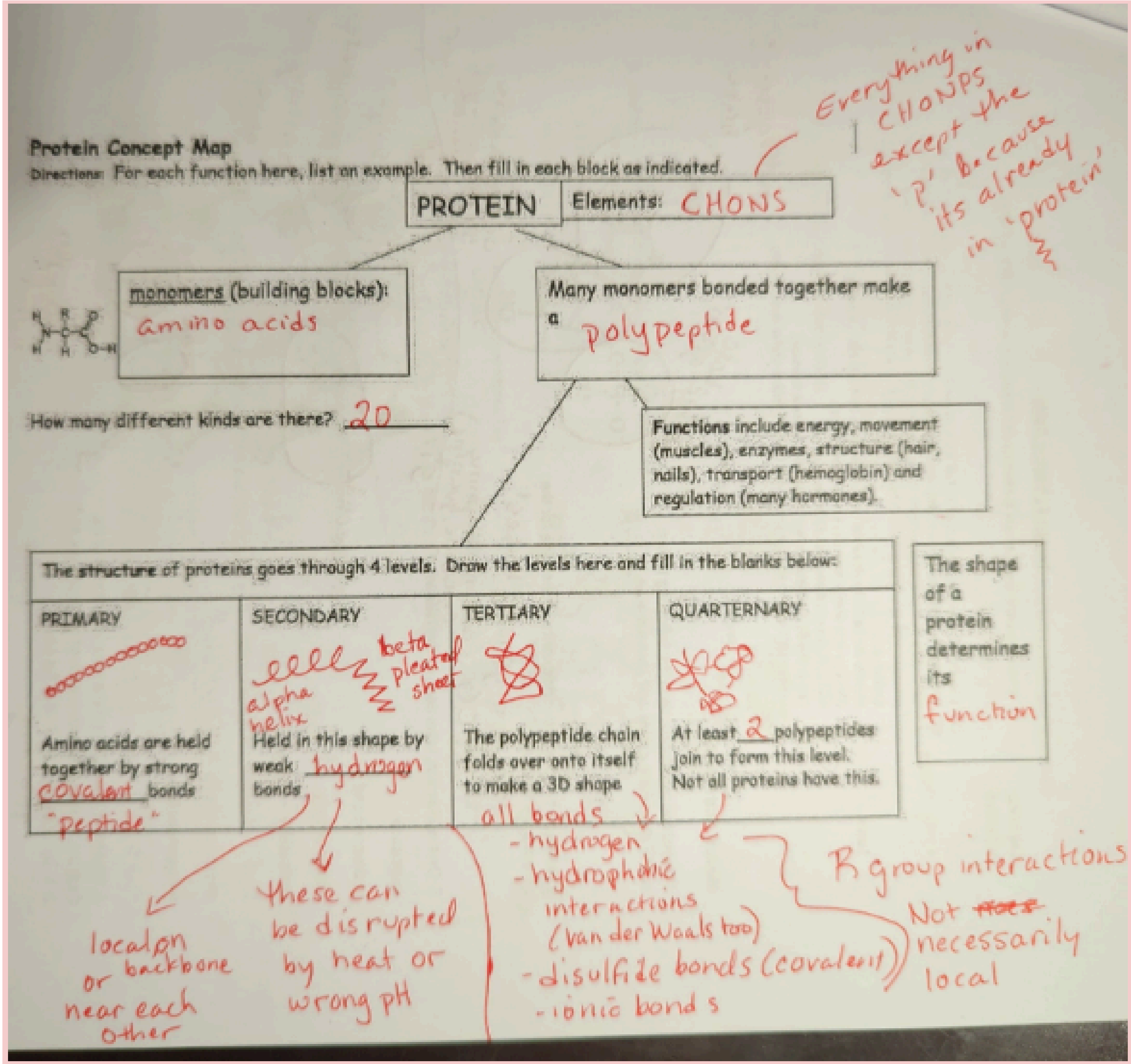
12. The function of a protein depends on its ________shape/structure/conformation (any of these words can be used, so know them all)______.



13. The structure of a protein is ultimately determined by____DNA code_______________.

14. Describe how a nonpolar to polar R group substitution changes the structure and function of a protein.

The protein may no longer fold the same way. If it's a membrane protein, it may no longer sit nicely inside a cell membrane. If it's a cytoplasmic protein, it may no longer perform its function.



Protein Concept Map

Directions: For each function here, list an example. Then fill in each block as indicated.

PROTEIN | Elements: CHONS

Everything in CHONPS except the 'P' because its already in 'protein'

monomers (building blocks): amino acids

How many different kinds are there? 20

Many monomers bonded together make a polypeptide

Functions include energy, movement (muscles), enzymes, structure (hair, nails), transport (hemoglobin) and regulation (many hormones).

The structure of proteins goes through 4 levels. Draw the levels here and fill in the blanks below:			
PRIMARY	SECONDARY	TERTIARY	QUARTERNARY
(alpha helix) (beta pleated sheet)			
Amino acids are held together by strong covalent bonds "peptide"	Held in this shape by weak hydrogen bonds	The polypeptide chain folds over onto itself to make a 3D shape	At least 2 polypeptides join to form this level. Not all proteins have this.

The shape of a protein determines its function

local on backbone or near each other

these can be disrupted by heat or wrong pH

all bonds
- hydrogen
- hydrophobic interactions (van der Waals too)
- disulfide bonds (covalent)
- ionic bonds

R group interactions

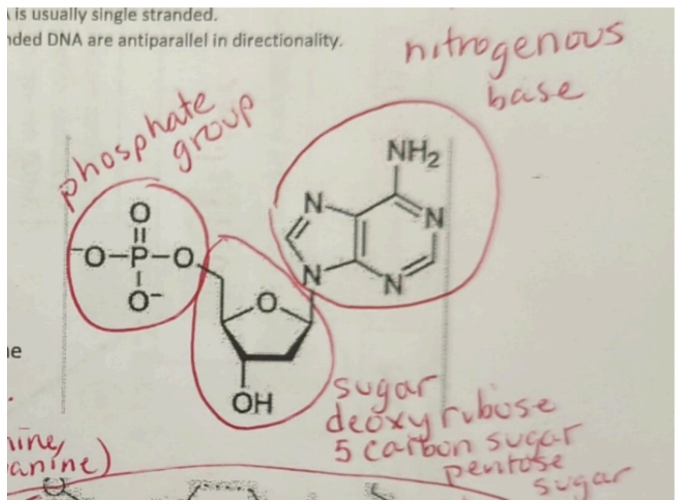
Not ~~necess~~ necessarily local

Topic 1.6: Nucleic Acids

Learning Objective	SYI-1.B Describe the structural similarities and differences between DNA and RNA..
I can…	◻ Identify the structural similarities and differences present in DNA and RNA molecules, such as: ◻ Both DNA and RNA have three components—sugar, a phosphate group, and a nitrogenous base—that form nucleotide units that are connected by covalent bonds to form a linear molecule with 5’ and 3’ ends, with the nitrogenous bases perpendicular to the sugar-phosphate backbone. ◻ Identify the basic structural differences between DNA and RNA including: DNA contains deoxyribose and RNA contains ribose. RNA contains uracil and DNA contains thymine. DNA is usually double stranded; RNA is usually single stranded. The two DNA strands in double-stranded DNA are antiparallel in directionality.

Nucleic Acid Practice

1. Label the nucleotide, with the following terms:
sugar, phosphate group, nitrogenous base.



2. What part of the nucleotide contains the code for the hereditary information?

The nitrogenous bases!

A (adenine)

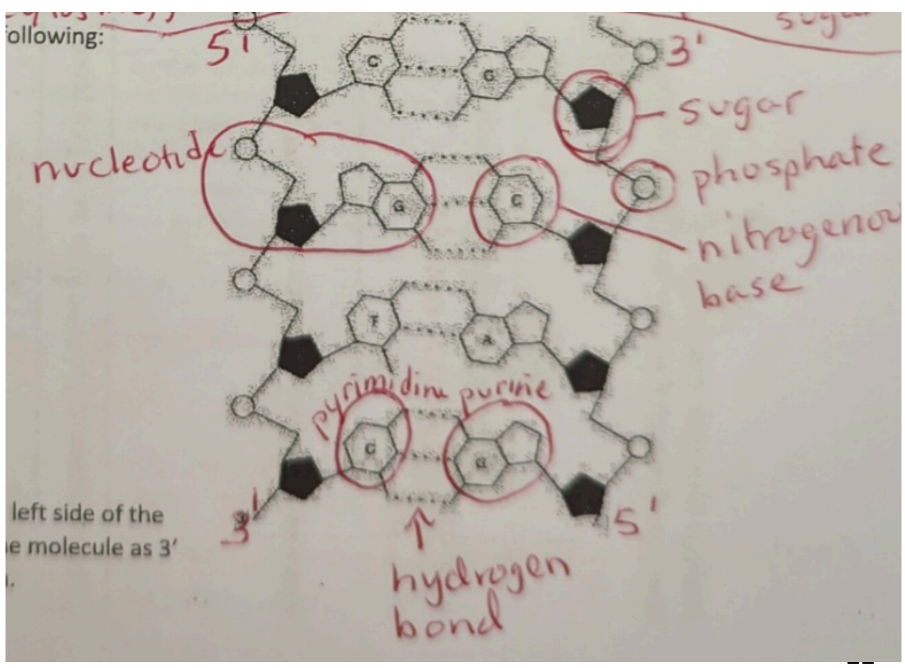
T (thymine)

C (cytosine)

G (guanine)

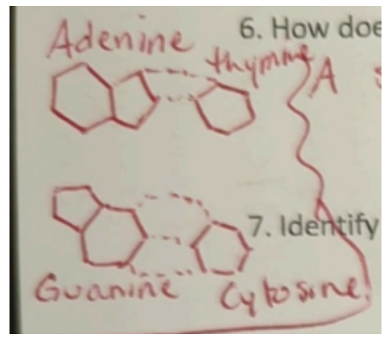
3. On the diagram, label each of the following:

4. Given the label of 3’ on the bottom left side of the diagram, indicate the other ends of the molecule as 3’ or 5’ by circling either 3’ or 5’ for each.



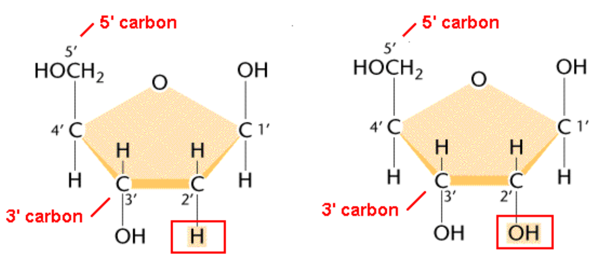
5. Which bases always join together and how many hydrogen bonds holds each pair together?

6. How does this keep the radius the same throughout the molecule?



A small base (pyrimidines; C and T) always pair with a large base (purines; A and G)

7. Identify ribose. Identify deoxyribose



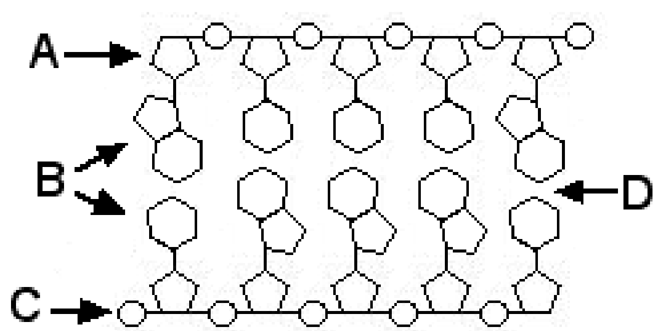
Deoxyribose Ribose

8. Label the parts of the DNA molecule as indicated

phosphate group ______C______

sugar group ______A______

nitrogenous bases ______B______

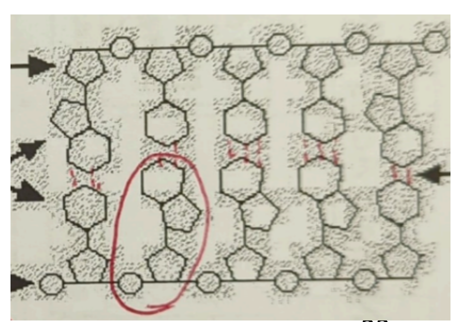


9. The sugar group can also be called by other names. List them.

pentose sugar, five carbon sugar, and either deoxyribose or ribose

10. Circle one nucleotide in the diagram.

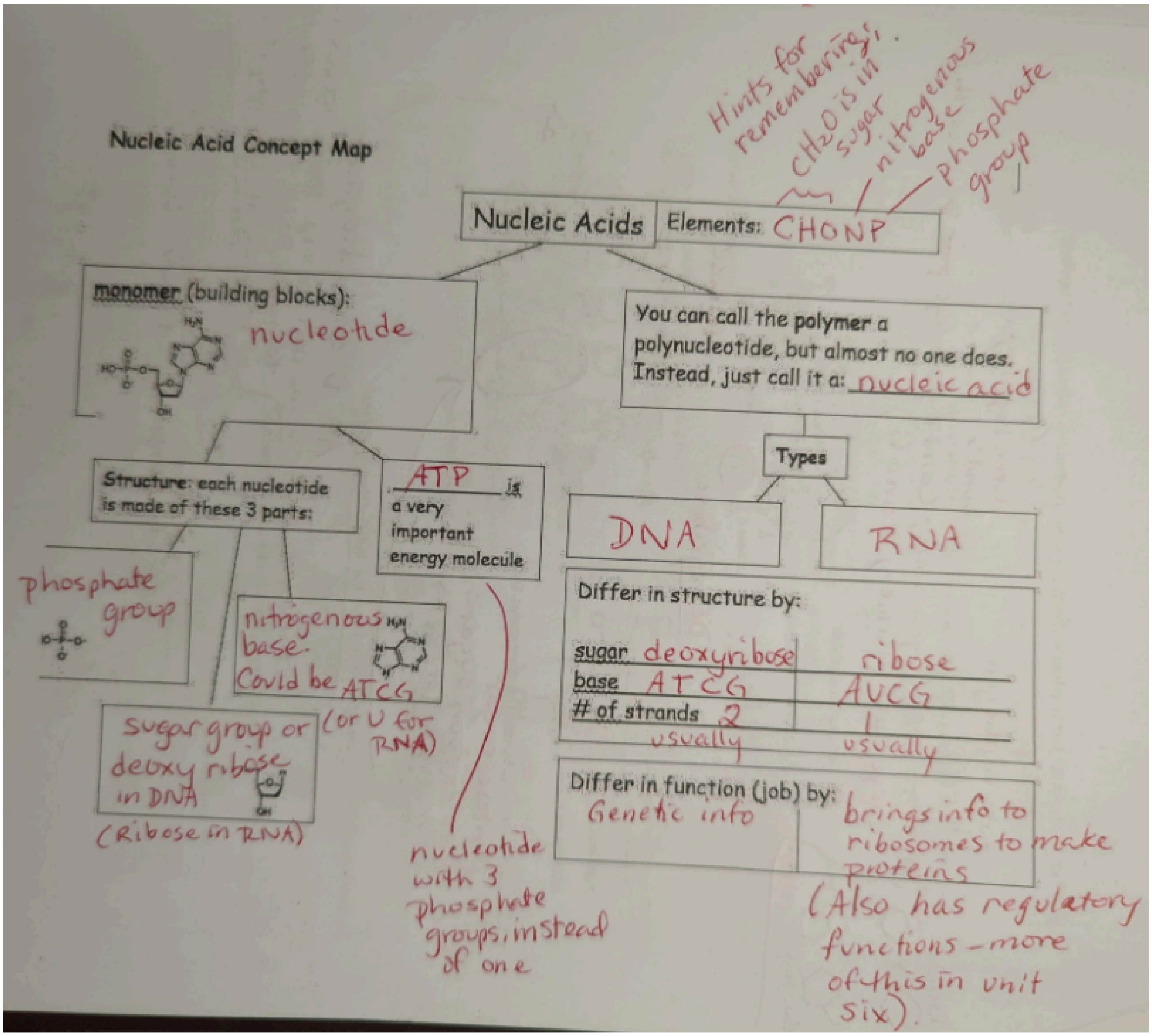
11. Draw in the hydrogen bonds. Why is it important that hydrogen bonds are here?

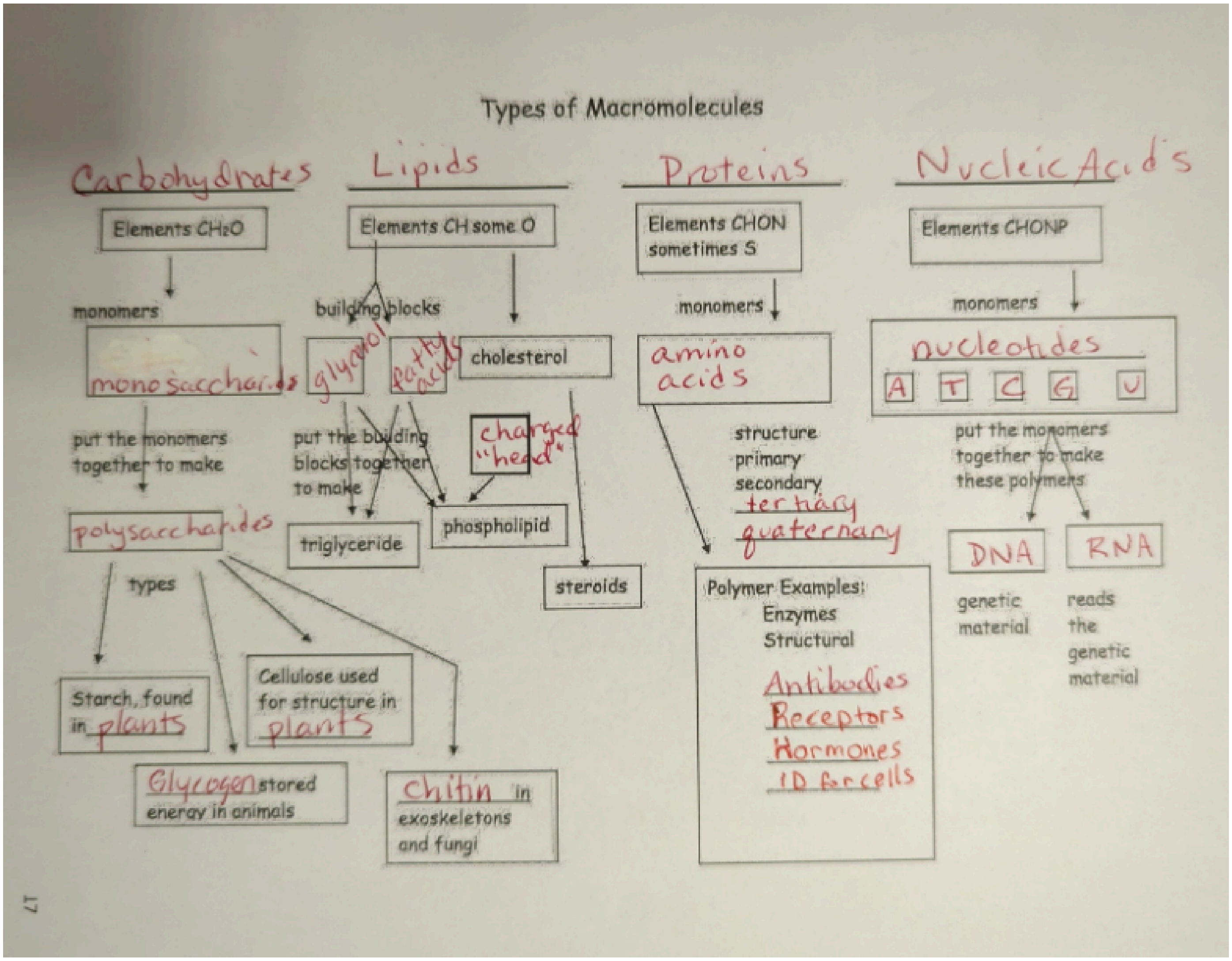


They are at "D." on the diagram. They are weak, so you can unzip DNA to use it to make RNA, then proteins, or to unzip it to copy it.

12. Fill in the diagram to show the differences between DNA and RNA structure:

	DNA	RNA
Sugar Present	Deoxyribose	Ribose
Bases Present	ATCG (T is for thymine)	AUCG (U is for uracil
Number of Strands (Usually)	2 usually	1 usually




Types of Macromolecules
Carbohydrates
Lipids
Proteins
Nucleic Acids
Elements CH2O
Elements CH some O
Elements CHON sometimes S
Elements CHONP
monomers
building blocks
monomers
monomers
monosaccharides
glycerol
fatty acids
cholesterol
amino acids
nucleotides
A
T
C
G
U
put the monomers together to make
put the building blocks together to make
charged "head"
structure
primary
secondary
tertiary
quaternary
put the monomers together to make these polymers
polysaccharides
triglyceride
phospholipid
steroids
DNA
RNA
types
Polymer Examples:
Enzymes
Structural
Antibodies
Receptors
Hormones
ID for cells
genetic material
reads the genetic material
Starch, found in plants
Cellulose used for structure in plants
Glycogen stored energy in animals
Chitin in exoskeletons and fungi
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