REVIEW

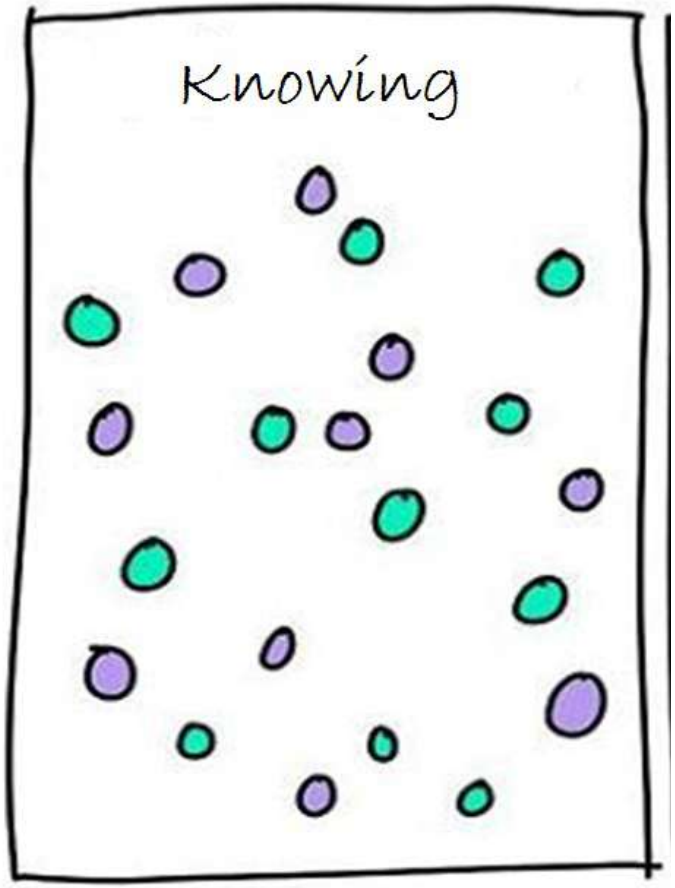
Chemistry, Water, Carbon, and Molecules

Kelly Riedell
Brookings Biology

BASED ON 2019 CED

Remember: Biology is more than "just the facts". It's all about connections.
(That said... you have to know the vocab and concepts to be able to see the "big picture" and make those connections)

Memorizing "facts"



See the BIG PICTURE and make Connections!

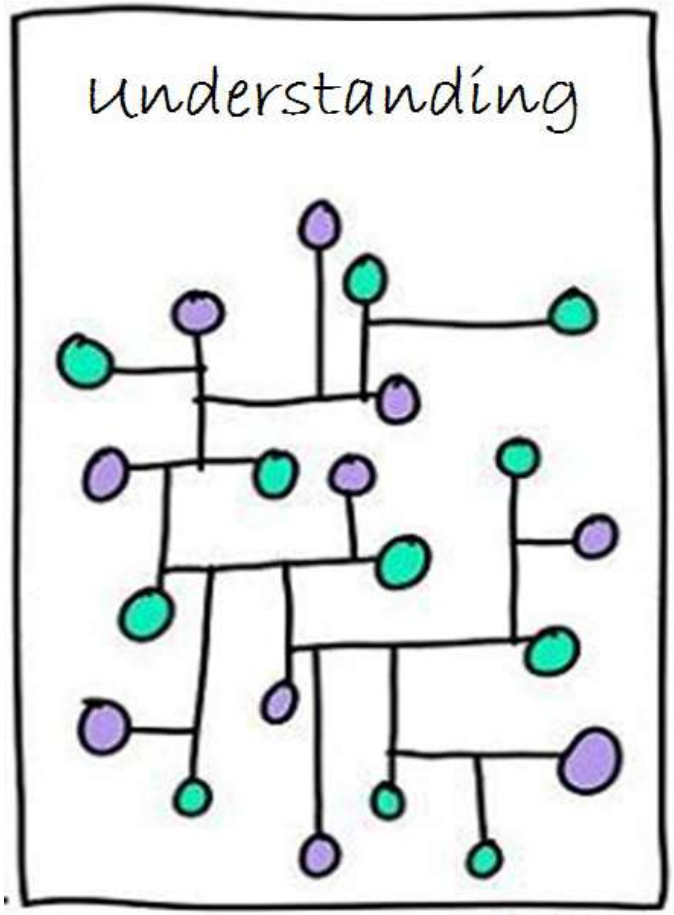


Image modified from: https://www.pinterest.com/pin/503137208158130 86/

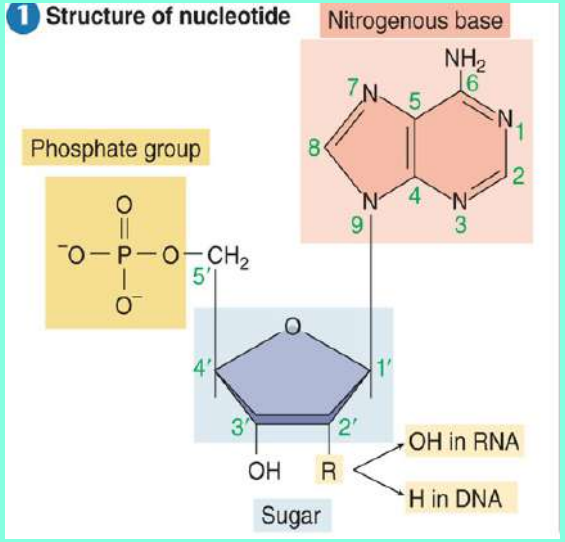
http://www.yellowtang.org/images/structure_of_nucleo_c_la_784.jpg

Macromolecule made by joining nucleotide subunits together

Nucleic acid (DNA & RNA)

Name the 3 components that make up a nucleotide

5 carbon sugar,
nitrogenous base,
phosphate group

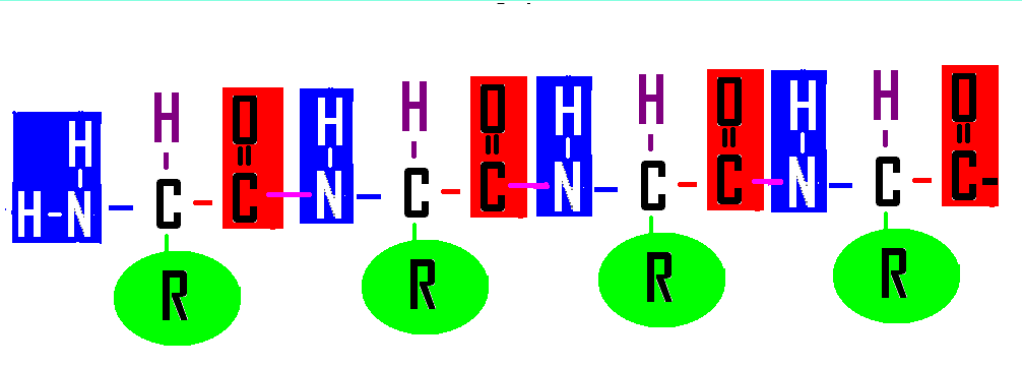


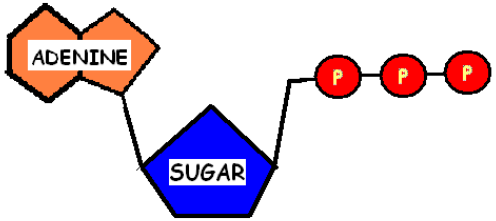
Essential knowledge

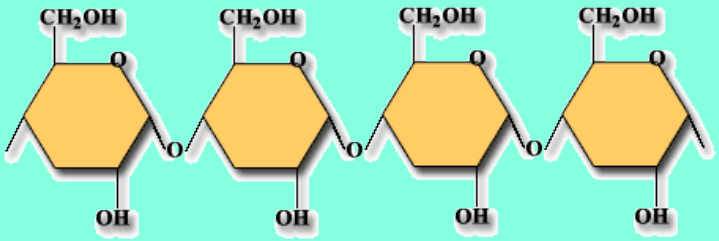
SYI 1.B. Structure and function of polymers are derived from the way their monomers are assembled—

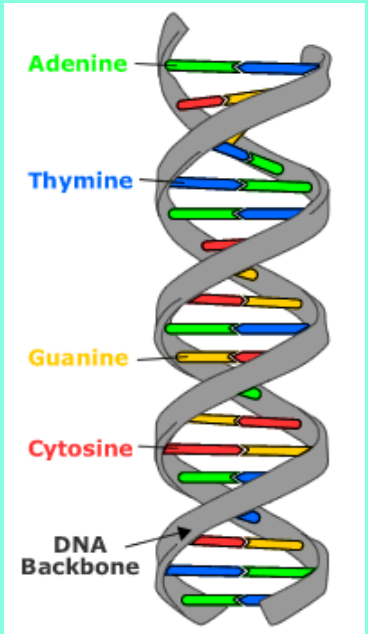
a. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose or ribose), a phosphate, and a nitrogen base (adenine, thymine, guanine, cytosine, or uracil). DNA and RNA differ in structure and functions

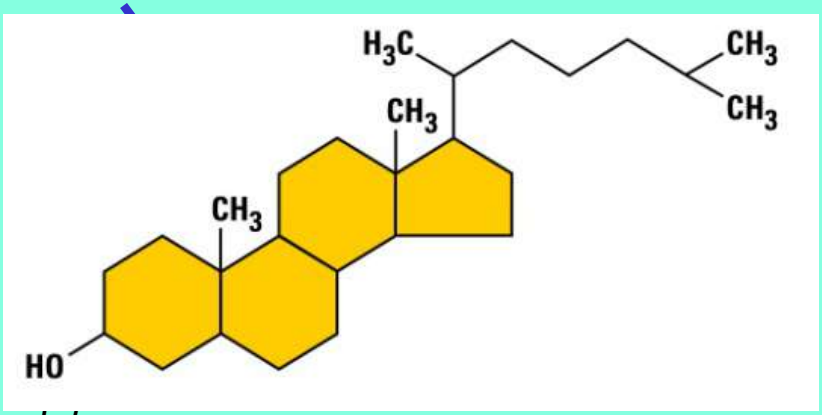
Which of these molecules is a steroid?









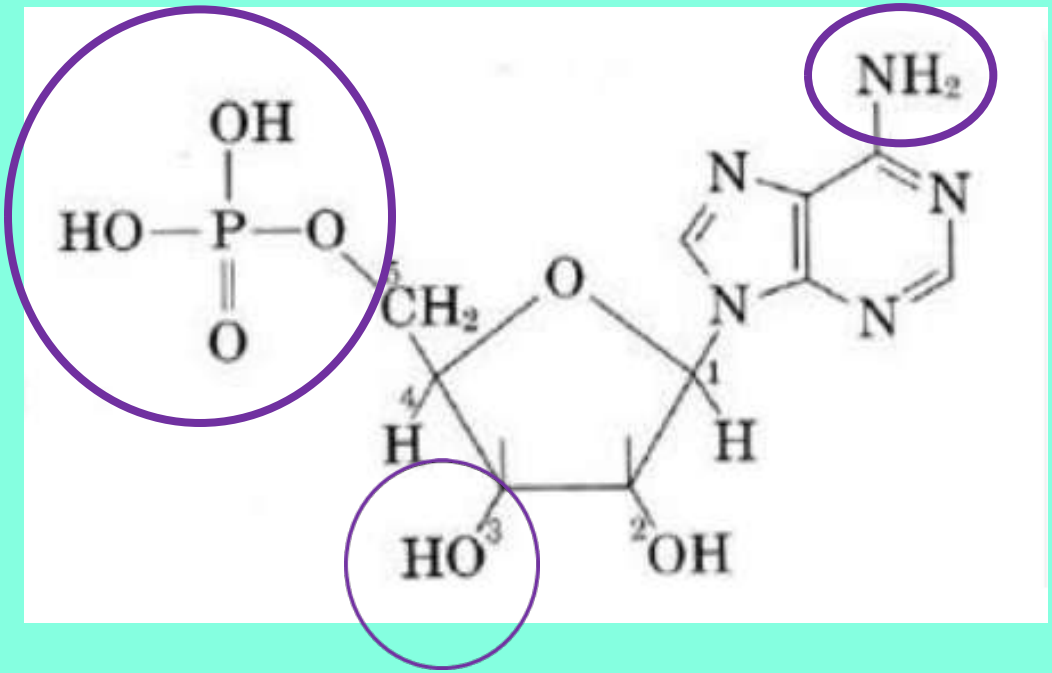


Essential knowledge

SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.

SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Which functional group is NOT pictured in this image?



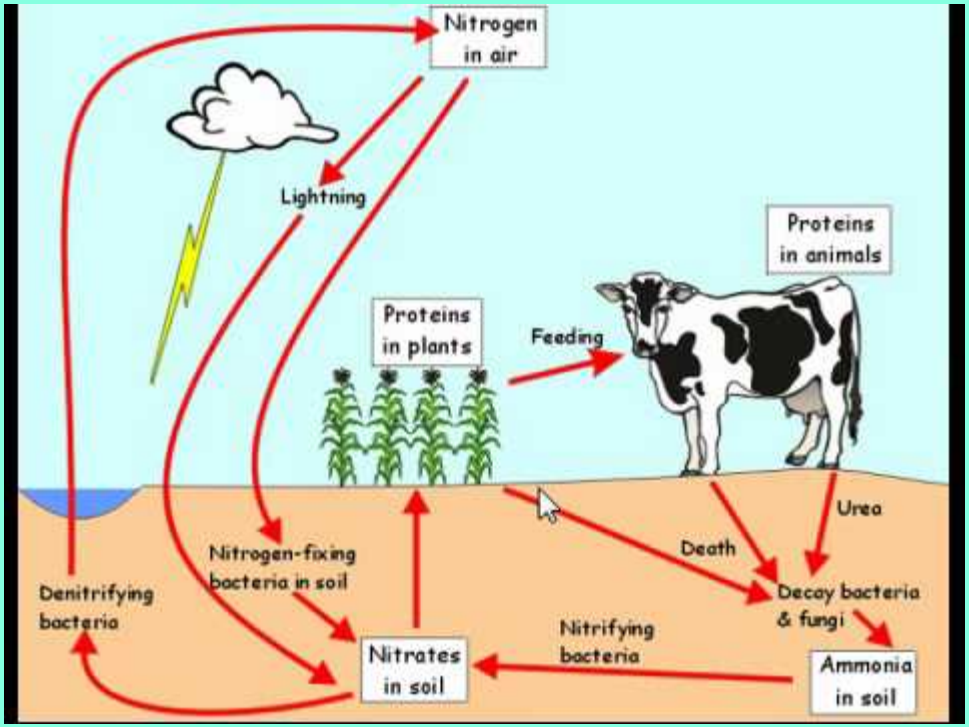
A. Phosphate
B. hydroxyl
C. amino
D. carboxyl

SP 2 A Describe characteristics of a biological process, or model, represented visually.

Image from: :https://i.ytimg.com/vi/m7eEv7gdg38/hqdefault.jpg

Although the atmosphere contains approximately 78% N_2 gas, heterotrophs are unable to use nitrogen in this form. Explain how heterotrophs (like you) get the nitrogen they need to build biomolecules during the nitrogen cycle.

Nitrogen is obtained by consuming other organisms as part of food web interactions.



ESSENTIAL KNOWLEDGE

ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules..

b. Nitrogen is used to build proteins and nucleic acids.

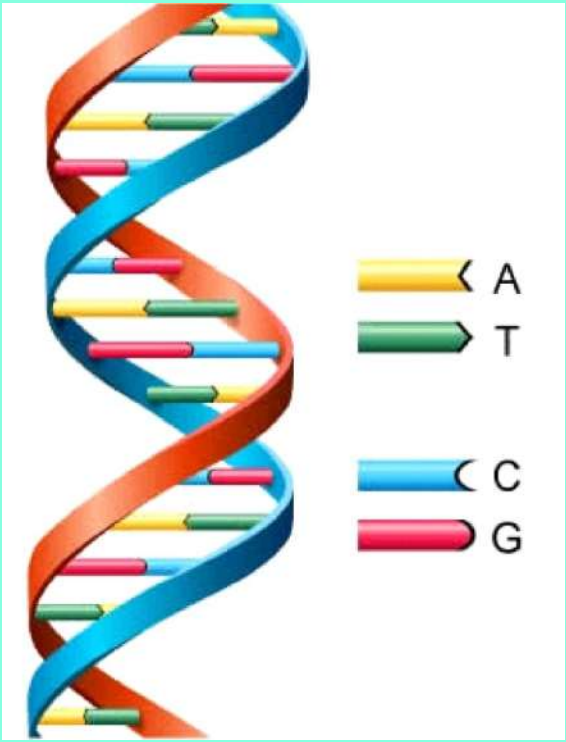
Image from: http://www.astrochem.org/sci_img/dna.jpg

Which type of bonds are found where?

HYDROGEN BONDS COVALENT BONDS

Bonds between nitrogen bases that hold the 2 DNA strands together. Hydrogen bonds

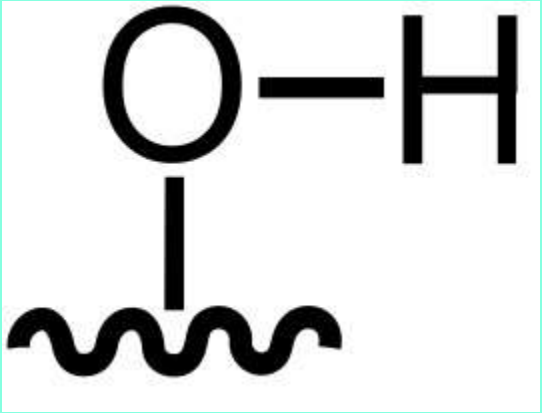
Bonds between sugars and phosphate groups in the DNA backbone. Covalent



SYI 1.C.1 Directionality of the subcomponents influences structure and function of the polymer—
a. 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.
b. 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.

Name this functional group

hydroxyl



How does adding this group change an organic molecule?

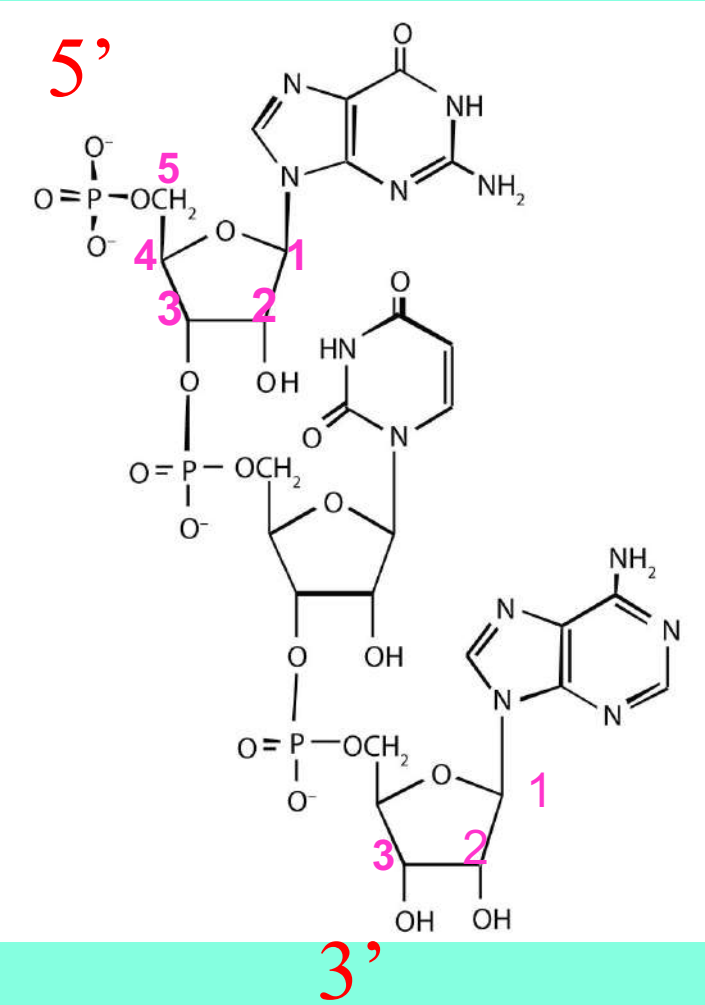
Makes it more polar

Makes it an alcohol

Essential knowledge

SYI 1.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule.

http://2012books.lardbucket.org/books/introduction-to-chemistry-general-organic-and-biological/section_22/a7fb0b8d8bd87a23d5e3d86f5452a2dc.jpg



Label the 3’ and 5’ ends of this strand of DNA

Direction is determined by the sugar carbon closest to that end

ESSENTIAL KNOWLEDGE

IST 1.A.1 DNA and RNA molecules have structural similarities and differences related to their function—

a. 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.

iv. The two DNA strands in double-stranded DNA are antiparallel in directionality.

SP 2 A Describe characteristics of a biological process, or model, represented visually.

Image from: http://scitechdaily.com/images/Four-stranded-quadruple-helix-DNA-structurein-human-cells.jpg

Which part of a nucleotide makes up the "rungs of the ladder" in a DNA molecule?

Nitrogen bases

Essential knowledge

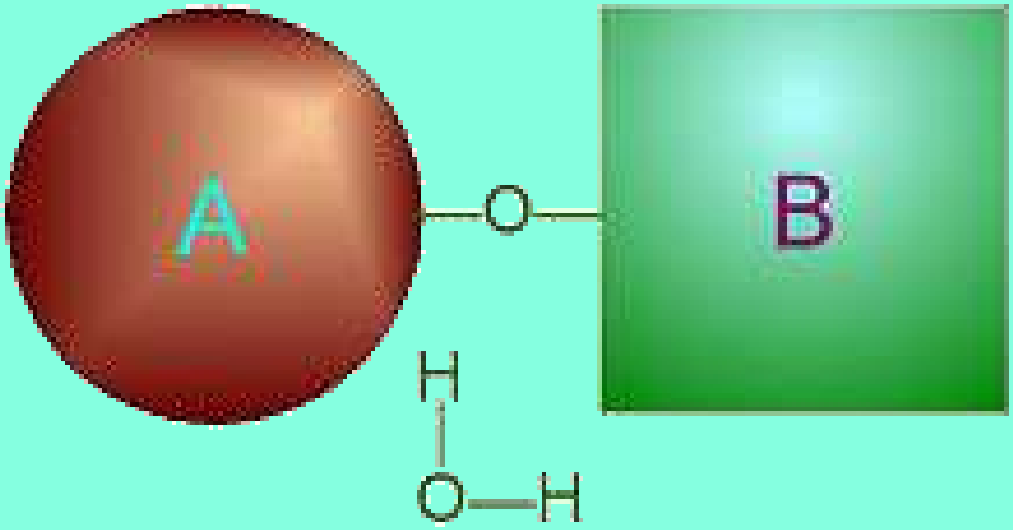
IST 1.A.4 DNA and RNA molecules have structural similarities and differences related to their function—

a. 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.

Animation from: http://biologyclermont.info/wwwroot/graphics/lect1/carbon/hydrolysis%20anim.gif

Chemical reaction in which a molecule is broken apart by the addition of the H and OH from a water molecule

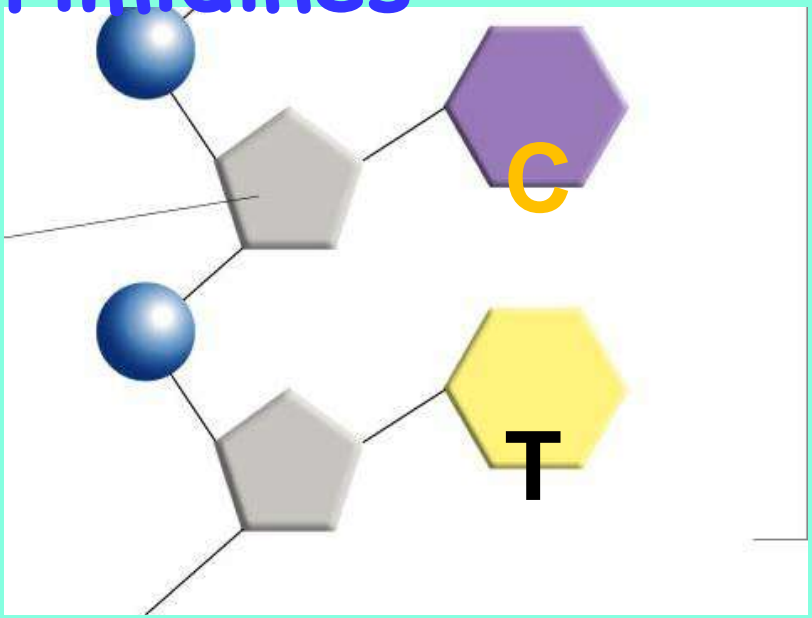
hydrolysis



Essential Knowledge SYI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.

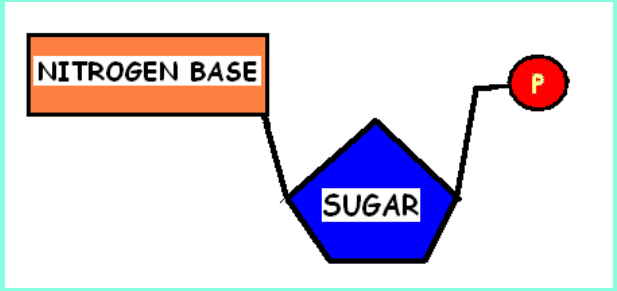
Nitrogen bases with 1 ring are called

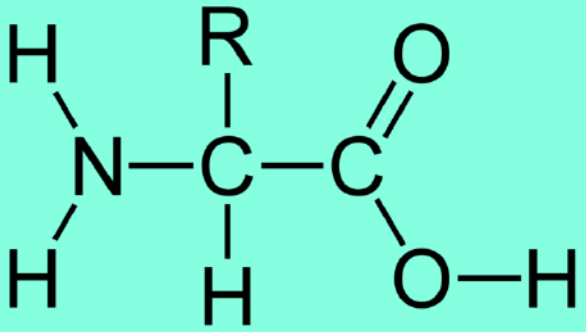
Pyrimidines

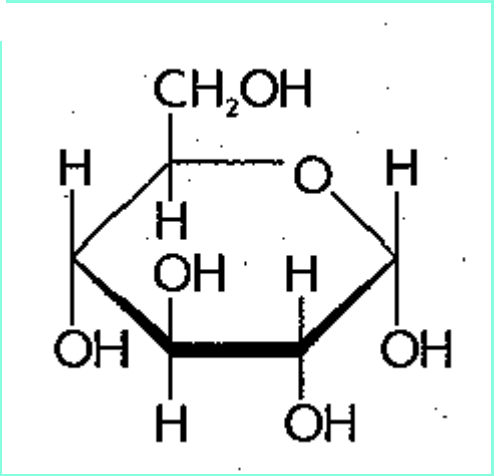


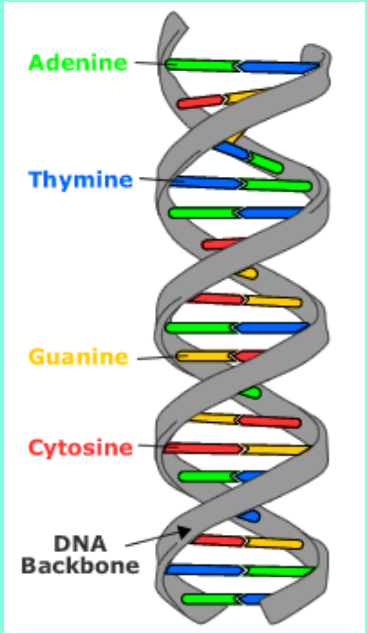
Essential Knowledge IST 1.L.1.
a. Purines (G and A) have a double ring structure.
b. Pyrimidines (C, T, and U) have a single ring structure.

Which of these molecules along with proteins is the major component in cell membranes?









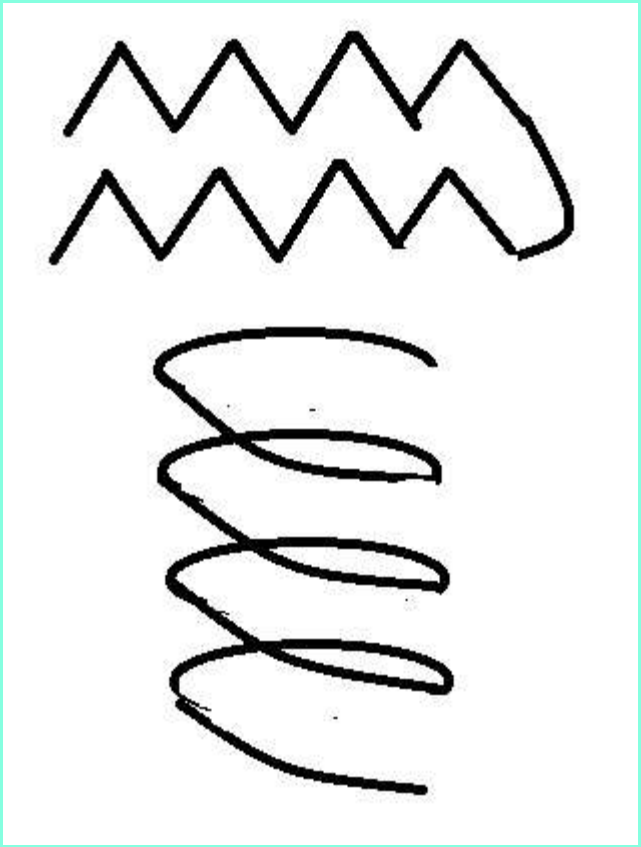
Essential knowledge

SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.

SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Draw and label the 2 kinds of shapes found in the secondary structure of proteins.

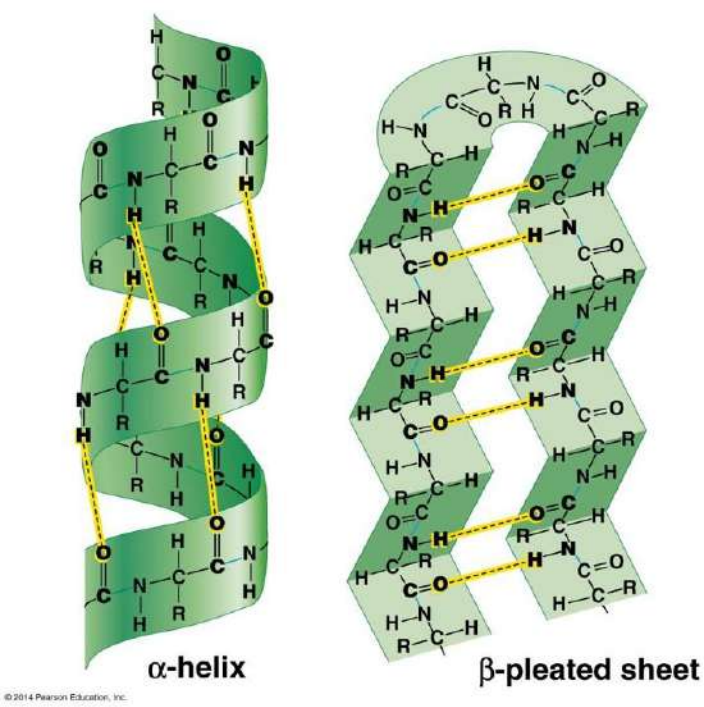
Beta pleated sheet



Alpha helix

https://s3.amazonaws.com/classconnection/448/flashcards/2303448/jpg/secondary_structure_proteins-14D1C8071264EA0F0FC.jpg

What kinds of bonds are involved in holding this secondary shape in position?



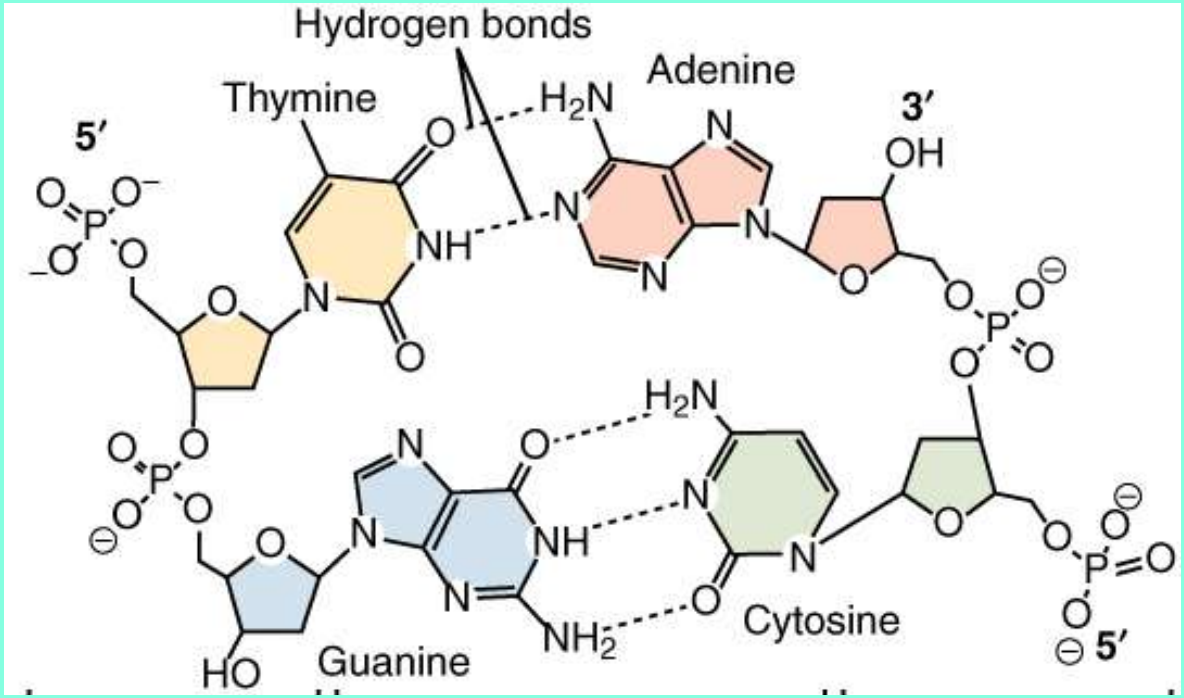
Hydrogen bonds between C=O on one amino acid and the N-H on another amino acid

R-groups NOT involved!

Essential knowledge SYI 1.C.1. d. 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.

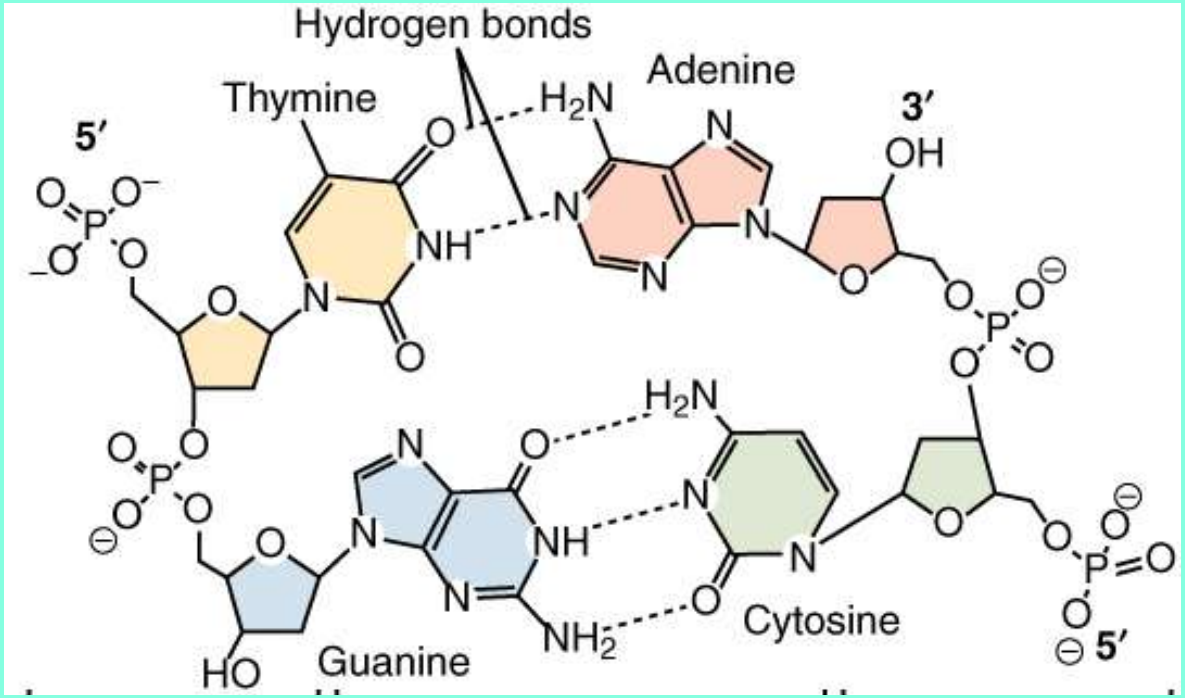
SP 2. A. Describe characteristics of a biological concept, process or model represented visually.

Image modified from: https://upload.wikimedia.org/wikipedia/commons/d/d3/0322_DNA_Nucleotides.jpg



Eukaryotic genes have regions of DNA called TATA boxes which have large numbers of A-T base pairs located nearby the promoter at the start of a gene. How might the arrangement of hydrogen bonds in these regions explain the ability of TATA boxes to help open the DNA more easily in these regions to increase transcription of the gene?

Image modified from: https://upload.wikimedia.org/wikipedia/commons/d/d3/0322_DNA_Nucleotides.jpg



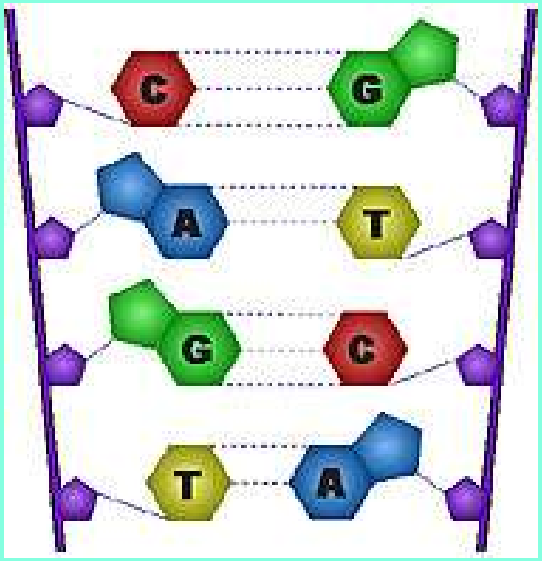
On the AP Exam questions will often include diagrams/graphs the answer to the question can be figured out just by looking at the picture. LOOK AT THE PICTURE

A's and T's are held together by 2 hydrogen bonds; G's and C's by 3. Hydrogen bonds holding areas with many A-T bonds are weaker than those with lots of G-C bonds, allowing the DNA strand to open and separate more easily here increasing the ease of transcription in these areas.

SP 1. C Explain biological concepts, processes, and/or models in applied contexts.
SP 2.B Explain relationships between different characteristics of biological concepts, processes, or models represented visually
b. in applied contexts

Which molecules make up the backbone (sides of ladder) in a DNA molecule?

Image from: http://www.tokyo-med.ac.jp/genet/picts/dna.jpg



Sugar (deoxyribose) and phosphates

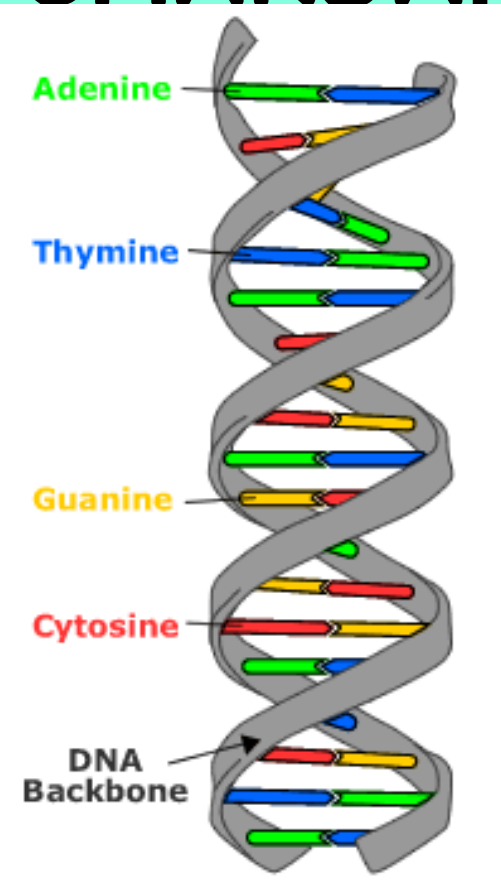
Essential knowledge

IST 1..A.1: DNA and RNA molecules have structural similarities and differences that define function.

a. Both DNA and RNA have three components — sugar, phosphate and a nitrogenous base — that form nucleotide units that are connected by covalent bonds to form a linear molecule with 3' and 5' ends, with the nitrogenous bases perpendicular to **the sugar-phosphate backbone.**

Image from: http://evolution.berkeley.edu/evosite/evo101/images/dna_bases.gif

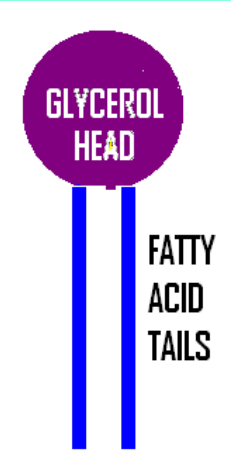
CHARGAFF'S RULES say that ?

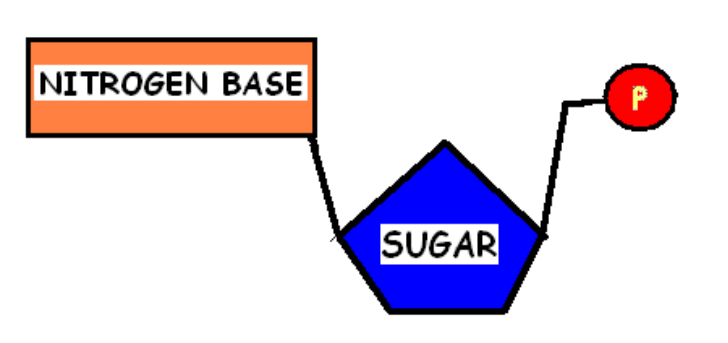


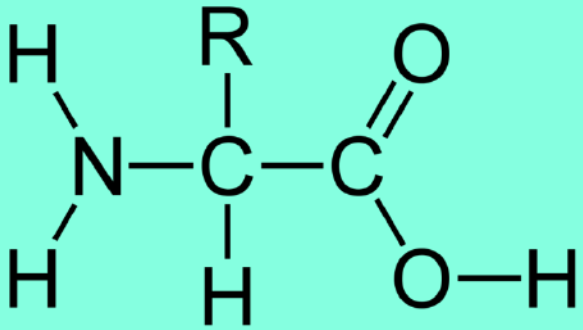
A = T G = C

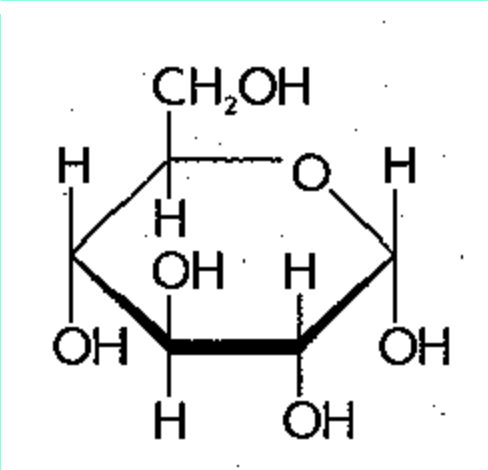
Essential Knowledge IST 1.L.1
DNA, and sometimes RNA, exhibits specific nucleotide base pairing that is conserved through evolution: adenine pairs with thymine or uracil (A-T or A-U) and cytosine pairs with guanine (C-G)—

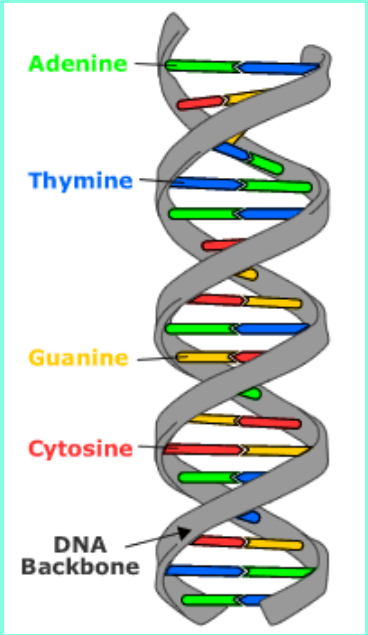
Which of these molecules is a carbohydrate?







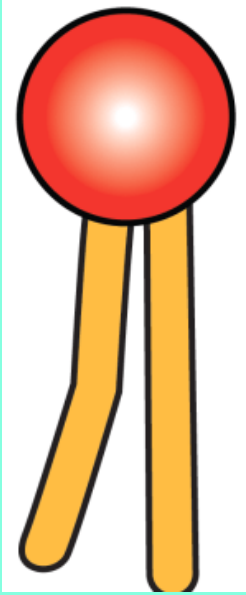




SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Image from: http://i0.wp.com/www.sciencemusicvideos.com/wp-content/uploads/2014/10/simple-phospholipid-no-numbers.png?resize=359%2C148

Identify this molecule and use the words: hydrophobic, hydrophilic, polar, non-polar to identify the parts of this molecule.



Head is polar and hydrophobic

Tails are non-polar and hydrophobic

Explain why this tail on the left is bent?

This fatty acid tail is unsaturated. It has a double bond which puts a "kink" in the tail

ESSENTIAL KNOWLEDGE

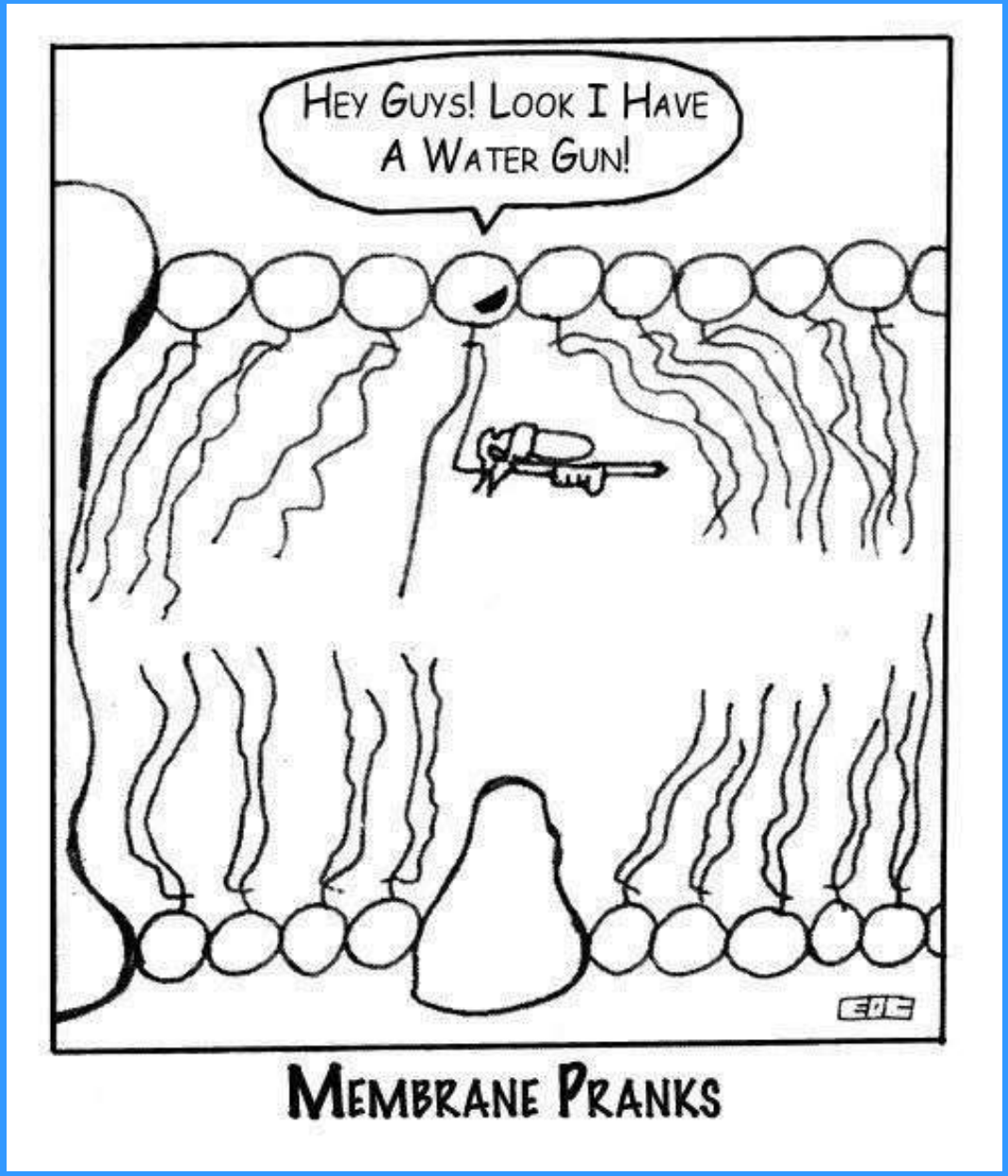
SYI 1.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule

SYI 1.B.2 d. Lipids are nonpolar macromolecules—

i. Differences in saturation determine the structure and function of lipids.

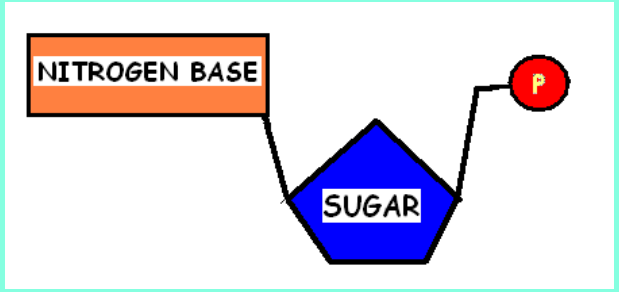
ENE 2.A.1 Phospholipids have both hydrophilic and hydrophobic regions. The hydrophilic phosphate regions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid regions face each other within the interior of the membrane.

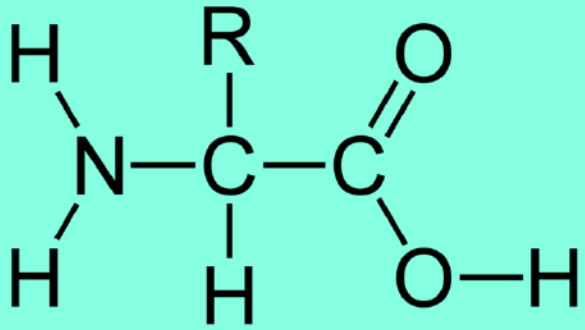
https://www.tumblr.com/tagged/cell-membrane

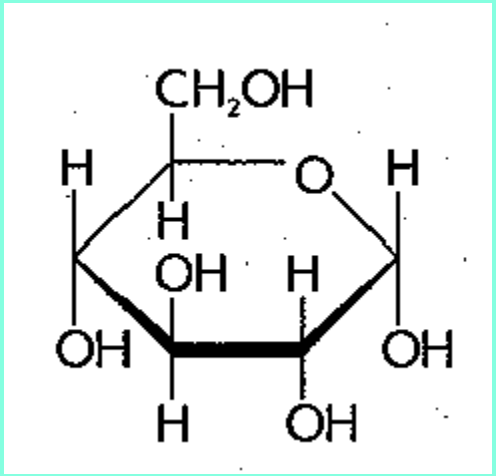


Take a break!

Which of these molecules is a nucleotide?







SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

IDENTIFY THE KINDS OF ATOMS THAT CAN BE FOUND IN EACH OF THE FOLLOWING

	Atoms that can be found					
MACROMOLECULE	C	O	H	N	S	P
PROTEINS AMINO ACIDS	✓	✓	✓	✓	✓	
CARBOHYDRATES	✓	✓	✓			
FATS	✓	✓	✓			
NUCLEIC ACIDS DNA,RNA	✓	✓	✓	✓		✓
PHOSPHOLIPIDS	✓	✓	✓			✓
ATP	✓	✓	✓			✓

Check mark image from: https://cdn4.vectorstock.com/i/1000x1000/76/78/red-check-mark-icon-tick-symbol-in-red-color-vector-23497678.jpg

ESSENTIAL KNOWLEDGE

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules.

a. Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms.

b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.

Name the molecule(s) that carry the genetic code found in all living things.

Nucleic acids
DNA or RNA

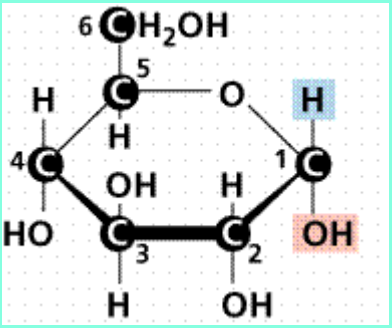
Which of these is found in retroviruses

RNA

ESSENTIAL KNOWLEDGE
EVO 2.A.1 DNA and RNA are carriers of genetic information
IST 1.K.2 Genetic information is transmitted from one generation to the next through DNA or RNA—
a . Genetic information is stored in and passed to subsequent generations through DNA molecules and, in some cases, RNA molecules..
IST 1.O.5 Genetic information in retroviruses is a special case and has an alternate flow of information: from RNA to DNA,

http://www.thisisitstores.co.uk/media/catalog/product/4/4/442916_1.jpg
http://www.clipartkid.com/images/648/water-drop-images-cliparts-co-aCb6i1-clipart.png

Monosaccharides (simple sugars) all have the same 1C:2H:1O ratio.
EX: Glucose = $C_6H_{12}O_6$ and Ribose = $C_5H_{10}O_5$



DISSACHARIDES like lactose and sucrose vary a little from this ratio. EX: Sucrose = $C_{12}H_{22}O_{11}$

Use what you learned about chemical reactions that join molecules and the numbers of sugar molecules found in different kinds of carbohydrates to explain why disaccharides seem to have a "few atoms missing".

http://www.thisisitstores.co.uk/media/catalog/product/4/4/442916_1.jpg
http://www.clipartkid.com/images/648/water-drop-images-cliparts-co-aCb6i1-clipart.png

Dehydration synthesis joins monosaccharides to make disaccharides by removing a water molecule (H_2O)

For 1C:2H:1O ratio expect $C_{12}H_{24}O_{12}$
but Sucrose = $C_{12}H_{22}O_{11}$

Missing atoms (2 H's and 1 O) are lost as water during dehydration synthesis

SP 1 Explain biological concepts , processes, and models presented in written format.
1.C Explain biological concepts, processes, and/or models in applied contexts

https://i.pinimg.com/originals/c9/f1/58/c9f1585926ebc34913646266212c1310.png

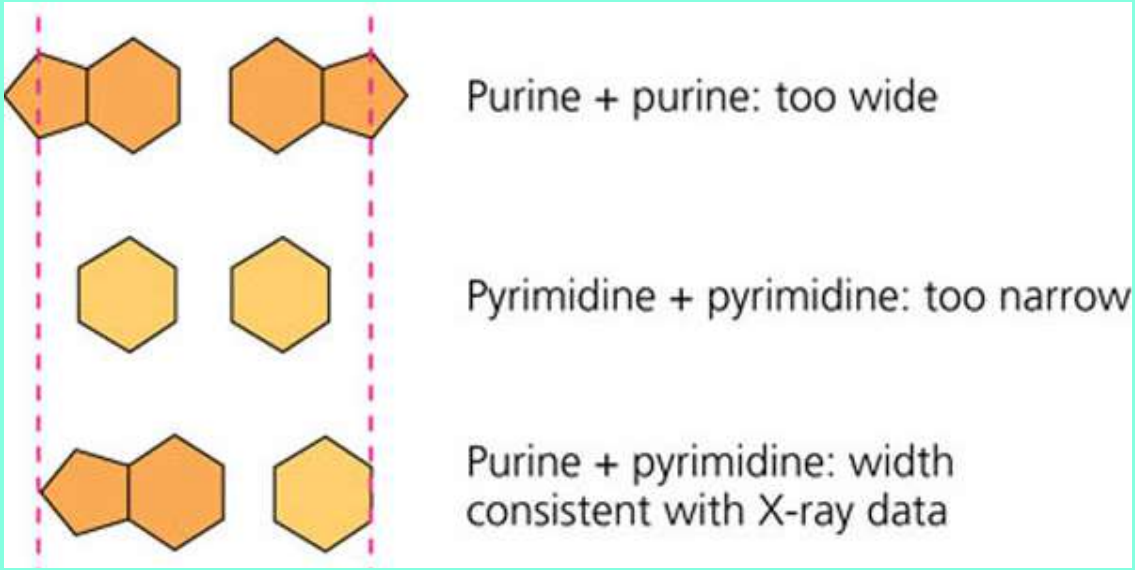
Which of the following is true:

In a DNA molecule

A. purines always bind with purines

B. pyrimidines always bind with pyrimidines

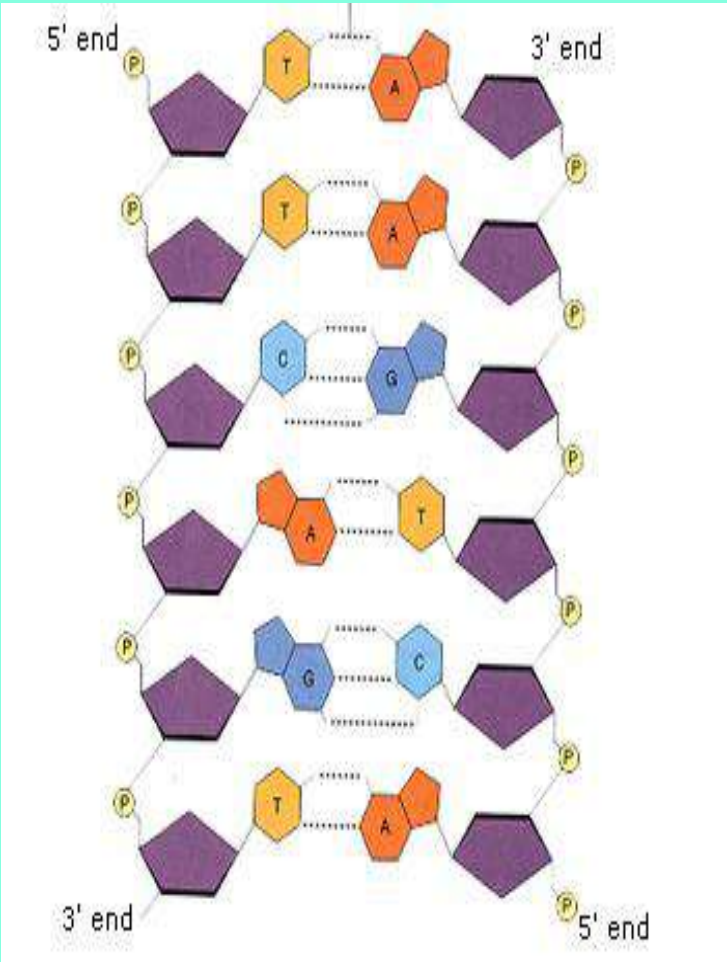
C. Purines always bind with pyrimidines



ESSENTIAL KNOWLEDGE IST 1.L.1

DNA, and sometimes RNA, exhibits specific nucleotide base pairing that is conserved through evolution: adenine pairs with thymine or uracil (A-T or A-U) and cytosine pairs with guanine (C-G)

http://images.tutorvista.com/cms/images/123/dna-base-pairing-structure.jpeg



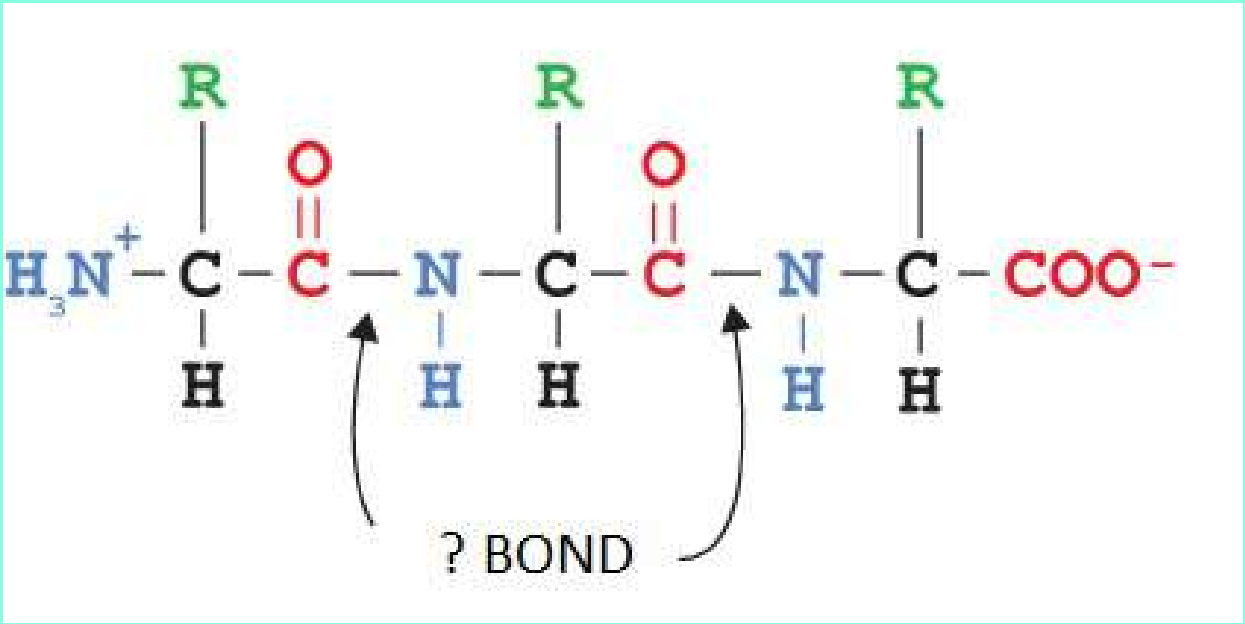
The two DNA strands are said to be

ANTIPARALLEL

because their 3′ and 5′ ends run in opposite directions.

Essential knowledge

SYI 1.C. 1 b. 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.



Name the bond that holds amino acid subunits together make a polypeptide

peptide bond

This is a covalent **bond.**

covalent ionic hydrogen

Essential Knowledge

SYI 1.B.2. b. 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

SYI 1.C.1 c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.

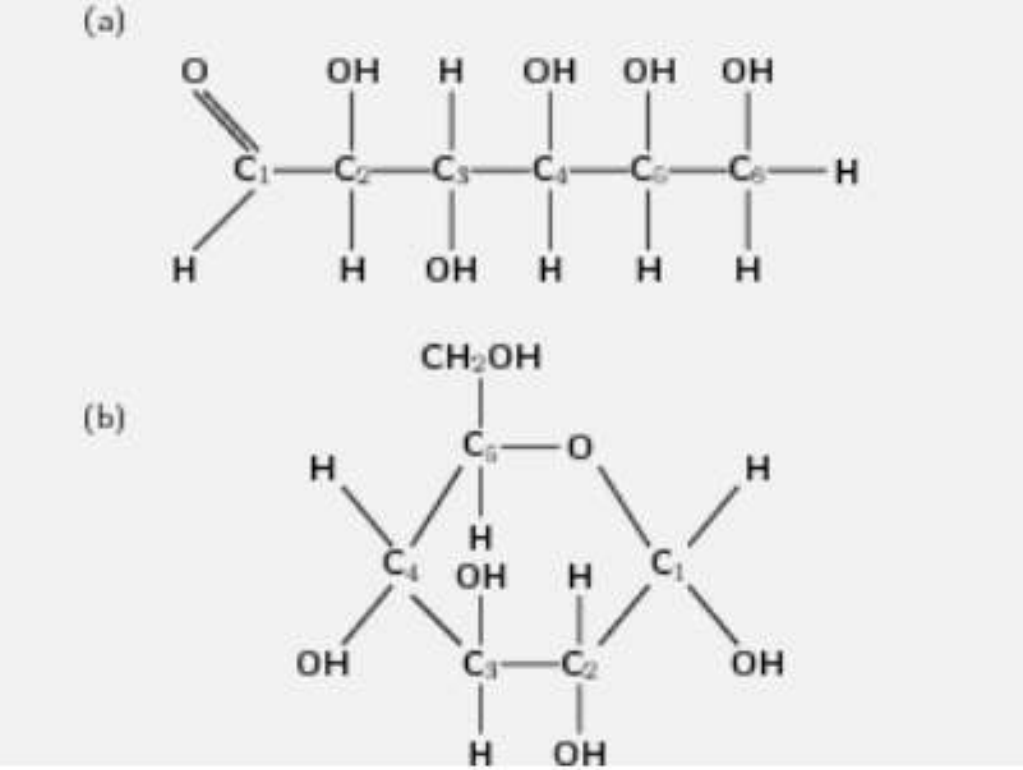
These molecules shown below are

A. lipids

B. carbohydrates

C. fats

D. nucleic acids

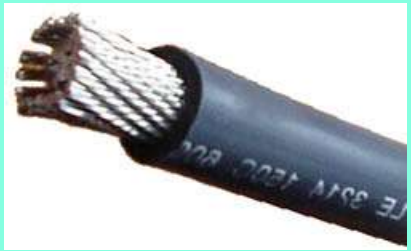


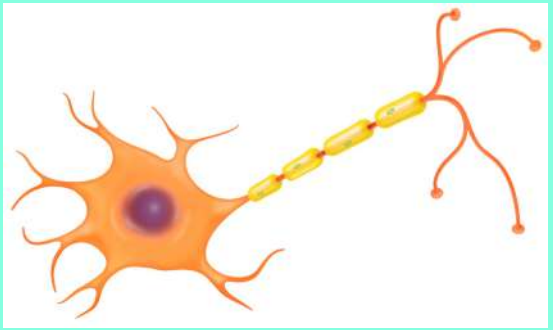
SP 2 A Describe characteristics of a biological process, or model, represented visually.

http://blackmovie.us/movie/Fat.Albert/fat.albert.movie.jpg
http://www.heraldsun.news.com.au/common/imagedata/0,1658,5116542,00.jpg
https://res.cloudinary.com/dk-find-out/image/upload/q_80,w_1920,f_auto/AW_Nerve_impulse2_tcnrmm.jpg
http://www.roweindustries.com/braidless-wire.html

The macromolecules that function in long term energy storage and insulation

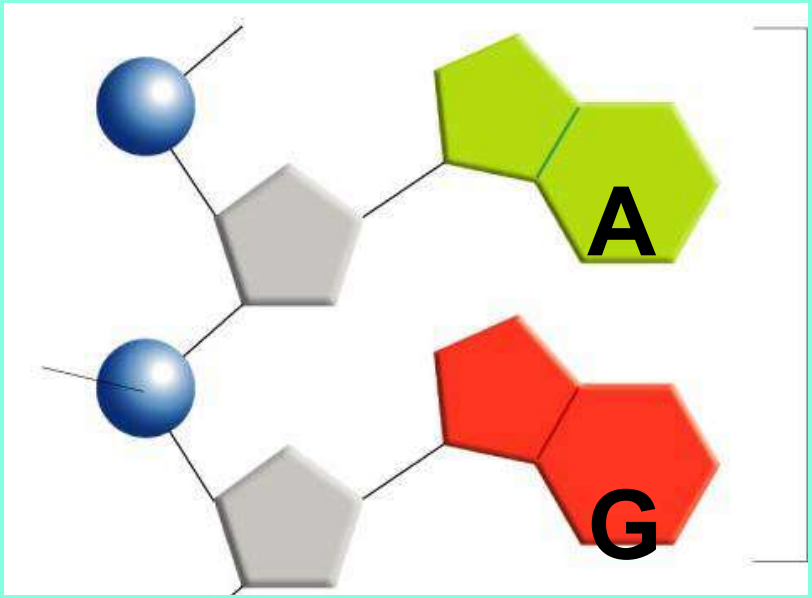
A. lipids
B. carbohydrates
C. proteins
D. nucleic acids





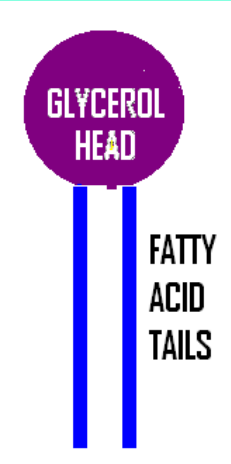
SP 2 A Describe characteristics of a biological process, or model, represented visually.

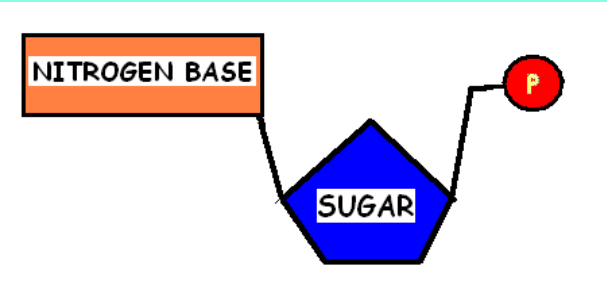
Nitrogen bases with 2 rings are called ~~Purines~~

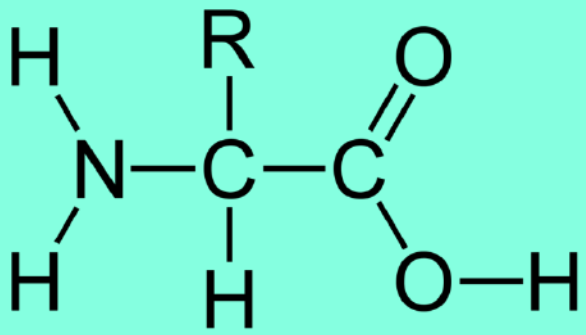


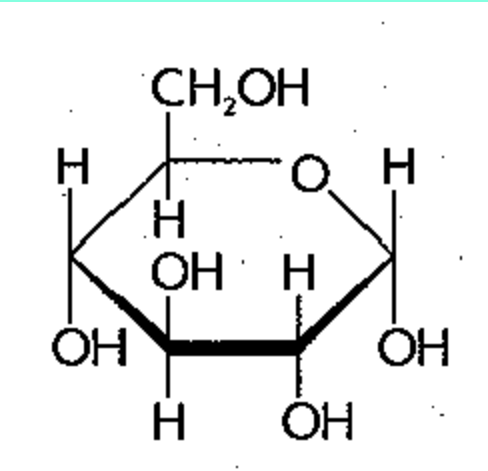
ESSENTIAL KNOWLEDGE
IST 1.L.1.
a. Purines (G and A) have a double ring structure.
b. Pyrimidines (C, T, and U) have a single ring structure.

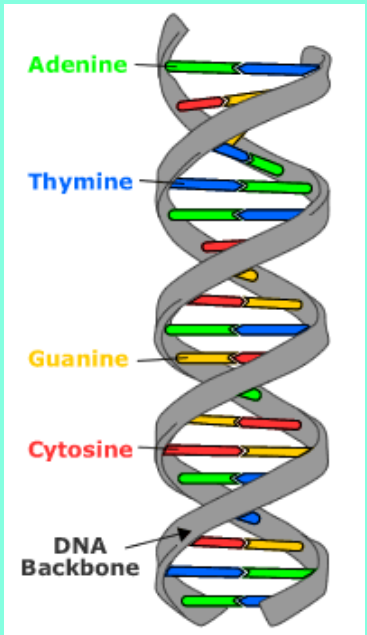
Which of these molecules is a nucleic acid?











ESSENTIAL KNOWLEDGE
SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Tell some ways DNA is different from RNA

DNA	RNA
Double stranded	single stranded
Contains A,T,C,G	Contains A,U,C,G
No U	no T
sugar = deoxyribose	sugar = ribose
Stores genetic info	transfers info from DNA to cell helps with protein synthesis

ESSENTIAL KNOWLEDGE

IST 1.A.4 DNA and RNA molecules have structural similarities and differences related to their function—

a. 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.

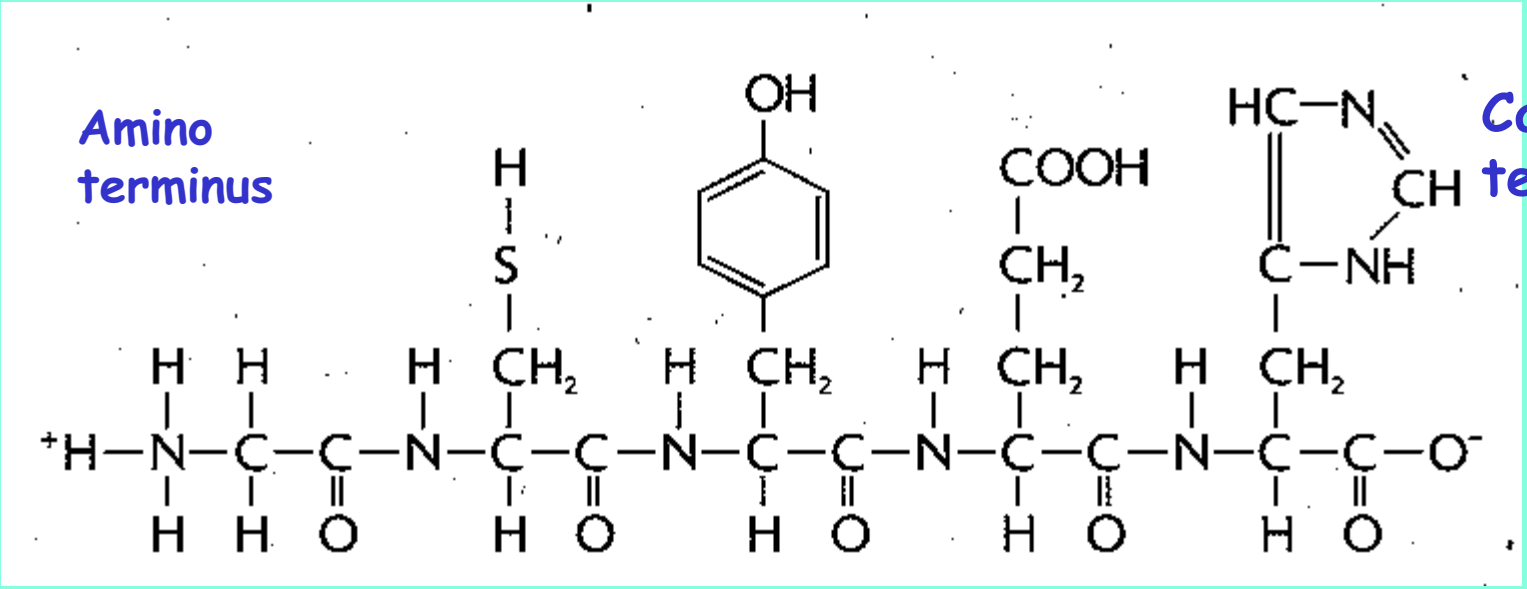
b. The basic structural differences between DNA and RNA include the following:

i. DNA contains deoxyribose and RNA contains ribose.

ii. RNA contains uracil and DNA contains thymine.

iii. DNA is usually double stranded; RNA is usually single stranded.

iv. The two DNA strands in double-stranded DNA are antiparallel in directionality.



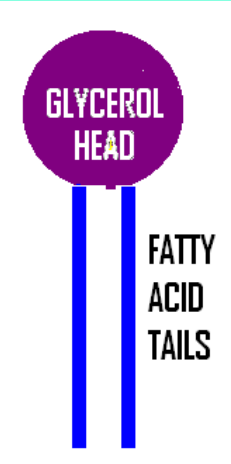
IDENTIFY the amino and carboxyl terminus on this polypeptide.

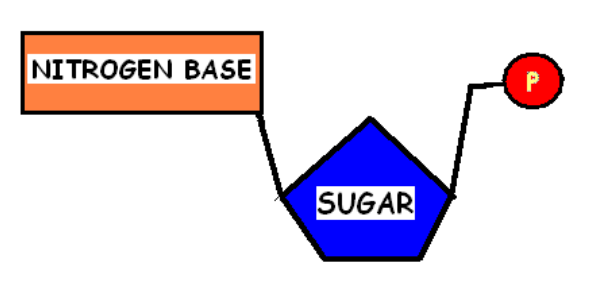
ESSENTIAL KNOWLEDGE

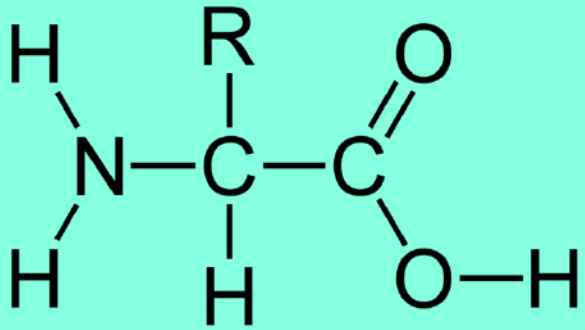
SYI 1.B.2. b. In proteins, the specific order of amino acids in a polypeptide (primary structure) determines the overall shape of the protein. Amino acids have directionality, with an amino (NH2) terminus and a carboxyl (COOH) terminus

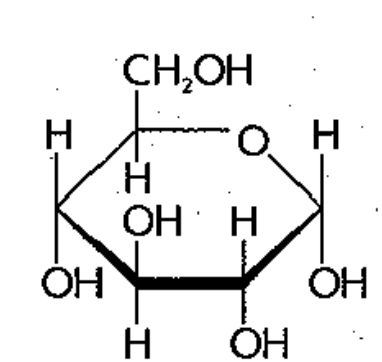
SYI 1.C.1 c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.

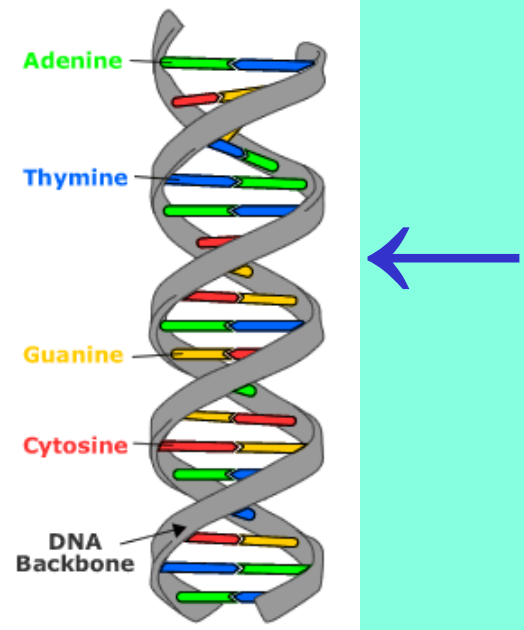
Which of these molecules stores genetic info?







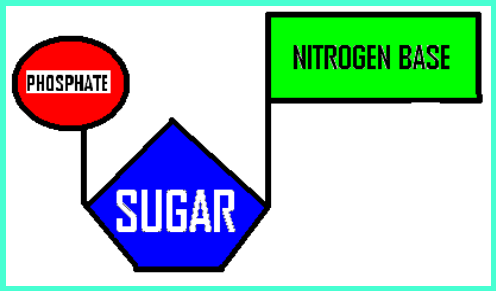




SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Image by: Riedell

Name this subunit used to build nucleic acids like DNA & RNA



NUCLEOTIDE

If this was going to make RNA what sugar would be used?

ribose

Which nitrogen base could NOT be used?

NO THYMINE

ESSENTIAL KNOWLEDGE

IST 1.A.1 DNA and RNA molecules have structural similarities and differences related to their function—

b. The basic structural differences between DNA and RNA include the following:

i. DNA contains deoxyribose and RNA contains ribose.

ii. RNA contains uracil and DNA contains thymine.

ESSENTIAL KNOWLEDGE

SYI 1.B.2 a In nucleic acids, Structure and function of polymers are derived from the way their monomers are assembled—

a. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: 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 functions

The interactions between the amino and carboxyl groups on different amino acids in the backbone of a polypeptide chain make up its SECONDARY structure.

primary secondary tertiary quaternary

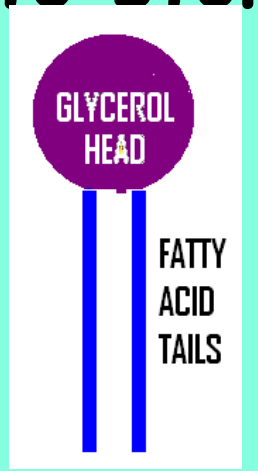
Name the kind of bonds/interactions that hold these together

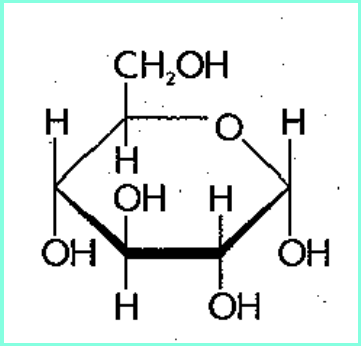
Hydrogen bonds

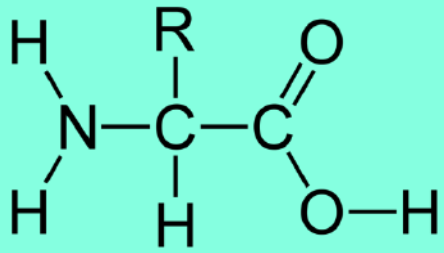
Essential knowledge

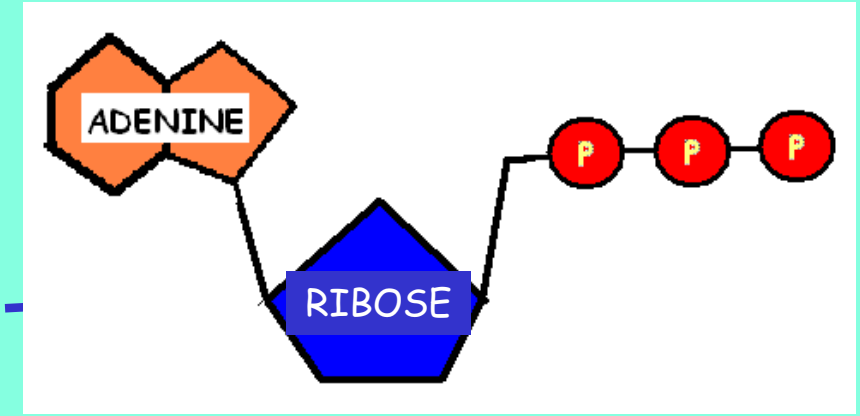
SYI 1.C.1 d. Proteins have primary structure determined by the sequence order of their constituent amino acids, secondary structure that arises through local folding of the amino acid chain into elements such as alpha-helices and beta-sheets, tertiary structure that is the overall three-dimensional shape 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.

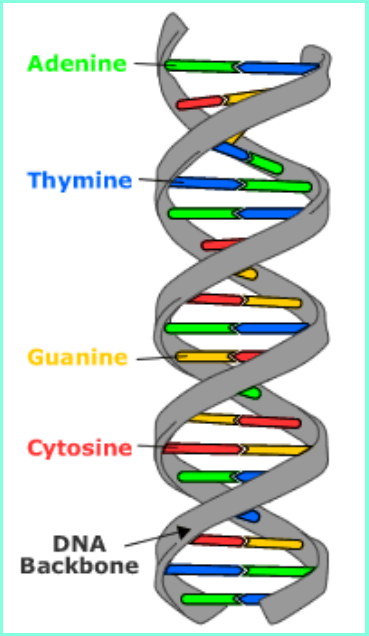
Which of these molecules is used by cells to store and transport energy?











Essential Knowledge
SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

The interactions between R groups on amino acids in a polypeptide chain makes up its TERTIARY structure.

primary secondary tertiary quaternary

Name some of the kinds of bonds/interactions that hold these together

Hydrogen bonds
Van der waals interactions
Ionic interactions
Hydrophobic/hydrophilic interactions
Disulfide bridges (covalent)

Essential knowledge SYI 1.C.1.d 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.

Compare & Contrast

Cohesion

Attraction between individual water molecules

Adhesion

Attraction between water molecules and other surfaces

BOTH DUE TO HYDROGEN BONDING

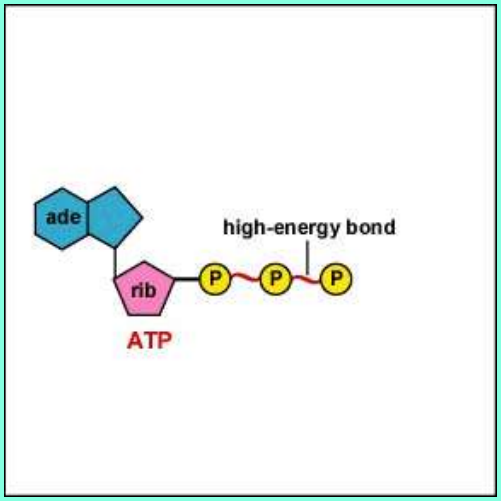
Essential knowledge

SYI 1.A.2 Living systems depend on properties of water that result from its polarity and hydrogen bonding

SYI 1.A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.

Animation from: http://faculty.ccbcmd.edu/biotutorials/energy/images/atp.gif

Explain the role of dehydration synthesis and hydrolysis in the charging and release of energy from ATP.



Dehydration synthesis removes a water molecule to add a phosphate group onto ADP to make ATP (stores energy)

Hydrolysis adds water back to break the bond, releasing the phosphate, and releasing energy.

Essential knowledge
SYI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.
ENE 1.L.7 The conversion of ATP to ADP releases energy, which is used to power many metabolic processes.

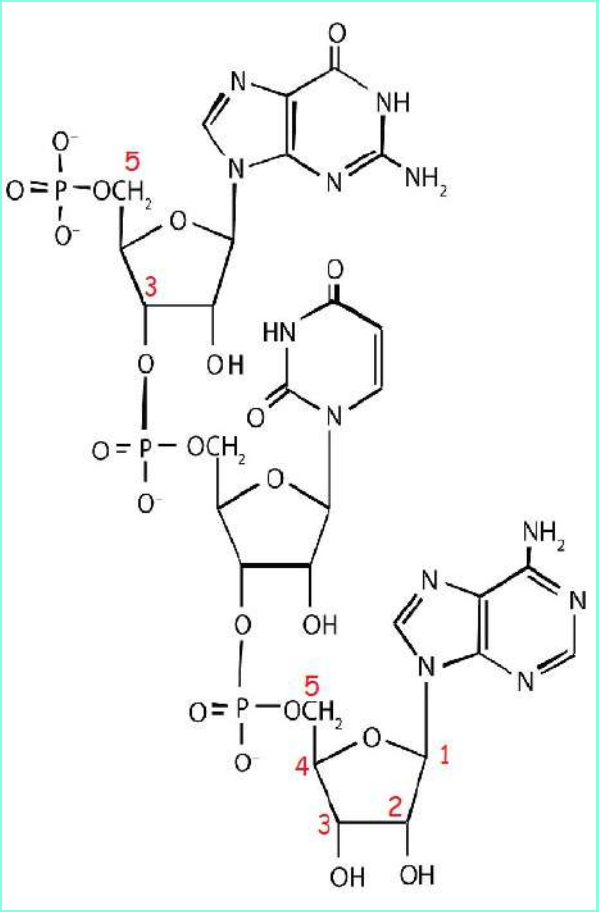
from: http://www.miranda.com/library.en/Images/Pictures/girls-runners.jpg

The macromolecules that is the main source for quick energy.

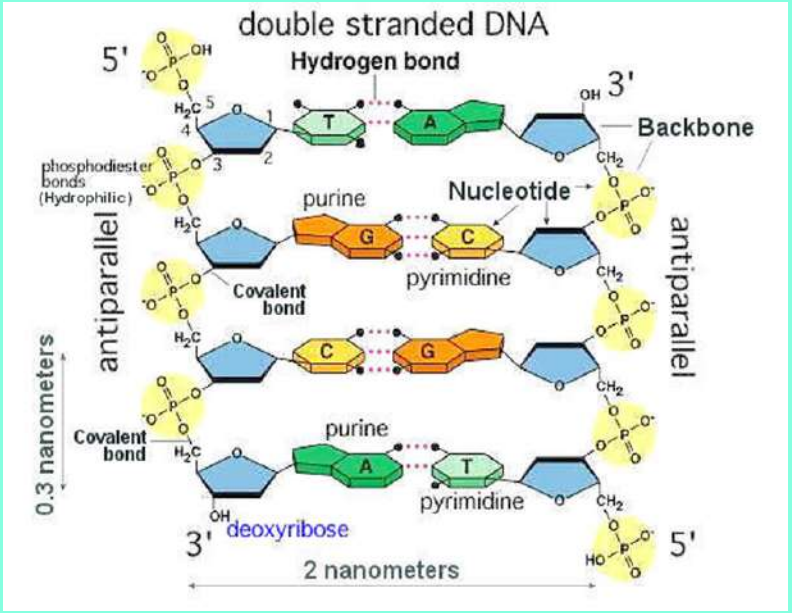
A. lipids
B. carbohydrates
C. fats
D. nucleic acids

SP 2 A Describe characteristics of a biological process, or model, represented visually.

Explain what the term 3′ and 5′ ends means when referring to a DNA molecule



The 2 strands in a DNA molecule run in opposite directions (antiparallel) and are identified by numbering the carbons of the deoxyribose sugar in the backbone. The #3 carbon is closest to the 3′ end. The #5 carbon is closest to the 5′ end.



Essential knowledge SYI 1.C.1. b. DNA is structured as an antiparallel double helix, with each strand running in opposite 5′ to 3′ orientation
SP 2 A Describe characteristics of a biological process, or model, represented visually.

The sequence of amino acids in a polypeptide chain makes up its PRIMARY structure.

primary secondary tertiary quaternary

The bond that holds 2 amino acids together in a chain is a(n) COVALENT bond

ionic covalent hydrogen

Essential knowledge SYI
1.C.1.

c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.

d. 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.

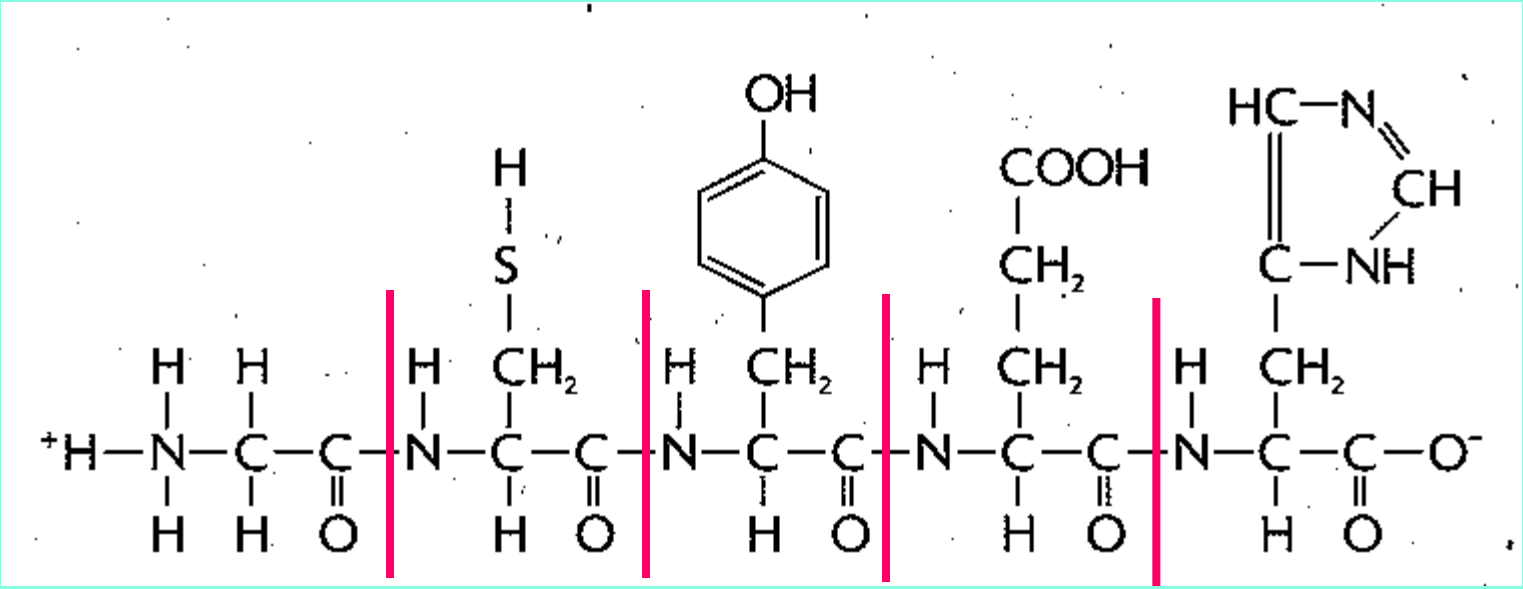
One way to identify specific molecules that are too small to be seen is to "tag" them with radioactive isotopes.

Name some kinds of macromolecules that would be labeled by the addition of ^{14}C

Carbon is found in carbohydrates, proteins, nucleic acids and lipids.

Essential knowledge

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules.
a. Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms.



How many amino acids are shown in this polypeptide chain?

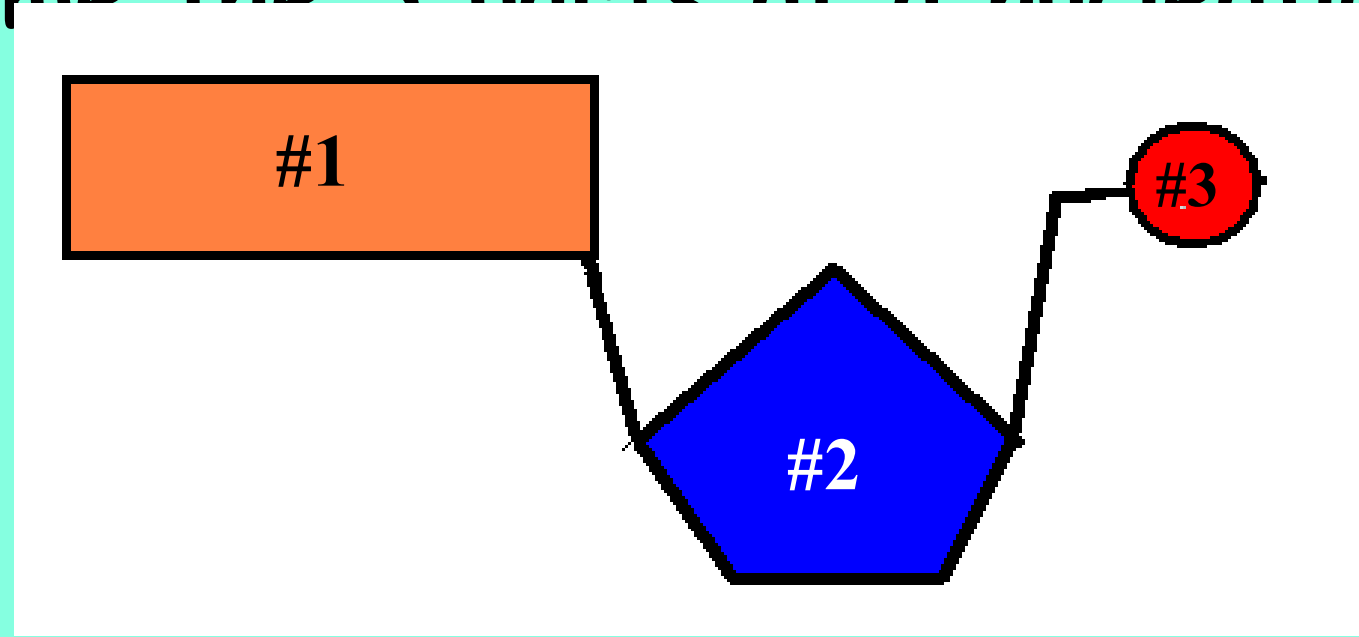
5

ESSENTIAL KNOWLEDGE

SYI 1.B.2 b. 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.

SYI 1.C.1 c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.

Name the 3 parts of a nucleotide



#1 = nitrogen base (A, T, C, G, or U)

#2 = sugar (deoxyribose or ribose)

#3 = phosphate

ESSENTIAL KNOWLEDGE

SYI 1.B.2 a In nucleic acids, Structure and function of polymers are derived from the way their monomers are assembled—

a. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: 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 functions

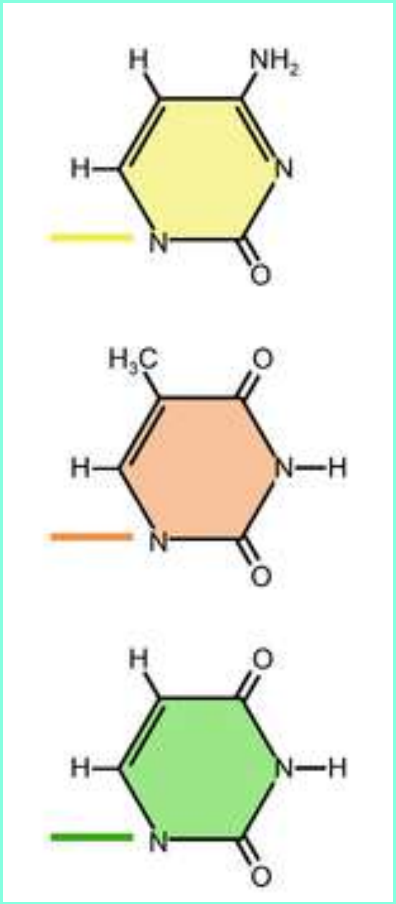
IST 4.A.1 .a. 1. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose o r ribose), a phosphate and a nitrogen base (adenine, thymine, guanine cytosine, or uracil). DNA and RNA differ in function and differ slightly in structure, and these structural difference account for the differing functions.

SP 2 A Describe characteristics of a biological process, or model, represented visually.

Which of the nitrogen bases are pyrimidines with 1 ring?

Hint:

Remember: *CUT* the Pie!



Cytosine, Uracil, and Thymine are Pyrimidines!

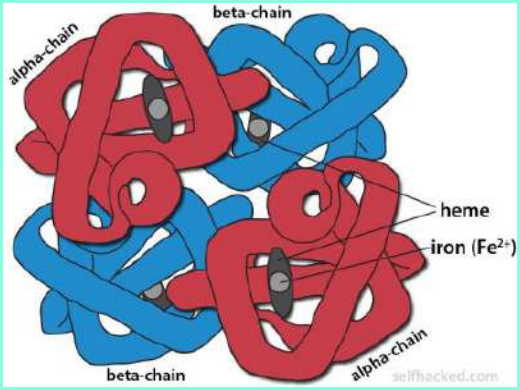
Essential Knowledge IST 1.L.1.
a. Purines (G and A) have a double ring structure.
b. **Pyrimidines (C, T, and U)** have a single ring structure.

Images from: Pearson Education Inc, publishing as Pearson Prentice Hall
https://upload.wikimedia.org/wikipedia/commons/thumb/f/f0/Blausen_0324_DNA_Pyrimidines.png/250px-Blausen_0324_DNA_Pyrimidines.png

https://i2.wp.com/selfhacked.com/app/uploads/2017/06/hemoglobin_structure.jpg?resize=450%2C336&ssl=1

Hemoglobin is an example of a protein with QUATERNARY structure because it is made up of multiple polypeptide chains.

primary secondary tertiary quaternary



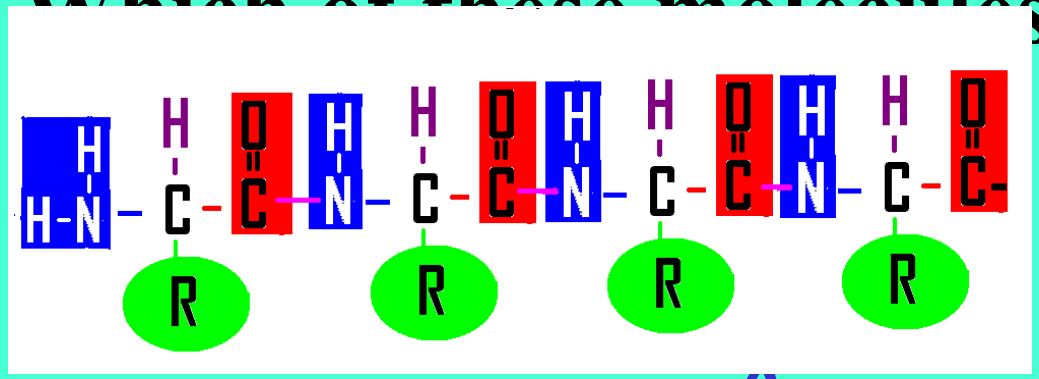
TRUE or FALSE

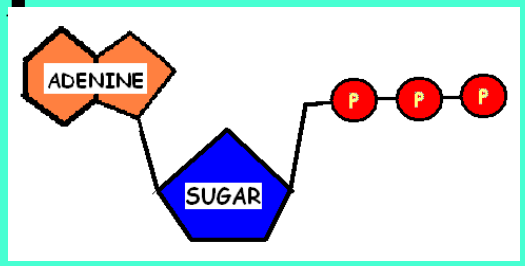
This type of structure is found in all proteins.

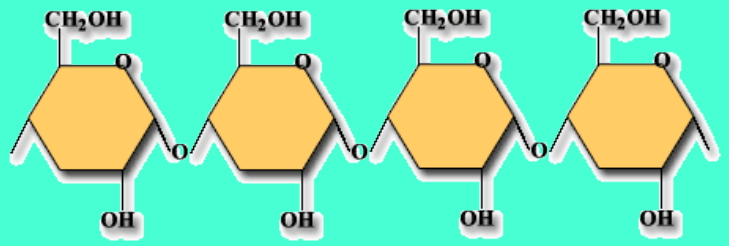
All proteins have primary, secondary, tertiary structure, but only some have quaternary structure.

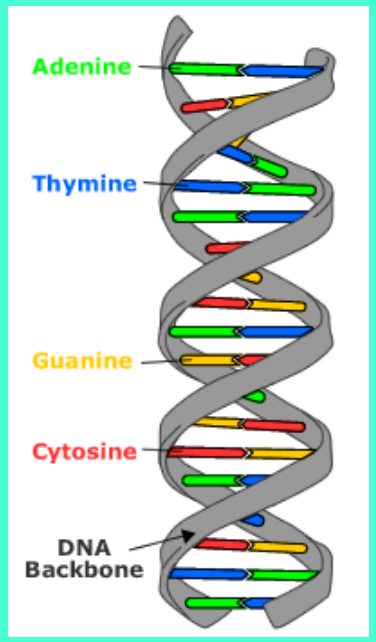
Essential knowledge SYI 1.C.1.d. Proteins have primary structure determined by the sequence order of their constituent amino acids, secondary structure that arises through local folding of the amino acid chain into elements such as alpha-helices and beta-sheets, tertiary structure that is the overall 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.

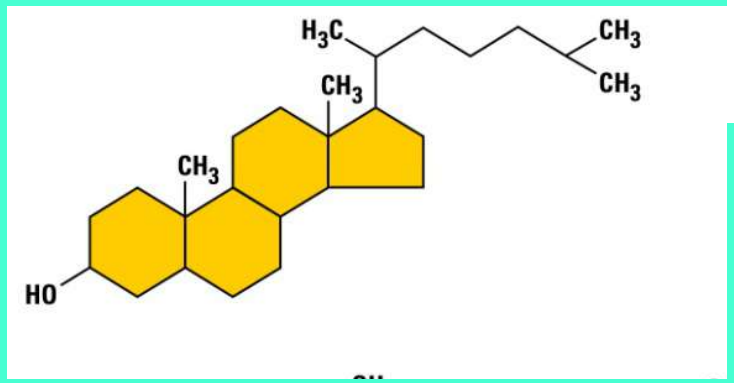
Which of these molecules is a protein?





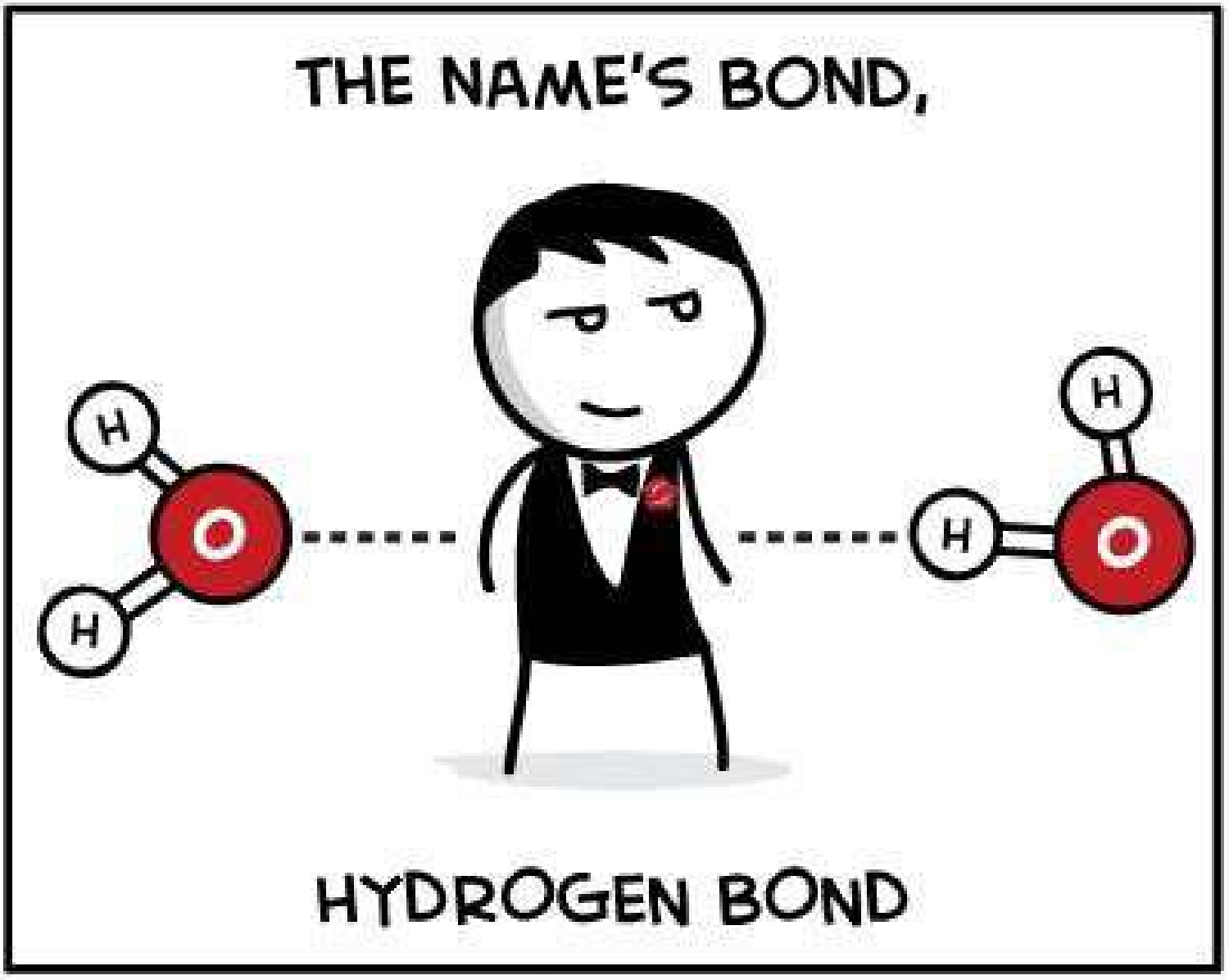






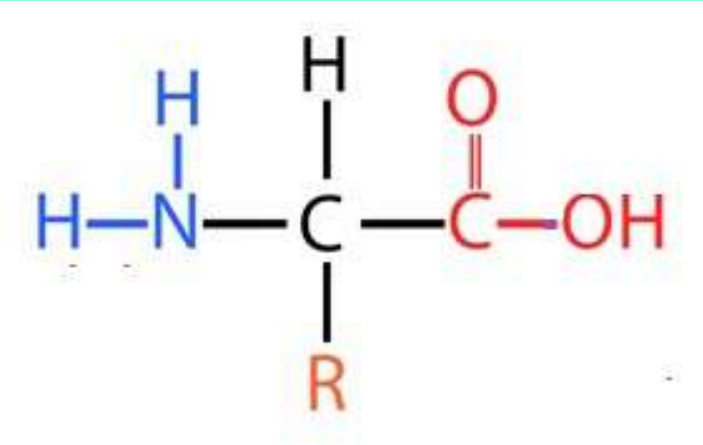
SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Take a break!

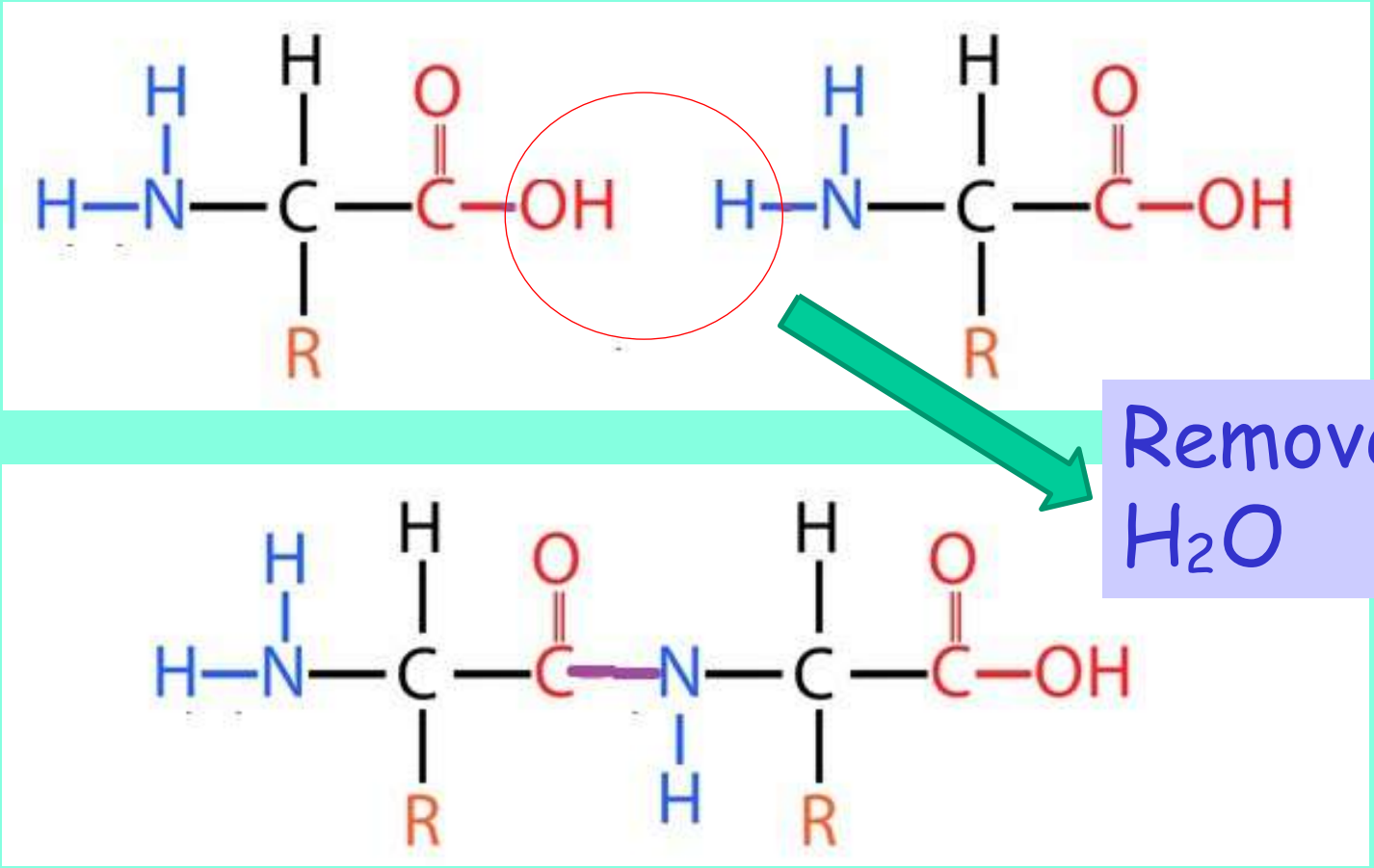


https://www.pinterest.com/pin/AY1yBSYigT3IoWFxRZCam3jqmB30fIz-OBOhiRM0PoZykOUd8OpEdhY/

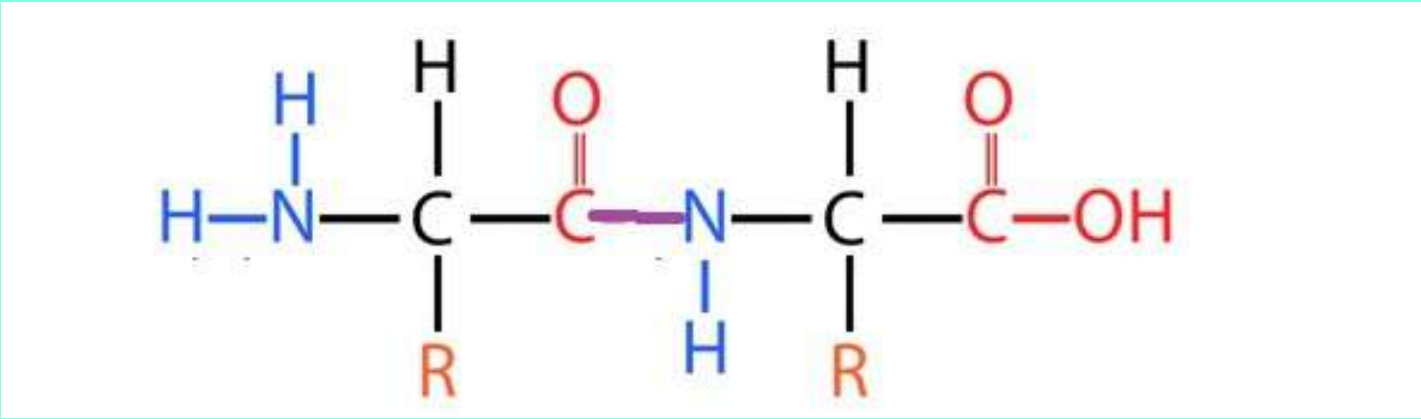
Draw a picture of an amino acid



Show how 2 amino acids could be joined together.



Identify this process and the type of bond formed



DEHYDRATION SYNTHESIS
Remove H_2O
MAKES A COVALENT PEPTIDE BOND

ESSENTIAL KNOWLEDGE
SBI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.
SYI 1.B.2 b. 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.
SYI 1.C.1 c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.
SP 2. A. Describe characteristics of a biological concept, process or model represented visually.

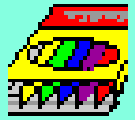
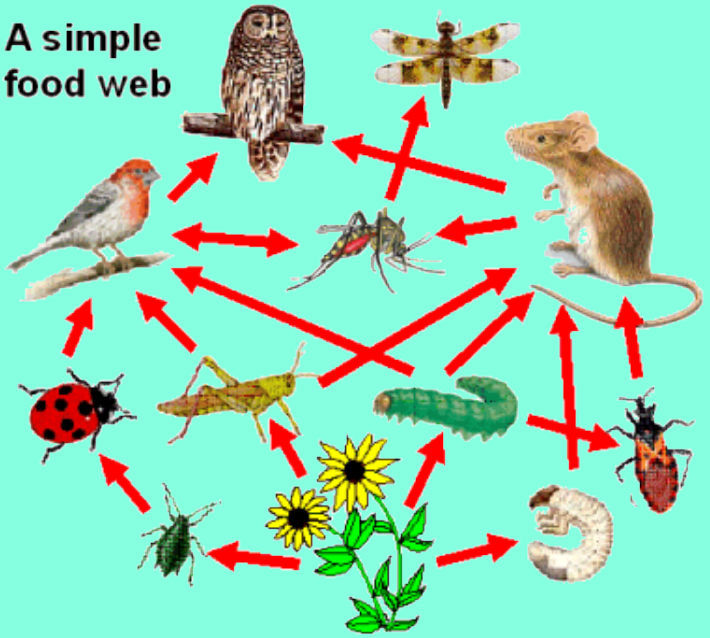


Image from: https://s-media-cache-ak0.pinimg.com/originals/bb/bb/1f/bbbb1fb27e83c9a5ba12fc9e2266eb5a.gif

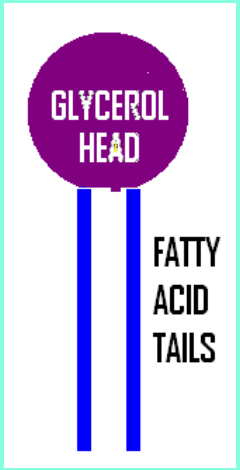
Explain where heterotrophs obtain the carbon they need to build molecules during the carbon cycle.

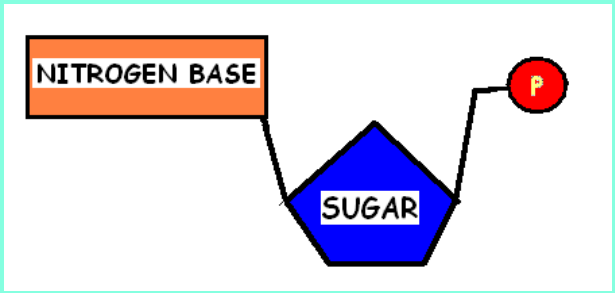
Carbon is obtained by consuming other organisms as part of food web interactions.

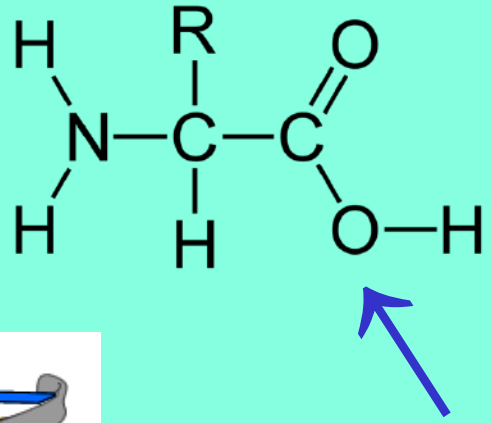


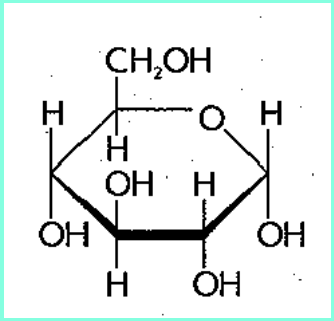
ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization
ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules.
a. Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms
ENE-1.N.1 Changes in energy availability can result in changes in population size.
ILLUSTRATIVE EXAMPLES: § Food chains/webs.

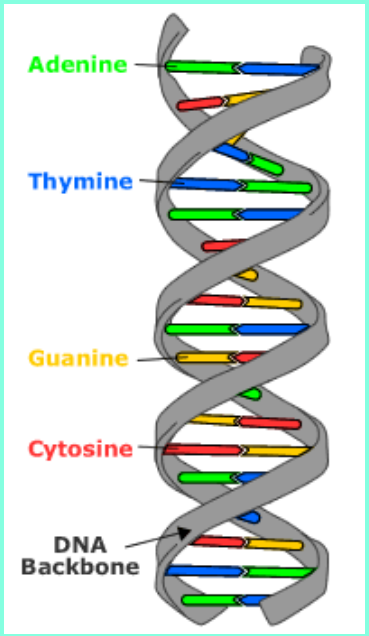
Which of these molecules is an amino acid?









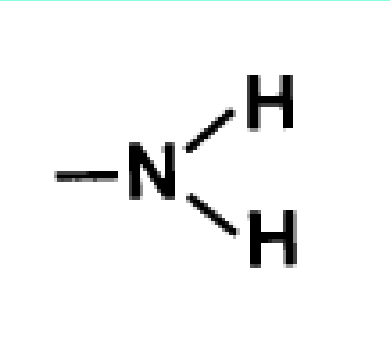


SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

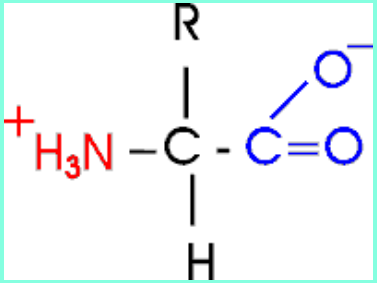
Image from: http://www.biology-pages.info/G/Groups_5.gif
http://ccnmtl.columbia.edu/projects/biology/lecture4/images/aacharched.3.gif

Name this functional group

amino



How does adding this group change an organic molecule?



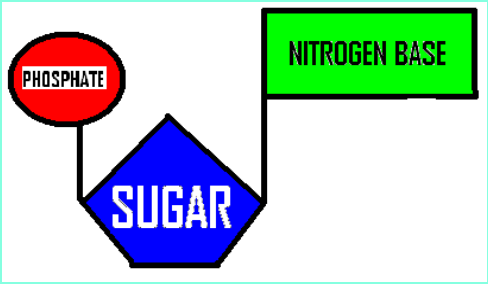
Makes it more polar

Makes it more basic (can pick up a H^+ ion) which gives it a slight positive charge

Essential knowledge SYI 1.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule.

Name this subunit used to build nucleic acids like DNA & RNA

Image by: Riedell



NUCLEOTIDE

If this was going to make DNA what sugar would be used?

deoxyribose

Which nitrogen base could NOT be used?

NO URACIL

ESSENTIAL KNOWLEDGE

IST 1.A.1 DNA and RNA molecules have structural similarities and differences related to their function—

b. The basic structural differences between DNA and RNA include the following:

i.DNA contains deoxyribose and RNA contains ribose.

ii. RNA contains uracil and DNA contains thymine.

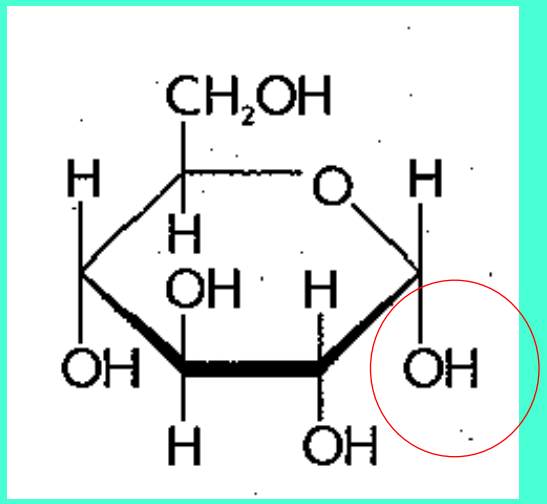
ESSENTIAL KNOWLEDGE

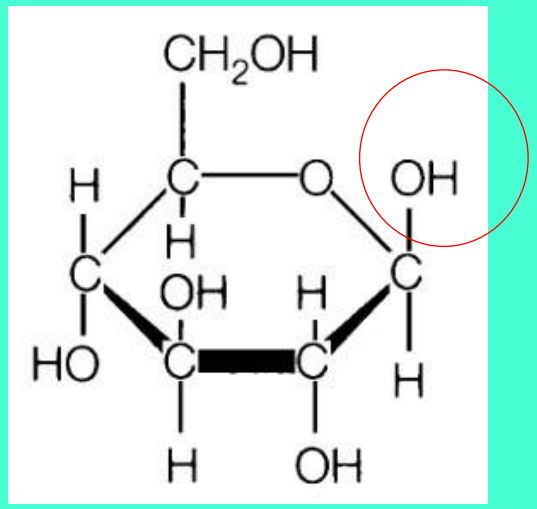
SYI 1.B.2 a In nucleic acids, Structure and function of polymers are derived from the way their monomers are assembled—

a. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: 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 functions

https://i.pinimg.com/originals/c9/f1/58/c9f1585926ebc34913646266212c1310.png

How are alpha and beta glucose different?





Give examples of polysaccharides made with each of these.

Alpha (α)glucose	Beta (β) glucose
glycogen & starch	cellulose & chitin

Which of these polysaccharide are humans and other animals unable to digest?

Humans and other animals are unable to break polysaccharides with β linkages

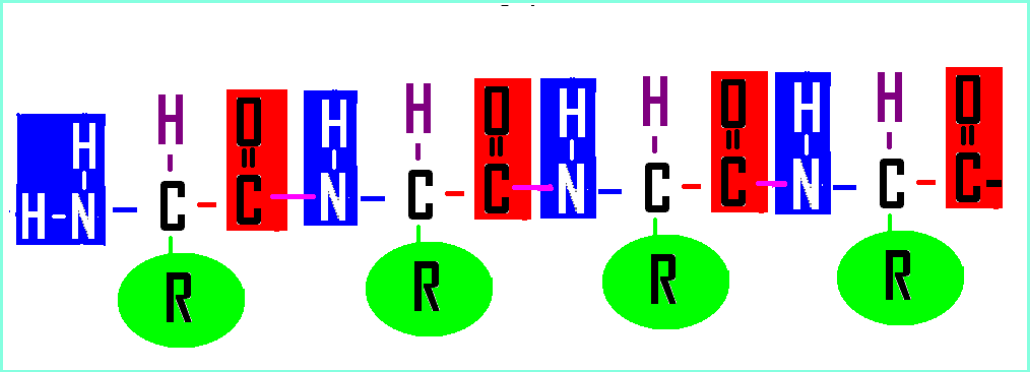
ESSENTIAL KNOWLEDGE

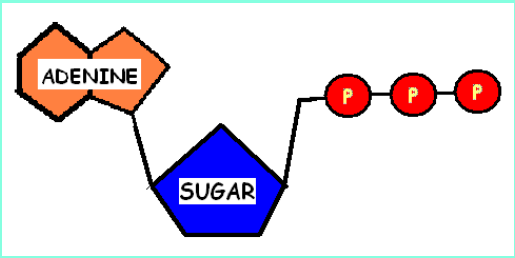
SYI 1.B.2 c. Complex carbohydrates comprise sugar monomers whose structures determine the properties and functions of the molecules

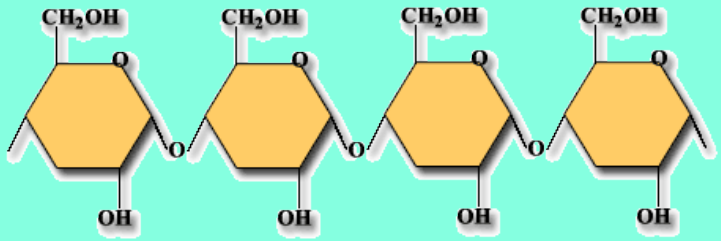
SP 2 A Describe characteristics of a biological process, or model, represented visually.

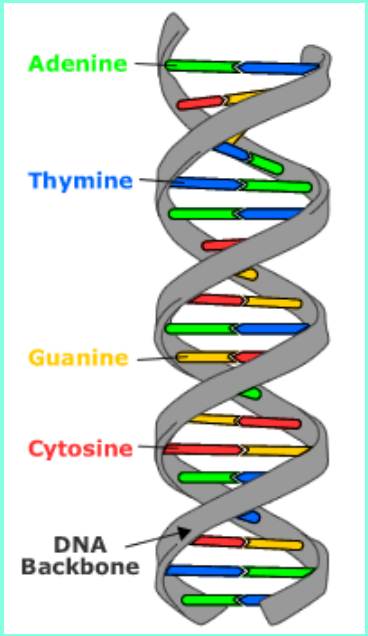
ILLUSTRATIVE EXAMPLE- Cellulose versus starch versus glycogen

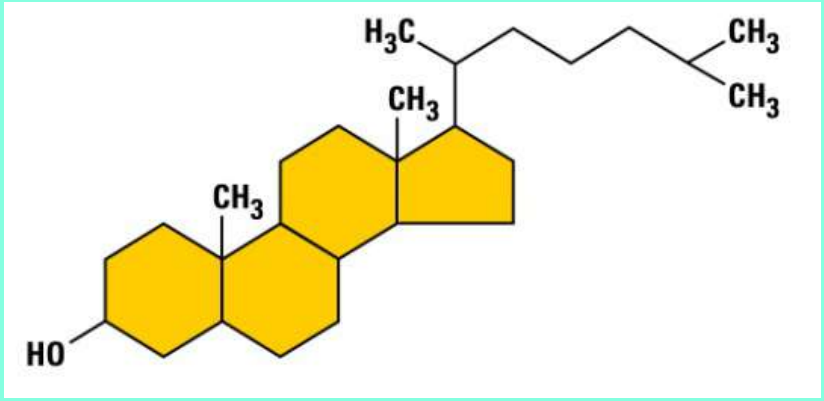
Which of these molecules is a carbohydrate?











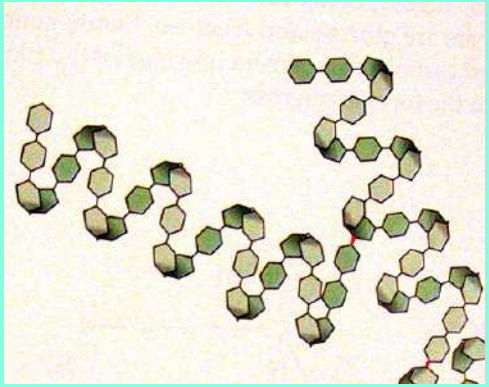
SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

http://www.msu.edu/course/lbs/145/smith/s02/graphics/campbell_5.6.gif

Name the polysaccharide used by plant cells to store glucose for later starch

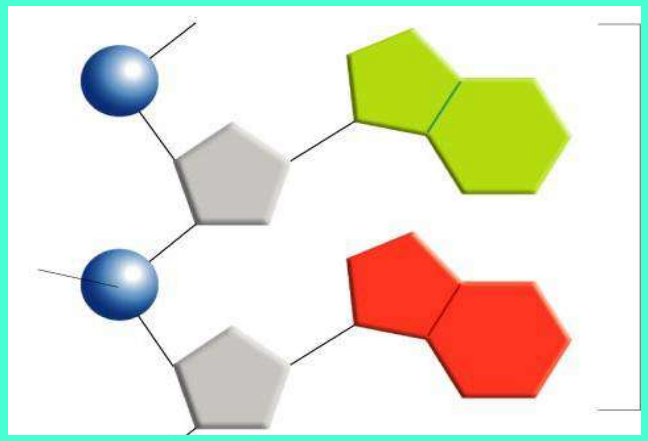
Polysaccharide used by animal cells to store glucose for later

glycogen



ESSENTIAL KNOWLEDGE
SYI 1.B.2 c. Complex carbohydrates comprise sugar monomers whose structures determine the properties and functions of the molecules
ILLUSTRATIVE EXAMPLE- Cellulose versus starch versus glycogen.

Which of the nitrogen bases are purines with 2 rings?



Hint:

Remember: CUT the Pie!

Cytosine, Uracil, and Thymine are Pyrimidines!

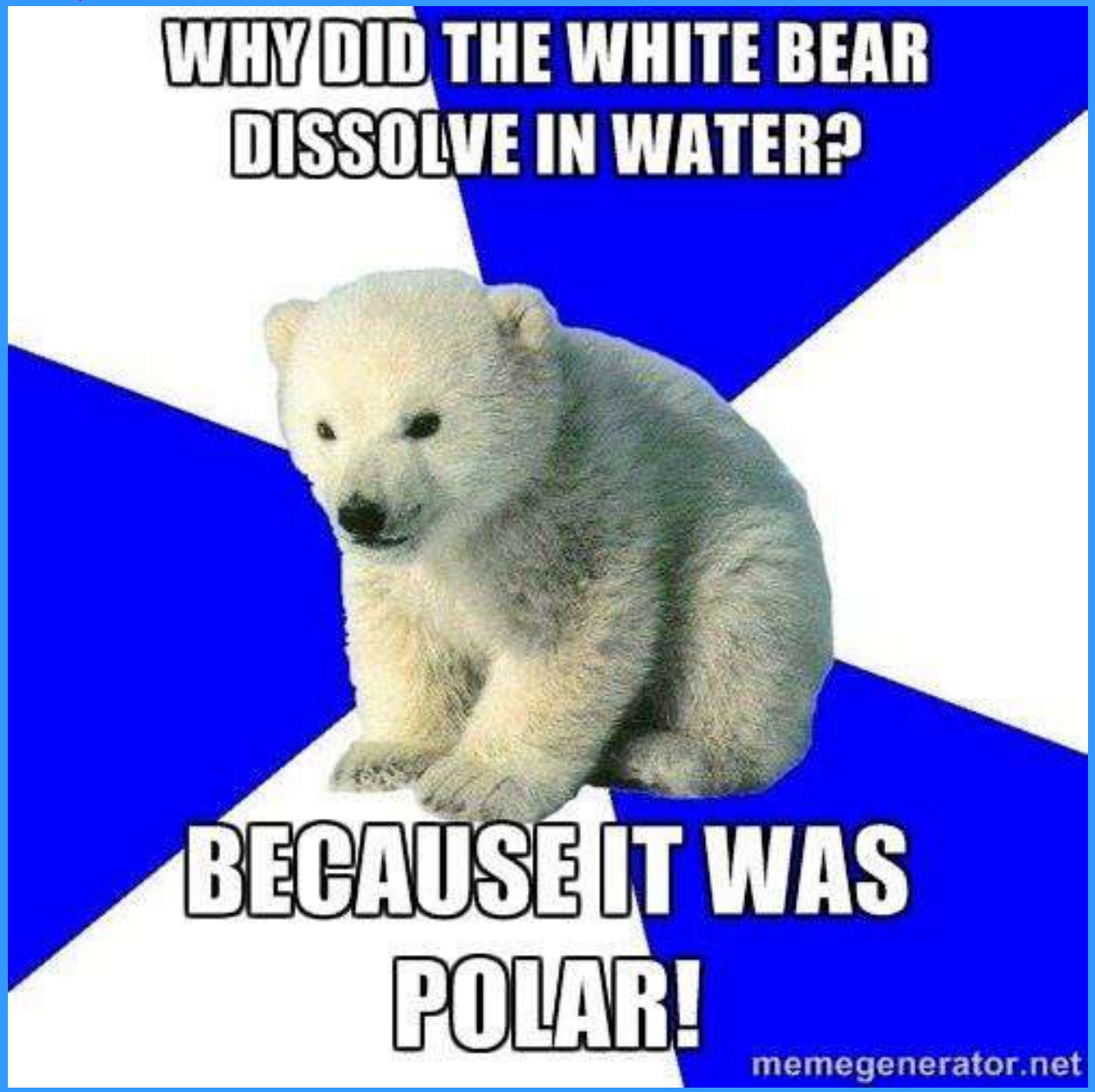
So…ADENINE and GUANINE are purines

Essential Knowledge IST 1.L.1.

a. Purines (G and A) have a double ring structure.

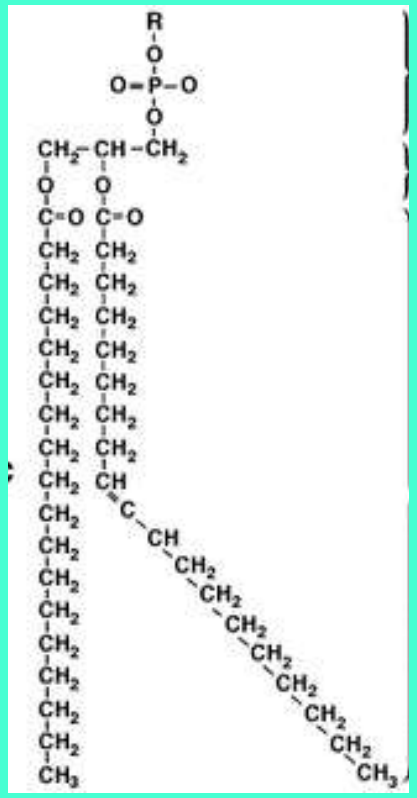
b. Pyrimidines (C, T, and U) have a single ring structure.

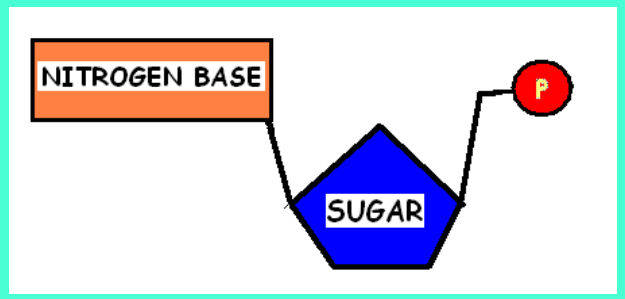
https://www.pinterest.com/pin/503137208171301 26/

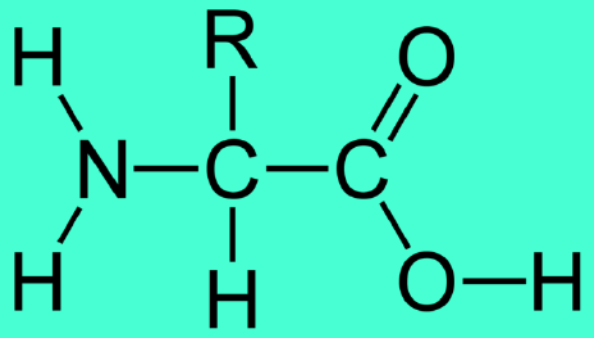


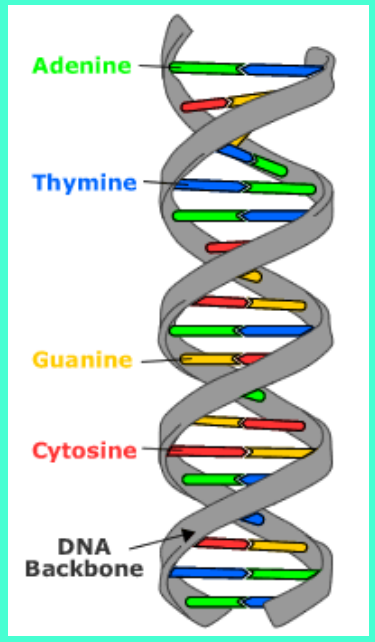
Take a break!

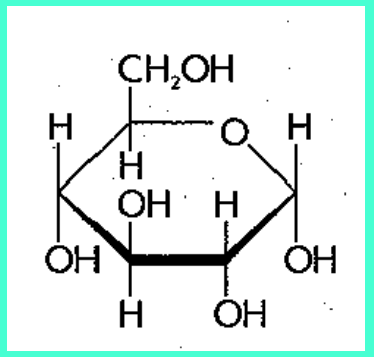
Which of these molecules could be used to make glycogen or starch?











SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.
SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules"

Images from: http://ppt.wz51z.com/PMP2/Science.To.WebText/animations/science/chemistry_physics/vp_beaker_bubbles_steam.htm
http://nobel.scas.bcit.ca/debeck_pt/science/images/blue_bubbling_liquid.gif
http://ps205.org/wp-content/uploads/2010/09/beaker_red_liquid_bubbling_sm_wht.gif

Which is acidic?
EXPLAIN YOUR ANSWER

pH 4
A

pH 7
B

pH 9
C

A has a pH <7

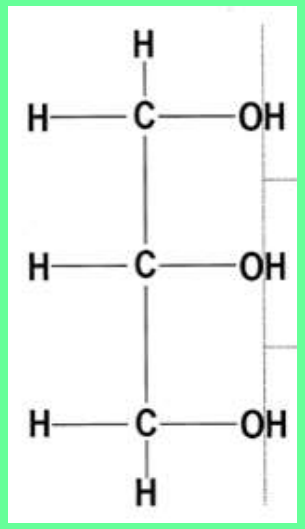
pH < 7 is acidic
pH 7 = neutral
pH > 7 is basic

SP 1.A Describe biological concepts or processes

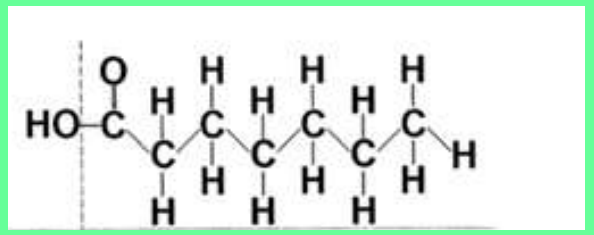
Molecule cut outs from Kim Foglia http://explorebiology.com/apbiology/labs/

Draw a picture showing how these components could be used to make a FAT molecule.

glycerol

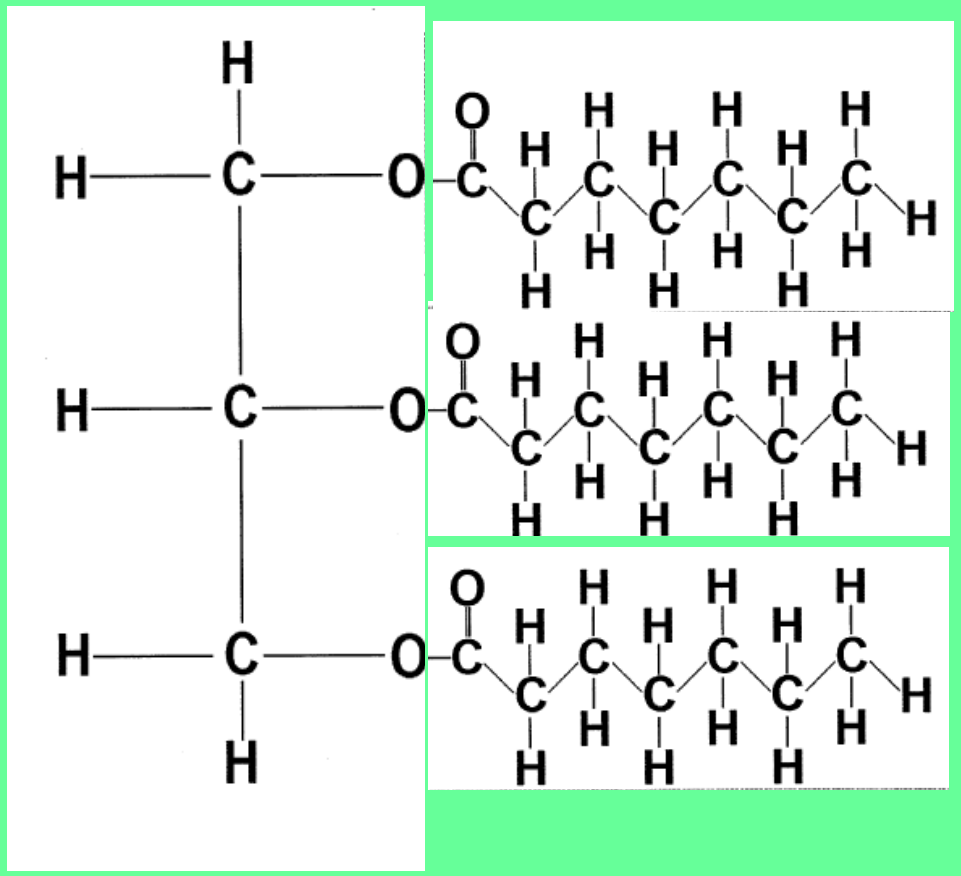


Fatty acid- long carbon chains can vary in length



Molecule cut outs from Kim Foglia http://explorebiology.com/apbiology/labs/

Draw a picture showing a FAT molecule. What kind of reaction joins the "pieces"?



Joined by dehydration synthesis

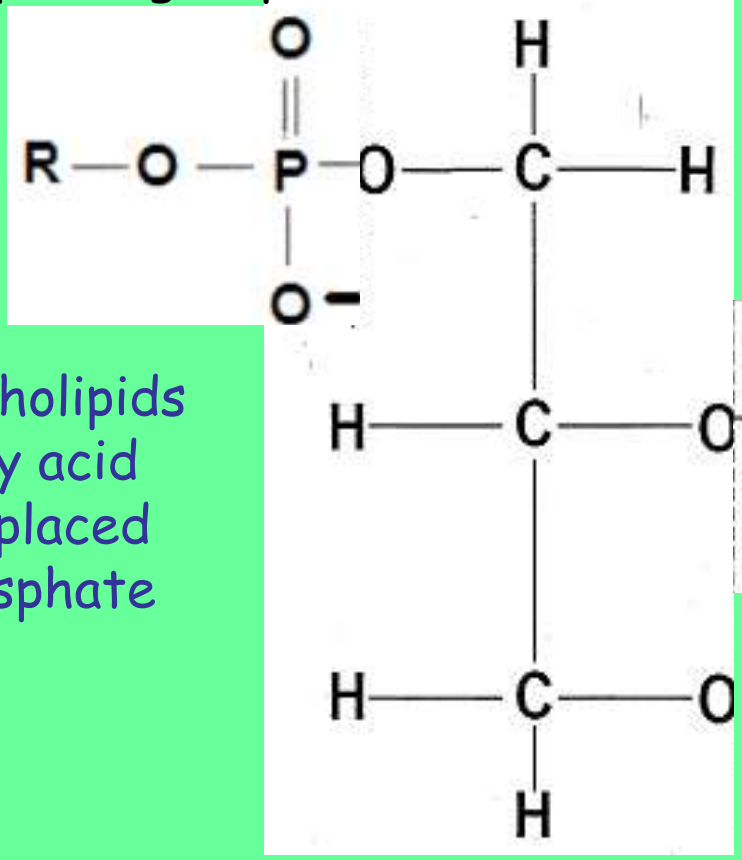
1 GLYCEROL + 3 FATTY ACIDS

Molecule cut outs from Kim Foglia http://explorebiology.com/apbiology/labs/

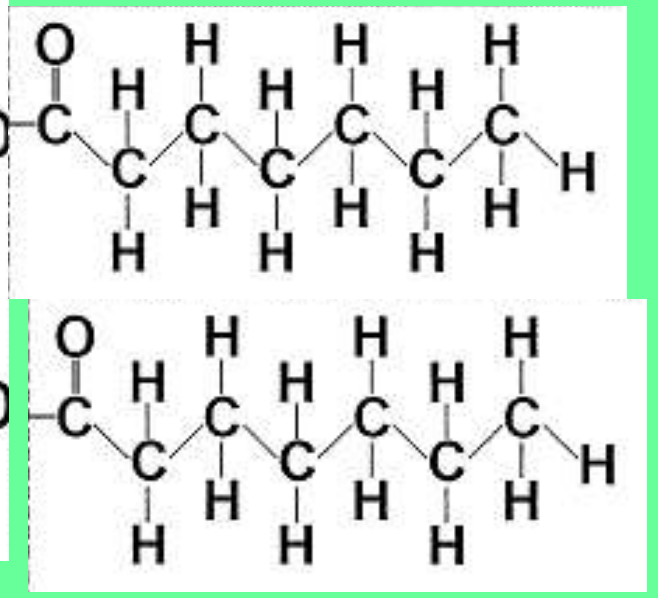
How is a fat different than a phospholipid?

Glycerol

phosphate group



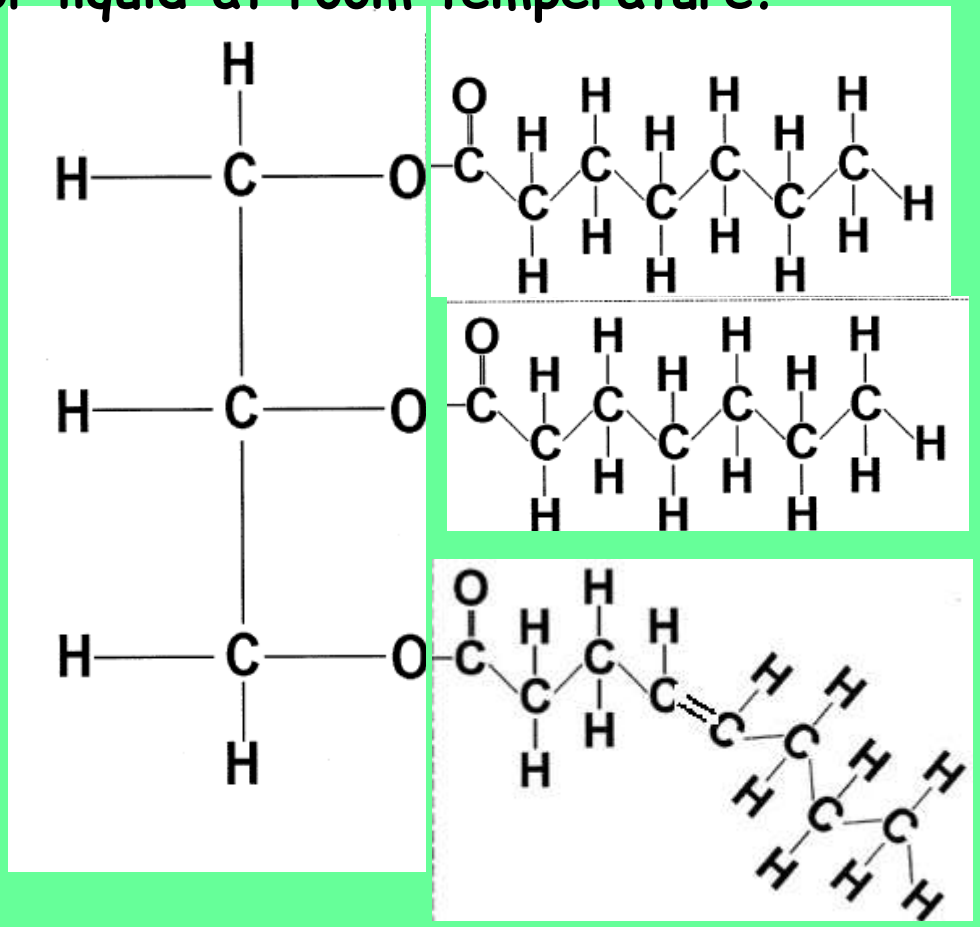
2 fatty acids



In Phospholipids one Fatty acid tail is replaced by a phosphate group

Molecule cut outs from Kim Foglia http://explorebiology.com/apbiology/labs/

How does adding unsaturated fatty acid tails change whether the fat is solid or liquid at room temperature?



UNSATURATED FA's have a double bond that puts "kinks" in tails

Can't pack as tightly.

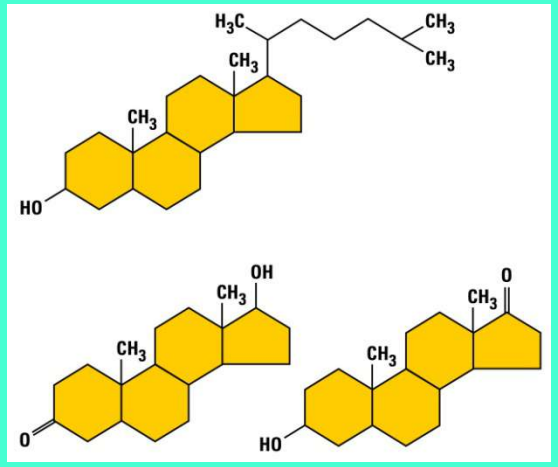
UNSATURATED Fats = liquid at room temperature.
Saturated fats = solid at room temperature.

SYI 1. B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers
SYI 1.B.2.d i. Differences in saturation determine the structure and function of lipids.
ii. Phospholipids contain polar regions that interact with other polar molecules, such as water, and with nonpolar regions that are often hydrophobic.
SP 2. A. Describe characteristics of a biological concept, process or model represented visually.

Image from: http://media.pearsoncmg.com/bc/bc_campbell_essentials_2/cipl/03/HTML/source/03-16-steroids-nl.htm

Name the kind of lipid joined in rings instead of chains made mainly from carbon and hydrogen that can be found in animal cell membranes and can act as hormones

steroids



Essential knowledge ENE 1.A Describe the composition of macromolecules required by living organisms .

One way to identify specific molecules that are too small to be seen is to "tag" them with radioactive isotopes.

Name some kinds of macromolecules that would be labeled by the addition of ^{35}S

Proteins (The amino acid cysteine that makes disulfide bridges contains sulfur)

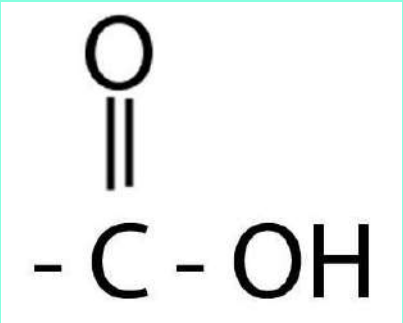
See a video

ESSENTIAL KNOWLEDGE
ENE 1.A. Describe the composition of macromolecules required by living organisms
ENE 1.A. 2. Atoms and molecules from the environment are necessary to build new molecules
SP 1 C.Explain biological concepts, processes, and/or models in applied contexts.

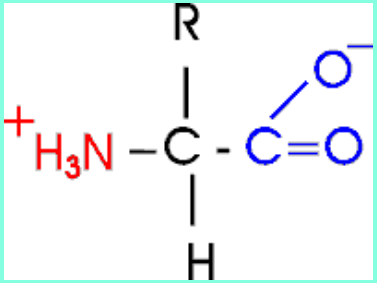
Images from: http://classconnection.s3.amazonaws.com/1522/flashcards/716539/jpg/carboxyl-functional-group.jp
http://ccnmtl.columbia.edu/projects/biology/lecture4/images/aacharched.3.gif

Name this functional group

carboxyl



How does adding this group change an organic molecule?



Makes it more polar

Makes it more acidic (can lose H^+ ion)

which gives it a slight negative charge

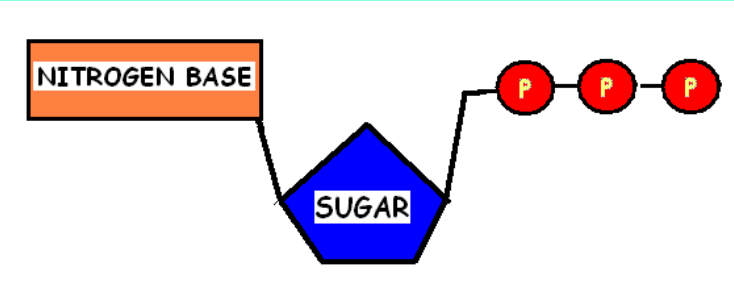
Essential knowledge

SYI 1.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule.

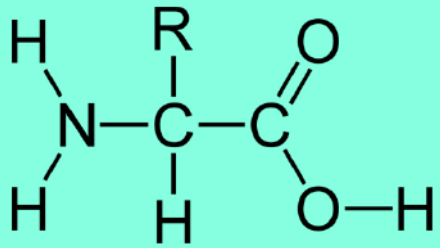
Match the building block with the molecule it makes.

proteins nucleic acids lipids carbohydrates

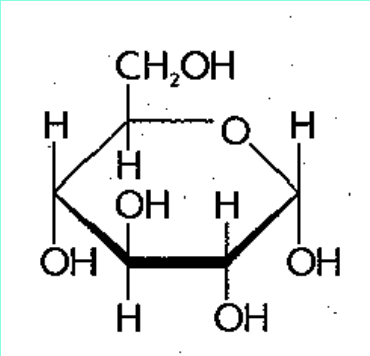
Nucleotide and amino acid images by Riedell



Nucleic acids



Proteins



Carbohydrates

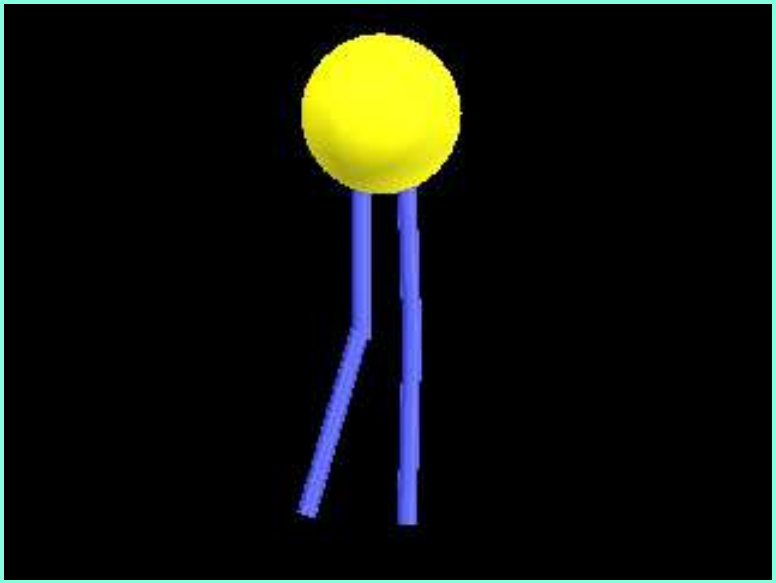
SYI 1.C.1

a. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose or ribose), a phosphate, and a nitrogen base (adenine, thymine, guanine, cytosine, or uracil).

c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain

e. Carbohydrates comprise linear chains of sugar monomers connected by covalent bonds.

The blue part of this phospholipid molecule is Non-polar



polar non-polar

The tails on this molecule are hydrophobic

hydrophilic hydrophobic

ESSENTIAL KNOWLEDGE
SYI 1.B.2 d. Lipids are nonpolar macromolecules—
ii. Phospholipids contain polar regions that interact with other polar molecules, such as water, and with nonpolar regions that are often hydrophobic.

The carbohydrate molecule that cells burn to release energy is _____.

glucose

Give an example of a monosaccharide

Glucose, galactose, fructose, ribose, deoxyribose,

Vocab

Not all but many carbohydrate names share the suffix -OSE

Not all but many enzyme names share the suffix -ASE

Describes molecules that try to stay away from water or other polar molecules

Hydrophobic; non-polar

Scale used to measure acidity

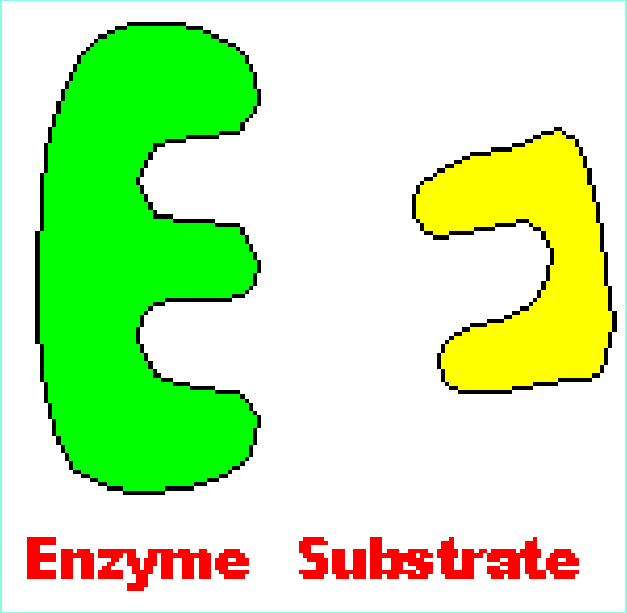
pH

Vocab

http://www.biologie.uni-hamburg.de/b-online/library/cat-removed/enzyme_.gif

Molecules that act as enzymes are

A. lipids
B. carbohydrates
C. proteins
D. nucleic acids

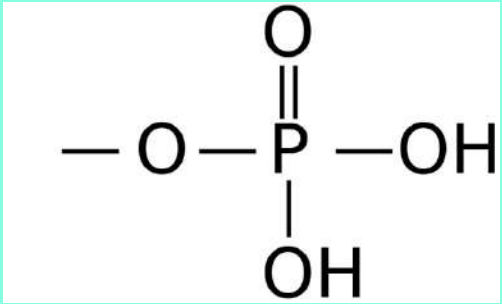


SP 2 A Describe characteristics of a biological process, or model, represented visually.

Images from: https://commons.wikimedia.org/wiki/File:Phosphate_Group.svg
https://s3.amazonaws.com/classconnection/220/flashcards/1019220/png/phosphate_group-15257F313A80BBCEDAC.png

Name this functional group

phosphate

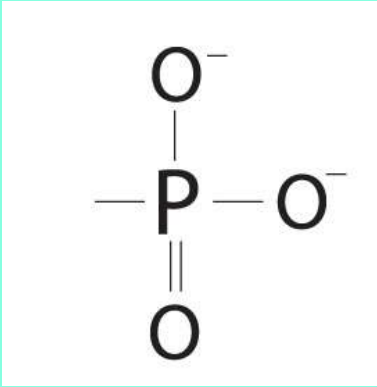


How does adding this group change an organic molecule?

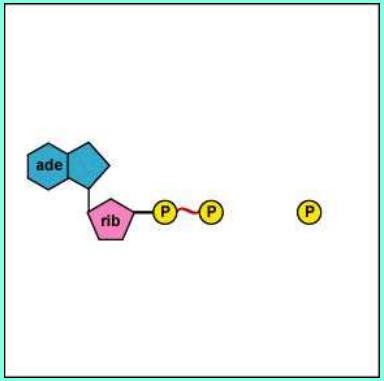
Makes it more polar

Makes it more acidic (can lose H^+ ions)

which gives it a slight negative charge



Adding a phosphate group to ADP stores energy as ATP



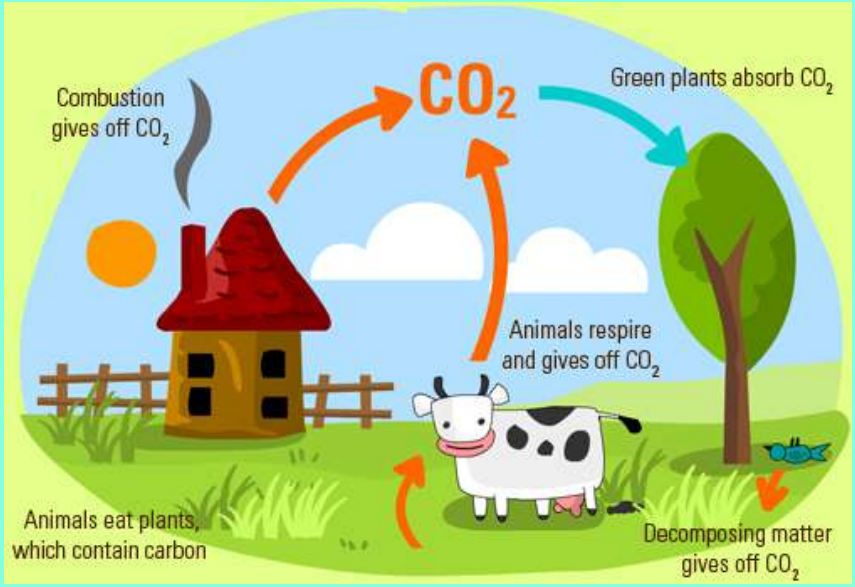
Essential knowledge

SYI 1.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule.

Explain how carbon moves from living things back into inorganic molecules in the ecosystem during the carbon cycle.

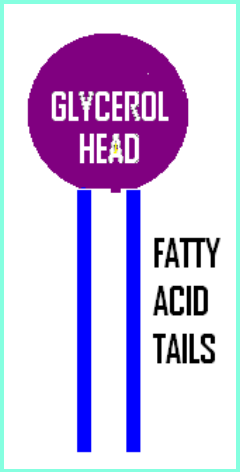
CO_2 is released into atmosphere during cellular respiration and decomposition.

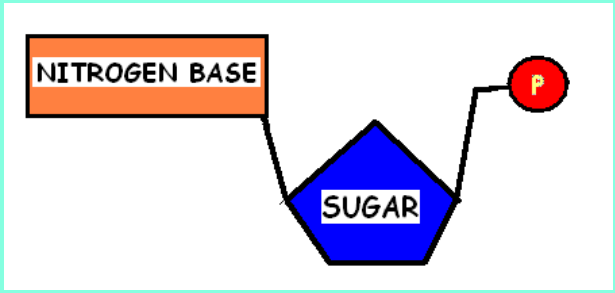
Carbon is returned to the soil when living things release waste or die/decompose

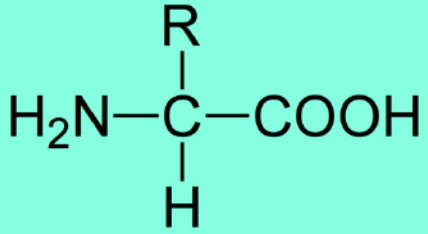


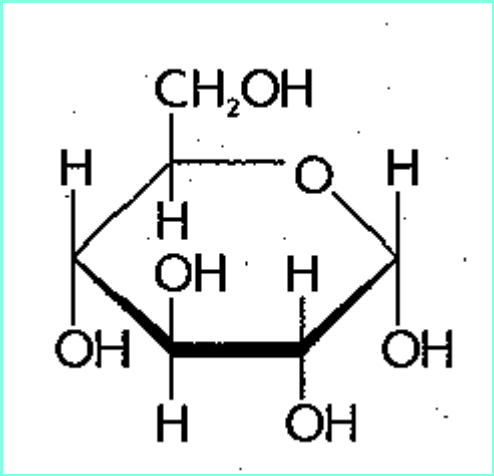
ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization
ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules.
a. Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms.

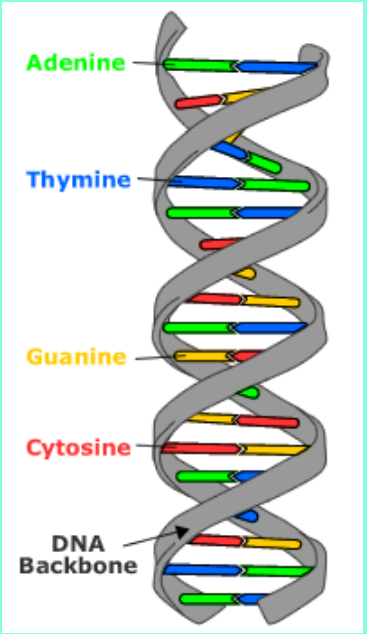
Which of these molecules could be used to make an RNA molecule?











Essential Knowledge

SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled.

SAMPLE ACTIVITY p 35 CED "Use pictures of biological molecules to find patterns in the molecules

Disaccharides are carbohydrates made from 2 sugar molecules

Give an example of a disaccharide you learned about

Sucrose (table sugar)
Lactose (milk sugar)

Vocab

One way to identify specific molecules that are too small to be seen is to "tag" them with radioactive isotopes.

Name some kinds of macromolecules that would be labeled by the addition of ^{13}N

Nitrogen is found in proteins and nucleic acids .

ESSENTIAL KNOWLEDGE

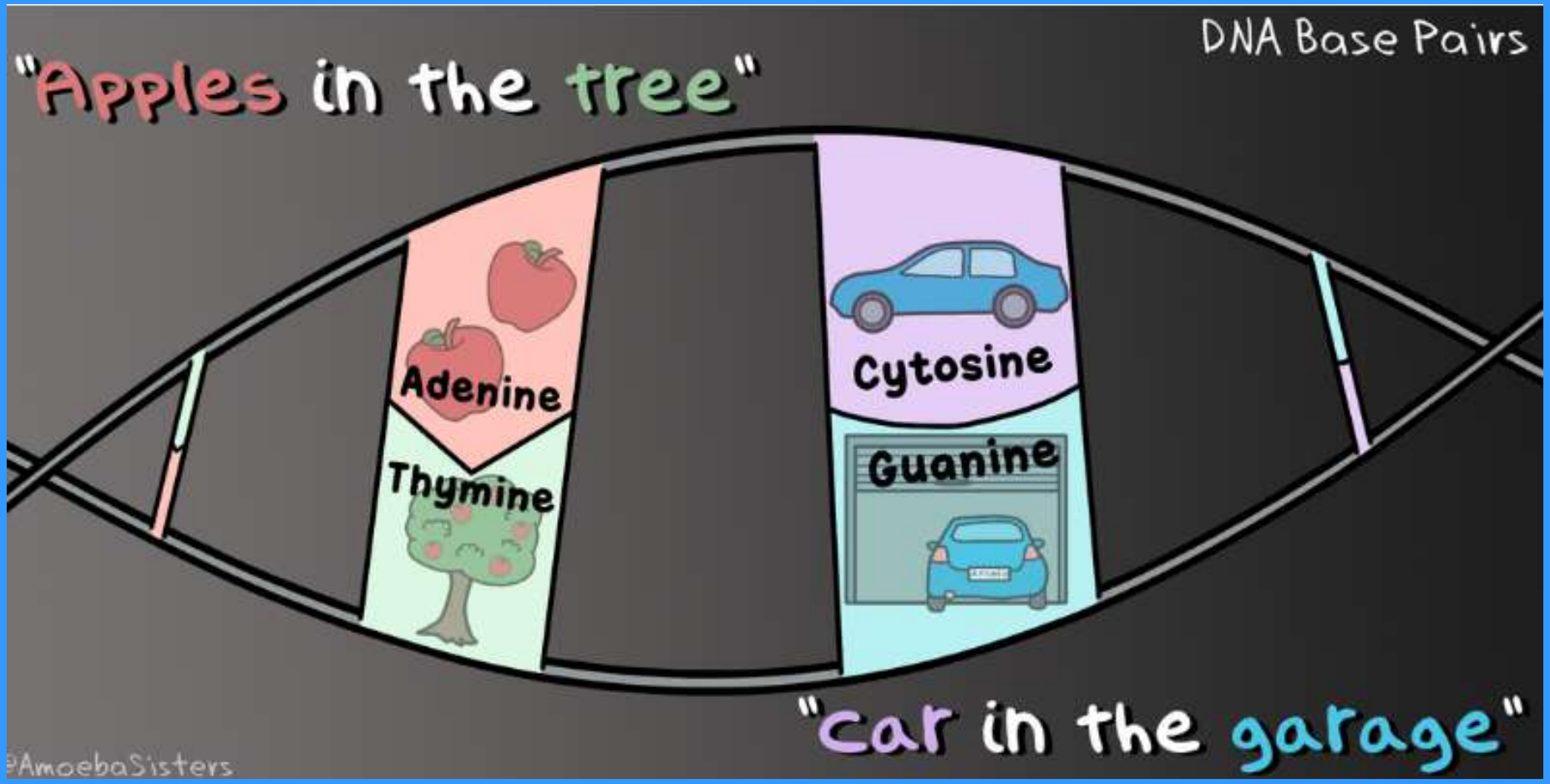
ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules-

b. . Nitrogen is used to build proteins and nucleic acids

SP 1 C. Explain biological concepts, processes, and/or models in applied contexts.

http://www.amoebasisters.com/parameciumparlorcomics



Take a break!

Images from: https://www.colourbox.com/preview/9746487-the-structural-formula-of-cellulose-polymer.jpg
http://www.blc.arizona.edu/courses/schaffer/182/ModCarb-c.jpeg

Compare and contrast CELLULOSE and STARCH

Both are plant polysaccharides made from glucose monomers

Cellulose is structural, made from β-glucose subunits, non-digestible by animals; STARCH is for energy storage, is made from α-glucose subunits, is digestible by animals.

ENE 1.A Describe the composition of macromolecules required by living organisms
SYI 1.B.2 c. Complex carbohydrates comprise sugar monomers whose structures determine the properties and functions of the molecules
ILLUSTRATIVE EXAMPLE- Cellulose versus starch versus glycogen.

Name the 2 kinds of nucleic acids you learned about.

DNA and RNA

Give an example of a polysaccharide

Cellulose, glycogen, starch

Vocab

ILLUSTRATIVE EXAMPLE- Cellulose versus starch versus glycogen.

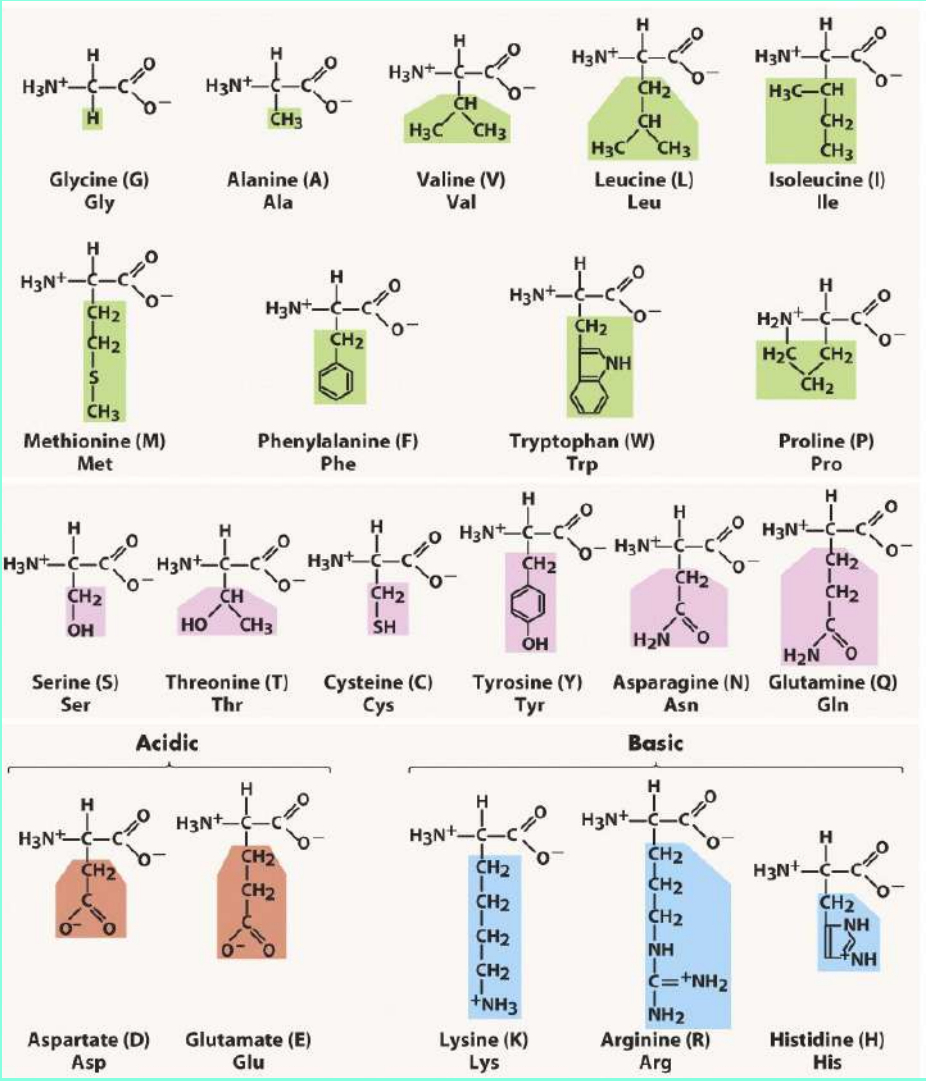


Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg

Which of these amino acids have R groups that would be attracted to lysine in the tertiary structure of a protein?

Aspartate and glutamate

Which of these amino acids would probably end up on the inside of a protein when it folds into its 3D shape?

Glycine, alanine, valine, leucine, isoleucine, methionine, phenylalanine, tryptophan, proline

SYI .C Explain biological concepts, processes, and/or models in applied contexts

SYI 1 B. 2 b. 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

SP 2 A Describe characteristics of a biological process, or model, represented visually.

Name the structural polysaccharide used to make plants sturdy

cellulose

Special kind of nucleotide used by cells to store the energy released from burning glucose.

ATP

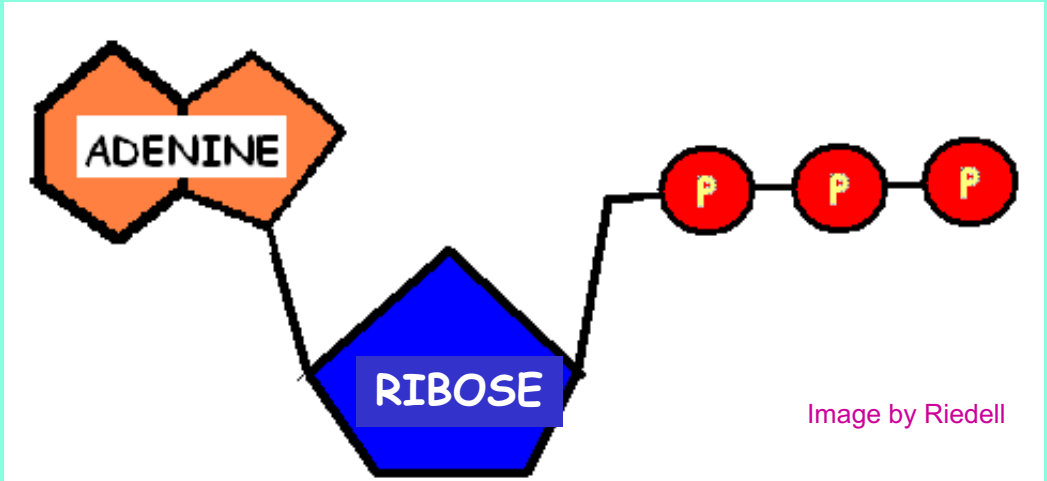


Image by Riedell

One way to identify specific molecules that are too small to be seen is to "tag" them with radioactive isotopes.

Name some kinds of macromolecules that would be labeled by the addition of ^{32}P

Nucleic acids (DNA, RNA)
phospholipids
ATP

ESSENTIAL KNOWLEDGE
ENE 1.A.1 *Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.*
ENE 1.A.2 *Atoms and molecules from the environment are necessary to build new molecules..*
b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids
SP 1 C. Explain biological concepts, processes, and/or models in applied contexts.

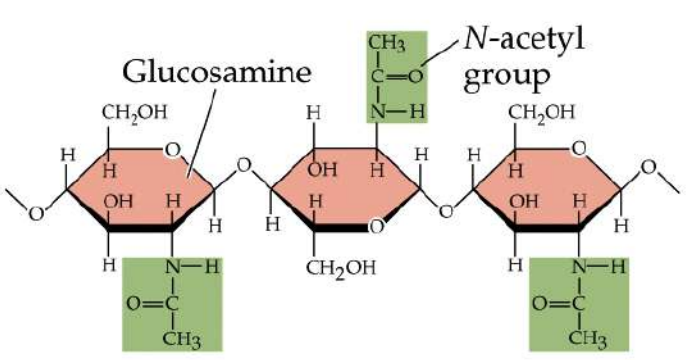
Images from: https://www.colourbox.com/preview/9746487-the-structural-formula-of-cellulose-polymer.jpg
http://www.blc.arizona.edu/courses/schaffer/182/ModCarb-c.jpeg

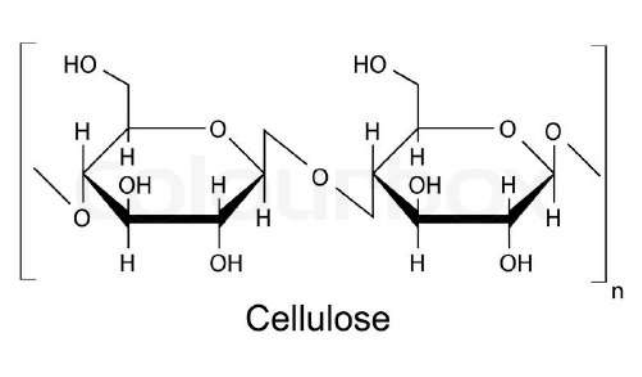
Compare and contrast CHITIN and CELLULOSE

Both are structural polysaccharides made from the same β-glucose monomers

Chitin has nitrogen groups attached to its β-glucose monomers.

Cellulose is found in plant cell walls; chitin in fungi cell walls and in exoskeletons of arthropods





ESSENTIAL KNOWLEDGE
ENE 1.A Describe the composition of macromolecules required by living organisms
SYI 1.B.2 c. Complex carbohydrates comprise sugar monomers whose structures determine the properties and functions of the molecules.

What ratio of carbon, hydrogen, and oxygen atoms is seen in simple carbohydrates?

1:2:1; 1 carbon:2 hydrogen:1 oxygen

What is the chemical formula for water?

H_2O

Vocab

A carbohydrate made by joining TWO sugar molecules

disaccharide

A short DNA segment that gives the instructions for a protein

gene

Vocab

Name the 4 main macromolecules that are important for all living things

Proteins, carbohydrates, lipids, nucleic acids

Lipids that are made of many carbon and hydrogen atoms are Non polar

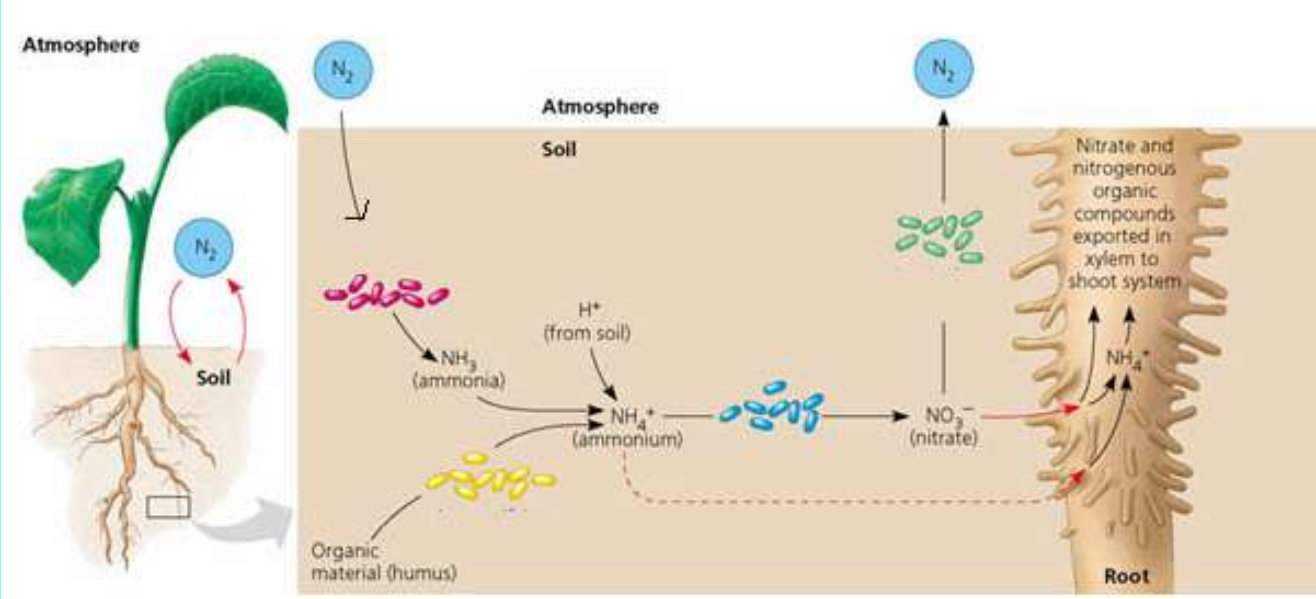
Polar non-polar

Vocab

Image from: https://classconnection.s3.amazonaws.com/346/flashcards/709346/jpg/picture11321381932244.jpg

Explain how green plants get the nitrogen they need to build biomolecules during the nitrogen cycle.

Absorbed via roots from soil made available by nitrogen fixing bacteria



ESSENTIAL KNOWLEDGE

ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules..

b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.

MOLECULES that have an uneven pattern of electric charge (more + on one side; more – on the other) are called polar.

ATOMS that have gained or lost electrons so that they have an electric charge are called ions.

In polymerization, complex molecules are formed by the joining together of

_____

A. macromolecules
B. carbohydrates
C. polymers
D. monomers

SYI 1. B Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.
1. Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.

Images from: http://ppt.wz51z.com/PMP2/Science.To.WebText/animations/science/chemistry_physics/vp_beaker_bubbles_steam.htm
http://nobel.scas.bcit.ca/debeck_pt/science/images/blue_bubbling_liquid.gif

Which contains more H^+ ions?
What is the $[H^+]$ in solution A and B?

pH 2
A

pH 8
B

A contains more H^+ ions

pH = -log[H+]
pH 2 has 1 X 10^{-2} or 0.01 H^+ per liter (0.01 M)
pH 8 has 1 X 10^{-8} or 0.00000001 H^+ per liter

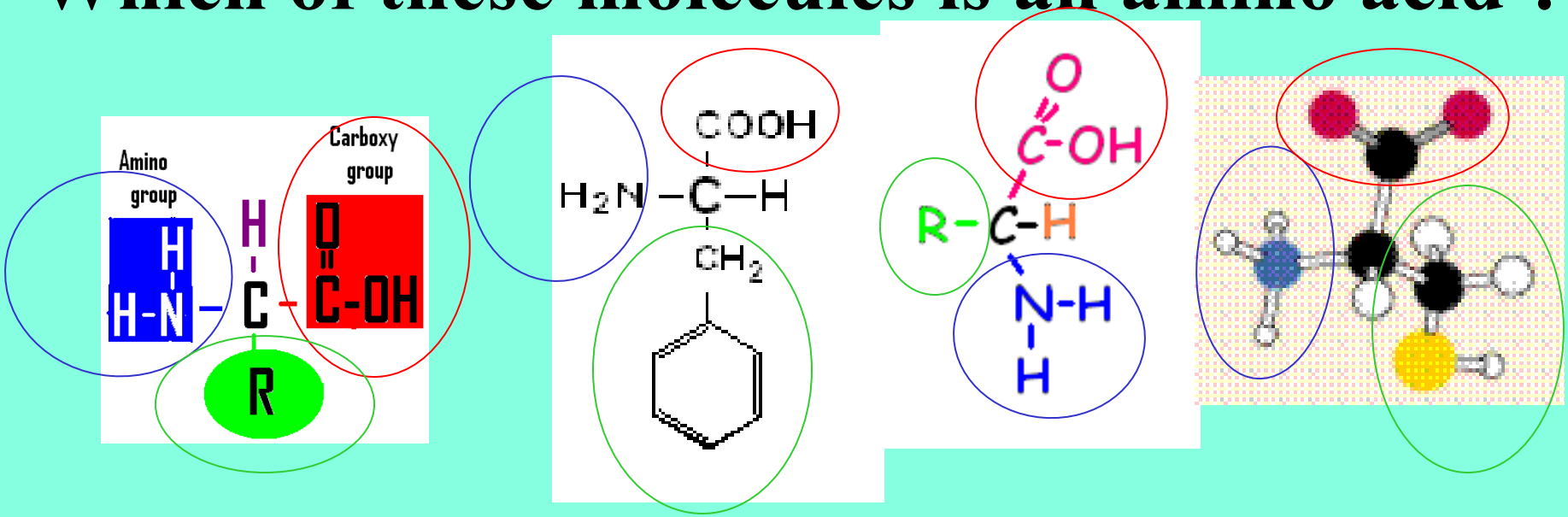
HEMOGLOBIN that carries oxygen in your blood, INSULIN that helps cells store sugar, and DIGESTIVE ENZYMES are all _____proteins_____.

Proteins carbohydrates nucleic acids lipids

Glucose is a _____carbohydrate_____.

Protein carbohydrate nucleic acid lipid

Which of these molecules is an amino acid ?



Look closely! They all are.
Look for the groups
on the center carbon: Amino, carboxyl, R

ESSENTIAL KNOWLEDGE
ENE 1.A Describe the composition of macromolecules required by living organisms .
SYI 1.B.2 b. 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.
SP 2 A Describe characteristics of a biological process, or model, represented visually.

Which of the following is TRUE?

Simple sugars are made of polysaccharides.

FALSE Simple sugars are monosaccharides.
Polysaccharides are complex carbo's made of many sugars.

RNA molecules are made of amino acids.

FALSE RNA is made of nucleotides
Proteins are made of amino acids

Amino acids are made of proteins

FALSE Proteins are made of amino acids

Glycogen, starch, and cellulose are made of glucose.

TRUE

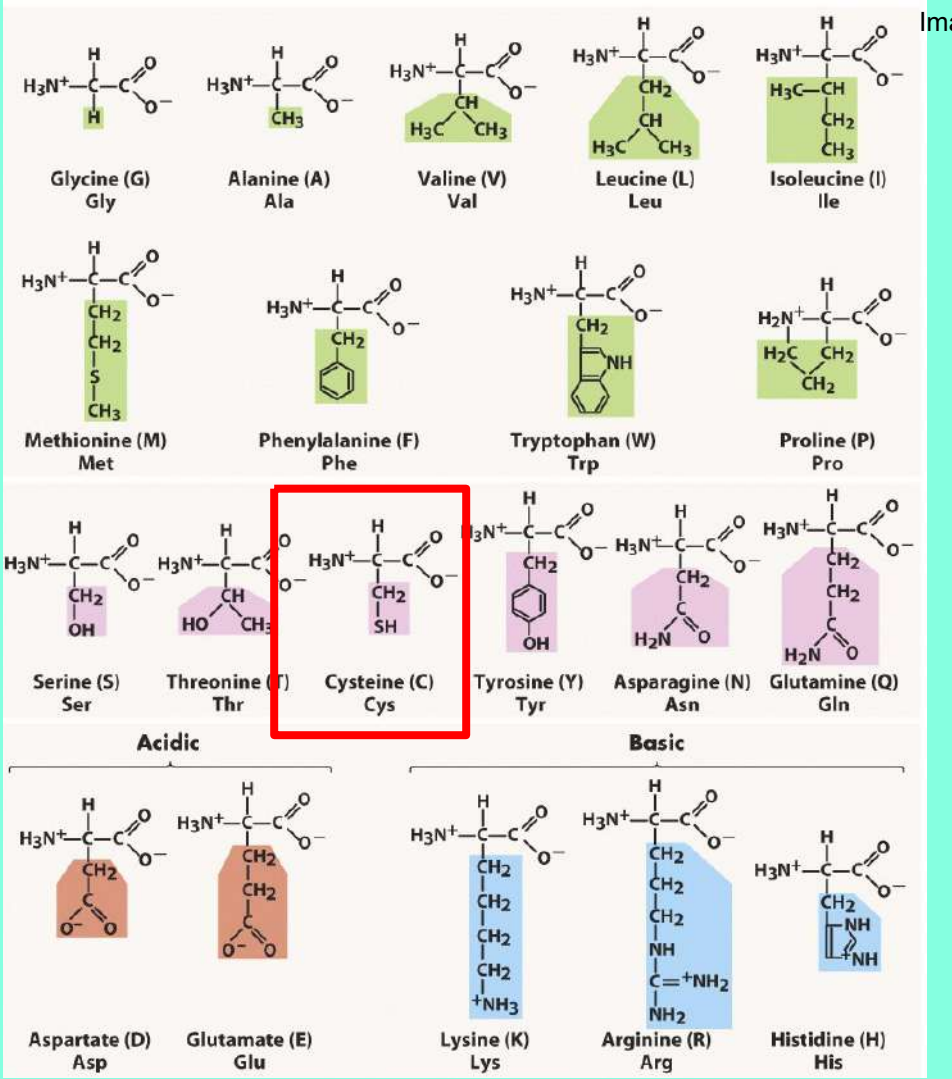


Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg

Which of these amino acids can form disulfide bridges to stabilize the tertiary structure in a protein?

Cysteine contains sulfur in its R group, so it can form disulfide bridges with other cysteines.

Methionine has a sulfur but it is not at the end of the chain.

SYI 1 B. 2 **b. 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**

SYI 1. C **Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule**

SP 1 Explain biological concepts , processes, and models presented in written format.

1.C Explain biological concepts, processes, and/or models in applied contexts

.

Give a function for nucleic acids in cells

Store genetic info (DNA)
transfer info from DNA to cell (RNA)
protein synthesis (RNA)

Name an ion that's important in living cells.

Sodium (Na^+)
Calcium (Ca^{++})
Potassium (K^+)
Chloride (Cl^-)
Hydrogen (H^+)

ESSENTIAL KNOWLEDGE
IST 1.K.1 DNA, and in some cases RNA, is the primary source of heritable information
IST 1.K.2 . Genetic information is transmitted from one generation to the next through DNA or RNA—
a . Genetic information is stored in and passed to subsequent generations through DNA molecules and, in some cases, RNA molecules.

Name some ways DNA and RNA are different

DNA	RNA
double stranded	single stranded
deoxyribose sugar	ribose sugar
A,T, G, C	A, U, G, C
No uracil	No thymine
stores genetic info	carries info to ribosomes; protein synthesis

Essential knowledge IST 1.A. 4

DNA and RNA molecules have structural similarities and differences related to their function—

a. 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.

b. The basic structural differences between DNA and RNA include the following:

i DNA.contains deoxyribose and RNA contains ribose.

ii. RNA contains uracil and DNA contains thymine.

iii. DNA is usually double stranded; RNA is usually single stranded.

The subunits that make nucleic acids are called nucleotides.

Glucose, sucrose, glycogen, and starch are all examples of carbohydrates.

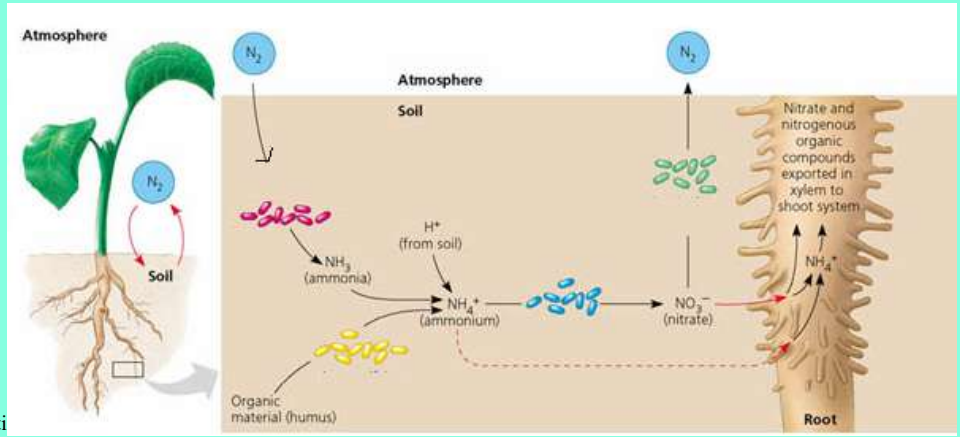
Image from: https://classconnection.s3.amazonaws.com/346/flashcards/709346/jpg/picture11321381932244.jpg

The process by which N_2 gas is changed into a form that plants can use is called

Nitrogen fixation

Which group of organisms are responsible for this process?

Nitrogen fixing bacteria that live in the soil and form symbiotic relationships with legumes change nitrogen into ammonia. Nitrifying bacteria can change ammonia into nitrates/nitrites



ESSENTIAL KNOWLEDGE

ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organizati

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules..

b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.

Carbon is an important atom to living things because it can form bonds with 4 other atoms at once to make chains, rings, and many different kinds of molecules.

Name 4 of the 6 atoms important for making molecules used in cells.

CHNOPS-
Carbon, hydrogen, nitrogen, oxygen, phosphorus, OR sulfur

Essential knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

a. Molecules and atoms from the environment are necessary to build new molecules.

Evidence of student learning is a demonstrated understanding of each of the following:

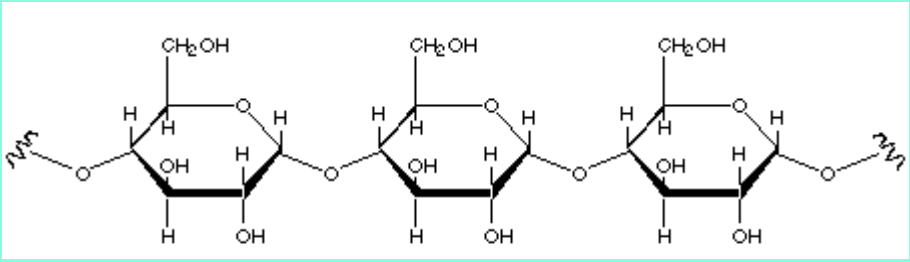
1. Carbon moves from the environment to organisms where it is used to build carbohydrates, proteins, lipids or nucleic acids.

Double stranded nucleic acid molecule containing A, T, C, G nitrogen bases found in chromosomes that stores genetic information

DNA

Macromolecule made by joining MANY sugar molecules together in a chain

polysaccharide



http://web.mit.edu/esgbio/www/lm/sugars/sugars.html

Amino acid subunits join together to make proteins

Lipids carbohydrates nucleic acids proteins

Adenine, Thymine, Cytosine, Guanine, and Uracil are used to make Nucleotides

polysaccharides amino acids nucleotides lipids

Name 3 of the many functions of proteins that you learned about

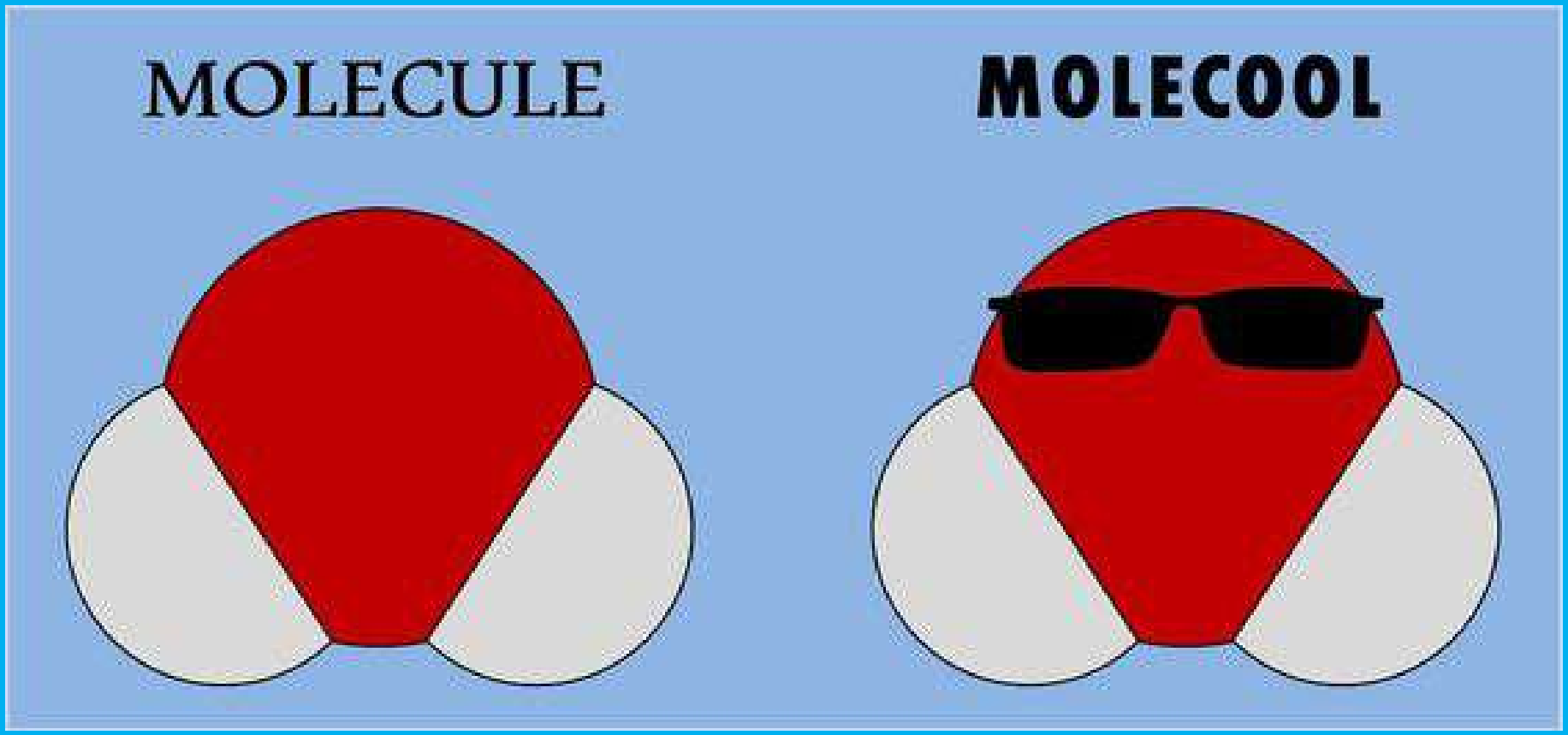
Act as enzymes
Transport (Help move substances in & out of cells) Help
Synthesize other proteins (part of ribosomes)
Movement (make up muscles, cytoskeleton, cilia/flagella)
Act as hormones (insulin)
Help cells recognize self (glycoproteins)
Structural (make cell membranes)
Fight germs (antibodies)
Carry oxygen in blood cells (hemoglobin)
Control blood sugar (insulin)

There are many more . . .

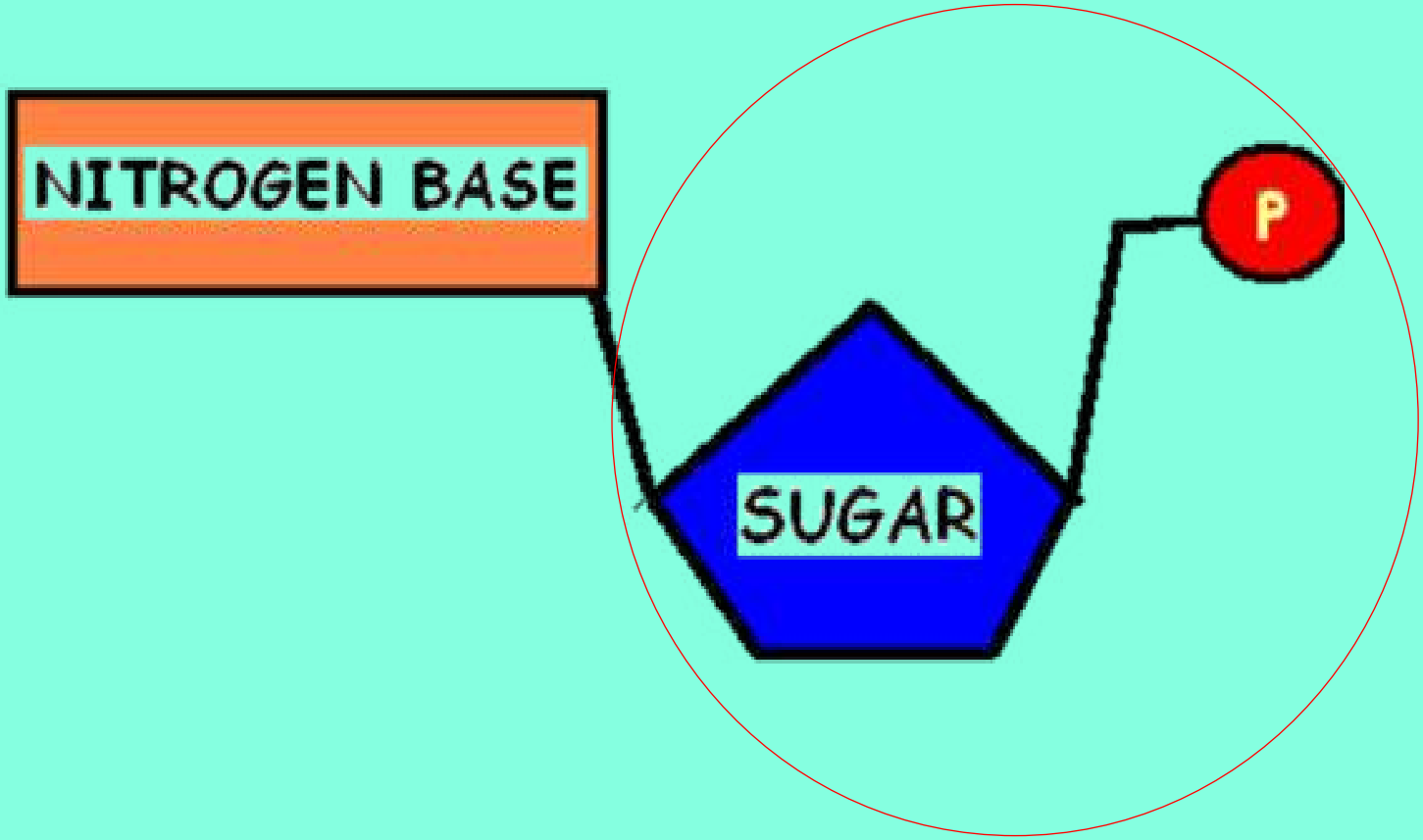
SP 1 C. Explain biological concepts, processes, and/or models in applied contexts

http://img1.rnkr-static.com/list_img_v2/7630/2427630/full/funny-science-puns.jpg

Take a break!



Circle the parts of this subunit that make the backbone of a DNA molecule



IST 4.A.1.a. 1. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose or ribose), a phosphate and a nitrogen base (adenine, thymine, guanine cytosine, or uracil). DNA and RNA differ in function and differ slightly in structure, and these structural difference account for the differing functions.

IST 3.A.1.b DNA and RNA molecules have structural similarities and differences that define function.

2. The basic structural differences include:

I DNA contains deoxyribose (RNA contains ribose)

Ii RNA contains uracil in lieu of thymine in DNA

Give an example of a molecule found in cell membranes that might have sugars attached

glycoprotein or glycolipid

Give an example of a disaccharide sugar

Table sugar(sucrose)
Lactose (milk sugar)

VOCAB

Name an atom found in DNA but not carbohydrates and lipids

Nitrogen OR phosphorus

Kind of chemical reaction used to join subunits when making polysaccharides, proteins, and nucleic acids

Dehydration synthesis

Vocab

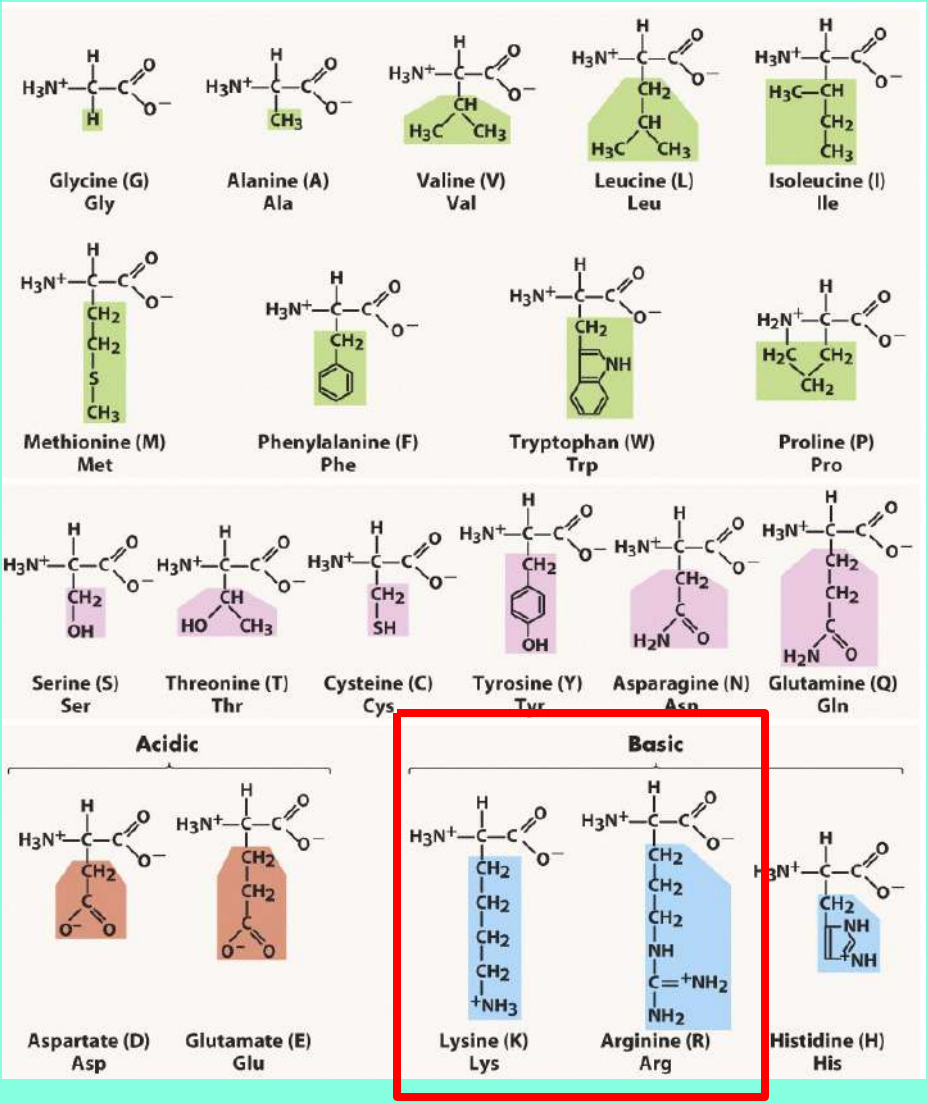
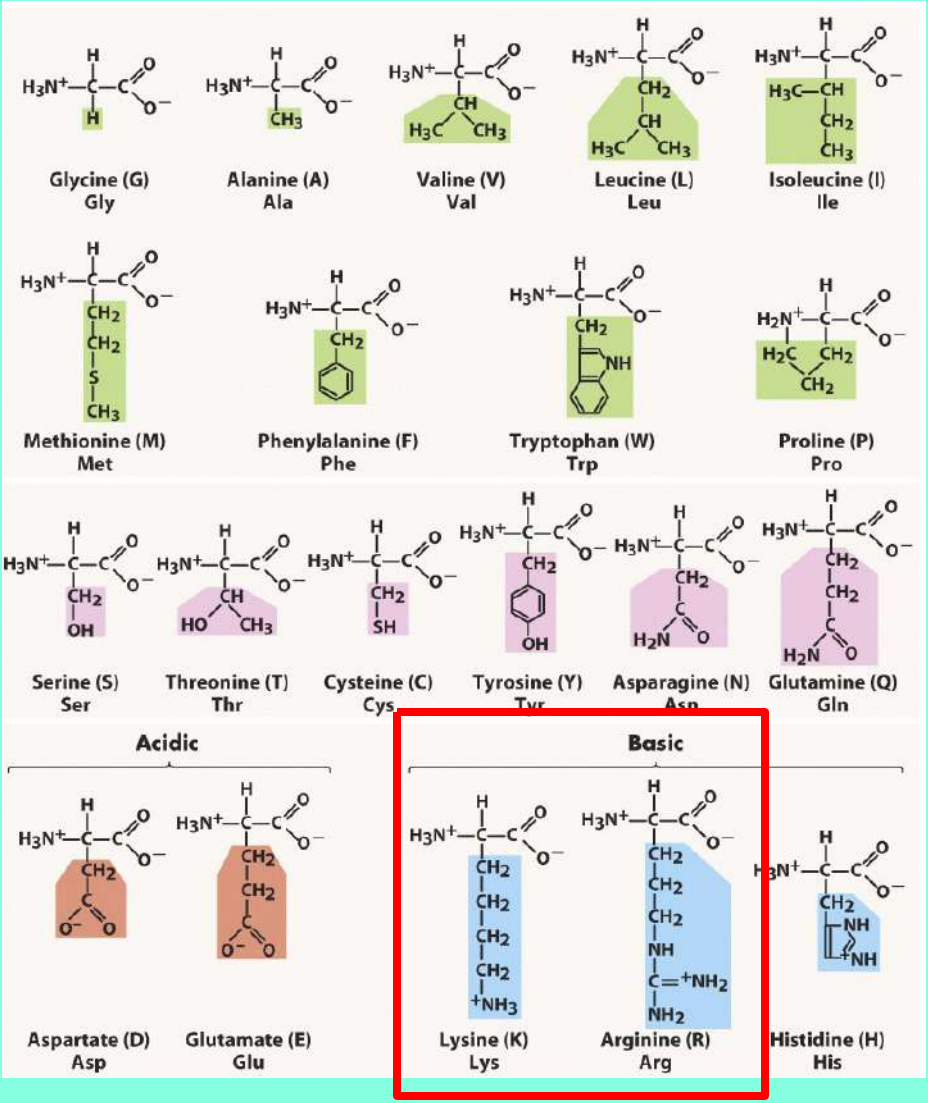


Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg

Mutations can change the amino acid sequence in a protein. PREDICT how replacing lysine with arginine might affect the secondary structure of a protein?

Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg



Impact would probably be minimal.

The shapes and charges of lysine and arginine are similar and R groups are not involved in secondary structure.

Amino and carboxyl groups in the backbone are responsible for 2° structure and these are not changed by switching the amino acid used.

ESSENTIAL KNOWLEDGE

SP 6. E. Predict the causes or effects of a change in, or disruption to one or more components in a biological system based on
b. A visual representation of a biological concept, process, or model.

SYI 1 B. 2 b. 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

SYI 1.C Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule..

SYI 1.C.1.d 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 . . .

Carbohydrate molecule like glucose that is made from only ONE sugar molecule

monosaccharide

Which ion is the pH scale used to measure?

H^+ ions

Vocab

EXPLAIN how the properties of water result in its label as the "UNIVERSAL SOLVENT"

~ **Polarity of H_2O** molecules result in their ability to dissolve many ionic and polar molecules important for living things (carbohydrates, nucleic acids, proteins, ions) that are **HYDROPHILIC**.

~ Water is major component in cytoplasm so serves as a medium for all chemical reactions to happen in cells.

~ **Cohesion of water** allows it to flow (ex blood) to transport dissolved substances throughout the body.

ESSENTIAL KNOWLEDGE
SYI 1.A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.
SYI 1.A.2 Living systems depend on properties of water that result from its polarity and hydrogen bonding
SP 1 Explain biological concepts , processes, and models presented in written format.
1.C Explain biological concepts, processes, and/or models in applied contexts

Name the only macromolecule group that is hydrophobic and not made by polymerizing monomers.

lipids

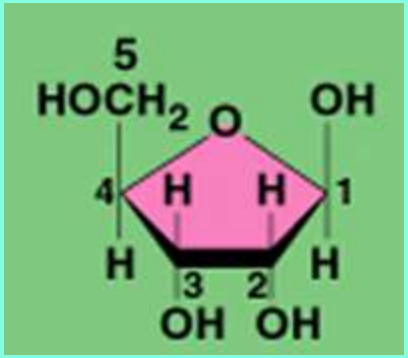
Thymine, cytosine, guanine, adenine, and uracil are

Nitrogen bases used to make nucleic acids

VOCAB

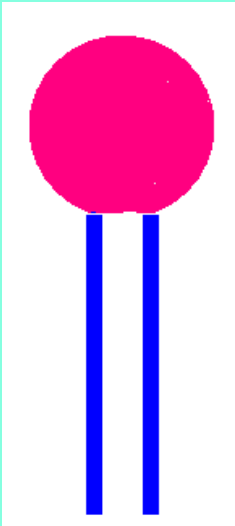
http://fig.cox.miami.edu/~cmallery/150/chemistry/fig5x27b.jpg

5 carbon sugar used to make RNA



ribose

Macromolecule made of a polar glycerol phosphate head and non- polar tails used to make cell membranes



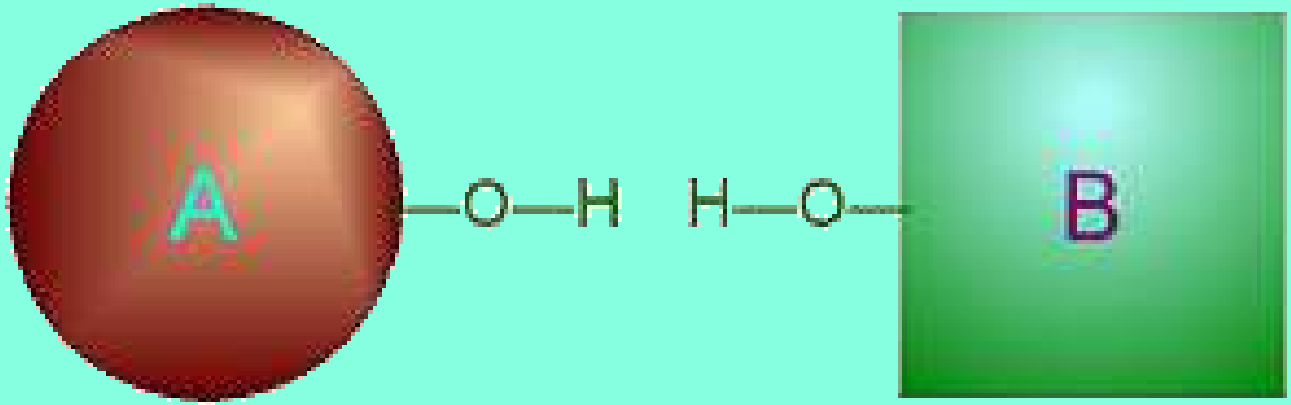
phospholipid

Image by Riedell

Vocab

Animation from: http://biologyclermont.info/wwwroot/graphics/lect1/carbon/dehydration%20anim.gif

Chemical reaction used by cells to join molecules together by removing an H and OH to make a water molecule



Dehydration synthesis

SYI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers. .

From: Biochemistry A Problems Approach Wood, Wilson, Benbow, and Hood

Match the property of water with its benefit to living things.

c Organisms are protected against freezing @ low temps

Higher heat of fusion = the more heat must be removed to freeze

e Land animals can cool themselves by surface evaporation with minimum expenditure of body fluid.

Considerable heat needed to evaporate water provided by body heat

d Membranes composed of low molecular weight, non-covalently bonded lipids are thermodynamically stable.

a Hydrophobic interactions are dependent on polarity of water

Temperature changes in organisms are minimized.

Effect of heat production/loss minimized by high heat capacity

b Aquatic environments in cold climates tend to freeze only on the surface rather than freezing solid.

Ice formed on the surface floats, insulating water below/stays liquid

a. High specific heat capacity
b. Higher density as ice
c. High heat of fusion
d. Polarity of water molecules
e. High heat of vaporization

Describes a polar molecule that mixes easily with water; means "water loving"

hydrophilic

Small unit that can join together with other small units to form polymers

monomer

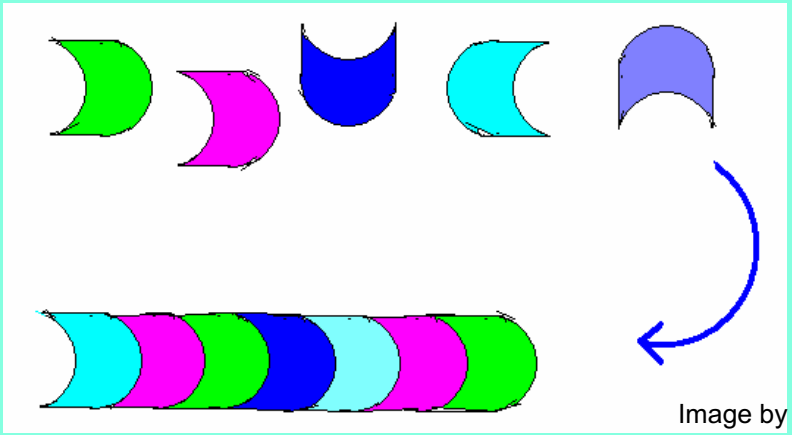


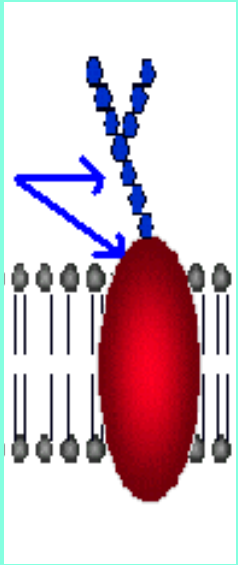
Image by Riedell

vocab

http://faculty.clintoncc.suny.edu/faculty/Michael.Gregory/files/Bio%20101/Bio%20101%20Lectures/Membranes/membrane.htm

Molecule made of a protein with carbohydrates attached found in cell membranes that helps in cell identification

glycoprotein



Protein hormone, missing in people with diabetes, that tells cells to store glucose as glycogen

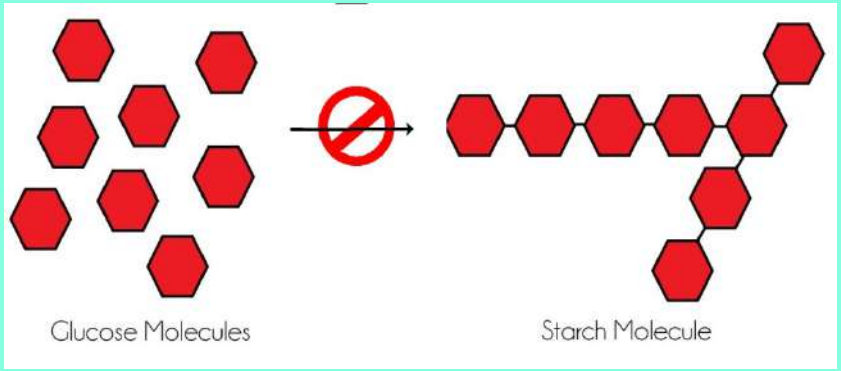
insulin

vocab

http://nourishednutrition.co.nz/wp-content/uploads/2014/05/Starch-glucose.jpg
http://www.gurneys.com/product/kandy_korn_se_sweet_corn/vegetables

"Candy Corn" is a variety of sweet corn that has been modified by geneticists to taste sweeter than other varieties because Candy Corn lacks an enzyme that "field" corn plants have. What do you think the function of this missing enzyme is in other corn plants? EXPLAIN YOUR ANSWER

"Candy corn" lacks the enzyme that joins glucose subunits to make starch. If glucose in corn is not converted to starch, it tastes sweeter.



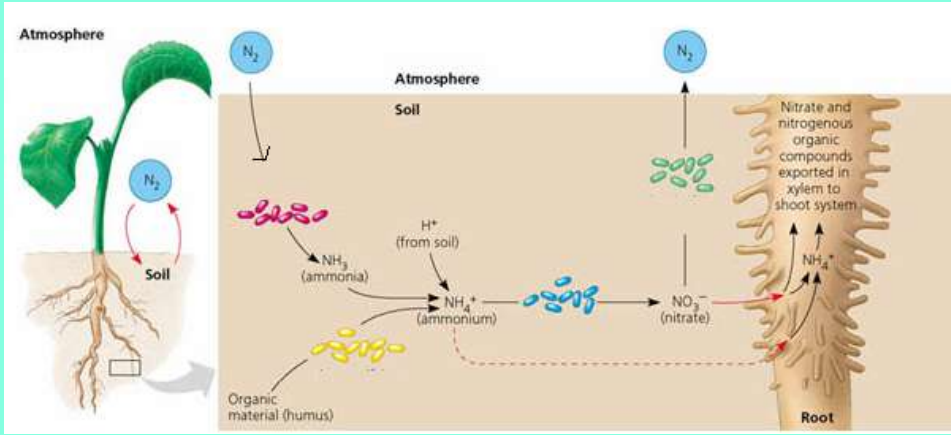
SP 1 Explain biological concepts , processes, and models presented in written format.
1.C Explain biological concepts, processes, and/or models in applied contexts

Image from: https://classconnection.s3.amazonaws.com/346/flashcards/709346/jpg/picture11321381932244.jpg

The process by which nitrates/nitrites in soil are changed into N_2 gas and returned to the atmosphere during the nitrogen cycle is called denitrification

Which group of organisms are responsible for this process?

Bacteria that live in the soil can change nitrates/nitrites into N_2 gas



ESSENTIAL KNOWLEDGE

ENE 1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.

ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules..

b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.

vocab

Protein that acts as a biological catalyst in living things to help chemical reactions happen faster

enzyme

Attraction between oppositely charged regions of nearby molecules involving the hydrogen atoms of one molecule and the partially negatively charged atoms in another molecule

Hydrogen bonds

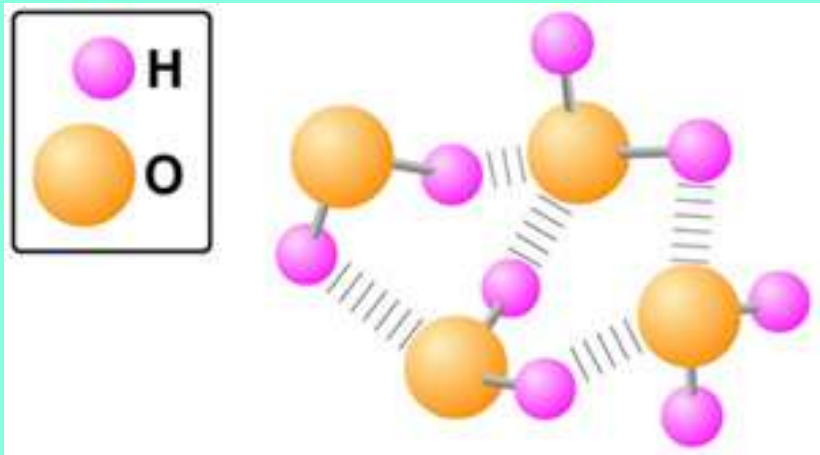


Image from: http://www.estrellamountain.edu/faculty/farabee/biobk/BioBookCHEM2.html

Images from: http://ppt.wz51z.com/PMP2/Science.To.WebText/animations/science/chemistry_physics/vp_beaker_bubbles_steam.htm
http://nobel.scas.bcit.ca/debeck_pt/science/images/blue_bubbling_liquid.gif

Which is more acidic?
How much more?
EXPLAIN YOUR ANSWER

$$pH = -\log[H^+]$$

pH 5
A

pH 7
B

Smaller pH number = more acidic;
each unit difference = 10 times more
pH 5 is 100 times more acidic than pH 7

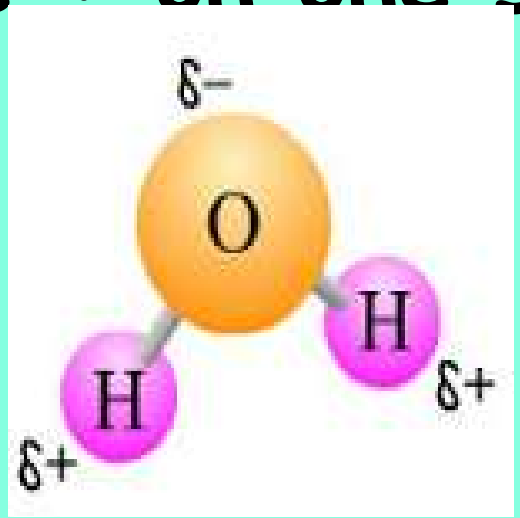
SP 1.A Describe biological concepts or processes

Macromolecule that contains carbon, hydrogen, oxygen, and nitrogen, made by joining amino acid subunits

protein

Molecule with an uneven pattern of electric charges; More + on one side/ more – on the other

polar



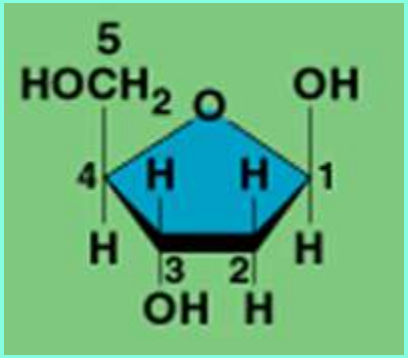
vocab

Image from: http://www.estrellamountain.edu/faculty/farabee/biobk/BioBookCHEM2.html

Image from: http://fig.cox.miami.edu/~cmallery/150/chemistry/fig5x27b.jpg

5 carbon sugar used to make DNA

deoxyribose



An atom that has gained or lost electrons so it has an electric charge

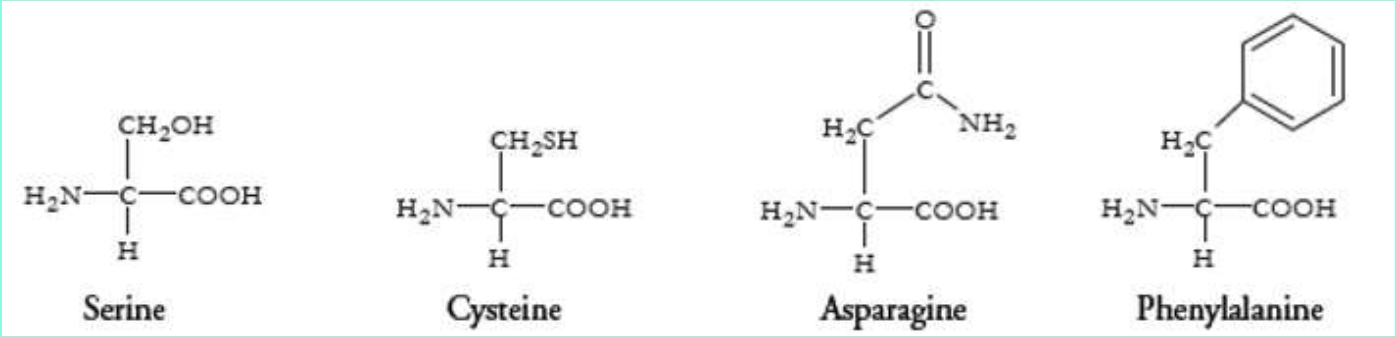
ion

Substances on the left side of a chemical equation which react

reactants

Question from Mrs. Chirby's Review posted on her website with answers https://mschirby.wordpress.com/exam-review/

Imagine a protein chain that includes the following amino acids among several others.



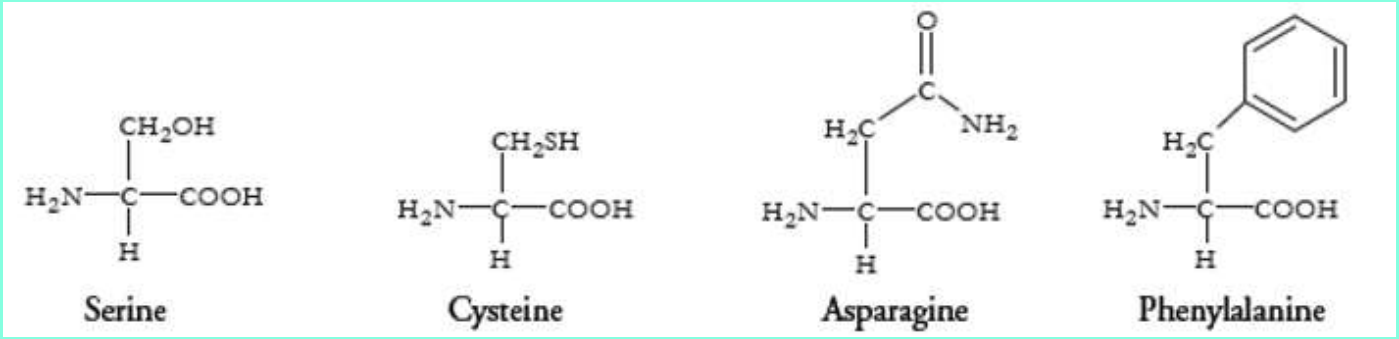
Which of these amino acids could participate in hydrophobic interactions with another amino acid in the chain to stabilize the tertiary structure of the protein?

Phenylalanine has a nonpolar R-group. Hydrophobic R groups are attracted to other nonpolar R-groups in the chain.

Which of these amino acids could form disulfide bonds with another amino acid in the chain to stabilize the tertiary structure of the protein?

Cysteine because it contains sulfur at the end of its R-group so it can form disulfide bridges with another cysteine in the protein chain

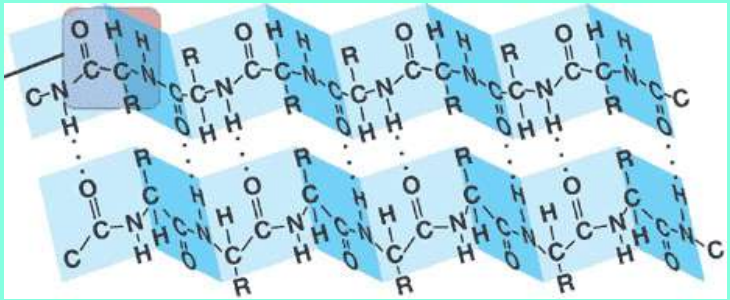
Question from Mrs. Chirby's Review posted on her website with answers https://mschirby.wordpress.com/exam-review/



Which of these amino acids could form a hydrogen bond with another amino acid in the chain to stabilize the secondary structure of a B-pleated sheet?

ALL OF THESE have amino and carboxyl groups so they could ALL form hydrogen bonds in the secondary structure of the protein chain.

The hydrogen bonds stabilizing B-pleated sheets form between the C=O and N-H of nearby amino acids.



R-GROUPS ARE NOT INVOLVED IN SECONDARY STRUCTURE !

ESSENTIAL KNOWLEDGE

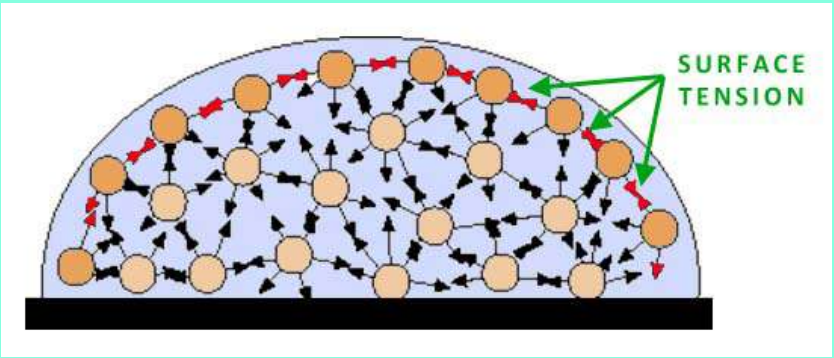
SYI 1.B.2 b. In proteins, the specific order of amino acids in a polypeptide (primary structure) determines the overall shape of the protein. Amino acids have directionality, with an amino (NH_2) terminus and a carboxyl (COOH) terminus. The R group of an amino acid can be categorized by chemical properties (hydrophobic, hydrophilic, or ionic), and the interactions of these R groups determine structure and function of that region of the protein

SYI 1.C.1 . d. 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.

https://classconnection.s3.amazonaws.com/734/flashcards/651734/gif/beta-pleated-sheet-14831C082746DEFAA4D.gif

Image from: http://fusedglass.org/imgs/02_surface_tension.jpg

The measure of how difficult it is to stretch or break the surface of a liquid = SURFACE TENSION



Surface tension is due to HYDROGEN bonding between water molecules.

Compared to other liquids water has a very HIGH surface tension.

LOW HIGH

ESSENTIAL KNOWLEDGE
SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function
1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding
1. A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.

Compound made up of carbon, hydrogen, and oxygen atoms usually in a ratio of 1 C: 2 H: 1 O which is a major source of energy for the human body

carbohydrate

Large molecule made by joining smaller monomer subunits together

polymer

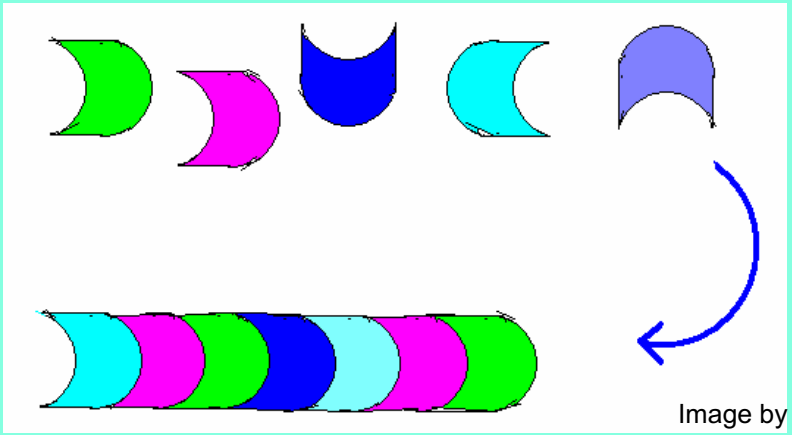


Image by Riedell

vocab

Macromolecules made mainly of carbon and hydrogen atoms; includes fats, oils, and waxes and steroids, which are generally hydrophobic

lipid

Macromolecule made of nucleotide subunits containing carbon, hydrogen, oxygen, nitrogen, and phosphorus which stores and transports information in cells and helps in protein synthesis

nucleic acid

Vocab

Lipids are hydrophobic

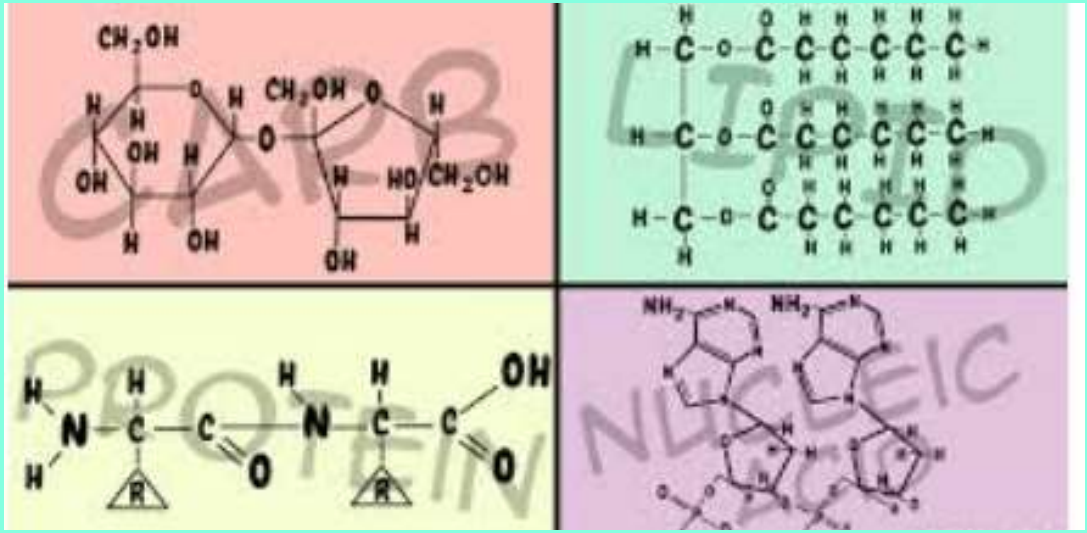
hydrophobic hydrophilic

Lipids are non-polar

polar non-polar

SYI 1.B.2 d. Lipids are nonpolar macromolecules—
i. Differences in saturation determine the structure and function of lipids.
ii. Phospholipids contain polar regions that interact with other polar molecules, such as water, and with nonpolar regions that are often hydrophobic.

Which atoms are common to all biomolecules?



A. carbon, hydrogen, nitrogen
B. carbon, hydrogen, sulfur
C. carbon, oxygen, phosphorus
D. carbon, hydrogen, oxygen

ESSENTIAL KNOWLEDGE
ENE 1.A.2 Atoms and molecules from the environment are necessary to build new molecules.
a. Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms.
b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.

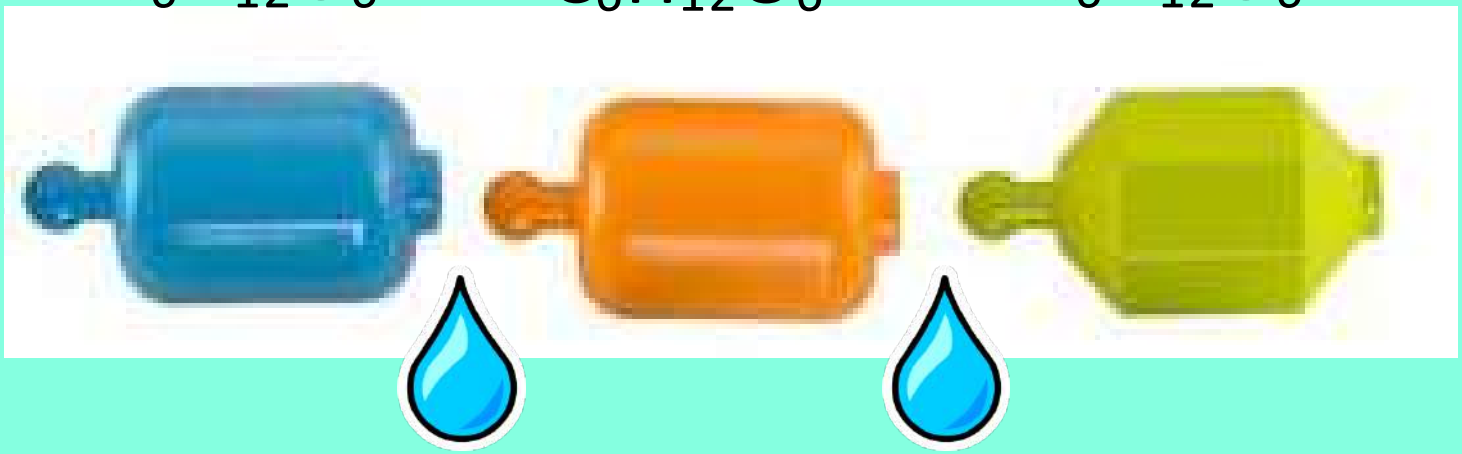
Glucose is a monosaccharide.
Its chemical formula is $C_6H_{12}O_6$.
Use what you know about carbohydrates and the reaction that joins subunits to WRITE a chemical formula for a carb made by joining THREE (3) glucose molecules.

ESSENTIAL KNOWLEDGE
SYI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers
SP 1C Explain biological concepts, processes, and/or models in applied contexts

http://www.thisisitstores.co.uk/media/catalog/product/4/4/442916_1.jpg
http://www.clipartkid.com/images/648/water-drop-images-cliparts-co-aCb6i1-clipart.png

$3 \times C_6H_{12}O_6 = C_{18}H_{36}O_{18}$

$C_6H_{12}O_6$ $C_6H_{12}O_6$ $C_6H_{12}O_6$



BUT dehydration synthesis removes 2 water molecules (H_2O)

Minus 4 H's and 2 O's

$C_{18}H_{32}O_{16}$

ESSENTIAL KNOWLEDGE
SYI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers
SP 1C Explain biological concepts, processes, and/or models in applied contexts

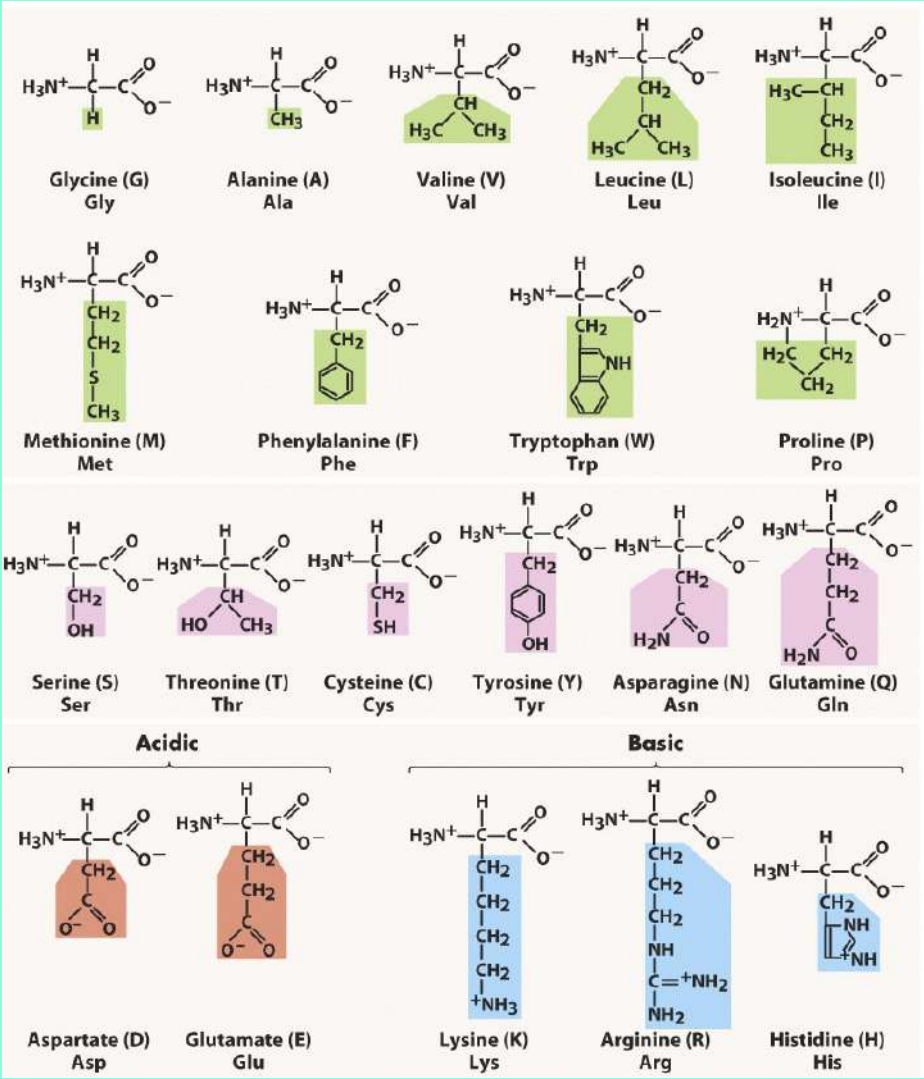


Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg

Mutations can change the amino acid sequence in a protein. PREDICT how replacing cysteine with serine might affect the tertiary structure of a protein?

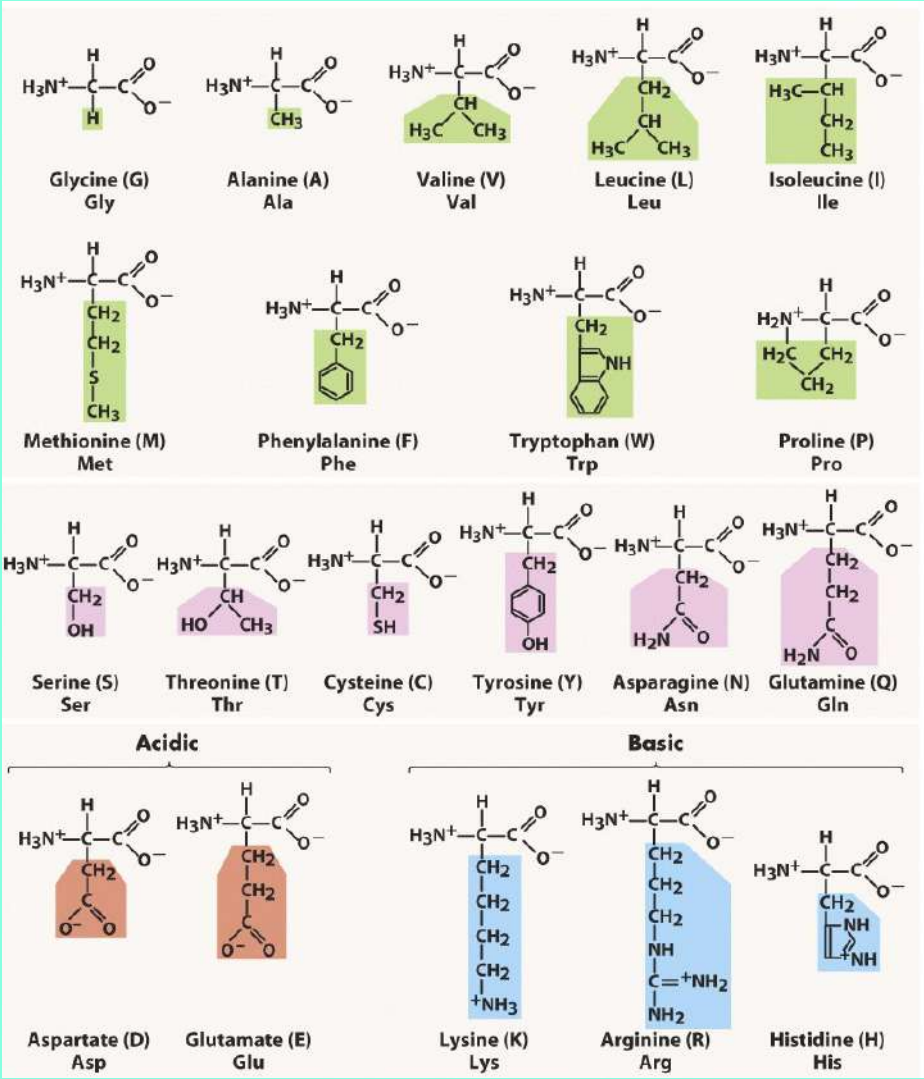


Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg

Interactions between side chain amino acid result in the folding of proteins and their ultimate overall 3D shape.

Although cysteine and serine have similar polar R groups, cysteine can make a disulfide bridge with another cysteine in the amino acid chain which helps stabilize its
3 structure.

This mutation would impact the protein's 3D shape by resulting in a cysteine bond not forming which could impact the stability of the protein.

SP 1.C Explain biological concepts, processes, and/or models in applied contexts

SP 6 E Predict the causes or effects of a change in or disruption to, one or more components in a biological system bases on a) Biological concepts or processes

SY1 B. 2 b. 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

SYI 1. C Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule.

SP 6 E. Predict the causes or effects of a change in or disruption to, one or more components in a biological system based on b. A visual representation of a biological concept, process, or model.

Image from: https://thumbs.dreamstime.com/t/huge-cow-eating-field-illustration-53978774.jpg

Starch and cellulose are both polysaccharides made by plants. Many organisms including humans can digest starch but not cellulose. WHY?

They have enzymes to break α-glycosidic linkages (starch) but not β-glycosidic linkages (cellulose).

Explain how cows can survive on a diet of hay and grass if they can't digest cellulose in their food ?

Cows (and humans) have symbiotic bacteria that live in their gut which CAN break β linkages

SP 1 Explain biological concepts , processes, and models presented in written format.
1.C Explain biological concepts, processes, and/or models in applied contexts

Which chemical reaction is used by your digestive tract to break down the proteins in the cheeseburger you had for lunch into amino acid subunits ?

hydrolysis

As the hydrogen ion concentration of a solution decreases, it's pH

increases

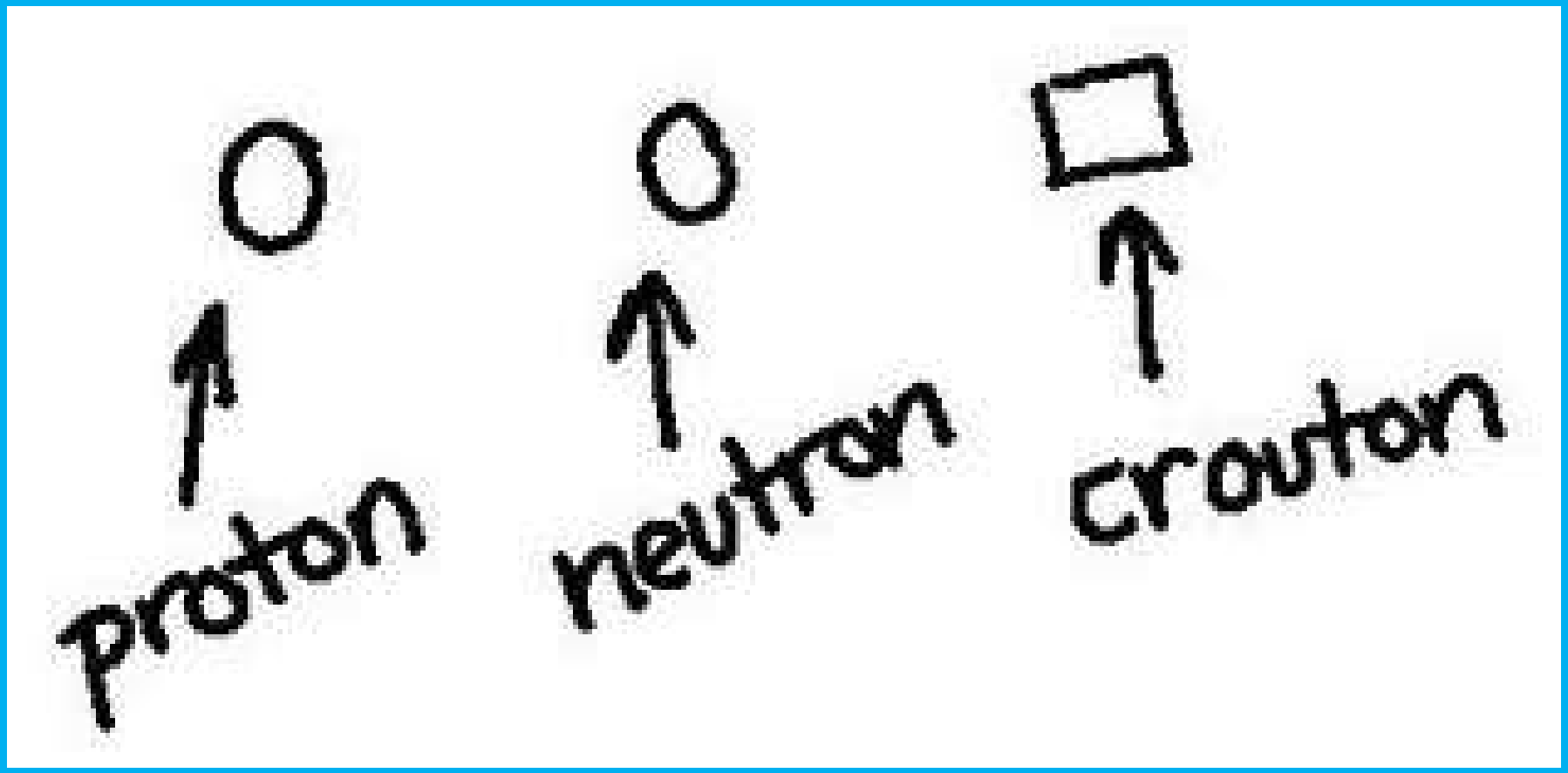
increases decreases

$$pH = -\log_{10} [H+]$$

ESSENTIAL KNOWLEDGE

SYI 1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.

http://ondulyne.tumblr.com/post/6007971588



Images from: http://ppt.wz51z.com/PMP2/Science.To.WebText/animations/science/chemistry_physics/vp_beaker_bubbles_steam.htm
http://nobel.scas.bcit.ca/debeck_pt/science/images/blue_bubbling_liquid.gif
http://ps205.org/wp-content/uploads/2010/09/beaker_red_liquid_bubbling_sm_wht.gif

Which is basic?
EXPLAIN YOUR ANSWER

pH 4
A

pH 7
B

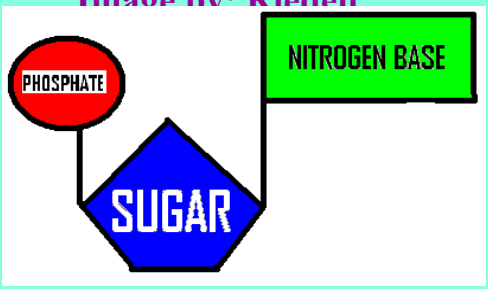
pH 9
C

pH < 7 is acidic
pH 7 = neutral
pH > 7 is basic

C has a pH >7

SP 1.A Describe biological concepts or processes

Name this subunit used to build nucleic acids like DNA & RNA



NUCLEOTIDE

If this was going to make DNA what sugar would be used?

deoxyribose

Which nitrogen base could NOT be used?

URACIL

Essential knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.

b. DNA and RNA molecules have structural similarities and differences that define function. [See also **4.A.1**]

Evidence of student learning is a demonstrated understanding of each of the following:

1. Both have three components — sugar, phosphate and a nitrogenous base — which form nucleotide units that are connected by covalent bonds to form a linear molecule with 3' and 5' ends, with the nitrogenous bases perpendicular to the sugar-phosphate backbone.
2. The basic structural differences include:
   i. DNA contains deoxyribose (RNA contains ribose).
   ii. RNA contains uracil in lieu of thymine in DNA.

Our stomachs produce hydrochloric acid to kill germs and help break down the food we eat. Too much stomach acid can cause an upset stomach. Use what you learned about acids and bases to explain why people take antacids (like Maalox, Tums, or Rolaids) when they get heartburn.
(Hint: The chemical in Maalox is magnesium HYDROXIDE)

H^+ in stomach acid is neutralized by OH^- in antacid

$$H^+ + OH^- \rightarrow H_2O$$

(Acid) (base) (Neutral)

SP 1 Explain biological concepts , processes, and models presented in written format.
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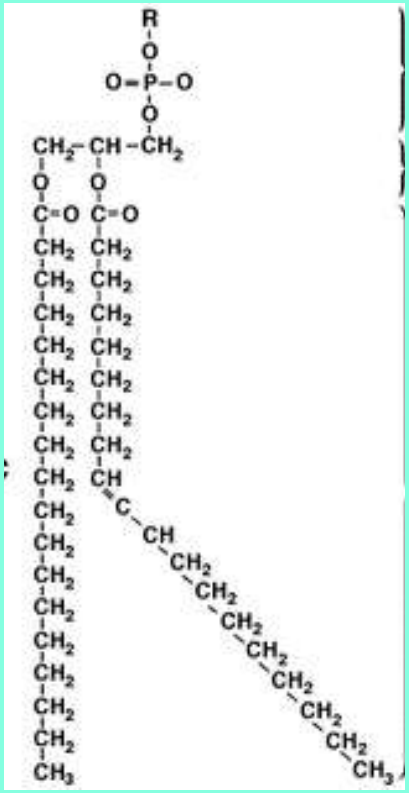
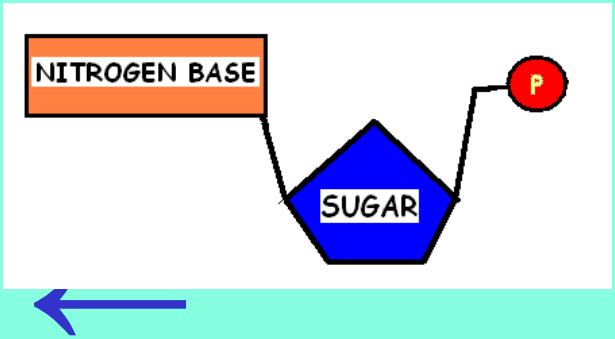
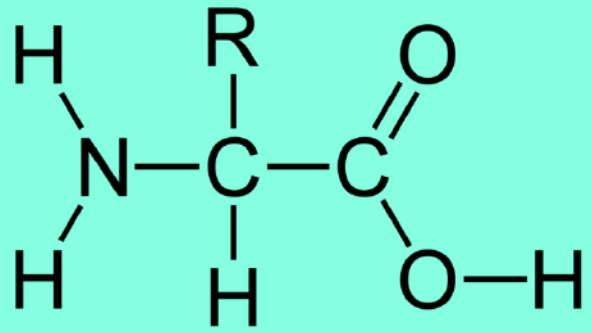
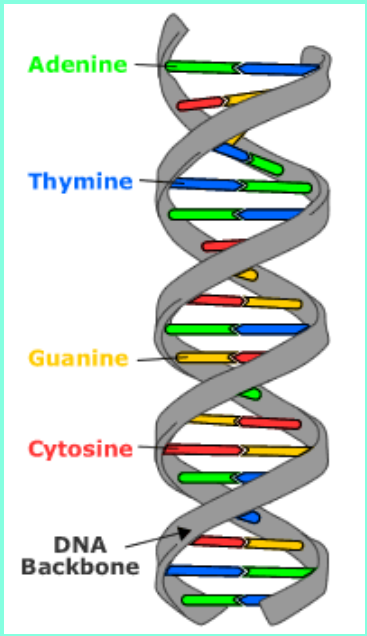
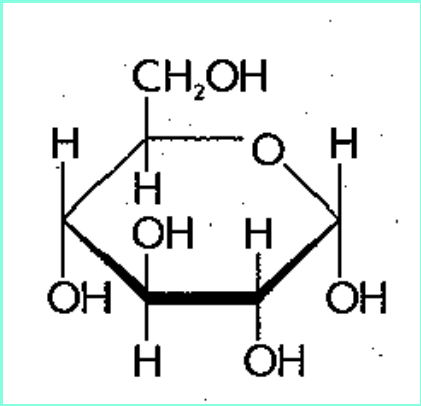










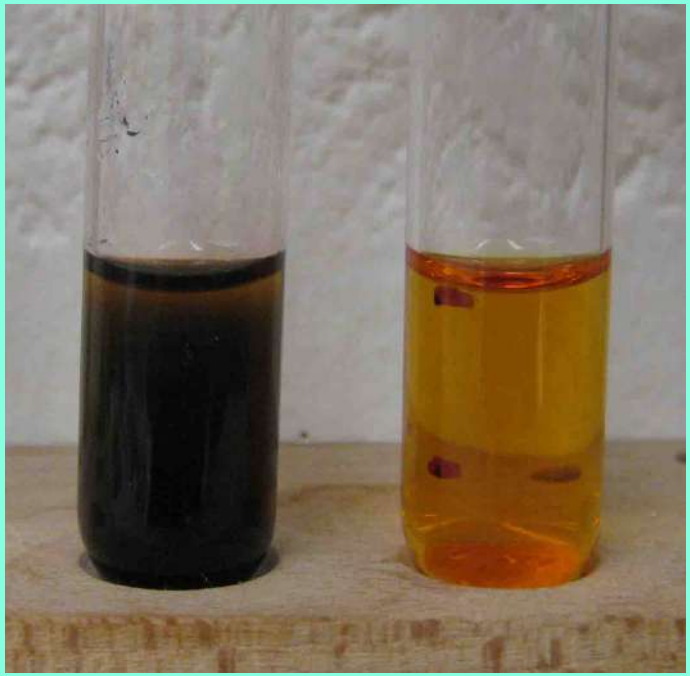
Which of these molecules is a phospholipid?

Essential knowledge ENE 1.A Describe the composition of macromolecules required by living organisms .

http://emp.byui.edu/wellerg/Molecules%20of%20the%20Cell%20Lab/images/instructions/iodineboth.jpg

During the food lab in Honors Bio you used iodine to test for the presence of starch. You accidently spill IODINE on your lab paper and get it on your finger while cleaning up.

EXPLAIN WHY your lab paper turns black but your finger doesn't.



Iodine turns black in presence of starch

Paper comes from plants.
Plants store glucose as starch

Humans (animals) store glucose as glycogen (NO starch) No starch so … no color change.

SP 1 Explain biological concepts , processes, and models presented in written format.
1.C Explain biological concepts, processes, and/or models in applied contexts

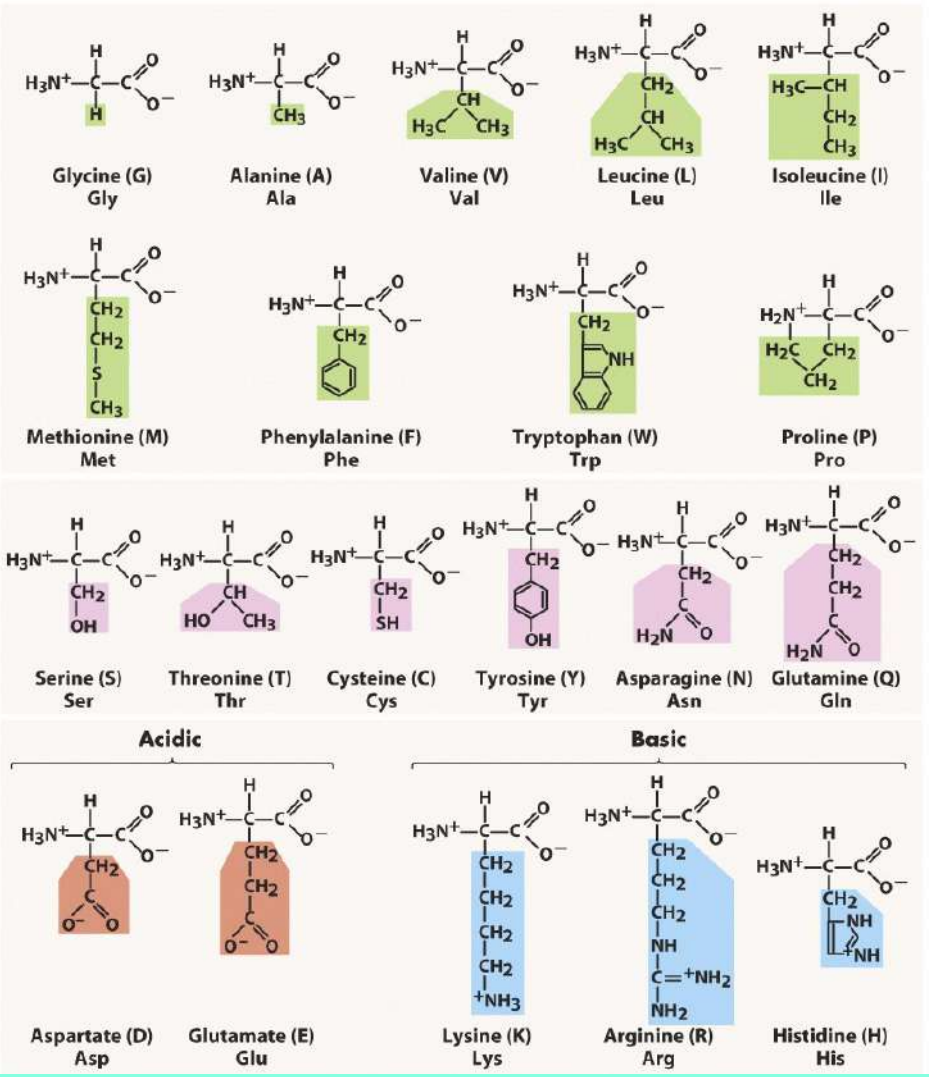


Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg

Which of these amino acids have non-polar side chains?

Glycine, alanine, valine, leucine, isoleucine, methionine, phenylalanine, tryptophan, proline have phobic side chains.

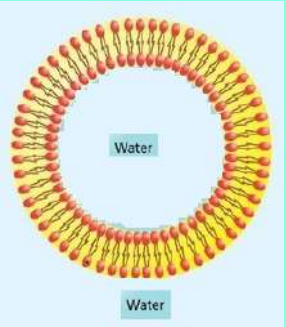
Which amino acids have R groups that would be hydrophilic?

Serine, threonine, cysteine, tyrosine, asparagine, glutamine, aspartate, glutamate, lysine, arginine, histidine

SYI 1 B. 2 b. 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.

Images from:https://o.quizlet.com/UjH7VJTp7w1js70vvFKSRw_m.jpg
https://i.ytimg.com/vi/LTK8wFcglyg/maxresdefault.jpg

EXPLAIN how the polar properties of water result i membrane formation.



~ **Polarity of H_2O** molecules result in the insolubility of molecules that are HYDROPHOBIC (lipids)

~ interaction with phospholipids results in the hydrophilic/polar heads orienting themselves in a bilayer with the polar/hydrophilic facing outward touching cytoplasm OR extracellular fluid, which are mostly water and the hydrophobic/nonpolar tails facing inward away from water

~ allows cell membranes to form the structure of cells and results in internal compartmentalization of chemical reactions in cells (Ex: mitochondria, chloroplasts, ER, lysosomes, etc.)

ESSENTIAL KNOWLEDGE

SYI 1.A.2 Living systems depend on properties of water that result from its polarity and hydrogen bonding

ENE 2.A.1 Phospholipids have both hydrophilic and hydrophobic regions. The hydrophilic phosphate regions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid regions face each other within the interior of the membrane.

SP 1 Explain biological concepts , processes, and models presented in written format.

1.C Explain biological concepts, processes, and/or models in applied contexts

http://bestlifemistake.blogspot.com/2014/02/middle-school-science-teacher-humor.html

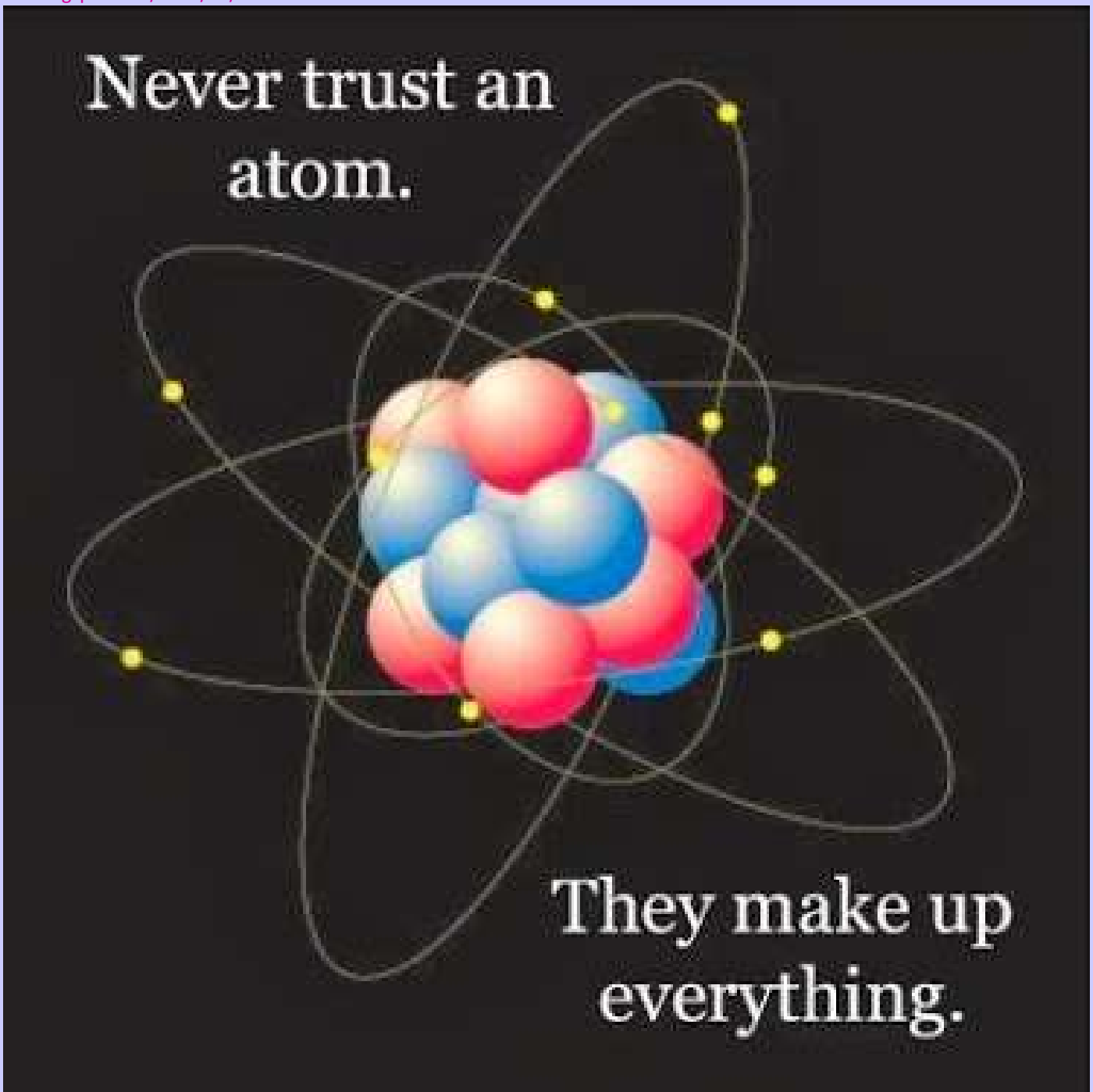
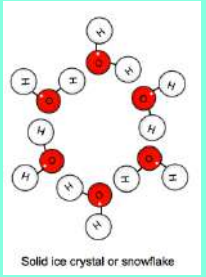


Image from:https://bsciencecenter.files.wordpress.com/2013/02/screen-shot-2013-02-09-at-6-16-44-pm.png
http://www.pitara.com/wordpress/wp-content/uploads/2013/12/5wh-25_1.gif

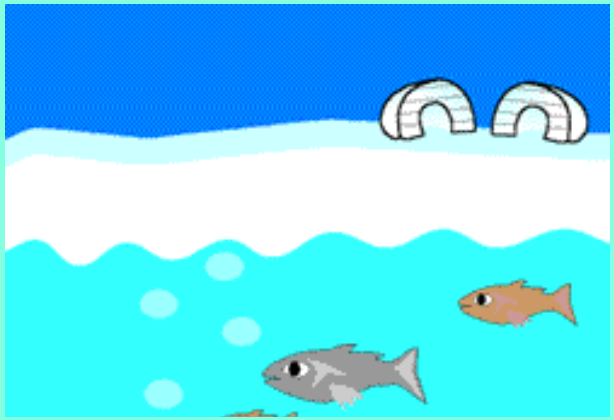
Water is ONLY substance that is LESS DENSE AS A SOLID THAN AS A LIQUID. Explain how this unique property of water allows aquatic life to survive when water freezes in winter.

When water changes from liquid to solid, the molecules form a lattice structure that causes the molecules to move farther apart.



Water expands as it freezes instead of contracting like other liquids. Since ice is less dense than liquid water lakes/ponds freeze from the top down instead of the bottom up.

Living things can survive under the surface of the ice during winter.

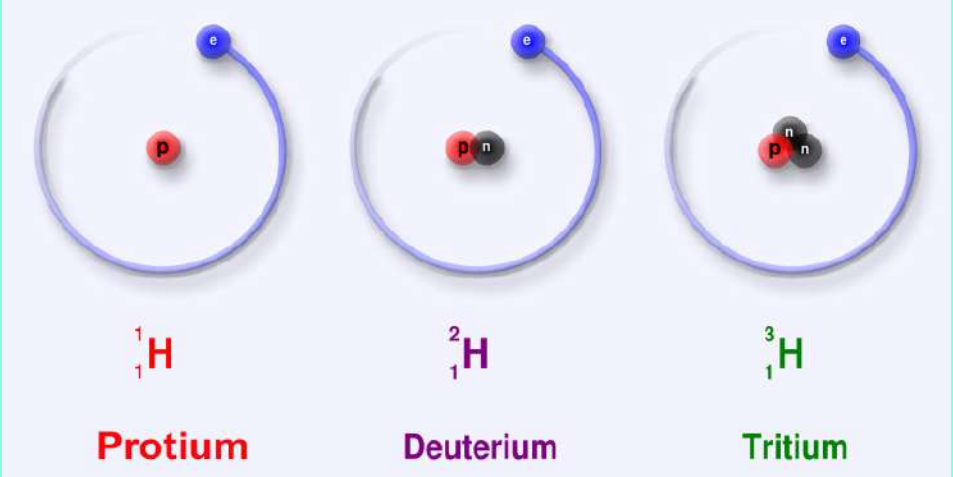


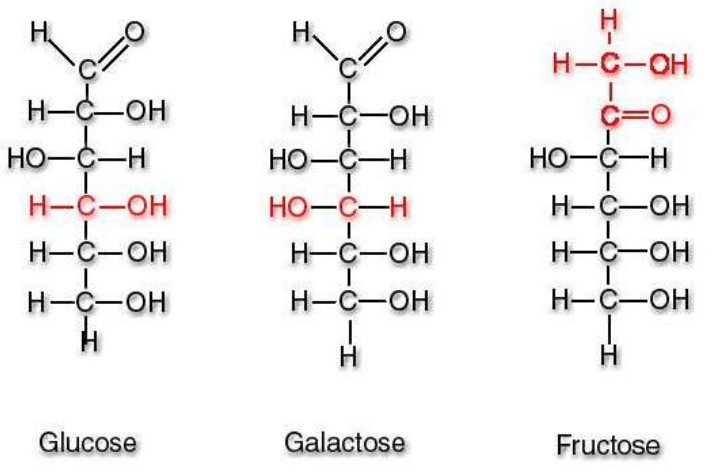
ESSENTIAL KNOKWLEDGE
SYI 1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.
SP 1 C Explain biological concepts, processes, and/or models in applied contexts.

Images from:
https://upload.wikimedia.org/wikipedia/commons/6/6c/Protium_deuterium_tritium.jpg
http://credit-help.biz/img/2551/monosaccharides1350254591202972.jpg

EXPLAIN the difference between an ISOTOPE and an ISOMER.

Isotopes are **ATOMS** that have the same number of protons & electrons but **different numbers of neutrons**





Isomers are **MOLECULES** that contain the same numbers and kinds of atoms **arranged in a different way**

VOCAB

Images from: http://ppt.wz51z.com/PMP2/Science.To.WebText/animations/science/chemistry_physics/vp_beaker_bubbles_steam.htm
http://nobel.scas.bcit.ca/debeck_pt/science/images/blue_bubbling_liquid.gif

Which is more basic?
How much more?
EXPLAIN YOUR ANSWER

$$pH = -\log[H^+]$$

pH 8
A

pH 12
B

pH greater than 7 is basic ; so both are basic
each unit difference = 10 times more
pH 12 is 10,000 times more basic than pH 8

SP 1.A Describe biological concepts or processes

Image from: http://water.usgs.gov/edu/pictures/meniscus-small.jpg

EXPLAIN why water in a glass graduated cylinder forms a meniscus.

Polarity of H_2O molecules results in ability of water molecules to **form hydrogen bonds** between water molecules (**cohesion**) and between water molecules and the surface of the glass (**adhesion**).

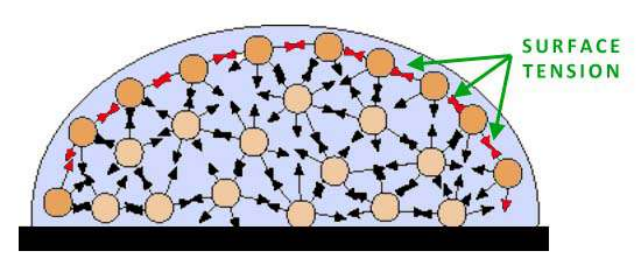
Because water is attracted to the glass, it moves up the sides of the graduated cylinder.

SP 1.C Explain biological concepts, processes, and/or models in applied contexts
SYI 1.A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.
SYI 1.A.3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.

Image from: http://fusedglass.org/imgs/02_surface_tension.jpg
http://www.dailyrogers.com/wp-content/uploads/2015/08/water_strider_robot-1.jpg
http://cuntamination.tumblr.com/post/17029767902

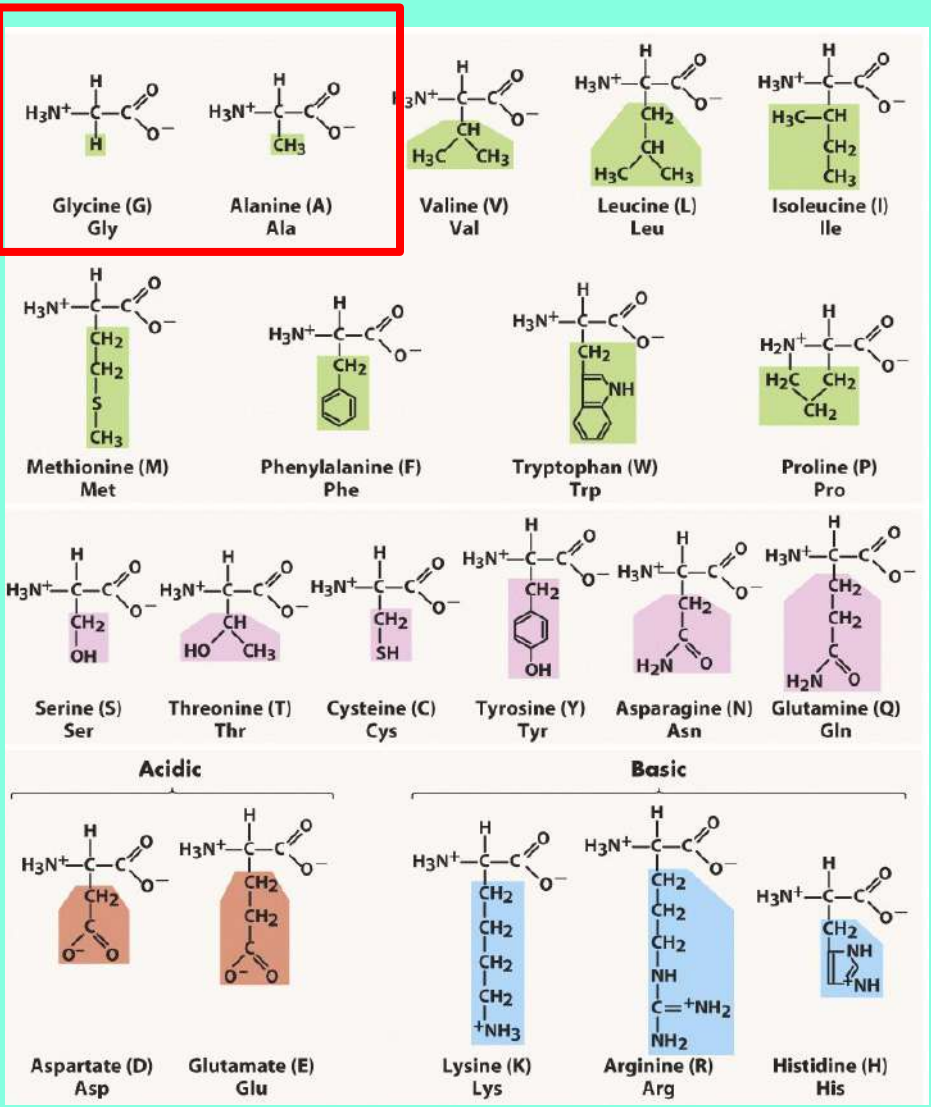
Use the properties of water to EXPLAIN why water bugs can "walk on water".

SURFACE TENSION is a measure of how difficult it is to stretch or break the surface of a liquid. There is an attraction between water molecules (COHESION) due to HYDROGEN bonds causing them to pull toward each other and gives water a very high surface tension which makes it behave as though it were coated with an invisible film.
This is enough to provide the support to hold up some organisms.



SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function
1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding
1. A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.
SP 1 Explain biological concepts , processes, and models presented in written format.
1.C Explain biological concepts, processes, and/or models in applied contexts

Image from: http://bio100.class.uic.edu/lectures/aminoacids01.jpg



In aqueous solutions at pH 7, most proteins fold so that non polar amino acid side chains are inside and most of the polar side chains are outside in contact with the water.

EXPLAIN why might Glycine and Alanine be found either inside or out?

These have small side chains- Not large enough to be strongly hydrophobic. So these can be found either place.

SYI 1 B. 2 **b. 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**

SYI 1. C **Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule**

SP 1 Explain biological concepts , processes, and models presented in written format.

1.C Explain biological concepts, processes, and/or models in applied contexts

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Image from: http://i.stack.imgur.com/sucSu.jpg

The amount of energy that must be absorbed for 1 g of liquid to be converted to gas =

heat of vaporization

The amount of energy that must be absorbed for 1 g of solid to be converted to liquid =

heat of fusion

ESSENTIAL KNOWLEDGE

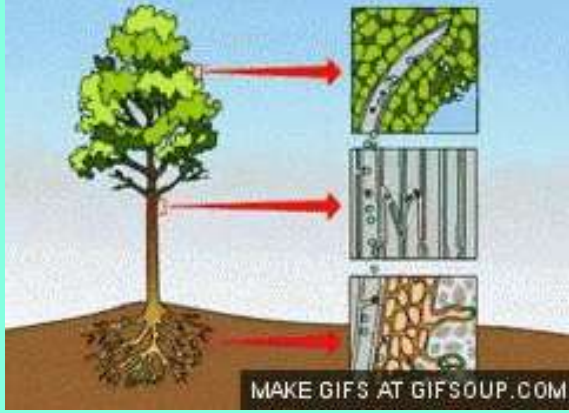
SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function

1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding

1. A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.

Animation from: http://stream1.gifsoup.com/view4/4699896/transpiration-pull-o.gif

EXPLAIN how the properties of water work to move water from roots to shoots in a tree.



Polarity of H_2O molecules results in ability of water molecules to **form hydrogen bonds** between water molecules (**cohesion**) and between water molecules and other surfaces (**adhesion**).

As water evaporates from leaf surface via openings (stomata), water molecules below are pulled up like "beads on string" due to **cohesion**. **Adhesion** of water molecules to the cell walls of transport tubes (xylem) resists pull of gravity back downward as water moves up from roots to leaves.

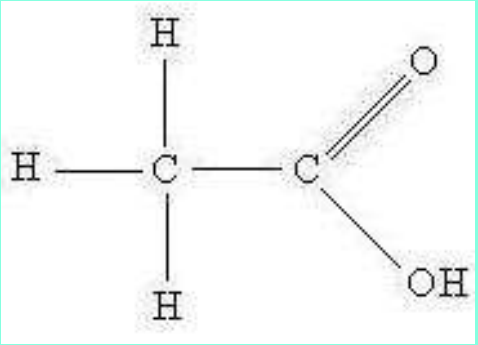
Cohesion, adhesion, and surface tension create a capillary action that keeps water molecules interacting and moving through the plant.

VIDEO

SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function
1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding
1. A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.
SP 1 Explain biological concepts , processes, and models presented in written format.
SP 1.C Explain biological concepts, processes, and/or models in applied contexts

Image and question from: Holtzclaw & Holtzclaw study guide

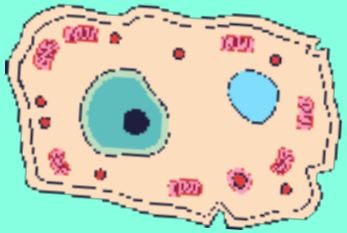
Do you think this molecule is hydrophilic or hydrophobic? EXPLAIN YOUR ANSWER



The addition of a carboxyl group makes this molecule more hydrophilic because the carboxyl group can lose a H^+ ion to become slightly charged. This would make it associate with a polar molecule like water.

$$pH = -\log[H^+]$$

As the H^+ ion concentration of a solution increases, what happens to its pH value?

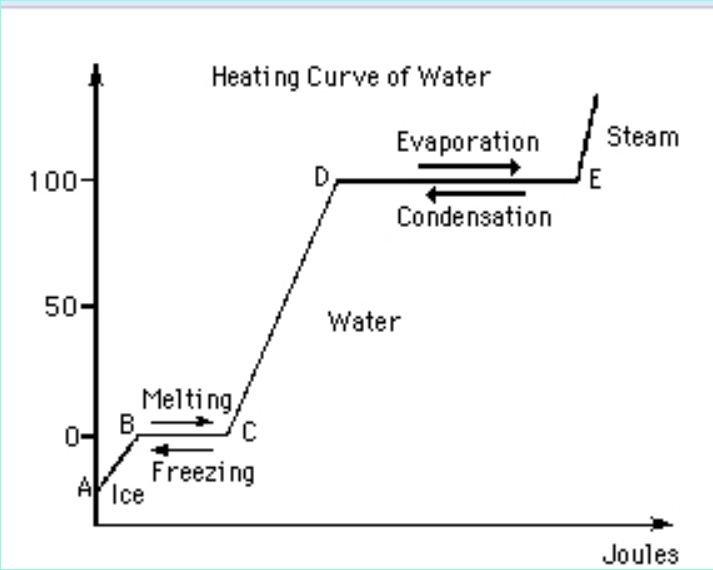


There is an inverse relationship between pH and H^+ concentration. As the hydrogen ion concentration increases, a solution's pH decreases.

ESSENTIAL KNOWLEDGE
SP 1.C Explain biological concepts, processes, and/or models in applied contexts

Image from: http://i.stack.imgur.com/sucSu.jpg

One type of question you may encounter on the AP Exam asks you to interpret a graph. What is happening to water molecules between points A-B and C-D on this graph.



Adding energy increases the kinetic energy of the molecules and the temperature of the H_2O molecules increases.

What is happening between points B-C and D-E?

At these points on the graph, water is changing phase (solid → liquid/liquid →gas) and adding energy increases the kinetic energy of the molecules but the temperature of the H_2O molecules stays the same until enough molecules have the energy to change phase.

ESSENTIAL KNOWLEDGE

SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function

1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding

1. A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.

Image from: http://fusedglass.org/imgs/02_surface_tension.jpg

The amount of heat that must be absorbed or lost for 1 g of a substance to change its temperature by 1° C = Specific heat

Compared to other substances water has a very HIGH specific heat due to HYDROGEN bonding.

LOW HIGH

Give an example of how this impacts life on Earth.

Moderates climate: Large bodies of water absorb and store heat from sun in day/summer and return it to environment at night/winter. Keeps temps on land/water within range that supports life.

Bodies of living things mainly water; resist changes in body temp

ESSENTIAL KNOWLEDGE

SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function

1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding

1. A. 3 The hydrogen bonds between water molecules result in cohesion, adhesion and surface tension.

Image from: http://image.shutterstock.com/z/stock-vector-sweating-cartoon-man-dying-of-heat-and-using-a-mini-fan-120823501.jpg
http://citadel.sjfc.edu/students/kmd06085/e-port/msti260/transpiration.gif

Water molecules must absorb energy from the environment in order to change phase from liquid to gas during evaporative cooling

absorb energy from release energy to

Body heat provides this energy.
(It's the reason why sweating when it's hot cools you off)

The evaporation of water (transpiration) from the surface of leaves helps keep the tissues cooler

warmer cooler

ESSENTIAL KNOWLEDGE

SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function

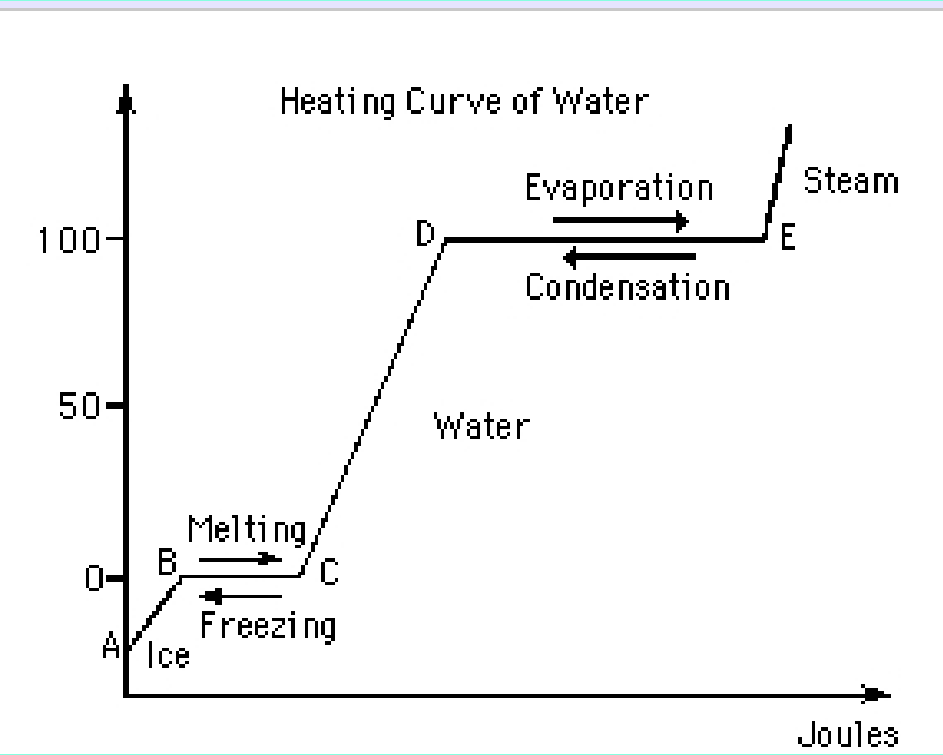
1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding.

Image from: http://i.stack.imgur.com/sucSu.jpg

In the graph shown, the line between points D-E doesn't increase even though energy is added because water has a _____ heat of vaporization

HIGH

low high



ESSENTIAL KNOWLEDGE

SYI A. Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function

1.A. 2 Living systems depend on properties of water that result from its polarity and hydrogen bonding

Images from: http://ppt.wz51z.com/PMP2/Science.To.WebText/animations/science/chemistry_physics/vp_beaker_bubbles_steam.htm
http://nobel.scas.bcit.ca/debeck_pt/science/images/blue_bubbling_liquid.gif
http://ps205.org/wp-content/uploads/2010/09/beaker_red_liquid_bubbling_sm_wht.gif

Which is neutral?
EXPLAIN YOUR ANSWER

pH 4
A

pH 7
B

pH 9
C

pH < 7 is acidic
pH 7 = neutral
pH > & is basic

B (pH 7)

SP 1.A Describe biological concepts or processes

By discharging electric sparks into a laboratory chamber atmosphere that consisted of water vapor, hydrogen gas, methane, and ammonia, Stanley Miller obtained data that showed that a number of organic molecules, including many amino acids, could be synthesized. Miller was attempting to model early Earth conditions as understood in the 1950s. The results of Miller's experiments best support which of the following hypotheses?

(A) The molecules essential to life today did not exist at the time Earth was first formed.

(B) The molecules essential to life today could not have been carried to the primordial Earth by a comet or meteorite.

(C) The molecules essential to life today could have formed under early Earth conditions.

(D) The molecules essential to life today were initially self-replicating proteins that were synthesized approximately four billion years ago.

NOT A SECURE EXAM QUESTION
Sample MC question from
2015 Course and Exam Description Book
posted to public on College board website

SYI 3.E.1.b. There are several models about the origin of life on Earth—

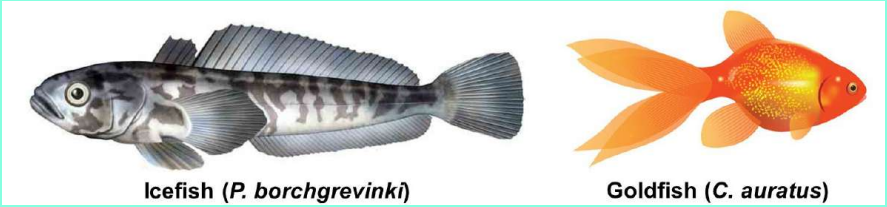
i. Primitive Earth provided inorganic precursors from which organic molecules could have been synthesized because of the presence of available free energy and the absence of a significant quantity of atmospheric oxygen (O2).

1 c. Chemical experiments have shown that it is possible to form complex organic molecules from inorganic molecules in the absence of life—

i. Organic molecules/monomers served as building blocks for the formation of more complex molecules, including amino acids and nucleotides.

ii. The joining of these monomers produced polymers with the ability to replicate, store, and transfer information.

Images from
https://i1.wp.com/oceanbites.org/wp-content/uploads/2015/11/F51.jpg

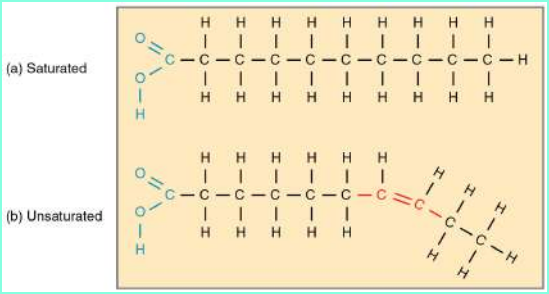


Fish that live in cold water environments have been shown to contain a higher concentration of unsaturated fatty acids in the phospholipids in their cell membranes compared to fish that live in warmer temperatures.

Use what you learned about the structure of fatty acids and membrane structure to explain this phenomena.

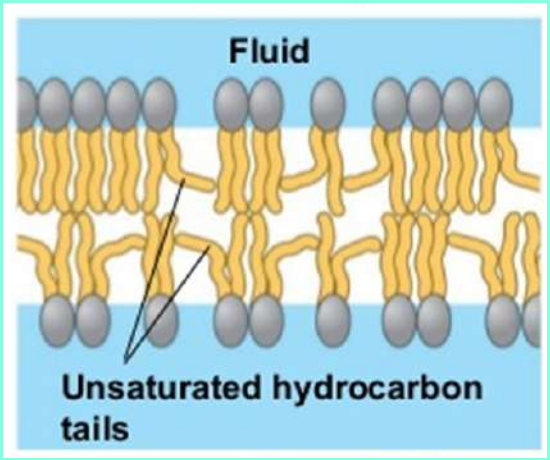
SYI 1.B.2
d. I Differences in saturation determine the structure and function of lipids.
SP 1:C Explain biological concepts, processes, and/or models in applied contexts.

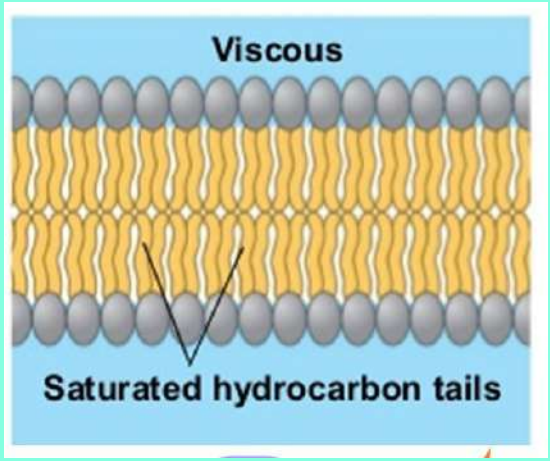
Images from
https://i1.wp.com/oceanbites.org/wp-content/uploads/2015/11/F51.jpg
https://opentextbc.ca/anatomyandphysiology/wp-content/uploads/sites/142/2016/03/221_Fatty_Acids_Shapes-01.jpg



Phospholipids that make up cell membranes consist of a phosphate group head and 2 fatty acid tails attached to a glycerol molecule.

Unsaturated fatty acids have a double bond which changes the shape of the molecule, causing the tail to bend.





Unsaturated fatty acid tails pack together less tightly in cell membranes because of these "kinks" in the tails making the cell membranes more fluid and less likely to freeze in colder temperatures. Membranes with more saturated fatty acid tails are more viscous and more susceptible to freezing in cold temps.

SYI 1.B.2
d. I Differences in saturation determine the structure and function of lipids.
SYI 3.A.2 Variation in the number and types of molecules within cells provides organisms a greater ability to survive and/or reproduce in different environments.
SP 1:C Explain biological concepts, processes, and/or models in applied contexts.

https://ib.bioninja.com.au/_Media/tertiary-structure_med.jpeg

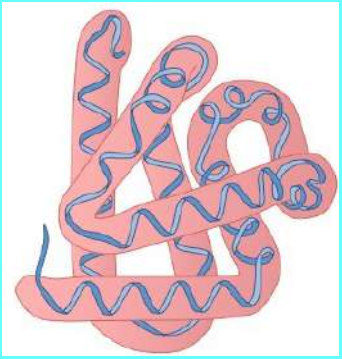
Scientists examined the folded structure of a purified protein resuspended in water and found that amino acids with nonpolar R groups were primarily buried in the middle of the protein, whereas amino acids with polar R groups were primarily on the surface of the protein. Which of the following best explains the location of the amino acids in the folded protein.

(A) Polar R groups on the surface of the protein can form ionic bonds with the charged ends of the water molecule.

(B) Polar R groups are too bulky to fit in the middle of the protein and are pushed toward the protein's surface.

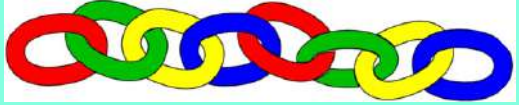
(C) Nonpolar R groups that cannot form hydrogen bonds with water are pushed into the middle of the protein.

(D) Nonpolar R groups from different parts of the protein form covalent bonds with each other to maintain the protein's structure.



NOT A SECURE EXAM QUESTION
Sample MC question from
2019 Course and Exam Description Book
posted to public on College board website

ESSENTIAL KNOWLEDGE
ENE 2.E.2 Embedded proteins can be hydrophilic, with charged and polar side groups, or hydrophobic, with nonpolar side groups
SP 1:C Explain biological concepts, processes, and/or models in applied contexts.



https://c2.staticflickr.com/8/7120/6904687426_4f5d9edaab_z.jpg
http://www.biologyjunction.com/images/earthw1.jpg

The study of biology encompasses a vast amount of info. On the AP Exam you should be prepared to encounter questions over info we have not covered in class. One type of question will give you a short paragraph like this to read and then ask you to interpret an observation, apply what you know to a new situation, or make a prediction.

You may encounter vocab words you are not familiar with. Because many science words/names have their origins in Latin, you can often decode the meaning of an unfamiliar word by becoming familiar with Latin prefixes/suffixes.

Many different kinds of carbs are built by joining monosaccharide subunits and are grouped/named accordingly. Two sugar carbs are disaccharides; oligosaccharides contain a few/some sugars; polysaccharides have many sugars.

Segmented worms are classified based on the number of bristles on their bodies.
(Remember Kingdom, Phylum, Class . . . From Honors Bio?)
Worms with "many bristles" are in the CLASS: Polychaeta.

Make a prediction about what the class name is for worms (like earthworms) with just "a few/some bristles"

OLIGOCHAETA

PAST MOLECULE FRQ's

2013 MC Exam Released to public by College Board

2008 #$1 **SCORING GUIDELINES**

Chemical bonds
protein structure

2017 #7 **SCORING GUIDELINES**

pH

2017 #8 **SCORING GUIDELINES**

Phospholipids in cell membranes

2006 #3 **SCORING GUIDELINES**

Properties of water
Transpiration

2004B #1 **SCORING GUIDELINES**

Molecule cycling

2004B #4 **SCORING GUIDELINES**

Compare molecules in organisms

2002B #3 **SCORING GUIDELINES**

Structure/function: chitin & cellulose

2001 #4 **SCORING GUIDELINES**

Structure of proteins
Role of DNA/RNA in protein synthesis
Role in cell membranes

Animation from:
http://static1.squarespace.com/static/538a9498e4b021e5d49572ab/t/55adc34be4b039eb798658ce/1437451121085/Hand-Writing-The-End-84758.gif?format=1000w