

Carbohydrates Class Activity

Instructions

Students work in groups of 2-3 students per group

1. **Fill out the table (20 minutes). Try your best to complete all parts of the table.**
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
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Carbohydrates Table

Molecule	Type of biomolecule (be specific)	Functional groups found in molecule	Elements found in molecule	C:H:O ratio (approx.)	Monomers composing polymer	Type of linkage connecting monomers (be specific)	Type of organisms where molecule is found	Functions in living organisms
Glucose								
Glycogen								
Cellulose								
Chitin								

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Compare the molecular formula of a carbohydrate with that of carbon dioxide. What does the presence of hydrogen atoms in carbohydrates indicate?

-  A. Carbohydrates are more oxidized than carbon dioxide, and are therefore higher in potential energy.
-  B. Carbohydrates are more reduced than carbon dioxide, and are therefore higher in potential energy.
-  C. Carbohydrates are more oxidized than carbon dioxide, and are therefore lower in potential energy.
-  D. Carbohydrates are more reduced than carbon dioxide, and are therefore lower in potential energy.

Across all animal species, the main function of carbohydrates is to act as

-  A. the structural components of cell walls.
-  B. the heritable instructions for life.
-  C. the linking molecule of triglycerides.
-  D. the sites of protein synthesis.
-  E. energy storage molecules.

The human stomach contains a carbohydrate-based antibiotic that protects a large portion of the population from various diseases caused by the bacterium *H. pylori*. (linked to peptic ulcers, gastritis, and stomach cancer). This naturally occurring antibiotic is described as having a terminal α 1,4-glycosidic-linked *N*-acetylglucosamine (NAG), which inhibits cell wall formation in *H. pylori*.

Which of the following structures is most consistent with the description of this antibiotic?



A. Structure A



B. Structure B

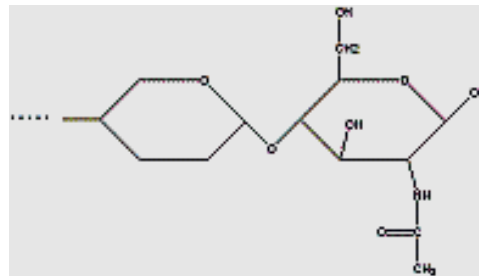


C. Structure C

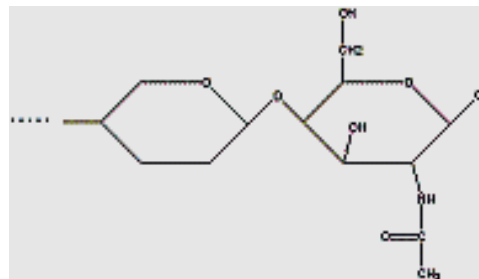


D. Structure D

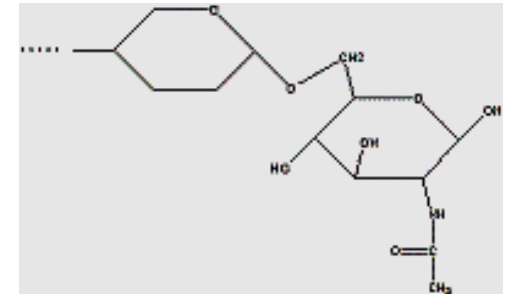
A



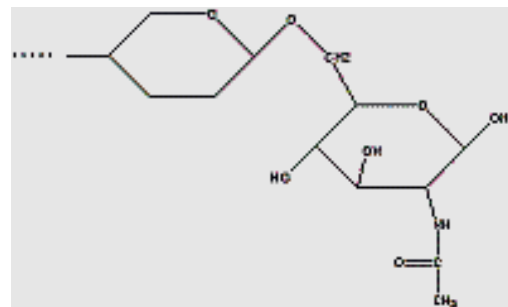
B



C



D



You were given 3 samples and told that 1 of them is a monosaccharide, 1 is an oligosaccharide, and 1 is a protein. The samples are in test tubes marked 1, 2, and 3. You don't know which compound is in which tube. You were instructed to analyze the tubes in order to identify their content. The results of your analysis are as follows:

- Tube 1 tested positive for S.

- Hydrolysis reactions occurred in tubes 1 and 3, but not tube 2.

Which tube contained the monosaccharide? The oligosaccharide?

X A. 1 and 2

X B. 2 and 3

X C. 1 and 3

X D. Not enough information is provided.

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Carbohydrates Class Activity Answers

101-NYA

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Glucose	monosaccharide	OH Carbonyl / Aldehyde	C H O	CH ₂ O	NA	NA	all	Energy Precursor to other molecules
Glycogen	polysaccharide	OH Carbonyl / Aldehyde	C H O	CH ₂ O	α-glucose	α-1,4 and α-1-6 glycosidic linkages	Animals	Short-term energy storage in animals
Cellulose	polysaccharide	OH Carbonyl / Aldehyde	C H O	CH ₂ O	β-glucose	β-1,4 glycosidic linkage	Plants	Cell wall
Chitin	polysaccharide	OH Carbonyl / Aldehyde Amine (N-acetyl)	C H O N	C ₈ H ₁₃ O ₅ N	N-acetyl-glucosamine	β-1,4 glycosidic linkage	Animals (Arthropods and some Mollusks) Fungi	Exoskeleton (animals) Cell wall (fungi)

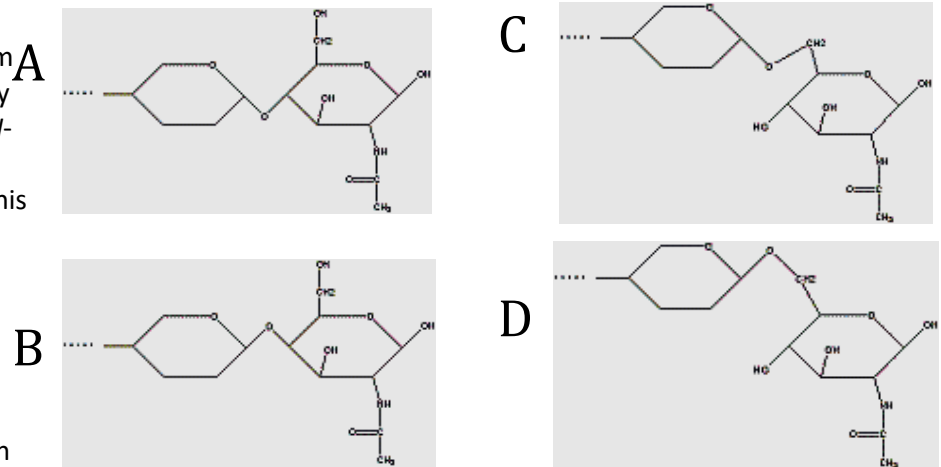
Clicker Questions

- 1- Compare the molecular formula of a carbohydrate with that of carbon dioxide. What does the presence of hydrogen atoms in carbohydrates indicate?
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- 2- Across all animal species, the main function of carbohydrates is to act as:
 - A. the structural components of cell walls.
 - B. the heritable instructions for life.
 - C. the linking molecule of triglycerides.
 - D. the sites of protein synthesis.
 - E. energy storage molecules.**

- 3- The human stomach contains a carbohydrate-based antibiotic that protects a large portion of the population from various diseases caused by the bacterium *H. pylori*. (linked to peptic ulcers, gastritis, and stomach cancer). This naturally occurring antibiotic is described as having a terminal α 1,4-glycosidic-linked *N*-acetylglucosamine (NAG), which inhibits cell wall formation in *H. pylori*. Which of the following structures is most consistent with the description of this antibiotic?

- A. Structure A**
- B. Structure B
- C. Structure C
- D. Structure D



- 4- You were given 3 samples and told that 1 of them is a monosaccharide, 1 is an oligosaccharide, and 1 is a protein. The samples are in test tubes marked 1, 2, and 3. You don't know which compound is in which tube. You were instructed to analyze the tubes in order to identify their content. The results of your analysis are as follows:
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Which tube contained the monosaccharide? The oligosaccharide?

- A. 1 and 2
- B. 2 and 3**
- C. 1 and 3
- D. Not enough information is provided.

Lipids Class Activity

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Students work in groups of 2-3 students per group

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Lipids Table

Molecule	Type of biomolecule (be specific)	Functional groups found in molecule	Elements found in molecule	C:H:O ratio (approx.)	Molecular arrangement (description of main components)	Type of linkage (be specific)	Type of organisms where molecule is found	Functions in living organisms
Cholesterol								
Oleic acid								
Phosphatidyl-ethanolamine (cephalin)								
Stearin								

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A molecule with the chemical formula $C_{18}H_{36}O_2$ is probably a:

- X** A. Carbohydrate
- X** B. Amino acid
- X** C. Protein
- X** D. Lipid

Which of the pairs to the right (image/chemical structure) is mismatched?

Beeswax



A



Safflower oil



B



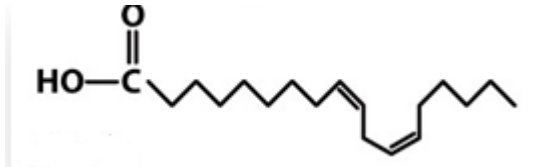
Butter



C



Safflower oil



D

X A. A

X B. B

X C. C

X D. D

Fats have more free energy per weight than carbohydrates because:

- X** A. They are made during photosynthesis.
- X** B. They have more kinetic energy.
- X** C. They have more C—H bonds.
- X** D. They have more C—O bonds.

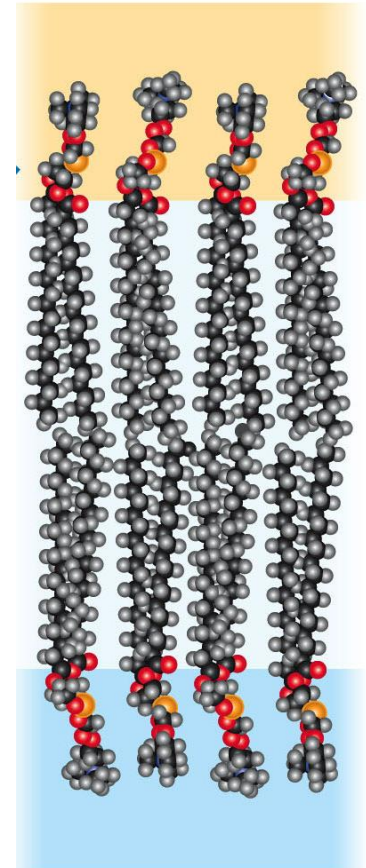
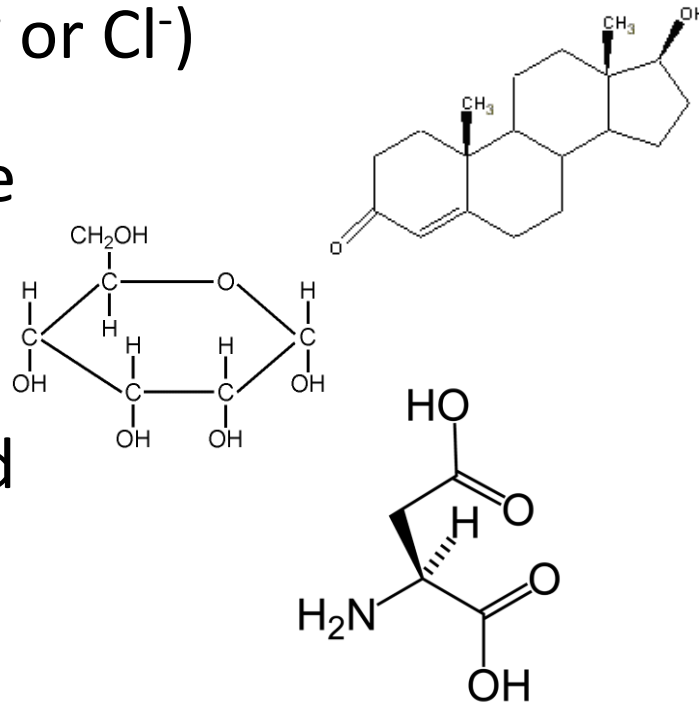
Which of the following chemical structures would be most likely to passively diffuse through the plasma membrane of a cell?

X A. Ions (K^+ , Na^+ or Cl^-)

X B. Testosterone

X C. Glucose

X D. Aspartic acid



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Cholesterol	Steroid	OH CH ₃	C H O	Variable with very low ratio for O compared to C and H	4 carbon rings	NA	animals	Cell membrane, precursor to hormones, vitamins
Oleic acid	Fatty acid	COOH	C H O	Variable with very low ratio for O compared to C and H	Monounsaturated hydrocarbon chain and carboxyl group	NA	plants	Energy storage (in the form of triglycerides)
Phosphatidyl-ethanolamine (cephalin)	Phospholipid	COOH Phosphate amino	C H O P N	Variable with very low ratio for O compared to C and H	Similar to triglyceride + phosphate + variable organic compounds	Ester and phosphodiester linkages	animals	Cell membrane
Stearin	Triglyceride	COOH OH	C H O	Variable with very low ratio for O compared to C and H	Three saturated fatty acid molecules linked to a molecule of glycerol via ester linkages	Ester linkages	animals	Energy storage

Clicker Questions

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- C. Protein
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2- Which of the following pairs (image/chemical structure) is mismatched?



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Butter



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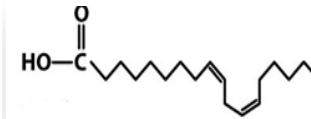
Safflower oil



B



Safflower oil



D

3- Why do fats have more free energy per weight than carbohydrates?

- A. They are made during photosynthesis.
- B. They have more kinetic energy.
- C. They have more C—H bonds.
- D. They have more C—O bonds.

4- Which of the following chemical structures would be most likely to passively diffuse through the plasma membrane of a cell?

- A. Ions (K^+ , Na^+ or Cl^-)
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- C. Glucose
- D. Aspartic acid