## Lab 9 Exercise 1: Macromolecules Student Handout

## Part I. Macromolecules

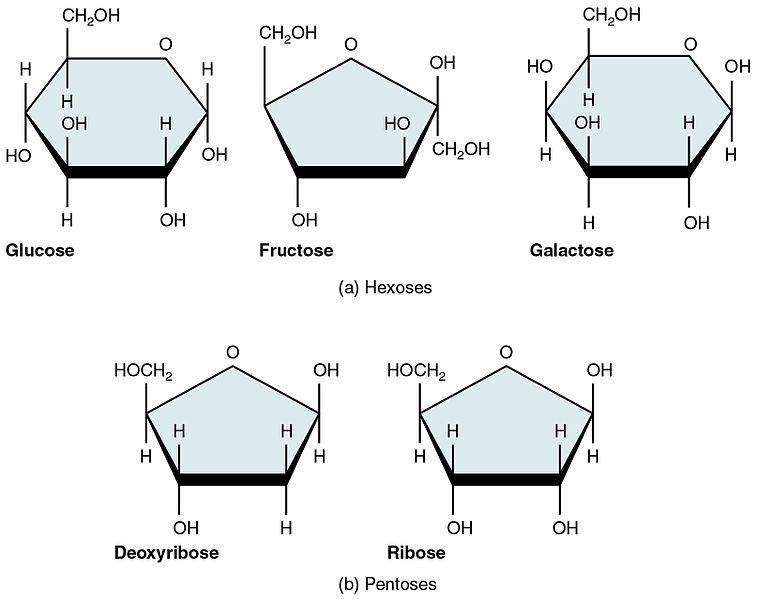
| Type | Example monomer (a molecule) | Example polymer (a macromolecule) | Example cellular structure |
| --- | --- | --- | --- |
| Carbohydrates | Glucose (a monosaccharide)  ring structure of glucose. | Amylose (a type of starch)  molecular structure of amylose a type of starch. The image has three glucose molecules attached. The dashed lines on the left and right of the molecule suffest there are additional connected molecules of glucose. | Starch granules in potato cells  starch granules in a potato cell |
| Nucleic acids | A nucleotide  the structure of a nucleotide, adenine. |  |  |
| Proteins | An amino acid The structure of an amino acid. The amino group has one nitrogen and two hydrogen atoms. The alpha carbon is in the center attached to nitrogen with an R group attached. To the right of the alpha carbon is the carboxyl gruoup.  R group= unique to each aa |  |  |
| Lipids | Fatty acid  (Contains long hydrocarbon tail)  a hydrocarbon tail |  |  |

*All images are in public domain:* [*Glucose*](https://commons.wikimedia.org/wiki/File:Alpha-D-Glucopyranose.svg#mw-jump-to-license) *and* [*Amylose*](https://en.m.wikipedia.org/wiki/File:Amylose3.svg) *by Neurotiker,* [*Nucleotide*](https://commons.wikimedia.org/wiki/File:DAMP_chemical_structure.png) *by cacycle,* [*Starch granules*](https://commons.wikimedia.org/wiki/File:PSM_V56_D0732_Starch_granules_of_the_potato.png) *from Popular Science Monthly (1899-1900),* [*Amino acid*](https://commons.wikimedia.org/wiki/File:AminoAcidball.svg) *by Yassine Mrabet,* [*Saturated Fatty acid*](https://commons.wikimedia.org/wiki/File:Blausen_0396_FattyAcid.png) *by Bruce Blaus. Blausen.com staff (2014). "*[*Medical gallery of Blausen Medical 2014*](https://en.wikiversity.org/wiki/WikiJournal_of_Medicine/Medical_gallery_of_Blausen_Medical_2014)*". WikiJournal of Medicine 1 (2)*

## Part II. Carbohydrates

Carbohydratesallow cells to store energy and provide structural support. Below are a few monosaccharides (simple sugars) important for cells. The energy in a candy bar comes from sugars, which are quickly broken down to release energy.

Figure . Five important monosaccharides



[Five Important Monosaccharides](https://commons.wikimedia.org/wiki/File:217_Five_Important_Monosaccharides-01.jpg) by OpenStax. Licensed as [CC-BY-3.0](https://creativecommons.org/licenses/by/3.0/deed.en)

The following questions require examining figures and drawing some shapes. Please contact the instructor for an alternative method to answer the questions.

Answer these questions:

1. What do you notice that is common between the naming of the sugars shown to the left?

| Click or tap here to enter text. |
| --- |

1. Which three elements are present in these sugars?

| Click or tap here to enter text. |
| --- |

1. Which of these sugars is found in DNA?

| Click or tap here to enter text. |
| --- |

1. Many sugars are used for energy storage. Figure 2 shows you a molecule of SUCROSE, which is the “table sugar” used for baking.

Sucrose is an example of a enter text saccharide.

To obtain energy from sucrose, enzymes in your body perform a enter text reaction.

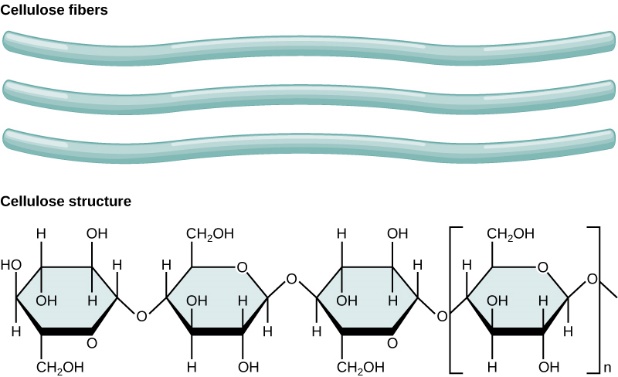
Figure . Structure of sucrose

The structure of the dissacharide sucrose.

[Structure of sucrose](https://commons.wikimedia.org/wiki/File:Saccharose2.svg) *by NEUROtiker. Image in public domain*

1. Some chains of sugars serve as structural material for cells. Plants have a cell wall made of the polysaccharide cellulose, which contains long chains of glucose subunits. Cellulose cannot be broken down by most animals, which is one reason wood is such a good building material.

Figure . Cellulose fibers and structure



[Cellulose](https://openstax.org/books/biology-2e/pages/3-2-carbohydrates) by OpenStax. [CC-BY-4.0](https://creativecommons.org/licenses/by/4.0/)

The bonds between glucose monomers are formed through (condensation/hydrolysis) reactions.

Name an organism that can break the linkages between these monomers:

| Click or tap here to enter text. |
| --- |

## Part II. Nucleic acids

Nucleic acids carry information inside cells. Genetic information is stored in DNA, and short-lived copies of this are made in the form of messenger RNA. The structure of DNA allows it to serve as a template with which cells can make a highly precise copy of their genetic information. The figure below shows you the structure of two chains (strands) of DNA nucleotides that interact together to form DNA (deoxyribose nucleic acid).

Figure . DNA nucleotides and deoxyribose nucleic acid

The DNA double helix with the nitrogenous bases inside the helix, noted as base pairs. The sugar-phosphate backbone is also labelled.

If the double helix were taken apart, we now have the structures of the nitrogenous bases and the hydrogen bonds between the two nitrogenous bases. There are two hydrogen bonds found between Thymine and Adenine and three hydrogen bonds found between Guanine and Cytosine.

[DNA Nucleotides](https://commons.wikimedia.org/wiki/File:0322_DNA_Nucleotides.jpg) by Open Stax. Licensed as [CC-BY](https://creativecommons.org/licenses/by/4.0/)

1. Every DNA strand has structural polarity (the two ends are different from each other).  
   Put a box around the PHOSPHATE GROUP at the 5’ end of each of the two strands.
2. Put a triangle around the DEOXYRIBOSE SUGAR at the 3’ end of each of the 2 DNA strands.
3. Circle a single nucleotide on each side of the model of DNA.
4. Which part of a nucleotide makes up the rung of the “ladder”?

Click or tap here to enter text.

1. When one nucleotide contains adenine, which base does the adenine interact with on the opposite strand of DNA?

Click or tap here to enter text.

1. These two strands of DNA are held together by **hydrogen bonds** between bases. How many hydrogen bonds connect the two bases from Question 10?

Click or tap here to enter text.

1. When one nucleotide contains cytosine, which base does the cytosine interact with on the opposite strand of DNA?

Click or tap here to enter text.

1. How many hydrogen bonds connect the two bases from Question 12?

Click or tap here to enter text.