**Modeling Life’s Organic Compounds**

|  |
| --- |
| This is a cut-and-tape paper exercise to emphasize the process of **dehydration synthesis**. You will be constructing models of each biochemical structure so that you have an understanding of how the structure helps the molecule perform certain functions. Sometimes it is difficult to visualize chemical reactions, especially biochemical ones. So we will be using paper models of the various organic polymers important to living things to demonstrate how they are made and broken apart for use by living organisms. |

**Introduction**

Organic molecules contain atoms of carbon bonded to hydrogen atoms. Compounds considered to be organic present in living organisms are classified into four groups of **macromolecules**: carbohydrates, lipids, proteins and nucleic acids. These are known as **polymers**, and are generally large molecules composed of smaller repeating subunits known as **monomers**. These monomers are assembled into polymers using a chemical reaction known as **dehydration synthesis** (or *condensation* – meaning that a molecule of water is a formed as a product when the two monomers join together).

An example is illustrated:



*In the figure above, notice how a glucose molecule and a fructose molecule are being joined together to make a molecule of sucrose. Notice that a water molecule is formed from the removal of a hydrogen ion and a hydroxide ion, and a* ***glycosidic linkage*** *forms between the two individual sugars.*

The reverse of this process is known as **hydrolysis**, and in living systems, involves enzymatic activity that results in adding a water molecule being *added* to join the individual monomers together.



*Notice how the figure above shows that a glucose molecule and a fructose molecule are being split apart from one another with the help of the enzyme invertase. Water is used to hydrolyze the glycosidic linkage that initially joins the monomers together.*

You will model these processes using paper models of the monomers used to construct the organic macromolecules.

Molecules for Cell Energy and Structure—Carbohydrates

1. To build carbohydrates, **monosaccharides** are needed. Obtain two glucose monomer papers and number the carbons like this:



Numbering the carbon atoms is important so that you can determine where the bonding of monomers will take place.

1. Now you will form a **disaccharide**. Join (bond) the two glucoses together by cutting off an –H– from one molecule and an –OH– from another and taping the 2 molecules together forming a **glycosidic** bond.
2. Then take the trimmed H-O-H, affix it to the water drop, and tape/glue the water drop onto the glycosidic bond. Your finished product may look something like this:



1. Create a second disaccharide (repeat steps 1-3).
2. Bond both disaccharides together using the same paper dehydration synthesis. You have now created a **polysaccharide**.
3. Name your sugar, keeping in mind that sugars end in the “-ose” suffix.

Molecules for Cell Energy and Structure—Lipids

To build lipids, you will first build a saturated fat and then build an unsaturated fat:

a. **Saturated**: these fatty acids have no double bonds along the carbon backbone

b. **Unsaturated**: these fatty acids have at least one double bond in the carbon backbone

1. **Saturated Fat**: Take one glycerol molecule and three differently colored **saturated** fatty acid molecules and join them by cutting off an –H– from one molecule and an –OH– from another and taping the two molecules together forming an **ester bond**. Label this bond.
2. Then take the trimmed H-O-H, affix it to the water drop, and tape the water drop onto each ester bond.
3. **Unsaturated Fat**: Repeat this process to build an unsaturated fat, except use an unsaturated fatty acid paper in place of ONE of the saturated fat papers.

Molecules For Cell Structure, Transport and Regulation—Proteins (polypeptides)

1. To build a protein, select at least 5 amino acid papers.
2. Now, join your amino acids together by cutting off an –H– from one molecule and an –OH– from another and taping the two amino acid molecules together to form a **peptide bond**. Be sure to label each amino acid and the peptide bond that forms between them.
3. Then, take the trimmed H-O-H, affix it to the water drop, and tape the water drop onto the peptide bond. Your finished product may look like this:



***Note****: This is a very short polypeptide and that proteins in biological systems can be hundreds or even thousands of amino acids long.*

1. Name your protein a name, keeping in mind that protein names typically end in the suffix “—in.”