Macromolecule Manipulative Review

Submitted by: Jennifer Tyrell, AP Biology Teacher, Jefferson County Schools, Dandridge, TN

Grade- 10

Lesson Duration- This activity is versatile; it can be a quick 10 minute review or a longer 30 minute activity.


Background Information

There are four groups of compounds that are found in all living things. These four groups are called Macromolecules or Biomolecules. These two words can be used interchangeably. Macro = big, so the word literally means "big molecules”. They are made of smaller units called monomers. Monomers join together to form polymers. Mono = one Poly = many

Carbohydrates are molecules made of a monomer called monosaccharides. Monosaccharides can join to form disaccharides (di-two) or polysaccharides. Carbohydrates serve 3 functions: 1. Primary energy storage 2. Provide structure 3. Cellular communication. Examples of carbohydrates include sugars & starches like glucose, cellulose, glycogen, ribose, sucrose. Many carbohydrate names end with “ose”.

Proteins are molecules made of a monomer called amino acids. Examples of amino acids: serine, tryptophan, leucine. There are 20 different standard amino acids found in nature. Amino acids are made of a carbon atom with an amino group, carboxyl group, and R group, which determine which amino acid is made. Proteins serve several different functions in the cell including: controlling reactions (enzymes), regulating cellular processes (insulin), forming (actin & myosin), transporting molecules (protein channels, hemoglobin), and fighting disease (antibodies).

Lipids are made from the monomer fatty acid. Fatty acids are hydrophobic, which means they don't mix with water. Lipids serve many functions in the cell including: secondary energy storage, boundaries, steroids, waterproofing. Examples of lipids include: fats, oils, waxes, testosterone, cholesterol, cell membrane

Nucleic acids are made of nucleotides. Nucleotides are a monomer made from a sugar, phosphate group, and a nitrogenous base. The primary function of nucleic acids is the carry the genetic code, but ATP, the molecule that serves as the currency for energy in the cell is also a nucleic acid. Examples of nucleic acids are DNA, RNA, and ATP.

There are laboratory tests that can be used to determine the presences of these macromolecules. These tests and their results are:

Benedict’s test for glucose (or reducing sugar): positive result - red/orange
Iodine test for starch, also called Lugol's test: positive result - black
Brown paper bag test for lipids: positive result - clear
Biuret's test for protein: positive result - purple

Lesson Objective

Students will be able distinguish between proteins, carbohydrates, lipids, and nucleic acids. Students will be able to recognize images of the 4 groups listed above. Students will be able to identify positive tests for the macromolecules.
**Instructional Process**

This activity should follow instruction on the 4 groups of macromolecules. Teacher should print the attached macromolecule manipulative sheets. A student aid can cut out the words and pictures in advance and place them in a small ziploc baggie. Print everything on cardstock to make it last. Students can work independently, in pairs, or in groups. Each needs 1 manipulative grid and a 1 baggie of words and pictures.

Students should be instructed to arrange the words and pictures on the grid to match them to the appropriate macromolecule.

After students have had time to arrange the words and pictures, teacher can show the answer key on the board for students to check their work.

**Assessment/Follow-up**

Create a Venn diagram to compare and contrast the 4 groups of macromolecules. Draw a large 4 part Venn diagram.

![Venn Diagram](image)

Label each circle with one of the 4 macromolecules. Fill in the diagram with as much information as possible. The locations where the circles overlap should be filled with information that the macromolecules have in common.

**Key Vocabulary**

Macromolecule, biomolecule, monomer, polymer, carbohydrate, monosaccharide, polysaccharide, disaccharide, protein, amino acid, lipid, fatty acid, nucleic acid, nucleotide, Biuret reagent, Benedict’s test, Lugol's test

**Safety and Cleanup Required**

If materials are printed on cardstock, they can be saved and used by classes year to year. Each set of words and pictures should be collected into a plastic baggie for storage.

**Alignment with TN Science and Math Standards**

CLE 3210.1.2 Distinguish among the structure and function of the four major organic macromolecules found in living things.

✓ 3210.1.3 Design a graphic organizer that compares proteins, carbohydrates, lipids, and nucleic acids. SPI 3210.1.3 Distinguish among proteins, carbohydrates, lipids, and nucleic acids.

SPI 3210.1.4 Identify positive tests for carbohydrates, lipids, and proteins.
<table>
<thead>
<tr>
<th>Carbohydrates</th>
<th>Proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipids</td>
<td>Nucleic Acids</td>
</tr>
<tr>
<td>Monosaccharide</td>
<td>Main energy storage</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Sugars</td>
<td>Starch</td>
</tr>
<tr>
<td><strong>Most names end in “ose”</strong></td>
<td>Ribose</td>
</tr>
<tr>
<td>Amino Acid</td>
<td>Indicator: Brown Paper</td>
</tr>
<tr>
<td>Control reactions</td>
<td>Transport molecules</td>
</tr>
<tr>
<td>Form bones &amp; muscles</td>
<td>Fight Disease</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>Insulin</td>
</tr>
<tr>
<td>Fatty acid</td>
<td>Steroids</td>
</tr>
<tr>
<td>Boundaries</td>
<td>Waterproofing</td>
</tr>
<tr>
<td>Oils</td>
<td>Waxes</td>
</tr>
<tr>
<td>Cell Membrane</td>
<td>Hydrophobic</td>
</tr>
<tr>
<td>Nucleotide</td>
<td>Indicator: Benedict’s</td>
</tr>
<tr>
<td>Carry the genetic code</td>
<td>DNA</td>
</tr>
<tr>
<td>Positive Test: Red/Orange</td>
<td>Positive Test: Clear</td>
</tr>
</tbody>
</table>
**Carbohydrates**
- Monosaccharide
- Sugars: Ribose, Glucose, Starch
- Main Energy Storage
- Provide Structure
- Most Names end in “ose”
- Indicator: Benedict
- Positive Test: Red/Orange
- Indicator: Iodine
- Positive Test: Black

**Proteins**
- Amino Acids
- Control Reactions
- Transport Molecules
- Regulate Cell processes
- Form bones & muscles
- Enzymes
- Fight Disease
- Insulin, Hemoglobin, Antibodies
- Indicator: Biuret’s
- Positive Test: Purple

**Lipids**
- Fatty acid
- Boundaries
- Oil, Steroids, Fats, Waterproofing
- Waxes, Secondary energy storage
- Cell Membrane
- Hydrophobic
- Indicator: Brown Bag
- Positive Test: Clear

**Nucleic Acids**
- Nucleotide
- Carry the genetic code
- DNA, RNA