Activity 2: McMush Lab

(Modified from South Orange and Maplewood School District; see “On the web”)

**Introduction:** Carbohydrates include sugars and their polymers. The simplest carbohydrates are the *monosaccharides*, single sugars also known as simple sugars. *Disaccharides* are double sugars, consisting of two monosaccharides joined by condensation synthesis. The most prevalent disaccharide is *sucrose*, better known as table sugar. Its two monomers are glucose and fructose.

Proteins account for more than 50% of the dry weight of cells, and they are instrumental in almost everything cells do. When two amino acids are arranged so that the carboxyl group of one is adjacent to the amino group of the other, an enzyme can join the amino acids by means of condensation synthesis, forming a covalent linkage called a *peptide bond*. A polymer of many amino acids linked by peptide bonds is a polypeptide chain.

Lipids are a chemically diverse group of compounds that share one important trait: They have little or no attraction for water. This hydrophobic behavior of lipids is based on their molecular structure. Although they may have some polar bonds associated with oxygen, lipids consist mostly of hydrocarbon regions with nonpolar bonds. Fats or triglycerides are large molecules constructed from two kinds of smaller molecules: glycerol and fatty acids. Animal fats, in general, are saturated and solidify at room temperature. Saturated lipids contain single bonds between carbon atoms. Plant fats are unsaturated, and liquid at room temperature. An unsaturated fatty acid has one or more double bonds, formed by the removal of hydrogen atoms from the carbon skeleton.

**Purpose:** In this lab, you will test for specific compounds and then determine if those compounds are present in a mystery meal using chemical indicators.

**Materials:**

 Mystery Mush Test Tube Clamp Graduated Cylinder

 Beaker Hot Plate Test tube/rack

 Biuret Solution Iodine Solution Benedict’s Solution

Known solutions: Monosaccharide, disaccharide, polysaccharide, protein, and lipid

**Safety Consideration:** All students are required to wear goggles for the duration of the lab. They may opt to wear an apron. Hot hands and test tube holders will be provided to remove test tubes from hot plate.

**Part I: Testing of Known Substances**

*Protein test:*

1. Place 5 mL of the protein solution (a ground up egg white) into your test tube.

2. Add 10 mL of Biuret solution.

3. Observe any color change. Record it in your chart.

*Glucose test (simple sugar):*

1. Place 5 mL of the glucose solution into your test tube.

2. Add 3 mL of Benedict's solution. Place the tube in a beaker of boiling water and boil for five minutes. Use test tube clamps to hold hot test tubes.

3. Observe any color change. Record it in your chart.

*Starch test (complex carbohydrate):*

 1. Place 5 mL of the starch solution into your test tube.

 2. Add 5 mL of Lugol's iodine solution.

 3. Observe any color change. Record it in your chart.

*Lipid Test*

1. Place 1 mL of vegetable oil on one small area of a paper bag. On another area, place a small amount of butter.
2. Foods that contain lipids will leave a translucent mark on brown paper bag material. Record your results in the chart.

|  |  |  |
| --- | --- | --- |
| Biomolecule | Indicator | Observations |
| Proteins | Biuret |  |
| Lipids | Brown paper bag |  |
| Simple Sugars | Benedict |  |
| Starch | Iodine |  |

**Part II: Mystery Meal**

**Hypothesis:** Write a statement (If…then…) that predicts what biomolecules may be present in the mystery meal.

**Procedure:**

1. Fill a beaker half full with water. Turn hot plate on high and place beaker on top.
2. Place 3 mL of the mystery meal onto one side of brown paper bag. On the other side, place 3 mL of water. Let sit for five minutes.
3. Place 5 mL of unknown sample into each test tube. In three other test tubes, place 5 mL of water.
4. In test tube 1, place 5 mL of Lugol's iodine solution. Observe any color changes and record in data table. Repeat this process in the test tube containing water.
5. In test tube 2, place 5 mL of Biuret solution. Observe any color changes and record in data table. Repeat this process in the test tube containing water.
6. In test tube 3, place 5 mL of Benedict’s solution. Then, place test tube in hot water bath for five minutes. Observe any color changes and record in data table. Repeat this process in the test tube containing water.
7. Wipe off any liquid from the brown paper bag and hold it up to the light. Translucence in the paper indicates lipids in the sample.

**Results:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bio-molecule** | **Prediction based on smell and appearance** | **Indicator** | **Observations** |
| Proteins |  | Biuret |  |
| Lipids |  | Brown paper bag |  |
| Simple Sugars |  | Benedict |  |
| Starch |  | Iodine |  |

Analysis:

1. What portion of the mystery meal might have provided each of the four macromolecules?

2. ***Predict*** which biomolecules should be present in the following food substances and indicate which test you would apply in order to detect the presence of these macromolecules. You may need to consult additional resources.

|  |  |  |
| --- | --- | --- |
| *Food Substance* | ***Predicted Macromolecule*** | ***Test to be used*** |
| Yucca root |  |  |
| Roti flatbread |  |  |
| Egg whites |  |  |
| Agave nectar |  |  |
| Black beans |  |  |
| Collard greens |  |  |

3. ***Infer*** how the presence of biomolecules can make food either “healthy” or “unhealthy.”

4. How might diet choices between different populations influence life expectancy? Give evidence to support your claim.

5. ***Infer*** how biomolecules and food relate to growth and development in an organism. How might this apply to plants or fungi? Give evidence to support your claim.

On the web

South Orange and Maplewood School District. McMush lab: Testing for the presence of macromolecules. [*www.somsd.k12.nj.us/Page/2902*](http://www.somsd.k12.nj.us/Page/2902)