

**Introduction:** There are four broad classes of macromolecules that can be found in living systems. Each type of macromolecule has a characteristic structure and function in living organisms. You can use your knowledge of the basic structure of each macromolecule to perform tests in the lab that detect the presence or absence of key functional groups or overall characteristics in various substances. In this lab, you will utilize the following procedures to detect three of these macromolecules in everyday household items - note what each procedure will detect in which macromolecules.

**Tests:** Chemicals are used many times as indicators - that is, they show us if the presence of specific macromolecules can be found in given substances. This lab focuses on identifying three of the four macromolecules we have studied (carbs, lipids, proteins) using **INDICATORS\*\***. Read the procedures for the Macromolecule Lab and complete the indicator table below.

**\*\*INDICATORS are chemicals that react or change color in the presence of another compound..we use them to test for the presence (or absence!) of particular compounds.**

**Table 1.** A list of the indicators (detection reagents) used to reveal the presence of specific macromolecules.

Test (Procedure)	Structure/Molecule Detected:	Structure/Molecule Found in:
Benedict's	Reducing Sugars (sugars with a free aldehydy or ketone group; typically mono disaccharides)	Carbohydrates
Iodine	Starch	Carbohydrates
Stain	Water insoluble substances	Lipids
Biuret's	Peptide Bonds	Protein

**Table 2.** Chemical explanations for he colorimetric changes observed in macromolecule detecton tests.

Detection Reagent	Explanation of Detection
Benedict's	Contains <b>Copper Sulfate</b> . Copper binds to oxygen in the free aldehyde or ketone group and the Coppoer Oxide that is formed transmits a brown color
Iodine	<b>Iodine</b> interacts with and binds to a structure in the starch molecule, the new structure transmits a dark bluish black color
Stain	Water insoluble substances interact with other water insoluble substances. Does it dissolve in water.
Biuret's	Contains <b>Copper Sulfate</b> and <b>Sodium Hydroxide</b> . Copper Sulfate actively binds to the peptide bonds found in proteins, and the structure formed transmits a violet color in an alkaline (basic) environment, which is provided by the presence of the NaOH.

**Pre-lab Questions:** Answer the following questions asking you to explain using complete sentences prior to starting the lab. **(6 points total)**

1. What are macromolecules and explain are they important?
2. What elements are present in all macromolecules?
3. Are all macromolecules found in food? Explain.

4. What macromolecule will you NOT be testing in today's lab? Why?
5. What elements are present in proteins not found in carbohydrates or lipids?
6. Biurets solution reacts with the peptide bonds in the polypeptide chains. A purple colored complex is formed. What macromolecule has peptide bonds?
7. Extra Credit (+2) Explain why the structure of a macromolecule is so important to function. Give an example or analogy.

**Purpose:** What is the purpose of this lab? (1 pt)

**Hypothesis:** Generate a hypothesis based on the introduction that you have on the Macromolecule Lab. Which foods will contain which macromolecules? (3 pt total)

1. Water
2. Oil
3. Milk
4. Oatmeal
5. Apple Juice
6. Unknown X

**Table 3. Indicator Table (8 pts total)**

Indicator/Test	Tests for presence of:	Original Color/Characterisitc	Color/Characteristic it changes to if macromolecule present

\*\*\*\*SHOW COMPLETED PRE-LAB ON LAB DAY 1 AND HAVE TEACHER INITIAL THIS LINE FOR 2 PTS CREDIT \_\_\_\_\*\*\*\*

**Background:**

One characteristic of life is that living things are made up of molecules containing carbon. These are called **ORGANIC MOLECULES**. In our class we have been referring to them as macromolecules since they are necessary for life. The most common organic compounds found in living organisms are **LIPIDS, CARBOHYDRATES, PROTEINS, and NUCLEIC ACIDS**. Common foods, which often consist of plant materials or substances derived from animals, are also combinations of these organic compounds. Simple chemical tests with substances called **indicators** can be conducted to determine the presence of organic compounds. *A color change of an indicator is usually a positive test for the presence of an organic compound.*

**Purpose:**

To use indicators to test for the presence of lipids, carbohydrates, and proteins in various foods.

**Materials:**

Indicators (Biuret reagent, Benedict's solution, Lugol's solution)

Food in bottles, 10 test tubes, beaker, hot plate, test tube holder, brown paper towel, 2 well plates.

**Procedure:****LIPIDS (1 test)**

## TEST 1: Testing for Lipids

1. Tear off a piece of paper towel 30 cm long and put the names of your group members in the upper right hand corner.
2. Draw 6 small squares, approximately 3 cm each, and label each with the name of 1 of the foods (water, oil, milk, oatmeal, apple juice, and Unknown X).
3. Put 1 drop of each of the foods in the corresponding boxes on the paper towel.
4. Put the paper towel aside while you do the other 4 tests.
5. When the paper towel is dry, record your observations in the data table below. Look for a grease stain.

**CARBOHYDRATES (2 tests)**

## TEST 2: Testing for Starches

1. Fill 6 wells in your well plate: water, oil, milk, oatmeal, apple juice, and Unknown X. (see diagram)
2. Add 10 drops of Iodine Solution to each well.
3. Check for any color change and record data in table.
4. Clean and dry well plate

## TEST 3: Testing for Sugars

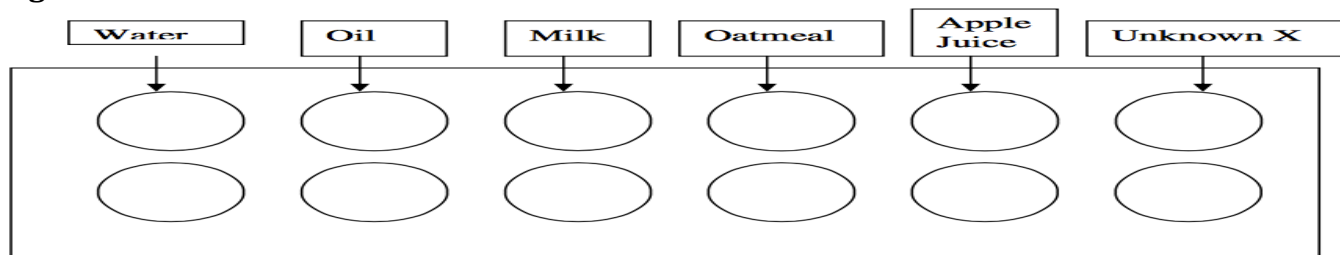
1. Put 1 dropper full of each food (water, oil, milk, oatmeal, apple juice, and Unknown X) in 6 different test tubes. Make sure to LABEL all test tubes.
2. Add 10 drops of Benedict's Solution to each test tube and place them all CAREFULLY into the hot water bath for 3-5 minutes.
3. Remove test tubes from hot water bath using designated tongs and place them into test tube holders. Note the color change and record into the table.
4. Wash all test tubes and place in test tube racks upside-down to dry.

**PROTEINS (1 test)**

## TEST 4: Testing for Proteins

1. Fill 6 wells in your well plate: water, oil, milk, oatmeal, apple juice, and Unknown X. (see diagram)
2. Add 10 drops of Biuret's Solution to each well.
3. Check for any color change and record data in table.
4. Clean and dry well plate

**Diagram:** 6 wells filled with the various substances.



**Table 4: Results from the testing of 4 solutions for organic compounds (carbohydrates, lipids, and proteins). (18 points total)**

Substances	Lipid Test (1 Test)		Carbohydrate Tests (2 Tests)				Protein Test (1 Test)	
	Spot or No Spot	Lipid Present (+)	Benedict Color	Sugar Present (+)	Iodine Color	Starch Present (+)	Biuret Color	Protein Present (+)
Water								
Oil								
Milk								
Oatmeal								
Apple Juice								
Unknown X								

**Results (5 points total):**

1. Which test substances contained LIPIDS?
2. Which test substances contained STARCH?
3. Which test substances contained SUGAR?
4. Which test substances contained PROTEIN?
5. Which test substances did not test positive for ANY organic compounds?

\*\*\*\*\*CLEAN UP STATION AND HAVE TEACHER INITIAL THIS LINE FOR 2 PTS CREDIT \_\_\_\_\_\*\*\*\*\*

**POST LAB QUESTIONS** – Answer the following questions asking you to explain using complete sentences. **(26 points total)**

1. Which macromolecules (or types of macromolecules) did you test for in this lab?
2. What were the test substances (reagents) you used to the tests?
3. What food substances did you test?

**4. Stain Test:**

- a. What is the name of the test substance and what does it test for?
- b. How do you know from the test that this macromolecule is present?
- c. What were the results of the test?
- d. What can you conclude from the results about the presence or absence of this macromolecule in each substance tested?

**5. Carbohydrate Benedict" Test:**

- a. What is the name of the test substance and what does it test for?
- b. How do you know from the test that this macromolecule is present?
- c. What were the results of the test?
- d. What can you conclude from the results about the presence or absence of this macromolecule in each substance tested?

**6. Carbohydrate Iodine Test:**

- a. What is the name of the test substance and what does it test for?
- b. How do you know from the test that this macromolecule is present?
- c. What were the results of the test?
- d. What can you conclude from the results about the presence or absence of this macromolecule in each substance tested?

**7. Protein Biurets Test:**

- a. What is the name of the test substance and what does it test for?
- b. How do you know from the test that this macromolecule is present?
- c. What were the results of the test?
- d. What can you conclude from the results about the presence or absence of this macromolecule in each substance tested?

8. Summarize all of the positive test results. (Connect your response to the purpose, hypothesis, data, and explanation as to how molecule was identified. 5 points total)

9. Describe anything that might have affected your results (sources of error).

10. Make a suggestion for improving the lab in the future.