Biology

Identifying Macromolecules

Purpose
To test for the presence of macromolecules in various foods.

Background
The most common macromolecules (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 macromolecules. Some of these compounds can be detected by taste, while others cannot. Therefore, scientists use certain tests to identify the presence of macromolecules.

Introduction
You're a scientist at the Food and Drug Administration's Center for Nutrient Analysis in Atlanta, Georgia. You analyze food based on the label declaration. Tests are performed for proteins, lipids and carbohydrates. Recently, there has been fear of an attack by a new species of undead (similar to a zombie). Scientists believe that the only way to combat this attack is by feeding them a substance with high levels of complex carbohydrates and protein, since these macromolecules appear to kill the new species' cells. Scientists have also found that the undead seem to thrive and grow rapidly when fed simple sugars. Your team is taking a break from the regular task of food label analysis in order to determine which of three substances – yogurt, milk or oatmeal – will be the best food to fight off the invasion, based on the tests you will be performing today. It is up to you and your team to save Earth!

Materials

Test Tube	Distilled Water	Glass Marking Pencil	Graduated Cylinder	Apple Juice
Test Tube Rack	Sudan III Stain	Pipette	Biuret Reagent	Potato Solution
Hot Plate	Beaker	Oatmeal Solution	Test Tube Holder	Milk
Benedict's Solution	Iodine	Cooking Oil	Gelatin Solution	Yogurt

Procedure (GOGGLES MUST BE WORN FOR THE ENTIRE LAB PERIOD!)

Lipid Test

1. Obtain five test tubes. Label each one of the following: distilled water, cooking oil, apple juice, gelatin solution, potato solution.
2. Use a graduated cylinder to transfer 5 mL of distilled water into the test tube labeled "distilled water."
3. Repeat step 2 with each of the food substances. (Each test tube should have only one food item in it.)
4. Add 5 drops of Sudan III stain to each test tube.
5. *Gently* shake the contents of each test tube. **CAUTION**: Use extreme care when handling Sudan III to avoid staining hands or clothing.
6. Sudan III will dissolve in lipids and stain them red. In the Data Table, write a "+" if lipids are present or a "-" if lipids are not present.
7. Wash the test tubes thoroughly. Move on to Procedure Part II.

Protein Test

1. Obtain five test tubes. Label each one of the following: distilled water, cooking oil, apple juice, gelatin solution, potato solution.
2. Use a graduated cylinder to transfer 5 mL of distilled water into the test tube labeled "distilled water."
3. Repeat step 2 with each of the food substances. (Each test tube should have only one food item in it.)

4. Add 5 drops of Biuret Reagent to each test tube.
5. *Gently* shake the contents of each test tube. **CAUTION:** Biuret Reagent contains a strong base. If you splash any on yourself wash it off immediately with water.
6. Biuret Reagent changes color from blue to violet in the presence of protein. In the Data Table, write a "+" if protein is present or a "-" if protein is not present.
7. Wash the test tubes thoroughly. Move on to Procedure Part II.

Simple Carbohydrate Test

1. Obtain five test tubes. Label each one of the following: distilled water, cooking oil, apple juice, gelatin solution, potato solution.
2. Use a graduated cylinder to transfer 5 mL of distilled water into the test tube labeled "distilled water."
3. Repeat step 2 with each of the food substances. (Each test tube should have only one food item in it.)
4. Add 10 drops of Benedict's Solution to each test tube.
5. *Gently* shake the contents of each test tube.
6. Place the test tubes in the hot water bath for 3-5 minutes. Remove the test tubes using test tube holders.
7. A rusty brown color in response to Benedict's Solution indicates a large amount of simple sugars. An orange color indicates a moderate amount and a green or yellow color indicates a small amount of sugar. A blue color indicates no sugar present. In the Data Table, write a "+" if simple carbohydrates are present or a "-" if simple carbohydrates are not present.
8. Allow the test tubes to cool and then wash them thoroughly. Move on to Procedure Part II.

Complex Carbohydrate Test

1. Obtain five test tubes. Label each one of the following: distilled water, cooking oil, apple juice, gelatin solution, potato solution.
2. Use a graduated cylinder to transfer 5 mL of distilled water into the test tube labeled "distilled water."
3. Repeat step 2 with each of the food substances. (Each test tube should have only one food item in it.)
4. Add 5 drops of Iodine to each test tube.
5. *Gently* shake the contents of each test tube.
6. Iodine causes complex carbohydrates to turn dark blue or black. Substances without starch are colored brown by the iodine, but do not react with it. In the Data Table, write a "+" if complex carbohydrates are present or a "-" if complex carbohydrates are not present.
7. Wash the test tubes thoroughly. Move on to Procedure Part II.

Procedure Part II (GOGGLES MUST BE WORN FOR THE ENTIRE LAB PERIOD!)

1. Share your results with the team members at your lab table. Your data table should now be complete for distilled water, apple juice, gelatin solution, potato solution and cooking oil.
2. Obtain an unknown substance from your teacher. Your teacher will tell you what the substance is. Using background knowledge, form a hypothesis that will state what macromolecules will be present in your unknown substance. Record your hypothesis on the answer sheet.
3. Perform the test you completed in Procedure Part I with your unknown substance. Use the same procedure, but only use the unknown substance. Record your data in the Data Table.
4. Once all groups at the lab table have completed the tests with the unknown substance, share your data.
5. Choose one member of the lab table to record all of the unknown data on the board. Record the data from the other two unknowns (on the board) in your Data Table.
6. Double check to make sure your station is clean and organized; then answer the analysis questions.

Biology Names _____

Identifying Macromolecules

Pre-Lab Questions: Answer the following questions using complete sentences prior to starting the lab procedure.

1. What is the purpose of using distilled water as one of your test substances?

2. What is the purpose of washing the test tubes thoroughly between uses?

3. What macromolecule will you NOT be testing in today's lab?

Data Table

	Lipid	Protein	Simple Carbohydrate	Complex Carbohydrate
Distilled Water				
Cooking Oil				
Gelatin Solution				
Apple Juice				
Potato Solution				
Unknown A _____				
Unknown B _____				
Unknown C _____				

Hypothesis _____
_____

Analysis & Conclusions: Answer the following questions using complete sentences. Be thorough in your responses, using lab data when applicable

1. Which macromolecules were present in your unknown? _____
Does this agree or disagree with your hypothesis? Be specific.

2. You are getting prepared to take a "Man vs. Wild" hike. Using your data and your understanding of nutrition, which of the unknown substances would provide the best fuel for your body to endure this long adventure? Explain.

3. Do the sugars in the apple juice need to be broken down by your digestive system before they can be utilized as an energy source for your body? Explain.

4. People with diabetes are instructed to avoid foods that are rich in carbohydrates. How could your observations in this investigation help you decide whether a food should be served to a person with diabetes?

5. What conclusion could you make if a positive test for any of the macromolecules occurred in the test tube containing only distilled water?

6. A very thin slice is removed from a peanut and treated with Sudan III stain. Then a drop of Biuret Reagent is added to the peanut slice. When you examine the peanut slice under a microscope, patches of red and blue-violet are visible. What conclusions can you draw from your examination?

7. You must save the world! Using your data and the information provided by the scientists (in the introduction), which of the unknown substances is the best defense against the undead? Why?

8. Using the Sudan III Stain, what indicates the presence of a lipid?

9. Using Iodine, what indicates the presence of a complex carbohydrate?

10. Using Benedict's Solution, what indicates the presence of a simple carbohydrate?

11. Using Biuret Reagent, what indicates the presence of a protein?

12. Describe at least two errors you may have made while completing this lab. Explain how these errors may have impacted your results.

13. Do you feel that the lab you are turning in is of exceptional quality? Explain.

14. Do you feel you were given adequate time to complete this lab? Do you believe you and your partner used your time wisely? Explain.