

Who took Kaleb's iPod? -- An organic compound mystery

Dr. Jennifer Doherty, Dr. Ingrid Waldron and Dr. Lori Spindler, Department of Biology, University of Pennsylvania, copyright 2009

Adapted from "Identity of Organic Compounds" from Biology Laboratory Manual A from Prentice-Hall;

Also inspired by "Crime Scene Activity" by Kathy Paris, Bethel High School <http://www.accessexcellence.org/AE/ATG/data/released/0535-KathyParis/index.php>

Kaleb is a 10th grade student at City High School who works at McDonald's on the weekends. While on break, Kaleb was studying for his biology test and listening to his new iPod. There were four other workers taking a break at the same time, each having something different for lunch.

Kaleb's girlfriend stopped by near the end of his break, and he rushed out to see her and forgot his iPod and biology book in the break room. When he realized, he hurried back and found only his biology book and some food crumbs. His iPod was gone!

First Kaleb freaked out, but he calmed down when he realized he could use his knowledge of organic compounds to figure out which of his coworkers left the crumbs on his textbook and who took his iPod.

Organic Compound Investigation – DAY 1

What are organic compounds?

Almost all of the food we eat comes from plants and animals. Plants and animals contain mainly water and organic compounds, which are molecules made by living organisms such as plants or animals. The table below lists the most common types of organic compounds found in living organisms. For each type of organic compound, give one or two examples and describe one characteristic, e.g. whether it is greasy, whether it contains genetic material, whether there is lots of this type of organic compound in meat or lots in pretzels and potatoes.

Type of Organic Compound	Examples	Characteristic or Type of Food That Has Lots of This Type of Organic Compound
Carbohydrates		
Lipids		
Nucleic acids		
Proteins		

Today you will be testing the substances listed in the following table. Predict what type of macromolecule(s) would be found in each of the substances below.

Substance	Would you find a carbohydrate, Lipid and/or protein? Or none of these?
Vegetable oil	
Glucose	
Starch from corn or potatoes	
Powdered egg whites	
Water	

What are indicators?

An indicator is a substance that changes color in the presence of a particular type of molecule. Today you will learn how to use several indicators to test for the presence of carbohydrates and proteins. You will also use a different type of test for lipids. In your next class, you will use these tests to analyze several types of food and the evidence left at the scene of the crime to find out who left the crumbs on Kaleb's textbook.

Testing for lipids

1. If a food that contains lipids is put on brown paper, it will leave a spot that lets light through. To test for lipids, divide a piece of a brown paper bag into 5 sections. Label the sections "vegetable oil", "glucose", "starch", "egg whites", and "water".
2. In each section, rub a small amount of the substance onto the brown paper.
3. With a paper towel, rub off any excess that may stick to the paper. Set the paper aside until the spots appear dry—about 10 to 15 minutes.
4. Which section do you expect to test positive for lipids?
5. Which sections do you expect to test negative for lipids?
What is the purpose of doing these tests?
6. Continue on with the rest of the tests. After all the sections of the brown paper are dry, hold it up to a bright light or window. You will notice that at least one sample has left a spot that lets light through on the brown paper. The spot indicates the presence of lipids.
7. Complete the last column of the data table below. Put a plus for any samples which tested positive for lipids and a minus for the samples which tested negative.

Sample	Carbohydrate Tests				Protein Test		Lipid Test
	Test tube color	Glucose present	Iodine test color	Starch present	Biuret test color	Protein present	Lipid present
Vegetable oil							
Glucose							
Starch from corn or potatoes							
Powdered egg whites							
Water							

Testing for Carbohydrates

1. Today you will be using chemicals as indicators. You must **wear gloves to protect yourself**.
2. You will use indicators to test for two common types of carbohydrates: glucose (a specific type of sugar) and starch. Obtain 5 containers and use masking tape to make labels for each container. Label the containers "vegetable oil", "glucose", "starch", "egg whites", and "water".
3. For each container, add a small amount of the substance indicated on the masking-tape label. Now add about 2 ml of water to each container. Stir the contents of each container to mix the sample and water.
4. To test for glucose you will use Benedict's solution. Follow the directions below to test for glucose (a carbohydrate).
 - 1) Gather the foods that you have at your lab station.
 - 2) Mix a small food sample with 6-8 drops of the turquoise Benedict's solution in a clean test tube.
 - 3) Mash up and stir with a glass rod if needed.
 - 4) Place the test tube into the boiling water for 3 minutes – **BE CAREFUL WITH THE HOT PLATE**
 - A. The hot plate will have warm water on it ready for you. Turn it up and allow the water to boil. As soon as you see a color change you may remove your test tube and let it cool.

A positive test is indicated by a reddish-yellow color change
5. Which substance do you expect to test positive for glucose?
6. Which substances do you expect to test negative for glucose?
What is the purpose of doing these tests?
7. After 3 minutes, record the color for each solution in the data table on page 2. Put a plus next to those samples testing positive for glucose and a minus for those testing negative.
8. To test for starch you will use iodine as an indicator. In the presence of starch, iodine will change color from yellow-brown to blue-black. Add 5 drops of iodine solution to each container. Stir the contents of each container.
CAUTION: Be careful when handling iodine; it can stain hands and clothing.
9. In the data table on page 2, record the color of the iodine solutions. Put a plus next to those samples testing positive for starch and a minus for those testing negative.

Testing for Proteins

1. Label five clean containers "vegetable oil", "glucose", "starch", "egg whites", and "water". Add a small amount of the substance indicated on the label to each container. Add about 2 ml of water to each container. Stir the contents of each container to mix the food and water.
2. To test for protein you will use Biuret reagent as an indicator. Biuret reagent turns from blue to purple in the presence of protein. Add 20 drops of biuret reagent to each container. Stir the contents of each container.
CAUTION: Biuret reagent contains sodium hydroxide, a strong base. Be very careful not to splash or spill any. If you splash any reagent on yourself, wash it off immediately with water. Call your teacher for assistance.

- Record the color of each Biuret solution in the data table on page 2. Put a plus next to those samples testing positive for protein and a minus for those testing negative.
- Rinse all ten containers thoroughly.

Testing Different Types of Food and Testing the Evidence – DAY 2

Today you will perform all four organic compound tests on one or two of the types of food listed below or the evidence Kaleb found at the crime scene (your teacher will assign you a sample or samples to test). Begin by predicting which types of compounds you expect to find in each type of food you will be testing.

Food	Do you expect this food to contain			
	Glucose?	Starch?	Protein?	Lipid?
Pretzel				
Butter				
Jelly				
Fat-free yogurt				
Beans				

Record your positive and negative test results using plus and minus signs in the data table below. After you perform the tests, your teacher will collect your data to share with the rest of the class. Complete the table below using data from your classmates.

Food	Carbohydrate Tests				Protein Test		Lipid Test
	Test Tube color	Glucose present	Iodine test color	Starch present	Biuret test color	Protein present	Lipid present
Pretzel (crumble into container)							
Butter							
Jelly							
Fat-free yogurt							
Beans (mash into a paste)							
Bread							
Tortilla							
Cheese							