5 E Lesson Plan

Title: You Are What You Eat: Testing for Organic Compounds in Foods
Grade Level and Course: 8th grade, Physical Science 10th grade, Biology 11th grade, Chemistry
Materials: 8 test tubes test-tube rack lab apron Benedict's solution stirring rod masking tape plastic gloves Biuret reagent test-tube holder pencil
Instructional Resources Used: Brainstorm, Group discussion • Teacher asks students to think about the food they ate for dinner the night before. Students then brainstorm about the chemical compounds contained in that food. They think about the question for one minute, then turn to a shoulder partner and discuss their thoughts to the question. When all students have discussed the question, the teacher leads students in a brief, whole class share out of ideas, scripting possible solutions on the board.
California State Standards: (written out) **Grade 8:** **6c:** Students know that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA. **Biology:** **1h:** Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors. **Chemistry:** **10a:** Students know large molecules (polymers), such as proteins, nucleic acids and starch, are formed by repetitive combinations of simple subunits. **10c:** Students know amino acids are the building blocks of proteins. Common Core State Standards: (written out):
Lesson Objectives:

Students will test various food substances to identify what kinds of macromolecules they contain.

Differentiation Strategies to meet the needs of diverse learners:

- English Learners: Using the FDA approved food pyramid chart, students will categorize different food items into one or more of the four types of macromolecules found in living things.
- Special Education: Students will create picture cards to identify the four types of macromolecules found in living things
- GATE: Students will analyze different food samples to identify the macromolecules they contain.

ENGAGE

Describe how the teacher will capture the students' interest.

What kind of questions should the students ask themselves after the engagement?

- Teacher will ask students to brainstorm what types of compounds are found in living organisms. Student responses will be scripted on the board, then students will be asked to brainstorm where these compounds come from.
- Questions students should ask themselves:

1. What types of organic compounds (macromolecules) are found in foods?
2. What structures in the body are synthesized from each type of macromolecule?

EXPLORE

Describe the hands-on laboratory activity that the students will be doing.

List the "big idea" conceptual questions that the teacher will ask to focus the student exploration.

- Students will test different food substances to identify what kinds of macromolecules they contain. Students will then infer what structures in the body are composed of each type of macromolecule.
- "Big Idea" Conceptual Questions:

1. What are the most common macromolecules found in the foods that we eat?
2. How are carbohydrates similar to lipids? Different?
3. Macromolecules found in living things are organic, meaning they contain the element carbon. What property of carbon enables it to form such a wide variety of compounds?

EXPLAIN

What is the "big idea" concept that students should have internalized from doing the exploration?

List the higher order questions that the teacher will ask to solicit student explanations for their laboratory outcomes, and justify their explanations.

- "Big Idea Concept:

1. Four main types of macromolecules found in living things include carbohydrates, lipids, proteins and nucleic acids.
2. Macromolecules found in living things are organic because they all contain the element carbon.
3. Carbon atoms have unique bonding properties, which enable it to form many different kinds of compounds.

- Higher order Questions:

1. Which compound is most common in foods that come from animals? Why might this be true?
2. Which foods tested would your body use for a quick burst of energy? Which could be used for energy when no carbohydrates are available?
3. If you wanted to reduce the amount of fat in your diet, what foods would you avoid?

EXTEND

Explain how students will develop a more sophisticated understanding of the concept. How is this knowledge applied in our daily lives?

- Students should build structural models of the different types of macromolecules found in living things to understand the bonding between atoms making up these compounds, and to better understand chemical reactions involving these compounds.
- Students should compare nutrition labels on various food items to identify what types of macromolecules they contain. This can be done at a grocery store.

EVALUATE

- How will the student demonstrate their new understanding and/or skill?

Teacher will present students with a list of foods/drinks students love to eat (chips, soda, cookies, cupcakes, juices, doughnuts, candy, hot dogs, etc). Students will be asked to pick three foods from the list that could sustain them for the longest if stranded on a deserted island. Students will then be asked to write a justification for their choices, and engage in a debate to defend the choices they made.

- What is the learning product for the lesson?

Students will provide justification for their food choices and participate in an oral debate.

Background Knowledge for the Teacher:

Little organic molecules are the basis for all life on earth. When these small organic molecules are joined together, larger molecules are produced. These larger molecules are called macromolecules. Macromolecules are polymers, which means they are large molecules made up of many smaller units linked together. The smaller units are called monomers.

Proteins are polymers of amino acids linked together by peptide bonds. Lipids are polymers made up of fatty acids and glycerol. Carbohydrates are macromolecules made up of sugars and starches; while nucleic acids are made up of monomers called nucleotides.

Sources:
http://biology.about.com/library/organs/bldigestoverview4.htm
http://biology.about.com/library/weekly/aa031501a.html

Student pages follow.

You Are What You Eat!
Testing for Organic Compounds in Foods

Objective: To identify macromolecules present in common food items.

Materials:

8 test tubes
test-tube rack
lab apron
Benedict's solution
stirring rod
masking tape
plastic gloves
Biuret reagent
test-tube holder
pencil
safety goggles
Lugol's iodine solution
distilled water
newsprint paper
medicine droppers

Food items:
apple juice
melted butter
raw egg white
raw fish
raw potato
raw spinach
vegetable oil

Procedures:

1 Put on safety goggles, lab apron, and plastic gloves.

2 Label 8 test tubes at the top edge of tube with food name to be tested. Mark the 8th tube water. In what capacity does the water serve? _____

Why is it important to have water serve in this way?

PART I: Testing for Carbohydrates (STARCH)

1 Use a medicine dropper to place approximately 10 drops of each food into the correct test tube. Add 3-4 drops of Lugol's solution (iodine) to each test tube.

2 Starch is one form of carbohydrate. If the substance in your test tube contains starch, it will turn a blue-black color when it mixes with the iodine solution.

3 Observe the contents of your test tubes. Record the amount of starch present (0, +, ++, +++, ++++) in your data chart. The food that contains the most starch should be recorded as ++++.

4 Empty, wash, and return each test tube to your test tube rack.

PART II: Testing for Carbohydrates (SUGAR)

1 Use a medicine dropper to place approximately 10 drops of each food into the correct test tube. Add 10 drops of Benedict's solution to each test tube. CAUTION: Benedict's solution is poisonous. Do not get any in your mouth!

2 Using a test-tube holder, carefully place the test tubes into the hot water bath your teacher has provided. Heat the test tubes for 2 to 3 minutes. CAUTION: Always use a test-tube holder to handle hot test tubes. Point the open end of a test tube away from yourself and others.

3 After 2-3 minutes, return the hot test tubes to the test-tube rack. If the substance in your test tube contains sugar, Benedict's solution will change color. See below:

Amount of Sugar in Food	**0 None**	**+ Trace**	**++ Little sugar**	**+++ Moderate sugar**	**++++ Much sugar**
Color	blue	blue/green	green	yellow	orange/red

4 Observe your test tubes (using white paper as a background). Record the amount of sugar present in your data table.

5 Empty your test tubes, clean them thoroughly, and return them to the test tube rack.

PART III: Testing for Lipids

1 Use a medicine dropper to put ~1 drop of each food onto the newsprint.

2 Observe and compare/contrast the translucence each food substance creates on the newsprint. Record the information, in order of translucence (0, +, ++, +++, ++++) in your data chart. The food that creates the largest spot (and thus containing the greatest amount of lipids) should be recorded as ++++.

PART IV: Testing for Protein

1 Use a medicine dropper to place approximately 10 drops of each food into the correct test tube. Use a medicine dropper to carefully add 10 drops of Biuret reagent to each test tube. CAUTION: Biuret reagent can burn your skin. Wash off spills and splashes immediately with plenty of water and inform the teacher should this occur.

2 Observe the contents of each test tube (using white paper as a background). If the food contains protein, it will turn a pinkish purple. Record the amount (0, +, ++, +++, ++++) of protein for each food substance in your data table. The food that contains the most protein should be recorded as ++++.

3 Empty, clean, and return all materials. Before leaving, wash hands thoroughly.

Results:

Data Table:

Food	Lipids Present	Protein Present	Starch Present (Carbohydrate)	Sugar Present (Carbohydrate)
Apple				
Butter				
Egg White				
Fish				
Potato				
Spinach				
Vegetable Oil				
Water				

Analysis Questions:

1. Which compound is most common in foods that come from plants?

   Which compound is most common in foods that come from animals? Why might this be true?

2. Does water contain any of the organic compounds you tested? Explain the role of water in the experiment.

3. If you wanted to reduce the amount of fat in your diet, what foods would you avoid?

4. Which foods tested would your body use for a quick burst of energy? Which could be used for energy when carbohydrates are available?

5. Which foods may be used for building body parts?