Food Detectives!

A Lesson on the Identification of Macromolecules

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Editor's notes:

Website URLs listed in this resource were current as of publication, but may now be obsolete. If you know of a replacement URL, please suggest it in the resource's "Comments" section http://www.apsarchive.org/resource.cfm?submissionID=3694.

The APS encourages teachers to give students a copy of the "ABC" (Appropriate, Beneficial, Caring) rules for use of animals in the classroom, to discuss the rules, and to ask students to sign the "ABC" rules contract (see References). Also, teachers should have a plan for short term care of the animals (with supporting references for appropriate care guidelines) and for disposal or long-term care of all classroom organisms.

Teachers should carefully review any stimulus or environmental change for an animal being used in experiments or observations before students are allowed to use that stimulus. This is especially important if the stimulus could cause pain or distress to the organism. Teachers may be able to identify a less stressful stimulus for the students to use in their experiment.

Although mammals provide excellent opportunities for observational studies, they require particular care in terms of handling and may cause allergic reactions in some students. The teacher should check local and state guidelines before using mammals in the classroom.

Disclaimer:

This activity was created by the author and reviewed by the American Physiological Society. Any interpretations, statements, or conclusions in this publication are those of the author and do not necessarily represent the views of either the American Physiological Society or the funding agencies supporting the professional development program in which the author participated.

PURPOSE

The purpose of this laboratory activity is for student teams to identify macromolecules present in identified and unknown food samples, some of which they may be unfamiliar with, by conducting chemical (indicator) tests using appropriate reagents. They will gain experience in finding relevant information on the Internet, preparing a lab report and preparing a poster for presentation to the class with their findings.

OBJECTIVES

Upon completion of this activity, students will be able to:

- conduct guided Internet Treasure Hunts.
- demonstrate safe use of laboratory equipment.
- develop lab procedures (experiment) designed to test the team's hypotheses, identifying the presence of macromolecules in food and which reagent is used as an indicator.
- demonstrate an understanding of the role each type of macromolecule plays in the survival of organisms.
- collect and analyze data.
- prepare a high-quality scientific lab report.
- create a poster to be displayed in a poster session communicating the results of the experiment.

GRADE LEVEL

Grades 9-12

PRIOR KNOWLEDGE

Students should have already participated in lab safety activities and signed their lab safety contract. They should be familiar with using common lab equipment such as handling test tubes, making accurate measurements, hot water baths, etc., as well as using the Internet to search for credible information. They also will conduct a typical macromolecule lab experiment to become familiar with reactions/color changes, which will occur as they test each food for the presence of macromolecules with the different reagents.

TIME REQUIRED

The approximate time to complete all components is four to six 50-minute periods.

INCLUDING ALL STUDENTS

Teams will be assigned to ethnic- and gender-diverse groups. Assemble the teams so there are students with varied learning styles (visual, auditory, kinesthetic) in each team, too. For the first part of the lab, students will bring in a food sample from home and are encouraged to choose something with which they are familiar, even if they think others may not be familiar with the food.

QUESTIONS TO ASK ALONG THE WAY

- What is the purpose of using distilled water as one of your test substances?
- Why do you think two different foods may test positive for the same test?
- After looking at some or the foods we eat in the United States, why do you think we have such a problem with obesity?
- How can obesity be prevented?
- If you wanted to reduce the amount of fat in your diet, what foods would you avoid?

NATIONAL SCIENCE EDUCATION STANDARDS

K-12 Unifying Concepts and Processes
Systems, order, and organization
Form and function
Grades 9-12
Science as Inquiry
Abilities necessary to do scientific inquiry
Understandings about scientific inquiry
Physical Science
Chemical reactions
Life Science
Matter, energy, and organization in living systems

MICHIGAN STATE SCIENCE EDUCATION STANDARDS

Standard B1: Inquiry, Reflection, and Social Implications

B1.1 Scientific Inquiry

Scientifically literate graduates make observations about the natural world, identify patterns in data, and propose explanations to account for the patterns. Scientific inquiry involves the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses to explain patterns in data. Scientific inquiry is a complex and time-intensive process that is iterative rather than linear. Habits of mind—curiosity, openness to new ideas, informed skepticism—are part of scientific inquiry. This includes the ability to read or listen critically to assertions in the media, deciding what evidence to pay attention to and what to dismiss, and distinguishing careful arguments from shoddy ones. Thus, Scientific Inquiry depends on the practices described above — Identifying Science Principles and Using Science Principles. *Content Expectations: B1.1A, B1.1B, B1.1C, B1.1D, B1.1E, B1.1f, B1.1g, B1.1h, B1.1i*

B1.2 Scientific Reflection and Social Implications

The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities. *Content Expectations: B1.2C, B1.2D, B1.2E, B1.2f*

Standard B2: Organization and Development of Living Systems

Students describe the general structure and function of cells. They can explain that all living systems are composed of cells and that organisms may be unicellular or multicellular. They understand that cells are composed of biological macromolecules and that the complex processes of the cell allow it to maintain a stable internal environment necessary to maintain life. They make predictions based on these understandings. *Content Expectations: B2.2, B2.2C, B2.2D, B2.5*

MATERIALS

Materials For Each Team of 3-4 students:

- 500 mL beaker
- aprons
- colored pencils or markers
- digital scale
- disposable 3.0 mL pipettes
- hot plate
- journals
- large poster paper
- mortar and pestle to mash food, if necessary
- non-latex gloves
- safety glasses
- spoons or scoops
- test tube brushes
- test tube holders
- test tube racks
- heat resistant test tubes, 6/team
- timers (optional)
- wax pencil
- water (soapy for washing test tubes between trials and distilled water for use in experimental control and food sample test tubes)

Reagents:

- absolute alcohol (100% ethanol)
- Benedict's solution
- Biuret reagent
- iodine

Food samples:

(macromolecule/reagent):

- apple juice and/or banana (simple sugar/Benedict's solution)
- instant potatoes (complex sugar-starch/iodine)
- raw egg white or canned tuna (protein/Biuret reagent),
- vegetable oil or Italian salad dressing, the kind that separates in the bottle (lipid solubility test/absolute alcohol)
- cookies

SAFETY

Students should exercise caution. Remind students of the following procedures and warnings:

- Some reagents used in this lab are poisonous and caustic.
- Do not ingest, allow solution to get on skin, or look directly into a heated test tube.
- Practice good lab safety procedures, including the use of goggles and lab coats/aprons and washing hands carefully before and after the lab.
- Remember that hot glassware appears the same as cool glassware.
- Benedict's solution is poisonous.
- Biuret reagent is caustic and can burn skin.
- Iodine will stain the skin and most material with which it comes into contact.
- The hot water bath is HOT enough to burn skin!

PREPARATION AND PROCEDURE

Teacher tips:

- *The teams will conduct tests for the presence of three organic compounds (macromolecules) – proteins, simple and complex carbohydrates, and lipids. They will NOT test for nucleic acids.*
- *The food samples I list are only examples – dig through your refrigerator and cupboards – you'll find all kinds of goodies you can use to test for the presence of macromolecules.*
- *Provide student teams with the included Protocol Instructions Sheet so they may gain experience on the types of reactions/color changes, which will occur as they test each food for the presence of macromolecules with*

PREPARATION AND PROCEDURE

the different reagents. Additionally, the teams should predict which macromolecules they think will be present in each food sample.

- *For the experimental design segment of the lab, (after they have performed the lab the first time), student teams should not proceed until after you have approved their experimental design!*
- *In addition to authentic assessment, providing feedback throughout the activity is very important for the teams. They may doubt their ability to "do" scientific inquiry and thinking. It is our job as educators to help them see that they can achieve anything they put their mind to. There are several ways to accomplish this: post-lab debriefing, approving experimental design, evaluating team-assessment rubrics, feedback on draft and final lab report, and evaluating team posters and presentations.*

Suggestions for Each Day

Day 1

1. Assemble lab materials and have them on display.
2. Assign students to teams, keeping in mind different learning styles and diversity. The teams should reach consensus on who will be doing which duty during the activities. There should be a recorder, materials collector, timer, reader, or whatever you deem appropriate. Once you have selected teams, encourage the recorder to create a list of the materials, especially the reagents, as they will need to research them as well as the macromolecules in the computer lab.
3. Distribute copies of the Student Section of this lab activity to the teams. Go through the sheet with them and answer any questions they may have about what they will accomplish each day. Provide guidance to teams as to how much food sample and reagent they should use, e.g., begin with a small amount of food sample and apply reagent in increments of 2 drops at a time.
4. Provide student teams with the included Protocol Instructions Sheet so they may gain experience on the types of reactions/color changes, which will occur as they test each food for the presence of macromolecules with the different reagents. Additionally, the teams should construct a data table and predict which macromolecules they think will be present in each food sample. After conducting the experiment, they should record their results.

Day 2-3

In the computer lab, distribute the guided Internet Treasure Hunt sheets to teams for them to gain knowledge about macromolecules found in foods, reagents, writing a scientific lab report, and diet-related diseases. (See Attached Internet Treasure Hunt sheets).

Day 2:

- What are macromolecules?
- Which macromolecule(s) may be present in common foods?
- What are reagents?

PREPARATION AND PROCEDURE

Day 3:

- How do I write a scientific lab report?
- Does one cultural group consume more of one type of macromolecule than does another group?
- Within different cultures, are there significant differences of incidence of diet-related diseases such as hypertension, obesity, diabetes and cardiovascular disorders?

Day 4 (and possibly 5)**:**

1. Upon completion of the first part of the lab (Day 1), they will design an experiment to investigate a food product claim such as "lower fat." "lower sugar," or "high protein." The teams may bring in these types of food products or you may provide them. They now have the prior knowledge and tools for identifying macromolecules in food samples. They should design their experiments without assistance from the instructor. Don't rush to answer their questions - you will be tempted to do just that - I have done it many times myself!
2. They may need to run a few trials or dilute the foods. They should be able to distinguish between "high" and "low"" foods. Their experimental design should also include how they will establish a control as well as sample sizes and how many trials they will perform.
3. Student teams should not proceed until after you have approved their experimental design!
4. When looking at the teams' experimental design, I am grading them as much on their effort at completing this type of inquiry lesson, which they are just learning how to do, as I am on content. The most important things I am looking for are: they have included a control; they are not mixing chemicals together; and they are testing all macromolecules with each of the reagents.
5. Distribute the three rubrics (Experimental Design and Lab Report Rubric, Presentation: Food Detectives Rubric, and Team Participation Rubric), have students write their names on them, and collect them for grading purposes.
6. If you choose, teams may work outside of class time on writing up the scientific lab report and preparing their posters for presenting their findings. That is up to you - you may add another day to the lab if you feel they need to accomplish this during class time.

Last Day:

1. Teams will present their findings in a poster (or PowerPoint) presentation.
2. Team members will anonymously grade other members using the Team Participation Rubric. I have found this activity to be very successful - the students who dig right into the work have an opportunity to grade those members who may not have been as diligent. And, the slackers know they will be graded by their peers and often, they get more involved in the project.

WHERE TO GO FROM HERE

This macromolecule lab provides the opportunity to move into even more depth discussion regarding the foods we consume and health issues such as obesity, anorexia, diabetes, arteriosclerosis, hypertension, stroke, and cardiovascular disease. A case study about the eating/nutritional habits in other cultures and their incidence of these diseases (or lack thereof) is another issue to explore.

SUGGESTIONS FOR ASSESSMENT

Experimental design, verbal tests, three rubrics - experimental design/ performance-based assessment (lab report); presentation; and for team members to anonymously grade each other's contribution to the laboratory activity.

REFERENCES AND RESOURCES

1. *7th Grade Life Science Curriculum: Cell Processes-Diffusion*
http://tlc.ousd.k12.ca.us/~acody/7cifunit2k.html
A lesson for two class periods on diffusion through a semi-permeable membrane. Accessed on February 21, 2008.

2. *Biological Macromolecules*
http://biology.unm.edu/ccouncil/Biology_124/Summaries/Macromol.html
This is a comprehensive laboratory activity on macromolecules developed for a college-level Biology course – good review questions at the end of the lab. Located on Cara Lea Council-Garcia's website, Department of Biology, University of New Mexico. Accessed on February 21, 2008.

3. *Burden of Cardiovascular Disease Consensus Reports,*
http://www.michigan.gov/mdch/0,1607,7-132-2940_2955_2959_3208-80201--,00.html
Michigan Department of Community Health. Accessed on February 21, 2008.

4. *How Can Physical Activity and Healthy Eating Impact Michigan Children? Michigan Department of Community Health.*
http://www.michigan.gov/documents/Childhood_Overweight_and_Healthy_School_Environment_Fact_Sheet_168750_7.pdf
There are so many reports about diet-related diseases for Michigan's residents! Accessed on February 21, 2008.

5. *Chem4Kids – Basics of Biochemistry*
http://www.chem4kids.com/files/bio_carbos.html
http://www.chem4kids.com/files/bio_lipids.html
http://www.chem4kids.com/files/bio_proteins.html
These particular links at Chem4Kids.com explain the role of macromolecules (organic compounds) in metabolism – our energy needs. Accessed on February 21, 2008.

REFERENCES AND RESOURCES

6. *Chemistry of Living Things, Organic Compounds by Heidi Haugen,* http://www.accessexcellence.org/AE/ATG/data/released/0335-HeidiHaugen/index.html
This is a good lab activity on organic compounds posted at Access Excellence, The National Health Museum, on its Activities Exchange page. These activities are posted by teachers for other teachers to utilize. Accessed on February 21, 2008.

7. *How the Body Uses Fat*
http://www.hhmi.org/biointeractive/obesity/usefat/index.html
Molecular Structures of Fat
http://www.hhmi.org/biointeractive/obesity/molfat/index.html
If, as a science teacher, you haven't discovered the Howard Hughes Medical Institute's website, then welcome to HHMI.org! This particular portion of the website is entitled Biointeractive.org. Check out its Holiday Lecture Series – Free DVDs, free S&H. A philanthropy serving society through biomedical research and science education. Howard Hughes Medical Institute, Chevy Chase, MD. Accessed on February 21, 2008.

8. *Organic Compounds*
http://www.okc.cc.ok.us/biologylabs/Documents/Organic%20Compounds/Organic%20Compounds.htm
This is an interactive website showing a lab activity on identifying organic compounds (macromolecules) created by Dennis Anderson, Professor of Biology, Oklahoma City Community College. Accessed on February 21, 2008.

9. *Physical Activity and Good Nutrition: Essential Elements to Prevent Chronic Diseases and Obesity, At-a-Glance 2007*
http://www.cdc.gov/nccdphp/aag/aag_dnpa.htm
This is a fantastic site authored by the Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA. It provides information about the link between physical activity and good nutrition in the prevention of chronic diseases and obesity. Accessed on February 21, 2008.

10. *Report Writing*
http://tigger.uic.edu/~magyar/Lab_Help/Report_Writing/body_report_writing.html
A great Internet resource on all things related to Chemistry. This particular link provides concise instructions on how to write a scientific lab report. Cal Chany 1996-2004, University of Illinois at Chicago and Rush University. Accessed on February 21, 2008.

11. *Rubistar4teachers*
http://rubistar.4teachers.org/index.php
Rubrics made easy. RubiStar is a free tool to help teachers create quality rubrics. Registration is free and simple. You may create your own rubrics or search for ones that have been produced by teachers and posted to the website. Advanced Learning Technologies in Education Consortia (ALTEC), Lawrence, KS. Accessed on February 21, 2008.

REFERENCES AND RESOURCES

12. *Scientific Reports*
http://www.unc.edu/depts/wcweb/handouts/lab_report_complete.html
The Writing Center is a free service available to students, faculty, and staff at University of North Carolina at Chapel Hill. The Writing Center has produced an extensive collection of handouts on a variety of writing issues, from tips on reading assignments to discussions of writing in specific disciplines. This work is licensed under a Creative Commons Attribution -NonCommercial-NoDerivative Works 2.5 Generic License. You may reproduce it for non-commercial use if you use the entire handout and attribute the source: The Writing Center, University of North Carolina at Chapel Hill. Accessed on February 21, 2008.

13. *Tests for Organic Compounds*
http://teachers.henrico.k12.va.us/deeprun/vest_m/organic_compounds_lab.doc
Nicely done cookbook lab with great images of the reactants' effects on foods. Henrico County Public Schools, Richmond, VA. Accessed on February 21, 2008.

14. *Wikipedia*
Benedict's Reagent at Wikipedia:
http://en.wikipedia.org/wiki/Benedict%27s_reagent
BiuretTtest at Wikipedia:
http://en.wikipedia.org/wiki/Biuret_test
Carbohydrates at Wikipedia:
http://en.wikipedia.org/wiki/Carbohydrate#Nutrition
Controlled Experiments at Wikipedia:
http://en.wikipedia.org/wiki/Experiment#Controlled_experiments
Lipid Nutrition and Health at Wikipedia:
http://en.wikipedia.org/wiki/Lipid#Nutrition_and_health
Proteins at Wikipedia:
http://en.wikipedia.org/wiki/Protein_in_nutrition#Sources_of_proteins

Several links are provided for relevant information from Wikipedia, which is a multilingual, web-based, free content encyclopedia project. While Wikipedia is an encyclopedia, it does have a wealth of information, and often leads the reader to in-depth information. You should double-check the information, as it can be edited and you want to be certain that what you are reading is accurate. Look for entries that site peer-reviewed work as the source of information.

Team Members: _____ _____

_____ _____

The most common organic compounds (macromolecules) found in living organisms are carbohydrates, lipids, proteins, and nucleic acids. Common foods, which consist of plant materials or substances derived from animals, are also combinations of these organic compounds. Simple chemical tests using different chemicals (indicators) can be conducted to determine the presence of different organic compounds. A **color change** of an indicator is usually a **positive test** for the presence of an organic compound.

READ ALL INSTRUCTIONS BEFORE JUMPING IN! YOU NEED TO KNOW WHERE YOU ARE GOING BEFORE YOU PUT ON THE SAFETY GLASSES, APRON/LAB COAT AND GLOVES!

Instructions:
Unlike some lab activities you have done in the past, you are truly going to be detectives on this one. Your team will be:

- Researching information about organic compounds (macromolecules) you are going to test,
- Researching what you are going to use to test for the presence of these molecules in the foods you eat,
- Designing your own experiment - I'll be around to guide you along with your detecting. However, I am not designing the lab – your team is designing it after you perform the lab experiment once with the food products I have provided. Your job will be to design an experiment that tests the food for something different - perhaps you want to investigate a food product claim such as "lower fat," "lower sugar," or "high protein." Your team may bring in these types of food products tomorrow and I will also provide some different food samples than what you previously used to test for macromolecules. Make sure you include a hypothesis, a control, and the procedure for conducting the tests.
- Learning how to write a scientific report.
- Exploring what the foods you eat or don't eat have to do with your overall health.
- Preparing a poster for class presentation, discussing your team's findings.

Working in cooperative teams, you will identify various macromolecules present in identified and unknown food samples by conducting chemical tests using appropriate reagents.

You will follow instructions on the Protocol Instruction Sheet provided by your teacher.

Guided Internet Treasure Hunt

In the computer lab, Use the guided Internet Treasure Hunt to gain knowledge about macromolecules found in foods, reagents, writing a scientific lab report, and diet-related diseases. (See attached Internet Treasure Hunt sheets).

You will investigate the following questions:

- What are macromolecules?
- Which macromolecule(s) may be present in common foods?
- What are reagents?
- How do I write a scientific lab report?
- Do different cultures consume more of one type of macromolecule than another?
- Within different cultures, are there significant differences in the incidence of diet-related diseases such as hypertension, obesity, diabetes, and cardiovascular disorders?

Upon completion of the first lab and the Internet Treasure Hunt:

1. Design the protocol (rules that define how something is to be done) of your experiment including writing the hypothesis. You should predict which macromolecules may be present in each of the identified and unknown food samples.
2. Teams **must** gain approval of their experimental design from the teacher prior to conducting any testing of food samples.
3. Design your data table for approval as well – this is what you will use to record and analyze your data.
4. Identify which of the available reagents in the laboratory activity is (are) used to indicate the presence of a particular macromolecule.
5. Test and record what the positive test and negative test indications are for each known and unknown food sample (no change, color change, precipitate, etc.).
6. Draw conclusions from the results of your experiment.
7. Run all tests your team deems necessary on an unknown food product as well as a mystery sample provided by the teacher for identification.
8. Submit a draft scientific lab report, which will be evaluated and returned with comments so teams may submit a final report.
9. Teams will prepare and present a poster to the class, explaining their findings.

BRING IN A FOOD FROM HOME FOR ANALYSIS DURING THE SECOND LAB! Choose something with which you are familiar, even if you think others may not be familiar with that food.

Team Members: _____ _____

_____ _____

Synthesis Questions

1. Monosaccharides and polysaccharides are two classes of _____.

2. Why was it important to use distilled water during the experiment?

For each of the following tests, please circle which substance would give a positive result:

3. Benedict's test - glucose lipid starch protein

4. Iodine test - glucose lipid starch protein

5. Absolute alcohol test - glucose lipid starch protein

6. Biuret test - glucose lipid starch protein

7. The cloudy, orange color that shows a positive result for the _____ test is due to simple sugars reducing cupric ions to cuprous ions, which oxidize to form copper oxide.

8. If a solution contains macromolecules that test positive for the _____ test, light refracts from copper-containing rings to produce a violet color.

9. The reagent used in the _____ test is soluble in lipid, but not in water.

10. Which of the tested food(s) contain lipids?

11. Which of the tested foods(s) contain starch?

12. Which of the tested food(s) contain a simple sugar?

13. Which of the tested food(s) contain protein?

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

15. Which foods tested would your body use for a quick burst of energy? For energy when no carbohydrates are available? For building body parts?

KEY - Synthesis Questions Correct answers are in boldface and underlined.

1. Monosaccharides and polysaccharides are two classes of **carbohydrates**.
2. Why was it important to use distilled water during the experiment? **Minerals and contaminants may affect/skew the results of experiment.**

For each of the following tests, please circle which substance would give a positive result:

3. Benedict's test -	**glucose**	lipid	starch	protein
4. Iodine test -	glucose	lipid	**starch**	protein
5. Absolute alcohol test -	glucose	**lipid**	starch	protein
6. Biuret test -	glucose	lipid	starch	**protein**

7. The cloudy, orange color that shows a positive result for the **Benedict's** test is due to simple sugars reducing cupric ions to cuprous ions, which oxidize to form copper oxide.
8. If a solution contains macromolecules that test positive for the **Iodine** test, light refracts from copper-containing rings to produce a violet color.
9. The reagent used in the **Absolute alcohol** test is soluble in lipid, but not in water.
10. Which of the tested food(s) contain lipids? **Answers will vary depending on foods tested.**
11. Which of the tested food(s) contain starch? **Answers will vary depending on foods tested.**
12. Which of the tested food(s) contain a simple sugar? **Answers will vary depending on foods tested.**
13. Which of the tested food(s) contain protein? **Answers will vary depending on foods tested.**
14. If you wanted to reduce the amount of fat in your diet, what of the tested food(s) would you avoid?
    Answers will vary depending on foods tested, although anything designated as high-fat foods should be avoided.
15. Which foods tested would your body use for a quick burst of energy? For energy when no carbohydrates are available? For building body parts?
    Answers will vary depending on foods tested,
    - **foods high in carbohydrates will give a quick burst of energy**
    - **foods high in starches when no carbohydrates are available**
    - **Proteins for building body parts**

Team Members: _____ _____

_____ _____

Experimental Design and Lab Report Rubric

CATEGORY	4	3	2	1
Question/ Purpose	The purpose of the lab or the question to be answered during the lab is clearly identified and stated.	The purpose of the lab or the question to be answered during the lab is identified, but is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is partially identified, and is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is erroneous or irrelevant.
Experimental Hypothesis	Hypothesized relationship between the variables and the predicted results is clear and reasonable based on what has been studied.	Hypothesized relationship between the variables and the predicted results is reasonable based on general knowledge and observations.	Hypothesized relationship between the variables and the predicted results has been stated, but appears to be based on flawed logic.	No hypothesis has been stated.
Experimental Design	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
Materials	All materials and setup used in the experiment are clearly and accurately described.	Almost all materials and the setup used in the experiment are clearly and accurately described.	Most of the materials and the setup used in the experiment are accurately described.	Many materials are described inaccurately OR are not described at all.
Procedures	Procedures are listed in clear steps. Each step is numbered and is a complete sentence.	Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences.	Procedures are listed but are not in a logical order or are difficult to follow.	Procedures do not accurately list the steps of the experiment.
Drawings/ Diagrams	Clear, accurate diagrams are included and make the experiment easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.
Data	Professional looking and accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in written form, but no graphs or tables are presented.	Data are not shown OR are inaccurate.
Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.
Spelling, Punctuation and Grammar	One or fewer errors in spelling, punctuation and grammar in the report.	Two or three errors in spelling, punctuation and grammar in the report.	Four errors in spelling, punctuation and grammar in the report.	More than four errors in spelling, punctuation and grammar in the report.

Team Members: _____ _____

_____ _____

Presentation: Food Detectives Rubric

CATEGORY	4	3	2	1
Project Requirements	All requirements are met and exceeded.	All requirements are met.	One requirement was not completely met.	More than one requirement was not completely met.
Oral Presentation	Interesting, well-rehearsed with smooth delivery that holds audience attention.	Relatively interesting, rehearsed with a fairly smooth delivery that usually holds audience attention.	Delivery not smooth, but able to hold audience attention most of the time.	Delivery not smooth and audience attention lost.
Attractiveness	Makes excellent use of font, color, graphics, effects, etc. to enhance the presentation.	Makes good use of font, color, graphics, effects, etc. to enhance to presentation.	Makes use of font, color, graphics, effects, etc. but occasionally these detract from the presentation content.	Use of font, color, graphics, effects etc. but these often distract from the presentation content.
Mechanics	No misspellings or grammatical errors.	Three or fewer misspellings and/or mechanical errors.	Four misspellings and/or grammatical errors.	More than four errors in spelling or grammar.
Content	Covers topic in-depth with details and examples. Subject knowledge is excellent.	Includes essential knowledge about the topic. Subject knowledge appears to be good.	Includes essential information about the topic but there are 1-2 factual errors.	Content is minimal OR there are several factual errors.
Originality	Product shows a large amount of original thought. Ideas are creative and inventive.	Product shows some original thought. Work shows new ideas and insights.	Uses other people's ideas (giving them credit), but there is little evidence of original thinking.	Uses other people's ideas, but does not give them credit.
Permissions	All permissions to use graphics "borrowed" from web pages or scanned from books have been requested, received, printed and saved for future reference.	All permissions to use graphics "borrowed" from web pages or scanned from books have been requested and received.	Most permission to use graphics "borrowed" from web pages or scanned from books have been requested and received.	Permissions were not requested for several graphics "borrowed" from web pages or scanned from books.

Name of team member you are evaluating: _____

Your name (if you wish): _____

Only the teacher will be see this sheet; your team member will not see it.

Collaborative Work Skills: Team Member Participation Rubric

CATEGORY	4	3	2	1
Working with Others	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares, with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.
Focuses on the Task	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Contributions	Routinely provides useful ideas when participating in the group and in classroom discussion. A definite leader who contributes a lot of effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Attitude	Never is publicly critical of the project or the work of others. Always has a positive attitude about the task(s).	Rarely is publicly critical of the project or the work of others. Often has a positive attitude about the task(s).	Occasionally is publicly critical of the project or the work of other members of the group. Usually has a positive attitude about the task(s).	Often is publicly critical of the project or the work of other members of the group. Often has a negative attitude about the task(s).
Problem-solving	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.
Time-Management	Routinely uses time well throughout the project to ensure things get done on time. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Usually uses time well throughout the project, but may have procrastinated on one thing. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Tends to procrastinate, but always gets things done by the deadlines. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Rarely gets things done by the deadlines AND group has to adjust deadlines or work responsibilities because of this person's inadequate time management.

Internet Treasure Hunt Name: _____ Date: _____

This web info search will help you find information about macromolecules. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

Question 1: What are macromolecules?		
	Site 1 *Chem4Kids* http://www.chem4kids.com/files/bio_carbos.html http://www.chem4kids.com/files/bio_lipids.html http://www.chem4kids.com/files/bio_proteins.html	**Site 2** *Major Types of Chemical Compounds in Plants & Animals* http://waynesword.palomar.edu/chemid1.htm
Who created this web site (organization, etc.)?		
Why did they create it? (check all that apply)	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure
How credible (accurate) do you think the info is?	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure
What did you learn?		

Internet Treasure Hunt Name: _____ Date: _____

This web info search will help you find information about macromolecules. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

Question 2: Which macromolecules are present in our foods?		
	Site 1 *Organic Molecules* http://www.okc.cc.ok.us/biologylabs/Documents/Organic%20Compounds/Organic%20Compounds.htm	**Site 2** *Wikipedia* http://en.wikipedia.org/wiki/Carbohydrate#Nutrition http://en.wikipedia.org/wiki/Lipid#Nutrition_and_health http://en.wikipedia.org/wiki/Protein_in_nutrition#Sources_of_proteins
Who created this web site (organization, etc.)?		
Why did they create it? (check all that apply)	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure
How credible (accurate) do you think the info is?	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure
What did you learn?		

Internet Treasure Hunt Name: _____ Date: _____

This web info search will help you find information about macromolecules. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

Question 3:	**Which reagent should I use to test for the presence of macromolecules in our foods?**	
	Site 1 *Wikipedia* http://en.wikipedia.org/wiki/Benedict%27s_reagent http://en.wikipedia.org/wiki/Biuret_test	**Site 2** *Biological Macromolecules* http://biology.unm.edu/ccouncil/Biology_124/Summaries/Macromol.html
Who created this web site (organization, etc.)?		
Why did they create it? (check all that apply)	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure
How credible (accurate) do you think the info is?	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure
What did you learn?		

Internet Treasure Hunt Name: _____ Date: _____

This web info search will help you find information about macromolecules. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

Question 4: How do I write a scientific lab report?		
	Site 1 *Report Writing* http://tigger.uic.edu/~magyar/Lab_Help/Report_Writing/body_report_writing.html	**Site 2** *Scientific Reports* http://www.unc.edu/depts/wcweb/handouts/lab_report_complete.html
Who created this web site (organization, etc.)?		
Why did they create it? (check all that apply)	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure
How credible (accurate) do you think the info is?	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure
What did you learn?		

Internet Treasure Hunt Name: _____ Date: _____

This web info search will help you find information about macromolecules. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

Question 5: Is there a connection between what I eat and my health?		
	Site 1 *Physical Activity and Healthy Eating* http://www.michigan.gov/documents/Childhood_Overweight_and_Healthy_School_Environment_Fact_Sheet_168750_7.pdf	**Site 2** *Burden of Cardiovascular Disease* http://www.michigan.gov/mdch/0,1607,7-132-2940_2955_2959_3208-80201--,00.html
Who created this web site (organization, etc.)?		
Why did they create it? (check all that apply)	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure	☐ To provide factual information ☐ To influence the reader's opinion ☐ To sell a product or service ☐ I'm not sure
How credible (accurate) do you think the info is?	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure	☐ Very accurate ☐ Somewhat accurate ☐ Not very accurate ☐ I'm not sure
What did you learn?		

PROTOCOL INSTRUCTION SHEET

PART I: Testing for Carbohydrates (STARCH)

1. Use a pipette to put 10 drops of each food in the test tube with the matching label. Add 3-4 drops of 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 and Record the amount of starch present (0, +, ++, +++, ++++) in your data chart. The food containing the most starch should be recorded as ++++.
4. Empty and wash each test tube and return it to your test tube rack.

PART II: Testing for Carbohydrates (SUGAR)

1. Use a pipette to put 10 drops of each food into the test tube with the matching label. Add 10 drops of Benedict's solution to each test tube. CAUTION: Benedict's solution is poisonous. Do not get any in your mouth and do not swallow any!
2. Use a test-tube holder to carefully place the test tubes in the hot water bath your teacher has prepared. Heat the test tubes for 2 to 3 minutes in the hot water bath. CAUTION: Use a test-tube holder to handle hot test tubes. Point the open end of a test tube away from yourself and others.
3. Use a test tube holder to 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 Table 1 below:

Table 1: Appearance of Substance After Adding Benedict's Solution

Amount of Sugar in Food	0 none	+ trace	++ little sugar	+++ some 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 (EMULSION)

1. Use a pipette to put 10 drops of each food into the test tube with the matching label. Add 10 drops of absolute alcohol to each test tube.
2. Stopper the test tube and shake vigorously to dissolve the lipid.
3. Add 20 drops of cold water. A cloudy white suspension should form in the presence of a lipid.
4. Observe your test tubes and record if oil is present in your data table.

PART IV: TESTING FOR PROTEIN

1. Use a pipette to put 10 drops of each food on the test tube with the matching label. Use a pipette 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 while calling to your teacher.
2. Observe the contents of each test tube (using white paper as a background). If the food contains proteins, it will turn a pinkish purple. Record the amount (0, +, ++, +++, ++++) of protein for each food substance in your data table. The food containing the most protein should be recorded as ++++.
3. Empty the test tubes and clean them thoroughly. Before leaving the laboratory, clean up all materials and wash your hands thoroughly.

Adapted from *Chemistry of Living Things, Organic Compounds* by Heidi Haugen, posted at Access Excellence, The National Health Museum, on its Activities Exchange page: http://www.accessexcellence.org/AE/ATG/data/released/0335-HeidiHaugen/index.html