Science Unit: *Plastics*
Lesson 5: *Bioplastic*

School year:	2008/2009
Developed for:	Tyee Elementary School, Vancouver School District
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Grade level:	Presented to grades 4, 5, & 6; appropriate for grades 1 – 7 with age appropriate modifications.
Duration of lesson:	1 hour and 15 minutes

Objectives

1. Discuss the advantages and disadvantages of bioplastic.
2. Make a simple corn bioplastic.

Background Information

Bioplastics are plastics created from biological materials such as starches and proteins. They generally contain little to no petroleum products. Because they are made from biological materials they are usually biodegradable. Consequently when exposed to the environment (microorganisms, light, heat, water, etc.) they breakdown into simple, non-toxic compounds such as carbon dioxide and water. This is in contrast to petroleum-based plastics which may claim to be biodegradable but are in fact only degradable. Being degradable simple means that these plastics will breakdown into smaller pieces, however, the pieces will still be plastic. In addition, unlike petroleum based plastics, bioplastics are made from renewable resources. Bioplastics can be made from a variety of different substances including cornstarch, potato starch, tapioca starch, and casein (milk protein).

Vocabulary

Plastic:	A synthetic polymer most commonly made from petrochemical products.
Bioplastic:	Plastic produced from organic and generally biodegradable compounds. Bioplastics generally contain little to no petroleum products.
Degradable plastic:	Plastic that can be broken down into smaller pieces by exposure to the environment (light, water, etc.). The plastic does not change in nature, it just gets smaller.
biodegradable plastic	Plastic that can be degraded, decomposed, or broken down by microorganisms into simple compounds such as water and carbon dioxide.

Materials

- cornstarch
- water
- corn oil
- droppers
- food coloring
- small Ziploc bags
- measuring spoons or containers
- small paper cups
- microwave
- Styrofoam packing peanuts
- cornstarch packing peanuts
- 2 clear glass jars

In the Classroom

Introductory Discussion

1. Hold up a handful of foam packing peanuts in each hand. One hand should contain Styrofoam packing peanuts and the other should contain packing peanuts made from starch. Announce "Today we are going to learn about the difference between these packing peanuts and these packing peanuts." Pass the peanuts around for the students to examine. At the same time place several peanuts of each type into separate clear glass jars of water. The cornstarch ones will dissolve instantly!

    - Let's refresh our memories and discuss what we talked about during our last lesson. (write ideas on the board or flipchart)
    - What is plastic made from?
    - How is plastic made?
    - Let's all think about that. What potential problems are associated with plastic production? (Environmental: mining impacts, landfills, greenhouse gases, pollution. Health: toxins released from factories, toxins potentially leaching into food, etc.)
    - What can we do to avoid or reduce these impacts? (reduce, reuse, recycle; degradable/biodegradable plastics; make out of another material, etc.)
    - What other materials can be used to make plastic? (cornstarch, potato starch, other plant starches, milk protein) These materials are similar to the petroleum products used to make regular plastics because starches and proteins are also polymers. As a result bioplastics have many of the same properties as regular plastics.
    - What does bioplastic mean? How does it differ from regular plastic? (less harmful ingredients, made from renewable resources, biodegradable)
    - Distinguish between degradable and biodegradable.
    - Introduce the activity.

2. Short description of other items to discuss or review.

    - If they have not been introduced to the concept of polymers (Lesson 4) this should be done prior to the lesson.

3. Briefly describe science experiment/activity.

    - Students will make a simple corn plastic using cornstarch, corn oil and water.

4. The students will practice making accurate measurements (when measuring out the ingredients) and focus on making observations/comparisons. They will record all of their observations on the supplied worksheet.

5. Briefly describe safety guidelines.

    - All of the ingredients are edible and non toxic.
    - The bioplastic will be hot when it comes out of the microwave so students should handle the cups with caution. For younger grades this step should be done by an adult.
    - After microwaving the bioplastic should be allowed to cool for several minutes before students are allowed to handle it.

Science Activity/Experiment

Activity Title: From Corn to Plastic

Purpose of Activity: Students will make a simple corn-based bioplastic

Methods and Instructions:

Set-up prior to experiment:

Each student should receive a Ziploc bag and a small paper cup. The bioplastic will be made in the Ziploc bag and the paper cup will be used to hold the bag during microwaving.

Students will work in groups of 4-6 students. Each student will make their own bioplastic but the groups will share supplies (cornstarch, corn oil, water, measuring devices).

1. Students will follow the directions on the worksheet. The scientist can demonstrate each step beforehand.
2. Use the paper cup to hold the Ziiplock bag upright and open.
3. Measure out 15 ml of cornstarch and place it into the Ziploc bag.
4. Measure out 20 ml of water and add it to the bag.
5. Add 2 small drops of corn oil (approximately 0.5 ml) to the bag.
6. Add 2 drops of food coloring to the bag.
7. Seal the bag and squish it gently to mix everything together. Ensure it is well mixed.
8. Gather the mixture into one corner of the plastic bag and place the bag into the paper cup (full corner first). Open the bag a tiny bit to allow the steam to vent out.
9. Place the paper cup into the microwave and microwave it on high power for 20-30 seconds. (The exact time will depend on the microwave's strength and how many cups are in the microwave at one time.)
10. Let the mixture cool for several minutes.
11. While the mixture is cooking/cooling the students can answer the questions on their worksheets.
12. Once it is cool the mixture can be kneaded through the bag or in the hands.

Closure Discussion

1. How does your bioplastic differ from the plastic we made in the last lesson?
2. What could you make with your bioplastic? What couldn't you make? Why?
3. What are some potential limitations of bioplastics?
4. What properties will they need in order to be capable of replacing regular plastics?

References

5. McKinney, Michael and Robert Schoch. 1998. Environmental Science: Systems and Solutions. Jones and BartlettPublishers.
6. <http://www.bpiworld.org/BPI-Public> The Biodegradable Products Institute. Accessed June 14, 2009.

7. <http://worldcentric.org/biocompostables/bioplastics> Bioplastics. Worldcentric. Accessed June 14, 2009.

Extension of Lesson Plan

1. Comparison of the properties of regular plastics and bioplastics (bags, packing peanuts, cutlery etc.).
2. Watch the documentary “Addicted to Plastic.” Available at some movie rental locations and public libraries or available to purchase from Chapters (online) or the distributor Cryptic Moth Productions http://www.crypticmoth.com/plastic.php.

Name:_____

From Corn to Plastic

MATERIALS

- Cornstarch
- Water
- Corn oil
- Food coloring
- Measuring spoons or containers
- Ziploc bag

PROCEDURE

1. Measure 15 ml (1 tablespoon) of cornstarch into your Ziplock bag.
2. Add 20 ml of water to the cornstarch.
3. Add 2 small drops of corn oil to the mixture in your bag.
4. Add 2 drops of food coloring to the mixture in your bag.
5. Seal the bag and squish it gently to mix everything together.

Describe the mixture in your Ziplock bag: _____

_____

How does it feel when you slowly squish the bag? _____

_____

Does it feel the same when you squeeze the bag quicker/harder? _____

_____

Is your mixture a solid or a liquid? _____

Name:_____

6. Microwave your mixture on high power for 20 seconds. Be sure to leave the bag open a tiny bit so that steam can escape.
7. Careful the plastic will be hot!!
8. Let it cool for several minutes. While it is cooling answer the questions below.

What does your new substance look like? How is it different from the mixture you started with?

_____

_____

_____

If your plastic is cool knead it with your hands. What does it feel like? Describe its other properties.

_____

_____

_____

How is your bioplastic different from the plastic you made in the last lesson? _____

_____

_____

What could you make with your bioplastic? What couldn't you make? Why?

_____

_____

_____

Name:_____

Bioplastic

Regular plastics are usually made of _____

What are some characteristics of petroleum? _____

_____

_____

What is used to make bioplastic?_____

_____

How are bioplastics different from regular plastics? _____

_____

_____

_____

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