Now You See It, Now You Don't

Below is an overview of the activity The Role of Microorganisms in the Ecosystem (MicrobeWorld Experiments) to incorporate information learned from Dr. Kerkhof's presentation and subsequent discussion.

Lesson Overview

Students use a controlled experiment to investigate the process by which commercial packing peanuts biodegrade.

Lesson Rationale

Microorganisms are ubiquitous in the environment, where they have a variety of essential functions. Microbes play an essential role in the natural recycling of living material. All naturally produced substances are biodegradable, which means that living organisms, such as bacteria or fungi, can break them down. Packing peanuts are something that many students are familiar with, but they may not realize that we have developed new types of peanuts that can break down, which reduces trash in the landfill.

Key Concept

Students will learn how to determine the rate of decomposition for different materials based upon their data and how to compare and contrast the nutritional requirements for microbes in different conditions.

NOW YOU SEE IT, NOW YOU DON'T

FACILITATOR

What happens to biodegradable products? Do they really just disappear, or do they break down into different things? What causes them to break down in the first place?

Goal

To investigate the process by which commercial packing peanuts biodegrade.

Activity Time

5 days

Time to Get Ready

20 minutes one day before

What You Need

Have the following for each team of 2:

6 clear plastic or glass jars (minimum 1 cup capacity)
1 measuring cup
eye droppers
7 biodegradable packing "peanuts" made of starch
7 packing "peanuts" made of plastic
iodine tincture solution (drugstore antiseptic version)
distilled or tap water
compost additive
corn starch or flour
1 potato slice
1 measuring teaspoon
test tube
1 coffee stirrer or plastic spoon
1 large bottle, cup, or bucket for waste liquids

Getting Ready

- Collect at least 2 varieties of packing peanuts. Verify that 1 type dissolves in water and the other does not.
- Use fresh iodine tincture that contains iodine and iodide salts. Decolorized iodine antiseptic may not work since it only contains iodide salts.
- Check that the water source does not contain chlorine that will interfere with the iodine test for starch. Mix 1/4 cup of water with 1 teaspoon of corn starch. Add a drop of brown-colored iodine to the starch solution. You should obtain a blue-black color when starch and iodine mix. If no reaction occurs, fill containers with tap water and let them sit overnight so the chlorine dissipates before the water is used.
- Purchase compost activator at a garden supply store or from a gardening catalog. Read the label on the compost additive/activator, and make sure that it contains live microorganisms and not just extra nutrients as some brands do.
- If the group will not be meeting over an extended period of time, make up sets of jars each day for 1 week before the group meets. They can test each set and see how changes occur over time.

Useful Information

Some packing materials are made of biodegradable substances. Because most are made of starch, water dissolves them. But for them to be broken down completely, the process depends on the many microorganisms commonly found in the soil. The microorganisms secrete a digestive enzyme that degrades the starch into its simple sugar building blocks. These simple sugars, or building blocks, can be used as energy sources by microorganisms. This is similar to what happens when a human eats starch. A digestive enzyme in saliva called "amylase" breaks down the starch into simple sugars. See Figure 1.

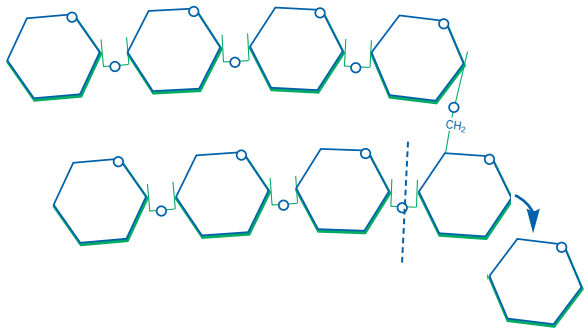


Figure 1. Diagram of a starch molecule with one unit of sugar removed.

Suggestions to Modify the Activity for Those Who Are Exceptional

Specific modifications for this activity are found here. For common considerations when modifying activities for exceptional participants, see page V of the **Introduction**.

Blind or Visually Impaired

- Encourage the participants to touch and describe any tactile differences in the packing peanuts. Squeezing and crunching the packing peanuts may help the participant to understand the possible variables and to develop independent hypotheses and conclusions.
- Emphasize group discussions and the importance of making specific observations. Refer often to color, texture, size, and moisture. Individuals who are blind have a good understanding of color and will appreciate the detailed observations.
- Construct a tactile model of a starch molecule if one is not available. See the materials suggested in the ***General Modifications*** for *Blind or Visually Impaired* listed in the **Introduction**, page V.

Deaf or Hard-of-Hearing

- See the ***General Modifications*** for *Blind or Visually Impaired* listed in the **Introduction**, page V.

Mobility Impaired

- See the ***General Modifications*** for *Mobility Impaired* listed in the **Introduction**, page V.

Physically Impaired

- Emphasize teamwork when using a medicine dropper, as it requires fine motor skills.

Cognitively Impaired

- See the ***General Modifications*** for *Cognitively Impaired* listed in the **Introduction**, page V.

For More Information

Brako, Elisa. "Investigating the Uses of Backyard Bacteria." AccessExcellence. [Online]. Available: *http://www.gene.com/ae/AE/AEC/AEF/1996/brako_bacteria.html.* [May 1, 1998].

National Council for Agricultural Education. (1994). Compost-Columns *Using Fast Plants and Bottle Biology in the Classroom.* Reston , VA: NABT Publications, Al.

National Starch and Chemical Company. "ECO-FOAM Starch Based Loosefill." National Starch and Chemical Company. [Online]. Available: *http://www.eco-foam.com.* [May 1, 1998].

Province of New Brunswick. "Building a Hot Compost Pile." Province of New Brunswick; Fredericton, N.B., Canada. [Online]. Available: *http://www.gov.nb.ca/environm/comucate/compost/build.html.* [May 1, 1998].

Wu, C. (1998). Burger boxes as starchy as the bun. *Science News, 154*(5), 79.

How to Start the Activity

- Show students the packing peanuts and ask what they think the packing material is made of. Place a plastic peanut in 1 glass of water, and a starch peanut in another. Observe the results.
- An iodine test is often used to confirm the presence of starch in a sample. When iodine is added to a starch solution, the resulting blue-black color is caused by a reaction between the starch and iodine. Repeat the iodine test with a sugar solution. This will remain a yellowish-brown color. Sugar does not react with iodine.

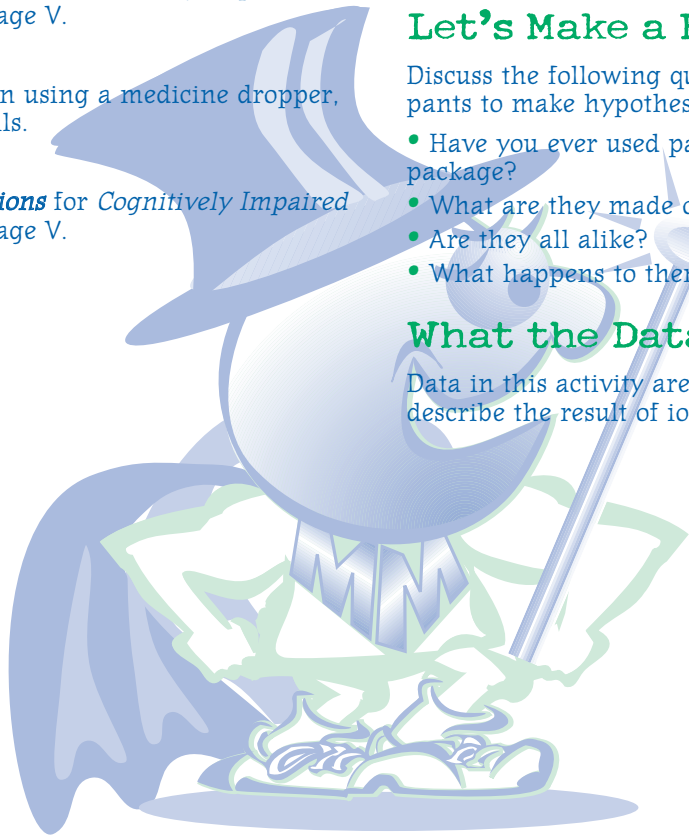
Let's Make a Hypothesis

Discuss the following questions to help guide the participants to make hypotheses.

- Have you ever used packing peanuts for filler in a package?
- What are they made of?
- Are they all alike?
- What happens to them when they reach the landfill?

What the Data Mean

Data in this activity are qualitative. Have the participants describe the result of iodine tests that they observe.



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PARTICIPANT

Questions to Think About

Mom, the family pack rat, stores old, empty boxes down in the basement to have a supply on hand just in case she needs to send packages to Grandma. One day, the washing machine overflowed, soaking the boxes. To her amazement, Mom found that the packing peanuts in one box had "melted away" while those in the other boxes were wet, but intact. What happened? Can you test packing peanuts to see if you can determine a difference?

Safety Notes

- Wash hands before and after the activity.
- No eating or drinking during the activity.
- Avoid getting iodine on skin or clothing.

What to Do

1. Lay a potato slice out on your table. Put drops of iodine at 4 separate locations on the slice. What happened? The resulting blue-black color is caused by a reaction between the starch in the potato and the iodine. An iodine test like this is often used to confirm the presence of starch in a sample.

2. Put a drop of iodine on a polystyrene and a biodegradable packing peanut. What happened? Is the result similar to the reaction you got when you put the iodine on the potato? What does this tell you about the makeup of the packing peanuts?

3. Label your jars 1 through 6. Put 1/4 cup or 50 mL of water in each. Put 1 teaspoon of corn starch in jars 1 and 2. Put 2 biodegradable peanuts in jars 3 and 4, and 2 polystyrene peanuts in jars 5 and 6. Add 1 teaspoon of compost activator to jars 2, 4, and 6. Mix the contents in each jar. See Figure 1.

4. Test the contents from each of your jars for starch. Put 5 drops of the solution from the first jar in a test tube. Add a drop of iodine to the solution. Record your results. Rinse your test tube thoroughly before testing the contents from the next jar.

5. Each day retest the contents from your jars for starch. Record your results. How long does it take for you to see a change?

6. Do your results and conclusions lead to other questions? What did you learn from this activity? How does this activity relate to your everyday life?

7. What would happen if you buried a starch peanut and a polystyrene peanut in the soil during the fall, and then dug them up in the spring? Does temperature have an effect on the rate of starch breakdown? Does the amount of bacteria or starch affect the rate of starch breakdown? Are live bacteria necessary for breakdown action? Could you design an experiment to test a new hypothesis or question?

8. Design a new experiment based on data you gathered or questions you asked during this investigation. Develop a hypothesis that can be tested in a controlled experiment that gathers data. Write a procedure in a numbered list to test your hypothesis. What is your control? What variables are important? How many trials have you included? What will you measure? How can you show your results in a graph?

What Did You Find Out By Doing the Activity?

Before doing "Now You See It, Now You Don't," did you know:

- that some packaging "peanuts" can be eaten?
- any substances that can be broken down into simpler parts in nature?

From this activity, did you discover:

- how substances are broken down in nature?
- why things that are able to break down into their basic parts are good for the environment?
- how microbes play a role in breaking down substances in nature?
- what happens to substances once they are broken down in nature?
- any frequently used products that can be made so that they break down easily in nature?

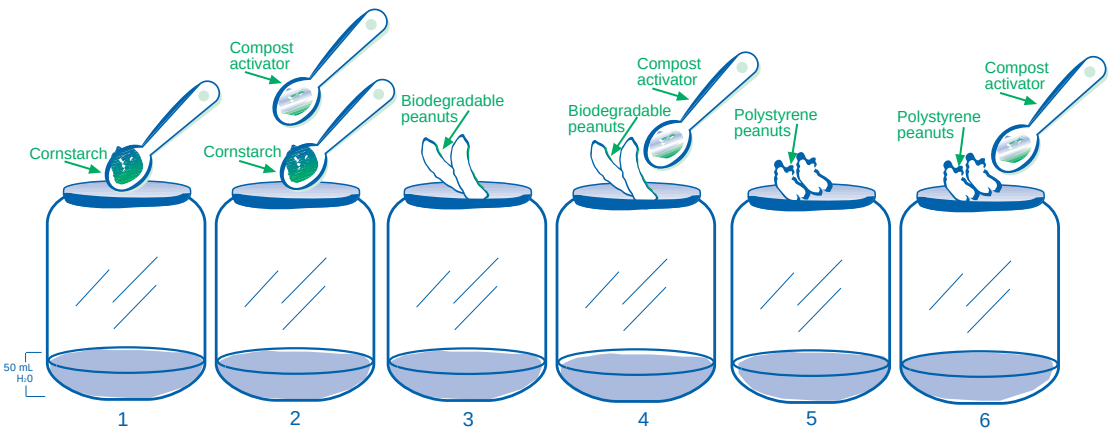

Figure 1. Possible setup.