

Starch-based Packing Peanuts

Objective:

Recognize and classify products as polymers and compare the usability of conventional polymers to bio-based packaging materials.

Keywords:

- Polymer
- Bioproducts
- Styrofoam

21st Century Skills Represented:

- Environmental Literacy
- Economic & Business Literacy
- Critical Thinking & Problem Solving
- Communication & Collaboration

National Science Education Standards:

- Physical Science: Matter & its Interactions
- Earth & Space Sciences: Earth & Human Activity
- Engineering, Technology & Applications of Science: Engineering Design; Links Among Engineering, Technology, Science & Society

feedstocks

processes

uses

Crop- starch from corn	Biological - fermentation Chemical conversion- polymerization Mechanical- extrusion	Plastics
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Background

What are polymers? How are natural and synthetic polymers different?

Polymers are a class of materials that we use every day. Some polymers are naturally occurring and others are man-made or synthetic. Examples of natural polymers include proteins, starch, cellulose, natural rubber, and RNA and DNA. Synthetic polymers include polyethylene, polystyrene, polypropylene and PVC.

Both cornstarch packing materials (peanuts) and polystyrene synthetic packaging materials are made up of polymers. Their composition, however, causes them to behave differently, especially in solvents and water. Students can compare the two and consider how these differences may affect performance and the environment.

Bacterial fermentation is used to produce lactic acid from corn starch or cane sugar. A process known as polymerization is then required to form polymer chains, which have useful physical properties.

Materials

For the group:

- Ladder or other high surface
- 1-2 Garbage bags

Per group of 2-3 students:

- 2 Eggs
- 1 8.5 x 11 in. piece of paper
- 2 identical containers (bigger than an egg, such as take-out food containers, plastic food containers with lid or plastic bags)
- Handful of Styrofoam packing peanuts and equal amount PLA packing peanuts

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Pre-Lab Preparation

1. Show the Akron's Global Polymer Academy's presentation titled, ["What Are Polymers?"](#)
2. Hold a class discussion on the following questions:
 - a. What is a polymer?
 - b. How are polymers used?
 - c. What are some different types of polymers?
3. Pass around Styrofoam packing peanuts and PLA packing peanuts.
4. Ask the students, "Which is a bioproduct? Why?"
5. Hold a class discussion on the following questions:
 - a. What is a bioproduct?
 - b. What are some other examples of bioproducts?

Lab Procedures

1. Split students into groups of 2 or 3.
2. Have each group gather a few Styrofoam packing peanuts and PLA packing peanuts.
3. Students should compare and contrast the characteristics of the different packing peanuts. Have each student record their observations.
4. When all groups are done with their observations tell the student they are going to conduct an experiment to see if PLA packing peanuts are a viable alternative for Styrofoam packing peanuts.
5. Have each group get a container, egg, and Styrofoam packing peanuts.
6. Tell the students that they need to package the egg in a way so that it will not break when it is dropped.
7. Give the students time to develop and plan. Have them draw out their plan on a white piece of paper.
8. Once every group is finished, test their design and material by dropping the containers from an elevated surface. Have each student record their results.
9. Have each group get a container, egg, and PLA packing peanuts. Tell the students to package the egg the same way they did with the Styrofoam peanuts.
10. Once all groups are finished testing their design and material by dropping the containers from an elevated surface, have each student record their results.

Post-Lab Discussion/Questions

1. Have the students record their answers to the following questions.
 - a. How were the characteristics of the Styrofoam and the PLA packing peanuts different?
 - b. Was there a difference in the performance of the different packing peanuts? If so, why do you think there was a difference?
 - c. How does the environmental impact of using Styrofoam packaging compare to that of using PLA packaging? Why?
 - d. Do you think that PLA is a good substitute for Styrofoam packaging? Why or why not?
 - e. Consider the needs of the shipping industry. How do these products measure up?
2. Explain to the students the importance of corn and polymer production in Ohio.
3. Ask the students, "What impact would there be if all of our packaging material could be made out of bio-based material?"

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Expansion Ideas

- Consider the needs of consumers as they ship products. What qualities are needed in packaging materials? Create different tests that compare the performance of the packing peanuts (crush force test, heat test, etc.).

Evaluation of Learning

- Students will turn in their procedures, results, observations and answers to all questions.

Resources

- [From Concept to Customer - Products](#) - Has "Ask an Engineer" feature by Plastic Ingenuity
- [Biodegradable Products Institute, Inc.](#)
- [Compostable Plastics](#) by World Centric
- [Sourcing Ingeo: Raw Materials](#) by NatureWorks LLC
- [Corn Plastic to the Rescue](#) by Elizabeth Royte, Smithsonian magazine
- [Nano-Activities for Kids \(including Packing Peanuts\)](#) by Materials Research Institute, Center for Nanoscale Science, Penn State

Contacts

- Univenture, Marysville, OH: <http://www.univenture.com/>
- Ohio Corn Marketing Program and Ohio Corn & Wheat Growers Association, Delaware, OH: <http://ohiocorn.org/> and <http://ohiocornandwheat.org/>