

Earth-Friendly Plastics

By Emma Corcoran and Jane E. Wissinger

Think about everything you have used today that contained plastic — like your toothbrush, shoes, water bottle, snack container, and more. Plastic is useful because it can be made to be strong or flexible, colorful or clear, and can stand up to heat or cold. Every year, humans make more than *300 million tons* of plastic — that’s as much as the weight of 1.5 million blue whales!

Plastic does a lot of good things for humans, but what happens when we are done using it? Plastic can be recycled, but only 14% actually is. If humans keep using plastics at current rates, by 2050, our oceans will contain more plastics (by weight) than fish. This is because fossil fuel-based plastics do not easily break down and can last for hundreds, or even thousands of years.

Fortunately, chemists are finding solutions to these problems using a set of rules called the green chemistry principles. These “green chemists” are inventing new earth-friendly plastics, or **bioplastics**, from plants — which break down into harmless chemicals once they enter the environment.

One exciting new discovery for replacing plastic water bottles is “Ooho!,” a product made by Skipping Rocks Lab. Ooho is an edible water pod, made from seaweed, that you can pop in your mouth and eat to quench your thirst! Or, you can just drink the water and throw the pod into a **compost** bin, where it will degrade in only six weeks. Oohos were used during the 2019 London Marathon, preventing the need for 200,000 plastic water bottles!

Do the following activity to see how you can make your own edible water pod ... and quench your thirst for learning about more earth-friendly plastics!

Materials

- electric blender
- 2 bowls:
 - One 1-qt. (about 1 L)
 - One 2- or 3-qt. (2 or 3 L)
- $\frac{1}{4}$ tsp. (1.2 mL) sodium alginate
- 1 tsp. (about 5 mL) calcium lactate
- measuring spoons
- large spoon (for mixing)
- paper towels
- optional: food coloring and/or pulpless juice

Procedure

1. Measure 1 cup (0.24 L) of cold water and place it in a blender. Add 1 or 2 drops of food coloring if desired. Add $\frac{1}{4}$ tsp. of sodium alginate to the blender and mix for about 20 seconds. Pour into a 1-qt. bowl.
Note: an additional $\frac{1}{8}$ tsp. (0.6 mL) of alginate can be added if the reaction does not work well. Different brands and grades of sodium alginate may react differently.
2. In the larger bowl, mix together 4 cups of cold water with 1 tsp. of calcium lactate with a large spoon until the calcium lactate is dissolved.
3. Fill a 1-tsp. measuring spoon with the alginate mixture and carefully lower it into the calcium lactate bowl so that the solution covers the spoon.

- Let the spoon of sodium alginate sit in the calcium lactate solution for about 5 seconds and then slowly turn the spoon over so the pod slides into the calcium lactate solution. Pull the spoon straight up out of the bowl. The alginate pod should now be floating in the calcium lactate bath. Repeat to make as many as up to eight pods at a time.
4. Let the pods sit for 15-20 minutes. If time is an issue, using a smaller measuring spoon will make the pods form faster.
5. Using the large spoon, carefully remove the pods from the calcium lactate liquid and set them on a paper towel. These pods can be squished open to observe the properties of the pods or can be eaten under adult supervision.

How does it work? Where’s the chemistry?

Sodium alginate is made up of long chains of repeating molecules, similar to necklaces. It comes from a type of seaweed. When the sodium alginate is placed in the calcium lactate, a **chemical reaction** occurs where the calcium and sodium switch places. The new calcium alginate is different, because now the long linked chains begin attaching to each other, a little like a chain link fence. This is called cross-linking. The connected strands of calcium alginate form the jelly-like outside of the pod. The water is trapped inside the pod as the cross-linked polymer forms on the teaspoon while it is carefully dropped in the solution.

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Safety Suggestions

- ✓ Safety goggles required
- ✓ Protective clothing suggested
- ✓ Caution: hot liquids
- ✓ If the pods made in this activity are to be eaten, all food safety rules must be followed;
 - ✓ Wash hands with soap and water before the activity
 - ✓ Clean/sanitize the work surface and where food will be consumed
 - ✓ Clean the inside and outside of all appliances
 - ✓ Use only food grade materials
 - ✓ Separate food items from other reagents
- ✓ Adults should supervise the use of the blender
- ✓ Thoroughly wash hands after this activity
- ✓ Note: The purchased sodium alginate and calcium lactate must be fresh and food grade or better and can be found at natural food stores or online at Amazon. The materials must be stored away from laboratory chemicals.

Note: Follow Milli’s Safety Tips found in this issue of *Celebrating Chemistry*.