

Recycling Bioplastics

Introduction: Many of the materials we use in our daily lives are polymers, chemicals made of short repeating units (monomers) linked to one another. In the 20th century we learned how to synthesize artificial polymers, or plastics, from fossil fuels, such as oil and natural gas. Today, increased awareness of the environmental effects of mining these fuels has led to the development of plastics that can be synthesized from natural feedstocks, these plastics are referred to as “bioplastics”. In today’s first activity, you will take one bioplastic, polylactic acid (PLA), and degrade it back into lactic acid using sodium hydroxide (lye), ethanol (drinking alcohol) and water. You will then neutralize (render harmless) the lactate/lye solution by adding vinegar to lower the pH of the solution. In our second activity, you will compare the hardness of biopolymers to traditional fossil fuel based polymers.

Learning Goals:

- You will be able to identify some different types of polymers.
- You will be able to determine the most environmentally friendly way of disposing of certain polymers.
- You will be able to describe the chemical concept of “stoichiometry”.
- You will be able to describe the chemical concept of “pH”.

Schedule:

- 11:00-11:15 *Cultural connection*
- 11:15-11:30 *Introduction to Biobased Plastics*
- 11:30-12:00 *Activity I – Measuring the Hardness of Plastics*
- 12:00-12:45 *Lunch*
- 12:45-1:00 *Introduction to Stoichiometry*
- 1:00-2:00 *Activity II – Depolymerizing Polylactic Acid (PLA)*
- 2:00-2:15 *Introduction to pH*
- 2:15-2:45 *Activity III – Neutralizing a Lactate Solution*
- 2:45-3:00 *Wrap up*

Activity 1 – Measuring the Hardness of Plastics

Materials:

- 1 Set of Pencils
- 1 Magnifying Glass
- 1 Set of Polymer Samples

Instructions: Try to bend each of the polymer samples, then rank the samples in order of easiest to bend to hardest to bend:

Easiest: _____

Hardest: _____

Predict which sample will be easiest to scratch, and which sample will be hardest to scratch:

Easiest: _____ Hardest: _____

Keep adding 2 mL of vinegar to your solution and recording the pH until the pH is below 7:

Amount of vinegar added	pH
0 mL	
2 mL	

On your sheet of graphing paper, plot the pH of your solution as a function of how much vinegar you added.

Congratulations, you have just turned your PLA cup into a vinegar and lactic acid based cleaning solution! This solution is safe to use for cleaning counters, windows, or tiling in the kitchen or bathroom.

¹"Recycling Polylactic Acid" *Beyond Benign* 2010 Web. 25 May 2017

<http://www.beyondbenign.org/K12education/hsgc/recycling%20polylactic%20acid.doc>

²"Hydrolysis of Post-Consumer Polylactic Acid Waste" *Greener Education Materials for Chemists*

University of Oregon 2008 Web. 25 May 2017 <http://greenchem.uoregon.edu/PDFs/GEMsID102.pdf>