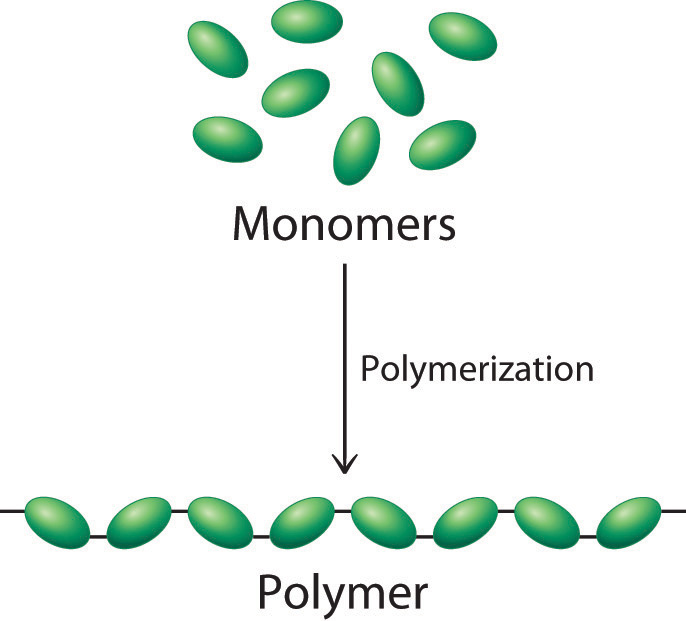
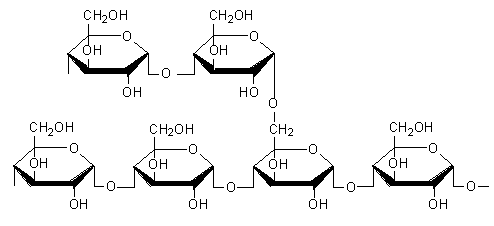
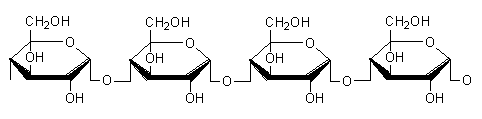
Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_ **Bioplastics Lab 1: Making a Bioplastic**

**Learning Targets**:

* Describe the chemical and physical changes involved in turning starch into bioplastic
* Follow a standard procedure for making a bioplastic
* Explain how a plasticizer affects the properties of a bioplastic
* Explain how the use of an acid and a base affect the properties of a bioplastic

**Background**:

*Polymers* are large molecules consisting of many repeating units, called *monomers*. During the process of *polymerization*, monomers are chemically bonded together to form a polymer. Starch is made of long chains of glucose molecules: *amylose*, a straight chain molecule and *amylopectin*, with a branched shape. These molecules form small particles called *granules*. Each type of plant starch has unique sizes of granules and ratios of amylose and amylopectin molecules. So, plastics made with starch from different plants may have different properties.



Amylose

Amylopectin

When making a *bioplastic*, the chains of molecules in starch line up and bond to make a strong material. Straight chain amylose molecules form a more ordered, stronger plastic film than do the branched amylopectin molecules that are more difficult to line up. Dilute hydrochloric acid can be used to break down the branched amylopectin molecules into straight chain amylose molecules. After adding acid, the mixture is heated to boiling. The starch first becomes soluble in the water, and the starch granules begin to swell up and form a paste—similar to gelatin in Jello. As the paste cools, the water leaves the paste and the amylose molecules bond to make a brittle plastic film. Other chemicals called *plasticizers*,such as glue, glycerol or vegetable oil, can be added to the solution before heating. Glycerol is a small molecule that traps water in the starch chain, making it less brittle.

In this lab, you will make a polymer from corn starch. You will also investigate how the addition of a plasticizer (glycerol) and the use of hydrochloric acid and sodium hydroxide affect the properties of the bioplastic.

**Prelab Assignment:**

1. Write and underline the title of the lab in your notebook.
2. Using your own words, rewrite the learning targets as objectives.
3. Answer the prelab questions in your notebook—sentences please.
4. Draw and label the equipment needed to do the lab. Read the procedure carefully and develop your own list. Think of everything you might need to perform each step.
5. Write the names, amounts and chemical formulas (when available) of any chemicals required.
6. Construct a flowcharted procedure, using pictures and words. Do not copy the procedure exactly as written—summarize and simplify. Your procedure must be replicable by another student.

**Prelab Questions:**

1. How is bioplastic different from most commercial plastics? Refer to the information you gathered when you read the article “Plastics Go Green”.
2. List three safety procedures that must be followed in this lab.
3. Compare/contrast amylose and amylopectin.
4. What is the purpose of adding dilute HCl before heating the starch mixture?
5. How does glycerol act to make a less brittle form of bioplastic?

**Procedure:   
NOTE that you can do several experiments at the same time, heating multiple beakers on the hot plate.**

**Each person needs to follow his or her own procedure carefully, as each trial is similar but different.**

**Trial 1 (Corn)**

1. Wear safety goggles and aprons.
2. Add 33.0 mL of distilled water to a 150 or 250 mL beaker.
3. Add 3.10 g of corn starch to the beaker.
4. Measure 5.0 mL of 0.1 M HCl, and add it to the mixture in the beaker. Stir with a glass stirring rod or wooden stick to thoroughly mix.
5. Slowly heat to a gentle boil on a hot plate. **DO NOT BOIL VIGOROUSLY**. Heat for 5-10 minutes, stirring occasionally.
6. While waiting for the mixture to heat, use masking tape to label the side of a plastic petri dish with your period, lab station, initials, and the word “**Corn**”.
7. Measure 5.0 mL of 0.1 M NaOH and stir into the beaker. Confirm that the mixture is basic by testing with pH paper. If it is not basic, continue to add NaOH in 1 mL increments until it is basic. Make a note of the total volume of NaOH you add.
8. Pour your sample into the labeled petri dish.
9. Stir again with a stirring rod to remove air bubbles.

**Trial 2 (Corn + Gly)**

1. Wear safety goggles and aprons.
2. Add 33.0 mL of distilled water to a 150 or 250 mL beaker.
3. Add 3.10 g of corn starch to the beaker.
4. Add 1.2 mL of glycerol.
5. Measure 5.0 mL of 0.1 M HCl, and add it to the mixture in the beaker. Stir with a glass stirring rod or wooden stick to thoroughly mix.
6. Slowly heat to a gentle boil on a hot plate. **DO NOT BOIL VIGOROUSLY**. Heat for 5-10 minutes, stirring occasionally.
7. While waiting for the mixture to heat, use masking tape to label the side of a plastic petri dish with your period, lab station, initials, and “**Corn +** **Gly**”.
8. Measure 5.0 mL of 0.1 M NaOH and stir into the beaker. Confirm that the mixture is basic by testing with pH paper. If it is not basic, continue to add NaOH in 1 mL increments until it is basic. Make a note of the total volume of NaOH you add.
9. Pour your sample into the labeled petri dish.
10. Stir again with a stirring rod to remove air bubbles.

**Trial 3 (Corn, no HCl)**

1. Wear safety goggles and aprons.
2. Add 33.0 mL of distilled water to a 150 or 250 mL beaker.
3. Add 3.10 g of corn starch to the beaker. Stir with a glass stirring rod or wooden stick to thoroughly mix.
4. Slowly heat to a gentle boil on a hot plate. **DO NOT BOIL VIGOROUSLY**. Heat for 5-10 minutes, stirring occasionally.
5. While waiting for the mixture to heat, use masking tape to label the side of a plastic petri dish with your period, lab station, initials, and the words “**Corn, no HCl**”.
6. Measure 5.0 mL of 0.1 M NaOH and stir into the beaker. Confirm that the mixture is basic by testing with pH paper. If it is not basic, continue to add NaOH in 1 mL increments until it is basic. Make a note of the total volume of NaOH you add.
7. Pour your sample into the labeled petri dish.
8. Stir again with a stirring rod to remove air bubbles.

**Trial 4 (Corn, no NaOH)**

1. Wear safety goggles and aprons.
2. Add 33.0 mL of distilled water to a 150 or 250 mL beaker.
3. Add 3.10 g of corn starch to the beaker.
4. Measure 5.0 mL of 0.1 M HCl, and add it to the mixture in the beaker. Stir with a glass stirring rod or wooden stick to thoroughly mix.
5. Slowly heat to a gentle boil on a hot plate. **DO NOT BOIL VIGOROUSLY**. Heat for 5-10 minutes, stirring occasionally.
6. While waiting for the mixture to heat, use masking tape to label the side of a plastic petri dish with your period, lab station, initials, and the word “**Corn, no NaOH**”.
7. Pour your sample into the labeled petri dish.
8. Stir again with a stirring rod to remove air bubbles.

**All Trials:** Allow all samples to dry on the lab counter over the weekend, or your teacher may ask you to place them into the drying oven at 55 °C for 1-2 days. Do not disturb your sample or other teams’ samples until completely dry.