**Lesson 3: Lab 2 Additives & Starches**

*Explore the Problem*:

**PROBLEM STATEMENT:**

How does the type of starch and the additive used affect the properties of a bioplastic?

**LEARNING OBJECTIVES:**

* Students will modify the bioplastic lab procedure to investigate the effect of different starches and additives on the properties of a bioplastic

**MATERIALS:**

### Bioplastics Lab 2 procedure, safety goggles, aprons, distilled water, corn starch, potato starch, tapioca starch, glycerol, calcium carbonate, glue, 0.1 M HCl, 0.1 M NaOH, 100 or 150 mL beakers, 10 mL graduated cylinders, electronic balances, hot plates, glass stirring rods (or wooden stir sticks), plastic petri dishes, labeling tape, Sharpie markers, Beral plastic pipets, optional drying oven, pH paper, optional FD& C food dyes (order from Flinn Scientific). (<http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=22213>)

**LESSON PREPARATION:**

* Students will work in assigned groups of 3-4. Each student team will be assigned a specific set of variables to investigate, as shown in the table below.

|  |  |  |
| --- | --- | --- |
| **Student Team** | **Starch Used** | **Additive** |
| 1 | Potato | Glycerol |
| 2 | Tapioca | Glycerol |
| 3 | Corn | Calcium carbonate |
| 4 | Corn | Glue |
| 5 | Tapioca | Calcium carbonate |
| 6 | Tapioca | Glue |
| 7 | Potato | Calcium carbonate |
| 8 | Potato | Glue |

* Print Bioplastic lab 2 handouts, 1 for each student.
* Using 1 M stock solutions (or other concentrated stocks) of HCl and NaOH, make up sufficient volume of 0.1 M solutions for your classes. Each lab group needs approximately 10 mL of each solution.
* Set up lab containers with necessary supplies for each team (two 10 mL graduated cylinders, two labeled pipets—NaOH and HCl, four 100 or 150 mL beakers, four glass stirring rods, four plastic or glass petri dish bottoms)
* On each lab station, set up:
  + Electronic balance
  + Plastic Ziploc containers of cornstarch, potato starch and tapioca starch. Label each container with a picture of the plant to help make the bioplastic connection.
  + Distilled water bottle
  + Hot plate
* On central lab table, make available:
  + pH strips or Hydrion pH paper
  + Sharpies + labeling tape
  + Glycerol, stored in plastic tray to contain sticky spills (NOTE: Glycerol is extremely flammable)
  + 1 L bottles of 0.1 M NaOH and HCl, stored in plastic trays to contain spills (NOTE: strong, concentrated acid and base)
  + Calcium carbonate
  + Set of 7 FD&C dyes (optional)
* On carts or counters, set up storage trays for each class and lab group. See Lab 1 for suggested setup.

**TIME REQUIRED: ONE 50-MINUTE PERIOD TO COMPLETE THE LAB**

* Students can complete the modified flowcharted procedure for homework. This is very similar to the procedure for Lab 1, using different starches and additives.
* The lab is easily completed in one class period.
* If the samples are dried on the lab counters, it may take up to 5 days before samples are sufficiently dry to examine.
* If a drying oven is used (set to about 55 °C), samples will be ready to examine in about 2 days.

**PROCEDURE:**

***Day 1 (about 25 minutes)***

* Use the Bioplastic Lessons 2&3 PPT to introduce the learning targets for the lesson.
* Provide about 5 minutes for students to review the lab procedure.
* Explain that student teams will be responsible for investigating a starch/additive combination. They will present their findings and test results during a class gallery walk.
* Assign student teams.
* Provide about 15 minutes of time in class for students to complete the pre-lab assignment (see lab sheet), or assign for homework.

***Day 2 (full 50 minute period)***

* On the day of the lab, spend about 5 minutes going through safety and other procedures. See the PPT for lab tips.
* Students can finish the lab in 40 minutes if they familiarized themselves with the procedure by completing the pre-lab flowchart. Store the labeled petri dishes on trays, or carts, or other designated areas.
* Allow the samples to dry on countertops for several days, or two days in a drying oven set at 55 °C.

**ACCOMMODATIONS:**

Assist visually impaired students with reading pipets and graduated cylinders. Team up IEP students with a peer—assign the same trial to both students. Review the names of equipment with ELL students by drawing labeled pictures of each piece of equipment on a central white board.

**EXTENSION:**

Students can use the FD&C dyes to produce many bright colors for their plastic, which is extremely motivating. Some students might want to try doubling the recipe. Provide larger glass containers if requested.