**Lesson 1: Bioplastics pbl Introduction**

*Understand the Problem:*

Students will be introduced to the problem statement: How can we design a more sustainable cell phone? Students will:

1. Complete a Plastics Pre-assessment.
2. Learn about the history and chemistry of polymers.
3. Investigate one of the seven plastics recycling codes, and prepare a poster and presentation.
4. Watch videos on problems with plastics and non-plastic packaging solutions.
5. Read an article about bioplastics.

Introduction/Problem Launch:

**PROBLEM STATEMENT:**

How can we design a more sustainable cell phone?

**LEARNING OBJECTIVES:**

* Describe the life cycle of a polymer
* Identify everyday items made from petroleum-based polymers
* Describe the relationship between a polymer and a monomer
* Explain why bioplastics could be a more sustainable option than traditional plastics for cell phone cases

**MATERIALS:**

* Pre-assessment worksheet
* 8 sets of plastics samples (8-10 samples per box or bag, various types of plastics from your recycle bin, other polymers if available such as carbon fiber or NOMEX).
* Life Cycle of a Polymer worksheet.
* Butcher paper and markers.
* Videos (links also available in PPT show)

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| **Video Title** | **Link** |
| Plastics and Polymers | https://www.youtube.com/watch?v=EoyWY-LlYTs |
| Plastic in the Pacific | http://www.pbs.org/wnet/need-to-know/environment/an-ocean-of-plastic/2686/ |
| Tough Truths About Plastic Pollution | <https://www.ted.com/talks/dianna_cohen_tough_truths_about_plastic_pollution> |
| Are Mushrooms the New Plastic? | https://www.ted.com/talks/eben\_bayer\_are\_mushrooms\_the\_new\_plastic |
| Crash Course in Chemistry: Polymers (extension) | https://www.youtube.com/watch?v=rHxxLYzJ8Sw |

* “Plastics Go Green: Bioplastics” article and worksheet.
* Lesson 1 PowerPoint slide show.

**LESSON PREPARATION:**

* Seven student groups with four students per group should be set up in advance for the duration of the unit.
* Print all worksheets (Pre-assessment, Life Cycle of a Polymer, Plastics Go Green)
* Print copies of the “Plastics Go Green” article with paragraphs numbered for each student (or post as pdf)
* Set up 8 boxes or bags with polymer samples; label each bag/box with one of the 7 recycling codes
* Obtain pieces of butcher paper for student posters

**TIME REQUIRED:**

Approximately 3-4 class periods

**PROCEDURE**: (See PPT for detailed sequencing)

***Day 1 (assumes 50 minute periods)***

Introduction (15 minutes)

* Ask students to complete the Plastics Pre-assessment
* Introduce the purpose of the Cell Phone Bioplastic PBL

Background Information (15 minutes)

* Use the PPT show to review the history of polymers
* Show the video clip on Plastics and Polymers

Exploration (20 minutes for polymer box exploration, 1-2 days to research and prepare poster)

* Assign student teams
* Hand out the Life Cycle of a Polymer worksheet
* Each team receives a container with a selection of plastics and other polymers, if available (NOMEX, carbon fiber). They will sort the items into 3-4 student-determined categories and speculate on their potential uses.
* Each team is assigned one of the 7 recycling codes. They will research the code and produce a simple butcher paper poster and two-minute presentation covering the details described on the Life Cycle of a Polymer worksheet.

***Day 2 (assumes 50 minute periods)***

Reading Assignment Introduction (10 minutes, finish as classwork or homework)

* Hand out the Plastics Go Green worksheet.
* As a whole class, read the 11 statements on the worksheet. Students should fill out column 1 (agree or disagree) with each statement.
* Hand out the article. Students should read and mark the text (underlining key ideas, highlighting key words, ??? for confusing sections) first, then complete the worksheet. The focus is on using evidence from the article to support or refute student agreements/disagreements.

Poster and Presentation Preparation (40 minutes)

* Have butcher paper, markers and computers (or use student personal devices) available for students research

***Day 3 (assumes 50 minute periods)***

Videos on Plastic Pollution (20 minutes)

* Show the two videos Plastics in the Pacific and Tough Truths About Plastic Pollution.

Student Presentations (15 minutes)

* Each student group will present their Recycling Code poster to the class.
* If desired, the teacher may use the posters or presentations as an informal assessment of learning.

Conclusion (15 minutes)

* Show the video “Are Mushrooms the New Plastic?” to introduce the idea of using biomaterials to replace petroleum-derived plastics.
* Use the PPT slide show to review basic ideas about recycling codes and polymer chemistry.

**ACCOMMODATIONS:**

* For visually impaired students, provide copies of the PPT slides as reference.
* For a learning extension, see below.

**EXTENSION:** (1-2 days)

If desired, and time is available, students can complete the “Using Molecular Models to Simulate Polymerization Reactions” activity. This provides a deeper understanding of how monomers polymerize to form polymers. You may also want to assign a reading on polymers from their chemistry textbook, and show the video “Crash Course in Chemistry—Polymers”.