Bay Area Scientists in Schools Presentation Plan

Lesson Name Polymer Chemistry: More than Just Plastic
Presenter(s) Alex Mastroianni , Shelley Claridge, Rachel Smith, Matt Sheldon, Bryce Sadtler, Josh Wittenberg

Grade Level 5th **Standards Connection(s)** Structure and properties of matter

Abstract: We will be introducing kids to the world of polymers. Examples of polymers are all around us whose properties and uses are largely determined by their chemical structure. We will explain how polymers are large molecules consisting of long chains of repeating units. Through activities and demonstrations we will look together with the class at the structure of polymers and how they are formed.

Vocabulary/Definitions: *3 – 6 important (new) words*

- *mer unit:* basic molecular unit which is repeated to form a polymer
- *polymer*: a chainlike molecule consisting of ten to over a million mer units
- *plastic*: A synthetic (man-made) polymer
- *biopolymer*: A polymer produced naturally

Materials: *What you'll bring with you*

- Several examples of polymers the students will be familiar with and some they won't
- Materials for students to synthesize their own polymer using borax, glue, and water

Classroom Set-up: *Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed*

-Open area for activity involving the formation of polymers
-Sink + 10 minutes of clean-up time at the end as the students will be making their own polymer

Classroom Visit

1. **Personal Introduction:** **5 Minutes**
Who are you? What do you want to share with students and why? How will you connect this with students' interests?

We are graduate students and postdoctoral researchers in the Alivisatos group at UC Berkeley. We have backgrounds in the fields of chemistry, material science, and math. Our research involves making and characterizing nanocrystals, which are tiny particles displaying a number of interesting properties due to their small size.

Topic Introduction: **12** **Minutes**

Big Idea(s), vocabulary, assessing prior knowledge. What questions will you ask to learn from students?

We will begin the classroom visit by showing several examples of polymers familiar from our daily lives such as milk cartons, nylon, and wood. We will ask the students to provide examples of polymers, which can be found in the classroom or their homes. Questions for the class will include: Why are polymers useful, what words describe the texture and consistency of polymers (rubbery, stretchy, soft), what materials are not polymers and why?

Two major classes of polymers are plastics and biopolymers. Plastics, such as nylon, are synthetic polymers made in laboratories by chemists and engineers, while biopolymers, such as wood and tortoise shells, are found in nature. The properties of a polymer, which determine its use, derive from its molecular structure. The basic unit of a polymer is called a "mer" unit, which is repeated to form the polymer chain. The polymer chain is large compared to most simple molecules but still very small compared to the objects made from polymers.

2. Learning Experience(s): **25** **Minutes**

Demonstrations, hands-on activities, images, games, discussion, writing, measuring… What will you do, what will kids do? Describe in order, including instructions to kids.

1) The children will represent mer units and will polymerize by joining hands. As individual mer units the students may easily move about. As they polymerize they begin to solidify, yet chains of students can still slide past each other. This is why many polymers can be described as stretchy. When you stretch a polymer by pulling it, chains of the polymer are sliding past each other.
2) Each student will then perform their own non-toxic polymerization experiment using Elmer's glue, water, and borax. We will pass out supplies to each student, that they will mix and observe, as we give the following instructions:
    a. Add water to the glue and stir. What happens? How does the glue change?
    b. In separate cup, add borax to water and stir. What happens to the borax in water?
    c. Combine solutions and stir thoroughly. What happens? Students should then examine/play with the putty to characterize its consistency.

The discussion will then relate this experiment to the earlier activity (1), where the students represented mer units and formed a polymer. What happened to the glue? First it was runny but as we added water, it became rubbery and even stiffer when the borax was added. The borax attached the long polymer units together [cross linked], making it harder for them to slide past one another.

3. **Wrap-up: Sharing Experiences and Building Connections** **8** **Minutes**
Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

The kids will discover that the properties of the polymer each one made will vary depending on the exact ratios of glue, water, and borax. Some of the synthesized polymers may be gooey while others rubbery. As chemists in the laboratory we perform chemical reactions similar to the polymerization. It is important to make observations such as the consistency of the polymer and correlate these observations with the way in which the polymer was synthesized (i.e. more borax lead to a rubbery polymer as the borax increases the number of links between polymer chains).

4. **Close:** **5** **Minutes**
How can kids learn more? Thanks and good-bye! Clean-up.
Websites are provided below for the kids to learn more about polymers and the activities done in class.

TOTAL 50 – 60 Minutes

Follow-up – After Presentation

We would love for the students to write a letter to us explaining "How we learned about the importance of polymers in their daily lives." They can also ask us any questions about the lecture and demonstration.

List or attach examples of activities, websites, connections for additional learning. Additional information about the activities done in class can be found at the following websites:

http://pslc.ws/macrog/kidsmac/kfloor4.htm

Attach worksheets, hand-outs, visuals used in classroom presentation.

We will be bringing a hand-out for the class to summarize the concepts presented on the structure, formation, and properties of polymers.