

Bay Area Scientists in Schools Presentation Plan

Lesson Name Plastics, Recycling, and Composting

Presenter(s) Prof. Michelle Chang, Laura Fredriksen, Maggie Brown, Brooks Bond-Watts, Mark Walker, Amy Weeks, Miao Wen

Grade Level 5 **Standards Connection(s)** atoms, molecules, substances

Next Generation Science Standards:

5-PS1-3. Make observations and measurements to identify materials based on their properties.

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

| Science & Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| <p><i>Developing and Using Models</i> Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> Develop a model to describe phenomena. (5-PS1-1) <p><i>Planning and Carrying Out Investigations</i></p> <p>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <p>Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4)</p> <p>Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)</p> | <p><i>PS1.B: Chemical Reactions</i></p> <p>When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)</p> | <p><i>Cause and Effect</i></p> <p>Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4)</p> <hr/> <p><i>Connections to Nature of Science</i> <i>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</i></p> <p>Science assumes consistent patterns</p> |



CRS

COMMUNITY RESOURCES FOR SCIENCE
practical support for great science teaching

1611 San Pablo Avenue, Suite 10 B
Berkeley, CA 94702

(510) 527-5212 | www.crs-science.org

Common Core Standards:

ELA/Literacy:

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.

FOSS Connections:

Grade 5 Module: *Mixtures and Solutions*

Abstract:

The goal of this lesson is to teach children about plastics and how some plastic waste can be degraded naturally and some cannot. We will explain what plastics are through a Red Rover-based game where the students play monomer units linked by "bonds" of different materials to make the polymer chain. At the same time, students will learn concepts about weaker and stronger bonds and plastics and how chemical bonding relates to their ability to be degraded. After this activity, we will show them how to make polymers using glue and borax. We will then ask the students to predict whether certain polymers will degrade or not. We will then ask them to complete a composting experiment to test their predictions. We will close the lesson with a discussion on waste habits.

Vocabulary/Definitions:

- **Plastic** – A substance that is a type of polymer.
- **Polymer** – A substance that is made of individual units that are connected together in a chain through bonds.
- **Bond** – A linkage between two polymer units. Some are easy to break and others are not.
- **Decomposition** – The process of polymer degradation back into individual units.
- **Biodegradable** – Something that can decompose by natural processes. For example, when food goes bad, it starts to decompose when microbes start to grow on it and is thus called "biodegradable".
- **Microbes** – Microscopic organisms that you cannot see with your eye such as bacteria or fungi
- **Compost** – A pile of material containing microbes along with biodegradable items for them to grow on.

Materials:

What will you bring with you?

- Paper towels/toilet paper
- Rope
- Borax
- Chemicals, safety equipment and other supplies for



CRS

COMMUNITY RESOURCES FOR SCIENCE
practical support for great science teaching

1611 San Pablo Avenue, Suite 10 B
Berkeley, CA 94702

(510) 527-5212 | www.crs-science.org

- nylon demonstration
- 4-6 bottles of Elmer's glue
- 4-6 Containers (plastic cups or equivalent size)

- Chalk board or marker board and chalk or markers to write on it.

What we'll need:

- Water

Classroom Set-up:

- The classroom should be set up in groups of small manageable numbers (4-6 groups for 20-30 students)

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 introduce ourselves as chemists who care about the environment. Chemists study materials that can be made into clothing, containers, and other useful things. We also care about what happens to all these things when they are thrown away.

2. **Topic Introduction:** _____ 10 _____ Minutes
Big Idea(s), vocabulary, assessing prior knowledge. What questions will you ask to learn from students?

We open by asking about the vocabulary words. We will probe and figure out what they do/do not know and talk about definitions briefly. Someone should write the words on the chalkboard or marker board.

3. **Learning Experience(s):** _____ 30 _____ 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.

A. Red Rover activity (15 min): We will have 2-3 of the groups assemble in a chain and ask the remaining students to gently try to move across the chain. After that, we will have the other 2-3 groups of students to assemble in a chain by holding onto paper towels or toilet paper. The remaining students will try to break through the paper links, and then we'll ask them how easy they thought it was. We will make the observation that the act of breaking the links was like decomposition, and that the chain the students formed was like a polymer and each individual student was a molecule in the polymer chain.

B. Degradable polymer demonstration (10 min): We make a polymer from glue and Borax with them in small groups. Each individual should be able to make it in a small cup. It will form a silly-putty type material. We will tell them that the glue is forming bonds with the borax in the



CRS

COMMUNITY RESOURCES FOR SCIENCE
practical support for great science teaching

1611 San Pablo Avenue, Suite 10 B
 Berkeley, CA 94702

(510) 527-5212 | www.crs-science.org

water and making long chains of individual glue and borax molecules. We will ask them to compare the final product to when glue dries.

C. Nylon pulling demonstration (5 min): This section can be removed if there is not enough time or if the class is more boisterous and takes too long on part A and B. Adipic acid with diaminoethane in a 5:2 volume ratio, do not mix. Pull the nylon out of the solution interfaces, and then bring it around to show it to students (no touching!). We will ask them to compare this to the borax/glue product and ask them if they think it would be easy to break the bonds in nylon compared to silly putty.

4. **Wrap-up: Sharing Experiences and Building Connections** _____ 10 Minutes
Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

Talk to them about what they learned about polymers. What do they think about nylon or the silly putty? Do they have strong bonds like hands holding or weak bonds like paper links? Do they think the nylon or the silly putty will degrade in the compost?

5. **Connections and Close:** _____ 5 Minutes
We ask the kids if they can follow up and answer their questions by doing small compost piles or a classroom compost pile (will depend on what the teacher wants to do, we'll talk to him/her beforehand). We will give the teacher information on the materials they'd need to collect to form the pile, and a follow-up sheet the kids can fill out on what degrades and what doesn't.

TOTAL 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to mix glue and Borax. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students experiment with different ratios of glue to Borax. Students can make predictions about what different ratios will yield and then test predictions.

Follow-up Possibilities

ELA Activity:

Students answer the following prompt:

"Write a letter to a friend explaining what you learned about polymers and chemical bonds."

Mathematics Activity:

Students can record and graph the volume of their compost pile each week or month.



CRS

COMMUNITY RESOURCES FOR SCIENCE
practical support for great science teaching

1611 San Pablo Avenue, Suite 10 B
Berkeley, CA 94702

(510) 527-5212 | www.crs-science.org

Other:

Follow the activity up by having the students create small compost piles in Ziploc bags that they can observe for weeks to come. Or, if time or supplies permit, build a compost pile in a large bucket. We will discuss what the teacher wants to do ahead of time. If they want to do this, we suggest getting all the supplies together on the day we come, and to initiate the experiment after we leave. If time does not permit, it may also be initiated at a later date. Lesson plan for large compost pile can be found at:

http://curriculalessons.suite101.com/article.cfm/spring_lesson_plans

If the compost pile is not possible, students can also be asked to do a homework project to write down what they threw away that day and which items they think can be degraded or if they can replace a non-biodegradable item with a biodegradable option.

Small compost piles (one for each group)

Materials needed:

- Ziploc bags
- Potting soil or soil from outside
- Fruit/vegetable peels
- Breads
- Beans (non-dry)
- Other vegetative materials
- Nylon and/or silly putty used on the activity day (the nylon definitely should not decompose, the silly putty will likely get hard or undergo some sort of change, it depends on the moisture in the bag)

*Do not use animal products in the compost or there will be a smell.

Optional: Ask the students what else they think should go in the bag. What else do they think might decompose?

Directions:

1. Place everything in a compost bag. Have the students write or draw what they see on the first day
2. Place the Ziploc bags in another part of the room. Keep at room temperature. Do not place in refrigerator.
3. After 1 week, have the students write down what they see, and compare it to what they saw the first day.
4. Continue observations for 1-2 months.
5. Collect all the students' work together and hand it back to them. Have them write up a final observation on which things they put in the bag that looked like they were rotting or



CRS

COMMUNITY RESOURCES FOR SCIENCE
practical support for great science teaching

1611 San Pablo Avenue, Suite 10 B
Berkeley, CA 94702

(510) 527-5212 | www.crs-science.org

decomposing. Ask them if they think the bonds in the polymers we made for them had strong or weak bonds. Close the experiment on a discussion about composting and waste management.

6. Please write to us on what you learned in this experiment!