Bay Area Scientists in Schools Presentation Plan

Lesson Name Plastics, Recycling, and Composting

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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
Developing and Using Models 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. • Develop a model to describe phenomena. (**5-PS1-1**) *Planning and Carrying Out Investigations* 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. 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**) Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (**5-PS1-3**)	*PS1.B: Chemical Reactions* When two or more different substances are mixed, a new substance with different properties may be formed. (**5-PS1-4**)	*Cause and Effect* Cause and effect relationships are routinely identified, tested, and used to explain change. (**5-PS1-4**) ---------- *Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems* Science assumes consistent patterns

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 is 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 is 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 nylon demonstration

- 4-6 Bottles of Elmer's glue
- 35 Containers (plastic cups or equivalent size)
- 35 Wooden sticks
- 10 Biodegradable packing peanuts (corn starch)
- 10 Non-biodegradable packing peanuts (polystyrene)

What we'll need:

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

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 (10 min): We will ask for ten volunteers. We will ask five to assemble in a chain by holding onto paper towels or toilet paper. The remaining five students will try to break through the paper links, and then we will 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 monomer in the polymer chain. Next, we will have the five students who broke the "bonds" form a chain by holding onto pieces of rope. We will then ask the other five students to try to gently pass through the chain. Once again we will ask them how difficult it was to break the chain.

We will make sure to specify which set of "bonds" represent traditional polymers and which represent newer, more degradable types.

B. Degradable polymer demonstration (5 min): We will distribute one polystyrene and one corn starch packing peanut to each group of students. We will ask the students if they think the packing peanuts are the same? How are they different? Does one seem stronger than the other? We will pour water into two clear bottles and ask for two student volunteers. We will drop a polystyrene peanut in one bottle and a corn starch peanut in the other bottle. We will ask the volunteers to shake the bottles vigorously. After shaking we will ask the students to look at the bottles and describe what happened. We will ask them what this tells us about the bonds in these polymers?

C. Hands-on polymer demonstration (10 min): The students will make their own polymer using glue and Borax. The students need to be in groups, so materials can be shared. We will pass out one cup and one wooden stick to each student. We will then pass out one bottle of glue to each group. We will have the students pour some glue into the cup. We will then add food coloring (a few drops) to the glue and ask the students to stir in the color. Then we will pass out a bottle of saturated Borax solution to each group. The students should slowly add the Borax and stir it into the glue mixture. It will form a silly putty-like material. We will tell them that the glue is forming bonds with the borax in the water, and making long chains of individual glue and borax molecules. We will ask them to compare the final product to when glue dries.

D. Nylon pulling demonstration (5 min): This section can be removed if there is not enough time.

Before the visit, we will premix 250 mg of hexamethyldiamine with 6.5 mL water and 223 µL sebacoyl chloride with 6.5ml hexanes or cyclohexane.

During the demonstration, we will gently pour the hexane solution on top of the water solution, pull the nylon out of the solution interfaces, and then bring it around to show to students (No touching!). We can also pass around some factory produced nylon. We will then 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** _____5_____ 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 rope 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 students 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.

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 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!

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