Bay Area Scientists in Schools Presentation Plan

Lesson Name **Chemical Reactions**

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Grade Level 5 **Standards Connection(s)** Matter and Its Interactions

Next Generation Science Standards:
5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
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 and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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) **Using Mathematics and Computational Thinking** Mathematical and computational	**PS1.A: Structure and Properties of Matter** -The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) -Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (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) -No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this	**Cause and Effect** -Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4) **Scale, Proportion, and Quantity** -Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2),(5-PS1-3) ---------- **Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems** -Science assumes consistent patterns in natural systems. (5-PS1-2)

thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. -Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)	grade level.) (5-PS1-2)	

Common Core Connections:
ELA/Literacy –
W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2),(5-PS1-3),(5-PS1-4)
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. (5-PS1-2),(5-PS1-3),(5-PS1-4)
W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2), (5-PS1-3),(5-PS1-4)
Mathematics –
MP.2 Reason abstractly and quantitatively. (5-PS1-2), (5-PS1-3)
MP.4 Model with mathematics. (5-PS1-2),(5-PS1-3)
MP.5 Use appropriate tools strategically. (5-PS1-2), (5-PS1-3)
5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. (5-PS1-2)

FOSS Connections: Mixtures and Solutions

Teaser: *Your opportunity to tell teachers and students what will be fun and interesting about your visit!*
We will introduce the concept of chemical reactions. We will demonstrate the reaction:
$2H_2O_2 \rightarrow 2H_2O + O_2$ by combining KI (catalyst) with hydrogen peroxide in the presence of soap…the oxygen gas evolved by the reaction causes soap to foam dramatically (this demonstration is often called “elephant toothpaste”). Then the students will perform their own chemical reactions by combining Elmer’s glue (polyvinyl acetate, a polymer) and Borax to make slime (this reaction is the crosslinking of a polymer).

Objective: *As a result of your lesson, what will students learn? What will they be able to do?*
The objective is to show that chemicals can react with each other to form new chemicals. By observing the decomposition of hydrogen peroxide and the cross-linking of a polyvinyl acetate polymer, they will have direct, hands-on experience of chemical reactions.

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

chemical reaction: a process that involves rearrangement of the molecular or ionic structure of a substance
reactant: a substance that takes part in and undergoes change during a reaction.
product: a substance that is formed as the result of a chemical reaction
catalyst: a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.
polymer: a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together.
cross-linking: make or become linked with a chemical cross-link.

Materials:

What will you bring with you?	
Hydrogen Peroxide (3% and 30%)	Borax Solution
Potassium Iodide solution (aqueous)	Food Coloring
500 mL Graduated Cylinder	Plastic Cups (4 oz.)
Dishwashing soap	Popsicle Sticks
Food coloring	Ziploc Bags
Active Yeast Packets	Plastic bins (1 per group of 5-6 kids, fairly large)
20 oz. empty soda bottles (5-8 bottles)	Warm water
Elmer's Glue	Paper Towels

Classroom Set-up: *Student grouping, Power/Water, Projector, Light/Dark,*

- Students will be divided into groups of 5-6 with one graduate student to each group.
- Whiteboard/chalkboard.
- Normal lighting

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 and experiences?

We are UC Berkeley students who study chemistry in order to become scientists. We are interested in the atoms and molecules that make up all the things we see and use in our daily lives…by researching these molecules, we can try to combine them to make new molecules like new medicines or new materials.

Topic Introduction: **_____10___ Minutes**

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

Have you heard of a chemical reaction? What are examples of some chemical reactions?
Write a simple reaction on the board, discuss what the numbers, letters, and arrow mean.
Describe reactants and products, discuss various types of changes that might occur during chemical reaction (release of heat, liquids becoming gases, etc)

2. Learning Experience(s): **____30___ Minutes**

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

- Divide students into groups of 5-6 kids. One graduate student will work with each group. The graduate student will setup the experiment by pouring ½ cup of 3% hydrogen peroxide into the bottle. One or more of the students can then help by pouring in about ¼ cup of soap, followed by a few drops of the desired food coloring.
- Another student at the same time can mix the active yeast with some warm water, and allow the yeast to activate for 5 minutes while the rest of the setup is occurring.
- When the yeast is activated, have one of the students pour the yeast solution into the bottle, and watch the reaction occur.
- After this demonstration, we will do a large scale experiment with the 30% H_2O_2 and KI solution, which will be performed in the front of the classroom (or perhaps outside) and will be setup and performed exclusively by the graduate students.
- **For slime:** Fill 4 oz. plastic cups a quarter of the way with the Elmer's Glue solution and hand out a cup to each student.
- Give the students another cup that is a quarter full of Borax solution. Have them add food coloring to the Elmer's Glue solution and then pour the borax solution into the Elmer's Glue solution.
- Mixing the two solutions causes it to stiffen into rubbery putty. Have the students write down their observations when they mix the two solutions. If they want to take the slime home, they can put it in the plastic bags.

- Adding borax to the PVA cross-links the polymers. This can be shown to the students by drawing the structure for PVA as long parallel chains and asking them if they think the chains can slide past each other. Then drawing in a chemical group that links the chains represents the concept of cross-linking, and should show the students that this restricts the movement of the chains. They should then relate this to the stiffening of the solutions when they mix them.

3. Wrap-up: Sharing Experiences _____10_ Minutes

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

- They will learn new scientific vocabulary (reaction, product, catalyst, decomposition) and how these words can be used outside of a scientific context.
- It may help them begin to question the things they interact with on an everyday basis; the idea that things decompose and change over time or with a catalyst may spark an interest in learning about what other things undergo such changes.
- They will learn about the properties of polymers and how adding certain chemicals will chemically change the polymer which also changes its physical properties, like flexibility.

4. Connections & Close: _____5_ Minutes

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

What other polymers do you find in your class or house? (Elmer's glue)

What are some other chemical reactions you can do at home? (Cooking/baking, vinegar and baking soda, etc.)

Total 50 – 60 Minutes

Follow-up – After Presentation

Students can write to the scientists or to a friend about what they learned during the presentation.

For a fun video on Elephant Toothpaste: https://www.youtube.com/watch?v=ZbUOPAgJIOQ

More resources for learning about chemical reactions: http://www.neok12.com/Chemical-Reactions.htm