Bay Area Scientists in Schools Presentation Plan

Lesson Name Chalk One Up for Science! pH and Chemical Reactions

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Grade Level 5 **Standards Connection(s)** 5-PS1 Matter and Its Interactions

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 and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations 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)	**Structure and Properties of Matter** 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) **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) **Scale, Proportions, and Quantity** Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-3)

Common Core State Standards 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-PS1-3),(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-PS1-3),(5-PS1-4)
W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-3),(5-PS1-4)

Mathematics
MP.2 Reason abstractly and quantitatively. (5-PS1-3)
MP.4 Model with mathematics. (5-PS1-3)
MP.5 Use appropriate tools strategically. (5-PS1-3)

Teaser: Visiting scientists will work with small student groups to test the pH of several household items, followed by student Q&A. Carbon dioxide will then be discussed in the context of combustion reactions and climate change (ocean acidification). The visiting scientists will complete an experiment with their student group that involves making calcium carbonate (chalk) from CO_2, calcium chloride and water (followed by Q&A). The effect of CO_2 on water pH will be discussed. Finally, the visiting scientists will demonstrate how water can be used to rapidly convert solid CO_2 to a gas, which can be used to create soap bubbles.

Objective: In this lesson, students will learn about two important chemicals, water and carbon dioxide. For water, the concepts of acidity and basicity will be introduced, emphasizing (1) common types of acidic and basic solutions commonly encountered, (2) how to determine if something is acidic or basic using cabbage juice and (3) important safety considerations of acids and bases.

Vocabulary/Definitions: *3 – 6 important (new) words*
Acid, Base, pH, carbon dioxide, hypothesis, chemical reaction, indicator

Materials:

What will you bring with you?	*What should students have ready?*
cabbage indicator, different household items with different pH (baking powder, baking soda, sour patch kids, lemon juice, lemonade, windex, vinegar, sparkling water). Setup for Making Chalk, safety glasses	writing material

Classroom Set-up: The students should be divided into 4-5 groups and gather around one table each.

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 scientists from UC Berkeley. What do we do, what do we study (Molecules etc.). Chemistry is important because chemical reactions happen all around us every day (body, gasoline, cooking). Learning chemistry helps us to understand our world better and improve our world (understand what chemicals are polluting our air, make new medicines).

Topic Introduction: **10 Minutes**

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

Chemical Reaction – process in which molecules rearrange into different products that have different properties. Sometimes we can see chemical reactions occurring (bubbles, color change). In today's reaction we'll see a color change. We will learn about 2 types of chemicals called acids and bases: Many things around your house are acids and bases and we'll explore this more today. An acidic solution has excess H+ molecules, a basic solution has excess OH- molecules, neutral solution is neither acidic or basic. Scientists use something called a pH scale to measure how acidic or basic a solution is. The scale goes from 0 to 14 (draw on board, mark acids and bases on scale). Today's chemical reaction: A purplish colored molecule in cabbage juice reacts with acids and bases with a color change. Therefore cabbage juice can be used to indicate if a solution is acidic or basic so it is called an indicator. Demonstration: water with methylene blue indicator, add dry ice, makes it acidic, color change, lead over to experiment with cabbage juice indicator

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.

Experiment 1: As a group the budding scientists will order the food and household products along the pH scale and fill out the hypothesis (prediction) for each product in each column of the worksheet. Then the students will use the cabbage indicator solutions to test the acidity and basicity of the products. Discuss in the group whether hypotheses were correct; fill out worksheet with pH of the household items. The students will then take a piece of Antacid (Tums) and put it into one of the acidic solutions discuss their observation with their peers.

Experiment 2: The visiting scientists will make chalk (calcium carbonate) by bubbling CO_2 through a basic solution containing $CaCl_2$. The students will describe their observations and apply the knowledge about acids and bases. After a while the solution will become too acidic due to excess CO_2 and the chalk will dissolve again, the visiting scientist will talk about the problem of CO_2 in the atmosphere and ocean acidification and what this means for see critters that have shells or corals.

3. Wrap-up: Sharing Experiences **10 Minutes**

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

What did we learn today about acids and bases? Were our hypotheses always correct? How does CO_2 react in water? Finally, the visiting scientists will demonstrate how water can be used to rapidly convert solid CO_2 to a gas, which can be used to create soap bubbles.

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.

Total 60 Minutes

WORKSHEET

Acids and Bases - Cabbage Indicator

1) *As a group, order the food and household products along the pH scale. Fill out your hypothesis (prediction) for each product in each column.*

Product	*Hypothesis: acid, base or neutral?*	*pH*
Windex		
Baking Soda		
Baking Powder		
Sour Patch Candy		
Lemon Juice		
Sprite		
Vinegar		
Sparkling Water		

2) *Use the cabbage indicator solutions to test the acidity and basicity of the products. What do you observe? You can use the pH indicator strips, too! Was your hypothesis in 1) correct?*
3)

Red Cabbage Indicator Colour Chart

pH	pH less than 7 = Acid			pH more than 7 = Base		
	2	4	6	8	10	12
Colour						
	Red	Purple	Violet	Blue	Blu-Grn	Grn-Yel

4) *Complete the table based on your observations. Write down the pH of that product in the correct column.*

5) *Take a piece of Antacid (Tums) and put it into one of the acidic solutions. What happens? Why?*

Turn page over

WORKSHEET

Experiment 2: Making chalk (calcium carbonate)

The visiting scientist needs your help in setting up their chalk-making device!

*1. What happens after you start bubbling CO_2 through a **basic** solution containing $CaCl_2$?*

2. What happens after you continue bubbling CO_2 through the solution?

3. Add some baking soda to an acidic solution. What happens?