4-1-2018

Backyard Science Adventures: Experimentation-Based Activities for Science Outreach

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Experimentation-Based Activities for Science Outreach

By Emily Ruba
Latham Science Engagement Initiative (LSEI), 2017-2018

Project Description

Backyard Science Adventures is a booklet consisting of four activity-based lessons from diverse areas of science. These activities are self-directed experiments that encourage elementary school-aged kids to make discoveries about novel scientific concepts. By carrying out these experiments, young students become familiar with the process of asking a scientific question, making a hypothesis, setting up a fair experiment, collecting data, and making conclusions based on the observed results.

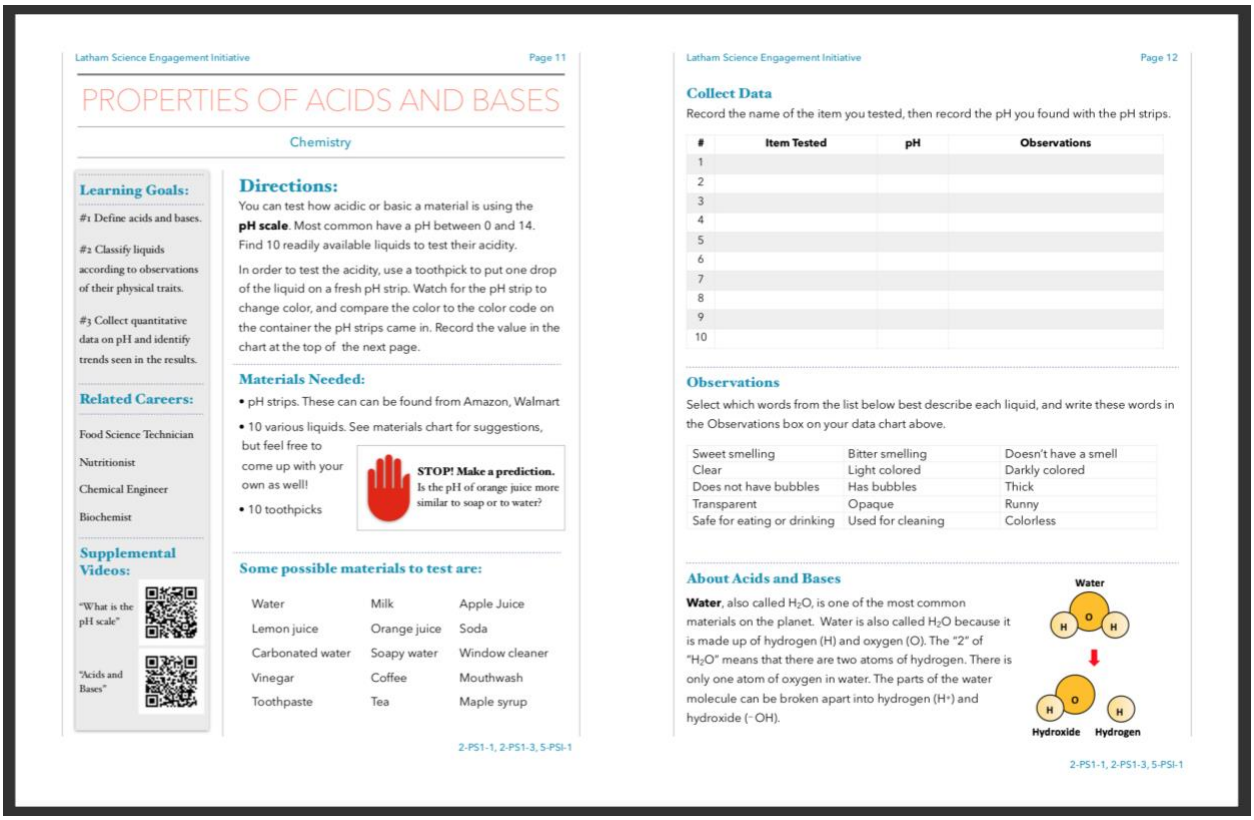
The content of this project aligns with the Next Generation Science Standards (NGSS). The NGSS are a set of academic standards which are widely used by teachers to identify age-appropriate concepts and practices that students should engage with at each grade level. By aligning with these standards, these activities reinforce concepts that students are likely to be exposed to in the classroom.

Project Purpose

I chose this project due to a desire to increase exposure of local students to diverse fields of STEM at an earlier age. Engagement in science is especially suitable for students at an age where they have curiosity about the world around them. By increasing access to educational materials about the experimental process, young students are also better equipped to tackle the sciences later in their education. Even in students who do not go on to pursue a career in the sciences, early exposure promotes a life-long enthusiasm for the sciences. Hands-on approaches to learning, like experimentation, are especially effective methods of delivery for young students.

Developing the Project

Over the course of several months, I designed the experiments and accompanying worksheets that composed the final booklet. I researched similar activities in order to understand how others before me had implemented them, and then I tested these strategies in order to develop my own methods of implementation. Each activity was followed by an explanation of the science involved. These explanations were based on personal knowledge of the content as well as research to ascertain the level of detail would be relevant to elementary school-aged students. A portion of one of these activities, shown below, demonstrates the format used by these activities.



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PROPERTIES OF ACIDS AND BASES

Chemistry

Learning Goals:

#1 Define acids and bases.

#2 Classify liquids according to observations of their physical traits.

#3 Collect quantitative data on pH and identify trends seen in the results.

Related Careers:

Food Science Technician

Nutritionist

Chemical Engineer

Biochemist

Supplemental Videos:

"What is the pH scale"

"Acids and Bases"

Directions:

You can test how acidic or basic a material is using the **pH scale**. Most common have a pH between 0 and 14. Find 10 readily available liquids to test their acidity.

In order to test the acidity, use a toothpick to put one drop of the liquid on a fresh pH strip. Watch for the pH strip to change color, and compare the color to the color code on the container the pH strips came in. Record the value in the chart at the top of the next page.

Materials Needed:

- pH strips. These can can be found from Amazon, Walmart
- 10 various liquids. See materials chart for suggestions, but feel free to come up with your own as well!
- 10 toothpicks

STOP! Make a prediction. Is the pH of orange juice more similar to soap or to water?

Some possible materials to test are:

Water	Milk	Apple Juice
Lemon juice	Orange juice	Soda
Carbonated water	Soapy water	Window cleaner
Vinegar	Coffee	Mouthwash
Toothpaste	Tea	Maple syrup

2-PS1-1, 2-PS1-3, 5-PSI-1

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Collect Data

Record the name of the item you tested, then record the pH you found with the pH strips.

#	Item Tested	pH	Observations
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Observations

Select which words from the list below best describe each liquid, and write these words in the Observations box on your data chart above.

Sweet smelling	Bitter smelling	Doesn't have a smell
Clear	Light colored	Darkly colored
Does not have bubbles	Has bubbles	Thick
Transparent	Opaque	Runny
Safe for eating or drinking	Used for cleaning	Colorless

About Acids and Bases

Water, also called H_2O, is one of the most common materials on the planet. Water is also called H_2O because it is made up of hydrogen (H) and oxygen (O). The "2" of "H_2O" means that there are two atoms of hydrogen. There is only one atom of oxygen in water. The parts of the water molecule can be broken apart into hydrogen (H^+) and hydroxide (^-OH).

2-PS1-1, 2-PS1-3, 5-PSI-1

Throughout the process, I had help from a few people to create materials using age-appropriate, precise language. Mark McDermott, a professor in the College of Education, and Lori Adams, Director of the LSEI program, graciously provided me with their guidance.

Originally, I had planned on creating a website with the intention of making these materials available and marketing them to a wide audience. However, I ended up moving away from the website strategy in favor of bringing these materials directly to students during a hands-on outreach event. I chose to do this because I wanted to be personally responsible for sparking these students' interest in my booklet. When I visited Robert Lucas Elementary in Iowa City, students completed one of my activities and then took the booklet home with them, excited to complete the rest.

Implementation

I distributed Backyard Science Adventures to 30 second-graders at Robert Lucas Elementary, as well as several others at the LSEI Project Engage showcase in April. Additionally, a PDF of the booklet will be made available for download through LSEI. The details of my outreach event are detailed by the following video: https://www.youtube.com/watch?v=HRUMuC8f3-M.

During my visit to Lucas Elementary, 18 students participated in an abridged version of my activity "Balloon Lung Capacity". After a lesson on the role of the respiratory system and circulatory system in providing our muscles with oxygen, we completed an activity using balloons to measure our lung capacity. Each student hypothesized whether or not exercise would increase or decrease their lung capacity. We then used balloons to measure the amount of air our lungs held both before and after exercise. Nearly every student had a smaller balloon after exercise. As a group, we concluded that this was likely due to tiredness from running, which made it more difficult for our muscles to forcibly exhale air from our lungs into the balloon. An image of the students comparing the size of their balloons is shown below, along with an image of the students preparing to run.

Project Impact and Future Directions

Since my booklet will continue to be available online, it can be accessed by parents, educators, or future Latham fellows. My activities have the potential to be used in a variety of settings, including at home, in the classroom, and as a tool for science outreach. After my visit to Lucas Elementary, students will continue to use the booklets over the next few weeks and during their summer vacation. Elise Denniston, coordinator of the after-school program at Lucas Elementary, will continue to distribute the remaining printed copies of the booklet. She also plans to use these activities with students who will be at Lucas Elementary for their summer program this year.

In addition to the Backyard Science Adventures booklet, I also developed “Emily’s Guide to Making a Facilitator’s Guide: Planning Science Outreach Activities”. This tool can be used by current and future Latham Fellows as a template to document the outreach activities they develop. This guide will instruct Latham Fellows on how to make a record of what worked best for their own outreach activities, from their own perspective, so that others make adopt their activities and follow suit. This will further sustainability as well as expand the influence of future Latham Fellows beyond the one-time implementation of their outreach activities.

Discussion

Throughout this process, I learned an incredible amount about planning outreach, editing and design, teaching, and building partnerships. Though I knew I wanted to develop a series of science experiments for kids, I never imaged how many aspects the project would involve. In doing this, I practiced resourcefulness and perseverance. Ultimately, I think I had success sharing my passion for science with these students.

L.S.E.I
LATHAM SCIENCE ENGAGEMENT INITIATIVE

A special thanks to…

Bob and Sue Latham
Lori Adams
Brinda Shetty
Elise Denniston
Mark McDermott
Diane Slusarski
Alexis Brannan
Marco Cuellar