Photo by Aaron Burden on Unsplash

BACKYARD SCIENCE ADVENTURES

Welcome!

Dear Parents and Caregivers,

This booklet contains four science activities your child can complete at home. These activities encourage your child to use experimentation in order to make scientific discoveries. By conducting experiments, your child will be able to explore the scientific method used in making a hypothesis, setting up a fair experiment, collecting data, and making conclusions about the observed results. Your child can complete these experiments independently, or you can work through these experiments together.

The goal of this booklet is to increase exposure of your child to STEM fields. Students learn better when engaged in hands-on problem-solving activities, like experimentation. By introducing kids to science earlier, they are better prepared to tackle science courses at the middle school, high school, or college level. Even in those who do not go on to a career in STEM, exposure at an early age can promote a life-long enthusiasm for the sciences. Additionally, this project increases exposure of students to science which supplements the time allotted for its instruction in schools.

These experiments align with the Next Generation Science Standards (NGSS). The NGSS are a set of academic standards developed by educators, policymakers, and content experts. The NGSS are widely used by teachers to identify age-appropriate concepts and practices that students should engage with at each grade level. Since the experiments within this booklet align with the NGSS, they reinforce crosscutting concepts and approaches that will likely be used in your child's classroom. To know which standards apply to each experiment, reference the footer of any page. For more detailed descriptions of these standards, visit https://www.nextgenscience.org/.

NGSS Practices For K-12 Science Classrooms

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

This booklet also contains a number of QR codes that refer you to related material to supplement each activity. To scan a QR Code, download a QR code reader app, or utilize the QR reader ability that is integrated into the camera software of some cell phones.

This booklet was produced as part of a year-long project through the Latham Science Engagement Initiative (LSEI) at the University of Iowa. Each year, Latham Fellows create, plan, and implement self-directed STEM outreach projects. These projects seek to engage the Iowa City community in thinking about science by making science more accessible to the general public. For more information about LSEI, or to access additional activities, please visit www.stem-o-sphere.org.

Sincerely,

Emily Ruba
Latham Fellow, 2017-2018

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"

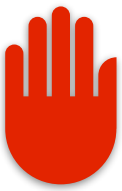
Directions:

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

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			

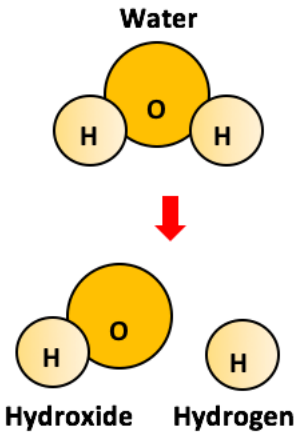
Observations

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

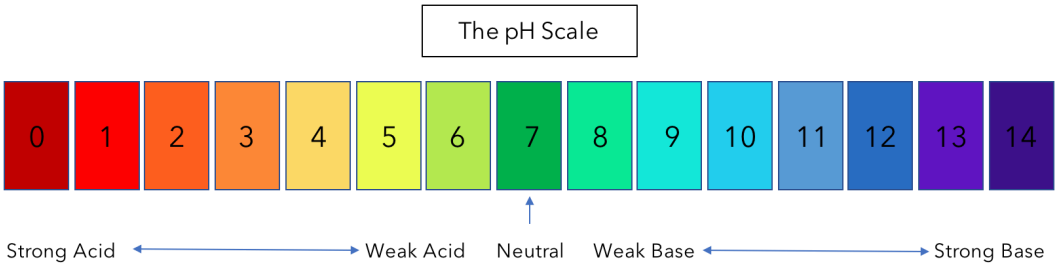
Sweet smelling	Bitter smelling	Doesn't have a smell
Clear	Light colored	Darkly colored
Does not have bubbles	Has bubbles	Thick
Transparent	Opaque	Runny
Safe for eating or drinking	Used for cleaning	Colorless

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).



The **pH scale** can be used to determine the amount of hydrogen atoms are present in a liquid. Most common items have a pH between 0 and 14. Regular water has a pH of 7, which is the middle of the pH scale, or neutral. Tap water may have a higher or lower pH depending on the chemicals added to purify it.



In water, the number of hydrogen atoms and hydroxide particles are equally balanced. However, some liquids have unequal amounts of hydrogen or hydroxide atoms, which gives those liquids special characteristics. Liquids with extra hydrogen atoms are called **acids**. Acids have much fewer hydroxide particles than hydrogen particles. Acids have a pH that is between 0 and 7. The acid in your stomach is a very strong acid, meaning that it is a very high number of hydrogen particles in it. Stomach acid, called **hydrochloric acid**, breaks down food as a part of digestion. It was a very low pH of around 1. **Citric acid**, which is found in citrus fruit, is a mild acid. Mild acids like citric acid often taste tart or sour. It has a pH of between 2 and 3.

Bases are essentially the opposite of acids. Bases have more hydroxide particles than hydrogen particles. Bases have a pH that is between 7 and 14. Bases are often slippery or slimy, and if you taste them they often have a bitter, unpleasant taste. You have probably experienced this if you have ever gotten soap in your mouth accidentally. Many bases are used in cleaning products. While mild bases (between 7 and 10) can usually be eaten, strong bases (between 11 and 14) can be dangerous to consume because bases can react with the acid in your stomach. In a lab, reactions between acids and bases can be very powerful because they release a lot of heat, even exploding in some cases.

Discussion Questions

1. What trends did you see in the types of liquids that had a pH of less than 7 and the types of liquids that had a pH of more than 7? What does it mean to have a pH less than 7? More than 7?
2. Based on your observations, what characteristics do acids have in common? What characteristics do bases have in common?

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