



# *Backyard Science Adventures*



Science Experiments  
You Can Do at Home

by **Emily Ruba**

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# BACKYARD SCIENCE ADVENTURES

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## Welcome!

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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](http://www.stem-o-sphere.org).

Sincerely,

Emily Ruba

Latham Fellow, 2017-2018

# LEMONADE STAND

## Biology | Chemistry

### Learning Goals:

#1 Make weaker solutions from stronger ones.

#2 Practice data collection to compare samples.

#3 Identify differences in taste buds between adults and kids.

### Related Careers:

Food Scientist

Food Manufacturer

Chemical Engineer

Food Marketing Specialist

### Supplemental Videos:

“Your Tongue: The Taste-Maker!”



“Controlled Experiments”



### Background:

Your taste buds can detect 5 tastes: **sweet**, **sour**, **salty**, **bitter**, and **savory**. These different flavors are detected by your taste buds, which send information to your brain about what kind of food you are eating. We like sweet foods because they provide the body with sugar, an important energy source. Bitter foods taste unpleasant, which can be the body's way of warning us we are eating something dangerous, like sour milk! Your taste buds can even change as you get older, causing adults to often like different flavors than kids do.

### Materials Needed:

- Water
- 2 cups of sugar
- 32 oz. 100% lemon juice
- Measuring cup
- Four containers
- Small cups for tasting
- Stovetop
- Saucepan

### Set Up

A **stock solution** is a liquid that you will use to set up your samples of lemonade. Your stock solution will be a **concentrated** solution of sugar and water. There will be a lot more sugar dissolved in the stock solution than your lemonade samples will have. What this means is that the stock solution will taste more sugary than the lemonade will.

## Set Up, Continued.

You will combine different amounts of the sugar stock solution with the lemon juice and water. The sugar in your samples will be **diluted** when you add it to water, giving the correct amount of sugar. You will need to boil water to dissolve the sugar. By making concentrated sugar water first, you will save time by only needing to boil water once.

With an adult's help, prepare the sugar stock solution:

1. Boil water in a saucepan.
2. In another container, carefully combine 3 cups of hot water with 1 cup + 5 tablespoons of sugar.
3. Mix it to dissolve the sugar.
4. Put a few drops of lemon juice in it. This will help it stay fresh!
5. Let it cool before making your lemonade!

## Directions:

### 1. Make the lemonade

Using the recipe list below, create 6 lemonade mixtures. Make sure to label your mixtures #1 through #6 so you don't mix them up. Trials 1 through 3 will be used to compare sourness of lemonade, so the amount of sugar in each will remain the same while the lemon juice varies. Trials 4 through 6 will be used to compare sweetness of lemonade, so the amount of lemon juice in each will remain the same while the sugar varies.

Trial	Batch	Water	Sugar (from stock)	Lemon juice
1	Low sourness	3 cups	1/3 cup	1/8 cup
2	Medium sourness	3 cups + 2 Tbsp	1/3 cup	1/2 cup
3	High sourness	2 2/3 cups	1/3 cup	1 cup
4	Low sweetness	3 1/3 cups	2 Tbsp	1/2 cup
5	Medium sweetness	3 cups + 2 Tbsp	1/3 cup	1/2 cup
6	High sweetness	3 cups	1/2 cup	1/2 cup



### **STOP! Make a prediction.**

Do you think the high sweetness, low sweetness, high sourness, or low sourness lemonade will be the most popular? Why?

## 2. Test the lemonade

You will need help from your family and friends in order to test the lemonade samples you have made. It is your goal to determine which sourness and sweetness are preferred by your test subjects. Find 15 people who are willing to be subjects and sample your lemonades. Determine the order people will sample the lemonade samples and use the same order for each person. Try to collect information from a mix of kids and adults. Fill out the chart below to record your data.

<b>Test Subject</b>	<b>Name</b>	<b>Kid or Adult?</b>	<b>Favorite Sour Drink (Drinks #1-3)</b>	<b>Favorite Sweet Drink (Drinks #4-6)</b>
I				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

### Discussion Questions

1. Can you see any trends in the types of lemonade your subjects liked?
2. Can you make any conclusions about which drink is preferred by kids and by adults? Why?
3. When you were making your lemonade samples, did you notice that the same recipe was used to make the medium sourness (Trial #2) and medium sweetness (Trial #5)? Why were these two lemonade samples the same? Did any of your test subjects notice that they were the same?