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

BALLOON LUNG CAPACITY

Exercise Science | Anatomy

Learning Goals:

#1 Demonstrate that activities like walking, running, and talking affect your lung capacity.

#2 Measure lung capacity using balloons.

#3 Identify general trends in balloon sizes.

Related Careers:

Exercise Scientist

Cardiologist

Respiratory Therapist

Biomedical Engineer

Supplemental Videos:

"How to Measure Your Lung Capacity"

"How to Feel Your Heart Beat"

Background:

Why does your heart beat faster when you are exercising? The answer lies in the fact that exercise uses more energy than normal activity does. Your blood carries the oxygen that you breathe to your muscles. Your muscles use more energy and more oxygen when they are working hard. Since your muscles demand extra oxygen, your body reacts to this by increasing your breathing and your heart rate. When you breathe harder, your lungs inhale more oxygen, and when your heart beats faster, your blood moves more quickly to carry oxygen to your muscles.

Materials Needed:

- A pack of balloons
- Running shoes
- Measuring tape
- Permanent marker
- An empty park or playground
- String
- A friend. One person should be the runner, and the other person should be in charge of the balloons.

STOP! Make a prediction. Which balloon will be bigger: a balloon you blow up after running, or a balloon you blow up after resting?

Collect Data:

1. Find a straight stretch of grass. Measure out 50 feet with the measuring tape. Mark the starting line and finishing line so that you know where to start and stop each time.

Trial 1	Walk
Trial 2	Speed walk
Trial 3	Jog
Trial 4	Sprint
Trial 5	Sprint while talking
Trial 6	Sprint while screaming
Trial 7	Stand still

2. The runner should stand at the starting line. Have a balloon in your hand, ready to blow up. Stretch the neck of the balloon three times to get the balloon ready.

3. Walk from the starting line to the finishing line.

4. As soon as you get to the finish line, take a large breath of air and blow into the balloon. Blow into the balloon four more times, for a total of five times. Tie a knot in the neck of the balloon. With a permanent marker, write "Trial 1" on the balloon. Tie a string to the balloon so that the balloon holder can hold onto it without it blowing away.

5. Make sure to rest for 1 minute in between each trial.

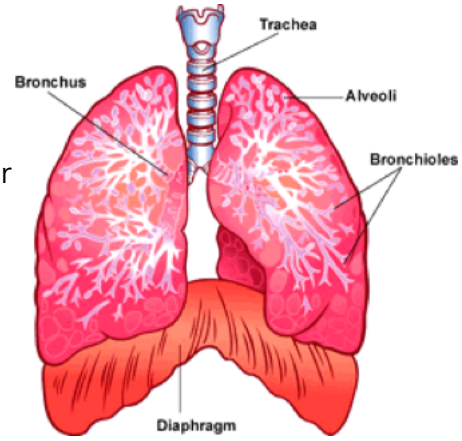
6. Repeat steps 2-5 with a second balloon. Instead of walking regularly, speed walk from the starting line to finish line, like shown in the chart above. Write "Trial 2" on the balloon after you have tied it off.

7. Repeat steps 2-5 five more times, following the directions in the chart for each balloon.

8. Compare the sizes of your balloons from Trials 1 through 7.

Anatomy of the Lungs

Your lungs are often described as balloons, responsible for exchanging air with the environment. **Oxygen**, which makes up 20% of the air in the atmosphere, is important for breathing. Oxygen enters the lungs through the **trachea**, or windpipe, and then splits off into the left lung and right lung at the **bronchus**. The bronchus branches off into smaller **bronchioles**, carrying air deeper into the lungs. At the deepest point, small air sacs called **alveoli** allow oxygen to move into your blood so that it can travel around the body.



The **diaphragm** is a muscle located under the lungs that helps the lungs inflate and deflate. When the lungs inflate, air moves into the lungs through the trachea, bronchus, bronchioles, and alveoli. When the lungs deflate, air moves back out the same way it came in. When your lungs inflate, you are inhaling. When your lungs deflate, you are exhaling.

Your blood contains **red blood cells**, which carry oxygen from the alveoli to other places in your body where it is needed. Oxygen is especially important for your muscles, brain, and liver. The red blood cells also carry **carbon dioxide** back to the alveoli so that it can be exhaled back out. Carbon dioxide is made by your body as it uses up oxygen. When exercising, your muscles use up oxygen more quickly as well as produce carbon dioxide more quickly than normal. This is why you breathe harder when exercising.

Discussion Questions:

1. For each trial, you had to start and stop at the same spot and stretch the balloon the same number of times in order to get the balloon ready. Why is it important to make sure each trial is conducted in the exact same way?
2. Your **lung capacity** is the amount of air your lungs are able to hold, which we can measure by seeing how much air you can blow into the balloon. How did exercise affect your lung capacity? How did talking or screaming impact your lung capacity? Which affected your lung capacity more? Why?
3. The balloon from Trial 7 is your **control** trial. The control shows you what a normal amount of air is when you haven't been running or talking. You can compare Trials 1 through 6 to Trial 7 to decide much of an effect the running and shouting had on your ability to blow up the balloon. Why is it important to have a control trial to compare all your experiments to?