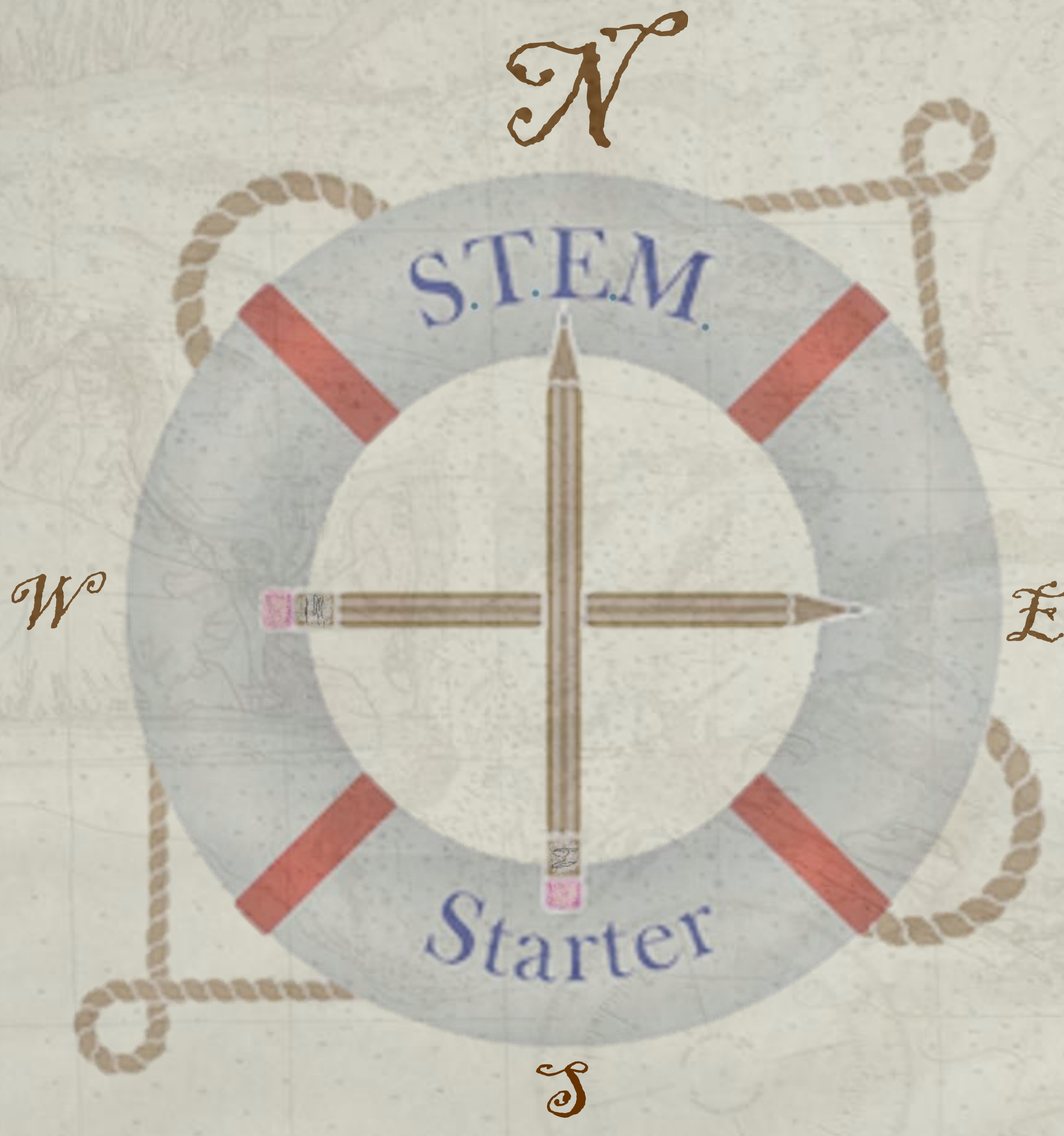
Charting a New Course

STEM Experiments for the Home and Classroom



SHANNON BRINDLE

S.T.E.M. STARTER

Charting a New Course

STEM Experiments for the Home and Classroom

Volume 1 Edition 1

BY

SHANNON BRINDLE

CHRISTIANE BRINDLE

"It is easier to build strong children than to repair broken men."

\- *Frederick Douglass*

Thank You

Mrs. Jessie George
Thank you for being an exemplary educator and offering invaluable insight.

Jonathan
Thank you for never failing to put a smile on my face no matter how far apart we are.

Dad
Thank you for being the ultimate source of nerdy dad jokes, going on rants about engineer stuff, and inspiring me to major in physics.

Mom
Thank you for having often more enthusiasm and optimism than me, always reminding me of the importance of this project, and for encouraging me to blaze my own path rather than follow the trail - you are my rock and I would be a mess without you.

My Lord & Savior

You are the Engineer of my soul & the Architect of my life.
All that I am and all that I have is because of You.

"He is before all things, and in Him all things hold together." Colossians 1:17

Dedication

To all of those who picked up this book, young and old –
You are my ultimate inspiration and your curiosity is my driving force.
Never abandon your childish wonderment, never stop asking questions and always nourish your imagination.

- Shannon

"Thirst was made for water; inquiry for truth." C.S. Lewis: *An Examined Life*

Acknowledgements:

Thank you for your advice, assistance, and guidance.

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"The task of the modern educator is not to cut down jungles, but to irrigate deserts."

C.S. Lewis, *Abolition of Man*

Preface

In my first year at Mary Washington, I began developing STEM Starter for my Service-Learning project, which is an opportunity the Honors Program formulated to allow honors students to contribute to our community. What was originally meant to be a much simpler project involving simple science experiment demonstrations for local students turned into a long-term project that brought the science into the home and our everyday surroundings. Learning should not end when you leave the classroom, often, the classroom is only the beginning.

Our goal is to inspire an interest in STEM in students of underserved communities. We developed experiments utilizing rudimentary objects to demonstrate daily STEM and how students can acquire tools for a bright future. STEM Starter is distinguished in its ability to reach children of all backgrounds and education levels. Our experiments present a structure that resembles high school and university labs by encouraging pre-experimental hypotheses, analysis, and conclusions. The instructions, materials, and questions are formulated to be flexible for adjustment for any age group. We also want to ensure that students with cognitive disabilities have exceptional access to STEM topics early in their education. Thus, we developed experiments with Individualized Education Plan goals in mind. The overall goal is to bring the STEM we encounter daily to every child regardless of location, finances, or education level.

"God has given us more than fourteen billion cells and connections in our brain. Why would God give us such a complex organ system unless he expects us to use it?"
— Ben Carson

Table of Contents

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Worth noting…

How the experiments are organized

Our experiments are divided into the following sections: Experiment Express, The Experiment, Post Experiment Questions, Post Experiment Answers, Draw Your Own Conclusion, Expansion Experiment and Additional Resources.

The Experiment Express

Offers the student and adult mentor a quick snapshot of the area being studied, the age group, the cost, the time involved, materials required, safety concerns and Individual Education Plan (IEP) areas of focus. <u>Please note the IEP goals are general goals. IEP Goals can vary from state to state so please make sure to consult the IEP goals as set forth from your state's Department of Education for additional guidance and application.</u>

The Experiment

The Experiment will always begin with a Question or Problem Statement; followed by a Hypothesis and Experiment Directions. We highly encourage you to ask your student(s) to develop a Hypothesis statement prior to beginning the experiment. The Question / Problem Statement and the Hypothesis are valuable steps in learning the Scientific Method.

Post Experiment Questions

With every experiment we have attempted to include questions that don't result in a simple yes or no answer. It is important for students to learn critical thinking and not be afraid to be wrong.

Post Experiment Answers

We want to provide adult mentors with the answers to the questions being asked as an additional layer of support and guidance. You will also find teaching support materials listed in the side column under Additional Resources.

Draw Your Own Conclusion

This section offers the student and adult mentor to think critically and attempt to find an answer together without the solution readily in front of you. This is a deeper thinking and challenging opportunity.

Expansion Experiment

For those students who want an additional challenge or perhaps you have some extra time available; we included this expansion opportunity to challenge the student.

Additional Resources Section

This column will always indicate three areas: Log Your Work; Real World Application and Additional Resources. The Log Your Work will suggest whether or not your student should record their efforts in a log book; The Real World Application indicates experiment application in the real world; Additional Resources will guide you to Online and Printed Resources to assist you with further exploration.

x

S.T.E.M. STARTER

Charting a New Course

STEM Experiments for the Home and Classroom

Experiments

"If I were to wish for anything, I should not wish for wealth and power, but for the passionate sense of the potential, for the eye which, ever young and ardent, sees the possible. Pleasure disappoints, possibility never. And what wine is so sparkling, what so fragrant, what so intoxicating as possibility!"

Søren Kierkegaard, Either / Or: A Fragment of Life

Aero plates?

Experiment Express

STEM Field of Study

Technology

Engineering

Specific STEM Area

Aerodynamics

Age Group

All

Cost

Less than (<) $10

Time

1 hour

Materials

2 paper plates; 2 Rubber bands; Scissors; Pencil; Fan (or if it's a windy day…. Go Outside!)

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Question:

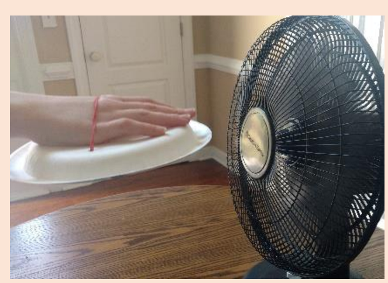
Can you feel air resistance?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Flip the paper plate over and using your pencil, on the back side of the paper plate draw on outline of your hand.
4. Now draw a large dot in between the thumb and index finger of the hands as well as near the pinky fingers of the hands.
5. Using your pencil punch a small hole through the dots you just created. Make sure not to make them too large; they need to be just large enough to push the rubber band through the hole.
6. Using your scissors cut each rubber band so you have 2 long rubber strings.
7. Feed each rubber band end through the holes you created.
8. Once you've fed the rubber ends through the holes; tie the ends together as tightly as possible without ripping the paper plate.
9. Next, you're going to use a fan. Turn on the fan and stand back approximately three feet.
10. Place the "Aero Plates" on your hands by feeding your hands through the rubber bands where you drew an outline of your hands.
11. Standing in front of the fan approximately three feet away, hold up your hands with the paper plates attached. Hold your hands so the plate is as if your holding up a "STOP" sign – like the red safety hand shown in this experiment. What do you feel?
12. Next, hold your hands, with the plates still on, flat and parallel to the ground as if you're going to bounce a ball. What do you feel?



Aero plates?

Post Experiment Questions for Adults to ask:

1. Did you feel air resistance when you held your hands in the stop sign position?
2. Why?
3. Did you for air resistance when you held your hands in the flat / bouncing the ball position?
4. Why?
5. Which had position do you feel was more aerodynamic?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. You should feel some pressure against the plate.
2. There is more surface area when the plate is in the stop sign position. The more surface area there is the more resistance you will feel.
3. You should feel less pressure against the plate and more air movement over the top of your hand.
4. There is less surface area – so there is less resistance do push against.
5. When your hand position is flat and parallel to the ground.

Draw your own conclusion:

Why do you think airplanes are shaped to resemble a bird? Why aren't airplanes shaped to look like a square? Or how about cars… Why do you think engineers design cars a certain way? This is a great time to research the history of flight as well as the history of the automobile. Here are some additional resources for you to review:
https://www.grc.nasa.gov/WWW/K-12/UEET/StudentSite/historyofflight.html

https://www.history.com/topics/inventions/automobiles

https://www.popularmechanics.com/cars/car-technology/a21272157/aerodynamics-car-science/

Expansion Experiments:

One of our favorite scientists is Leonardo da Vinci! He was a remarkable scientist, artist, inventor, genius! We all can benefit from his experiments and thankfully he maintained a log of his work (hint you should too) as well as detailed sketches. If you would like to see more of his work, try this book for more experiments: Leonardo da Vinci's Flying Machines Kit: Paper Airplanes Based on the Great Master's Sketches - That Really Fly! (13 Pop-out models; Easy-to-follow instructions; Slingshot launcher) Paperback – October 15, 2019 by Andrew Dewar

Log your work:

Absolutely!

Channel your inner Leonardo da Vinci and record what you observe by drawing what you see. Who said art and the STEM fields aren't connected? Leonardo certainly proves otherwise.

Real World Application:

Aerodynamics

Aeronautics

Renewable Wind Energy

Pilot / Flying

Additional Resources:

https://www.real-world-physics-problems.com/

https://www.grc.nasa.gov/www/k-12/airplane/bga.html

The Illustrated Guide to Aerodynamics by Hubert C. Smith (Author)

Alarming Science

Experiment Express

STEM Field of Study

Science

Technology

Engineering

Math

Specific STEM Area

Safety

Age Group

All

Cost

$0 - $5

Time

45 minutes

Materials

Notebook, Pencil, Access to Fire Extinguisher, Access to Internet or Information at the Library about Fire Extinguisher

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

Question:

Can you help to protect your home from fires?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. First, walk around your home / school and identify equipment used to alert you of a fire or carbon monoxide leak. Make sure to test detectors monthly.
4. If it is Fall or Spring, make sure that the Fire Extinguisher is fully charged and there are new batteries in the smoke / carbon monoxide detectors.
5. Next, walk around your home and school to locate the equipment that's used to extinguish a fire. This could be a fire extinguisher, a sprinkler system or both.
6. Then, with a parent or teacher, try to identify potential fire hazards in your home or school.
7. Finally, develop a Fire Evacuation Plan with your parents, caregivers or teachers. Here is a resource to help you get started: www.nfpa.org.

Friends of Franklin Needed:

Did you know that Benjamin Franklin is considered the founding father of firefighting? Isn't that awesome!! In fact, volunteer firefighting is older than our country! Benjamin Franklin, along with 4 friends, founded the Union Fire Company on December 7, 1736. Their Fire Company had 26 members and kept growing until they had so many volunteers, they had to start another brigade! What an amazing man he was! Today, there are over 1 million firefighters and nearly 70% of them are volunteers. Thank you, Ben!

What's even more important is that we can all help each other to be safe by remembering that a fire requires three items to burn:

1. Heat – Such as stove, match, fireplace or spark.
2. Fuel – Wood, paper, gas, chemical
3. Oxygen

Think about it!

These three items combined are what's called, "The Fire Triangle." Your mission, should you accept it, is to keep a watchful eye and if you see a potential fire hazard then tell an adult as soon as possible!

Post Experiment Questions for Adults to ask:

1. Did you identify where all the equipment is located to notify you of a fire or carbon monoxide leak?
2. Did you test any of the monitors to make sure they are working? If you're conducting this experiment in the Fall or Spring; did you change the batteries in the alarms?
3. Did you identify the equipment that is used to extinguish a fire?
4. Did you identify any potential fire hazards? If so, what did you do to eliminate that hazard?
5. Did you develop a Fire Evacuation Plan with your parents or caregivers?

Let's Talk

Discussion of Results / Post Experiment Answers:

1. Yes! State in your logbook where they're located.
2. Yes! If it's Fall or Spring, change the batteries.
3. Yes! Fantastic!
4. Hopefully there aren't any; however, if you did find some – way to go and help keep your family safe!
5. Yes! Please share your plan with us: www.startingwithstem.org

Draw your own conclusion:

While a fire, at times, may be wonderful and cozy – it's important to recognize potential hazards before they become a part of the "Fire Triangle." If you don't have a fire extinguisher in your home, try to identify items that you can use to extinguish a fire as well as items you should never use to extinguish a fire. For example, a grease fire is extremely dangerous and two items you should never use when there's a grease fire are: water and flour. Water repels grease & the fire will spread further. Flour is very fine, like dust and will catch fire. Instead, you should always turn off the heat source, put a lid on it (if it's small) and if you need to, you can pour baking soda on the fire to extinguish it.

Expansion Experiments:

Visit your local fire department and meet some of the best people in the world! Ask if they would consider taking you on a tour of the station and learn about the equipment, they use to extinguish very large fires. These Firemen and Women are truly committed to keeping you and your family safe; it's worthwhile to get to know them and learn how you can make their job easier while making your community safer.

Log your work:

Go for it!

Logbook Tip:

When you walk around your home or school, identify the various locations of fire extinguishers, fire alarms and exits. You can also indicate potential fire hazards and inform and adult.

Real World Application:

Fire Safety

Firefighting

Baking / Cooking

Homeownership

Additional Resources:

http://www.firesafekids.org/science.html

The Magic School Bus Gets All Fired Up: Fire Safety Story by Joanna Cole & Bruce Degen

The Magic School Bus to the Rescue: Forest Fire by Anne Capeci

All in Vane

Experiment Express

STEM Field of Study

Science

Technology

Specific STEM Area

Meteorology

Age Group

5-10

Cost

Less than (<) $10

Time

Ongoing Activity (more than one day)

Materials

Paper or Styrofoam Cup; Black Marker, Ruler, Construction Paper, Straw, Tape, Thumbtack or Push Pin, Compass

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Question:

Can you build a weathervane & use it to show wind direction?

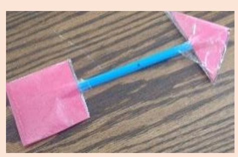
Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Flip your Styrofoam cup upside down. After you flip it over, using the black marker you're going to indicate the four main directions: North (N); South (S); East (E) and West (W).

4. Take the pencil and insert it into the base of the cup with the eraser at the top and the point at the base of the cup. This is going to be used as a stake to insert it into the ground.



5. With your construction paper and ruler draw a 4" square and a triangle with a 4" base. Tape the triangle on one side of the straw so that it looks like an arrow pointing and tape the square to the other end.

6. Find the midpoint (middle) of the straw and poke a push pin through the middle of the straw and then into the eraser of the pencil.
7. Time to head outside! Using your directional compass; find North. Take your cup and turn your cup until the North section of your cup is facing North.

8. Now place your cup in the ground, making sure the North side of your cup is facing North. You just made your own wind vane! Whichever direction the arrow is pointing is the direction from where the wind is blowing.

How is wind speed measured?

Think about it!

Wind is measured with a device called an ***Anemometer.*** It comes from the Greek word ***anemos*** which means wind. Some are so small you can hold them in your hand. Wind speeds can be measured in Miles Per Hour, Knots (sea), Feet Per Second, Feet Per Second or Kilometers Per Second. Take a moment to research the wind speeds that may occur in your area.

Post Experiment Questions for Adults to ask:

1. From your experiment, what direction did the wind come from?
2. Can you name people who need to know the wind direction in order to do their jobs?
3. If you moved around your home or town, did the wind direction change? If so, why do you think it changed? If you didn't move around your home or town; what do you think can change the direction of the wind?
4. At what speed do you think the wind was travelling during your experiment? This is a guess based on the information provided in the "Think About It," section.
5. If wind speed is too fast, can it cause damage?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary depending on the area. This question is to help develop directional awareness. You want your student to be able to indicate that the wind came from the North, South, East or West.
2. Aside from Meteorologists, Pilots, Crane Operators, Safety Personnel such as Fire Fighters; Farmers; Sailors, just to name a few.
3. Answers will vary, however, make sure your student takes into consideration surrounding obstacles that can change wind direction near them. For example, tall buildings or trees.
4. Wind speed is measured in Miles Per Hour
5. Absolutely! Read on in the Draw Your Own Conclusion.

Draw your own conclusion:

The fastest wind speed ever reordered was 253 mph on Barrow Island, Australia during the Typhoon called Olivia. However, the fasted Tornado speed ever captured was 318 mph in May 1999 in Oklahoma. The tornado caused the death of 36 people and damages of $1 billion. Tell us why you think knowing where the wind is coming from and at what speed it is travelling is so important at: www.startingwithstem.org.

Expansion Experiments:

We're going to speed this along and encourage you to make your own Anemometer! It's easy! The first known Anemometer was made in 1450! For a great Anemometer Experiment go to Weather Wiz Kids at: http://www.weatherwizkids.com/experiments-anemometer.htm

Log your work:

Absolutely!

We love this experiment for a logbook. Try this:

Log the wind direction in different areas around your home or town. Does the wind change direction depend on where you are?

Real World Application:

Meteorology

Weather Forecasting

Pilots

Air Traffic Control

Additional Resources:

The Magic School Bus Inside A Hurricane by Joanna Cole (Author), Bruce Degen (Illustrator)

The Magic School Bus Kicks Up A Storm: A Book About Weather by Nancy White (Author), Art Ruiz (Illustrator)

Magic School Bus Presents: Wild Weatherby Tom Jackson (Author), Sean Callery (Author), Carolyn Bracken (Illustrator)

Any Way the Wind Blows

Experiment Express

STEM Field of Study

Engineering

Specific STEM Area

Engineering - Marine

Hydrodynamics

Age Group

All

Cost

$0 - $5

Time

1 hour

Materials

Bowl or Bathtub with water
Floating Bath Toys of different shapes or you can make Cardboard Boats like we show here.

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Motor

Question: Can you observe resistance?

Hypothesis: Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Fill the bathtub with just an inch or two of water - you don't have to fill it all the way. If you have a pool, you can use that for the experiment or, if you live near a pond – that works just as well.

4. If you would like to make your own Cardboard Boat – here is a great resource for that activity: https://www.instructables.com/id/How-to-make-a-toy-boat-from-recycled-material/
Otherwise – Just place all the floating bath toys in the water.

5. Observe how they move and what force creates that movement. Is the wind blowing? Are there waves? Etc.
6. If you push each toy one by one, which one appears to move faster in the water.
7. Which toy appears to move with difficulty?

Think about it!

Boats vs. Submarines:

Nautical vessels are wonderful. We love seeing the variety of ships that are on the high seas. However, it's ships that you **can't** see that are some of the most interesting to learn about. If you've ever played the game Battleship, one of the more difficult boats to find is the sneaky submarine. Did you know that the idea for a submarine dates to 1620! However, during the American Revolution a graduate from Yale University created a one-man submarine called, "The Turtle." Today's submarines can hold over 100 people! Aside from the submarine's ability to be stealth-like; do you think there is resistance for the submarine because it is under water? Let us know what you think about it!

Post Experiment Questions for Adults to ask:

1. Which toy moved farther?
2. Which toy required more effort to move?
3. Which toy experienced more difficulty in moving?
4. Why do you think it was easier for some toys to move?
5. Why do you think it was difficult for some toys to move?

Let's talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary depending on the toys available. However, more than likely the toys that would move farther away when the wind (or your student was creating wind) was blowing are the toys that are more streamline with less resistance.
2. Answers will vary, however, toys that are bulky or awkwardly shaped could require more effort to move.
3. The toys that experienced more difficulty moving are probably the same toys that required more effort to move them.
4. The toys that were easier to move require less effort and are sleeker and more streamlined in their appearance.
5. When a toy is bulky there is more surface area for resistance. Basically, there is more to move. The narrower and sleek a toy is – the less resistance there will be.

Draw your own conclusion:

When engineers are designing items; there are quite a few important factors that they must take into consideration are resistance or drag. Besides Fluid Resistance (which is what this experiment is about) there is also Air Resistance. Where do you think Air Resistance is an important factor to consider?
Hint: Think of ways in which people travel.

Expansion Experiments:

Believe it or not… There are Cardboard Boat Races!! Perhaps there is one near you! What we want you to do is imagine you were to design & build your own cardboard boat for a race; what kind would you make and why?
Here are some fantastic resources to help get you started:
https://thecardboardboatbook.com/
http://www.catonsisland.com/wp-content/uploads/CARDBOARD-BOAT-BUILDING-101.pdf
And don't forget to share your creation with us!

Log your work:

Go for it!

Logbook Tip:

For this experiment make sure to enter our boat design ideas if we made a cardboard boat. If you used bath toys; jot down what toy moved faster, slower and why.

Real World Application:

Study of Fluids

Water Drag

Boat

Marine Engineering

Additional Resources:

https://k8schoollessons.com/air-resistance-for-kids/

https://www.dkfindout.com/us/science/forces-and-motion/how-does-plane-fly/

The Magic School Bus Takes Flight

Back to Square One

Experiment Express

STEM Field of Study

Engineering

Math

Specific STEM Area

Geometry

Engineering

Age Group

11+

Cost

$0 - $5

Time

45 minutes

Materials

Measuring Tape or ruler; paper (regular or graph); pencil, calculator

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

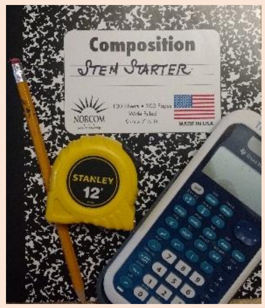
Question:

How do measure the amount of square feet in a room?

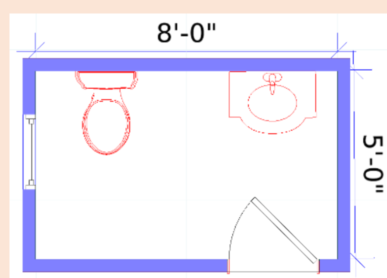
Hypothesis:

Before you start your experiment, can you predict the answer to the question above? Make sure to write down your hypothesis in your logbook.

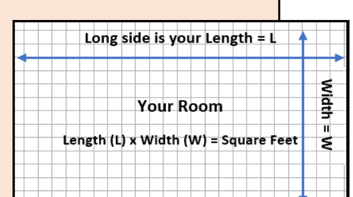
Instructions



1. Gather your materials together.
2. Review all Safety Precautions.
3. Go to a room within your home or school; preferably a room that is a rectangle.
4. We know that a rectangle is four sides; however, for this experiment, we only need to use two. The two sides we will use one of the longest sides and one of the shortest sides.
5. Using the tape measure, and help from an assistant, measure the length of longest wall. We will call the longest wall "L" for Length. Write that number in your logbook.
6. Now, measure the shorter wall. We will call this wall, "W" for Width. Write this number in your logbook.
7. In order to calculate the number of square feet in the room, you will have to multiply L x W. That means whatever number you measured for the Length (L) you will multiply that to the number you measured for the Width (W).
8. Your answer is the amount of square feet in the room.
9. *TIP:* Sometimes it helps if you create a drawing.



"Back to Square One."



Have you ever heard of this saying before? It means to go back to the beginning and start again. Sometimes we can become very aggravated if we re-start a project by going back to the beginning; however, we can learn more and create something that is better than we ever imagined! If you're finding this experiment difficult – don't worry – just go back to and try again. We believe in you and your ability to do anything!

Back to Square One

Post Experiment Questions for Adults to ask:
1. What is the Length (L) of your room?
2. What is the Width (W) of your room?
3. What is the total amount of Square Feet in your room?
4. Can you determine the square feet of a room with only one measurement?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:
1. Answers will vary. As an example, we measured a bathroom and the Length (L) of the long wall was 8 feet.
2. Answers will vary. Using the same example above, the Width (W) of the bathroom is 5 feet.
3. Answers will vary. Using the bathroom example from above: The Length (L) of our bathroom is 8 feet and the Width (W) is five feet. We multiply the two numbers 8 feet x 5 feet = 40 square feet. Please note that the answer specifically must say "square feet" not just feet. If you only used the word "feet" that would mean it's a straight line and not the entire area of the floor.
4. No. In order to calculate the square feet; you must have both measurements; the length and the width.
5. If your hypothesis was correct, congratulations! If not, don't worry and keep trying!

Draw your own conclusion:
In the Post Experiment Questions and Answers you were asked, "…can you determine the square feet of a room with only one measurement?" You can't determine the total square feet with only one number or value, however, what if you were given the length of the longest wall and the **total square feet**? If you were told the length of the room is 10 feet and the total square feet is 50. What is the width of the room? What can you do to figure out the width of the room? Let us know how you determine the answer at: www.startingwithstem.org

Expansion Experiments:
Volume is another important factor that scientists must take into consideration. Using the example of the bathroom that is 8 feet in Length (L) and 5 feet in Width (W) if we want to find the volume of a room we would need to also multiply the Height (H) of that room to the square feet. To find the volume the math problem would look like this: 8ft. L x 5ft W x 8ft H = 320 CUBIC FEET. Now that we added a third side, the value changes from square feet to cubed feet because we're no longer working with a flat rectangle but a 3-dimensional cube. So, what is the volume of your room?

Log your work:

Absolutely!

This is a great time to practice drawing geometry.

Real World Application:

Real Estate

Construction

Architecture

Engineering

Interior Design / Decorating

Logistics / Planning

Additional Resources:

Mastering Essential Math Skills GEOMETRY Grades 4-6 by Richard W. Fisher

The Future Architect's Handbook by Barbara Beck

The Future Architect's Tool Kit by Barbara Beck

www.khanacademy.org

www.splashlearn.com

Balancing Act

Experiment Express

STEM Field of Study

Technology

Engineering

Specific STEM Area

Physics

Age Group

All

Cost

$0 - $5

Time

30 minutes

Materials

1 Large Funnel; Ruler, Various Change (pennies, nickels, dimes, quarters)

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Social

Question:

Can you create a fulcrum (see definition below) and what household items can you use to make it?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Using the funnel, flip it upside down so the wide section is on a table.
4. Place the ruler on the small narrow spout of the funnel and make sure it balances.

5. Taking two pennies, place one on each side so the ruler continues to balance. You may have to take the ruler off the funnel first, place the pennies equally distant from the center and then try to rebalance the ruler on the funnel.

6. Move both pennies toward the center of the ruler and try to balance the ruler on the funnel. After you moved both near the center and balanced them, move only one away from the center of the ruler and observe.

7. Now place a penny at one end of the ruler and a nickel at the other end. However, this time move the nickel closer to the center until the ruler is level and balanced.
8. Try using different change, try to maintain a balanced ruler. For example, place a quarter on one side and try to balance the ruler with a change on the other.

Foraging for Fulcrums! One important word you learn is: Fulcrum. A Fulcrum is a pivot on which a lever is supported, rests and moves around. For example, the center portion of a See Saw is a fulcrum. What we want you to think about is finding more fulcrums in your home, community or school! So, time to go on a scavenger hunt and Foraging for Fulcrums. Make sure to show us what you found at: www.startingwithstem.org.

Post Experiment Questions for Adults to ask:

1. How difficult, or easy, was it to maintain a balanced ruler using only pennies?
2. What did you have to do in order to maintain a balanced ruler using the pennies?
3. How difficult, or easy, was it to maintain a balanced ruler using the penny and the nickel?
4. What did you have to do in order to maintain a balanced ruler while using the penny and nickel?
5. In Step #8 of this experiment, you were invited to use a variety of change; however, you had to maintain a balanced ruler. What coin combination to you use in order to balance the ruler?

Let's talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary, however, your student may indicate it was slightly difficult or tricky to balance the ruler with the pennies.
2. For the ruler to remain balanced, the pennies must be equidistant (equally distant) from the center – regardless of how close or far.
3. Answers will vary, however, your student may indicate that balancing the penny and nickel proved to be more difficult. Your student had to place more effort in finding the right balance.
4. In order to balance the penny and the nickel, the nickel will have to be closer to the center and the penny will be further away from the center of the ruler.
5. Answers vary. the goal is to discuss the various techniques your student used in order to maintain a balanced ruler.

Draw your own conclusion:

Have you ever seen the large cranes used to construct very tall buildings? These large cranes appear as though they're off balance and you may be wondering why they don't tip over. We do too! So, based on your experiment, and maybe a little bit of research at the library- we want you to tell us how the large cranes function and, more importantly, why they don't tip over! We can't wait to hear (learn) what you discovered at: www.startingwithstem.org.

Expansion Experiments:

Try moving this experiment outdoors! The perfect place to try this experiment is at the playground with friends and family! Give it a try and let us know how you did at: www.startingwithstem.com

Log your work:

Go for it!

What a great chance to log a unique experiment. This activity is slightly challenging, but you can do it! Try recording each effort to balance the ruler. You can also take a picture of your Balancing Act and send it to us at: www.startingwithstem.org
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Real World Application:

Engineering

Math

Physics

Construction

Force / Load / Effort

Additional Resources:

https://educationpossible.com/science-activities-learn-levers/

Hands-On Science: Forces and Motion by Jack Challoner (Author), Maggie Hewson (Author)

Motion: Push and Pull, Fast and Slow by Darlene Ruth Stille (Author), Sheree Boyd (Illustrator)

Boiling Over

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Age Group

5-7

Cost

$0 - $5

Time

30 minutes

Materials

Water, Stopwatch (you can use an app on a phone or just watch the clock); Stove top, small sauce pot with lid

Safety

Adult Supervision Necessary

Heat involved - Use extra caution

IEP Goals

Academic

Motor

Question:

Will water boil faster with or without a lid on?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety.
3. Begin by filling Sauce Pot with 2 cups of cold water. Place the Sauce Pot on the stove top and turn on the stove to a medium-high heat. Once you turn the stove on; begin the stopwatch.
4. Once the water has come to rolling boil; stop the stopwatch and note the time. Turn off the stove and dump the water out of the sauce pot.
5. Allow the sauce pot to cool completely.
6. Once the sauce pot is cool, pour 2 cups of cold water back into the same sauce pot.
7. Place the sauce pot on the stove and cover the sauce with a lid. Turn the stove back on to a medium-high heat and start the stopwatch.
8. Once the water with the lid on begins to boil, stop the stopwatch and note the time. Turn off the stove and carefully empty the hot water.

Think about it!

The Fahrenheit Scale was proposed in 1724 by Daniel Gabriel Fahrenheit. He was a Polish born – Dutch physicist, engineer, inventor and glass blower. What a talented fellow! He invented many scientific instruments. In fact, he invented an instrument that we still use today and is probably in every household. Can you guess what he is credited with developing? Think about it… measuring heat and combine that with an ability for glass blowing…

If you guessed thermometer… YOU’RE RIGHT. Now whenever you need to use the thermometer – you know exactly who to thank - Daniel Gabriel Fahrenheit!

Boiling Over

Post Experiment Questions for Adults to ask:

1. Which pot of water boiled faster; the first or the second?
2. Why did the second pot of water boil faster?
3. What helped the water to boil faster?
4. Why was the first pot of water slower to boil?
5. Did you observe steam when the first or the second pot of water was boiling?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The second should have boiled faster.
2. The second pot of water was closed so less water vapor can escape from the pot; so, the temperature in the pot is able to rise faster since more heat is circulated.
3. The lid helped the second pot boil faster. By preventing the release of heat, the water can reach a boiling temperature faster.
4. There wasn't a lid to prevent the water vapor from escaping and retaining the heat inside the pot.
5. Your student should observe more water vapor / steam when the pot isn't covered.

Draw your own conclusion:

Here at STEM Starter – we love food and we love to eat! One of our favorite meals is Spaghetti! Let's say you were cooking a Spaghetti dinner for your family and you need to warm up the sauce (or gravy depending on what you call it in your family), but you don't want it to burn. How would you warm up the sauce, keep it warm without burning that wonderful topping? Let us know your tips and tricks for keeping the sauce warm enough for dinner time at: www.startingwithstem.org.

Expansion Experiments:

The role of bread at dinner is very important. A slice of bread can either help the meal get started as an appetizer, aid in dinner by holding food or help by mopping up the best part of the meal – gravy! While cold bread will work, it isn't the ideal temperature. We want warm and toasty for this task not cold and soggy. So, time to test the bread. How would you keep the bread warm throughout dinner? There are various things you can use, towels, aluminum foil or just keep the bread in a low and warm oven. Try testing a variety of ways to keep the bread warm and let us know which technique was the best at www.startingwithstem.org

Log your work:

Absolutely!

This is a great opportunity to log your observations. By using the stopwatch; you can easily include the time it takes to boil each pot of water in your logbook observations. You could also try the same experiment using other types of liquid. Water has a boiling point of 100 degrees Fahrenheit or 212 Celsius. What do you think the boiling point is for Milk? Salted Water?

Real World Application:

Boiling Points

Cooking

Vehicle Maintenance - Antifreeze

Medicine

Thermodynamics

Climate / Weather

Additional Resources:

The Magic School Bus & a Book about Heat.

http://www.physics4kids.com/files/thermo_intro.html

https://kids.kiddle.co/Boiling_point

Bridging the Gap

Experiment Express

STEM Field of Study

Engineering

Specific STEM Area

Construction

Physics

Engineering

Age Group

All

Cost

$0 - $5

Time

Ongoing Activity (more than one day)

Materials

Notebook, Pencil, Camera (optional)

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Question: Are all bridges the same? Different?

Hypothesis: Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

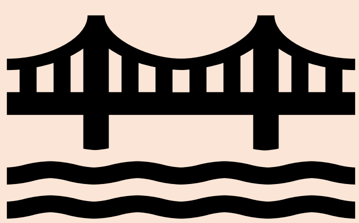
Instructions:

1. Gather all your materials together.
2.  Review all Safety Precautions.

3. When you're travelling around your local area or on a road trip, try drawing pictures of the various bridges that you see. Keep in mind that not all bridges span over waterways. Like this bridge in Texarkana, TX. This bridge is over roadways.

4. After you're done drawing your bridge, take a moment to write down details about the bridge. What did you like about it? Did it cross over a canyon, roadway or waterway? What do you think it was made of?

5. Next, when you have an opportunity, research those bridges and learn more about the engineering and design that was used to construct them.



Think about bridges in the context of history. What important role to you think bridges played in medieval times? What about the significance of bridges for the military? What role do you feel bridges played in the ability to move military troops and how important were they for defense?

Post Experiment Questions for Adults to ask:

1. What shapes do you see in the bridge?
2. What do you think the bridge is made of?
3. Can you name the types of bridges that you saw?
4. What were some of the similarities that you notice between the various bridges you saw?
5. What were some of the differences?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary here, however, your student will probably indicate seeing an arch, arc, triangle, rectangle and square.
2. This depends on when the bridge was made, the span that it must cross and the materials that were available at the time. For example, a covered bridge from the 1800's you could expect to see timber, stone and masonry construction. A bridge that crosses a large waterway would be made of out of steel, concrete and stainless steel.
3. There are 6 different types of bridges: Arch, Beam, Cable-Stayed, Cantilever, Suspension and Truss.
4. Answers will vary. Shape, Length, Height and materials used to construct the varying bridges may all be similar depending on location. Also encourage thinking about the similarity of purpose – what purpose do the bridges serve.
5. Answers will vary as well. Slight difference in shape and construction should be stated. However, there may be difference in purpose as well. For example, while one bridge is for cars another could be for trains only or the bridge could be constructed only for people and foot traffic.

Draw your own conclusion:

When engineers are assigned to build a bridge, what factors do you think they must take into consideration? Try listing all the important factors and variables that an engineer must think about when he or she must design a bridge. Let us know what you come up with and send us a picture of a bridge that you would design if you were an engineer. We can't wait to see what you designed for us at: www.startingwithstem.org

Expansion Experiments:

Unfortunately, there have been some engineering disasters with bridges. This is a great opportunity to learn about them and why those bridges failed and more importantly, what engineers are doing to prevent disasters from reoccurring.

Log your work:

Absolutely!

Logbook Tip: This is a great opportunity to be an active observer. Sketch the bridges that you see in your logbook and quickly jot down what type of bridge you think it could be.

Real World Application:

Civil Engineering

Materials Science

Construction

History

Geometry

Bridge Building

Additional Resources:

A Book of Bridges: Here to There and From Me to You by Cheryl Keely & Celia Krampien

Bridges and Tunnels: Investigate Feats of Engineering by Donna Latham

13 Bridges Kids Should Know by Brad Finger

https://easyscienceforkids.com/all-about-bridges/

https://kidskonnect.com/science/bridges/

Chromatography

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Age Group

8-11

Cost

Less than (<) $10

Time

1 hour

Materials

Coffee Filters, 2 Pencils, Paper Plate, Binder Clip, Wide Mouth Jar (old Mayonnaise Jar is fine); soluble Black Marker; Nail Polish Remover with Acetone
REMEMBER: ACETONE will remove any stain from a wooden table.

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Question:

Do colors have weight?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Cut off the sides of the coffee filter so you have a rectangle.
4. Draw a line with a pencil an inch from the edge of the paper.

5. Using your black marker, trace over the pencil line that you just drew.

6. Pour nail polish remover into the glass jar. You need just a small amount – enough to cover the bottom of the jar.
7. Using your filter paper, binder clip and pencil; take the filter paper and attach it to the pencil using the binder clip. Make sure to attach the side opposite the marker line.

8. Lay the pencil across the top of the glass jar containing the acetone and allow the filter paper to hang inside with the black marker side closer to the bottom of the jar and low enough so the filter paper barely touches the acetone at the bottom. You may need to adjust the filter length for it to reach the acetone.

9. When the acetone has travelled ¾ of the way up the filter paper and past the black marker line; remove the filter paper and lay it flat on a paper plate. DO NOT lay the filter paper on a wooden surface!!

Chromatography

Post Experiment Questions for Adults to ask:

1. Based on your observations, is there only one color in the black marker's dye?
2. How many colors did you observe?
3. Why do you think one color goes farther than another?
4. Tell us what object remained still (didn't move) in this experiment?
5. Tell us what moved in this experiment?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary but should include red, blue, yellow.
2. Answers will very but at least three should be identified.
3. Different pigments used to make the black ink can be different weights. Smaller pigments will move faster and farther than heavier particles.
4. The coffee filter remained still. This is called the "Stationary Phase," because it remained in place and acted a path for the pigments to travel.
5. The acetone (nail polish remover) moved and this is called the mobile phase.

Draw your own conclusion:

Chromatography is a type of technique scientists use to separate chemicals or substances. They can separate based on different properties that a particle may have like a charge due to the number of electrons or protons, or weight like in this experiment. Imagine yourself carrying groceries to your kitchen, if you are carrying five bags in each hand, you may need to take a break and it will take you longer to get to the kitchen. However, if you care carrying just one bag in each hand; you will get to the kitchen faster. This is what happened in you experiment! The heavier colors (particles) went slower and didn't go as far. In fact, the lightweight colors zoomed right past the them!

Expansion Experiments:

Want to know what other secrets markers have? Try the same experiment with other colored markers or a different solution like water, vinegar or even window cleaner. Do the colors separate in one solution but not another? Why do you think this might happen? Tell us all about your expanded experiment at: www.startingwithstem.org – We can wait to see all the wonderful, colorful chromatography combinations your discovered!

Log your work:

Absolutely!

Logbook Tip:

You can indicate how many colors and what colors you observed. Additionally, using a ruler, you can measure how far each color travelled from the initial pencil line that you drew.

Real World Application:

Chromatography

Filtration

Organic Chemistry

Analytical Chemistry

Biochemistry

Additional Resources:

Chromatopia: An Illustrated History of Color by David Coles

https://kids.kiddle.co/Chromatography

https://babbledabbledo.com/chromatography-for-kids/

Experiment Express

STEM Field of Study

Technology

Specific STEM Area

Coding

Age Group

5-10

Cost

Less than (<) $10

Time

1 hour

Materials

Jewelry cord or strong string / twine; 2 packages of different colored beads, Scissors

Safety

It's a good idea to have an adult nearby.

Please be careful of the beads. They are a choking hazard for young children.

IEP Goals

Academic

Motor

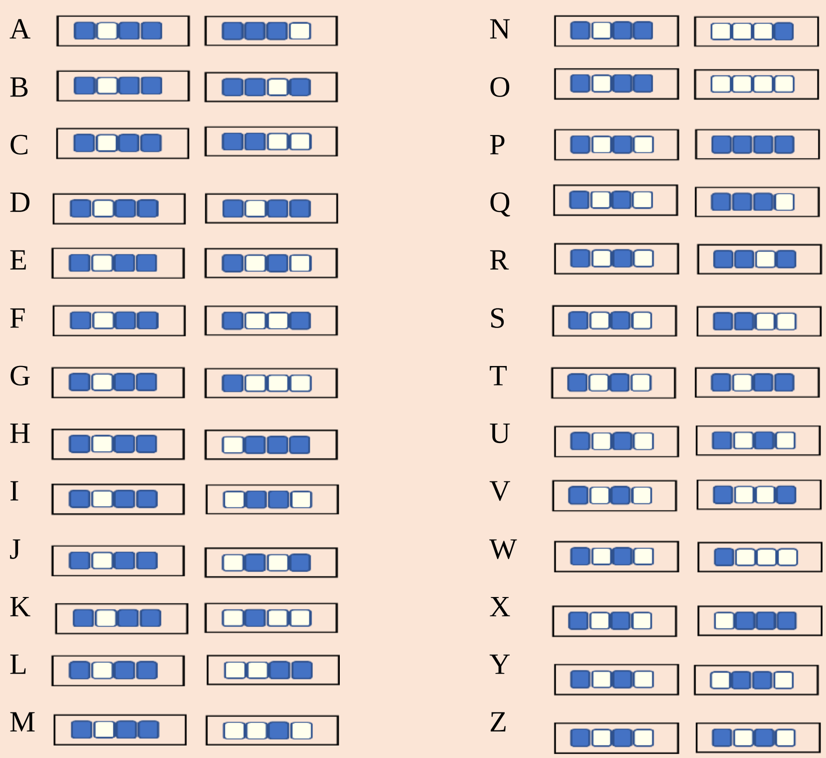
Question: What's a Binary Code & why is it important?

Hypothesis: Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Review the Binary Code Alphabet below. ***The Binary Code is a computer language made up of only 0 and 1.*** Each letter in the alphabet has a different combination of zeros and ones and the Binary Code is the translator that helps computers work.
4. Using the Binary Code Chart, you're going to "translate" your initials from the Alphabet to the Binary Code Alphabet.
5. In Binary Code the Blue Beads represent "Zero" and the White Beads represent "One."
6. Cut a string long enough string for your initials. This could become a long bracelet or necklace! Next thread the beads on the string and tie the ends.

Binary Code Alphabet:



Post Experiment Questions for Adults to ask:

1. Was it easy or difficult to “create” your initials with the beads?
2. Why was it easy or difficult?
3. Would you prefer to use the Word Alphabet or the Binary Code Alphabet to write your initials?
4. Why?
5. Was your hypothesis correct? Where you able to guess what the Binary Code is and why it’s important?

Let’s Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary. Depending on how many letters are in the student’s name – there could be some frustration with creating their “computer name.”
2. The purpose of this question is to encourage discussion.
3. Answers will vary.
4. The purpose of this question is to encourage discussion.
5. Answers will vary.

Draw Your Own Conclusion:

How old do you think the Binary Code is?
10 years old? 20 years old? 50 years old? Take a guess.
What if we told you that the Binary Code used today is over 300 years old! Believe it or not, the Binary Code was created in 1689 by German mathematician & philosopher Gottfried Wilhelm Leibniz and his inspiration for the code was based from Chinese text that is over 5,000 years old! It’s almost unfathomable that a code developed over 340 years ago would have such an impact on our daily lives. For the Draw Your Own Conclusion section, we want you to think about is – What would our modern-day world be like if the code had never been invented? Write us an essay or draw us a picture of life in the 21st Century without the knowledge of the Binary Code from the 17th Century. Send it to: www.startingwithstem.org - We can’t wait to hear from you!

Expansion Experiments:

For the Expansion Experiment we want you to research the types of Coding Software that are available and the try and write your name using the Binary Code of Zeros and Ones.
For example, the title of this experiment in Binary Code would look like this:
0100001101001111010001000100100101001110010001110
0100011001001111010100100
01001011010010010100010001010011
WOW !!! or should we say: 010101110100111101010111!!!

Log your work:

Maybe, what do you think?

Logbook Tip:

If you opt to log your work; here’s a tip you can use. Try writing your name and the names of your family or friends in the logbook. Additionally, you can also include any Coding Software research you may have found.

Real World Application:

Computers

Calculators

Braille

Morse Code

Additional Resources:

Coding Projects in Scratch: A Step-by-Step Visual Guide to Coding Your Own Animations, Games, Simulations by Jon Woodcock

Code Your Own Games!: 20 Games to Create with Scratch Hardcover by Max Wainewright

My First Coding Book Board book – by Kiki Prottsman

Community Timeline

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Archeaology

Historical Preservation

Age Group

All

Cost

$0 - $5

Time

Ongoing Activity (more than one day)

Materials

Notebook, Pencil, Camera optional

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

Question:

What do science and history have in common?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. While you're walking around your local town, look for building with plaques that indicate if it is on the National Register of Historic Buildings. For example, the picture on the left is of the Red Fox Inn, Middleburg, Va. This restaurant is older than the United States of America! This restaurant dates to 1728 and is the oldest restaurant in Virginia!

4. If you find a Historic Building, take a picture and note the date and either sketch or take a picture of the building. This house on the left is in Gettysburg, Pennsylvania and it's a little log cabin from 1863 that used to belong to Thaddeus Stevens!

5. Look and try to identify what the building is made of, brick, wood, stone, or plaster. For example, this home, located in Newport, RI is called "The Marble House." It was owned by William K Vanderbilt and construction took four years! It was built from 1888-1892 and was supposed to be a "summer cottage."
6. Your turn. Find at least three building and plot the age of those buildings on a timeline starting from the oldest building and end with the year you were born. If time permits, research historical events that occurred when the buildings were created.

Think about it!

Do you love history? Science? Art? Guess what - there are jobs that combine all these passions! One is Archeology and the other is Historical Preservation and Restoration! There are some wonderful colleges that have phenomenal educational programs that are designed to teach and inspire upcoming historians!

Community Timeline

Post Experiment Questions for Adults to ask:

1. The buildings you found, what were they made of?
2. When were the buildings constructed?
3. Why do you think they were made of those materials?
4. How do you think these buildings are being preserved?
5. Do you like the architecture of these buildings? Why?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary depending on what is found.
2. Answers will vary.
3. Typically, historic homes utilized material that was in abundance. For example, you may have more wood homes in the northeast United States but more clay and Adobe homes in the South West.
4. Historic preservation requires engineering and artistry.
5. Answers will vary, however, encourage your child/student to provide more than a singular word answer. Help them to really explore what they find interesting and unique about architecture.

Draw your own conclusion:

Time to pretend. Let's say you have a dog; and your dog needs a new doghouse. What materials can you use that are readily accessible to build your dog a new home? If you live in the suburbs or the country – what would you use? If you live in the city or an apartment building – let's just say the doghouse is more of a little room for inside the apartment. What would you use? What materials would you gather and how would you construct it? Draw a picture first, then show an adult. Perhaps you can build your own doghouse!

Expansion Experiments:

Restoration is an art. Today, we see so many TV shows, magazines and books that are devoted to helping teach people how to restore old homes, cars and furniture. For this Expansion Experiment we want you to tell us what you would like to restore, how you would try to restore it but more importantly, why would you want to restore this item. Send us your ideas to: www.startingwithstem.org. We can't wait to hear from you and make sure to include pictures!!

Log your work:

Absolutely!

Logbook Tip:

This is an excellent opportunity to combine logging and sketching all in one! Or… if you are taking pictures; add those to your logbook and discover your scrapbooking skills!

Real World Application:

Engineering

History

Archeology

Historical Preservation

Historical Restoration

Additional Resources:

http://www.ala.org/alcts/preservationweek/ch/kids

When Jackie Saved Grand Central by Natasha Wing and Alexandra Boiger

http://preservation50.org/educational-resources-k-12/

Condensing Condensation

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Physics

Weather

Age Group

5-7

Cost

$0 - $5

Time

30 minutes

Materials

Cold Soda in an unopened can; Water glass, Cold Water; Warm Food in Left over container, Small Pot with lid

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Question:

Why does water form on the outside of a can & on the inside of lid of leftovers after I take them out of the refrigerator?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all materials together.
2. Review all Safety Precautions.
3. Take a cold soda can from your fridge and leave on the counter for a few minutes or until you see droplets on the outside of the can. OR you can use a glass of ice water.

4. You can also take a container of leftovers from the fridge and observe the water droplets on the lid.

5. To create condensation, take a small pot and fill with just an inch of cold water and place the lid on the pot.
6. Place the pot on the stove and turn the heat on to high. Let the water come to a boil.

7. Once the water has boiled, turn off the heat and observe the condensation on the inside of the lid.

Think about it!

A few more words about water…

Condensation occurs when warm humid air (vapor / gas) encounters a cooler surface and converts back to a liquid. It truly is an amazing process. Water can exist in three different forms (or phases): 1. A liquid – water; 2. A solid – Ice 3. A Gas. What is even more amazing is that you can have all three phases existing in your home at one time! If you're drinking water, boiling water and freezing water you're demonstrating a Condensation Sensation!

Condensing Condensation

Post Experiment Questions for Adults to ask:

1. If you boiled water on the stove with a lid or used a closed container of leftover food; did you observe condensation form on the inside of the lid?
2. Why do you think there was condensation on the lid?
3. If you placed a cold soda can or glass of ice water on the counter for a few minutes, did condensation form on the can or glass?
4. Why do you think there was condensation on the can or glass?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The answer should be yes.
2. The condensation on the lids formed when the steam from the hot water or food met the colder lid and converted from steam (vapor) to water.
3. The answer should be yes; however, this section may have taken a little longer.
4. Condensation can also occur when a cold surface (the can or glass of water) encounters warmer air.
5. Answers may vary, however, encourage your student to develop a hypothesis and write it down.

Draw your own conclusion:

Is it possible for Water to convert from Ice to Steam without going through liquid phase or does ice first have to melt before it can become a vapor? Do you think it's possible for Steam to convert to Ice without first converting to a liquid? Do some research into the Water Cycle and find out it if it's possible.
HINT: Start by researching the word: sublimation and deposition.

Expansion Experiments:

Do you live in a cold weather environment? Did you know, that in North Dakota the coldest ever recorded temperature was in 1936 and it was -60^{O}F! Did you also know that during the winter season in North Dakota you could take a pot of boiling water outside and throw the water in the air and it would turn to ice before it hit the ground?! Amazing! Condensation is a phenomenal activity in science, and we want you to tell us more about it! List all the types of condensation that occur and why they're so valuable. You can write or draw your answer and send it to: www.startingwithstem.org.

Log your work:

Maybe, what do you think?

Logbook Hint:

You can always write down your Hypothesis in your logbook before you begin your experiment and after it's complete; indicate whether you were correct or incorrect.

Real World Application:

Weather

Water Cycle

Hydrology

Additional Resources:

The Magic School Bus Wet All Over: A Book About The Water Cycle by Pat Relf & Carolyn Bracken

The Magic School Bus At The Waterworks by Joanna Cole & Bruce Degen

https://www.usgs.gov/special-topic/water-science-school/science/water-cycle-schools-and-kids?qt-science_center_objects=0#qt-science_center_objects

Digging Up a Sensory Bin

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Geology

Archeaology

Age Group

5-7

Cost

$0 - $5

Time

30 minutes

Materials

Bin, Dirt, Rocks, Sand, Flowers, Bolts, Metal Washers

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Social

Question:

How can you sense what an item is without looking at it?

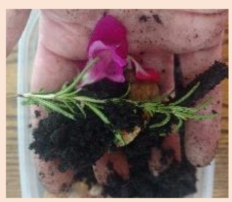
Hypothesis:

Before you do this experiment; try to predict the answer to the question above

Instructions:

1. Gather all of your materials together.
2. Review all Safety Precautions.
3. Discuss with a parent or adult all the items you wish to collect for the sensory bin.

4. Make sure to collect items that aren't sharp or dangerous. Do not include any nails or poisonous plants!



5. After you collected all of the items for your sensory bin – place all of the items in the bin.
6. With your hands in the bin scoop up the items with your hands and let the items slip in between fingers.
7. Now with your eyes closed and your hands still in the sensory bin; scoop the items up with your hands and allow the items to gently slip in between your fingers.

8. With your eyes still closed and your hands still in the bin; scoop up some items and hold them in your hands. Try and feel for each item and say what that item is – without opening your eyes.

Think about it!

9. Open your eyes, not pick up each item – one at a time and feel for the temperature of each item.

Some new words for you!

Archeology: Is the study of human history by digging in the dirt to find objects that were made by humans long, long, long ago.

Archeologist: An archeologist is the scientist who studies about human history and gets to do all the digging to find objects that were made a very long time ago.

Superposition is a fancy word in archeology. It means that the older the object the further you will have to dig to find it. Objects that are not very old are easier to dig up than older objects.

Digging Up a Sensory Bin

Post Experiment Questions for Adults to ask:

1. Are some of the objects cooler than others?
2. Which items are cooler?
3. Which items are warmer?
4. Why do you think some items are cooler than others?
5. Why do you think some items are warmer than other?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Yes – if you used metal objects.
2. If you used metal objects such as nuts, bolts or washers – these items should feel cooler than other items in the bin. It is also possible for the dirt and rocks to feel cooler as well.
3. If you used flowers, plants or leaves – these will feel warmer than the metal items. It' is also possible for the sand / dirt to feel warm – it all depends if you gathered some dirt / sand on a warm day.
4. It takes more energy to heat the metal than it does the plant, leaf or flower. The more energy it takes to heat something – the cooler it will feel before you try to warm it up.
5. It takes very little energy for flower, leaves and plants to warm up when compared to the metal objects in your bin. So the less energy it take for the item to warm up – the warmer it will feel.

Draw your own conclusion:

Let's dig a little deeper into this subject & become junior archeologists. Earth is just like a humungous sensory bin for archeologists. Archeologists love digging and find artifacts (old stuff) from a very long time ago. When we say a very long time ago; we mean hundreds to thousands of years ago! WOW! Could you imagine finding something that existed before people walked the earth? But time to put your thinking cap on and imagine you're an archeologists. Do you think it would be easier to find tools from 1776 BC or 1776 AD? Let us know! If you were an archeologist, tell us about some of the items you would find from 1776 BC vs. items from 1776 AD. We look forward to hearing from you!

Expansion Experiments:

Try this and let us know what happens! Using the same Sensory Bin you created – add more items to it – fill it up with items you don't necessarily need or want. Now, put a lid on the sensory bin or cover it tightly with some plastic wrap. After you cover the sensory bin – shake it GENTLY from side to side. What happens to the items in the bin? Did some of the items drop to the bottom of the bin and did some go to the top of the pile? Let us know what happened!

Log your work:

Not at this time. Just have fun!

Real World Application:

Superposition

History

Archeology

Medicine: The Senses

Additional Resources:

The Magic School Bus Shows and Tells: A Book About Archeology

The Magic School Bus Explores the Senses

Don't Bust My Balloon

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Physics

Age Group

5-10

Cost

Less than (<) $5

Time

30 minutes

Materials

Two Balloons; Water, Candle, Lighter or Matches

Safety

Eye protection.

Tie Loose Hair back.

Don't wear loose clothing.

Ear protection if sensitive to loud noises.

Adult Supervision Necessary

Heat involved - Use extra caution

IEP Goals

Academic

Behavioral

Motor

Question:

What will pop faster when placed over a candle: A balloon filled with air or a balloon filled of water?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Blow up a balloon with air. You don't have to fill up very much.
4. In another balloon, fill the balloon with some water. If it makes it easier, insert a straw to into the balloon and then hold the straw under some running water. After the balloon has some water in it; blow up the balloon with air; about the same size as the other balloon.

5. Next, before you light the candle; make sure you have no loose clothing dangling. Place the tealight candle in a small glass container or in a sink. Here, we did both.

6. WITH ADULT SUPERVISION, carefully light the tealight candle.
7. Put on eye protection and ear protection.

Don't Bust My Balloon

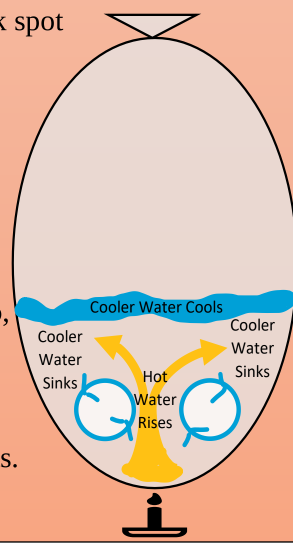
Post Experiment Questions for Adults to ask:

1. Which balloon popped quickly? The one with only the air in it or the balloon with the water and air in it?
2. Why do you think the balloon with only the air in it popped quickly?
3. Did the balloon with the water pop?
4. If it didn't pop; why do you think the water balloon didn't pop? If it did pop, did it pop faster than the balloon with only the air in it? Why Not?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The balloon with only the air in it pops quicker.
2. The AIR balloon begins to weaken as it gets closer to the flame. Eventually it pops because the air pressure inside the balloon is forced out at the weak spot created by the flame.
3. No.
4. Water is an excellent conductor of heat. The water is absorbing the heat of the candle rather than the latex or the balloon. Here is a drawing that may assist you in learning why the balloon didn't pop,
5. If your hypothesis was correct, congratulations! If your hypothesis wasn't correct, that's okay. That is why we conduct experiments.



Think about it!

Draw your own conclusion:

Based on the experiment you just did; what do you think causes human beings to sweat and what is the purpose of sweating? Tell us what you came up with and let us know at: www.startingwithstem.org!

Expansion Experiments:
Your home is full of daily science, technology, engineering and math experiments! So that is what we want you to think about. Here are a few suggestions to help get you started and then we want you to expand on these ideas and tell us what you discovered! Science in the home: The furnace. Technology in the home: Microwave. Engineering in the home: Insulation. Math in the Home: Square footage of your home. Now you try and tell us what you discovered!

Log your work:

Absolutely!

Logbook Tip:

Record how long it takes for the balloon to pop.

Real World Application:

Water being used to control heat, which is a transfer of energy, is a process that is extremely important in constructing new materials.

Thermal Conduction

Additional Resources:

For very young readers:

Baby Loves Thermodynamics!
by Ruth Spiro, Irene Chan

Metal Conductivity:

http://www.physics4kids.com/files/thermo_transfer.html

Great Science Fair Project!

https://www.education.com/science-fair/article/which-metal-conducts-heat-best/

Electric Slide

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Physics - Classical

Age Group

5-10

Cost

Less than (<) $5

Time

30 minutes

Materials

Balloons

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Think about it!

Question:

How can you observe static electricity?

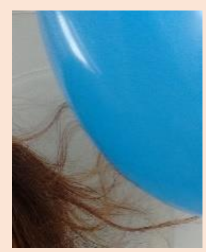
Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Now, inflate a couple of balloons. If you can't do it by yourself, ask an adult for help.
4. After you've inflated a couple of balloons; rub the inflated balloon on your head. Then hold the inflated balloon a couple of inches away from your head.
   ** If you have very short or no hair try this: Put on a sweater and rub the balloon back and forth on the sweater and see if the balloon will stick against the sweater. The other option is to borrow an adult, sibling or friend and ask them if they are willing to participate in the experiment.

5. Observe what happens.



It's Electric!

Did you know that **everything** is made up of electric charges? Even you! That's right. For example, your heart beats because of an electric charge from the Sinoatrial node. This node sends a very small flash of electricity through your heart that helps it squeeze and push blood through all of the areas of the heart! Isn't that amazing! When you remember that **everything** has an electric charge – it becomes easier to learn and understand how electricity works.

Why is friction important?

Friction is a force, a pushing or pulling action, that allows us to grip onto things & allows for someone or something to maintain its position. If friction didn't exist – we would just slide around and not stay still. Friction is the reason you can walk across the floor and not slide. Friction is the reason why your chair stays put when you sit down quickly. When two surfaces rub against each other is causes friction. Remember… **everything is made up of electrical charges**; so, when two surfaces rub against each other – so are the electrical charges. What do you think happens when two electrical charges are rubbing against each other? Sometimes those electric charges build up and build up; this is called Static Electricity. Sometimes there is so much static electricity that it causes a spark!

Electric Slide

Post Experiment Questions for Adults to ask:

1. What is the reason we ask you to rub the inflated balloon against your head?
2. What happened when you placed the balloon a couple of inches away from your head?
3. Why do you think the balloon stuck to your head?
4. Do balloons have static electricity?
5. Does your head have static electricity?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. By rubbing the balloon against your head – you create friction and friction is what makes static electricity.
2. It may take a couple of times, but the balloon should either: cause your hair to become attracted to the balloon, or if you have very short hair the balloon will stick to your head.
3. Static electricity is an imbalance between negative and positive charges in objects. When static charge builds from friction - it creates a spark. When two objects are rubbed together, one object becomes more negative and the other object becomes more positive and creates static electricity.
4. No, balloons don't have static electricity.
5. No, your head doesn't have electricity. The friction of rubbing the balloon against your head causes static electricity.

Draw your own conclusion:

For this experiment, we asked you to rub an inflated balloon against your head. What do you think would happen if:
- You rubbed an inflated balloon against a sweater?
- What do you think would happen if you rubbed against a wall?
- A Coat?
- A wooden floor?

Expansion Experiments:

Let's talk about expanding on this experiment by investigating Static Electricity in other places in the house – particularly the Clothes Dryer. If you do a load of laundry, and choose to dry your clothes in the dryer, you may notice that sometimes the clothes will stick together after they're dry. You may even hear some crackling or see sparks when you pull clothes apart. Why do you think this happens? Usually people add a dryer sheet to the dryer to help prevent static electricity / static cling. How do you think the dryer sheet helps to prevent static electricity? Let us know what you learn at www.startingwithstem.org.

Log your work:

Absolutely!

Log Suggestion:

Try logging your work this way: Indicate how many times you must rub the balloon against your head before you get it to stick. Also, you can indicate if you notice any sparks from the static electricity.

Real World Application:

Electricity, Weather

Meteorology

Conductivity

Additional Resources:

The Magic School Bus: Jumping into Electricity

https://www.scientificamerican.com/article/static-science-how-well-do-different-materials-make-static-electricity/

Estimation Creation

Experiment Express

STEM Field of Study

Math

Specific STEM Area

Probability

Age Group

8-11

Cost

Less than (<) $10

Time

15 minutes

Materials

Jar; Nuts and Candy of different sizes such as: Tic-tac's; Jellybeans; M & M's, Skittles, etc. your candy of choice; Logbook, Pencil / Colored Pencils

Safety

It's a good idea to have an adult nearby. Please be careful as some candy can be a choking hazard.

IEP Goals

Academic

Motor

Question:

When is it important to estimate and when is it important to be precise?

Hypothesis:

Try and answer the question above and write your answer in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Have an adult place a known number of nuts in the jar.

4. Have an adult place a known amount of candy in the jar.
5. Have an adult gently stir the mixture in the jar.

6. Guess how much of each candy / nut is in the jar.
7. Guess the total amount of mixture is in the jar.
8. Now, before you eat this delicious snack, holding the top of the jar, gently twist the jar from side to side for 30 seconds & observe what happens to the candy.

9. Now it's time to see if your count was correct. Take the mixture out of the jar and separate the candies and count each item.

Learning estimation and accuracy is important for everyday life – not just in the field of Science, Technology, Engineering and Math. When a person drives a car; they estimate the distance between their car and the car in front of them. When your parent goes food shopping, they estimate how much food they will need for the week as well as how much money they will need to purchase the food. Learning to estimate is a phenomenal skill --- but it takes practice!

Estimation Creation

Post Experiment Questions for Adults to ask:

1. Did you guess the amount of each nut or candy correctly?
2. Did you guess the total amount of the entire mixture correctly?
3. Is learning to estimate important for Math? Why?
4. Is learning to estimate important for Science? Why?
5. What happened to the mixture after you twisted it from side to side? Why do you think the mixture began forming layers?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary.
2. Answers will vary.
3. Estimation is extremely important when doing Math. If you can estimate what an answer may be; it will help you to know if you're doing a problem correctly.
4. Absolutely! Estimation in Science allows you make an educated guess or a Hypothesis.
5. When you twist the jar from side to side the mixture begins to form layers. The smaller layers fall to the bottom. And the larger layers move to the top.

Draw your own conclusion:

Think of areas in your life where you are doing estimating. Do you play sports? Ride a bike? Do crafts? Have you celebrated a birthday? All these activities / events involve some sort of estimation. We want you to tell us how. Let's take another scenario. One day, you decide to host a lemonade or a hot cocoa stand in your neighborhood. In order to have a stand; you must estimate what you need to make sure you have enough lemonade or hot cocoa to provide to your customers. Think about it and tell us about how estimating will help your business!

Talk to your parents, caregiver or an adult you trust and ask them when they use the skill of estimation. We estimate that you'll learn they use that skill a lot!

Expansion Experiments:

Learning how to shop at a store is an extremely important skill – particularly when there is a sale! Time for more math. You earned $20 from the lemonade stand and you want to purchase a new Science book that costs $20. But when you get to the store you learn that the book is on sale and 50% off the regular sale price. Can you purchase the book and how much do you think it will cost?

Log your work:

Maybe, what do you think?

Logbook tip:

After you shake the jar, you can indicate what you observed by drawing what you see. Try using colored pencils or crayons to draw the jar and its contents.

Real World Application:

Practice estimations and probability.

Business

Economics

Daily Life

Additional Resources:

https://carrotsareorange.com/early-math-estimation/

http://www.jumpstart.com/parents/activities/rounding-and-estimation-activities

https://playtolearnpreschool.us/estimation-station/

Betcha! Estimating by Stuart J. Murphy

Let's Estimate: A Book about Estimating & Rounding Numbers by David A. Adler and Edward Miller

Finding Fibonacci

Experiment Express

STEM Field of Study

Science

Technology

Engineering

Math

Specific STEM Area

Math

Statistics

Biology

Age Group

All

Cost

$0 - $5

Time

45 minutes

Materials

Notebook, 2 sheets of graph paper, scissors, pencil, crayons, Camera

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

Question:

Where can you find a Fibonacci Spiral, and can you recreate it?

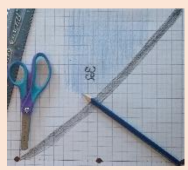
Hypothesis:

A Fibonacci Spiral is a unique type of spiral that looks like this:

Before you do your experiment, can you think about the question above & guess all the various places that you might see a Fibonacci Spiral?

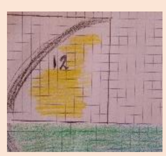
Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. You're going to create a puzzle that forms into a Fibonacci Spiral. Using graph paper, you are going to cut out six boxes that are different in size.

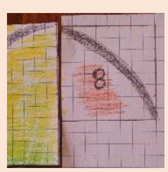


4. The first box you will cut out is the largest. The box is comprised of 32 small boxes across and 32 small boxes down. Cut this box out and color it Blue. After you color it blue, draw an arc that extends from the upper right corner of the square to the bottom left as shown in the picture. Label this large box "32."

5. Using another piece of graph paper, the next box is 20 small boxes across and 20 small boxes down. Cut this square out and color it green. Draw another arc that extends from the lower right corner to the upper left corner and label the square "20."

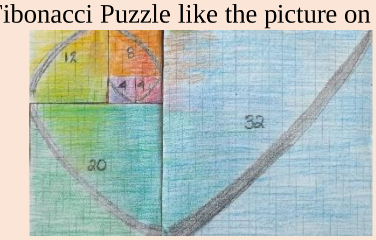


6. The third square is 12 boxes across and 12 boxes down. Cut this square out and color it yellow. Draw an arc from the bottom left corner to the upper right corner. Label the square "12."



7. The fourth square is only eight small boxes across and 8 small boxes down. Cut this out and color it orange. Draw an arc from the upper left corner of the box to the bottom right corner of the box and label it "8."

8. The final squares are 4 across and 4 down. Cut these two squares out and color one purple and one red. For one of the red boxes draw an arc from top right to the bottom left of the box. In the other red box draw and arc from the lower right to the upper left of the square.
9. Now assemble the Fibonacci Puzzle like the picture on the below



Think about it!

Leonardo Fibonacci was a brilliant Italian mathematician who lived around 1170-1240. You can learn more about Fibonacci and his contribution to math at: www.thoughtco.com/leonardo-pisano-fibonacci-biography-2312397

Finding Fibonacci

Post Experiment Questions for Adults to ask:

1. What did you notice about the numbers within the Fibonacci Spiral?
2. If you were to continue creating the spiral, what number would you label the next square?
3. Was it easy to create the Fibonacci Spiral puzzle? Why or why not?
4. Now that you completed the activity, where do you think you might find a Fibonacci Spiral?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Beginning in the center add the ones 1+1 = 2 & that is the size of the next box, 2 across and 2 down. Then if you add 1+2=3 and that becomes the size of the next box 3 across and 3 down. Using the 2 square and 3 square add those numbers and you get the 5 square, 5 boxes across and 5 boxes down. Finally, add the 3 square and the 5 square and you get the 8 square, 8 boxes across and 8 boxes down.
2. 13
3. Answers will vary.
4. Answers will vary. In flower heads or the bottom of a pinecone, you will probably notice more arcs, like half circles than a full spiral. This is because spirals are overlapping and crossing over each other.

Draw your own conclusion:

Now it's your turn to tell us what you think about the occurrence of a Fibonacci Spiral in nature. Why do you think they're important? Do you think that a spiral shell may serve a purpose for certain animals? Or, what about our galaxy – does it look like a spiral when it spins? You can tell an adult, a teacher or us what you learned about Fibonacci spirals. Take a picture of your Fibonacci Find and tell us all about it at: www.startingwithstem.org!

Expansion Experiments:

Did you know there are different types of spirals and these wonderful shapes also impact the world of art? In fact, there's a very famous museum that is shaped liked a spiral! Take some time to research the Guggenheim Art Museum in New York City to learn more about this magnificent building! www.guggenheim.org

Log your work:

Go for it!

Logbook Tip:

When you find a Fibonacci Spiral you have a unique opportunity to capture valuable information. For example, you can estimate the length and width of the spiral; where was the spiral; how was the spiral being used. Next, you can try drawing the spiral and attempting to make it appear 3-dimensional.

Real World Application:

Architecture, The Golden Ratio, Math, Number Theory, Engineering, Sequences, Natural Science, Economics, Technology, Art

Additional Resources:

Blockhead: The Life of Fibonacci byJoseph D'Agnese & John O'Brien

Fibonacci Zoo by Tom Robinson, Christina Wald

Mensa for Kids www.mensaforkids.org

Math is Good for You www.mathisgoodforyou.com

The Forensics of Your Finger

Experiment Express

STEM Field of Study

Science

Technology

Specific STEM Area

Forensic Science

Biometrics

Age Group

2-7

Cost

$0 - $5

Time

30 minutes

Materials

Scotch Tape; A dark towel and maybe some volunteers.

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Social

Question:

What is a fingerprint and why is it important?

Hypothesis:

Before you do the experiment, think about the question and predict what a fingerprint is and why it is important.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Pull out a long piece of tape from a tape dispenser. Here we used packing tape; however, you can use scotch tape.
4. Placing the tape on a dark surface with the sticky side facing up, gently press your thumb on the sticky side and lift.

5. You may have to hold the fingerprint against a dark surface to see it clearly or up to a light. You can ask some volunteers to do the same.

The History of Fingerprints

Did you know that fingerprints have a very long history of being used? Long before fingerprints were used to identify criminals, they were used to sign legal documents nearly 3000 years ago. It wasn't until the late 1600's that a professor in Italy discovered the familiar patterns that we see today such as whorls, loops, arches and ridges. Then in 1892, Argentinian police were able to solve a crime because a fingerprint was left at a crime scene. Fingerprints have a long and lasting history that is worth reading and learning about. Here is a great website to help get you started:
http://www.softschools.com/timelines/history_of_fingerprinting_timeline/287/

The Future of the Fingerprint is in the Eye of the Beholder

One important use for fingerprints is in the area of Biometrics. According to Homeland Security, "Biometrics are unique physical characteristics such as fingerprints, that can be used for automated recognition." That means a computer can be used to recognize unique physical characteristics in the face, fingerprints, retina (eye), voice and handwriting! Did you know that you probably already use Biometrics? Go to Question and Answer section to find out where you use Biometrics!

The Forensics of Your Finger

Post Experiment Questions for Adults to ask:

1. What shapes & patterns do you notice on the tape where you pressed your finger?
2. Do you see any similarities between different fingerprints?
3. Do you see any differences between different fingerprints?
4. How do you think forensic scientists use fingerprints to solve crimes?
5. Where else are fingerprints being used?
6. How did your finger leave the print on the tape? What created that print?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Your student should notice basic oval shape of the print. Perhaps they can see swirls (whorl), loops and arches.
2. Your student should notice some patterns. Fingerprints have three basic patterns: Whorls, Loops (2 different types of loops) and arches.
3. If your student has volunteers for fingerprinting; they will most likely notice differences between each print.
4. Since fingerprints are permanent and individually unique; whenever a criminal leaves a fingerprint at the scene of a crime; the forensic scientists use special powders and brushes to help find the fingerprints that belong to the criminal.
5. As we mention on the previous page, fingerprints are also used for Biometrics security. You will see biometrics used for identification at Airport Security, in the workplace to mark time and attendance, banking you even use biometrics to sign on to your computer and cell phone!
6. The sweat from your skin is oily and when you touch something, that oil sticks to the item you touched and stays there until it is wiped off.

Think about it!

Draw your own conclusion:

Time to do a little detective work – which is a fun way of saying it is time to do a little research! Think about fingerprints and how everyone has different fingerprints – no two fingerprints are the same – even on your own hands. You have ten fingers – so you have ten different fingerprints. But what about identical twins? Do they have identical fingerprints as well or are they all different?

Expansion Experiments:

What about your toes? Try and see if your toes have different prints than your fingers. Do your toeprints have whorls and loops and arches just like your fingers? Are your toe prints all the same or different?

Log your work:

Absolutely!

After you're done with the experiment; make sure to throw away your fingerprints. Your fingerprint is personal information and should remain that way – so protect it!

Real World Application:

Forensic Science

Police

FBI

CIA

Technology

Additional Resources:

CSI Expert!: Forensic Science for Kids by Karen Schulz

http://kidsahead.com/subjects/3-forensics

Detective Science: 40 Crime-Solving, Case-Breaking, Crook-Catching Activities for Kids by Jim Wiese

Galileo's Gravity

Experiment Express

STEM Field of Study

Engineering

Math

Specific STEM Area

Physics - Classical

Age Group

All

Cost

$0 - $5

Time

30 minutes

Materials

Paper and Pencil
Two small, empty plastic water bottles with lids.
Stopwatch (optional)

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Social

Question:

If you drop two water bottles of the exact same size; but one is full and the other empty, which bottle will land first?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions

1. Gather all materials together.

2. Review all Safety Precautions.

3. Fill one of the plastic water bottles with water. You don't have to fill it completely, just halfway is enough.

4. Holding the water bottles at the same height / level.

5. When you're ready, drop the water bottles at the same time.

6. Repeat four more times and record your observations in your logbook.

7. Optional: Have an adult or friend time how long it takes for the water bottles to drop. Record this data in your logbook.

Think about it!

Who was Galileo?

Galileo Galilei was a philosopher, astronomer and mathematician who lived in Italy from 1564 to 1642. His contributions to science include: improving the telescope that allowed him to view the heavens at a 20 times magnification and discovering the four largest moons of Jupiter and the rings around Saturn; he refined the theories on motion and falling objects as well as a simple thermometer.

Here are a few more resources to help support your learning of this exquisite scientist: Galileo for Kids: His Life and Ideas, 25 Activities by Richard Panchyk Who Was Galileo? by Patricia Brennan Demuth (Author)

Galileo's Gravity

Post Experiment Questions for Adults to ask:

1. Which water bottle hit the ground first?
2. If one object hit the floor first, why do you think it hit first?
3. Scientists must be able to explain where a mistake in their experiment may have been made. Do you think you made a mistake, if so, where?
4. If you were to try this experiment again, what do you think you could do to make it more accurate?
5. Based on your experimental results, if you dropped a hollow basketball and bowling ball from a high tower, which would hit the ground first?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. They are expected to hit at the same time.
2. The objects are the same size which means that as they fall, both experience the same amount of air resistance as they fall. Air resistance is the interaction that air molecules have with the surface of an object. So, if there is more surface area, there is more resistance.
3. The most likely answer is that the objects were not dropped at the exact same moment
4. You can always improve the accuracy of your results by completing more trials. This allows you to find the average of your results.
5. Since both the bowling ball and basketball are about the same size, buy very different weight, we can expect them to hit the ground at the same time as the air resistance they experience is the same.

Draw your own conclusion:

Aristotle predicted the heavier the object the faster it would fall. Galileo tested his theory and proved him wrong by dropping two objects of different weights off the Leaning Tower of Pisa. Both hit at the same time. Does this mean if you dropped a feather and bowling ball at the same time they would land at the same time?

Expansion Experiments:

Are you feeling the weight of gravity yet? Well, if you're still little lightheaded try looking at this experiment to ground you – the gravity pendulum. A pendulum is a simple yet effective way to study gravity, force and motion all at once! Here's are two great websites to learn more: www.sciencebuddies.org or https://kids.kiddle.co/Foucault_pendulum

Log your work:

Go for it!

Logbook Tip: Record the number of times you dropped both items and their corresponding times to hit the floor.

Real World Application:

Gravity / Gravitational Pull

Earth and it's rotation

Force and Motion

Nature and Tides

Additional Resources:

https://www.science-sparks.com/gravity-experiments-for-kids-galileo/

Galileo's Leaning Tower Experiment (Junior Guild Selection (Charlesbridge Paper) by Wendy Macdonald

Galileo for Kids: His Life and Ideas by Richard Panchyk

Getting Heated

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Physics

Thermodynamics

Age Group

8-11

Cost

Less than (<) $10

Time

1 hour

Materials

Meat thermometer; Three containers of water. The containers should be of similar size. 1 container is for cold-water; 1 container is for room temperature water and the last container is for hot water.

Safety

Adult Supervision Necessary

Heat involved - Use extra caution

IEP Goals

Academic

Question:

Is it possible to observe changes in temperature?

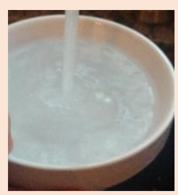
Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Label the cold-water container #1; the room temperature water container #2 and the hot water container #3.



4. Fill Container #1 with Ice Cold water; Fill Container #2 with Room Temperature Water and Fill Container #3 with Hot Water. Make sure to ask an adult for help when you are handling hot water.

5. Using a meat thermometer, measure the temperature of the water in each container and record the temperature in your logbook.

6. Continue to measure the temperature of each container every ten minutes for one hour. By the end of the hour you should have six - seven temperatures.
7. Record all temperatures in your logbook.

Think about it!

Thermodynamics is the section of physical science that studies the relationship between heat and energy. The energy can be mechanical, chemical or electrical.

Getting Heated

Post Experiment Questions for Adults to ask:

1. What happened to the temperature of Container #1? Did the temperature become colder, warmer or remain the same?
2. What happened to Container #2? Did the temperature become colder, warmer or remain the same?
3. What happened to Container #3? Did the temperature become colder, warmer or remain the same?
4. What do you think has more energy Heat or Cold?
5. Why do you think the Hot water became Cooler and the Cold water became Warmer?

Let’s Talk!

Discussion of Results / Post Experiment Answers:

1. The temperature changed and slowly became warmer.
2. The temperature remained the same or the temperature change was very slight.
3. The temperature changed and slowly became cooler.
4. Heat has more energy and it likes to move. Heat will move from where it is warm to where it is cooler.
5. The Hot water became cooler because heat likes to move from areas that are warm to areas that are cooler for there to be a balance of temperature. The cooler water became warmer because it absorbed heat that was in the room.

Draw your own conclusion:

Consider the following:
When you have two temperatures that are very different – there will be a flow of energy until the temperatures are balanced. When two temperatures are the same – the energy is very low and there is no flow of energy. During this experiment, the Room temperature water didn’t change significantly; why?

Expansion Experiments:

Our favorite experiments are when we can cook, bake or drink something that is delicious. So, here is an experiment for you to consider when it is a cold day. Make two cups of Hot Cocoa. Instead of drinking them right away; try this. Place just one of the cups of Hot Cocoa in front of a fan that is blowing and place the other cup of Hot Cocoa out of the path of the blowing fan. Set a timer for 5 minutes. At the end of 5 minutes, take the temperature of both cups of Hot Cocoa. Which one is cooler & which one is warmer? Okay, now you can have the Hot Cocoa…. But don’t forget the marshmallows and whipped cream!

Log your work:

Absolutely!

Logbook Tip:

Before you begin, record the temperature of the room in your logbook. After you complete the experiment record the temperature in the room again.

Real World Application:

Thermodynamics

Equilibrium

Weather / Meteorology

Space Exploration

Additional Resources:

www.physics4kids.com

The Magic School Bus in the Artic: A Book about Heat

https://kids.kiddle.co/Second_law_of_thermodynamics

www.nasa.gov/kidsclub/

Hey Butter, Butter, Butter!

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Food Science

Age Group

5-7

Cost

$0 - $5

Time

1 hour

Materials

Bowl, Colander, Pure heavy cream with no additives and a large mason jar or an old mayonnaise jar work very well.

Safety

It's a good idea to have an adult nearby. Be careful with glass mason jar.

IEP Goals

Academic

Social

Behavioral

Motor

Question:

How does cream turn into butter?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions. Please note that this is going to take a lot of arm work and shaking! So, if your arms get tired – take a break. Don't keep shaking the jar with over tired arms.
3. About an hour before you start, take the heavy cream out of the refrigerator and allow it to come to room temperature. If you want – you can pour it into the jar you're using for the experiment.
4. If you haven't already, pour the heavy cream into the jar.
5. Make sure to put the lid on tight before you move on with the rest of the experiment.

6. Begin shaking the jar of cream very hard for about 2 minutes. You might notice some whipped cream forming. Shake the jar another 30 seconds and you will see solids forming and you should see some watery liquid. This is buttermilk. You can save this and use it to make buttermilk pancakes.
7. Your goal is to shake the jar or mix the cream until you begin to see some water separate from the cream.

8. Once you see a large light, yellow clump of butter and white watery butter milk – it's time to drain the mixture. Using a Colander; place the colander over a bowl and drain off all the buttermilk and save for another time.

9. Rinse the butter off in a bowl full of ice water, add some salt if you like and store in the refrigerator! Enjoy!

Hey Butter, Butter, Butter!

Post Experiment Questions for Adults to ask:

1. Why do you think you're able to make butter from heavy cream?
2. Do you think you would be able to make butter from skim milk?
3. A Centrifuge is a special machine that uses the force of spinning to separate liquids from solids. In this experiment, what force did you use to separate the butter from the buttermilk?
4. Other than shaking a container of heavy cream to make butter, what kitchen equipment could you use to make butter?
5. If butter is a solid fat, what would happen if it was cold? What will happen if we use it in a frying pan to cook?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. A block of butter is about 80% fat and the shaking process allows the fat to stick together while the water milk and lactose is left behind.
2. No. Skim milk doesn't have any fat solids in it to make butter.
3. You used the force of shaking to separate the butter from the buttermilk.
4. You can use a hand mixer, food processer or a butter churner!
5. If you place the butter in the refrigerator or the freezer it will become harder – just like ice cream. If you place butter in the frying pan the solid butter goes through a physical change and melts. If there is any water leftover in the butter that will evaporate when heated.

Draw your own conclusion:

There are many different types of butter in the store. Usually we see butters divided into two categories: salted and unsalted. In this, "Draw Your Own Conclusion," section we want you to decide which you prefer, salted or unsalted. We also want you to think about why companies sell butter with salt and without salt? Why, do you think, is salt added to butter? Did you taste the butter before you added salt and after you added salt? Which did you prefer and why?

Let us know at: www.startingwithstem.org

Expansion Experiments:

What exactly is a "Churn," and how does it work?

https://www.seriouseats.com/2014/10/the-science-of-whipped-cream-butter-creme-fraiche.html

Log your work:

Not this time.

Just have fun!

Real World Application:

Roto-Vap

Centrifuge

Churning

Separation of fats & liquids

Food Science and Gastronomy

Additional Resources:

https://www.scientificamerican.com/article/bring-science-home-shaking-butter/

Beginners Guide to Making Homemade Cheese, Butter & Yogurt: Delicious Recipes Perfect for Every Beginner! By Carson Wyatt

Hit the Slopes

Experiment Express

STEM Field of Study

Math

Specific STEM Area

Geometry

Algebra

Physics

Age Group

8-11

Cost

Less than (<) $5

Time

30 minutes

Materials

Access to a small set of stairs. For example, steps up to a front porch or deck. Tape measure, Ruler, Logbook and pencil

Safety

Adult Supervision Necessary

IEP Goals

Academic

Motor

Question:

How can you determine the angle of a slope?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all materials together.

2. Review all Safety Precautions.

3. Time to do a little exploring. Find a set of stairs that are easily accessible and safe. We're only going to work with two steps, so the staircase doesn't have to be large.

4. Pick two steps that are together. The lower step we will call: Step 1 and the upper step we will call: Step 2.

5. Use your tape measure to measure the horizontal portion of Step 1. You will measure from the back of the step to the front of the step. Record this measurement in your logbook. This number is called, "The Run."

6. Using your tape measure again, measure the vertical or the height of Step 2. You will measure from the bottom were Step 2 meets with Step 1 straight up to the top of Step 2. Record this measurement in your logbook. This number is called, "The Rise."

7. Now using your tape measure one last time, measure the distance from the edge of top edge of Step 2 to the edge of Step 1. Record this measurement in your logbook.

8. You should have three measurements, the length, the height and the slope. Now time for some math. To determine the slope of the stairs you will divide "The Rise" number by "The Run" number. This is your slope.

Which would make a ball roll faster: A very steep hill or gradual hill?

Hit the Slopes

Post Experiment Questions for Adults to ask:

1. Besides staircases, where else can you find slope?
2. Why do you think it is important to know how to calculate the slope?
3. Do you think it's important for a skier to know the slope of a mountain? Why
4. Do you think it's important for a truck driver to know how steep of an incline or decline a road may have? Why?
5. What about airline pilots; do you think they use slope information to help them fly a plane?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. In nature, mountains / hills. Homes. Roads. Playgrounds
2. Knowing how steep something is will offer you more information about how to approach that slope.
3. It's very important for a skier to know how steep a slope is. The steeper the hill the faster the skier.
4. Absolutely! A truck driver must know how steep a hill is when he or she is driving. If the truck is going downhill, the steeper the hill the faster the truck will drive and the harder the truck will be to stop. If the truck is going uphill the truck will have to work harder because the steepness of the hill is working against the weight of the truck. Knowing how the slope of a hill is a matter of safety for truck drivers. The last thing they want to happen is for the truck to runaway out of control or not be able to make it to the top!
5. Slope is particularly important in the field of aeronautics. Flying a plane involves great attention to detail – particularly when it comes to the landing a plane. A pilot must take great care in their approach and descent to the runway. This is called the Glide Slope.

Draw your own conclusion:

Slopes are a lot more fun when you're playing. Tell us when and where you use a Slope to have fun. Think about it – where do you see slopes being used for fun? Is there a special time of year when you use slopes to have fun? Tell us what you discovered at: www.startingwithstem.org.

Expansion Experiments:

The next time you head to the playground, look for a slope or slopes. If you have your tape measure with you, you can easily learn the slope of some of the playground equipment. We'll give you a hint…. It rhymes with – GLIDE. Have fun!

Log your work:

Absolutely!

Tip:

Try drawing what you're measuring and then label what you are drawing. Sometimes if you are a visual person, it helps to see and draw what you're doing.

Real World Application:

Engineering

Physics

Construction

Architecture

Skiing

Aeronautics

Additional Resources:

https://www.ducksters.com/kidsmath/slope.php

https://www.mathworksheets4kids.com/slope.php

Everything You Need to Ace Math in One Big Fat Notebook: The Complete Middle School Study Guide by Workman Publishing (Author), Ouida Newton

Iron Man

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Physics

Age Group

2 - 7

Cost

Less than (<) $5

Time

15 minutes

Materials

One small bowl; A handful of cereal with at least 45% of the daily recommended iron. 100% is the most effective for this experiment; Water; Strong Magnet

Safety

It's always nice to have an adult standing by for help.

IEP Goals

Academic

Behavioral

Motor

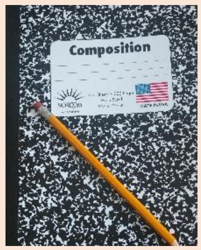
Question:

Can your cereal conduct electricity?

Hypothesis:

Before you start your experiment, can you predict the answer to the question? Write down your hypothesis in your logbook.

Instructions:



1. Gather all the materials for the experiment.

2. Make sure to review Safety precautions with an adult.

3. Fill a bowl with water. You don't need a large bowl – a small one will do. Just enough for some cereal to float on the top.

4. Take a small handful of IRON fortified cereal (use a cereal that is at least over 45% - 100% is preferable) and gently place the cereal in the bowl.

   Cereals with lots of iron in them: Total, Special K and Cheerios.

5. Now dip the magnet into the water and watch the cereal become attracted to the magnet. You may have to move the magnet around a little bit. Be patient, the cereal will become attracted to the magnet.

Think about it!

A Conductor, a conductor & conductivity

When it comes to electricity – two important words are: conductor & conductivity. Explaining these words can be tricky, however, we'll do our best. You may have heard of the word "conductor" as it relates to a musical conductor. A musical conductor permits an orchestra to perform & allows the music to flow easily. An electrical conductor isn't a person; it's a material such as metal, that permits electricity to flow. There are some materials like silver & copper that permit electricity to flow easily; while other materials such as rubber don't allow electricity to conduct.

Conductivity is how well the electricity moves through the material. Since copper is an excellent conductor of electricity it is used for electrical wiring in homes. However, since plastic doesn't conduct electricity it's used to insulate the copper wires and protect a home from electrical fires.

Iron Man

Post Experiment Questions for Adults to ask:

1. Did the cereal move toward the magnet or away from the magnet?
2. Why?
3. Is Iron bad for you?
4. Why or Why not?
5. Are magnets important?
6. Why?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The cereal should move toward the magnet.
2. Many cereals are fortified with vitamins and minerals including iron! An iron magnet will attract other materials that contain iron.
3. Well…. No and Yes
4. The right amount of Iron is not bad for you because your body needs Iron to work. **HOWEVER,** too much Iron is not good for your body. So, make sure you listen to your doctor about how much Iron you need to help keep your body working!
5. YES!
6. Magnets are extremely important because Magnets and Electricity have a very strong relationship. Did you know that the movement of a magnet can generate electricity and you can use electricity to make a magnet?

Draw your own conclusion:

Now it is your turn to tell us what you think about magnets. Do you feel magnets are important? Why or why not? Do we need magnets to help us? Can we live without magnets?

You can tell an adult what you learned about magnets, a teacher or even us! Log on to www.startingwithstem.org to tell us what you learned! We can't wait to hear from you!

Expansion Experiments:

The relationship between electricity and magnets can be a difficult concept to understand. Make sure to review the resources provided in the Additional Resources section for more information and experiments that expand on the ideas presented here. Let us know what you discovered at www.startingwithstem.org

Log your work:

You absolutely can! In this book we provided a sample log sheet that you can duplicate and reuse. You can also go to:

www.startingwithstem.org

and download a log sheet.

Real World Application:

Magnetism

Electricity

Compass

Generators

Technology: Computers,

Phones & Speakers

Electromagnetism

Additional Resources:

The Magic School Bus Series: Book #12: Amazing Magnetism

www.sciencekids.co.nz/sciencefacts/magnets.html

easyscienceforkids.com/all-about-magnetism/

Man-Made Wonders

Experiment Express

STEM Field of Study

Engineering

Specific STEM Area

Engineering - Ancient

Architecture

Age Group

All

Cost

$0 - $5

Time

Ongoing Activity (more than one day)

Materials

Notebook; Pencil; Access to History Books at the Library or the Internet

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

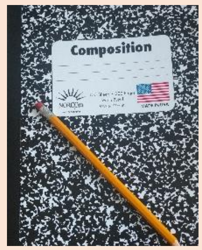
Question:

How are the Man-Made Wonders of the World unique and why?

Hypothesis:

Before you start your experiment, can you predict your answer to the question above? Write down your answer in your logbook.

Instructions:



1. Gather all your materials together.
2. Review all Safety Precautions.

3. To help get you started, here is a brief list of some Man-Made Wonders of the World: The Pyramids of Giza, Great Wall of China, Colosseum, Taj Mahal, Stonehenge, Easter Island, Machu Picchu and Christ the Redeemer Statue in Peru.

4. Now, it's your turn to search for more. Look at Man-Made Wonders for the United States of America or Wonders of your state. Have you ever been there? If so, tell us about the wonder near you at: www.startingwithstem.org

5. In your logbook, sketch the Man-Made Wonders that you learned about and record brief facts about that wonder.

Think about it!

There's More!!!

There are a variety of "wonders" throughout the world and some of them are right here in the United States of America! The Grand Canyon; Niagara Falls; Denali / Mt. McKinley, Yellowstone National Park; Redwoods National Park, Yosemite National Park just to name a few!

Perhaps you have been to one of these wonders – if you have share your story with us at: www.startingwithstem.org

Man-Made Wonders

Post Experiment Questions for Adults to ask:

1. What wonder did you enjoy researching the most?
2. Which wonder do you think was most difficult to build? Why?
3. What materials were used in building these man-made wonders?
4. Why do you think those types of materials were used?
5. If you could visit only one of the Man-Made Wonder – which one would you visit and why?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary and there is no right or wrong answer to this question.
2. This is an opinion question, so answers will vary.
3. The materials used are dependent on the region which they are located. However, timber, stone, masonry, marble, limestone, granite, etc.
4. Typically, materials that are used for a project are resources that are found in abundance in the area.
5. Answers will vary. The true focus of this question is for a student to think critically and have a conversation rather than offering a simple one -word answer.

Draw your own conclusion:

If you could duplicate one of Man-Made Wonders, on a smaller scale of course, which one would you choose? More importantly, what materials would you utilize? Very few of us live near rock quarry where we could mine for limestone or granite – so you would have to make do with what you have. Tell us about what Man-Made Wonder you would recreate, why and what you would use to build it. Make sure to keep a record of your efforts and send us pictures! We can't wait to see all your wonderous creations at www.startingwithstem.org

Expansion Experiments:

Don't stop here! There are so many beautiful wonders of the world to learn about! There are the 7 Natural Wonders of the World; The Seven Wonders of Ancient Earth and there are even the Seven Wonders of North America! Who knows – you might live near one of these wonderous wonders! Show us what you learned about these magnificent sites and share them with us at: www.startingwithstem.org – we can't wait to hear from you!

Log your work:

Absolutely!

Logbook Tip: After you sketch a Man-Made Wonder; indicate important facts about the wonder. For example: Indicate the dimensions, how it was made, when it was made and why it's so valuable to history.

Real World Application:

History

Culture

Innovations

Construction

Engineering

Business

Additional Resources:

https://www.abcya.com/games/world_wonders_spot_difference

Empire the Skyscraper in the Land of Man-Made Wonders Michael David Drucker (Author), Sumser III, Raymond Joseph (Illustrator)

https://easyscienceforkids.com/all-about-the-man-made-wonders-of-the-world/

The Mariners Multi-tool

Experiment Express

STEM Field of Study

Technology

Math

Specific STEM Area

Astronomy

Navigation

Age Group

8-11

Cost

Less than (<) $10

Time

45 minutes

Materials

Cardboard, protractor, drawing compass, ruler, pencil, straw, scissors, tape, string, metal washer or a Lifesaver candy

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Question: If I am standing outside, can I measure the angle to the top of any tree near me?

Hypothesis: Before you start the experiment, think about it and guess or predict what might happen.

Instructions:

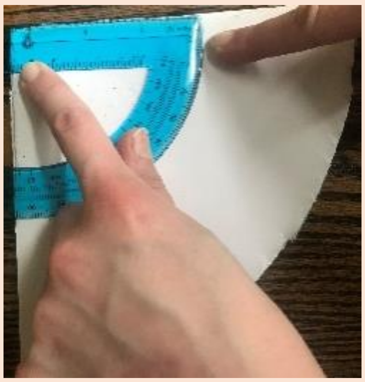
1. Gather all your materials together.
2. Review all Safety Precautions.
3. Begin by using your Cardboard, Pencil and Ruler. Horizontally, place the 6" mark of the ruler at the center of the cardboard, draw a straight line from the 0" to the 12" mark. Make sure to mark your center point at 6". Now repeat this process going vertically. Place the 6" mark at the center point and draw another line extending from 0" to 12".

4. Setting the ruler aside and using your drawing compass, place the point where the 6" center mark extend the pencil of the compass to the end of one of the lines. Keeping the point at the center swirl the pencil point around the center mark to create a perfect circle. Your compass pencil should touch the end of every line. If you don't have a compass – don't worry. Find a dish plate or another circle that is 12" wide and just trace around it.

5. Carefully cut out the cardboard circle. Using the lines that you drew, cut along those same lines to create four equal pie wedges. We're only going to use one of the pie wedges – so cut out only one of the pie wedges from the circle. The rest of the circle can be set aside.
6. Using one wedge, your protractor and pencil; place the cardboard wedge on the table so there is a straight side on the left and the rounded section is to the right. The rounded section should be closest to you. Notice in the top left corner of the wedge there are two straight sides that meet. Take the protractor and you will notice it looks like a ½ of a circle. Hold the protractor so the rounded section is closer to you. Next, Place the straight section of the protractor one the cardboard wedge and match it to the top side of the wedge. You will see a small hole in the protractor near the number 3; place that hole slightly inside of where the two straight sides of your cardboard wedge meet. Take your pencil and place a pencil dot at the same location where the hole of the protractor is located.

Instructions:

7. Continue holding your protractor on the cardboard wedge and look at the numbers on the OUTSIDE of the half circle of the protractor. At the top righthand side there may be two zeros. We are going to use the lower zero. Follow the outside of the ½ circle down and to the left. You will see that that numbers increase from 10 to 90. Using your pencil, place a small hash mark on the cardboard wedge at the 0, 10, 20, 30, 40, 45, 50, 60, 70, 80, 90. These are your degrees for measuring an angle.



8. Setting your protractor aside, you'll now use your pencil and ruler. Draw a straight line from the dot that you made with your protractor to each hash tag mark. After your done, label each line with its correct degree.



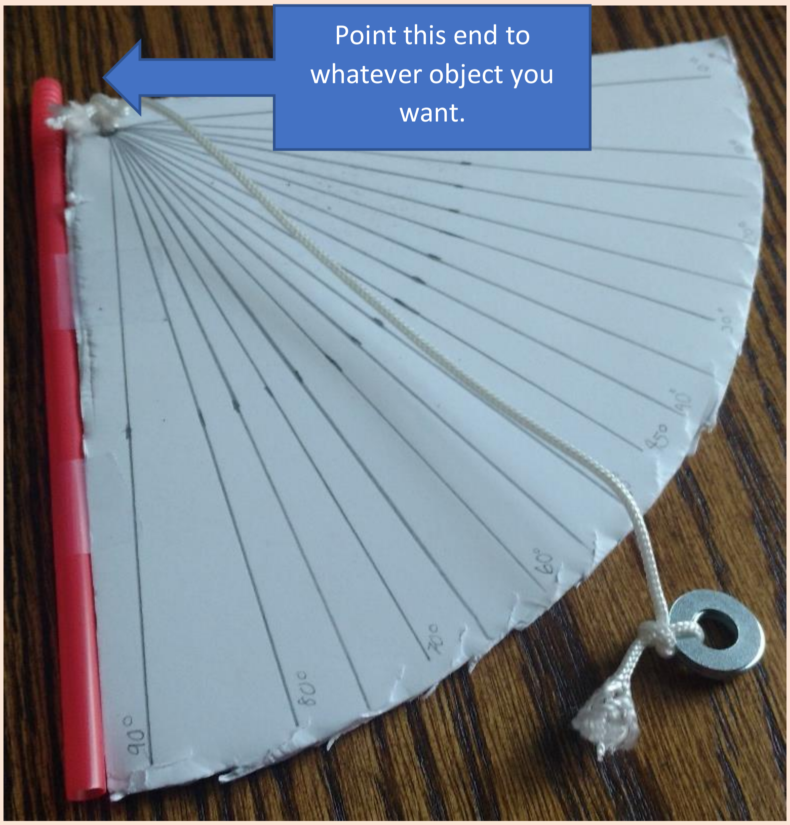
9. At the corner of the wedge where the two straight lines meet, poke a small hole about a ¼" away from the corner.
Then cut a 10" piece of string and tie one end in the hole of the wedge and tie the washer to the other end. Using the straw and tape, gently attach the straw with the tape on the left side (90-degree side) of the wedge. Make sure the sure the straw doesn't bend and is taped flush at the 90-degree mark. This is the side you will look through, so don't cover the hole of the straw.



Instructions:

10. To use your Astrolabe, walk outside and look through the straw on the 90-degree side. The string with the washer will naturally swing down and tell you what your angle is to the top of the tree.

Try this with a variety of items such as buildings, moon and stars.



Look through the straw here.

Think about it!

The Navigator's Astrolabe… The Original Multi-Tool of the Ancient World

It's hard to imagine, but you just created a device with historical roots to 220 B.C.! That is over 2,200 years old! You should be very proud for completing this experiment. It is by far the longest and most difficult experiment in this book. We hope that you take a moment to send us a picture of your Astrolabe and let us know how you've used it!

The Navigator's Astrolabe truly is the original multi-tool of the ancient world. Mariners would use the astrolabe to measure latitude and longitude during the Age of Exploration. Of course, there were a variety of astrolabes that had multiple options available for its handler to use. According to the Smithsonian Museum (which calls the astrolabe the original smartphone) some of these handy devices would, "give you the time, your location, your horoscope, and even help you make decisions." Would you ever guess that a 2,000-year-old device could do the same work of a present-day smartphone?

The word "astrolabe" comes from the Greek word ***astrolabes*** which means, "star-taking." How appropriate is the name of this device? If you had to rename the astrolabe, what would you choose? Let us know at: www.startingwithstem.org.

Post Experiment Questions for Adults to ask:

1. Where do you think an astrolabe would be helpful?
2. Why did navigators use astrolabes while sailing ships?
3. List the devices or objects that you know of that can be used to help us navigate.
4. If you look up at the sky at a star, what does your angle of elevation tell you the star is.
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Astrolabes are applied where one needs to know the angle of elevation. They are useful in engineering, construction and direction.
2. The North Star is probably the most important star in the night sky. Mariners could use an astrolabe to find the angle in degrees from their viewpoint to the North Star, this angle would then tell the sailors the latitude of the ship.
3. GPS (Global Positioning System); Radar, compasses and good ole' maps are all used to help us find our way.
4. Answers will vary. The purpose of the question is to encourage use of the astrolabe and conversation.
5. If it was correct, congratulations! If not – don't worry, this is exactly why we do these experiments.

Draw your own conclusion:

Sea captains didn't have GPS When navigating the high seas; they had to rely on the stars. The ancient Greeks began using the astrolabe to tell time and mariners began using the astrolabe for navigation. Our methods of navigation have become more accurate, detailed and complex over the centuries; however, many are still based on ancient techniques.

Expansion Experiments:

If you're ready to expand your learning of angles, draw a sketch of yourself looking at the stars. You may notice that if you stand on the ground looking up at the stars, the shape of a triangle is formed between your gaze up at the star and your gaze forward parallel to the ground.

Log your work:

Absolutely!

Real World Application:

Astronomy

Navigation

Geometry

Additional Resources:

The Age of Exploration by Kenneth Pletcher

https://kids.kiddle.co/Astrolabe

Tools of Navigation: A Kid's Guide to the History & Science of Finding Your Way by Rachel Dickinson

Material World

Experiment Express

STEM Field of Study

Science
Engineering

Specific STEM Area

Material Science

Age Group

2-7

Cost

Less than (<) $10

Time

About 1 hour

Materials

Water Glass & Plastic Cup; Watch; Wooden & Metal Utensils; Water; Notebook and Pencil

Safety

Absolutely! Make sure an adult is supervising while pouring the hot water into the cup or glass.

IEP Goals

Academic

Behavioral

Motor

Question:

What conducts (heat / electricity) better; a wooden spoon or a metal spoon? Why?

Hypothesis:

Before you start your experiment, can you predict your answer to the question above? Write down your answer in your logbook.

Instructions:

1. Gather all materials together for the experiment.

2. Create the Material World Log Sheet. It's easy, you can make one in your notebook just like it is shown in the picture.
3. Before you begin, feel the temperature of each utensil. Are the cool, warm or hot? Indicate this on your log sheet.
4. Now you're ready to begin. With the help of an adult, pour hot water into the water glass (you can also use a coffee mug) and pour hot water into the plastic cup.

5. Now place the metal utensil into the water glass and place the wooden utensil into the plastic cup. Make sure the utensils aren't fully submersed in the water. You want to make sure to leave enough room sticking out of the water.
6. Set a timer for 5 minutes.
7. After five minutes is done, feel the temperature of each utensil only at the very top. Make sure to NOT stick your in the hot water. Is the utensil cool, warm or hot? Now record that in your notebook.
8. Repeat this exercise five more times until 30 minutes has passed – making sure to record the temperature every five minutes.

Conduction and Insulation:

In the "Iron Man" experiment we reviewed the terms: conductor and conductivity. While the "Iron Man" experiment touched on Electrical Conductivity; this experiment is about Heat Conductivity. You may recall **Conduction / Conductivity** is the way heat or electricity moves through something. **Insulation**, however, is a material that protects something from heat or electricity. Remember this for special question in the, "Draw Your Own Conclusion" section.

Material Science is the study of how ceramics, metals and plastics are made as well as how to use those materials. Here is a great website to go to where you can find more information:

Post Experiment Questions for Adults to ask:

1. At any time during the experiment, did one utensil become warmer than the other?
2. Why?
3. Which utensil stayed the same temperature?
4. Why?
5. When you are cooking with heat, would you prefer using a metal utensil or a wooden utensil?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The metal utensil should become slightly warmer.
2. Metal conducts heat.
3. The wooden spoon should remain same temperature.
4. Wood doesn't conduct heat.
5. Metal conducts electricity like heat; but plastic insulates.
6. There is no right or wrong answer to this question. Using a wooden utensil allows you to cook without burning your hand; however, if you had a metal utensil with a plastic handle – that would work as well.

Draw your own conclusion:

Why do you think pots and pans are made of metal?

Why do you think the handles of pots and pans are plastic or wood?

Why do you think electrical wires (which are made of metal) are wrapped in plastic?

What do you think OVEN MITTS are? Do you think they are a Conductor or an Insulator?

Expansion Experiments:

Would you like to learn more about how thermal conduction and insulation works? The next time you go to an outdoor sporting event that requires you to sit on cold metal benches try this experiment. Bring a foam pad or a thick blanket to sit on. Record how long it takes for your body to feel the cold from sitting on the plain, uninsulated metal bench. Then place the blanket on the bench and record how long it takes for your body to feel the cold bench. Which do you think will take longer and why? Let us know at: www.startingwithstem.org

Log your work:

You absolutely can!

All you need is some paper and a pencil and keep record of everything you do!

Real World Application:

Electricity

Safety

Conduction

Insulation

Material Science

Additional Resources:

Heat Transfer: http://www.sciencekids.co.nz/gamesactivities/keepingwarm.html

www.science-sparks.com

The Magic School Bus in the Arctic: A Book About Heat by Joanna Cole

Maxwell's Top

Experiment Express

STEM Field of Study

Science

Technology

Specific STEM Area

Classical Physics

Age Group

2-7

Cost

$0 - $5

Time

45 minutes

Materials

White Paper, Crayons: Red, Orange, Yellow, Green, Blue, Indigo, Violet, CD, Cardboard, scissors; 1 good pencil for tracing and 1 short and blunt pencil for the spinning top.

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Motor

Social

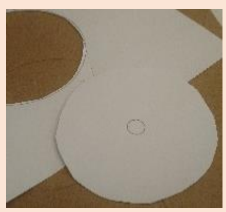
Question: What happens to the colors of the rainbow when spun at high speed?

Hypothesis: Before you start your experiment, can you predict your answer to the question above? Write down your answer in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Using the CD as a guide, trace around the CD to create a circle on the white paper and repeat the same procedure on the cardboard. You don't have to use a CD. You can also use the round lid of a container or a small bowl.
4. Time for help from an adult. Now we must cut out both circles – the one on the white paper and the one on the cardboard. Make sure to be careful with the scissors.



5. Now that both circles are cut, it is time to color! We're going to color only on the white paper. Divide the white circle into seven equal (7) sections - just like you would a pie or cake. Color each pie section a different color but you must go in order. 1st color is RED; 2nd color is ORANGE; 3rd color is YELLOW; 4th color is GREEN; 5th color is BLUE; 6th color is INDIGO and the 7th color is VIOLET. Make sure your colors are in the correct location and match the picture shown.
6. Now it's time to glue your colorful circle onto the cardboard circle. Make sure the white side of your colorful circle is the side with the glue. You don't want to glue the colorful side to the cardboard.

7. Now you're ready to make a spinning top. You might need some help with adult for this section. Take your scissors again and make a small hole in the very center of your color wheel. Don't make it too big.
8. Now take your small, blunt pencil – and push the blunt side through the center small hole so the blunt side of the pencil is on the cardboard side and the eraser side is on the color wheel side.

9. Are you ready to take it for a spin? Ok…. Here we go. Place the blunt end of the pencil on a flat surface, like a table or floor.
10. Grab the top section of the small pencil and twist the top so the circle spins fast. This might take a couple of attempts; but you'll get the hang of it – just be patient.

Post Experiment Questions for Adults to ask:

1. What happened to the colors when the top was spinning?
2. Why do you think the colors look almost white when the top was spinning very fast?
3. What happens when the top begins to slow down?
4. Which colors do you see more clearly when the top is spinning slower?
5. This experiment is also called Newton's Disc and was created by Isaac Newton. Do you know what else Isaac Newton is famous for?

Let's Talk!

Discussion of Results
Post Experiment Answers:

1. If the top is spinning fast enough; you no longer see the individual colors. Instead the colors begin to fade into white.
2. This is activity is a little trick of the mind. When the colors are moving so fast, they blend together to form one image – a white disc.
3. You begin to see more colors.
4. This may take a couple of attempts; however, you mainly begin to see red, blue and yellow.
5. Isaac Newton is famous for math and for building the first reflector telescope in 1668.

Think about it!

Draw your own conclusion:

If the top spins fast the colors almost disappear to white. Let's think about the light from the sun. Do you think light from the sun is moving very fast or very slow? When does the light from the sun split into different colors in the sky?

Expansion Experiments:

Try recreating Newtons experiment of splitting light with a prism. Here is a website to assist you with this wonderful experiment! https://buggyandbuddy.com/rainbow-science-for-kids-exploring-prisms/

Log your work:

It's worth a try!

You can record your activity and send that to us also!

Real World Application:

Photography

Optics

Art

Construction (Windows)

Additional Resources:

The Magic School Bus Makes a Rainbow: A Book About Color

The Magic School Bus: Gets A Bright Idea, The: A Book About Light by Nancy White (Author),

https://www.ducksters.com/science/light.php

Melting Cup

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Age Group

8-11

Cost

Less than (<) $5

Time

15 minutes

Materials

Styrofoam – you can use a cup; Nail Polish Remover that contains Acetone and a Glass Bowl, Metal Spoon

Safety

Chemicals Involved - Exercise extra caution. An adult **MUST** be present. Make sure you are in a well-ventilated area, **NOT** near an open flame and **DO NOT** handle the acetone with bare hands and **DO NOT** swallow acetone.

IEP Goals

Academic

Behavioral

Motor

Question:

Why does Acetone melt polystyrene, also known as Styrofoam?

Hypothesis:

Before you start your experiment, try to predict the answer to the above question. Write down your answer in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions. Make sure an adult is present and you are in a room with good air flow. The best places to do this experiment are either outside in the fresh air OR in the kitchen on a stone surface near a window.
3. WARNING: If the Acetone liquid touches a wooden surface; it will remove the stain. This is what happened to our kitchen table when the Acetone dripped down the side of the bottle.
4. You can either crumble the polystyrene into the bowl, or if you are using a Styrofoam cup you can place the cup into the bowl.
5. Pour a VERY SMALL amount of Acetone into the bowl with the polystyrene. Make sure to put the cap back on the bottle of acetone. If you feel more comfortable pouring the Acetone in the bowl first and then adding the polystyrene – you can do that as well.
6. Observe when the acetone touches the Styrofoam; the polystyrene begins to bubble and "melt" from the acetone.
7. Take a metal spoon and stir the mixture.
8. Observe the polystyrene turns into a slime mixture. DO NOT TOUCH the mixture with bare hands.

Can you recycle polystyrene?

Think about it!

This is a common question for recycling centers and the best answer they can provide is: Sometimes. Polystyrene is used for the construction of docks, surf boards and electronics. While polystyrene is Reusable it's not always Recyclable. Additionally, if the polystyrene is used as a food container it is at times contaminated with food and oils that render it unusable. What are your options? Try minimizing your use of polystyrene and reuse the polystyrene you have.

Melting Cup

Post Experiment Questions for Adults to ask:

1. What happens to the Styrofoam?
2. What is left over after the Styrofoam is "melted?"
3. Why do you think the Styrofoam melted?
4. Why is it a good safety precaution to do the experiment outside or in a large room with the window open?
5. Why is it a good safety precaution to not handle the chemical with bare hands?
6. Why is it a good safety precaution to have an adult help you?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The Styrofoam seems to "melt."
2. The Styrofoam seems to transform or turn into a gel-like material.
3. The Acetone in the nail polish remover is a solvent and the solvent released or popped the air from the Styrofoam.
4. The Acetone smells very bad and it's dangerous to inhale bad fumes. The most important job of any good scientist is to practice excellent safety precautions. If you don't protect yourself – how can you become a great scientist and make the world a better place?
5. This is another great safety precaution for scientists! The last thing a scientist wants is to become injured. So, the safer you are with chemicals – the better!
6. You're a scientist in training – it's okay to let an adult help you and show you the right way to do a science experiment. When your teacher or mom or dad or caregiver thinks your ready to do more – they will tell you. For now, let them help you.

Draw your own conclusion:

Acetone is what is called a, "solvent." A solvent can dissolve other substances and acetone is used in many cleaning products not just in nail polish remover. Try doing some research and find out more about acetone, what it's made from and where else it used.

Expansion Experiments:

Polystyrene. Seems like a weird word doesn't it? Polystyrene is the scientific word for Styrofoam. Take some time to learn more about this unique and sometimes controversial product and tell us what you think! Good? Bad? Both? Tell us where Styrofoam is used.

Log your work:

Go for it!

This is a great opportunity to log your work and record your observations. What did you see? Hear? Smell? How long did it take for the Styrofoam to melt?

Real World Application:

Chemistry

Cosmetics Industry

Food Industry

Recycling Science

Additional Resources:

https://www.stevespanglerscience.com/lab/experiments/vanishing-styrofoam/

Elements: A Visual Exploration of Every Known Atom in the Universe by Theodore Gray

Mirror, Mirror

Experiment Express

STEM Field of Study

Science

Technology

Engineering

Specific STEM Area

Chemistry

Optics

Physics

Age Group

11+

Cost

$0 - $5

Time

30 minutes

Materials

A small piece of glass; colored construction paper; plastic shopping bag, aluminum foil, scissors

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

Question: What color of construction paper or materials helps create the best mirror?

Hypothesis: Before you start your experiment, can you predict the answer to the question above? Make sure to write down your hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Choose either a piece of glass or a window to use. Here we used a piece of glass from a small picture frame. Make sure to handle the glass with care.
4. Using your piece of class as a guide; cut out pieces of construction paper that will completely cover your piece of glass. Do the same with the plastic bag and aluminum foil.
5. Take one piece of construction paper that you cut out and place it on a table. Then place the glass over the construction paper.
6. Look down at the glass as if you're looking into a pool of water.
7. How well can you see yourself? Make a note in your logbook. You could utilize a scale system to "grade" your mirror. For example: 0=Poor; 1=Satisfactory; 2=Good; 3=Excellent.
8. Repeat this process for all the construction paper colors you have as well as the plastic bag(s) and the aluminum foil. Make sure to rate and record each type of material you use.

Mirror, Mirror on the Wall…

Think about it!

Mirrors have a remarkable history! While the earliest form of the mirror dates back to nearly 6000 years ago; the mirrors that we use today are relatively a recent invention. Typically, mirrors were reserved for only the wealthiest of people; but that all changed in 1835. The German chemist, Justus von Liebig, created a process by attaching a thin layer of silver to the back of glass. Because of his invention, mirrors were being produced on a large scale which offered everyone an opportunity to own one. So, the next time you pass by a mirror; you know who to thank for the beautiful reflection you see!

Mirror, Mirror

Post Experiment Questions for Adults to ask:

1. Which construction paper colors were the most difficult to see your reflection?
2.Which construction paper colors were the best to see your reflection?
3. Which material was the most reflective?
4. Why is it necessary to have a backing behind the glass in order to see your reflection?
5.Was your hypothesis correct?

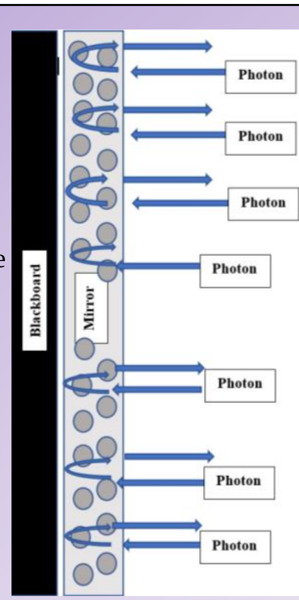
Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary, however, for us the worst colors were white, yellow, green and pink.
2. Answers will vary, however, for us the best colors were: black, red, brown and blue.
3. The aluminum foil.
4. Glass is transparent, which means it allows light to pass through – just like a window. However, in order to stop the transparency, you need something behind the glass to redirect the light and let it recycle back to you.
5. If your hypothesis was correct; congratulations! If not, don't worry and keep trying!

Draw your own conclusion:

Mirrors are great at recycling. Does this statement make sense to you? Well, you be the judge. This is how a mirror works: Pieces of light are called photons; and the photons pass through the transparent, clear glass and are then forced to make a U-turn when they encounter the silver back of the mirror. After the photons turn around – they have nowhere else to go but back out through the clear and transparent glass. It's like a tennis ball hitting a wall and coming right back – but faster. A photon never slows down when it goes into the mirror; the speed it travels at is the same going in as it is coming out. Can you change direction that quickly? So, what do you think, are mirrors great at recycling? Let us know at: www.startingwithstem.org



Expansion Experiments:

Reflect on this: If you write a word on a piece of paper and then hold that paper with the word facing a person – the person can read the word correctly. However, if you hold that same piece of paper with the word facing a mirror – the word appears reversed – but is it? Is the word reversed? Tell us what you think at www.startingwithstem.org.

Log your work:

Absolutely!

This experiment offers a phenomenal opportunity to log your work and present your findings to another person. Follow the tip we provided in Step #7 to accurately record your experiment.

Real World Application:

Physics / Optics

Defense systems

Astronomy / Telescopes

Daily Life

Satellites

Automobiles

Lasers

Photography

Additional Resources:

https://www.sciencealert.com/how-do-mirrors-work

Through the Looking Glass Science Activities: Science with Light and Mirrors / Science with Water / Science with Magnets
by Helen Edom

http://www.mirrorhistory.com

Mr. Bones

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Medicine

Chemistry

Age Group

2-7

Cost

Less than (<) $5

Time

Ongoing Activity (more than one day)

Materials

Glass Container, White Vinegar and Chicken Bones

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Question:

What happens to bones after sitting in an acidic solution like vinegar?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Place chicken bones in glass container.
4. Pour enough vinegar into the container to cover the bones.
5. Place the container of chicken wings and vinegar in the fridge for 3-5 days.
6. Observe difference in color and or texture each day and log any changes you observe.

ACIDS vs. BASES

Acids and Bases are one of the most important sections of Chemistry and guess what? – They're everywhere! In soap, juice, batteries and food like tomatoes! So, let's learn about what acids and bases and how they are used. The first question we will try to answer is: What is an Acid? An Acid is a chemical material that is in a lot of items. Sometimes the acid can be very strong and dangerous like Battery Acid, less dangerous like lemon juice or very weak and safe like milk. The opposite of an acid is called a base. A base is also a chemical material that is in several items as well and can either be very strong and dangerous like drain cleaner or very weak and safe like sea water or eggs. Thankfully there is a scale called a pH scale and special paper called Litmus Paper that tells us when something is very safe, mild or strong and very dangerous. The most important skill you can learn today is to ALWAYS ask an adult which ones are safe to use, and which ones are not!

Do you know Stephanie Kwolek?

Stephanie Kowlek is the amazing person and chemist who invented Kevlar! That's right – the very tough plastic that protects our fine police officers & phenomenal U.S. Military members from injury. To learn more about this amazing scientist go to: www.sciencehistory.org/historical-profile/stephanie-l-kwolek for more information.

Post Experiment Questions for Adults to ask:

1. How long did it take before you noticed any changes?
2. What happened to the bones?
3. What differences did you see in color?
4. What difference did you see in texture?
5. Did you notice anything around the inside of the bowl?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. This may take a couple of days before your student notices any changes. The changes may be small – but that is okay. A student noticing small changes has an eye for detail. That is a great skill to possess!
2. Your student may first notice puddles of oil at the top of the vinegar.
3. The bones may begin to appear grey in color.
4. The bones may begin to look rough on the surface.
5. There may be a collection of white film on the side of the bowl. This is calcium.

Draw your own conclusion:

Vinegar is considered a strong acid with a pH around 2.5. Vinegar is used many helpful ways from canning to make pickles to cleaning your kitchen counters!
Sodas, pops, etc. are also very acidic substances with pH levels ranging from 2.3 – 3.0. The chicken bones are made with a lot of calcium as are your teeth. After watching what vinegar did to the bones in this experiment; what do you think would happen to your teeth after years of drinking an acidic substance like soda?
Take some time to talk to your dentist and your doctor about the impact of drinking too much soda has on your teeth and your body.

Expansion Experiments:

Try the same experiment – but this time use soda or a variety of sodas. If you take the time do this experiment – make sure to take pictures and record the results. You might be able to display your results at a science fair! We would love to hear about your efforts with this experiment – so make sure to tell us what you learned.

Log your work:

It's worth a try!

This is a fun experiment to write about. We know that it may seem boring at first and the changes are small; but you learn so much from watching small changes.

Real World Application:

Bone Health

Dental Health

Medicine

Digestion

pH

Acid vs. Base

Chemistry

Additional Resources:

https://easyscienceforkids.com/acids-and-bases/

https://scienceexplorers.com/teaching-children-about-acids-and-bases/

Musical Glasses

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Physics

Music

Geology

Age Group

All

Cost

Less than (<) $10

Time

45 minutes

Materials

A Variety of water / wine stemmed glasses. glasses work better); Water, Food dye to color the water is optional. If the student has physical limitations - a small metal spoon works perfectly.

Safety

Adult Supervision Necessary

IEP Goals

Academic

Motor

Question:

How and what makes a glass "sing"?

Hypothesis:

Before you start your experiment, can you predict the answer to the question? Write down your hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. First, fill your water glasses with varying amounts of water. Just make sure to leave one of your glasses empty.
4. Carefully, place the glasses on a surface that you don't mind getting wet.
5. Next, dunk your finger in the water and while pressing gently; trace the rim of the glass.
6. Continue tracing finger around the rim of the glass while trying to pick up a little speed. Be careful though, this is a glass and you don't want it to break.
7. If you're not hearing any sound, try moving the glass to a different surface and see if that helps. You can also hold the stem of the glass while tracing the rim.
8. Once you have the hang of it, try making music using the other glasses with varying amounts of water.
9. Don't forget to try and make music with the empty glass.
10. If you need a little assistance, you can use a small metal spoon to gently tap the glass.

The Speed of Sound

Think about it!

Did you know that sound can travel at about 1.4 meters per second through water and about 4.5 meters per second through glass? Changing the amount of water in the glass allows the pitch to change. The motion of running your finger over the rim of the glass is known as Slip-Stick Motion. This motion occurs when two surfaces are alternating between sticking and sliding and have a change in the force and friction. Slip-Stick motion occurs in a variety of ways ranging from the simple action of drawing a bow across a violin, stepping on the brake in a car or even in fractures deep underground that cause the Earth to quake!

Musical Glasses

Post Experiment Questions for Adults to ask:

1. Why do you think the different glasses have a different sound or pitch?
2. Do you think the pitch or sound is dependent upon how much water is in the glass? Ex. Less water higher pitch; more water deeper tone.
3. Why do you think tracing the rim of the glass with your finger creates a musical tone?
4. Did you observe and changes in the appearance of the water while you were making the glass sing?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The sound the glass makes depends upon how much or how little water there is in the glass.
2. The pitch or sound is dependent on the volume of water in the glass. The less water, the higher the pitch. More water the lower the pitch.
3. By tracing the rim of the glass, you create a type of friction called slip-stick motion. This slip-stick motion causes the glass to vibrate and the vibrating glass affects the air inside the glass to create waves of pressure that we call sound.
4. It is possible to observe a change in the water inside the glass. The water appears to shiver and stop and then shiver again.
5. If your hypothesis was correct, congratulations! If not, don't worry and keep trying!

Draw your own conclusion:

There's a famous, classical book that was written over 150 years ago by Jules Verne called Journey to the Center of The Earth. While the book was purely science fiction; it does inspire some to learn more about what is deep inside the Earth. We want you to take a journey as well – to your local library. Here you will find how earthquakes are created and learn more about the role that Slip-Stick motion plays in their creation. What a great science fair topic! Oh… a don't forget to pick up a copy of Journey to the Center of the Earth! Jules would be proud!

Expansion Experiments:

Expanding on this experiment can be very interesting. Try changing the glasses that you use as well as the liquid. For example, try using Jell-O instead of water or a large water glass instead of a wine glass. Tell us what you discover at: www.startingwithstem.org.

Log your work:

It's worth a try!

Logbook Tip:

Record your observations regarding changes in tone and if the water appears to vibrate or shiver.

Real World Application:

Music

Engineering

Mechanical Engineering / Automotive Engineering

Sonar

Seismology

Tectonics

Additional Resources:

https://www.scientificamerican.com/article/singing-glasses1/

Why Do Tectonic Plates Crash and Slip? by Baby Professor

The Incredible Plate Tectonics Comic: The Adventures of Geo, Vol. 1 by Kanani K. M. Lee (Author), Adam Wallenta (Author)

Nature is Calling

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Ecology

Age Group

2-7

Cost

Less than (<) $5

Time

1 hour

Materials

Access to Large Trees, Compass, Pencil or Colored Pencils, Paper or Notebook

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Question:

How can you find North in nature? Is it accurate?

Hypothesis:

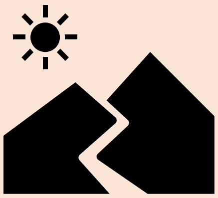
Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together. You can either use an app on your phone for a compass or find one in sporting goods store.
2. Review all Safety Precautions.

3. Use your compass to identify North, South, East and West.
4. Find a large tree that is nearly straight up and down – or nearly vertical. If you don't live near many trees – don't worry. You can apply the same procedure to buildings.
5. Find the North side of the tree or building.

6. Try to find moss on the tree or building and remember moss comes in a variety of colors like grey, orange, yellow, blue or pale green.
7. Take pictures of each side of the tree or sketch pictures of each side in your notebook.
8. How much moss is on each side of the tree or building? Indicate this in your notebook.
9. Now find at least two more trees or buildings and repeat the same procedures above.



Orienteering

Have you ever heard of this unique and fun sport? Orienteering is an activity that challenges you to find your way through a variety of checkpoints by only using a map and a compass. That's right… no phones, no apps to guide you left or right; all you have is a paper map and a compass for your guide. Do you think you could that? We bet you could once you learn how. Make sure to look at the Additional Resources section for books and websites to help you navigate your way to learning how to navigate. It's a skill that you will not regret learning. There are boys' and girls' clubs that teach orienteering and offer merit badges for this activity. Make sure you do this event with an adult nearby and never go alone.

Post Experiment Questions for Adults to ask:

1. Do you notice a pattern or similarities between all the trees/buildings? Was there moss on the North side of every tree / building you studied?
2. How do you think moss growth can help indicate direction?
3. Why do you think moss grows mainly on the North side of the tree / building?
4. Why do you think there is less or no moss on the South side of the tree / building?
5. Does moss ONLY grow on the North side of trees / buildings?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. You should notice there is greater presence of moss growing on the North side of trees / buildings. There may not be moss growing on the North side of every tree or building or there might be moss growing on every side of the tree or building – it all depends on how much moisture there is in that area.
2. The presence of moss can give you hint of a northerly direction – but it is not foolproof.
3. The North side of a tree / building is usually protected from the bright southerly sunrays; so, moss has an increased chance of growing on the shady North side of a tree or building.
4. If you're in the Northern Hemisphere – the sun shines mainly from the South and moss prefers to grow in conditions that are not as sunny.
5. No, moss can grow anywhere the conditions allow it to grow; that's why using a compass for direction is far more accurate than moss on a tree or building.

Draw your own conclusion:

The United States of America is in the Northern Hemisphere; which means it is above the Equator. In Northern Hemisphere countries, moss grows mainly on the North side of trees. But what if you were in Australia? Australia is in the Southern Hemisphere; so, where do you think moss mainly grows in countries that are in the Southern Hemisphere? Why?

Expansion Experiments:

Besides moss on the north side of the trees and buildings; do you notice any other vegetation that grows more on the North side than the South side? Take pictures or sketch a drawing of what you see. You don't have to touch the vegetation – just record what you see and show a parent.

Log your work:

Absolutely!

Tell us about how you did by going to www.startingwithstem.org

This experiment is a great opportunity to combine science and art while logging your efforts!

Real World Application:

Ecology

Navigation

Orienteering

Geography

Additional Resources:

www.orienteering.org

Follow That Map!: A First Book of Mapping Skills (Exploring Our Community) by Scot Ritchie

The Lost Art of Reading Nature's Signs: Use Outdoor Clues to Find Your Way, Predict the Weather, Locate Water, Track Animals—and Other Forgotten Skills by Tristan Gooley

'Petri'fied of Bacteria?

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Biology - Microbiology

Medicine

Age Group

8-11

Cost

Less than (<) $10

Time

Ongoing Activity (more than one day)

Materials

Small Pot, 2 pkgs. Gelatin, 1 pkg Beef Bouillon, 1 tsp of sugar, 1Cup of Boiled Water, Q-tips, Aluminum Baking Cups, Plastic Sandwich Bags, Measuring Spoons; Mixing Bowl, Yogurt

Safety

Adult Supervision Necessary

Heat involved - Use extra caution

IEP Goals

Academic

Behavioral

Motor

Question:

Can you observe the growth of bacteria?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Pour 1 cup of water into the small cooking pot and bring to a boil.

4. While the water is warming, in a mixing bowl mix together: 2 pkgs of gelatin, 1 teaspoon of sugar, 1 package of beef bouillon.
5. After the water has boiled; let it cool slightly and then add to the gelatin mixture and stir until the gelatin is completely dissolved.

6. Place your Aluminum Foil Baking Cups onto a plate. Next spoon equal amounts of the gelatin liquid into the cups until they are filled ¼ of the way.
7. Cover the cups with plastic and place the gelatin cups inside the refrigerator and leave overnight.

8. After the gelatin cups are solid, take them out of the refrigerator. Next, using a clean Q-Tip – dip it in the yogurt you plan on sampling. You don't need a lot; a very small amount will work.

9. Using the same Q-Tip you just dipped in the yogurt; gently rub it back and forth along one of the Gelatin Cups. Throw the Q-Tip away.
10. Take a clean plastic bag and label it as "Yogurt A," and place the gelatin cup in the plastic bag.

11. You can repeat this process for other types of yogurt if you wish; just make sure to properly mark each of them and never use reuse a Q-tip.

'Petri'fied of Bacteria?

Post Experiment Questions for Adults to ask:

1. Which gelatin cup / surface had the most bacteria form?
2. Which gelatin cup / surface had the least bacteria form?
3. Where you surprised by the results? Why / Why not?
4. Why are bacteria obvious after it's been on a gelatin cup and enclosed in a plastic bag for 4-6 days?
5. Why do you think the bacteria is less obvious on the surfaces you sampled?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary depending on the samples taken.
2. Answers will vary depending on the samples taken.
3. Answers vary.
4. Bacteria is 0.2 to 10 micrometers. In comparison the diameter of a human hair is 40 to 120 micrometers. Bacteria is just too small to see with the naked eye; that is until you begin growing it and it turns into what is called a "Colony." The Petri dish you made provide the bacteria an opportunity to grow enough to the point it was visible by us.
5. As we mentioned above, bacteria are too small to see with the naked eye. In order to discover exactly what type of bacteria may be on a surface; you must grow a large amount.

Think about it!

Draw your own conclusion:

The Petri Dishes that you created are called, "growth mediums" or "culture mediums." Scientists use these specifically to grow microorganisms such as bacteria. The Petri Dish was invented by German microbiologist Julius Richard Petri in 1887. His invention has aided scientists for over a 130 years and we want you to tell us how. This is a scientist who change medical history by making bacteria bigger. Here are a couple resources to help you learn about this stupendous scientist!
https://thebiomedicalscientist.net/science/big-story-petri-dish
https://blog.nationalgeographic.org/2013/05/31/celebrating-julius-richard-petri-a-man-a-dish-a-google-doodle/

Expansion Experiments:

This experiment is perfect opportunity to learn more about microbiology and bacteria. There are 10,000 known species of bacteria and perhaps more waiting to be discovered – perhaps by you! Here are fantastic resources to explore the 'Petri'fying world of bacteria: www.easyscienceforkids.com & Virus vs. Bacteria: Knowing the Difference by Baby Professor.

Log your work:

Absolutely!

Logbook Tip: This is a fantastic opportunity to log your work! First, in your logbook you can indicate how many bacteria samples you gathered. Next, make sure you label and number each one. Then, make a daily record of what each sample looks like. Five days is plenty. Finally, draw a conclusion about those samples and share them with us at: www.startingwithstem.org

Real World Application:

Microbiology

Lab techniques

Medicine

Research Techniques

Additional Resources:

The Sci Guys You Tube videos are fantastic! Here is one with bacteria: https://www.youtube.com/watch?v=yY8STATjZ6U

The Magic School Bus Fights Germs by Kate Egan & Carolyn Bracken

The Bacteria Book: The Big World of Really Tiny Microbes by Steve Mould

Ocean in a Bottle

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Biology - Marine

Chemistry

Age Group

All

Cost

Less than (<) $5

Time

30 minutes

Materials

Clear Water Bottle or Soda Bottle; Blue Food Dye; Oil

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Motor

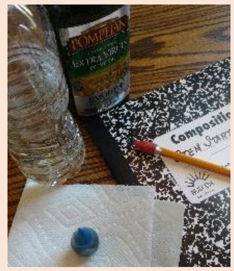
Question:

Why doesn't oil dissolve in water?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:



1. Gather all your materials together.
2. Review all Safety Precautions.
3. Fill clear water bottle halfway with water.

4. Add a couple of drops of blue food coloring, place the cap back on and shake the water bottle.
5. Now add some oil. Any type of oil is fine and add just enough to add a thin layer on top of the blue water.

6. Replace the cape on the bottle and tighten.
7. Shake the bottle and observe.
8. Observe.
9. Allow the water and oil to settle.

10. Observe.

Have you ever heard the old English Proverb?

Think about it!

"Oil and water don't mix."?

Do you know what it means?
If you do, tell an adult what you think it means.
If not, don't worry; just take a moment to research the meaning of this old phrase.
Believe it or not, it's based on a very scientific observation.

Ocean in a Bottle

Post Experiment Questions for Adults to ask:

1. What happened when you added the blue food coloring to the bottle of water?
2. Why did the blue food coloring mix completely with the clear water?
3. What happened when you added the oil to the bottle of blue water? What happened when you shook the bottle? Did the oil mix with the water?
4. Why did the oil float on top and not mix with the water as well as the blue food coloring?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The blue food coloring / dye mix with the clear water.
2. When water boils it has energy because it's hot. Even though the water in the bottle isn't boiling – it still has energy and the water is moving. This energy pushes the food coloring around and spreads it out that's why the water goes from clear to blue.
3. The oil floats on top and doesn't spread out. When you shake the bottle of blue water the oil breaks into what appears to be small round bubbles; however, it never completely mixes with the water. After the water is calm – the oil floats to the top & reforms a layer.
4. Water is amazing! It's also a "polar" molecule which means it is negatively charged. Water likes to bond to molecules; however, oil is a "nonpolar" and is happy being by itself and not bonding to other types of molecules. Oil is also less dense than water. The molecules that make up oil are larger than the molecules that make up water – that's why they float.
5. Right or wrong – We are very happy you tried! Keep up the good work!

Draw your own conclusion:

Will food coloring mix faster in cold water, room temperature water or hot water? Why?
You already know that oil at room temperature that is in liquid form will float. What about oil that is frozen? Will the oil float or sink? Why or why not?

Let us know at: www.startingwithstem.org.

Expansion Experiments:

After you complete the above experiment; open the water bottle and add a few drops of liquid soap to the mixture in the bottle. Make sure you are watching the reaction when the soap interacts with the oil. What happens? Why do you think this occurs? Let us know at www.startingwithstem.org

Log your work:

Absolutely!

Make sure to write down your hypothesis and observations; particularly after you add the blue food coloring and the oil.

Real World Application:

Oil Spills & Clean up

Density

Polarity

Buoyant Force

Additional Resources:

Oil Spill! by Melvin Berger (Author), Paul Mirocha (Illustrator)

https://sciencing.com/oil-spill-information-kids-5444185.html

https://stemactivitiesforkids.com/2016/04/22/earth-day-stem-challenge/

Opaque Eggs

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Medicine

Osmosis

Age Group

5-10

Cost

Less than (<) $5

Time

Ongoing Activity (more than one day)

Materials

1 Egg (White egg or brown egg); 16 ounces of Vinegar; 1 Water glass large enough to hold the egg; Ruler, 10”-12” of string.

Safety

Adult Supervision Necessary

IEP Goals

Academic

Social

Behavioral

Motor

Question:

Why does vinegar dissolve an eggshell but not the egg?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all materials together.
   Please note experiment will take 2-3 days.
2. Review all Safety Precautions.
3. Measure the length of the egg. Take the string and measure the length of the egg from one end to the other. Hold that length next to a ruler and write this measurement down.
4. Measure the circumference of the egg. Take the string and wrap it around the center of the egg. Hold that length of string next to the egg and write that measurement down.
5. Make sure the egg doesn’t have any cracks. If it does, you will have to choose another egg to use.
6. Gently place the uncooked egg in the water glass.
7. Pour the vinegar into the glass with the egg. Make sure the egg is completely covered with vinegar. You may not use the entire 16 ounces of vinegar.
8. If the egg floats slightly, that’s okay.
9. Let the egg sit in the vinegar bath and change the vinegar bath every 24 hours.
10. Now you wait.
11. After 24 hours has passed, carefully record your observations. What do you notice? Are there any changes? Record the changes you see.

Note to Adult: You may notice some bubbling activity on the eggshell; this is normal and a good sign that the experiment is working. When you notice a white foam on the top of the surface of the vinegar – you are making progress.

12. After your egg has soaked for a day, ask for the help of an adult and carefully pour the vinegar into another cup. There will be a white chalkiness on the egg.
13. Carefully wipe the white powder off the egg. At this point you may already have an Opaque Egg. If you do, fantastic! If not, that’s okay. Just put the egg back into an empty water glass and cover the egg with vinegar and let it sit for another day.
14. After two days – your egg should be completely opaque. Remeasure the length and circumference of your egg and record this measurement in your logbook.

Opaque Eggs

Post Experiment Questions for Adults to ask:

1. What happened to the egg after Day 1?
2. Why do you think this happened?
3. When did you notice major changes to the eggshell?
4. Did the egg become larger or smaller?
5. Why do you think the egg became larger?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Your student may indicate that he/she observed bubbling on the outside of the eggshell and that there was white foam floating on the top of the vinegar.
2. Vinegar is Acetic Acid and it reacts with the eggshell that is made mostly of Calcium Carbonate. The Acetic Acid begins dissolving the Calcium Carbonate and the bubbles are from that reaction. The bubbles are Carbon Dioxide.
3. Your student should mention that the shell dissolved.
4. The egg becomes slightly larger.
5. This is because of Osmosis. The membrane of the egg is semi permeable. This means that the egg membrane allowed water (there is a little bit of water in vinegar) to move inside the egg.

Draw your own conclusion:

You just learned so many things in this one little, and simple, experiment! Let's take this a little further and see if you can guess what would happen next. You learned about Osmosis – where water travels through a semi-permeable membrane. So, what is a semi-permeable membrane?
Basically, it's a filter. A semi-permeable membrane keeps larger items out and lets smaller items pass through. Can you find items around your house that are used as a semi-permeable membrane? Think about it…
Maybe start in the kitchen.

Think about it!

Expansion Experiments:

Would you like to R E A L L Y E X P A N D on this experiment? Try this: Take the egg that you used in this experiment and place that egg inside a glass of cold water. Make sure to cover the egg with water. Now you wait. Based on what you just learned about Osmosis and Semi-Permeable Membranes; what do you think will happen to the egg?

Log your work:

Absolutely!

This is a perfect experiment to try your hand at maintaining a logbook; particularly with measuring the egg and daily observations! Don't forget; you can take pictures of your work as well and use those pictures in your logbook.

Real World Application:

Osmosis is so very important in our everyday lives! It helps with our daily absorption of minerals and nutrients that we need to survive!

Additional Resources:

The Magic School Bus: Inside the Human Body.

www.kids-fun-science.com

Repeat Yourself

Experiment Express

STEM Field of Study

Technology

Math

Specific STEM Area

Meterology

Geology

Geometry

Age Group

8-11

Cost

Less than (<) $5

Time

30 minutes

Materials

Notebook and Pencil or colored pencils

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Motor

Question:

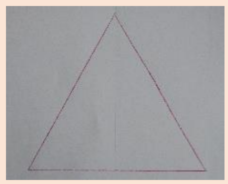
What are fractals and where are they found?

Hypothesis:

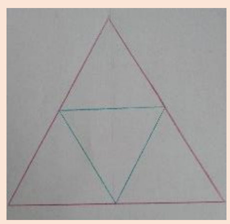
Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

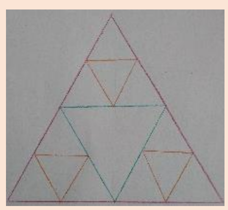
1. Gather your materials together.
2. Review all Safety Precautions.



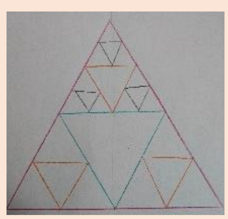
3. Draw a large triangle on your paper or in your logbook, like the on the left.



4. Now, inside the large triangle, draw another triangle.



5. Continue the same drawing pattern as shown on the left.



6. Continue drawing triangles until you can no longer draw any triangles. If you want, you may color in your design and welcome to the wonderful world of fractals!

So, what exactly is a fractal?

Here at STEM Starter we really love how The Fractal Foundation describes fractals, also known as a Sierpinski Triangle as:

> *"...a never-ending pattern that repeats itself at different scales. This property is called Self-Similarity. Although fractals are very complex, they are made by repeating a simple process."*

We highly encourage you to visit this website for more information on Fractals and Chaos Theory: www.fractalfoundation.org

Post Experiment Questions for Adults to ask:

1. Where else do you see fractal patterns like a Sierpinski Triangle?
2. How else, do you think, they are important?
3. As you were completing the experiment, did it become easier or more difficult to draw the triangles?
4. What other shapes can you use to create a fractal pattern?
5. Do you think there is a connection between Fibonacci and Fractal Patterns?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Fractal patterns can be seen all in nature. For example, tree trunks divide into branches which then separate further into smaller and smaller branches.
2. Fractal patterns help with a variety of subjects such as: nature, weather, turbulence, space, earthquakes and more!
3. Answers will vary. There is no wrong answer here.
4. Squares work wonderfully! But there really are too many to mention.
5. There is! Leonardo Pisano (Fibonacci) was working on fractals prior to developing the Fibonacci Sequence.

Draw your own conclusion:

Fractals aid us in studying crystal growth, earthquakes, meteorology, nature and polymer structures. Fractals also play an important role in Chaos Theory. What in the world is "Chaos Theory?" Glad you asked! Chaos Theory is area of Math that focuses on systems that are UNPREDICTABLE and HIGHLY SENSITIVE to very little change. No, we're not talking about teenagers… We're talking about things like weather, turbulence, plasma physics and star clusters! Keep looking into the subject of fractals. Yes, it might be hard to understand at first – but maybe YOU might be the person that makes a connection between: Chaos Theory and space travel; or Fractals and curing cancer! Just because it's hard – doesn't mean you shouldn't try. Make sure to tell us what you discovered at: www.startingwithstem.org.

Expansion Experiments:

Did you know that you can grow your own Candy Crystals? Well… you can! How AWESOME is that?! All you need is sugar, water, food coloring, mason jar (or an old Mayonnaise Jar), straw, and flavoring or edible glitter or both! To learn more about fractals & crystal growth go to www.startingwithstem for more experiments!

Log your work:

Absolutely!

Logbook Tip:

In your logbook you can draw the Sierpinski Triangle. In fact, you can draw as many as you like and in varying colors!

Real World Application:

Fractals

Geology

Seismology

Art

Nature…. There are too many to mention!!

Additional Resources:

www.fractalfoundation.org

Zoom by Istvan Banyai

Mysterious Patterns: Finding Fractals in Nature by Sarah C. Campbell and Richard P. Campbell.

Ring My Bell

Experiment Express

STEM Field of Study

Science

Technology

Specific STEM Area

Sound

Sonar

Medicine

Age Group

2-7

Cost

Less than (<) $10

Time

15 minutes

Materials

Hand bell, long pencil, bucket and water

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Social

Behavioral

Question: If you ring a bell under water, does it still make a sound?

Hypothesis: Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Have a small hand / counter bell available – like the one in the picture.

4. Before you place the bell in the bucket – ring the bell and listen closely for the ring that it makes. You can use either a finger to ring the bell or a pencil.
5. Place the bell in the empty bucket and ring the bell. You can ring it several times if you like. Again, listen closely to the sound it makes.
6. Now fill the bucket full of water.

7. Gently place the bell in the water
8. Now, try and ring the bell.

Think about it!

What is Sonar?

Let's answer that question with another question. Imagine you were blindfolded in a dark room; how would you find your way around the room? You would probably move slowly & put your arms out in front of you to make sure you didn't bump into anything. You also might put your foot out in front of you to feel for a sturdy floor to make sure you didn't fall. Sonar works the same way for submarines, but instead of using hands and feet – the subs use sound. When the sound bounces back – the submarine knows something is in their way. When animals use sound, it's called Echolocation!

Ring My Bell

Post Experiment Questions for Adults to ask:

1. Do you notice a difference between ringing the bell outside of the empty bucket and ringing the bell inside the empty bucket?
2. Why do you think there is a difference between the ring inside and outside of the empty bucket?
3. Do you notice a difference between ringing the bell in the empty bucket and ringing the bell when it is under water?
4. Why do you think there is a difference between the ring in the empty bucket and when the bucket is full of water?
5. Is sonar used only by boats and fish and bats?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. This might be difficult for the student to answer depending on the bucket that is used. They may not hear a difference or the difference in sound may be very slight. It's okay if they say either Yes or No.
2. If they hear a difference – that's great. They may say the ring sounds softer or perhaps the ring doesn't last as long. The sound is travelling towards the side of the bucket and bouncing back so they may hear additional vibration.
3. Yes. Here you would expect them to say Yes. There is a distinct difference between ringing the bell out of the water and in the water.
4. The water is muffling the sound of the bell therefore it's harder to hear. Water is denser (think and compact) than air. The sound of the bell should sound blunt and short. The distortion of sound is from when the waves hit the less dense are and bend.
5. Nope! People use special sonar equipment in medicine too! Go to the next section to learn more!

Draw your own conclusion:

Can you think of where sonar is used to help people? Sonar was invented in 1906 by American Naval architect Lewis Nixon. He invented the first sonar equipment to help ships locate icebergs in the ocean. But what about sonar in medicine? Can you think of where and when sonar is used in a hospital?
We'll give you a little hint: It is used for a baby's very first picture!!

Expansion Experiments:

Ask a parent or guardian if they have your baby ultrasound pictures – then look at some online or in the library! Thanks to the science of sonar and Lewis Nixon – we can see babies before their born! You can also use sonar to look at your internal organs! WOW!

Log your work:

Go for it!

This is a great opportunity to write down your observations! Remember, even the smallest change can make a difference!

Real World Application:

Sonar

Marine Biology

Military: Naval Submarine

Maritime

Medicine

Zoology

Echolocation

Additional Resources:

Magic School Bus: Going Batty

www.accousticalsolutions.com

www.teacher.scholastic.com

https://kids.kiddle.co/Sonar

https://pbskids.org/video/

Salt versus Ice!

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Age Group

2 - 7

Cost

Less than (<) $5

Time

30 minutes

Materials

Two Plates

Ice Cubes

Salt

Safety

It's always nice to have an adult standing by for help.

IEP Goals

Academic

Behavioral

Motor

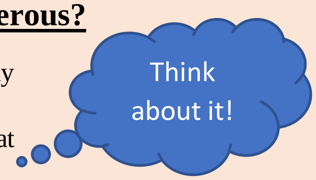
Question: How does salt help melt ice?

Hypothesis: Before you start your experiment, can you predict the answer to the question above? Make sure to write down your hypothesis in your logbook.

Instructions:

1. Gather all of materials together.
2. Review safety precautions with an adult.
3. Place a 1 ice cubes on each plate. (A small handful of crushed ice cubes also works) Ensure the same amount of ice on each plate.
4. Measure about a tablespoon of salt.
5. Now you're ready to do your experiment. However, before you pour the salt onto the ice, can you guess which one will melt first?
6. Pour salt over just one of the plates with ice. Try to do an even layer over the ice. Now watch. Make observations along the process of what you see!

What is Clear Ice and why is it so dangerous?



Clear Ice (also known as black ice); is an extremely dangerous condition where water freezes on the roadways and it's so clear that drivers can't tell that roads are icy. Thankfully, there are men and women who work extremely hard to eliminate clear / black ice from the roads, so drivers and their passengers remain safe.

Clear / Black Ice forms when the air temperature is warmer than the pavement and this allows ice to melt and refreeze to a thin, nearly transparent, layer of ice. The Department of Transportation can use different forms of deicing chemicals to help prevent and or remove ice from the roadways and salt, or its fancy name *Sodium Chloride*, is just one of the chemicals they can use. We want you to *Think About It* and learn more about how the Department of Transportation in your state works so hard to protect your family from dangerous clear / black ice. Then tell us what you learned! Send us your results and finding to: www.startingwithstem.org

Salt versus Ice!

Post Experiment Questions for Adults to ask:

1. Which melted first?
2. Why do you think the one with salt sank first?
3. Which took longer melt?
4. Why do you think the one without salt melted slower?
5. In the winter, if you salt the roads/sidewalks will the snow melt faster?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The ice that salt was added to will melt first.
2. Adding salt to the ice creates what is called a solution. A solution has a lower freezing point (a temperature where the solution freezes) than pure water. Therefore, at the same temperature, the ice with salt will melt faster.
3. The pure ice will take longer to melt.
4. The pure ice took longer to melt because it has a higher freezing temperature. Pure water freezes at 32°F or 0°C. A solution could have a freezing point of 30°F or -1°C. So, at the same temperature the pure water will melt slower.
5. The snow will melt faster! We are making a solution by adding salt to the snow.

Draw your own conclusion:

Now it is your turn to tell us what you think about the change in the freezing point from a solution. Why do you think it's important to know that the freezing point changes? Do you think the boiling point of a solution would change also? Do you think the boiling point would be higher or lower? (Hint: why do we salt the water when cooking pasta?)

You can tell an adult, a teacher, or us what you learned about the melting point of a pure substance verses a solution. Log on to www.startingwithstem.org to tell us what you learned. We can't wait to hear from you!

Expansion Experiments:

As an expansion experiment, place a small fan next to the ice, add salt and then turn the fan on. Do you think the ice will melt faster or slower because you applied the movement of air over the salted ice? Try using varying speeds on the fan. Does it accelerate the melting process or does the water begin to refreeze?
Additionally, you could also use different items to melt the ice. For example, Sugar, Baking Soda, Spices and Vinegar. Remember to use new ice every time you use a new item for melting. Make sure to log everything in your logbook and tell us all about your efforts at: www.startingwithstem.org.

Log your work:

You absolutely can!

Logbook Tip:

In your logbook you can indicate how long it took each pile of ice to melt. Simply record the time. Additionally, you can either take a picture of your experiment, like we did, or you can draw your experiment. Show us your results at: www.startingwithstem.org

Real World Application:

Weather

Cooking

Thermodynamics – study of the transfer of energy through heat.

Road Maintenance

Additional Resources:

http://www.espsciencetime.org/SaltandIce.aspx

https://littlebinsforlittlehands.com/20-melting-ice-science-sensory-play-activities/

Freezing and Melting by Robin Nelson

The Science of Safety

Experiment Express

STEM Field of Study

Science

Technology

Engineering

Math

Specific STEM Area

Safety

Chemistry

Age Group

11+

Cost

$0 - $5

Time

Ongoing Activity (more than one day)

Materials

Notebook, Pencil, Access to the Internet or Library to obtain Safety information.

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

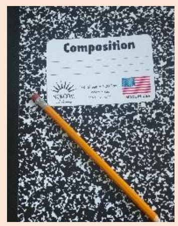
Question:

How can science and safety help me:

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:



1. Gather all your materials together.
2. Review all Safety Precautions.
3. Research the pictograms that are used to identify various hazards. We have pictured some more common hazard pictograms on the left.

Have you ever seen these symbols before?

4. WITH AN ADULT - Try to identify various examples of cleaning products, outdoor lawn and garden treatments with the same pictogram that you found. Remember, you must be with an adult and DON'T touch any of the products!

5. WITH AN ADULT - Try to identify what dangers they may pose.

Think about it!

The Science of Safety is such an important topic – particularly when it involves conducting experiments in a Lab. As you progress through your education and should you decide to take Science courses you will at some point find yourself in a laboratory. Safety in a lab is of paramount concern for educators and if you are not prepared for the hazards that exist you could easily be hurt. Learning about safety may be boring and at times tedious; however, the old saying, "An ounce of prevention is worth a pound of cure," is very applicable when it involves safety in Lab.

Post Experiment Questions for Adults to ask:

1. What type of pictograms did you discover around your home?
2. What hazard do you think these pictograms represent?
3. Do you feel the pictogram accurately represents the type of hazard it is? Why or Why not?
4. What are some the easiest safety precautions you can take in your home?
5. If you see a pictogram and aren't sure what it is or what hazard it represents, what should you do?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary. If you didn't find any pictograms around your home – look around your community.
2. Answers will vary.
3. There is no wrong answer here. The main purpose of the question is to engage in a conversation.
4. Having a household fire extinguisher. Knowledge of how to escape your home if there is a hazardous situation. Having smoke / carbon monoxide detectors.
5. Always talk to an adult that you trust for help and guidance.

Draw your own conclusion:

Let's investigate the future and think about future classes that you might take when you're in High School. What we want you to do is imagine for a moment the safety concerns and safety precautions that you will have to take when you are taking: Biology, Chemistry or Physics. We know that this might be difficult to imagine right now – but try. What type of experiments do you think you may do in each of those subjects and then develop a list of safety equipment you would expect to see in the laboratory? Make sure to use your resources! Do you know an adult who took science in high school? Ask them what type of hazards are in a lab and what type of safety precautions students must use to avoid accidents.

Expansion Experiments:

Did you identify some hazards in this experiment?
Well, here is your chance to help protect yourself, your friends and your family. First, tell an adult. Then, identify the hazard to the adult. Next, develop a plan with the adult to make sure the hazard will not harm anyone else. Finally, tell us what you did and how you made your home, school or environment safer! We would love to hear about it at: www.startingwithstem.org

Log your work:

It's worth a try!

Logbook Tip:

Try sketching the Hazard Pictograms in your logbook and recording the hazard that they represent. Also, you can make a list of the safety precautions you use in your home to protect your family!

Real World Application:

Any and all work and home environments where hazardous materials are present. The Science of Safety truly impacts our daily lives and it is one of the most important subjects that we cover at STEM Starter!

Additional Resources:

American Chemical Society

www.sciencebuddies.org

Science Safety Rules by Kelli Hicks

Searing the Senses

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Food Science

Biology

Age Group

11+

Cost

Less than (<) $10

Time

45 minutes

Materials

Paper Towel or Napkins; Frying Pan; Cooktop; Two Hot Dogs Split in Half – you could also use steak or chicken for this experiment.

Safety

Adult Supervision Necessary

Heat involved - Use extra caution

IEP Goals

Academic

Behavioral

Motor

Question: How does cooking affect the senses?

Hypothesis: Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Open package of Beef Hot Dogs and allow an adult to split the hot dogs in half.

4. After the hot dogs are split in half, take paper towel and pat dry only one of the hot dogs in order to reduce any moisture on the hot dog.
5. Place your frying pan on the stove and turn stove on to a medium heat. You are only going to cook one hot dog at a time.

6. Take the hot dog that you patted dry and place it in the hot pan to cook. This should only take a couple of minutes. If you choose to cook steak or chicken, this will take longer. While the hot dog is cooking, make sure to observe how it is cooking. Use some of your senses, what do you see, hear or smell?

7. After the hot dog is cooked, have an adult place the hot dog on a plate and allow it to cool & have an adult carefully wash the frying pan.

8. Now repeat the cooking process using the hot dog that you didn't pat dry. Place the frying pan on the stove, turn the heat on to a medium heat and cook for a couple of minutes. Make sure to cook the 2nd hot dog for the same amount of time as the first one. If you cooked the first hot dog for 5 minutes - then you must cook the 2nd hot dog for five minutes. Again, make sure to use your senses, what do you see, hear or smell?

After the hot dog is cooked, place it on the plate with the 1st hot dog you cooked and allow it to cool. Now comes the fun part! Time to use your senses one more time to tell the difference between the two hot dogs. Do you see, smell or taste a difference?

Searing the Senses

Post Experiment Questions for Adults to ask:

1. What difference did you see between the two hot dogs?
2. Did the hot dogs seem to cook differently?
3. Did the hot dogs smell different?
4. Did the hot dogs taste different?
5. Was there a difference in texture between hot dog 1 and hot dog 2?
6. How important were your five senses: sight, sound, taste, smell and touch for this experiment?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. One hot dog may appear more burnt, black or crispy than the other.
2. The dried hot dog may have cooked quicker that the other hot dog. There may have been more sizzling from the 2nd hot dog which was the water heating and evaporating.
3. There may not be a difference in smell or at the very least a minimal burnt smell.
4. One hot dog may be juicier than the other. The water droplets on the hot dog that was not dried formed a layer between the hot dog and the hot pan; so, when the water from the hot dog hit the pan it evaporated immediately. However, with the dry hot dog, the actual meat contacted the hot pan and formed a caramelization on the hot dog and that allowed the meat to hold moisture in and made the hot dog juicier and less dry.
5. One hot dog may appear more burnt or wrinkled than the other.
6. Senses are extremely important in experiments – and life! It's our senses that allow us to notice small changes and help guide us in learning more about science!

Draw your own conclusion:

What would happen if you redid this experiment, however, this time before you taste the hot dogs – you hold your nose. Do you think the hot dogs would taste: better, the same, worse or there wouldn't be any taste at all? Try it and let us know what happens!

Expansion Experiments:

Try the same experiment again, but this time cover your ears with earmuffs. Do you notice a change in your other senses? Did your sense of smell become stronger?

Log your work:

Not at this time. Just have fun!

Real World Application:

Change of phases

Gastronomy

Senses and Scientific Observation

Additional Resources:

The Magic School Bus Explores the Senses

https://www.sciencebuddies.org/science-fair-projects/project-ideas/cooking-food-science

Shape Shifter

Experiment Express

STEM Field of Study

Math

Specific STEM Area

Geometry

Visual Math

Spatial Awareness

Age Group

2-7

Cost

Less than (<) $10

Time

About 1 hour

Materials

Construction Paper or wrapping paper.

Scissors

Glue

Poster Board or Cardboard

Safety

It's a good idea to have adult supervision, particularly when using the scissors.

IEP Goals

Academic

Motor

Question:

What are tessellations and how are they used? Where are they seen in nature?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together for the experiment.
2. Pick your favorite color or colors of construction paper or wrapping paper. You can also use brown paper bags or tissue paper.

3. Now pick your favorite shape. Here we used a diamond shape; however, you can use any shape you like.
4. Now it's time to cut out your shape. Try to cut out as many shapes as you can and try to keep them all the same size. This might be a good time to use the help of an adult.
5. You can cut out the same shape in different colors or patterns if you want.
6. Arrange the shapes so that only the flat edges touch. Here we did a star pattern; but you can do what ever shape you wish if the shapes are close together without gaps or they can be overlapping. What you just created is called a tessellation.

The word tessellation is a very… very … old word! The word tessellation means to cover an area with a pattern of repeating shapes – usually squares / polygons. But the word tessellation comes from the small Latin word "tessella" which means small cube or square.

The next time you're at the library look for books on tessellations! Then let us know what book you found at: www.startingwithstem.org ! You can also share your design from this experiment. We would love to see your tessellation creation!

Shape Shifter

Post Experiment Questions for Adults to ask:

1. Where else do you see tessellations?
2. Can tessellations occur in the nature?
3. If so, where?
4. What about animals; is it possible that tessellations can occur in the animal kingdom as well?
5. If so, where?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. You can see tessellations in buildings that use mosaics, tile work and bricklaying.
2. Absolutely!
3. You can see tessellations in pineapples, bark and in special locations like the Giants Causeway in Ireland. The Giant's Causeway is a bed of hexagonal columns that formed from crack molten lava!
4. There are tessellations in the animal kingdom also!
5. You can see tessellations in snakeskin, butterfly wings, turtle shells and beehives just like the one in this picture!

Draw your own conclusion:

Where else do you see tessellations?

Can you see tessellations in material / fabric?

What about quilting; do you think there might be tessellations in a quilt?

Expansion Experiments:

Why are tessellations important?

Tessellations are particularly helpful because they help students recognize the importance of math within the world of art. Try to identify tessellations within your community - they are all around you! Wallpaper, brick and tile work, mosaics, animals and nature. Record what you see and let us know about it! We can't wait to hear from you!

Log your work:

You absolutely can!

In this book we provided a sample log sheet that you can duplicate & reuse for all the experiments in this book. You can also go to:

www.startingwithstem.org

and download a log sheet.

Real World Application:

Masonry Work

Sewing / Clothing Designing

Interior Decorating

Mosaic Tile work

Spatial Awareness

Natural Exploration

Additional Resources:

https://www.mathsisfun.com/geometry/tessellation.html

Here is a book to help get you started on your next tessellation activity:

Tessallation!: A Children's Picture Book with Tessellations by Emily Grosvenor

Sink or Swim

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Physics

Age Group

2 - 7

Cost

Less than (<) $5

Time

30 minutes

Materials

One glass of cold water; two small metal paper clips; A soapy sponge.

Safety

It's always nice to have an adult standing by for help.

IEP Goals

Academic

Behavioral

Motor

Question:

Is it possible to make a paper clip float?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

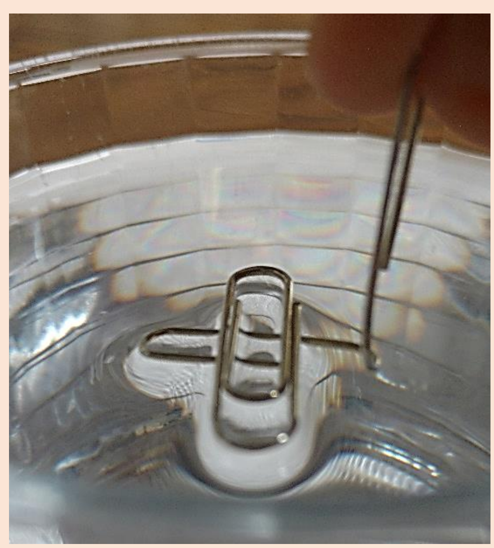
Instructions:

1. Gather all of materials together.
2. Review safety precautions with an adult.
3. Fill a glass with cold water.

4. Try floating the paper clip on top of the water just by using your hands. You may be able to do this without following the next few steps. If you can't, proceed to Step 5.
5. Take one of your paper clips and bend the center loop upwards. Refer to the third picture for assistance. You are trying to create a handle in order to hold another paper clip.

6. Gently place the second paper clip on the first paper clip.
7. Gently and slowly lower the paper clip in the water. Once the unbent paper clip is in the water, gently pull your paper clip handle away to allow the unbent paper clip to float.

8. Using your Q-Tip; gently dip one end of the Q-Tip near the floating paper clip. Observe.
9. Now, using your paper clip handle try raising the floating paperclip up slightly. Observe. Go to Expansion Experiment for fun addition to this lab!



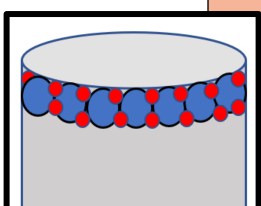
Sink or Swim

Post Experiment Questions for Adults to ask:

1. Why do you think your paperclip floated on top of the water?
2. Did you feel any resistance or a pulling when you tried to place the paperclip in the water with your hand? What about when you used the paper clip?
3. What happened when you used the Q-Tip and gently dipped it into the water near the paperclip?
4. What happened to the paperclip in the water when you gently raised it using the other paperclip? Did you feel any resistance when you tried to raise the paperclip?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:



1. The paper clip floats due to surface tension of water. The ingredients that make water create what is called a water molecule. There are ALOT of water molecules in one glass of water. On the very top of the water, where the water meets the air, there is a layer of water molecules that form a type of skin. This water skin can act like a trampoline and stretch in all directions while holding the weight of the paper clip and stop it from sinking.
2. You may feel some tension or pulling while placing the paper clip on the water while using the other paperclip.
3. The paper clip may move slightly; however, the paperclip shouldn't sink.
4. You may be able to notice the water adhering to the paperclip and stretching as you gently try to raise it. You may feel some resistance.
5. Answers will vary. If your student guessed correctly, congratulations! If not, don't worry, there are many more experiments to try.

Think about it!

Draw your own conclusion:

Have you ever seen water droplets bead on a car after the car has been washed and waxed? Why do you think this occurs?

Expansion Experiments:

Since you were able to make the paperclip "swim," let's see if you can make it sink. While your paperclip is still floating, take the soapy sponge you made up prior to starting your lab and observe what happens when you gently squeeze a drop or two into the glass of floating water and AWAY from the paperclip. Don't squeeze soapy water directly on the paperclip. Why to you think the paperclip reacted this way? Let us know at: www.startingwithstem.org

Log your work:

You absolutely can! In this book we provided a sample log sheet that you can duplicate and reuse. You can also go to:

www.startingwithstem.org and download a log sheet.

Real World Application:

Surface Tension

Tensile Force – which also means tension

Hydrodynamics – the study of forces acting on or exerted by fluids or liquids.

Additional Resources:

The Magic School Bus: Ups and Downs - A Book about Floating and Sinking

www.coolkidfacts.com/sink-and-float-facts-for-kids/

Sweet and Soluble

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Chemistry

Pharmaceutical

Age Group

5-7

Cost

$0 - $5

Time

15 minutes

Materials

You can use one of the following: lemonade mix; sweet tea mix or crystal light. You will also need to large clear pitchers or glasses and 2 spoons and cold and warm water.

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Social

Behavioral

Motor

Question:

Will sugar dissolve faster in cold water or warm water? Why?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all of your materials together.
2. Review all Safety Precautions.
3. Mark one pitcher or glass “Cold.”
4. Mark one pitcher or glass “Warm.”
5. Fill “Cold” water pitcher or glass with enough cold water to add your drink mix.
6. Add the drink mix to the “Cold” water pitcher / glass.
7. Add the same amount of drink mix to the “Warm” pitcher / glass.
8. Stir both pitchers / glasses for 30 seconds.
9. Observe, taste and record.

Think about it!

Why is this experiment important?

Well – let’s think about it. Solubility is particularly important when it involves health and medicine. When we’re sick, the doctor prescribes us medicine to feel better. If we follow the directions of the physician; the medicine must dissolve perfectly in our bodies to make us feel better.

Sweet and Soluble

Post Experiment Questions for Adults to ask:

1. What do you notice about the flavor of the cold drink? Is it sweet?
2. What do you notice about the flavor of the warm drink?
3. Is there sediment, or sugar crystals, remaining at the bottom of the pitcher / glass?
4. Is there more sediment in the cold or warm pitcher?
5. Why?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Your student could simply state that it's cold and perhaps not as sweet as the expected.
2. Your student may state that it's warm and slightly sweet.
3. There may be sediment or sugar crystals still remaining in both or only one of the glasses / pitchers.
4. More than likely there is more sediment in the bottom of the cold pitcher.
5. Heat, in this case the warm water, helps dissolve a solid – which is the sugar. The sugar in the cold glass will eventually dissolve, but the warmth of the warm water will make dissolving the sugar more efficient.

Draw your own conclusion:

What would happen if you place a glass of water in the freezer and leave it overnight? If you said it would freeze… You're right! Now try this: What would happen if you dissolve salt in water and then place it in the freezer? Do you think if would freeze just as quickly as the regular glass of water? Do you think it would freeze faster? Take longer? Try and see how long it takes for saltwater to freeze.

Expansion Experiments:

You witness the dissolving of a solid every time you see ice melt. If you live in an area of the country that receives snow and ice, you know that after you shovel your driveway you may add salt on the driveway to help melt the ice. Have you ever stopped to think about why the salt helps to melt the ice? Try our expansion experiment, "I Dissolved My Driveway," this winter!

Log your work:

Go for it!

This is a great experiment to try and log your work. You can record how long it takes for the sugar crystals to dissolve in each and record the difference!

Real World Application:

Solubility

Coffee

Medicine

Pharmaceutical

Additional Resources:

https://kids.kiddle.co/Solubility

https://easyscienceforkids.com/dissolving-video-for-kids/

Take the Wheel

Experiment Express

STEM Field of Study

Technology

Engineering

Specific STEM Area

Construction

Physics

Invention

Age Group

All

Cost

$0 - $5

Time

Ongoing Activity (more than one day)

Materials

Notebook; pencil, tape; construction paper, marbles, dice, tape measure or ruler

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Question:

Which do you feel would roll further, a di (cube) or a marble? Why?

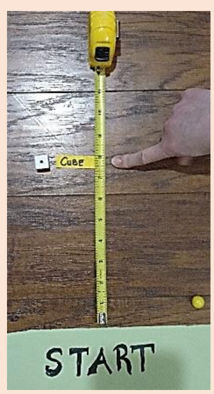
Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Experiments involve a lot of observation and then thinking about what you observed. For this experiment you will need to clear an area on the floor long enough to roll a marble or ball.

4. Next, on a sheet of paper write the word, "START." Tape the paper to one side of the area you cleared. This will be your starting line.
5. Now, while sitting down behind the "starting line" place the di and the marbles side by side in front of the starting line.



6. Gently push one di and marble away from you at the same time.
7. With a piece of tape or small post-it tab; mark the location where the di and the marble came to a stop. Then, using your ruler or tape measure, measure the distance from the starting line to that mark. Make sure to record the measurement in your logbook.

Think about it!

"Don't reinvent the wheel!"

Have you ever heard this saying? Do you know what it means? This is an old saying that means, "…don't waste your time changing something that already works." Sometimes science, technology, engineering and math change; however, there are some items that are just fine the way they are. We want to hear from you, do you think there is another shape that works better than the wheel or do you think it is perfect just the way it is? Let us know at www.startingwithstem.org

Take the Wheel

Post Experiment Questions for Adults to ask:

1. What item rolled further? The di or the marble?
2. Why do you think the marble rolled further than the di?
3. What do you think prevented the di from rolling further?
4. What could you change on the di that would make the di roll further away from you? What could you change on the marble that would prevent it from rolling further away?
5. Was your hypothesis correct?

Let's Talk

Discussion of Results / Post Experiment Answers:

1. The marble.
2. The marble doesn't have any flat edges and it takes less energy for the marble to roll because there aren't edges to slow it down.
3. The flat edges. It takes more energy to push an edge over than it does to push a circle without an edge.
4. Roll it scotch tape to create a round shape around the di. Use scotch tape to create and define edges on the marble.
5. If yes, congratulations! If not, that's okay – keep trying!

Draw your own conclusion:

Did you know the wheel was invented over 3,500 years ago? Did you also know that, unlike the telephone or the lightbulb, we don't know who invented the wheel? It was invented between two unique sections of history call the Neolithic Age and the Bronze Age. Neolithic era was at the end of the Sone Age and just before the Bronze Age. There was more farming, weaving, pottery and domestication of animals in the Neolithic Era. However, while the invention of the wheel is significant to our world's history; would you believe us if we told you that there are inventions that are older than the wheel? Can you guess what some of those are? Try doing some research first on the subject. Until then… here are a few clues: One invention that's older than the wheel goes in the water; another you can wear and the last one you can put flowers in.

Expansion Experiments:

Did you know that some of the coolest inventions came from kids? Have you ever heard of the trampoline? George Nissen was 16 when he invented this fun pastime. How about Hot Seat? This was created by 14-year-old Alissa Chavez. It's a sensor for a baby car seat that warns parents if they left their baby in the car. Lastly, have you heard about Braille? Louis Braille was only 15 years-old when he created a series of dots that can be used by the blind in order to read. This proves that you're never too young to make a difference!

Log your work:

Absolutely!

Record your observations and distances. You can do the experiment multiple times and record the distances each time.

Real World Application:

Farming & Agriculture

Transportation

Sports & Recreation

Inventions

Art

Additional Resources:

Invent It! by Rob Beattie

Calling All Minds: How To Think and Create Like an Inventor by Temple Grandin

Invent Your Own Computer Games with Python, 4E by Al Sweigart

The Girl Who Thought in Pictures: The Story of Dr. Temple Grandin by Julia Finley Mosca (Author), Daniel Rieley

http://kidinventorsday.com

Taste with Your Nose?

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Biology

Psychology

Age Group

5-10

Cost

Less than (<) $5

Time

30 minutes

Materials

A variety of candies (jellybeans or Skittles work best); a food extract: vanilla, citrus, almond. You don't need a variety – one type of extract is fine. If you want to use more than one type – that is okay too!

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

Question:

What happens when you eat food but smell something different at the same time?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Recreate the chart below in your logbook. The candy and extract flavors may change – but the arrangement is the same.

Candy Flavor	Extract #1 Vanilla
#1	
#2	
#3	
#4	

4. Separate the candy flavors. You will need 2 of each flavor.

5. Taste Candy #1. Write down the candy flavor in the #1 Candy Flavor Box.

6. Taste Candy #1 again, HOWEVER, this time smell Extract #1 WHILE you're chewing Candy #1. Write down what you taste in the Extract #1 column and the #1 Candy Row.

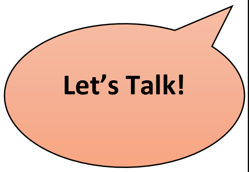
7. Repeat the process above for the nest three flavors.

FYI… The chart is an example of how to create and complete one of your own.

Taste with Your Nose?

Post Experiment Questions for Adults to ask:

1. Does smelling the extract while you're eating the candy change how the candy tastes?
2. What different flavors did you taste before you smelled the extract?
3. What different flavors taste while you were smelling the extract?
4. Why do you think you experience different tastes while smelling the extract?
5. Was your hypothesis correct?



Discussion of Results / Post Experiment Answers:

1. Answers may vary depending on the person.
2. Answers may vary depending on the candy and extract used.
3. Answers will vary depending on the candy and extract used.
4. In your mouth and nose there are cells and their job are telling you what you're eating and smelling. It just so happens that the cell receptors in your mouth and nose are the same.
5. If your hypothesis was correct, Congratulations! If it wasn't correct, don't worry – that's why we do experiments!

Draw your own conclusion:

What do you think would happen if you held your nose while you ate one of the candies? Do you think you would still be able to taste the candy? This is actually very difficult to do. The benefit of having a nose, particularly while we are eating, is so that we can continue breathing while we are chewing. Think of this situation another way. Have you ever had a cold with a stuffy nose? Well, if you have had a stuffy nose, were able to taste your food or not taste your food? Did you find it difficult to chew because your nose was stuffed? Tell us your thoughts about this at: www.startingwithstem.org.

Expansion Experiments:

The great part about this experiment is that you get to eat! We love food and we really loved this experiment. To make it even better – try using different types of extract. Vanilla is the most common; however, these flavored extract may also be fun to try: Anise – which is a licorice flavor; Almond, Coconut, Lemon, Orange and more! Just look in the baking aisle in your food store to see all the wonderful flavors! We can't wait to hear about all the wonderful combinations you discovered!

Log your work:

Absolutely!

Logbook Tip: The chart provided is an excellent item to recreate and use to log your findings.

Real World Application:

Cooking

Gastronomy

Medicine

Additional Resources:

Books:

The Magic School Bus Explores the Senses by Joanna Cole and Bruce Degen

Smell (Five Senses Series) by Maria Rius (Author), J.M. Parramon (Author), J.J. Puig (Author)

Taste (Five Senses Series) by Maria Rius, J.M. Parramon, et al.

Websites:

https://easyscienceforkids.com/whats-that-smell-all-about-your-sense-of-smell/

https://www.brainfacts.org/Thinking-Sensing-and-Behaving/Taste/2012/Taste-and-Smell

Tasty Topology Treats

Experiment Express

STEM Field of Study

Technology

Math

Specific STEM Area

Topology

Age Group

5-10

Cost

Less than (<) $5

Time

30 minutes

Materials

1 Can of Breadstick Dough (If you're short on time you could substitute the breadsticks with Construction Paper. You'll just need some scissors and Scotch tape and of course don't bake it.)

Safety

Adult Supervision Necessary

Heat involved - Use extra caution

IEP Goals

Academic

Behavioral

Motor

Question:

What is Rubber Sheet Geometry and where is it used?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Follow heating instructions on Breadstick Can.
4. After you open the Breadstick Can, separate the dough into strips. If you're going with the No-Bake Paper version of this experiment – just take a piece of construction paper (any paper will work) and cut strips of paper that are 1" (one inch) wide.
5. For the breadsticks or the paper version; twist and manipulate the strip to form a variety of shapes. These shapes can resemble an infinity symbol; a pretzel or a closed knot. If you close the loop; you can make any shape you want. You may also link strips of bread together to form different shapes and knots. For the paper version – you can also link the twisted paper together like a paper chain or form a large knot.
6. Once you're done twisting, turn and linking your breadsticks; place them in the oven to bake at the recommended temperature. If you're using strips of paper – DON'T BAKE YOUR paper creation. You're all done! Just step back and enjoy your Topological creation.
7. After the breadsticks are done baking, wait for them to cool and then enjoy!

Think about it!

Topology and the Mobius Strip:

If you completed the paper version of this experiment, when you twisted and taped one paper strip what you just created is called a Mobius Strip, or twisted cylinder. This is just the beginning for learning about the subject of Topology. Topology is the study of shapes and spatial relations that can change without breaking or tearing. While Topology may seem like a very new concept; it's hundreds of years old and is being used for modern day applications ranging from Space Exploration to Robotics. Sometimes Topology is called Rubber Sheet Geometry!

Post Experiment Questions for Adults to ask:

1. What did you enjoy about this experiment?
2. What did you find difficult with this experiment?
3. During this experiment, we asked that you twist, turn and close your breadstick or paper loop. Why?
4. If you decided to link the breadsticks or paper strips together; what did you notice about the shape of your Topology Treat?
5. Nearly everyday people around the world take a string and twist it and tie it to form a loop; what is it?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary, however, your student may state smelling the treats baking, or eating them. If you used paper strips perhaps, they may state they enjoy watching the different types of shapes they could create. The point of this question is to have a dialogue with your student.
2. Answers will vary.
3. Topology is about studying shapes that aren't affected by change. While this is a simple experiment, we want you to see how closing the loop and connecting other twisted loops together can change the shape of the breadstick or paper.
4. Answers will vary, however, the student should try and recognize that the more loops they link together the more the shape changes.
5. Shoelaces!

Draw your own conclusion:

Now it's your turn to find Topology and ask questions. For example, do you live near an amusement park, and if so, would you consider a Roller Coaster an example of Engineered Topology? Let's say you live in a city with a subway system, would you say the subway tunnels are another example of Topology? Perhaps you live near an ocean, do you think the coral is an example of natural topology? Draw your own conclusion and try to discover more examples of topology in your town, toys and treats! Tell us what you discovered at: www.startingwithstem.org.

Expansion Experiments:

While Topology has new and exciting applications in the fields of technology, we just can't stop thinking about food. Keep searching for Topological examples in the things you eat – they're all over and it's exciting when you find a new example of topology! Share your Tasty Topology Treat with us at: www.startingwithstem.org!

Log your work:

Not at this time. Just have fun!

However, if you choose to log your work, try drawing pictures (or taking pictures) of your Topological Treats!

Real World Application:

Topology

Computer Networks

Biology / DNA

Robotics

Economics

Additional Resources:

https://kids.kiddle.co/Topology

http://www.mathlabforkids.com/

Geometry and Topology: Fun, Hands-On Activities for Learning Math (Math Lab for Kids) by Rebecca Rapoport & J. A. Yoder

Twist & Torque

Experiment Express

STEM Field of Study

Technology

Engineering

Specific STEM Area

Physics

Construction

Age Group

8-11

Cost

$0 - $5

Time

30 minutes

Materials

Notebook, Pencil and a jar of peanut butter.

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Question:

When you twist a lid off a jar; why does the lid move up?

Hypothesis:

Before you start your experiment, can you predict the answer to the question above? Make sure to write down your hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.
3. Select your favorite jar of peanut butter.

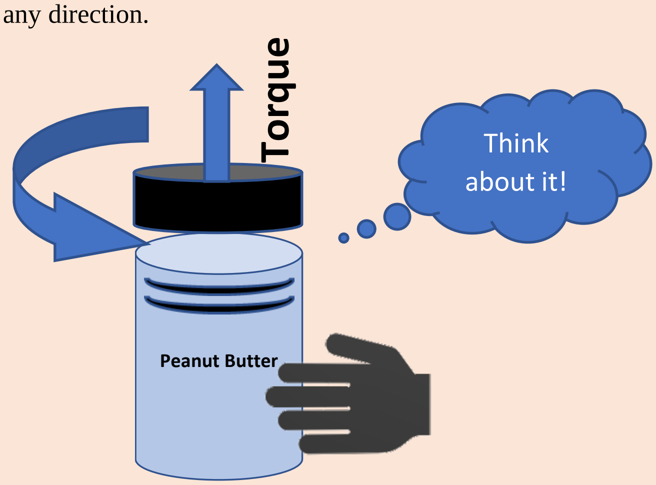
4. With the jar closed, try to twist off the lid without holding the jar of peanut butter. Record what happens.
5. Now while holding the jar of peanut butter, begin twisting the lid off. Record the direction in which the lid moves. Does it turn right or left? Does the lid travel up or down?

6. Hold the jar of peanut butter again and twist the lid back on to the jar. Record the direction in which the lid moves.

What is "torque?" (Pronounced like stork but without the "s")

Before we explain what ***torque*** is – it's important for you to know about linear motion. Linear motion is movement along a straight line. That straight line can either be pushing or pulling.

Now for Torque… Torque is the **direction** that comes from twisting something around another point. That direction can either be up, down, right or left – really any direction.



Twist & Torque

Post Experiment Questions for Adults to ask:

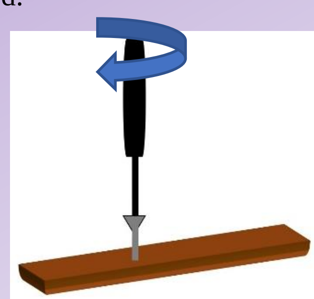
1. Was it difficult to open the jar of peanut butter while you weren't holding the jar?
2. Why?
3. Was it easier to open the jar of peanut butter while you were holding the jar?
4. Why?
5. Was your hypothesis correct?

Discussion of Results / Post Experiment Answers:

1. It should be extremely difficult (if not impossible) to open the jar of peanut butter if you aren't holding the jar.
2. In order to twist off the lid, you must have a stationary object that resists the twisting motion.
3. It is much easier to twist off the lid while holding the jar of peanut butter.
4. By holding the jar still, you're providing resistance against the twisting motion and allowing the lid to twist upwards and off the jar.
5. If your hypothesis was correct – congratulations!!If not, don't worry about it and keep trying.

Draw your own conclusion:

When building a home or a piece of furniture a builder must use a screwdriver to insert screws into wood. The picture at right is a simple demonstration of a screwdriver turning a screw into a block of wood. Is this an example of torque? Remember, applying torque is most effective at 90 degrees. Is the screwdriver at a 90-degree angle to the block of wood?



Expansion Experiments:

Here at STEM Starter we love the work of auto mechanics & home builders. They make sure we are safe in our cars and in our homes. We showed you how important torque is for building – now learn how important torque is for cars. The best way to learn about the impact of torque on cars is learning how to change a tire. Have a parent, guardian or teacher teach you how to change a tire. Where do you think the use of torque is applied during this activity? Tell us at www.startingwithstem.org

Log your work:

Absolutely!

This is a perfect opportunity to record your activity. Don't forget – you can take pictures of your efforts and then include them in your logbook.

Real World Application:

Construction

Auto Mechanics

Technology

Engineering

Additional Resources:

The Little Engineer Coloring Book: Cars and Trucks: Fun and Educational Coloring Book for Preschool and Elementary Children
by Mr. Seth McKay and Mrs. Autumn McKay

Engines! How Do Car Engines Work - Cars for Kids Edition - Children's Cars, Trains & Things That Go Books
by Pfiffikus

What Goes Around Comes Around

Experiment Express

STEM Field of Study

Science

Engineering

Specific STEM Area

Physics

Centripetal Force

Age Group

11+

Cost

$0 - $5

Time

30 minutes

Materials

Two Tennis balls (or you could use 2 lemons or 2 apples); scissors; 1 plastic bag; 1 long shoelace that is the length of your arm

Safety

Adult Supervision Necessary

IEP Goals

Academic

Behavioral

Motor

Social

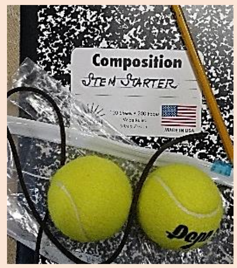
Question:

What is easier to swing in a circle; a bag with only one tennis ball or a bag with two tennis balls?

Hypothesis:

Before you start your experiment, can you predict the answer to the question above? Make sure to write down your hypothesis in your logbook.

Instructions:



1. Gather all your materials together.
2. Review all Safety Precautions.
3. Make sure you're in open space, preferably outside, where you won't hit anything.
4. Place one tennis ball in the plastic bag and make sure to squeeze all the air out of the bag. Using the shoelace; tie the shoelace in a knot around the plastic bag and close near the tennis ball.
5. While standing outside; hold the opposite end of the shoelace (no longer than from your wrist to your elbow). Extend your arm straight out in front of you and swing the tennis ball around in a circle that is parallel to the ground.
6. Repeat the same process, however this time add the second tennis ball to the bag and securely tie it with the shoelace.
7. While standing outside, swing the bag with both tennis ball around in a circle that is parallel to the ground.

Think about it!

It will all come out in the wash…

Did you know that ***Centrifugal*** means "center fleeing" and ***Centripetal*** means "center-seeking?" Additionally, one of the best examples of Centripetal Force is the Washing Machine. That's right – that wonderful machine tucked away in the basement; carport or closet is a wonder of physics that we can all learn from. The "spin" cycle of a washing machine utilizes the mass of the wet clothes and Centripetal Force in order to force the water out of the wet clothes and into the drain. Can you find other examples in your home where Centripetal Force is used? Let us know at: www.startingwithstem.org

What Goes Around Comes Around

Post Experiment Questions for Adults to ask:

1. What did you feel when you swung the tennis ball around in a circle? What about both tennis balls?
2. Which were you able to swing faster, one tennis ball or two?
3. Which was easier to swing; one tennis ball or two?
4. Why?
5. Was your hypothesis correct?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. You may feel a slight pull or a tug as the tennis ball swings around in a circle. This is due to tension and the mass of the tennis ball pulling on the string. When swinging both tennis balls you may feel a stronger pulling on the string.
2. Your student was probably able swing one tennis ball faster than two.
3. It's easier to swing only one tennis ball.
4. The mass of one tennis ball is less than the mass of two.
5. If your hypothesis was correct, Congratulations! If not, don't worry and keep trying!

Draw your own conclusion:

All too often when STEM students say, "physics is fun," we're usually greeted with a misshapen grimace and a hardy groan. However, the moment we mention, "roller coaster," a wave of appreciation for the application of physics in an American pastime grants physics (and those who study it) a nod of respect and appreciation. Roller Coasters have graced the United States, and the world, for approximately 150 years and the use of Centripetal Force has only added to the exciting, heart-pounding experience. We want you to research other amusement rides that utilize physics and centripetal force in order to create a thrilling adventure for fun seeking folks. Tell us what you found at: www.startingwithstem.org

Expansion Experiments:

A key lesson for every good scientist to learn is the art of observation. Learning to recognize similarities & differences in the world around you are phenomenal qualities to possess; however, it takes practice! We want you to walk around your home and observe the household items that incorporate physics and Centripetal Force as key functions of their use. We've already provided you with one, the washing machine; keep going and tell us what you found at: www.startingwithstem.org.

Log your work:

Go for it!

Tip: For this experiment make sure to indicate your observations in your logbook. Write down what you see, hear and feel.

Real World Application:

Centrifuge

Engineering

Acceleration

Newton's Laws

Amusement Parks

Household Appliances

Sports (Golfing)

Additional Resources:

www.homesciencetools.com

https://www.usga.org/resources/stemfiles/DRVG912/driving_activity_centripetal_force_HS.pdf

Forces Make Things Move by Kimberly Bradley and Paul Meisel

www.stevespanglerscience.com

What Takes the Cake?

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Heat Transfer

Chemistry

Age Group

5-10

Cost

Less than (<) $10

Time

Ongoing Activity (more than one day)

Materials

1 box of cake mix, water oil/butter, eggs, vanilla, aluminum cake tin, glass cake dish

Safety

Heat involved - Use extra caution

IEP Goals

Academic

Behavioral

Motor

Question:

What bakes a better cake, an aluminum pan or glass pan?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather all your materials together.
2. Review all Safety Precautions.

3. Utilizing the cake mix from the box; follow the directions on the box. The directions on our cake mix box called for eggs, butter, water and vanilla.
4. After the cake mix is ready, prep two different cake pans to bake the cake.
5. Place half of the batter in an aluminum cake pan.

6. Place the other half of the cake batter in the glass cake dish.
7. Bake both according the directions on the box.

8. After baking is completed, what do you notice about the two cake halves?

GASTRONOMY is such a fun word. According to Dictionary.com it means: the art and *science* of eating good food. How about that?! This is a class that we would like to take! Did you know that Gastronomy was taught in school? It absolutely was. Back then we called it Home Economics! Would you just love to bring the STEM of Gastronomy back to education? Us too!

What Takes the Cake?

Let's Talk!

Post Experiment Questions for Adults to ask:

1. Which cake half was better?
2. Which cake was cooked more evenly?
3. Did either of the burn? If so, which one?
4. Were either of them undercooked in the middle?
5. Which one tasted better?
6. Which do you think heats faster: the aluminum or the glass cake pan? Why?
7. Which do you think stays hotter longer: the aluminum or the glass cake pan?

Discussion of Results / Post Experiment Answers:

1. Opinions can vary.
2. In our experiment the cake that was baked in the glass dish cooked evenly.
3. The cake baked in the aluminum pan was slightly brown around the edges – but it didn't burn.
4. Neither were undercooked.
5. Opinions vary – for our experiment the cake baked in the glass dish was better.
6. The aluminum cake pan will heat faster. Metal heats faster than glass.
7. The glass cake pan will stay hotter longer.

Draw your own conclusion:

Working with glass cookware can be tricky. Glass doesn't respond well to drastic temperature changes. For example, glass would not react very well if it went from very hot to very cold. In fact, if you took a hot glass dish out of the oven and ran it under cold water it would crack. Why do you think this occurs?

On the other hand, working with metal can also be interesting. For example, a metal, such as aluminum reacts with food that are acidic like tomatoes. Some people can taste the difference between food cooked in glass pan or metal pan. So, here are a couple of interesting questions for you;

If you had a choice, what would you prefer to cook Lasagna in, a metal or glass dish? How about Macaroni & Cheese?

Expansion Experiments:

What would happen if you baked the cake at a higher temperature but faster? What about slower temperature but longer? Try these techniques to see if there's a difference between following the directions or not. Baking is a science and there are directions on the box for a reason.

Log your work:

Maybe, what do you think?

This is a fantastic experiment to log your work. Chefs and bakers are always testing their recipes in order to achieve the best possible item to offer to their customers! Log your efforts and let us know how you do!

Logbook entry tip:

Find out what the word *Gastro* means and then find out what the suffix *nomy* means.

Real World Application:

Food Chemistry

Gastronomy

Medicine

Dietician / Dietary

Heat Transfer

Additional Resources:

How Baking Works: Exploring the Fundamentals of Baking Science by Paula Figoni

American Chemical Society: ChemClub Cookbook

You're My Density

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Physics

Chemistry

Age Group

5-7

Cost

Less than (<) $5

Time

1+ hour (s)

Materials

One can of sugar sweetened soda; One can of diet soda; Large bowl (or sink) and water

Safety

It's a good idea to have an adult nearby

IEP Goals

Academic

Behavioral

Motor

Question:

Which will float, a can of regular soda or diet soda?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:

1. Gather your materials together.
2. Review all Safety Precautions.
3. Before you begin the experiment – Don't open any of the cans. Leave them all closed. Hold one can of soda in your right hand and the other in your left. Does one feel heavier than the other or do they feel like they are the same amount of weight?

4. Okay, now your ready to begin the experiment. Do not open the any cans of soda. Leave them all closed.
5. Fill a pitcher with water

6. Place the can of regular soda in the pitcher of water.
7. Observe. The can may bob for a short amount of time. Try bringing the regular can of soda to the surface and let go. What happens?

8. Now place the can of diet soda in the bowl of water.
9. Observe.
10. Try pushing the diet soda down. What happens?

Think about it!

What is density?

Sometimes density is confused with weight or mass; but they are not the same. Density means how tightly compact something is. Let's give you and example and see if the helps:
Let's pretend there are two dump trucks side by side. The dump trucks are the same size and shape. Dump Truck #1 is full of soccer balls. Dump Truck #2 if full of Bowling Balls. Which do you think is denser – Dump Truck #1 or Dump Truck #2?

If you said #2 – You are correct! Since a bowling ball weighs more than a soccer ball - Dump Truck #2 is very dense. Can you think of any examples of density? Share your thoughts and ideas with us at: www.startingwithstem.org

You're My Density

Post Experiment Questions for Adults to ask:

1. Which can of soda sank?
2. Which can of soda floated?
3. Which can is heavier?
4. Which can is lighter?
5. What do you think makes the regular soda heavier?
6. What do you think makes the diet soda lighter?
7. When you held each can of soda in your hands, could you feel a difference in weight?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. The regular can of soda sank.
2. The diet can of soda floated.
3. The Regular Soda is heavier.
4. The Diet Soda is lighter.
5. The sugar in regular soda makes it heavier.
6. Sugar is not as sweet as artificial sweetener; so, you less artificial sweetener to make the soda taste sweet – that's why it's not as heavy.
7. Your student may not feel a difference; however, they will notice a difference when the cans of soda are placed in the water.

Draw your own conclusion:

This is the time when we use a little bit of math. Don't worry – you will do just fine. You might notice on the side of a 12oz can of that regular soda that there is 40 grams to 70 grams of sugar in that can. So how much is that? Is that a lot of sugar or a little/ Well… let's figure it out: every gram of sugar is almost equal to a ¼ teaspoon. So how many ¼ teaspoon do we need to equal 30 grams of sugar? This is where you divide. Divide 40 (the number of grams of sugar) by 4 (¼ of a teaspoon) and you get 10. Now take measuring spoons and some sugar and measure 10 teaspoons of sugar into a bowl. What do you think? Is that a lot of sugar? What if the drink has 50 grams of sugar? 60? 70? Let us know what you think. Is it a lot or a little sugar? Note: Try using a kitchen scale if it is available; mass is more accurate.

Expansion Experiments:

You can use varying drinks to compare weight / density. Try using a can of seltzer water, or lemonade or iced tea. But make sure you use only unopened aluminum cans.

Log your work:

Absolutely!

Log suggestion: This is a great opportunity to look up what your daily sugar intake should be for your age group!

Real World Application:

Density

Manufacturing

Maritime

Additional Resources:

www.sciencing.com

https://www.stevespanglerscience.com/lab/experiments/density-tower-magic-with-science/

Zookeeper

Experiment Express

STEM Field of Study

Science

Specific STEM Area

Biology

Zoology

Age Group

All

Cost

$0 - $5

Time

Ongoing Activity (more than one day)

Materials

Notebook, Colored Pencils, Camera (optional)

Safety

Adult Supervision Necessary

Never approach an animal with out the permission of its owner and adult supervision!

IEP Goals

Academic

Behavioral

Motor

Social

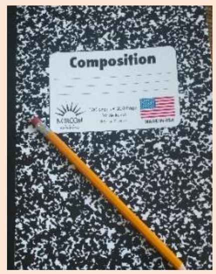
Question:

Why is it important to observe animals?

Hypothesis:

Before you do this experiment; try to predict the answer to the question above. Write down your Hypothesis in your logbook.

Instructions:



1. Gather all your materials together.
2. Review all Safety Precautions.

3. Take a few days to look in your backyard or community. If opportunity allows, you could also try and take a field trip to a zoo or animal farm.
4. Record the animals that you observe in your logbook.

5. Try sketching from memory what the animal looks like.
6. With each animal note their color, habitat and actions (what are they doing).
7. Now try to group animals based on their similarities.

Think about it!

Did you know that there is a branch of science that focuses on the classification of animals? It's called Taxonomy. This is a perfect experiment to practice this skill for future Biology classes. After you record your observations, try researching the taxonomy classification for the animals you saw. This skill will give you a head start for your future science classes!

Here are a couple of websites to help get you started:
www.biology4kids.com
https://kids.kiddle.co/Taxonomy

Post Experiment Questions for Adults to ask:

1. Do you notice any similarities between animals?
2. Do you see any differences?
3. What behavioral observations did you notice?
4. What region / climate do you live in? The animals that you observed, what characteristics do they have to assist them in surviving the area in which they live?
5. What animals, do you feel, would NOT survive or thrive in your region? Why?

Let's Talk!

Discussion of Results / Post Experiment Answers:

1. Answers will vary, however, the student may state that all the animals had fur, two eyes, two ears, etc.
2. Answers will vary, but make sure the student notes some difference. Perhaps some animals had four legs and others had two. Some had fur while others had feathers.
3. Answers will vary. Perhaps birds that develop a flock / gaggle for protection from predators. Squirrels making unique noises when a predator is near. Horses ears will pin with they're mad. Etc.
4. Answers will vary, however try to encourage your student to indicate North, South, East, West and the animals they encounter should have characteristics that support them in surviving in the region which they live. Fur to keep warm, long tail to swat flies, long claws for digging for food.
5. Answers will vary. For example, any animal that relies on water for survival probably wouldn't survive in the desert.

Draw your own conclusion:

As stated in the beginning of this experiment, Taxonomy is a science dedicated to classification of animals. What we want to know from you is: Why do you think Taxonomy and the classification of animals is important to science? How does classifying animals assist scientists? Tell us what you think at: www.startingwithstem.org!

Expansion Experiments:

Do you have a pet, or wish you had a pet? What we want you to do is create a new animal and then tell us what that animal's Taxonomic Classification would look like. Or, you can do the taxonomic classification for your animal or your favorite animal and share your results with us at: www.startingwithstem.org.

Log your work:

Absolutely!

Logbook Tip: This is a fantastic opportunity to log what you see and record your observations.

Real World Application:

Biological Sciences

Animal Behavior

Veterinarian

Taxonomy

additional

Resources:

http://www.zoologyforkids.org/

Zoology for Kids: Understanding and Working with Animals, with 21 Activities by Josh Hestermann, Bethanie Hestermann

www.amnh.org/explore/ology/zoology

S.T.E.M. STARTER

Charting a New Course

STEM Experiments for the Home and Classroom

Read on

&

Resources

"You can find magic wherever you look. Sit back and relax,

all you need is a book."

Dr. Seuss

Science

Biology Books:

Bacteria Book: The Big World of Really Tiny Microbes by Steve Mould

Beginners Guide to Making Homemade Cheese, Butter & Yogurt: Delicious Recipes Perfect for Every Beginner! By Carson Wyatt

Follow That Map!: A First Book of Mapping Skills (Exploring Our Community) by Scot Ritchie

Lost Art of Reading Nature's Signs: Use Outdoor Clues to Find Your Way, Predict the Weather, Locate Water, Track Animals—and Other Forgotten Skills by Tristan Gooley

Magic School Bus Series:

A Book about Heat.

At The Waterworks by Joanna Cole & Bruce Degen

Explores the Senses by Joanna Cole and Bruce Degen

Fights Germs by Kate Egan & Carolyn Bracken

Gets All Fired Up: Fire Safety Story by Joanna Cole & Bruce Degen

Inside the Human Body by Joanna Cole

Inside A Hurricane by Joanna Cole (Author), Bruce Degen (Illustrator)

Kicks Up A Storm: A Book About Weather by Nancy White (Author), Art Ruiz (Illustrator)

Plants Seeds: A Book About How Living Things Grow by Joanna Cole, Bruce Degen,

Presents: Wild Weatherby Tom Jackson (Author), Sean Callery (Author), Carolyn Bracken (Illustrator)

To the Rescue: Forest Fire by Anne Capeci

Magic School Bus - Wet All Over: A Book About The Water Cycle by Pat Relf & Carolyn Bracken

Oil Spill! by Melvin Berger (Author), Paul Mirocha (Illustrator)

Science Safety Rules by Kelli Hicks

Smell (Five Senses Series) by Maria Rius (Author), J.M. Parramon (Author), J.J. Puig (Author)

Taste (Five Senses Series) by Maria Rius, J.M. Parramon, et al.

Zoology for Kids: Understanding and Working with Animals, with 21 Activities by Josh Hestermann, Bethanie Hestermann

Biology Online Resources

https://www.brainfacts.org/Thinking-Sensing-and-Behaving/Taste/2012/Taste-and-Smell

https://easyscienceforkids.com/whats-that-smell-all-about-your-sense-of-smell/

https://kids.kiddle.co/Boiling_point

The Sci Guys You Tube videos are fantastic! Here is one with bacteria:
https://www.youtube.com/watch?v=yY8STATjZ6U

https://www.usgs.gov/special-topic/water-science-school/science/water-cycle-schools-and-kids?qt-science_center_objects=0#qt-science_center_objects

Chemistry Books:

American Chemical Society: ChemClub Cookbook

Chromatopia: An Illustrated History of Color by David Coles

CSI Expert!: Forensic Science for Kids by Karen Schulz

Detective Science: 40 Crime-Solving, Case-Breaking, Crook-Catching Activities for Kids by Jim Wiese

How Baking Works: Exploring the Fundamentals of Baking Science by Paula Figoni

Oil Spill! by Melvin Berger (Author), Paul Mirocha (Illustrator)

Science Safety Rules by Kelli Hicks

Chemistry Online Resources

American Chemical Society – www.acs.org

https://babbledabbledo.com/chromatography-for-kids/

http://www.firesafekids.org/science.html

https://www.brainfacts.org/Thinking-Sensing-and-Behaving/Taste/2012/Taste-and-Smell

https://easyscienceforkids.com/acids-and-bases/

https://easyscienceforkids.com/whats-that-smell-all-about-your-sense-of-smell/

https://kids.kiddle.co/Chromatography

https://www.scientificamerican.com/article/bring-science-home-shaking-butter/

https://www.stevespanglerscience.com/lab/experiments/vanishing-styrofoam/

Physics Books

Baby Loves Thermodynamics! by Ruth Spiro, Irene Chan

The Illustrated Guide to Aerodynamics by Hubert C. Smith (Author)

Elements: A Visual Exploration of Every Known Atom in the Universe by Theodore Gray

Forces Make Things Move by Kimberly Bradley and Paul Meisel

Freezing and Melting by Robin Nelson

Magic School Bus Series

- Amazing Magnetism by Rebecca Carmi
- Gets A Bright Idea, The: A Book About Light by Nancy White
- Shows and Tells: A Book About Archeology by Joanna Cole
- In the Artic: A Book about Heat by Joanna Cole
- Ups and Downs - A Book about Floating and Sinking by Jane B. Mason and Joanna Cole

Science Safety Rules by Kelli Hicks

Physics DVD Resources:

Magic School Bus Series Takes Flight - Scholastic

Physics Online Resources

www.accousticalsolutions.com

www.amnh.org/explore/ology/zoology

www.coolkidfacts.com/sink-and-float-facts-for-kids/

https://www.dkfindout.com/us/science/forces-and-motion/how-does-plane-fly/

https://www.ducksters.com/science/light.php

https://easyscienceforkids.com/dissolving-video-for-kids/

easyscienceforkids.com/all-about-magnetism/

https://www.education.com/science-fair/article/which-metal-conducts-heat-best/

http://www.espsciencetime.org/SaltandIce.aspx

Physics Online Resources

https://www.fws.gov/international/education-zone/conservation-kids.html

www.homesciencetools.com

https://k8schoollessons.com/air-resistance-for-kids/

http://kidsahead.com/subjects/3-forensics

www.kids-fun-science.com

https://kids.kiddle.co/Solubility

https://kids.kiddle.co/Sonar

https://kids.kiddle.co/Second_law_of_thermodynamics

https://littlebinsforlittlehands.com/20-melting-ice-science-sensory-play-activities/

https://www.grc.nasa.gov/www/k-12/airplane/bga.html

www.nasa.gov/kidsclub/

https://kids.niehs.nih.gov/topics/reduce/index.htm

www.orienteering.org

https://pbskids.org/video/

www.physics4kids.com

http://www.physics4kids.com/files/thermo_intro.html

http://www.physics4kids.com/files/thermo_transfer.html

https://www.real-world-physics-problems.com/

https://www.sciencebuddies.org/science-fair-projects/project-ideas/cooking-food-science

www.sciencebuddies.org

www.sciencing.com

https://sciencing.com/oil-spill-information-kids-5444185.html

www.sciencekids.co.nz/sciencefacts/magnets.html

https://stemactivitiesforkids.com/2016/04/22/earth-day-stem-challenge/

www.stevespanglerscience.com

https://www.stevespanglerscience.com/lab/experiments/density-tower-magic-with-science/

https://www.usga.org/resources/stemfiles/DRVG912/driving_activity_centripetal_force_HS.pdf

http://www.zoologyforkids.org/

Technology

Technology Books

The Age of Exploration by Kenneth Pletcher

Calling All Minds: How To Think and Create Like an Inventor by Temple Grandin

Code Your Own Games!: 20 Games to Create with Scratch Hardcover by Max Wainewright

Coding Projects in Scratch: A Step-by-Step Visual Guide to Coding Your Own Animations, Games, Simulations by Jon Woodcock

CSI Expert!: Forensic Science for Kids by Karen Schulz

Follow That Map!: A First Book of Mapping Skills (Exploring Our Community) by Scot Ritchie
The Lost Art of Reading Nature's Signs: Use Outdoor Clues to Find Your Way, Predict the Weather, Locate Water, Track Animals—and Other Forgotten Skills by Tristan Gooley

The Girl Who Thought in Pictures: The Story of Dr. Temple Grandin by Julia Finley Mosca (Author), Daniel Rieley

Engines! How Do Car Engines Work - Cars for Kids Edition - Children's Cars, Trains & Things That Go Books by Pfiffikus
Invent It! by Rob Beattie

Invent Your Own Computer Games with Python, 4E by Al Sweigart

The Little Engineer Coloring Book: Cars and Trucks: Fun and Educational Coloring Book for Preschool and Elementary Children by Mr. Seth McKay and Mrs. Autumn McKay
My First Coding Book Board book – by Kiki Prottsman

Through the Looking Glass Science Activities: Science with Light and Mirrors / Science with Water / Science with Magnets by Helen Edom

Tools of Navigation: A Kid's Guide to the History & Science of Finding Your Way by Rachel Dickinson

Technology Online Resources

www.accousticalsolutions.com

https://www.ducksters.com/science/light.php

www.fractalfoundation.org

http://kidsahead.com/subjects/3-forensics

http://kidinventorsday.com

https://kids.kiddle.co/Astrolabe

https://kids.kiddle.co/Sonar

http://www.mirrorhistory.com

www.orienteering.org

Technology Online Resources

https://pbskids.org/video/

http://preservation50.org/educational-resources-k-12/

https://scienceexplorers.com/teaching-children-about-acids-and-bases/

www.teacher.scholastic.com

Engineering

Engineering Books

13 Bridges Kids Should Know by Brad Finger

A Book of Bridges: Here to There and From Me to You by Cheryl Keely & Celia Krampien

Bridges and Tunnels: Investigate Feats of Engineering by Donna Latham

Calling All Minds: How To Think and Create Like an Inventor by Temple Grandin

Empire the Skyscraper in the Land of Man-Made Wonders Michael David Drucker (Author), Sumser III, Raymond Joseph (Illustrator)

Engines! How Do Car Engines Work - Cars for Kids Edition - Children's Cars, Trains & Things That Go Books by Pfiffikus

The Future Architect's Handbook by Barbara Beck

Galileo for Kids: His Life and Ideas by Richard Panchyk

Galileo's Leaning Tower Experiment (Junior Guild Selection (Charlesbridge Paper) by Wendy Macdonald

The Girl Who Thought in Pictures: The Story of Dr. Temple Grandin by Julia Finley Mosca (Author), Daniel Rieley

Hands-On Science: Forces and Motion by Jack Challoner (Author), Maggie Hewson (Author)

The Incredible Plate Tectonics Comic: The Adventures of Geo, Vol. 1 by Kanani K. M. Lee (Author), Adam Wallenta (Author)

Invent It! by Rob Beattie

Invent Your Own Computer Games with Python, 4E by Al Sweigart

The Little Engineer Coloring Book: Cars and Trucks: Fun and Educational Coloring Book for Preschool and Elementary Children by Mr. Seth McKay and Mrs. Autumn McKay

The Magic School Bus Series:
- A Book about Floating and Sinking
- In the Arctic: A Book About Heat by Joanna Cole
- Jumping into Electricity

Engineering Books

Motion: Push and Pull, Fast and Slow by Darlene Ruth Stille (Author), Sheree Boyd (Illustrator)

When Jackie Saved Grand Central by Natasha Wing and Alexandra Boiger

Why Do Tectonic Plates Crash and Slip? by Baby Professor

Engineering Online Resources

https://www.abcya.com/games/world_wonders_spot_difference

http://www.ala.org/alcts/preservationweek/ch/kids

www.coolkidfacts.com/sink-and-float-facts-for-kids/

https://easyscienceforkids.com/all-about-bridges/

https://easyscienceforkids.com/all-about-the-man-made-wonders-of-the-world/

https://educationpossible.com/science-activities-learn-levers/

https://kidskonnect.com/science/bridges/

http://kidinventorsday.com

https://www.sciencealert.com/how-do-mirrors-work

https://www.scientificamerican.com/article/singing-glasses1/

https://www.scientificamerican.com/article/static-science-how-well-do-different-materials-make-static-electricity/

http://www.sciencekids.co.nz/gamesactivities/keepingwarm.html

www.science-sparks.com

https://www.science-sparks.com/gravity-experiments-for-kids-galileo/

Math

Books:

The Age of Exploration by Kenneth Pletcher

Betcha! Estimating by Stuart J. Murphy

Blockhead: The Life of Fibonacci by Joseph D'Agnese & John O'Brien

Everything You Need to Ace Math in One Big Fat Notebook: The Complete Middle School Study Guide by Workman Publishing (Author), Ouida Newton

Fibonacci Zoo by Tom Robinson, Christina Wald

The Future Architect's Handbook by Barbara Beck

Let's Estimate: A Book about Estimating & Rounding Numbers by David A. Adler and Edward Miller

Mastering Essential Math Skills GEOMETRY Grades 4-6 by Richard W. Fisher

Mysterious Patterns: Finding Fractals in Nature by Sarah C. Campbell and Richard P. Campbell.

Tessallation!: A Children's Picture Book with Tessellations by Emily Grosvenor

Tools of Navigation: A Kid's Guide to the History & Science of Finding Your Way by Rachel Dickinson
Zoom by Istvan Banyai

Online Resources

Carrots are Orange https://carrotsareorange.com/early-math-estimation/

Ducksters https://www.ducksters.com/kidsmath/slope.php

Fractal Foundation www.fractalfoundation.org

Jumpstart http://www.jumpstart.com/parents/activities/rounding-and-estimation-activities

Khan Academy www.khanacademy.org

Kids Kiddle https://kids.kiddle.co/Astrolabe

Math is Fun https://www.mathsisfun.com/geometry/tessellation.html

Math is Good for You www.mathisgoodforyou.com

Math worksheets 4 Kids https://www.mathworksheets4kids.com/slope.php

Mensa for Kids www.mensaforkids.org

Play to learn preschool https://playtolearnpreschool.us/estimation-station/

Splash Learn www.splashlearn.com

STEM Starter: *"Chock and Block "*

Have you ever heard this term before? Chock and Block is a nautical saying that means, "crammed tightly to prevent movement." At STEM Starter we know that a family's life is chock full of activities that tend to block your time together. The experiments included in this book are designed to be quick, easy, inexpensive but full of knowledge and resources that will challenge and inspire young scholars. We intentionally designed each experiment, so you have the option to manipulate the experiment to fit the schedule of your family. Below is a sample Experiment Schedule; however, this is by no means a required format and course of approach. Do what works for you, your family, or the classroom.

STEM Experiment Weekly Schedule:

Monday Log: Review the Experiment Express

Prepare for the Experiment (Gather Materials, Review Safety precautions)

Review Experiment Question asked.

Develop a hypothesis for the experiment.

Prepare Logbook

Tuesday Log: Conduct the Experiment

Log Experiment

Wednesday Log: Ask the Post Experiment Questions

Discuss the Results

Thursday Log: Discuss the Draw Your own Conclusion and Real-World Applications

Friday Log: Review Experiment Expansion

Assign Additional Resources for Homework over the Weekend.

STEM Starter: *Lab Book Example*

Your Name:____Date:________________________

Lab Partner / Partners:____

Experiment Title:____

With any experiment, **SAFETY IS THE MOST IMPORTANT SECTION**! You will notice that you are asked several times if you reviewed the safety precautions for the experiment. There is an exceptionally good reason for this – If you are safe with small things – you will be safe with big things and therefore can be trusted in a laboratory. Take SAFETY SERIOUSLY and there will not be a problem. Every scientist must be responsible and safe every time they are in the laboratory. If you do not listen to an adult, if you are not safe, then you should not do the experiment. End of story.

Experiment Checklist:

1. Did you ask and parent, adult, or caregiver if you can do the experiment? Yes_____ No_____
2. If no, then you must go and ask for permission before continuing.
3. Did you review all the safety precautions with a parent, adult, or caregiver? Yes_____ No_____
4. If no, then you must review all the safety precautions WITH AN ADULT before continuing.
5. Are you sure you have enough time to complete the experiment? Yes_____ No_____
6. If no, then just wait until you have an appropriate enough time to complete the experiment.

Experiment Instructions:

1. Gather your experiment materials.
2. Review the SAFETY PROCEDURES again. After instruction #2 the experiment instructions will vary. There may be only 6 steps to complete or there may be 12. You do not have to write the instructions down, however, you may use the space below to make notes about the instruction.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

STEM Starter: *Lab Book Example*

Discussion of Results and Post Experiment Answers:

1.

2.

3.

4.

5.

Draw Your Own Conclusion: You do not have to do this section, but if you choose to – use this space to complete it.

Expansion Experiment: You do not have to do this section, but if you choose to – use this space to complete it.

Signing your work is extremely important in the STEM field. This demonstrates that you take ownership over the work that is done, you followed all the rules and you did not use another person's work to complete your own. So, make sure to sign it and be proud of your hard work!

Your Signature:____Date:___________________

About the Author

Shannon Brindle, Founder of STEM Starter

Miss. Brindle is a Pre-Medical student pursuing a degree in Physics at the University of Mary Washington in Fredericksburg, VA. She is originally from a Mayfield, New York, a small, rural, upstate town. Shannon and her family were granted with the opportunity to travel across the United States of America courtesy of the United States Air Force. They have travelled throughout this great nation and been able to call Grand Forks, ND; Wasilla, AK, Shreveport, LA; Tacoma, WA; and Stafford, VA home. However, Shannon learned that it does not matter where you live - home is your family. While there have been ups and downs throughout her life, her desire to pursue medicine came after she went five years with an undiagnosed chronic condition. After 50 physicians and countless tests; Shannon was finally diagnosed with a histamine intolerance. After two years of adjusting diets and lifestyle changes, Shannon's health is flourishing and she is thankful to God, her family and healthcare providers for their dedication to her well-being. Her healthcare experience was the filter for her educational goals and what was left behind was a passion for medicine. Currently, Shannon's goals are to attend medical school with the hope of becoming an Interventional Radiologist in the military. Her other hobbies include equestrian sports, singing opera, cooking, and upland bird hunting.

"Mankind was my business. The common welfare was my business; charity, mercy, forbearance, benevolence, were all my business. The dealings of my trade were but a drop of the water in the comprehensive ocean of my business!"

Charles Dickens, A Christmas Carol

Revealing sound approaches to extraordinary destinations.

Fear is free & easy.

However, in learning & education, fear can be a crippling emotion to bear. The fear of being wrong, not understanding or failing are exactly what feeds a monstrous notion that the STEM fields are too difficult to learn or, worse yet, impossible to learn.

This is where STEM Starter comes in.

STEM Starter is charting a new course in STEM education by demonstrating in a clear, cost effective & timely manner the Science, Technology, Engineering & Math that exists in our daily lives. The motto of STEM Starter is:

“We didn’t invent the wheel; we show why it works.”

This perfectly captures who we are & what we do. It is our mission to utilize the resources that surround us in order to explain some of the most complex theories that exist in our world. We don’t use expensive lab equipment or chemicals to teach; rather we utilize simple, inexpensive and easily accessible materials to reveal the most amazing accomplishments and discoveries known to mankind. If Isaac Newton required only an apple to unlock the mystery of gravity – we think you can work with the items in your cupboard.

Marie Curie once stated,

“Nothing in life is to be feared, it is only to be understood.

Now is the time to understand more, so that we may fear less."

We could not agree more.