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STEMendously Fun Time STEM Club

Sarah Altman

Rhiannon Carlile

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NEBRASKA HONORS PROGRAM
CLC EXPANDED LEARNING OPPORTUNITY CLUBS
INFORMATION SHEET

Name of Club: STEMendously Fun Time!

Age/Grade Level: Middle School

Number of Attendees: (ideal number) 8 or fewer

Goal of the Club:

Develop a scientific mindset and an interest in STEM careers. Learn how to ask questions and provide answers without shame. Engage in experiments and understand the underlying scientific principles.

Resources: (Information for club provided by)

Many scientific experiment websites, as referenced in each individual lesson plan.

Content Areas: (check all that apply)

- Arts (Visual, Music, Theater & Performance)
- Literacy
- STEM (Science, Technology, Engineering & Math)
- Social Studies
- Wellness (Physical Education, Health, Nutrition & Character Education)

Outputs or final products: (Does the club have a final product/project to showcase to community?)

N/A

Introducing your Club/Activities:

Students will delve into the scientific method and learn how to think skeptically by performing experiments. They will also learn about STEM careers and scientific fundamentals.

General Directions:

Start with an engaging brainteaser and a presentation of the scientific principles underlying the experiment, and then let the students engage with the experiment to pique their interest and understanding of STEM.

Tips/Tricks:

Provide opportunities for students to ask questions with positive outcomes and support. Encourage them to answer questions and acknowledge that it is OK to be incorrect.

Make PowerPoints that can be projected/shared on a smart board.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Intro to STEM Club and the Scientific Method.
Length of Activity:	Hour and a half
Supplies:	Paper, tape, white board eraser (a heavier thing that can be safely dropped), a book and a swivel chair. This can typically be found in a classroom.

Directions:

Start off with introductions and fun icebreakers. Engaging science brainteasers can be found at <https://www.prodigygame.com/main-en/blog/brain-teasers-for-kids/>

Talk about the different aspects of STEM and the abundance of STEM careers. Talk about where we see STEM every day. Discuss the steps of the scientific method and how to have a scientific attitude. Then, test two hypotheses with your students:

- 1) Do things fall at the same rate? Have your students hypothesize about this and test it several times. Ask students to think of ways to reduce air resistance on the paper so that it falls at the same rate as the heavier object (HINT: Make the paper into a ball, place it on top of the notebook, drop a stack of paper).
- 2) How can you make yourself speed up and slow down in a chair without touching the ground? Use the swivel chair to demonstrate the conservation of angular momentum. Have students bring in and out their arms and legs after an initial spin to see how they speed up.

Conclusion of the activity:

Students gained an interest in experimentation and developed the confidence to propose hypotheses.

Parts of activity that worked:

Students enjoyed being able to spin in the chair and actively participate in testing the first and second hypotheses.

Parts of activity that did not work:

The science concepts underlying the conservation of angular momentum and the fact that all things fall at the same rate are too hard for middle schoolers to grasp. Instead, just focus of formulating hypotheses.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Elephant's toothpaste experiment
Length of Activity:	Hour and a half
Supplies:	Hydrogen peroxide (1 bottle 6%), dish soap, yeast, plastic bottles, food coloring, plastic table liners, a disposable bowl and spoon for mixing, warm water, measuring cups.

Directions:

Start off with a fun icebreaker or brainteaser for the first 15 minutes. (Ideas can be found here: <https://www.prodigygame.com/main-en/blog/brain-teasers-for-kids/>)

Explain the concepts of chemical reactions to students by stating that reactants interact to form new products. Explain that in this experiment, Hydrogen peroxide is interacting to form water and oxygen gas, which then wants to escape and causes bubbles in the soap! Have them hypothesize what will happen in the experiment if we add differing levels of yeast (explain that yeast is a catalyst which speeds up reactions). More detailed experiment instructions can be found at <https://www.scientificamerican.com/article/make-elephant-toothpaste/>

Conclusion of the activity:

Students were excited to see the reaction and they were excited that they could help mix the food coloring.

Parts of activity that worked:

The experiment was done outside, so the cleanup was very minimal.

Parts of activity that did not work:

Because yeast is a natural catalyst, the experiment was not as explosive as it would have been with a chemical grade potassium catalyst. The students were somewhat underwhelmed, but a yeast catalyst is much safer.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Egg Pressure Experiment
Length of Activity:	Hour and a half
Supplies:	Hard-boiled eggs, matches (or a lighter may be easier), glass bottles, paper.

Directions:

Start with an icebreaker or other fun brainteaser for around 15 minutes (ideas can be found online or here: <https://www.prodigygame.com/main-en/blog/brain-teasers-for-kids/>)

Start by explaining the concepts related to pressure systems and gradients. To explain that things want to move from high pressure to low pressure, use the analogy that air particles want their own “personal space”. Also, use the example that if 100 people were asked to go into a room, they would spread out instead of huddling together. Explain what a vacuum is and what forces they can exert. Tie the idea of the vacuum back to that of the pressure gradient to explain how they work. Preferably outside, use lit matches (dropped into glass bottles) and the hard-boiled eggs to show the eggs being sucked into the bottles. It is better if the bottle is larger (like a milk bottle), and you may need to use paper as a kindling to get a small fire started inside the bottle. More detailed instructions can be found here: <https://sciencing.com/easy-high-school-physics-experiments-6702224.html>

Conclusion of the activity:

The students were very fascinated by the experiment, and they understood the underlying principles very well.

Parts of activity that worked:

Students were very engaged and were excited that the egg went into the bottle!

Parts of activity that did not work:

For this to work, you need to use a larger bottle, otherwise the vacuum created likely won't be great enough to suck the egg in. Also, paper may need to be used as kindling to keep a SMALL fire going for a little bit.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Candle Vacuum Experiment

Name:

Length of Activity: 1 hour

Supplies: Candle, matches (lighter may work better), water, plate/dish, 2-liter soda bottle, 16 oz. soda bottle, food coloring (optional to make the water colorful).

Directions:

Start with a brainteaser for about 15 minutes. (Ideas can be found online or here:

<https://www.prodigygame.com/main-en/blog/brain-teasers-for-kids/>)

Start by explaining about pressure gradients and the importance of oxygen in combustion reactions. Use the analogies from the egg-pressure experiment, as they are very similar. Talk about partial vacuums and the concepts of system vs. surroundings. Explain that the pressure is low in the system due to the low temperature after the candle goes out, and that the pressure of the surroundings is high, so the water gets “pushed in” by the surroundings. Place the candle on the plate, pour water around it, light candle, and cover with both the 16 oz. and 2 liter bottle. Watch as the water level rises! For more complete details, look here: <https://medium.com/stem-little-explorers/candle-in-the-vacuum-experiment-9b9fbd52118a>

Conclusion of the activity:

The students were fascinated that water seemed to work against gravity. Relate this back to the egg-pressure experiment so students can see the concepts in real life.

Parts of activity that worked:

The system created a partial vacuum relatively well.

Parts of activity that did not work:

The vacuum effect is not very extreme, so be patient and wait it out! Also, because this is a shorter experiment with less set up, use different bottles and amounts of water and have the students hypothesize.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Coke and Mentos Experiment

Name:

Length of Activity: Hour and a half.

Supplies: 2 2-liter Diet cokes (NOTE: it must be diet), a roll of mentos, construction paper, tape, string, scissors.

Directions:

Start with an icebreaker or brainteaser. They can be found online at websites such as this:

<https://icebreakerideas.com/math-riddles/>

Explain the reaction that happens in the famous coke and mentos experiment. Why does the explosion happen? Make the experiment more challenging by requiring your students to come up with 2 methods of getting the mentos in the bottle without directly dropping them in. Nobody wants to get showered with coke, so get them to come up with methods than can be executed from a few feet away! (HINT: Students could make a paper funnel and try to toss the mentos in, or they could make a cylinder with a folded flat that gets pulled out with a string).

When your ready to test, go outside (preferably on grass because this is sticky) and use half of the roll of mentos for each bottle. Watch the explosion soar!

Conclusion of the activity:

Students liked to see the reaction! Reflect on the engineering and design process.

Parts of activity that worked:

The students liked to see the eruption and were cooperative in working together to develop 2 methods.

Parts of activity that did not work:

Do this outside on grass to avoid a sticky, messy cleanup. NOTE, the reaction can be more than 10 feet tall, so instruct everyone who doesn't want to get any coke on them to stand back!

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Strawberry DNA experiment
Length of Activity:	Hour and a half.
Supplies:	Strawberries, Ziploc bags, isopropyl alcohol, dish soap, tweezers, water, cups, salt.

Directions:

Start with a fun math riddle or brainteaser. Ideas can be found here or online with a simple google search: <https://icebreakerideas.com/math-riddles/> .

Explain the basics of what DNA is. What are the building blocks of DNA and what does DNA do in our body? Discuss how DNA is like the blueprint for our construction, and how every living things DNA is different. Discuss solubility and polarity, as well as protein structures in the cell membrane. This can be difficult to grasp, so just simplify it and explain “like dissolves like”. Crush the strawberries. Mix water with dish soap and add salt. Add in isopropyl alcohol and strawberries and watch the DNA separate! For more detailed instructions, look here:

<https://www.stevespanglerscience.com/lab/experiments/strawberry-dna/>

Conclusion of the activity:

The students liked the hands-on participation. Have students reflect by discussing how our DNA is similar and different from strawberry DNA.

Parts of activity that worked:

The materials are relatively easy to get, and students enjoyed following the scientific method steps.

Parts of activity that did not work:

This can get a little messy! Make sure to clean up well.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Rock Candy Experiment

Name:

Length of Activity: 2 hours

Supplies: Cane sugar (imperial brand), string (or wooden skewers), pencils (only if using string), microwave safe measuring cups, disposable cups, parchment paper, food coloring, water (with a microwave to heat it), hot pads/oven mitts, disposable tablecloth.

Directions:

Start off with an icebreaker or riddle. (Examples can be found online on websites like this:

<https://icebreakerideas.com/math-riddles/>)

Explain what solutions are (solute, solvent, dissolving, etc.). Talk about crystallization and evaporation. Explain the concept of a super-saturated solution and tell students how this excess solute leads to solid crystals forming. Microwave sugar and water together for 2 2-minute intervals, add food coloring, and use pencil to suspend string in mixture. Pull string out and let dry on wax paper (can take a long time). Re-submerge and then let sit for one week. Then you have rock candy! For more detailed instructions, reference:

<https://www.stevespanglerscience.com/lab/experiments/homemade-rock-candy/>

Conclusion of the activity:

Students got to eat their rock candy. Reflect on how science experiments sometimes take time, and that patience is important in research.

Parts of activity that worked:

When you add a lot of sugar (just as the instructions state), the experiment works really well!

Parts of activity that did not work:

Make sure to set aside time for the strings to dry initially. This could take along time, possibly a whole day! Be prepared to return to re-submerge them. When combining the sugar and water, make sure to mix well! Use hot pads to handle the hot mixture and glass! Don't use less sugar than the instructions state, otherwise you will not form a super-saturated solution, and candy WILL NOT form. This is a messy experiment, so set out a tablecloth and be ready for a sticky clean up!

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Steel Wool Experiment

Name:

Length of Activity: 1 hour

Supplies: Steel Wool (fine, grade 0), 9 V battery, aluminum pan (baking dish to set steel wool in).

Directions:

Start off with a fun science riddle or math brainteaser. Examples can be found online at websites such as this: <https://icebreakerideas.com/math-riddles/>.

Explain the concepts of voltage, current and resistance which are associated with electricity and magnetism. To explain current, explain it like a river. To explain resistance, use the analogy of boats and rocks in the river using the river (current) to move and slowing the river down. To explain voltage, use the example of a water mill at the end of the river. Talk about the chemical composition of steel wool and how it reacts with oxygen. Touch the battery to yourself and explain how nothing happens. Touch it to your tongue to feel a slight shock (you have completed a circuit)! For the experiment: touch each terminal of the battery to the steel wool and watch as it burns! More information at: <https://thehomeschoolscientist.com/steel-wool-9-volt-battery-experiment/>

Conclusion of the activity:

Students were fascinated that the wool burned, and they didn't! Use this to reflect on electrical safety.

Parts of activity that worked:

The students were engaged and there was little clean up.

Parts of activity that did not work:

It is preferable to do this outside, as the wool will make sparks/embers.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Egg Drop Experiment

Name:

Length of Activity: 1 hour

Supplies: Eggs (boiled or raw), straws, paper cups, tape, paper towels, paper plates, paper (basically, cheap household materials the kids can use to try and insulate their eggs).

Directions:

Start with a fun icebreaker. They can be found online or at websites previously mentioned in these lesson plans. Just search on google! Explain the physics concepts of acceleration under gravity and how all things fall at the same rate. Relate this back to the first club where we hypothesized this already. Then relate this to a discussion of force, momentum, and impulse-momentum theory. Use the example of an egg toss. Why do people move their hands back when they catch an egg? Because they know that increasing the time of impact will decrease the force! Using this information, students can then try to insulate their eggs from a fall using the materials given. Give students 40 minutes to design their egg cages, and limit them to 1 yd tape, 2 cups, and 2 plates each (unlimited paper towels and paper). More info can be found here:

<https://buggyandbuddy.com/stem-kids-egg-drop-project/>

Conclusion of the activity:

Students liked to compete and design their own crafts. In your reflection, relate this to engineering and how any body can design and be an engineer!

Parts of activity that worked:

Students liked to be hands-on and were invested in the activity.

Parts of activity that did not work:

Some students had already done this, so they were not as interested. It may be good to get a prize (like candy) to keep them engaged.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Newspaper construction

Name:

Length of Activity: 1 hour

Supplies: Newspaper, tape, tape measurer, books (something to test the strength of the structure).

Directions:

Start with a fun brainteaser or icebreaker from websites provided in previous lesson plans or from google! Discuss some basic principles of architecture and engineering. What makes buildings strong? What makes certain structures able to withstand stress and wind? Explain how certain shapes can hold more weight and provide pictures of basic structures as models. Then, host a series of 2 competitions to make;

- 1) The tallest tower using only 2 sheets of newspaper and 12 inches of tape in 15 minutes, and
- 2) The strongest structure (which can hold textbooks up at least 12 inches off of the ground for 10 seconds) using 10 sheets of newspaper and 18 inches of tape.

NOTE: Taping the structures to the tables is not allowed.

Conclusion of the activity:

The students worked hard to build their structures. Reflect on the building process and talk about civil engineering.

Parts of activity that worked:

Students were able to build successfully. It can be helpful to separate the club into 2-3 competing teams.

Parts of activity that did not work:

Some students did not want to participate. It could be helpful to incorporate a prize, such as candy.
