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STEM Opportunities - High School 2019

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Nebraska Honors Program
CLC Expanded Learning Opportunity Clubs
Information Sheet

Name of Club: Your Opportunities in STEM

Age/Grade Level: 9-12

Number of Attendees: (ideal number) 10-20 students

Goal of the Club: (learning objectives/outcomes)

The clubs primary objective is to inform high school students in the local Lincoln area about the many interesting opportunities and career accessible to them in STEM fields. We want to expand what being a "scientist" is to students and to teach them about the variety of careers available in STEM fields as well as demonstrate practical application of science, technology, engineering, and mathematics.

Resources: (Information for club provided by)

We find experiments for students to perform and understand from preexisting high school experiments we've performed as well as find instructions and ideas for further experiments on a multitude of websites on the Internet, including Thoughtco, Discover Magazine, Fisher Thermo Scientific, and more. We consult professors and past high school educators if needed for further advice on how to successfully inform, teach, and provide a meaningful opportunity for students.

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?)

The final products of this club is increased awareness and interest within high school students of the opportunities they are able to pursue in STEM fields. We would like to give increased self confidence to students about their ability to perform scientific experiments and inspire students in their abilities to become involved in STEM fields.

Introducing your Club/Activities:

To introduce our club, we first performed a sample experiment in a center of high student activity, in our case this was the library. We made this activity of a competition and winners received rewards (food) increasing interest. The experiment served the purpose of introducing the club to the student and raising awareness as well as increasing interest in our club. At this time we polled students on experiments they would be interested in performing as part of our club.

General Directions:

The general layout of our club began with a slideshow as well as a short informational video focusing on communicating information about the specific career we were teaching about that day. This informational presentation lasted no longer than 10-15 minutes. Following this, we assisted students via instructions and close monitoring to successfully perform the experiments we had planned for the day.

Tips/Tricks:

For a successful implementation of lesson plan set up small stations with individual supplies for each student prior to beginning the experiment, this mitigates the chass of student trying to get materials all at once. When experiments do not work out, ask students why they think the experiment failed to produce the intended results, create a discussion out of the failure.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	Geologists Rock!
Length of Activity:	50 minutes
Supplies:	All per person: 8oz water bottle Flour (3cups) Salt (1 cup) Oil (2 tablespoons) Water (1 cup) Black acrylic paint Paper plate Warm Water (1/4 full) Red food coloring (6-8 drops) Dishwashing liquid (just a squirt) Baking Soda (1 tbspoon) Vinegar

Directions:

Give a presentation detailing the careers available in volcanology and geology.

https://docs.google.com/presentation/d/1yKjeFU82kj8qiTLoO_c-3Z7lrpLlzCFQf2FyVGytqNo/edit?usp=sharing

Stir the volcano mixture until it becomes malleable and wrap around 8oz bottle to form a volcano shape. Paint black. Place on paper plate. For the lava, fill the volcano ¼ of the way with warm water. Add 6-8 drops of food coloring. Add dishwashing liquid. Add baking soda. Add vinegar. Have students collect samples of lava "rock" dough like a volcanologist would.

Conclusion of the activity:

Discuss with students if they understand the chemistry underlying the reaction making their volcano's lava. Elaborate further on the careers available in geology and volcanology.

Students should gain an understanding of basic chemical reaction concepts and careers they can pursue in geology and volcanology.

Parts of activity that worked:

Creating the volcano itself was very fun and enjoyable for most students. Adding the vinegar fairly quickly provided a more explosive reaction that students enjoyed more than gradual addition of vinegar.

Parts of activity that did not work:

This experiment worked very well overall.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	They did surgery on a grape!
Length of Activity:	50 minutes
Supplies:	5-8 Oranges 5-8 Bananas Variety Pack of Sewing Needles and/or suturing kits Thread Grapes Variety Pack of Sewing Needles and/or suturing kits Thread

Directions:

Presentation:
https://docs.google.com/presentation/d/1mOtCU89wevMUFd2EbJ3eGY6P6HPISt9ie-dPSEc-T7s/edit?usp=sharing

Cut fruit into shapes. Cleaner, smoother cuts will be easier to suture together. Thread the needles in advance of students using them. Have students sew the fruit together according to guidelines. No stitches should be too big, far apart from each other, or different in appearance from each other. Stitches that violate guidelines will cause the fruit to be thrown out. A completed piece of fruit should be able to be picked up and shouldn't be squished, deflated, or damaged. The most skilled competitors should be able to sew back grape skin onto a grape.

Conclusion of the activity:

Throughout the lesson, inform the students about the various careers suturing is applicable towards, including nurses, physicians, surgeons, physician's assistants, veterinarians, morticians, and more. Further educate them about the different types of threads and needles used in suturing, such as the various scenarios in which nylon, prolene, silk, or polyester will be used and the meanings of 3-0, 4-0, and 5-0 as well as different types of sutures.

Students should gain an understanding of the career paths available in the medical field and the necessary training and basic skills needed to pursue careers in the medical field.

Parts of activity that worked:

Suturing the larger fruits, as in the oranges and bananas, were fairly easy to suture. Not many students will be able to suture the grape skin.

Parts of activity that did not work:

We recommend peeling the grape skins ahead of the experiment as it takes some time. If you're unable to peel the grapes, cut the grapes, rather than just the skin, and have students suture the grape halves back together.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name: Ice scream, you scream

Length of Activity: 50 minutes

Supplies:

Per person:

Half & half (½ cup)

Sugar (1 tbs)

Vanilla (¼ tbs)

Ziploc bag (1 quart and 1 gallon sized)

Ice

Rock salt (½ cup)

Ice cream toppings (chocolate syrup, cherries, candy, etc…)

Directions:

Presentation:

https://docs.google.com/presentation/d/1h2NflQGRV6qbh-feWiT_XuANkotoEZrhXyabAeqJFY0/edit?usp=sharing

Mix together all of the ingredients into a quart sized Ziploc bag. Fill the gallon Ziploc bag ⅓ full of ice. Add salt into the gallon Ziploc bag and then place the quart ziploc into the gallon bag. Mix the bag for 10 minutes or until ice cream forms.

Conclusion of the activity:

Most people know that water freezes at a temperature of 32 degrees celsius. This lab shows how solutes in water can cause a freezing point depression, and subsequently cause the milk mixture to freeze into ice cream. Food chemists commonly work with chemical and physical concepts like those demonstrated in this experiment, aiming to develop and improve food products in today's society. At the end of the experiment, make sure to inform and emphasize to students the underlying scientific concepts in the experiment.

Students should gain an understanding of basic chemistry concepts regarding freezing point depression and boiling point elevation and careers they can pursue in food science and chemistry.

Parts of activity that worked:

Students successfully made ice cream using manipulation of freezing points.

Parts of activity that did not work:

Make sure individual stations with pre-measured materials are made prior to beginning the lesson plan to minimize the chaos as students grab for materials. Don't put out the toppings before the ice cream is made, they will be eaten.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name: Drinking Water, Eating Water Bottles

Length of Activity: 1 hour 30 minutes

Supplies:

Water (flavored waters and juice additionally but optionally)
Sodium Alginate
Calcium Lactate
Large Bowl
Smaller Bowl
Hand Mixer
Ladles

Directions:

Presentation:
https://docs.google.com/presentation/d/11O85lWNEpTeCSk7edu3v_zfBmWw2vnrjbwJ309XinqE/edit?usp=sharing

In a small bowl, add 1 gram of sodium alginate to 1 cup of water. Use a hand mixer to make sure the sodium alginate is combined with the water. Let the mixture sit for about 15 minutes to remove any air bubbles. The mixture will turn from a white liquid to a clear mixture. In a large bowl, stir 5 grams of calcium lactate into 4 cups of water. Mix well to dissolve the calcium lactate. Use your rounded spoon to scoop up the sodium alginate solution. Gently drop the sodium alginate solution into the bowl containing the calcium lactate solution. It will immediately form a ball of water in the bowl. You can drop more spoonfuls of sodium alginate solution into the calcium lactate bath. Just be careful the water balls don't touch each other because they stick together. Let the water balls sit in the calcium lactate solution for 3 minutes (Note: the time determines the thickness of the polymer coating. Use less time for a thinner coating and more time for a thicker coating.). Using a slotted spoon gently remove each water ball. Place each ball in a bowl of water to stop any further reaction. Remove edible water bottles and drink them.

Conclusion of the activity:

Have students try to eat the water bottles they made. Discuss with them ideas they have that can help prevent waste and encourage environmental awareness. Have them act as an environmental engineer in devising ideas on how to mitigate human environmental impact.

Students should gain an understanding of what environmental engineers do and how they contribute to today's society.

Parts of activity that worked:

We successfully made droplets of water encased in calcium lactate and sodium alginate. Using purple gatorade, we were able to achieve similar results of somewhat flavored edible water droplets.

Parts of activity that did not work:

It was very difficult to make complete water bottles, rather, small blobs containing water were made. They were more gelatinous than filled with water. This could have been in part that the experiment was performed outside as it was a nice day and the reaction requires cooler temperatures and electric mixing. Inform participants prior to the experiment they should expect drops rather than large containers from this experiment.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	Pringle Ringles
Length of Activity:	50 minutes
Supplies:	Multiple Cans of Pringles

Directions:

Presentation:
https://docs.google.com/presentation/d/1WsNU1lXgG0L8p4V8aK5evMGnkKrpujxxvFieSrtlfS0/edit?usp=sharing

Give students pringles, a can or less should be enough to build and entire ring. Show a youtube video demonstrating the construction of the ring or a premade pringles ring you have already constructed. Have students try to build rings like in the video. The first one done gets a high five and can eat theirs first.

Conclusion of the activity:

Throughout the experiment, explain to students physical and mathematical concepts involved in the construction of the ring.

Students should gain an understanding of hyperbolic paraboloids and other mathematical shapes as well as basic physics concepts of friction and gravity. They should understand the careers they can pursue in the fields of physics and mathematics.

Parts of activity that worked:

Two students were able to successfully construct the pringles ring. The other students seemed to enjoy the experiment despite being unable to also construct the ring.

Parts of activity that did not work:

Very few students were actually patiently able to construct this ring out of Pringles. It is easier to build a ring on a flat surface instead of plates, clean tables before making rings or use a flat mat or wax paper.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	Walking on Water...well more like Oobleck!
Length of Activity:	50 minutes
Supplies:	100 boxes of cornstarch (may be excessive, depends on the size of the pool) 10 gallons of water Small plastic kiddie pool or large plastic tub Bottle of ketchup

Directions:

Go outside! Pour all corn starch into the pool. Mix all of the corn starch with equal parts water. Have students take turns running across the water. Have them take turns stepping in, sinking, and getting stuck in the oobleck. Explain the properties of non-Newtonian fluids. Explain various applications of non-Newtonian fluids to material chemistry. Show the concept of non-Newtonian fluids in a bottle of ketchup to supplement the explanation of these unique substances.

Conclusion of the activity:

By the end of this experiment, students should understand basic chemical and physical concepts that make oobleck the way it is. Students should understand careers they can pursue in material chemistry.

Parts of activity that worked:

N/A (unperformed)

Parts of activity that did not work:

N/A (unperformed)

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	EW Bacteria!
Length of Activity:	50 minutes
Supplies:	Plastic Petri Dish Nutrient Agar Powder as Growth Medium for Bacteria Sterile cotton swabs for collection of bacteria Beaker Stirring Stick

Directions:

Have students practice making hypotheses regarding the places in the school with the highest amount of bacteria. Have them swab areas they believe have higher levels of bacteria. Demonstrate how to swatch area on petri dish for proper bacterial growth and laboratory techniques such as streaking agar. Store the bacteria in a dark cabinet or other convenient place for bacterial growth for about a week. Observe and measure bacteria next week.

Conclusion of the activity:

Throughout the lesson, we should be informing the students about bacterial growth, including the concept of limited and exponential growth, the distinction between bacteria and viruses, how disease is contained, and the careers of epidemiology and other professions in public health.

By the end of this experiment, students should have a more thorough understanding of what bacteria and viruses are. They should understand the potential careers waiting for them in epidemiology and the life sciences.

Parts of activity that worked:

N/A (unperformed)

Parts of activity that did not work:

N/A (unperformed)

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name: Drop it like it's Hot

Length of Activity: 1 hour 30 minutes

Supplies:

Paper
Plastic Bags
Straws
Cups
Packing peanuts
Marshmallows
Foam
Tape
Glue

Go wild, anything that you think could be useful or fun at the store, someone will find a way to use!

Directions:

Presentation:
https://docs.google.com/presentation/d/14yPmChY4zQH5ILLO3SpLhvbQ1wPtiyldWn69aWvxqU4/edit?usp=sharing

Set out all materials in a visible area but do not allow students to touch any materials. Students are given ten minutes (timed) to plan what they're going to make to protect their eggs from the drop. Give students 30 minutes to build their contraptions. At the end of the 30 minutes, have everyone bring their devices to the front so they can be loaded with an egg. Choose a low drop height to drop the eggs from. This should be around five feet off the ground. Drop each contraption one by one until all the teams have gone. Check to see if the eggs have survived. If the eggs survived the lower drop height find a relatively higher place to drop them from. Again drop eggs one by one from the higher drop point. Any eggs that survive will receive a reward.

Conclusion of the activity:

Students should understand basic physics concepts and have increased self-confidence in their ability to create, engineer, and innovate mechanical devices.

Parts of activity that worked:

Students seemed to enjoy the design aspect of using given materials to construct a contraption of their own! After constructing one device, they even asked to construct a second device to retry dropping eggs that didn't break. They particularly enjoyed using peanut butter, bread, and marshmallows to construct their egg protection devices. Due to the students' gravitation towards food items, it could be fun to provide only other food materials to construct an egg protection device for future attempts.

Parts of activity that did not work:

We would recommend that you identify several locations to potentially drop the eggs from in advance and garbage bags or tarps be put down to contain any messes as eggs drop. We further recommend having each contraption be wrapped in a plastic bag if possible prior to dropping to contain the mess of breaking eggs.

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name: Race to the Finish

Length of Activity: 50 minutes

Supplies:

Cardboard
Plastic bottles
Paper or paper plates
Bottle caps
CDs (optional but make for better wheels)
Long wooden skewers / toothpicks
Pipe cleaners
Balloons
Rubber bands

Directions:

Start with the base of the car of your choice. Here is where students are most likely to use cardboard, paper or paper plates, for example. The rest of the lab should be spent on the construction of the car and is primarily up to the creativity of the students and how they choose to assemble or design their projects. Once the cars are bound together, likely with the use of balloons, rubber bands, or other similar materials, student will be given one chance to push their cars as strong as they can to race their cars across the floor. The car that goes the farthest wins a competition.

Conclusion of the activity:

Students should understand basic physics concepts as well as careers available as mechanical engineers. They should understand the role of mechanical engineers in today's society.

Parts of activity that worked:

N/A (unperformed)

Parts of activity that did not work:

N/A (unperformed)

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	Book ‘em and Print ‘em (Forensic Lesson 1)
Length of Activity:	1 hour 30 minutes
Supplies:	Microscope Slide Fingerprint powder (ie talcum powder, cornstarch, or cocoa powder) Soft Hair Small Paint Brushes Clear Tape Lotion Stamp Ink Pad Microscope Slides Small Airtight Jars or Containers (tupperware or mason jars) Piece of Aluminum Foil Superglue Cup or Bowl of Hot Water

Directions:

Touch a microscope slide with a finger a few times to leave prints. Use lotion on the hands for more obvious prints. Set the slide on a piece of paper before dusting.Sprinkle a little bit of powder on the microscope slide, then gently swipe off the excess powder with a soft brush, being careful to leave the fingerprint intact. This may take some practice to get right. Stick a piece of clear tape over the fingerprint firmly, and then lift it up; the print should adhere to the tape. You can then stick it to contrasting paper to maintain a record of the print. After you become proficient with dusting a slide, try to test other surfaces like doorknobs or faucets.Handout Fingerprint Analysis Worksheets and have students stamp their own fingerprints onto a paper. For fuming rather than dusting for prints, touch the microscope slide with your finger to leave latent prints on it. Place the piece of aluminum foil in the bottom of the airtight container. Put 3 drops of superglue on the center of the foil. Place the microscope slide in the container (don’t let it touch the glue; you may need to prop it up diagonally). Put the lid on tightly. Place the container in a cup or bowl of hot water. The heat will cause the superglue to give off fumes more quickly. After 15-20 minutes check the microscope slide to see if any prints have developed on it. They will appear an off-white color and can be seen well if you hold the slide up to the light or over a piece of black paper. Analyze fingerprints.

Conclusion of the activity:

Students should understand the fundamental chemical reactions in fuming for fingerprints and conceptualize the careers they can pursue in the field of forensic science.

Parts of activity that worked:

N/A (unperformed)

Parts of activity that did not work:

N/A (unperformed)

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name: Colorful Chromatography (Forensic Lesson 2)

Length of Activity: 50 minutes

Supplies:

Coffee Filter paper
3-4 different brands of black markers (Crayola, Sharpie, Generic, etc.)
Scissors
Small cups or beakers (one for each marker being tested)
Toothpicks
Rulers
Water

Directions:

Pour 10 mL of water into a beaker or small cup. Cut a strip of filter paper to form a point at one end. Choose a marker to test. Record the brand you are testing on the edge of the filter paper. Use the marker to make a good-sized dot of color (about a grain of rice) about 1.5 cm from the pointed end of the paper. Use a pencil and make a mark on the paper strip beside the ink dot. Lower the pointed end of the paper into the solvent but make sure the color dot stays above the solvent level but make sure the color dot stays above the solvent level. Carefully push a toothpick through the top of the paper to hold the strip at just the right level in the beaker or cup. The solvent should immediately start moving up the paper strip carrying the ink pigments with it. While waiting for the solvent to rise toward the top of the paper, set up your other beakers and test other markers! When the solvent has finished moving up the filter paper, you can remove the paper from the test tube and mark with a pencil the highest point the solvent traveled up the paper strip.

Conclusion of the activity:

Students should understand the fundamental chemical reactions in chromatography, its applications to real life, and conceptualize the careers they can pursue in the field of forensic science.

Parts of activity that worked:

N/A (unperformed)

Parts of activity that did not work:

N/A (unperformed)

Lesson Plan Worksheet

(copy table as needed)

Lesson Activity Name:	Orange you glad we know how to extract DNA? (Forensic Lesson 3)
Length of Activity:	50 minutes
Supplies:	1/2 Peeled ripe banana (you can also use strawberries or other fruit) 1/2 cup hot water 1 tsp salt 1/2 tsp liquid dishwashing soap Resealable Ziploc bag (quart size) Cold rubbing alcohol (isopropyl alcohol) Coffee filter Narrow glass cup Wooden stirrer

Directions:

Crush a banana or other fruit in a resealable bag for a minute until the mixture is uniform and resembles pudding. Fill a cup with hot water and salt.Pour saltwater mix into the bag. Close the bag and squeeze the bag to mix the saltwater with the fruit. Do this for about 30 - 45 seconds. Add dishwashing detergent to this bag. Further mix these contents. Place a coffee filter on a clear glass cup, securing the top of the filter around the lid of the cup. Pour the mix into the filter and let the apparatus sit until liquid finishes dripping into the cup. Remove the coffee filter and throw away. Tilt the glass and slowly add cold alcohol into the cup. The alcohol will form a distinct layer on top of the fruit mixture. It needs to stay in a separate mixture so don't pour too fast. Pouring too fast will disturb the mixture and mix the two layers. Pour about 2.5-5 cm of alcohol. Wait eight minutes. Bubbles and cloudy material in the alcohol is the DNA moving! Use a wooden stirrer to start poking the cloud stuff in the alcohol layer. Spinning a stirrer to gather the cloudy stuff will effectively grasp the DNA. Students can examine this cloudy stuff! It's DNA!

Conclusion of the activity:

Students should understand the fundamental chemical reactions in the extraction of DNA, including the purpose of using saltwater, dish soap, and alcohol, its applications to real life, and conceptualize the careers they can pursue in the field of forensic science. They should additionally understand basic

biotechnology commonly used in forensic science and significant cases in which biotechnology has played a pivotal role.

Parts of activity that worked:

N/A (unperformed)

Parts of activity that did not work:

N/A (unperformed)
