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Full STEM Ahead

Shawn Knowlton

Megan Elbel

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NEBRASKA HONORS PROGRAM
CLC EXPANDED LEARNING OPPORTUNITY CLUBS
INFORMATION SHEET

Name of Club: Full STEM Ahead

Age/Grade Level: Elementary and Middle School

Number of Attendees: (ideal number) 20-25 Students

Goal of the Club: (learning objectives/outcomes)

Our club aims to introduce STEM concepts, foster teamwork, critical thinking, and problem solving, and encourage students to pursue STEM subjects.

Resources: (Information for club provided by)

Invisible Ink: <https://www.kidzworld.com/article/3844-making-invisible-ink-appear>

Cabbage pH Indicator: <https://www.youtube.com/watch?v=I18K2upEHLc>

Hexaflexagons: <http://vihart.com/hexaflexagons/>

Oobleck: <https://www.livescience.com/21536-oobleck-recipe.html>

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?)

Students will be able to take some of their experiments (invisible ink, Oobleck, hexaflexagons) home with them. There is no formal final project.

Introducing your Club/Activities:

Full STEM Ahead consists of table/group experiments that encourage teamwork and problem solving.

General Directions:

Present a STEM topic to the class, and explain how it is relevant or significant. Then, introduce the corresponding experiment and provide necessary instructions. While the students are working on their experiments, provide gentle guidance and answer questions. After the experiment is complete, recap the STEM topic and the lessons learned. Ask the students critical questions, like “What did ‘x’ show us?” or “Why did ‘x’ behave in this way?”.

Tips/Tricks:

Incentives are a good way to keep the students on task. We gave kids tickets for participating and behaving well, which they could later redeem for small toys or candy.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name: Introductions and STEM Nametags

Length of Activity: 1 Hour

Supplies: Paper and coloring supplies

Directions:

Introduce yourself to the students, and ask them if they know what STEM stands for. Give examples of the 4 parts of STEM. Then, ask students what they enjoy doing or what jobs they would like to have and relate their answers back to STEM. For example: Sports are related to physics (angles and momentum), video games rely on programming and computer science, and veterinarians need to study biology.

For the nametag activity, pass out a piece of paper and coloring supplies to all students. Have the children draw their name on the paper and decorate it with STEM-themed images. If children aren't sure what to draw, simply ask them what they like and explain how that may relate to STEM. Rocket ships, flowers, and dinosaurs call all be tied into a STEM field. Once the name tags are finished, sit in a circle and have the students present their name tags and explain their decorations.

Conclusion of the activity:

Students will understand the four parts of STEM, be more familiar with the instructors, and understand that STEM is involved with many activities they enjoy.

Parts of activity that worked:

It provided a wonderful way of exploring how things relate to STEM fields. Allowing them to draw anything STEM related resulted in exceptional drawings of rockets, butterflies, animals, etc. Students were proud of their artwork and seemed to enjoy drawing.

Parts of activity that did not work:

Some students were not willing to share in groups. In this case, we simply had them show us and we presented it.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Spaghetti Towers
Length of Activity:	1 Hour
Supplies:	Spaghetti noodles, scotch tape, and string

Directions:

Give students a thick bundle of dried spaghetti noodles, 2 meters of string (and scissors to cut the string), a jumbo marshmallow, and 3 1-foot strands of scotch tape. The students can use all of these materials to build their spaghetti tower in any way they see fit. The final spaghetti tower must be able to remain standing once another jumbo marshmallow is placed on top. The tallest tower that can still support the marshmallow is the winner. Allow time at the end for students to dispose of their towers. Furthermore, students are allowed to build any way they want as long as the tower is free-standing.

Conclusion of the activity:

This is a team-based Engineering exercise. Students will cooperate and work together to build their towers. This introduces teamwork and problem-solving skills. This task also seemed to excite the students for next week's activities.

Parts of activity that worked:

Students were very excited, and every student was wanting to participate. Furthermore, offering tickets to the winners promoted lots of participation.

Parts of activity that did not work:

Students would oftentimes struggle to participate as a team, and some students' ideas were disregarded. In this case, provide encouragement for teamwork through the ticket system discussed in the tips and tricks.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Disappearing Ink
Length of Activity:	30 Minutes
Supplies:	Baking soda, water, Q-tips, white paper, grape juice concentrate, sponge

Directions:

Invisible ink instructions: <https://www.kidzworld.com/article/3844-making-invisible-ink-appear>
Mix the invisible ink according to the instructions, and have the students paint on to the white paper using Q-tips. Once their messages are dry, dip a sponge into the grape juice concentrate and run it over the page to reveal the hidden message.

Because the grape juice is acidic and baking soda is a base, they react with each other, staining the part of the paper where the secret messages were written.

Conclusion of the activity:

Students will have a better understanding of chemical reactions. They will become familiar with the idea of the pH scale, and they will also learn how it relates to chemistry, a STEM field.

Parts of activity that worked:

Hidden messages were revealed quite well with a color change to green when using an acceptable amount of baking soda solution.

Parts of activity that did not work:

Some students painted either too much or too little baking soda solution. This resulted in not being able to see whatever message they drew or wrote on the paper.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name: Colorful Volcanoes

Length of Activity: 30 Minutes

Supplies: Cabbage water, baking soda, vinegar, clear plastic cups

Directions:

Cabbage water pH Instructional Video: <https://www.youtube.com/watch?v=I18K2upEHLc>

Students will likely be familiar with the classic baking soda and vinegar volcano model. This activity improves upon the tried-and-true demonstration of chemical reactions.

First, introduce students to the pH scale. The number 7 on the pH scale is in the middle and neutral. Water is a 7. Numbers below seven are acidic, and numbers above 7 (up to 14) are basic. Acids and bases react with each other.

For a demonstration of the pH scale, set out 3 glasses of red cabbage water, which reacts with acids and bases. They should all be a dark purple. Pour some of your base (in this case, baking soda) into a cabbage water solution. Explain to the students that it is becoming green because the cabbage water is reacting with the base. Pour vinegar into another cabbage water solution. Because vinegar is acidic, the solution should turn a bright red. Keep the neutral cabbage water solution in the middle as a baseline.

To set off the colorful volcano, pour your vinegar solution into your baking soda solution. The solutions should have a dramatic baking soda volcano reaction, but this time with color! Once the reaction is complete, and the acid and base have neutralized each other, the color in your cup should be the same as the color of your neutral cabbage water cup.

Conclusion of the activity:

Students will understand that some chemicals can react very actively and will deepen their understanding of the pH scale. This will also help to demonstrate how opposites on the pH scale react to neutralize.

Parts of activity that worked:

The cabbage water worked very well at showing the acidity of any solution put into it. The color change for acids was intense and wowed the students. At the end, we used the neutral cabbage solution for the volcano, and it caused a huge color shift during the reaction that made a variety of colors that amazed students.

Parts of activity that did not work:

The bases we used to show color difference were not basic enough. This resulted in only a slight color change and was not as dramatic in its color change.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name: Tape roll, Yarn, and Ball Activity

Length of Activity: 5-10 Minutes

Supplies: A roll of duct tape (or a similarly ring-shaped object), a soccer ball, a spool of yarn, scissors, and a backpack.

Directions:

Cut several (10-15) 4-foot long strands of yarn, and tie them to the roll of tape. Place an unzipped backpack several feet away, it will serve as the goal. Have students stand around the roll of tape and hold on to their yarn, suspending the tape roll in the air between them. Place the soccer ball on the roll of tape, balancing. The students will use teamwork and problem-solving skills to walk over to the backpack (balancing the soccer ball) and drop the ball into the bag. If the ball falls off early, they must go back to their starting point.

Explain to the students that just as their teamwork got the soccer ball into the backpack, teamwork and coordination also got man to the moon. This activity is a good introduction into the bottle rocket activity as it is quite a quick one.

Conclusion of the activity:

Students will learn coordinate with each other while working towards a goal. Furthermore, the activity will help foster the development of the students' problem-solving skills as more and more problems were introduced.

Parts of activity that worked:

Every challenge we introduced to the students were solved swiftly but were still challenging as the ball needed to be balanced.

Parts of activity that did not work:

Students sometimes struggled with getting the ball balanced due to lack of teamwork. This led to some students getting angry. Eventually students would start fighting until we intervened by presenting new ways to solve the problem.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Bottle Rockets
Length of Activity:	20-25 Minutes per group
Supplies:	Empty 2-liter soda bottles, bike pump, bottle rocket launchpad

Directions:

Find or build a bottle rocket launchpad. Our club was fortunate enough to have one on hand. Attach a bike pump to the air intake nozzle on the launcher, and put a 2-liter bottle on the launching stem. Slide the safety lock up over the neck of the bottle to hold it in place. Introduce the students to air pressure by telling them that the more pressure they have in the bottle rocket, the higher it will go. Demonstrate by putting a few weak pumps of air into the bottle, and have them note that it didn't get very far once you launched it. Emphasize that it was such a weak launch because it didn't have much air pressure. Then, pump it full of air as much as you safely are able, and let it fly. Have students note that it went much higher because there was more air pressure in the bottle.

After you have demonstrated the safe way to launch the bottles, allow students to launch their own bottles. Make sure that they squat down to the side of the launcher and don't lean over the bottle as they release it. You can encourage the students to try and catch their bottles too, if they would like.

Conclusion of the activity:

Students will become familiar with air pressure, thrust, and other terms that could impact their understanding of a simplified version of basic physics. They will also become familiar with potential opportunities in the engineering fields involving physics and rocket science.

Parts of activity that worked:

The bottles launched far into the air and students had a blast launching them. Club staff told them to try to catch their own rockets for tickets as they fell slowly enough to safely catch. This ended up being a blast for the students.

Parts of activity that did not work:

Students would often be overly excited about launching and as a result, they would often disregard all safety instructions. We were constantly instructing them to stand back or not to lean over the rocket at any moment. This was a large concern throughout the activity.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Oobleck
Length of Activity:	40 Minutes
Supplies:	Corn starch, water, Styrofoam bowls, plastic stirring spoons

Directions:

Oobleck website: <https://www.livescience.com/21536-oobleck-recipe.html>

Oobleck is a special type of slime. It is a non-Newtonian fluid, which means it has properties of both solid and liquid objects. In styrofoam bowls, have students mix 1 part water with 1.5 - 2 parts corn starch. You can also provide the students with food coloring for more vibrant slime. Once the Oobleck is mixed well, demonstrate that if you dip your finger in slowly, it behaves like a liquid, and if you tap or hit it rapidly it is hard like a solid. If the students make a mess, the Oobleck can easily be washed off with soap and water.

Conclusion of the activity:

Students will be familiar with a new type of substance interaction. It will also result in the understanding of matter and its different states of matter (solids, liquids, gasses, etc).

Parts of activity that worked:

Bringing bowls to mix the Oobleck in helped to avoid messes as we could just dispose of the bowls afterwards. The students also loved the ability to take the Oobleck home to play with later.

Parts of activity that did not work:

The Oobleck was difficult to get right every time, so we ended up having to add or take away cornstarch from nearly every kid to get the perfect consistency. This caused the activity to be a lot longer than intended. Furthermore, the plastic spoons we brought kept breaking once the mixture became tougher to stir. This could be a problem as the plastic could be sharp after breaking and could injure someone.

LESSON PLAN WORKSHEET

(copy table as needed)

Lesson Activity Name:	Hexaflexagons
Length of Activity:	20 Minutes
Supplies:	Hexaflexagon template paper, scissors, coloring supplies

Directions:

Hexaflexagon instructional video: <https://www.youtube.com/watch?v=Svq2Kscmmwc>

Printable Hexaflexagon template: <http://vihart.com/hexaflexagons/>

Pass out a printed hexaflexagon sheet to each student, and instruct them to cut them out. Then, following the instructions on the sheet and in the video, have them fold and assemble their hexaflexagons. Demonstrate that the hexaflexagons can be turned inside-out to reveal 3 sides.

Conclusion of the activity:

Students will engage in a fun hands-on exercise about geometry and shapes. This will also serve to introduce students into more advanced math topics such as complex geometry. As a result, it serves to introduce the idea that mathematics can also be more than just a “sheet full of problems”.

Parts of activity that worked:

The students were amazed by the ability to show so many different colors just by simply flipping the hexaflexagon in a different way. The templates we printed off made the hexaflexagons easy to make for any age.

Parts of activity that did not work:

The gluing of the hexaflexagons did not work so well due to the children not knowing much about how to glue it correctly. Furthermore, it was easier to glue with extra hands helping hold it. This led to staff and us gluing a lot of the students’ hexaflexagons ourselves.
