



PROJECT TITLE: Fun with Chemistry

PROJECT TAGLINE/CAPTION (160 characters): A Houston area outreach program to inspire elementary through high school students to explore science with hands-on, exciting, and educational demonstrations.

IMAGE:



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Name of Group/Organization: László Kürti Lab

PROJECT DETAILS

Fun with Chemistry will travel to local schools in the greater Houston area to perform shows and teach students of all ages to develop an interest and love of science. The project is a collaboration with Dr. Katherine Biberdorf's Fun with Chemistry program at The University of Texas at Austin.

We have several shows outlined based on the age of the audience. For younger elementary age students, the "chemistry circus" includes safe demonstrations such as placing helium

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balloon animals in liquid nitrogen, making colorful silly putty, genie in a bottle, elephant toothpaste, and universal indicator tests. For older elementary and middle school students, the fire breathing dragon and hydrogen balloon fireworks are added. These demonstrations all focus around the central concepts of states of matter, physical versus chemical changes, endothermic versus exothermic processes, and combustion reactions. Depending on the age of the audience, the explanations throughout the presentation can be modified to be more or less in depth. All the activities allow for audience participation in the demonstration as well as time for collaborative discussion between peers about the related science. Depending on the requirements of the venue, the shows can range in duration from 30 minutes to an hour.

For high school students, we incorporate higher-level concepts through some of the same demonstrations while also adding bottle rockets and alcohol cannons. These demonstrations incorporate many of the same general principles, but the explanations are more in depth for the older audiences. Demonstration of the fire-breathing dragon using flour, cornstarch, and powdered sugar allows the students to think about the molecular composition of the substances to determine trends in reactivity. For the alcohol cannons, the differences in methanol, ethanol, and propanol are evaluated to understand how changing the length of the carbon chain induces a different chemical response. The table below describes the outcome and results of some typical experiments.

Name of Experiment	Description of Experiment	Concept
Genie in a Bottle	Hydrogen peroxide decomposes into water and oxygen gas in the presence of a manganese catalyst. Steam is observed.	Exothermic chemical change and decomposition reactions
Universal Indicator	Universal indicator is combined with water, varying amounts of base, and dry ice. Color changes occur and dry ice solid becomes gaseous.	Physical change (sublimation, endothermic), chemical change (colors, exothermic), acid/base chemistry
Fire-breathing Dragon	Flour, powdered sugar, and cornstarch are blown over a propane torch to produce a temporary flame.	Properties of combustion reactions, differences between fuel sources based on molecular composition
Hydrogen Balloon Fireworks	Balloons are filled with hydrogen gas. Potassium chloride, sodium chloride, copper chloride, and strontium chloride solutions are added to one balloon. Balloon is ignited with a long stick with a candle. Each balloon displays a different color when popped.	Energy absorption of inorganic salts to produce color changes, combustion reactions
Liquid Nitrogen Thunder Cloud	Liquid nitrogen is poured over boiling water in a bucket. Giant cloud erupts.	Thermal energy, endothermic processes, liquid nitrogen vaporization to gaseous nitrogen

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Balloon Animals in Liquid Nitrogen	Balloon animal is placed in liquid nitrogen. Balloon becomes smaller and expands as it warms to room temperature.	Compression of air molecules, thermal energy, endothermic processes
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Our show also can be modified to connect with school interests and seasonal activities. For example, the helium balloon animals can be made into the shapes of a school mascot to get the students more involved in the presentation. Some demonstrations such as the puking pumpkin and exploding watermelon are added seasonally around Halloween and summertime. Additionally, depending on the audience, food chemistry demonstrations can be included where the audiences participates in creating and consuming ice cream made with liquid nitrogen!

Overall, the purpose of the program is to show students that science can be exciting as well as educational. We take safety very seriously and will provide the appropriate personal protective equipment for ourselves as well the volunteers. We are fully aware of the hazards associated with each demonstration and have established thorough procedures in case an experiment does not proceed completely as planned.

Timeline: If the project will take place at a specific time and place, please give details. Is it a one-time event or a series?

Fun with Chemistry will be a year-round program. Our first show was conducted in early May 2017 at The Woodlands High School for the Science National Honor Society club. We have just begun planning a second show for the week of July 17th with CampSpark! here at Rice University.

This summer we will begin advertising the program to establish a list of graduate and undergraduate students who are interested in volunteering. Once school resumes in the fall, our goal is to perform one show each month at a local elementary, middle, or high school.

Audience: Who is your target audience? (e.g. program-specific, interdisciplinary, or university-wide? Will undergraduates, faculty, staff, or postdocs be involved? Any off campus participants?)

The target audience is elementary through high school students in the greater Houston area. Off campus participants include teachers at the schools we are visiting.

Fun with Chemistry events will be organized by:
 Nicole Behnke, Outreach Coordinator and Director
 Kaitlyn Lovato, Activities Director
 Katie Kuykendall, School Liaison
 Dr. László Kürti, faculty sponsor, Associate Professor of Chemistry

We will ask for volunteers to help setup and conduct each show. These volunteers will include undergraduate and graduate students in science fields at Rice University. We are not restricting the program to chemistry students, but are interested in any STEM field volunteer who is interested in working within the community to get kids excited about science.



How many people do you anticipate will participate?

The participation depends on the event, but can range from smaller individual classes of 15-20 students to larger events of 50-100 students.

Marketing Plan: How do you plan to publicize the project?

We will advertise the program through the Graduate Student Association weekly newsletter and the Chemistry Graduate Student Association. Additionally, we will post on these Facebook and Instagram pages to spread the word. To reach undergrads, we will advertise with the Owlchemy chemistry organization. We plan to gain a list of volunteers who want to participate in the program. For each show, we will send out email notifications to our volunteers with a sign-up.

To spread the word about Fun with Chemistry and develop relationships with schools and teachers in the Houston area, we will also reach out to larger science events in the Houston area. For example, we are interested in performing a show at the next Science and Engineering Fair of Houston and at seasonal events at the Children's Museum.

ADVANCEMENT

What are the goals of the project?

1. **Get kids excited about science!** Many students throughout their primary education do not enjoy science and do not get the opportunity to experience creative, hands-on, and relevant applications of this field. Our goal is to introduce exciting and entertaining demonstrations in an educational way to help students understand that chemistry really is fun. By instilling these ideals at an early age, we can encourage young students to continue exploring and experimenting to one day pursue a career in science.

2. **Get girls interested in science!** Women continue to be under-represented in science careers. Many times this is due to a lack of science-based female role models for children. Our Fun with Chemistry shows are led by three female, chemistry graduate students who hope to inspire young girls to continue in science fields by acting as strong role models.

3. **Find creative ways to present science!** We believe that the way information is presented can have a strong impact on the outcome of the lesson. Students who are only taught by PowerPoint lectures and textbook readings can easily become bored with a subject that is so focused around hands-on applications. Our presentations are instead focused on participation and discussion. By starting with a short introduction of the topic, we are able to present important information before diving into the exciting and fun demonstration. After application of each concept, we ask critical thinking questions tailored to the level of the audience and ask students to discuss with their peers. This fosters intellectual discussion of the lesson and allows students to begin thinking critically and creatively about science.

Briefly explain the need for the project and how it will promote excellence in scholarship, training, and/or development?

The United States currently ranks 44th in STEM education in the world. Factors such as lack of available funding and experienced science teachers, especially in areas of low income and high



ethnic minority populations, create a lack of exposure and interest in science. We strive to resolve this issue by piquing curiosity through fun demonstrations, highlighting important educational lessons, and providing role models who are currently pursuing higher education in STEM fields. As the STEM industry is one of the fastest growing areas, this gives the students an opportunity to meet real life scientists and hopefully be encouraged to pursue a STEM field in college.

In addition to the help provided to the community, Fun with Chemistry provides many opportunities for graduate and undergraduate students at Rice University to grow. Through the program, our volunteers will work on presentation skills, leadership, and involvement in the Houston community. While much of graduate school is taken up with research, this program allows students to take fun break while continuing to expand important skills necessary for a career in science.

If this is an existing project/event or a similar one exists, describe how the project/event is being expanded or enhanced.

Fun with Chemistry is an established program at The University of Texas at Austin run by Dr. Katherine Biberdorf. This program focuses on outreach in the Austin area whereas we are working to establish educational impact in the Houston area. Compared to the program at UT, our program will be run by graduate students. This will provide the graduate students coordinators and volunteers with the opportunity to develop teaching skills as well as increase involvement within the community. Additionally, some of the demonstrations will be focused on the visibility and school spirit of Rice University. As the program expands, we will continue to create new and innovative demonstrations.

If your proposal is for a pilot project, suggest how it might develop over a three-year period.

One of the future goals of our program is to conduct a chemistry demonstration show once per month. In order to do this, we need to start slow and work our way up by developing critical relationships with local schools and teachers. Our first show was in May and we will be conducting another in July. This summer, we will begin contacting schools in the Houston area to plan upcoming shows when school resumes in the fall. Our initial estimate for the first year of operation is to conduct a show every 3-4 months. These shows will mainly incorporate already established demonstrations and will allow us to build inventory of necessary supplies. In our second year, we plan to conduct a show every 2-3 months and begin experimenting with new demonstrations. By the third year, we hope to conduct one show per month and have a well-organized list of demonstrations and different show topics.

Describe how you will measure the success and impact of this project. Please, provide quantitative targets, if possible.

One way to measure the success of the program is with the frequency of shows and number of students in the audience. If we are successful in developing important relationships with schools in the community, then the number of shows we conduct should increase throughout the next few years. Additionally, once we establish a good reputation, we hope to perform shows at larger events such as local area science fairs and children's museums.

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Another way to quantify the impact of the project is through student and teacher evaluations. At the beginning of each show we will ask students to raise their hands if they are interested in science. At the end of the show we will repeat the question and see how many students have changed their answer. Hopefully we will be able to ignite curiosity in these students that will continue throughout their education and eventually influence career paths. Additionally, we will create a satisfaction and comment survey to be filled out by the teachers. Based on the feedback, we will modify the shows accordingly to incorporate different demonstrations or explanations. Over time, as we become more familiar with the audiences, the feedback should continue to be positive with fewer areas for improvement.



BUDGET

Itemized Budget

Please, provide an itemized budget. List each item, a description, and the anticipated cost.

Item	Description	Cost
Activity Supplies: Chemicals	Hydrogen peroxide, methanol, ethanol, propanol, potassium chloride, sodium chloride, strontium chloride, copper chloride, calcium carbide, potassium iodide, etc.	\$1,200
Activity Supplies: Household	Dish soap, balloons, tarps, food coloring, trash bags, Ziploc bags, cornstarch, flour, plastic cups and spoons, candle stick, string, vinegar, glue, borax, milk, yeast, water jugs, PVC pipe, etc.	\$700
Propane Torch	For fire-breathing dragon and hydrogen balloon demonstrations	\$30
Travel	Transportation to and from each show, reimbursement for gas mileage	\$500
Folding Dolly Cart	Cart to transport materials to and from the shows	\$50
Storage Containers	For packaging of materials into organized sections	\$120
T-shirts	For volunteers, with logo design	\$300
Liquid Nitrogen	For several demonstrations, require approximately 10 liters per show (\$2.25/liter at the chemistry stockroom)	\$200
Dry Ice	For several demonstrations, require approximately 3 pounds per show (\$7/pound at the chemistry stockroom)	\$250
Glassware	Beakers, graduate cylinders, Erlenmeyer flasks, vials. New glassware that will avoid contamination from laboratory glassware.	\$100
Electric Water Boiler	To heat water for the liquid nitrogen thunder cloud demonstration	\$50
Total Expenses		\$3,500.00

Funds from other sources

Please, provide any information on funds from other sources that you have secured or potential funds that you plan to apply for.

Source	Status	Cost
Welch Foundation	Writing application for February 2018	\$50,000

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Total Amount	\$50,000
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If the project/event has been offered in the past, how was it supported?

The show conduct in May at The Woodlands High School was supported by supplies from the Fun with Chemistry program at The University of Texas.