2021-2022 Science for All Outreach Program
Annual Report
8/4/2022

In 2021-2022, UMN Science for All (SFA) worked with **four teachers across three Minneapolis and Saint Paul middle schools to conduct 30 visits** with hands-on science experiments focused on teaching scientific-method-focused inquiry. A summary of participants and experiments conducted can be found below (**Table 1**). The experiments this year covered broad topics including magnetism, fluid flow, neuroscience, electrochemistry, and much more. The fifty minute school visits consisted of a pre- and post-evaluation, brief background of the topic, and the majority of time was spent doing the experiments. All visits over the 2021-2022 year were held in-person with graduate students visiting the classrooms every month. Each visit had **at least one grad student per five middle school students**. The graduate student guided the students through experiments, answering questions that arose. For more information about the experiments completed this year visit the SFA blog, sfa.cems.umn.edu/blog.

Due to capacity limitations and COVID-restrictions, we weren't able to reconnect with all of our previously partnered schools, but we were able to build partnerships with Heritage STEM Academy and Andersen Middle School. We continued our partnership with Murray Middle School for the 5th consecutive year. We **worked with 130 students** throughout the year. Continued funding has allowed SFA to keep growing and expanding the number of schools and classrooms we are able to visit for in-person experiments. We were also able to design new experiments to keep up with the ever advancing science instruction for middle schools. **We are extremely grateful for our financial and institutional support over the past year. Without the support these visits would not have been possible.**

Table 1: 2021-2021 SFA Participants and Experiments

School	Students	Graduate Volunteers	Experiments conducted
Heritage STEM Academy	30	25	Food Physics (Density & Gels)
two hour visits→ two experiments per visit			Energy Storage (Batteries & Calorimetry)
			Robotics (Coding & Soft Robotics)
			Water Treatment for Microplastics (Filtration & Flocculation
			DNA (Extraction & Diffusion)
			Cardiovascular Science (Blood Types & Blood Flow)
Murray Middle School	20	12	Lava Lamps: Acids & Bases
(different class each semester)			Neuroscience: Brains
			Fluids: Fluid Flow & Viscosity
			Electrochemistry
			Magnetism
			Diffraction: Light & Color
Andersen Community School	45	19	Cloud in a Bottle

(two classes)			Marble Roller Coaster
			Mixtures, Solutions, & Colloids
			Surface Tension
			Ocean Acidification
			Magnetism
			Gasses & Phases of Matter

This year SFA had graduate students from Biomedical Engineering (BME), Chemical Engineering and Materials Science (CEMS), Chemistry (CHEM), Electrical and Computer Engineering (ECE), and other UMN departments. SFA continued the **effort to recruit graduate students from a range of different departments.** Due to this effort, SFA was able to retain and expand involvement from ECE and add members from Medicinal Chemistry and Neuroscience. In 2021-2022, SFA had 62 active graduate students mentors (**Figure 1, Table 2**).

Figure 1: Photo of a few of the active SFA graduate student mentors

In 2021-2022, SFA was happy to resume in-person visits to the classrooms. Based on feedback from our funding sources, **SFA expanded our efforts to tie the in-class experiments to careers, STEM education paths, and real-life connections.** This effort was achieved by including real-life examples in the experiment introduction slides, incorporating more objective, concrete experiments that relate to current state-of-the-art science, and having discussions during the small group experiments. **We continued to assess learning of the scientific concepts from the experiments through pre- and post-experiment assessments.** These assessments were a combination of multiple choice and short answer questions with the same wording before and after the experiment. After collecting the results of over 200 surveys, we saw an **overall improvement of ~15% increase in correct answers with a ~70% correct answer rate** after the lessons and

experiments. While the improvement increase is not as large as previous years, the correct answer rate on the post-assessment is similar to previous years. This suggests the students have a broader scientific understanding going into the experiments compared to past years, either from science curriculum or difficulty of the assessments. In the upcoming year, SFA plans to evaluate the effectiveness of the assessments throughout the year and adjust difficulty based on students' understanding and expand analysis to include question-level evaluation of learning. In addition to gauging learning of participating students, the assessments also encourage graduate students to develop clear learning objectives for each experiment. **SFA is dedicated to self-evaluating impact and improving our methods wherever possible.**

Figure 2: Various pictures from the end of year field trip showing the three experiments. Top left: building mechanical hand, bottom left: thermal shock, right: polymerization

At the end of the academic year, **SFA had the students visit campus to conduct more elaborate experiments and see real laboratory space**s. This year SFA had three experiments during the field trip: building mechanical hands, thermal shock, and polymerization of nylon (**Figure 2**). The thermal shock experiment was completed in the Valspar Materials Characterization Lab and was accompanied by a tour of Prof. David Poerschke's lab. This allowed the visiting students to see lab space and equipment used by

researchers. Unfortunately, Andersen was unable to attend due to a COVID related cancellation, but the other two schools were able to attend. During lunch we had professors from BME and CEMS visit with the students to talk about college and career paths. One improvement to make in the future is to have lunch be a little more structured so that all the students get an opportunity to talk with a professor. We still believe that it is important to give the students some downtime during lunch to enjoy the day and let out some pent-up energy. SFA ended the field trip by making liquid nitrogen ice cream for the students and volunteers. We were grateful to resume the field trips after two missed years.

In the upcoming year, SFA plans to maintain connections with the schools we partnered with this year as well as renew partnerships with previous schools now that almost all COVID restrictions have been lifted. We **aim to maintain and expand the broad reach of our program** and continue to improve upon the quality of our experiments. SFA hopes to **deepen our impact on middle school students** and connect our experiments to career paths and scientific programs for continuing education.

Best,

SFA 2021-2022 Leadership Team

MaryJane Been, *Co-President*

Ela Engen*, Co-President*

Kaylie Richard and Andrew Johannesen, *Andersen Community School Team Leads*

Maya Ramamurthy, *Murray Middle School Team Lead*

Hongrong Zhang and Rohan Chakraborty, *Heritage STEM Academy Team Leads*

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Table 2: 2021-2022 SFA Members

Name	Dept.	Name	Dept.	Name	Dept.	Name	Dept.
Aaron Shih	CEMS	**Emily Lecy**	NSCI	**Matt Lawler**	BME	**Simon Willis**	CEMS
Abbigael Harthorn	BME	**Emma Pettit**	CEMS	**Matthew Hausladen**	CEMS	**Supriya Ghosh**	CEMS
AJ Zervoudakis	CEMS	**Evgeny Pakhomenko**	CEMS	**Maya Ramamurthy**	CEMS	**Yeena Ng**	ECE
Amber Walton	CEMS	**Grant Larson**	CHEM	**Mayank Tanwar**	CEMS	**Zhichen Shi**	CEMS
Andreas Mueller	CEMS	**Hanchu Wang**	CEMS	**Meenal Rathi**	CEMS	**Zixue Ma**	CEMS
Andrew Baldys	BME	**Hongrang Zhang**	BME	**Michael Harris**	CHEM		
Andrew Johannesen	CHEM	**Huzefa Husain**	BME	**Michael Leyden**	CEMS		
Angelica DaSilva	BME	**Isaac Mastalski**	CEMS	**Moujhuri Sau**	CEMS		
Ben Yeh	CEMS	**Jane Been**	BME	**Murphi Williams**	CHEM		
Brady Bresnahan	CEMS	**Jimmy Soeherman**	CEMS	**Nathan Sidhu**	CEMS		
Carly Donahue	BME	**Joe Hassler**	CEMS	**Nicholas Van Zee**	CHEM		
Casey Kraft	BME	**Joe Vallin**	CEMS	**Nolan Concannon**	CEMS		
Chris Carchi	BME	**Josh Gavin**	CHEM	**Parth Bhide**	CEMS		
Clara Kirkvold	CHEM	**Juil (Jay) Chung**	CEMS	**Prafful Golani**	ECE		
Daniel Krajovic	CEMS	**Kaylie Richard**	CEMS	**Rashmi Choudhary**	CEMS		
Diana Zhang	CEMS	**Koen Verrijt**	CEMS	**Rohan Chakraborty**	CEMS		
Eaindra Yee	CHEM	**Kristine Loh**	CEMS	**Rowan Matney**	CHEM		
Ela Engen	CEMS	**Lizzy Crist**	BME	**Sam Boland**	BME		
Elizabeth Komosa	BME	**Maggie Lau**	CEMS	**Saurabh Usgaonkar**	CEMS		