2019 – 2020 Debrief

In 2019 – 2020, Science for All (SFA) worked with ~100 students and teachers from three Minneapolis middle schools and conducted 15 monthly evidence-based science experiments (**Table 1**). Broad subjects ranging from fluid mechanics, electrocatalysis, neuroscience, and chemical reactions were conveyed in 50-minute experiments to the students (**Figure 1**).

Table 1. SFA Participating Schools and Experiments

School	Students	Experiments Conducted
Marcy Open School	45 (2 classrooms)	Fruit Power Battery Lava Lamp and Oozing Pumpkin : Everyday Chemical Reactions The DNA Race Physics of Marble Roller Coasters
Murray Middle School	25	Is Mint Actually Cool? Hydrogels for Drug Delivery Where Does Light Come From? All About Soap Mechanical Properties of Candy
Venture Academy	30	Swelling Gummy Bears : Archimedes Principle Atoms and Molecules : Reaction Basics Brain Elasticity Fluids in Motion Microscopy Fundamentals : Plants and Animal Cells Carbon Dioxide and the Environment

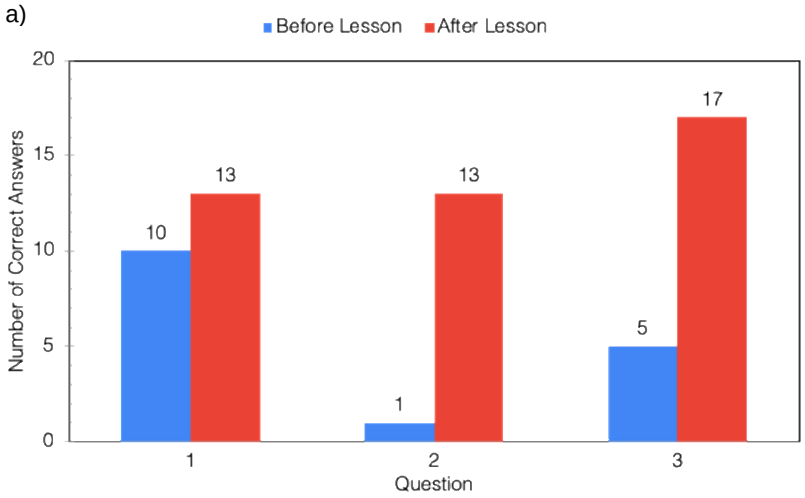
Figure 1. Pictures taken for the SFA blog at the various school visits in 2019.

SFA mentors composed of graduate students from various UMN departments, including Biomedical Engineering (BME), Chemical Engineering and Materials Science (CEMS), Chemistry (CHEM), Mechanical Engineering (ME), and Neuroscience (**Figure 2**). This past year, a greater effort was placed on recruiting graduate students from more departments. As a result, SFA was able to recruit members from two additional departments: Mechanical Engineering and Neuroscience. Additionally, the number of active volunteers increased by ~40% from 40 to 58 members (**Table 2**).

Figure 2. SFA 2019 – 2020 teams at Marcy Open School (top left), Murray Middle School (top right), and Venture Academy (bottom).

In 2019 – 2020, SFA also initiated testing metrics to attempt to quantify understanding of the scientific concepts by the students. As shown in **Figure 3**, students had a better understanding of these concepts after designing and performing hands-on experiments with the graduate mentors. At the end of a typical academic year, the students would come to the university campus to conduct more elaborate experiments in the organic chemistry labs, such as making elastic bouncy balls, finding the energy content in food, and building mechanical hands from household materials. However, this visit did not happen this year due to the COVID-19 pandemic.

a)



b)

1. What force pulls objects toward the center of the earth?
   a) Magnetism
   b) Gravity
   c) Strong Force
   d) The Force

2. The law of conservation of energy states that...
   a) we should replace our incandescent light bulbs with LEDs.
   b) energy cannot be transferred between two objects.
   c) energy can be neither created nor destroyed.
   d) all matter is merely energy condensed to a slow vibration.

3. Frictional force...
   a) often acts in the direction opposing the motion of any object.
   b) always exists for any object in motion.
   c) represents loss of kinetic energy through heat.
   d) all of the above.

Figure 3. Examples of Quantitative Assessments of Student Learning. **(a)** Five-minute evaluations were taken before and after lessons at Marcy Open School for the physics of marble roller coasters experiments. **(b)** Questions included in the physics of marble roller coasters experiment. Overall, the assessments demonstrate that students had a better grasp of the concepts after performing hands-on experiments with the mentors.

Plan for 2020 – 2021

In the coming school year, SFA will be 100% virtual. The format of instruction will incorporate online demonstrations via Zoom and YouTube Live. Graduate student mentors will be assigned to breakout rooms on Zoom to work with 2 to 3 middle school students. Demonstrations can be in the form of computation or experiments with easily obtainable supplies. The Zoom demonstrations will be recorded and posted on the SFA website and YouTube. In this way, our impact outside SFA can be assessed by the number of views.

To increase more meaningful interactions between students and our mentors, SFA will pair 1 to 2 student mentees with each graduate student mentor and encourage long-term mentor-mentee relationships beyond one school year. The mentorship program is designed to offer academic and life advice to middle school students from under-represented groups as they enter high schools and colleges. We hope to start this mentorship program initially with one classroom, depending on the mentor availability and mentee interest.

Additionally, due to the virtual nature of our instruction next year, SFA would likely have the capacity to double the number of classrooms in the three schools we currently work with and potentially expand to one or two more schools. The schools we are considering expanding to are American Indian Magnet School and KIPP North Star Academy - two schools that we have collaborated with in previous years. This expansion will increase the number of students SFA work with from 80 to ~200.

Additional expenses are expected as SFA adapts the online mode to cover the cost of experiment kits as well as delivery fees. Filming equipment including tripods and camera (or phone) will be needed for the zoom demonstrations and recordings. Additionally, we won't be able to recycle the supplies as was done in previous years. Some initial ideas for experiment kits to distribute include owl pellets scavenging, strawberry DNA extraction, and toothpaste solar cells. We have previously performed these experiments in classrooms, but they can be adapted for at-home experiments.

By expanding to a virtual platform next year, SFA hopes to continue building on the relationships that we have with the existing local Minneapolis schools and help provide a unique learning experience that these students are not able to receive otherwise. We are extremely grateful for your financial and institutional support over the past few years – these visits would not have been possible without you.

Best,
SFA 2019 – 2020 Leadership Team
ChoongSze Lee, *Co-President*
Yutong Pang*, Co-President*
Annie Brinda, *Marcy Open School Team Lead*
Nolan Concannon, *Murray Middle School Team Lead*
Shweta Narayan, *Venture Academy School Team Lead*

Table 2. 2019 – 2020 SFA Active Members

Last	First	Department
Adrahtas	Demetra	CEMS
Banerji	Aditya	CEMS
Been	MaryJane	BME
Brinda	Annie	BME
Chakraborty	Rohan	CEMS
Chandel	Durgesh	ME
Chu	Sami	CHEM
Concannon	Nolan	CEMS
Cook	Bernard	BME
Crist	Lizzy	BME
Engen	Ela	CEMS
Gacek	Liz	BME
Gangwar	Lakshya	ME
Ghosh	Supriya	CEMS
Godbole	Eeshani	CEMS
Hassler	Joe	CEMS
Hausladen	Matthew	CEMS
Jayaraman	Ashish	CEMS
Jeong	Gookyeong	CEMS
Johannesen	Andrew	CHEM
Kumar	Santosh	ME
Kumar	Gaurav	CEMS
Lawler	Matthew	BME
Lee	ChoongSze	CEMS
Lemke	Jonathan	ME
Li	Zhaohan	ME
Ma	Zixue	CEMS
Maines	Erin	CEMS
Mastalski	Isaac	CEMS
McCauley	Patrick	CEMS
McConnell	Adam	BME
McCutcheon	Charles	CEMS
Metaxas	Athena	CEMS
Miller	Jake	CEMS
Narayan	Shweta	ME
Narayan	Janani	CEMS
Nikpasand	Maryam	ME
Pang	Yutong	CEMS
Pasek-Allen	Jacqueline	ME
Punnoose	Josh	BME
Ramamurthy	Maya	CEMS
Robertson	Ben	CEMS
Rodriguez	Gerardo	BME
Rothermel	Taylor	BME
Roy	Priyatanu	ME
Sau	Moujhuri	CEMS
Shi	Jane	CEMS
Shih	Elizabeth	BME
Sidhu	Nathan	BME
Stieve	Bethany	Neuroscience
Tu	Qiaomiao	CEMS
Udyavara	Sagar	CEMS
Wang	Hanchu	CEMS
Wang	Ziwei	CEMS
Wilson	Elizabeth	BME
Yeh	Ben	CEMS
Zhang	Diana	CEMS
Zografos	Teli	CEMS
	Mentors	**58**