SOCIETY OF PHYSICS STUDENTS
An organization of the American Institute of Physics

Marsh White Award Report 2017

Project Proposal Title	Sound and the Sources Around Us
Name of School	Cleveland State University
SPS Chapter Number	1247
Project Lead (name then email address)	Samantha Tietjen stietjen.2015@gmail.com
Additional Project Leads (two lists: names then emails)	Jim Pitchford j.e.pitchford@gmail.com
SPS Chapter Advisor	Kiril A Streletzky k.streletzky@csuohio.edu
Total Amount Received from SPS	$499.00
Total Amount Expended from SPS	$499.00

Summary of Award Activities

Cleveland State University's SPS developed a set of monthly interactive lessons for K-8 school students about vibrations and sound to promote an interest in the common, every day physics phenomenon in the world around us. These lessons were carried out through our established physics outreach ("Physics Fridays") with Campus International School, a public school in downtown Cleveland.

Statement of Activity

Overview of Award Activity

Cleveland State University's chapter of SPS continued our established physics outreach program ("Physics Fridays") for the students at Campus International School, a public K-8 school located in downtown Cleveland. Inspired by the fact that sound is all around us in the world, Cleveland State University's chapter of SPS developed a set of lessons focusing on vibrations and sound. Our hands-on lessons walked students through the fundamentals of the physics behind sound.

Our outreach program has been delivered over three days during the afterschool program: December 12, March 10, and May 12. We started with demos and activities that illustrated the basic types of waves and how they produce the noise we hear through vibrations. We then used hands-on demos to "show" the kids the sound waves using tuning forks and water, ropes, and the Amazing Wave-Viewer of Science. Next, pitch and volume, allowing the students to investigate how waves can be manipulated to create changes in these. After establishing this foundation, we introduced some real world, application-based lessons, using string instruments, speakers, and music boxes, all of which utilized the foundational physics taught in previous lessons. Each specific lesson was delivered via interactive activities and demos taught within the 1-1.5 hour timeframe that is the Campus International School (CIS) afterschool care program. The program—ran by YMCA—is ever growing and caters to students from kindergarten to 8th grade.

This presents a bit of a challenge for us, since the maturity, interest, and intellectual levels of our group are as widely diverse as the students' ages. This was addressed through the careful planning of each individual demo; each demonstrator had lessons prepared that ranged from the most basic to more advanced concepts to engage all ages (and sometimes the kids taught us a thing or two!). Sound is a perfect topic for this as the physics ranges from the most basic concepts such as the kinds of waves and how they make vibrations to resonant frequencies and beats. We had many lessons pre-established from previous Marsh White awards that provided the foundation lessons for the younger students and the purchase of new supplies allowed for the old lessons to be adapted and built upon for the older students. The violin was a particular hit for all age groups!

While the final Outreach event of the semester strayed from the "Physics Fridays" lessons on sound, it was a great opportunity and success for both the department and chapter. On May 5th, Cleveland State University and NASA Glenn Research Center hosted the "From Hidden to Modern Figures" event to celebrate late CSU alumni Annie Easley as well as the legacy of women at NASA. The event began at 8:00 a.m. with our Outreach group running official NASA demo carts which included demos on wind tunnels, green energy, vacuum chambers, and bottle rockets. The event was open to the public, and CIS students were brought in groups to enjoy the demos (many CSU students even stopped by to see the demos). Following the demos, retired NASA Glenn director Dr. Julian Earls moderated a panel discussion featuring women currently working within NASA including: Dr. Marla Pérez-Davis, deputy director of NASA Glenn; Dr. Concha Reid, energy storage specialist at NASA Glenn; and Dr. Lizalyn Smith, aerospace engineer at NASA Glenn. The event ended with a free screening of "Hidden Figures".

Outside of our visits to CIS's afterschool program for "Physics Fridays", a pair of Outreach members accompanied Dr. Streletzky to one of CIS's third grade classrooms to give two interactive lessons on matter phase transitions to augment what they had been learning in their usual science lessons, once on January 13th and once on January 20th. In these visits, the lessons began with discussions on the basic forms of matter and how and why they change. The kids then helped our small team in activities such as changing a solid to a gas by heating ice, making chocolate "gems" by changing chocolate from solid to liquid to solid again, freezing water bottles instantly, playing with non-Newtonian fluids, and making plaster medallions. As part of their final project for the class, the kids were later asked to pick one activity that they enjoyed the most and make a small

poster on it. Fun was had by all during these lessons and the kids even asked if we could come back for more even after their projects were complete!

Impact Assement: How the Project/Activity/Event Promoted Interest in Physics

Our goal was to promote an interest in science (particularly physics) by cultivating inquiry-based discovery and development of science/physics intuition. We had hoped that through this set of lessons, where we will attempt to take the "hands-on" approach to a whole new level, we would bring out the scientific inquirer within all of the students. By teaching the students about sound, which they interact with and observe constantly throughout each day, we hoped to give them pieces of knowledge that they would think of often and recall in the future.

This was well illustrated even as the group entered CIS for the first time during the semester at the December lesson. Several students exclaimed, "You're back!" and all of them quickly gathered to eagerly await instructions for the lesson. As lessons progressed, students became more and more excited to explain the concepts they had learned when asked and to apply them to guessing how more complicated phenomena worked.

Key Metrics and Reflection

Who was the target audience of your project?	Students in grades K-8.
How many attendees/participants were directly impacted by your project? Please describe them (for example "50 third grade students" or "25 families").	Anywhere between 30-60 kids Grades K-3 each were represented by about 5-10 kids with the rest of kids coming from grades 4-7.
How many students from your SPS chapter were involved in the activity, and in what capacity?	Two members of the SPS chapter planned/scheduled the activity in advance with help from Dr. Streletzky. Six to twelve SPS members and Dr. Streletzky were involved in specific lesson planning, rehearsing, and delivering the outreach.
Was the amount of money you received from SPS sufficient to carry out the activities outlined in your proposal? Could you have used additional funding? If yes, how much would you have liked and how would the additional funding have augmented your activity?	The amount of money was sufficient for the Spring semester. We were able to purchase all the supplies listed, and in combination with the basics lessons we had previously designed, there were more than enough demos, maybe even enough to fall through to Fall semester. However, we had to use about $250 of SPS pizza money for the outreach supplies as only one half

	of the awarded sum was sent to us. Therefore, we would like to receive the second half of $500 award to replenish our pizza money.
Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.	We would like to bring all of the musical instruments together for an entirely music themed lesson/activity.
What new relationships did you build through this project?	Meeting new kids and inspiring them to be curious. Also, many new Outreach members joined this semester's lessons, so new friendships were established through that, as well as raising interest in SPS itself, as many of these students said they were interested in continuing with the Outreach program and several began to regularly attend SPS meetings.
If you were to do your project again, what would you do differently?	We would like to go to CIS more consistently next semester. This previous semester several things and events came up that had to be worked around, which became somewhat difficult (though were were still able to go three times). The planning for the NASA event did take quite a bit of time that would have otherwise be given to lessons at CIS itself; however, many attendees (including both students and teachers) said it was one of their favorite events, so it did end up paying off in the end.

Press Coverage (if applicable)

N/A

Expenditures

The SPS outreach team had previously developed some sound demos with the aid of previous Marsh White awards. We also had a collaboration with CSU's Physics Department, which provided a wealth of sound-based equipment. However, we wanted to have some outreach equipment strictly dedicated to sound. We eventually were able to receive supplies to effectively teach about the workings of acoustics, sound reproduction, and recording.

Expenditure Table

Item	Cost
Whoopi Cushions	$28.00
Violin	$60.00
Drum Kit	$159.00
Make Your Own Music Box Kit	$24.00
Microphone/Speakers	$121.00
Sound Proof Padding	$28.00
Chladni Plate Set	$79.00
Total of Expenses	$499.00

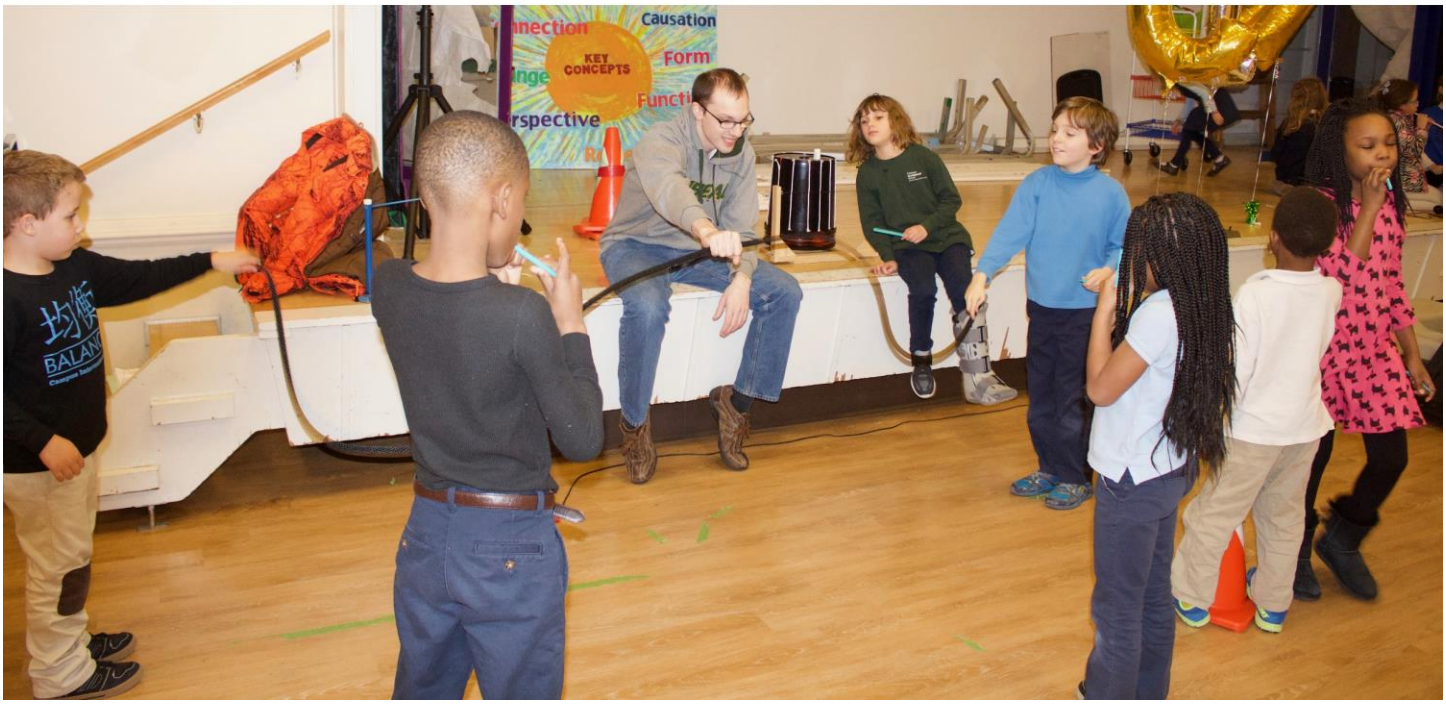
Activity Photos

The following photographs, unless otherwise noted, were taken courtesy of Dr. Kiril Streletzky.

Intro Demos as done by Dr. Streletzky and Jim Pitchford; Group shots of this year's Outreach team

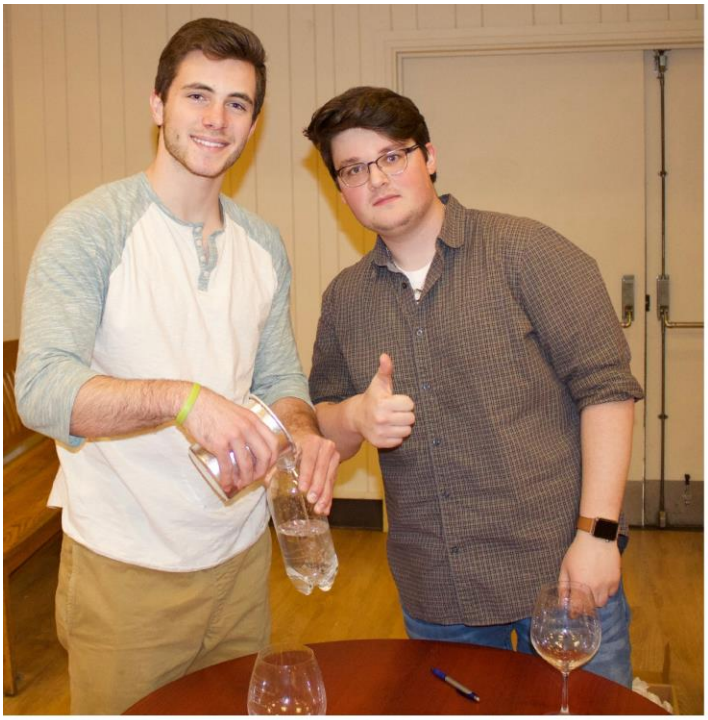
Learning about how pitch corresponds to length using boom whackers and then making straw oboes!

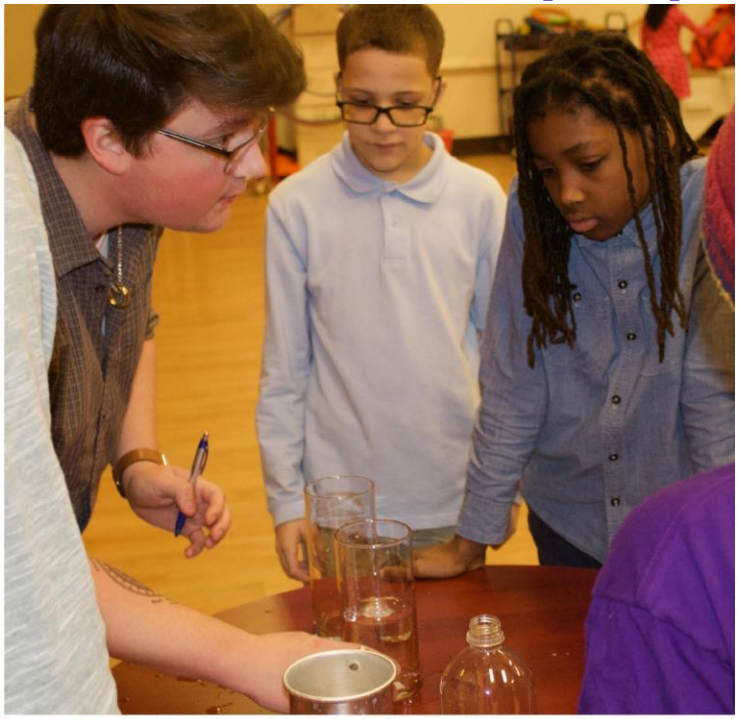
(Exploratorium Teacher Institute. "Straw Oboe." *Exploratorium*. Exploratorium, 16 Mar. 2016. Web. 26 Apr. 2017.)

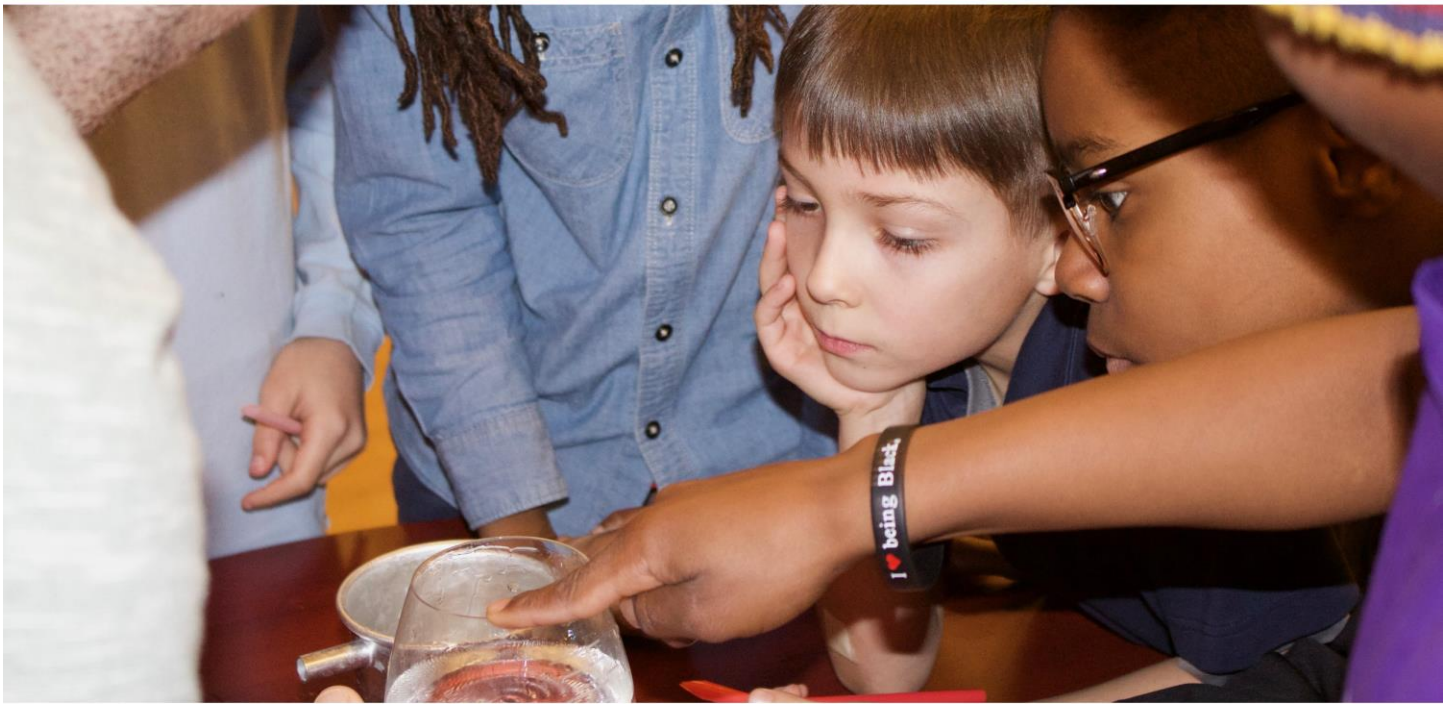


What are waves? Making waves using ropes and springs, then looking at them using the Amazing Wave-Viewer of Science!

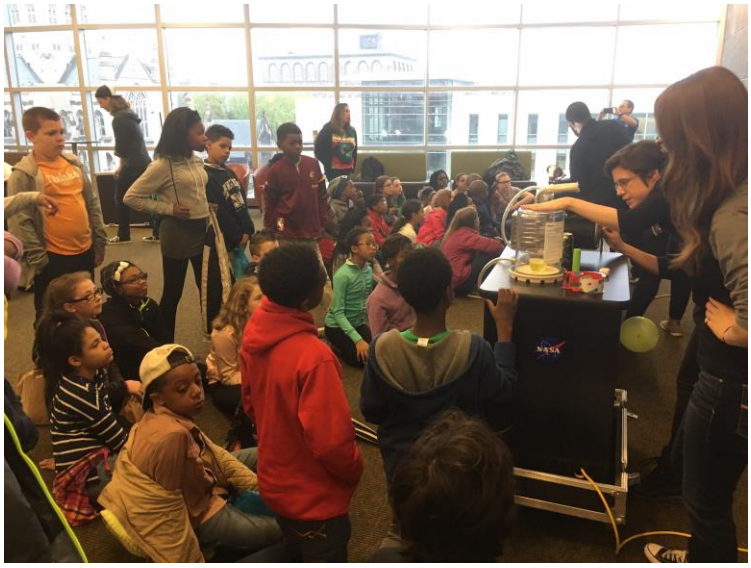
Sound as vibrations: Using singing-tubes and balloons to make vibrations, then seeing how vibrations interact with different mediums like wood or plastic.

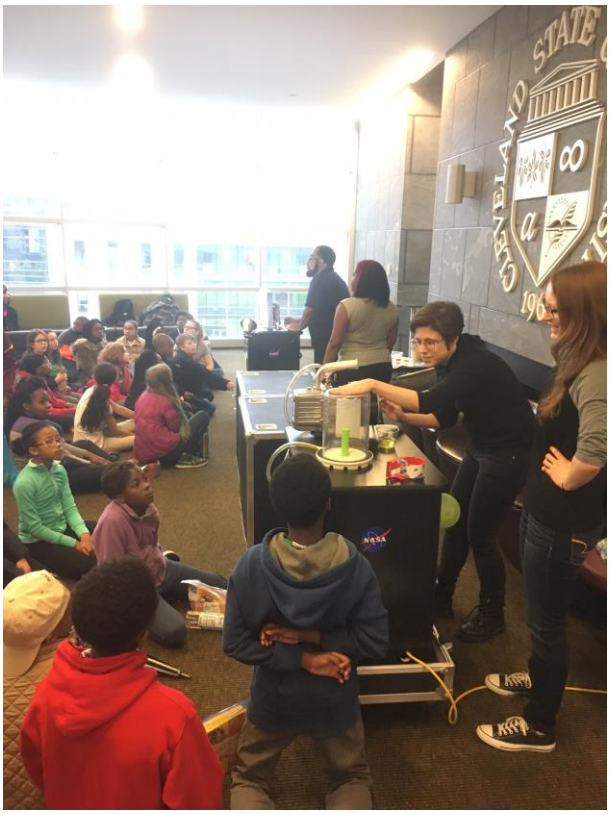




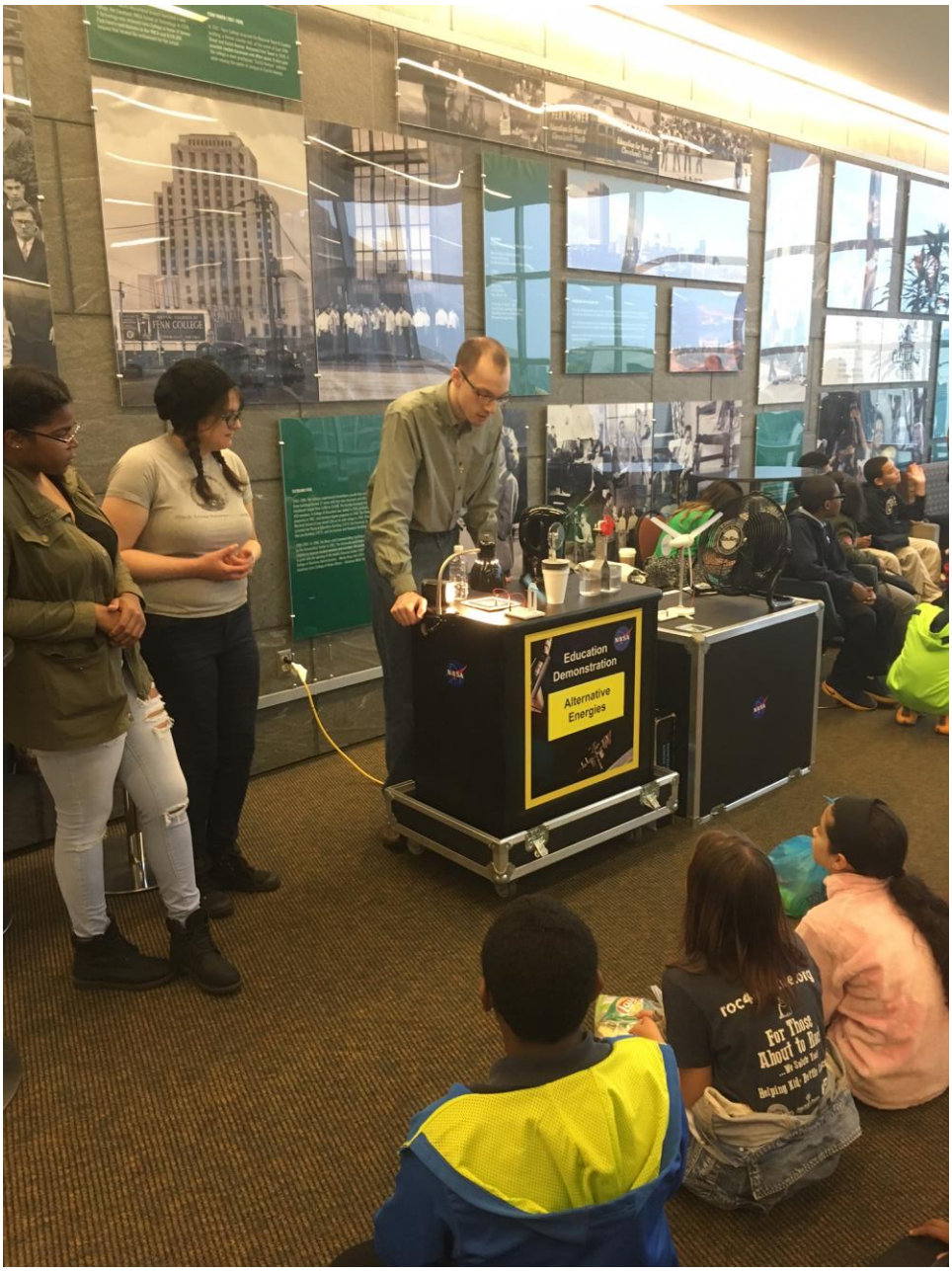


Using Singing Glasses to investigate how vibrations make waves and how pitch can change by changing the volume.

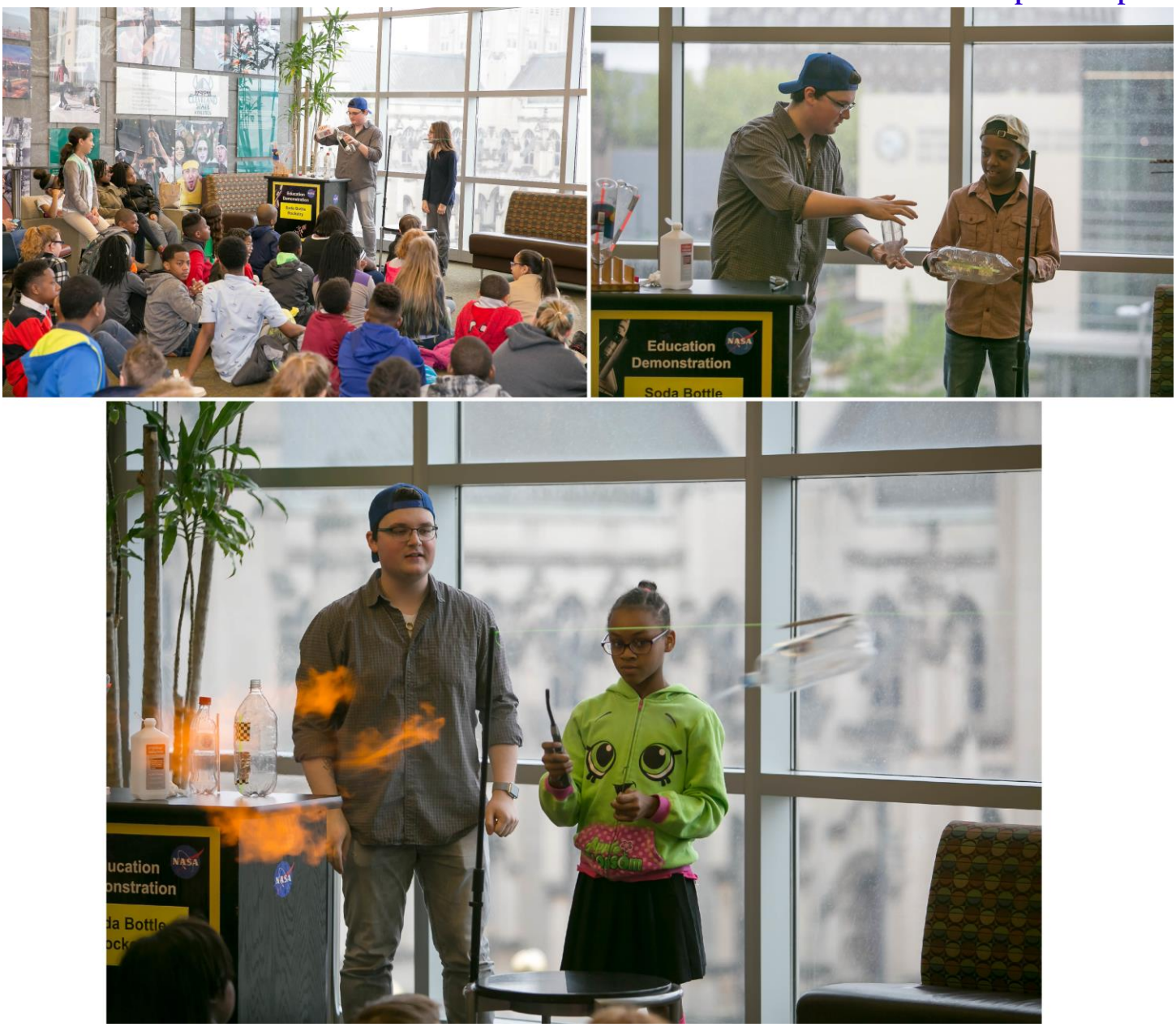




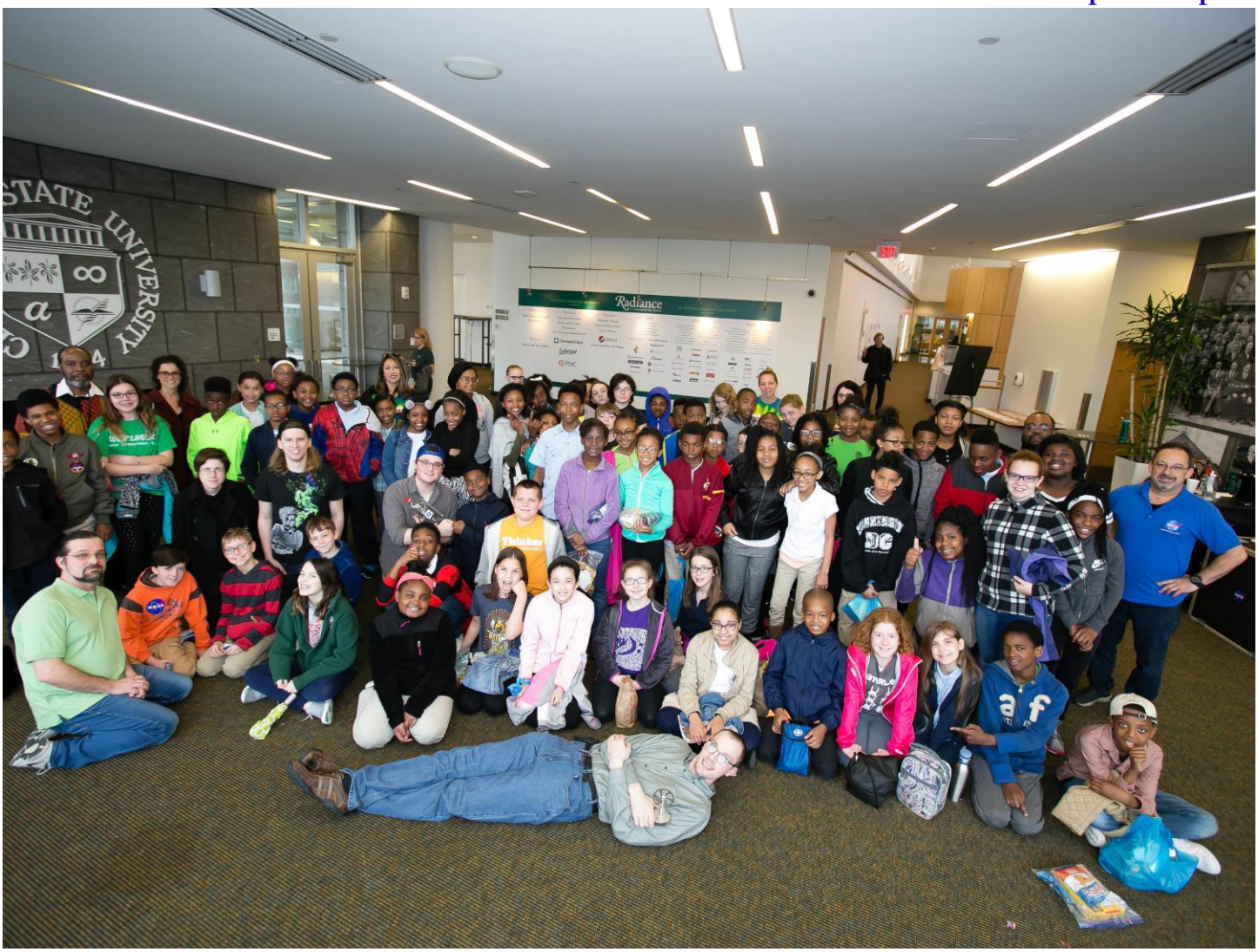
NASA Demo Carts: Vacuum Chamber – using vacuums to inflate marshmallow and boil soda at room temperature!



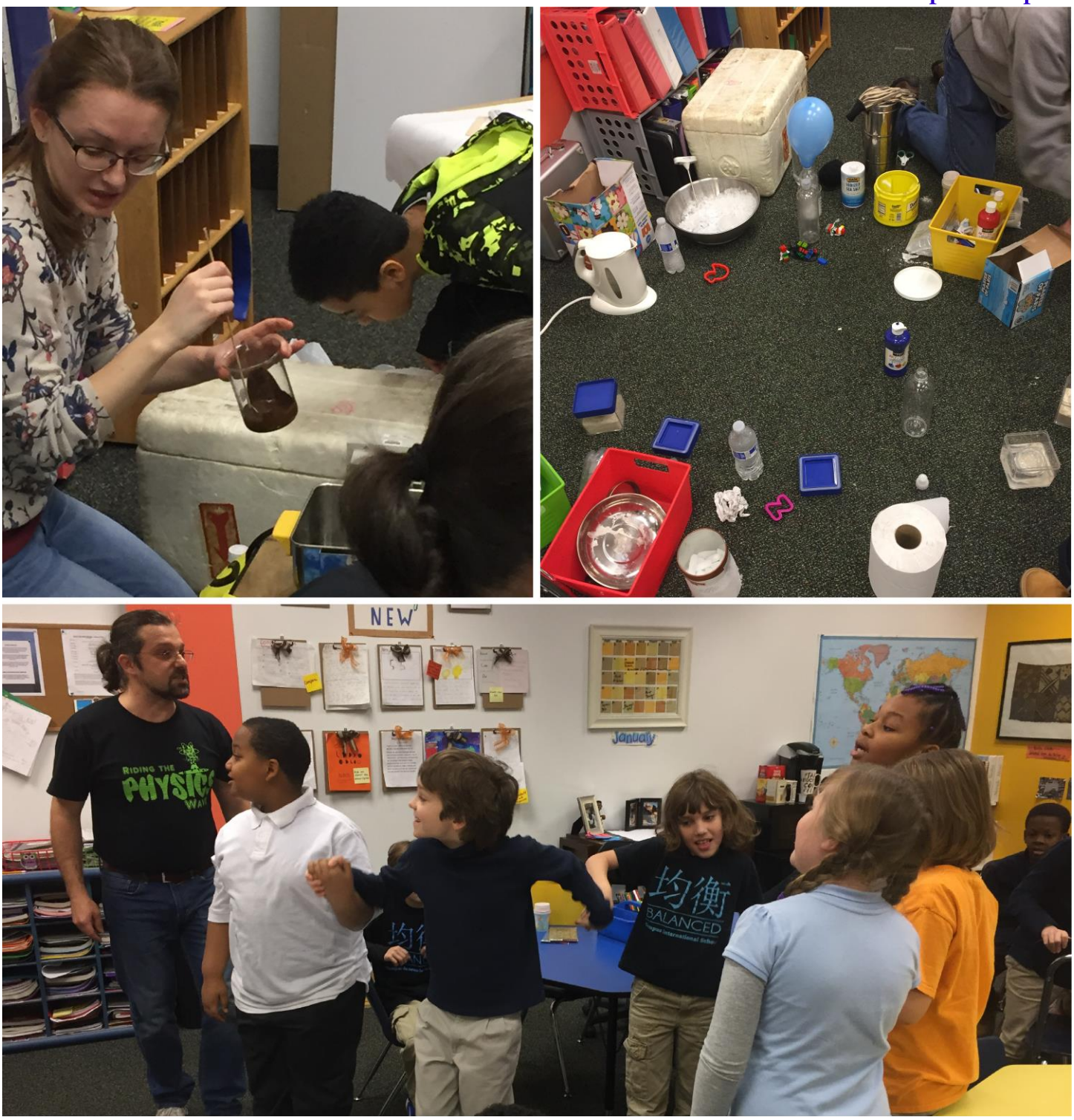
NASA Demo Carts: Alternative Energies



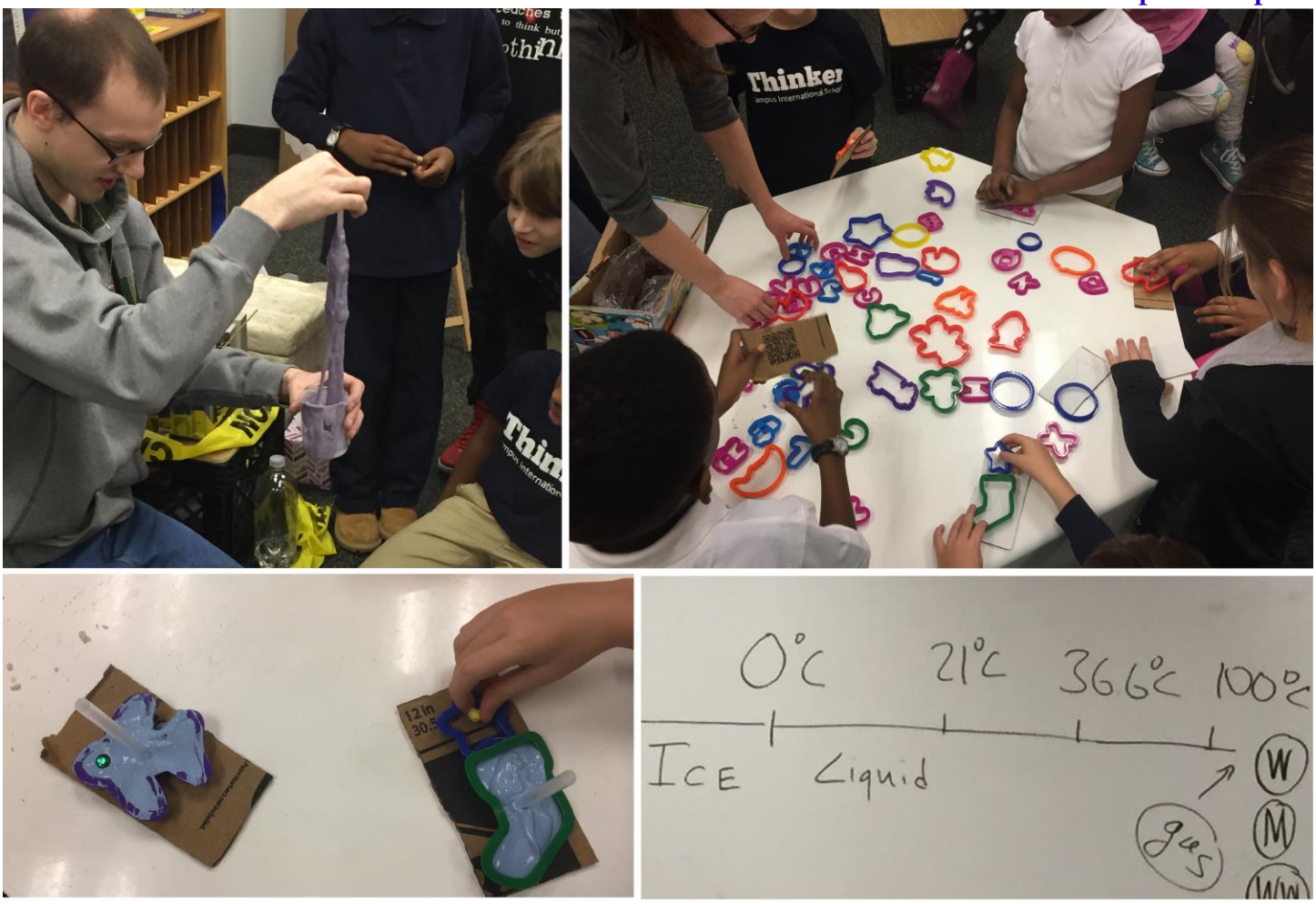
NASA Demo Carts: Bottle Rockets – making soda bottles take flight with rubbing alcohol (yes, those are flames!!) ~ Photos courtesy of BThomasHart Photography



Group shot at the NASA carts – this was only a small portion of the students who visited the carts that day! ~ Photo courtesy of BThomasHart Photography



January Matter Lessons: Melty chocolate, science supplies, and "matter chains"



January Matter Lessons: Non-Newtonian fluid fun, plaster medallions, and what changes matter!

Surveys

SPS Survey: Outreach Members

How well do we do?

1. How effective do you believe visiting Campus International is for the students? Check all that apply.

   - [ ] Very Effective
   - [ ] Effective
   - [ ] Not Effective

2. How effective do you believe Physics Day 2016 was in promoting careers in the STEM fields for the students? Check all that apply.

   - [ ] Very Effective
   - [ ] Effective
   - [ ] Not Effective

3. How would you improve Outreach for next year?

   .....

4. What Fall 2015/ Spring 2016 Outreach event strikes you as the most successful and why?

   .....

5. What do you believe the students take away from CSU SPS Outreach?

   .....

6. What do you take away from participating in the Outreach?