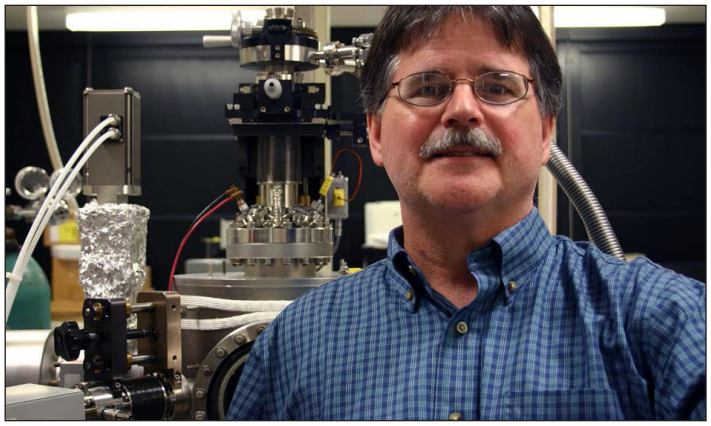
American Physical Society
New York State Section
Winter 2022–2023

From the Section Chair

It is with great pleasure that I give this update on the activities and status of the New York State Section (NYSS) of the American Physical Society (APS). In particular, I am happy to report that the NYSS had its first in-person topical symposium since the beginning of the COVID-19 pandemic on November 18-19, 2022 at SUNY Brockport. The theme of the symposium was "Applications of Optics", and the scientific program included invited talks in areas such as optical characterization of materials, ultra-fast optics, hard X-ray astronomy, and recent discoveries from the James Webb space telescope. Further highlights of the symposium are given in the Past Section Meetings section of this newsletter. The NYSS is dedicated to promoting the advancement and diffusion of the knowledge of physics. As part of this mission, we encourage undergraduate and graduate students to attend our symposia and present their research in poster format. Therefore, it was particularly satisfying to see the students presenting their research at the poster session of the Fall 2022 topical symposium. The last in-person student poster session was held three years earlier at the Fall 2019 topical symposium hosted by Corning. I am also happy to announce that the venue for the Spring 2023 NYSS topical symposium has been decided. It will be held at the University at Buffalo and is scheduled to take place on April 29, 2023. The theme of the symposium is "Quantum Science and Technologies". This year's Nobel Prize in Physics was awarded "for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science". Therefore, the theme chosen for the Spring 2023 topical symposium is particularly timely. I am definitely looking forward to the symposium and hope to see you in Buffalo in April.

The NYSS executive committee has had a couple of personnel changes over the last year. I took over as Chair of the section in July of this year. Samuel Amanuel had been our Chair since April 2021. He joined the NYSS executive committee as a Member-at-Large in 2015 and became Vice-Chair in 2019. Because of family and health reasons, he resigned his position on the executive committee in July of this year. I thank Samuel for his many years of service to the NYSS and hope that he will join us again in the future. To fill the Vice-Chair position that I vacated, the NYSS executive committee asked Ken Podolak to take over as Vice-Chair of the section until a new Vice-Chair can be elected at our Spring 2023 election. He has accepted this position. Another member of the executive committee who has left us is Kristen Burson, who recently accepted a faculty position at Grinell College in Iowa. She resigned her position as a Member-at-Large on the executive committee last May. I wish her the best of luck in her new faculty position at Grinell College. As mentioned above, the NYSS will have an election in Spring 2023. Every two years, the section has an election. The positions that will be filled are the Vice-Chair, Secretary-Treasurer, and the open Member-at-Large positions. The person who is elected Vice-Chair serves a two-year term and becomes Chair at the end of their term. There are a total of 12 Member-at-Large positions. Each has a four-year term, with half being filled at every other election cycle.



Carl Ventrice, chair of the NY State Section

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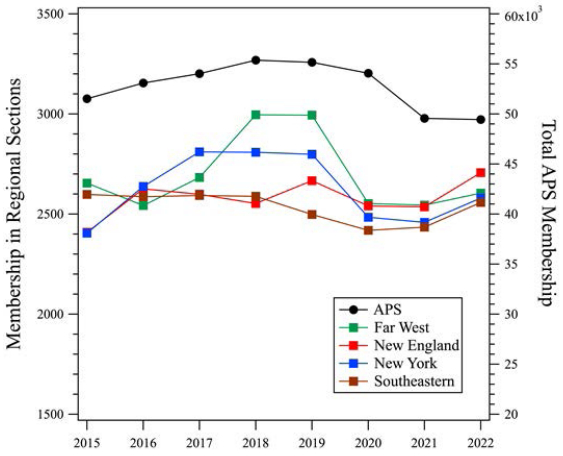
Section Chair continued from page 1

Membership within APS and the NYSS is down somewhat over the last few years. The NYSS is one of ten regional sections of the APS. Our section has 2,580 members and is currently the third largest regional section. Membership in the APS and each of the regional sections decreased during the pandemic. Our membership dropped from 2,799 in 2019 to 2,580 in 2022. This mirrors the drop in APS membership from 55,158 in 2019 to 49,443 in 2022. The membership trends from 2015 to present of the APS and the four largest regional sections are shown below in the figure below. During the COVID-19 pandemic, several regional and national meetings of the APS were cancelled. Since many members renew their membership when registering for APS meetings, this resulted in a drop in membership. Now that both the NYSS and the APS have returned to in-person meetings, it is expected that membership should climb back to pre-pandemic levels within the next couple of years. If you are an APS member but are not a NYSS member, please consider joining the section. This can be done by logging into your APS account and selecting the NYSS. There is no cost to adding the NYSS to your membership.



Yearly membership in the APS (right) and the four largest regional sections of the APS (left).

Past Section Meetings

Fall 2022 Topical Symposium on Applications of Optics (In Person)

Wow! What an incredible experience to be back in person for the NYSS APS symposium since Fall 2019. If you missed it, you have to check us out again in a future symposium. The 126th Topical Symposium was on November 18-19, 2022, hosted by SUNY Brockport.

The theme was "Applications of Optics" which had talks on applications with molecular optics and results from the James Webb telescope among others. The invited speakers were George Marcus (upper left), David McCamant (upper middle), Marc Currie (upper right), Anne Pellerin (lower left), Jeyhan Kartaltepe (lower right), and Ka-Wah Wong. Keynote speakers were Danae Polsin (middle right) and Gilbert "Kip" Collins (lower middle) with talks on the Laboratory of Laser Energetics. We also had a highly successful outreach grant talk by Merrill Asp and Sarthak Gupta (middle left) that brought physics research to high schools. We hope to see more talks on future outreach grants in our symposia. All of the talks were very well received and appreciated.

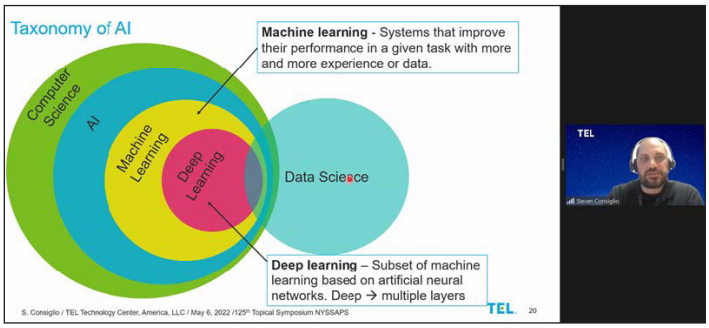
Lastly, we had an excellent poster session with over 20 posters from undergraduate and graduate students. The award winners are shown (middle of collage) with our current chair of NYSS, Carl Ventrice.

We hope to see you at our next symposium.

Spring 2022 Topical Symposium on Physics of Semiconductor Device Manufacturing

The NYSS APS held its 125th Topical Symposium on May 6, 2022. The meeting was held virtually and the theme was "Physics of Semiconductor Device Manufacturing". The meeting was hosted by the College of Nanoscale Science & Engineering at SUNY Polytechnic Institute. Due to the virtual nature of the meeting, there were no poster presentations or contributed talks.

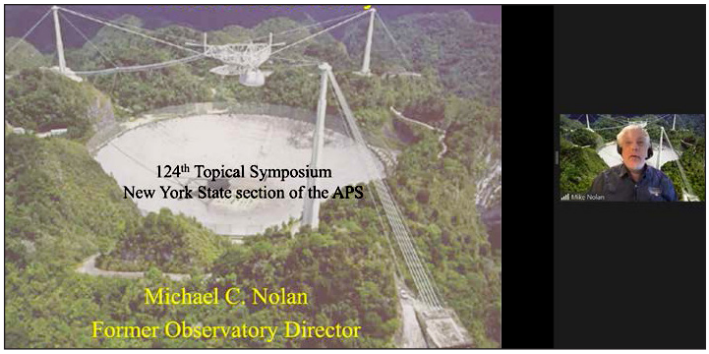
The invited speakers for this symposia and their talks were: Karsten Beckman (SUNY Poly.) "Physics-driven Engineering Ingenuity Enabling Modern CMOS Technology," Robert Brainard (SUNY Poly.) "The Physics of the Exposure of Photoresists to Extreme Ultraviolet (EUV, 13.5 nm) Light (From the Perspective of a Chemist)," Steven Consiglio (TEL Technology Center) "Advancing Digital and Analog Computing with HfO2-based Thin Films," and Christophe Vallée (SUNY Poly.) "Atomic-scale Processing in Semiconductor Device Manufacturing.



We would like to thank each of the speakers for an interesting and informative discussion of the topic.

Fall 2021 Topical Symposium on Science and Discoveries at Arecibo Observatory

Our 124th Topical Symposium took place virtually on November 6, 2021 and was a joint meeting of the New York State Section of APS and the Astronomical Society of New York (ASNY). The topic of the meeting was "Science and Discoveries at Arecibo Observatory". There were 72 people in attendance at the meeting.

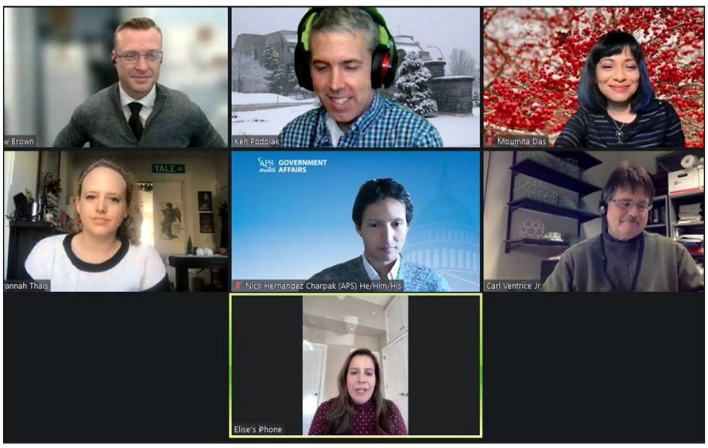


Due to the virtual nature of the meeting, contributed talks and poster sessions were not included. The meeting began with an introduction by Charles Liu, the president of ASNY. The invited speakers included Mike Sulzer (Arecibo Observatory) "The Arecibo Incoherent Scatter Radar", Allison Smith (Arecibo Observatory) "Highlights from the Astronomical Sciences at Arecibo Observatory", Tracey Becker (Southwest Research Institute) "Planetary Science from Arecibo", Michael Nolan (University of Arizona) "Arecibo Observatory", and Noemi Pinilla-Alonso (University of Central Florida) "Arecibo Observatory; Current State and Future Visions".

The talks were enjoyable and informative. We are grateful for the time and effort put forward by the speakers and for the participation of ASNY in our joint meeting.

NYSSAPS Leadership Virtually Advocates for APS Issues

In January 2022, APS hosted virtually its annual leadership meeting and Congressional Visit Day (CVD). NYSSAPS executive committee members Carl Ventrice (SUNY Poly.) and Ken Podolak (SUNY Plattsburgh) participated this year to advocate for APS issues on monitoring methane emissions, testing missile defense systems, addressing the shortage of STEM teachers, supporting dual intent VISAs, and having robust R&D funding. We met with staffers from the offices of Rep. Delgado (NY-19), Rep. Jeffries (NY-8), Rep. Morelle (NY-25), and Sen. Schumer. All were very supportive of these issues. Of particular note, Rep. Stefanik (NY-21) held the virtual visit herself. She was also very supportive of APS and advancing science. Last year, every issue that advocates raised with members of Congress resulted in legislation being introduced to address the issue, which shows the importance of this advocacy process. Thank you to the APS Government Affairs office, particularly Callie Pruett, for all the work that went into this event.



Ken Podolak (SUNY Plattsburgh, top middle) and Carl Ventrice (SUNY Poly., middle right) meeting virtually with Congresswoman Elise Stefanik (NY-21).

A Look Back… 1972

50 years ago the Spring Meeting of the NYSS APS was held at the IBM Development Laboratory in Poughkeepsie NY on April 21 – 22, 1972. The theme was Modern Optics and New York State was at the top of research and development in this area

1972 saw the first fiber optic communications network and the first instant color camera (the Polaroid). The invention of optical tweezers occurred the year before. Diode lasers were in their infancy, with the first commercial diode laser not becoming a reality for another few years. Rudolf Kompfner from Bell Labs gave a talk on the possibilities of optical communication, something we take for granted today. It was in Bell Labs where they designed the first semiconductor laser that operated continuously at room temperature, paving the way to make communications through fiber optics possible. Other topics included in the meeting were Modulation Spectroscopy, Nonlinear Optics and Holography. Lasers were a big topic of conversation at this meeting. In addition to the semiconductor lasers, tunable dye lasers and UV lasers were also discussed.

Outreach Grants Available

The NYSS APS has a strong history of producing topical symposia since 1938 that were designed to introduce different disciplines within physics in a tutorial fashion. The talks that were given in the spring of 1972 were excellent examples of the cutting edge technology at the time and were organized so that an attendee could walk away with an overview of the field of Modern Optics.

The NYSS Outreach Grants Program is funded by the NYSS-APS to provide seed money for projects intended to bring physics-related learning experiences to the general public, and in particular to K through 12 students. Projects are funded that will potentially lead to sustained programming and that increase the participation and achievement of underrepresented groups in the sciences, mathematics, and engineering. Discussed below are two of the most recent projects supported by the NYSS APS unit. Please visit our website at https://engage.aps.org/nyss/home to learn more about how to apply.

Outreach Grant Results

Westchester Children's Museum

Catapult Lessons: The mission of Westchester Children's Museum is to be a vibrant, interactive learning space providing children, families and school groups the opportunity to nurture curiosity, enhance knowledge and ignite imagination through creative hands-on exploration. The museum offers a wide range of STEAM based programs for children as young as pre-k and up through middle school. They strive to be a space where children can share, collaborate, problem solve, and develop critical thinking skills, and encourage collaboration with other children and within their own families. This type of institution was well suited to be granted a New York State Section (NYSS) Outreach Grant in order to help local teachers reinvigorate science curriculum coming out of the pandemic shutdowns.

A lesson on energy using catapults was delivered to 174 third-grade students at Jefferson Elementary School in New Rochelle, NY (92 students in May 2021 and 82 in December 2021). Since each third-grade class has been exposed to a different level of preparation, that level was assessed with a short Q&A and the presentation adjusted accordingly. To spark interest, the lesson began by viewing a poster of a medieval castle under siege. The concepts and many examples of kinetic and potential energy in that picture were introduced for the first time. The core of the instructional component began with the history of the catapult, starting with the bow and arrow, possibly 6,000 years ago. Using a toy model, there was an explanation of a distorted (drawn) bow's potential energy and its conversion to kinetic energy on release. That demonstration was followed by illustrating the evolution of the longbow into a crossbow, then to larger crossbows on wheels, eventually to a true catapult (incorporating a lever arm) all the way to trebuchet. At each point, the specific energy conversions were pointed out.

The highlight of the lesson was when each student built their own catapult from skewers and candy orange slices, basically a stick pyramid and a launching skewer fitted with a spoon and powered by a rubber band (kineticpotentialkinetic energy again). There's a host of scientifically interesting experiments suggested that they can carry out with their catapult at home! The images show several of the students from the classrooms with their catapults.

Syracuse: Closing the gap – bringing physics from universities to high schools

This outreach grant was proposed and orchestrated by graduate students, Merrill As and Sarthak Gupta, from Syracuse University (SU). As noted by the authors one of the instances of inspiration in a student's life could be when they see a scientist at work. One trivial question or one simple demonstration can evoke curiosity in young minds to take up scientific thought as a way of life. With their outreach program, they attempted to create those moments of inspiration for hundreds of students. The idea was to visit high schools to show students the fun and approaches of interdisciplinary Physics with two newly developed outreach lessons on Diffusion and Viscoelasticity.

The group, consisting of Sarthak Gupta and Merrill Asp (co-PIs), as well as six other graduate and undergraduate students: Renita Saldanha, Prashali Chauhan, Nimisha Krishnan, Matt Cufari, Daniel Paradiso, and Shabeeb Ameen, started by reaching out to resources on their own campus, such as The Shaw Center in order to develop assessment questions to quantity the impact they are able to achieve. They also recruited other graduate students to help in development and implementation of the lessons. They had reached out to teachers both from personal contacts and the network of physics teachers SU has developed as part of Prof. Allen Miller's 30-year work of creating physics demonstrations for high school teachers. Another integral part of the team was the graduate student advisors Prof. Alison Patteson and Jennifer Schwarz who guided the process of grant writing and reporting. Pilot lessons were run with the participation of the summer camp program at the Milton J. Rubenstein Museum of Science & Technology (MoST) in Syracuse city.

The desired format for the two lessons was to introduce a single concept, illustrate it with an in-person demonstration, and then lead a group activity where the students could explore it first-hand. Throughout, it was intended to illustrate current research and open questions related to the concept. Since they wanted students to follow up on the lessons, they provided resources where the students could learn more about the lesson topic on their own. Furthermore, the work and pictures of two scientists from underrepresented communities were included to highlight that one need not belong to any particular group to do Physics and that society needs future scientists and researchers from all communities

Diffusion Lesson: A live demonstration was performed using a compact but powerful microscope shown in Fig. 1 that showed the class the real-time motion of microscopic plastic beads suspended in water. We showed students two bead sizes (1 and 5 microns in diameter) suspended in water and prompted observations from the students and encouraged scientific discussions and methods of developing hypotheses. We discussed how we as researchers use this concept of random motion from collisions in our research into bacterial swarms, microtubules, and enzyme activity.

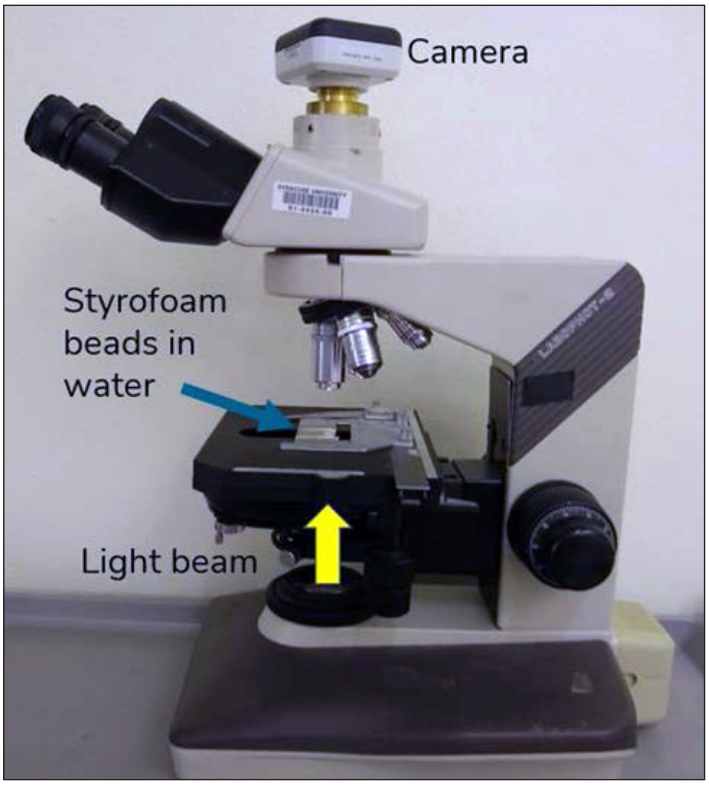


Figure 1. The microscope used for showing the movement of microscopic Styrofoam beads in water in real-time.

For the group activity, we gave students a sheet of graph paper with two concentric circles on it, an 8-sided die, and a key on the paper telling students in which direction to redraw their dot when a certain number is rolled on the die. At the start of the activity, students roll the die, find the number and the corresponding direction from the key, and then move a step away from the center. Students quickly repeat these steps, tallying moves along the way, to see how long it takes for the dot to escape the two circles in its random path. so. At the conclusion of the simulation, we showed that, on average, it took more time for the dot to get from the first circle to the second circle than from the center to the first circle although the distance is identical. When the random walker crosses the boundary of the first circle, it has an equal probability of going back versus continuing outwards, slowing its average progress over time. We again led the group discussion on how the model of a random walk captures the behavior of diffusion. We asked how this model is different from the real-world motion and how one could play with temperature in this random walk model.

Viscoelasticity: Viscoelasticity is the material property of various objects in our daily lives such as tofu, mozzarella cheese, memory foam, etc. To demonstrate viscoelasticity in the classroom, we use an instrument called a rheometer, such as the portable table-top one our lab previously developed shown in Fig. 2.

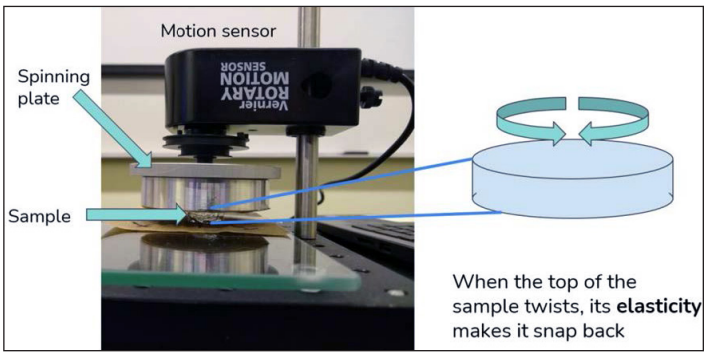
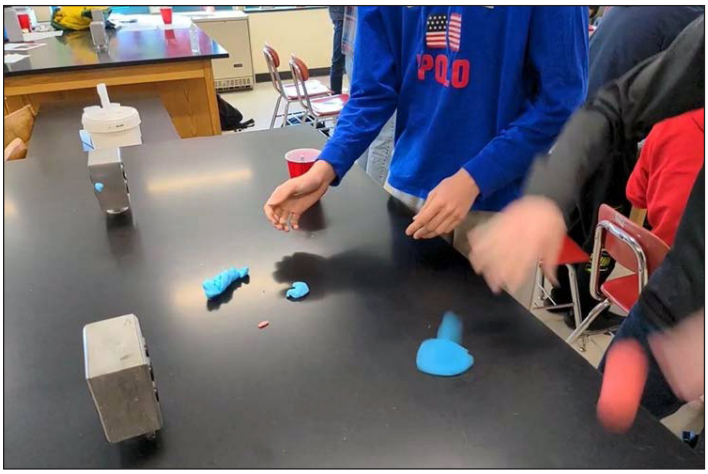


Figure 2. A portable classroom rheometer that can deform a sample and read out its response. The response curve is used to quantify the elasticity and viscosity of a sample.

The rheometer consists of a rotating circular plate attached to a rotary motion sensor. The sample material is placed between the rotating plate and a fixed bottom surface. When the upper plate is nudged, shear stress is applied to the material as its lower layer is at rest but the upper layer is moving with the plate. Once the upper plate stops, the material bounces back and causes the plate to oscillate at a particular frequency, showing its elastic property. The decrease in oscillation amplitude shows the viscous property of the material:

the higher the viscosity, the faster the oscillations die out. We collect data in real-time to show students the response curve for materials that are purely elastic (hydrogel) and purely viscous (water), and we then ask them to predict the viscoelastic material curve. We also demonstrate the response of a viscoelastic material, Jell-O which is 10% viscous and 90% elastic, to confirm the predictions. Furthermore, we ask students to discuss in groups their predicted response curves for materials that are 30% viscous and 70% elastic, and 70% viscous and 30% elastic.

In this lesson, we also want students to experience viscoelastic materials firsthand. Each student gets a mixture of glue and water in a cup with a spoon and food coloring, then explores the difference with different amounts of borax+water as a cross-linker which joins the glue polymers together so they can no longer flow past each other. The more crosslinks, the more the polymers will join to each other, forming a more solid-like slime. We asked students to compare their slime with their neighbors by doing a pinch and bounce test. In a pinch test, if you pinch the slime on one end and let it hang, depending upon the high or low borax/crosslink concentration it either flows slower or faster respectively, showing the viscous property. In the bounce test, we ask students to roll the slime into a ball and bounce it on their desks. See the pictures included. With this group activity, students experience the viscoelastic material and test its properties themselves. Moreover, we ask students to solve additional questions on the worksheet, which asks them to apply their observations to real-world applications.



Students testing the elasticity of different borax slime recipes

The group found that after the lessons, students improved in their ability to understand and explain the lessons' concepts. The assessments showed an increased desire for students to take Physics in college, which was one of the goals of the work. After the lesson one of the high school teachers had commented that "Students who may have been less interested in physics research and who anticipate studying medicine become more engaged in the subject". In the future, they are planning to expand the lessons to various other Physics topics, include more undergraduate and graduate students, and visit more high schools in the area. Clearly, some of the enthusiasm following this project came from the other teacher reflections such as: "[After the visits], students are excited to talk about the applications of physics outside the classroom", and "It [Outreach visits] gives me new ideas for hand-on activities/ applications with course content".

The group is considering working with their department outreach committee to make these lessons public on the departmental website. They would like more graduate students to pursue outreach in high schools around the world, and these already developed lessons would help them in doing that, especially in the less represented but fast-growing field of soft matter/biophysics.

Student showing the elastic nature of borax slime during the viscoelastic lesson at MoST.