The Biophysicist

Exploring Viscoelasticity: An Outreach Workshop for Middle and High School Students

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ABSTRACT Engaging students in hands-on activities and providing out-of-school experiences have been shown to improve academic performance and spark interest in science. Our interdisciplinary team developed a workshop for middle and high school students as part of a summer program at a Hispanic-serving institution in southern New Mexico. The goal was to foster interest and readiness for science, technology, engineering, and mathematics careers and college entry. The workshop introduced students to viscoelasticity, a key concept in biophysics that describes the mechanical behavior of biological tissues, which is vital for understanding their structural and functional properties under various physical forces and conditions. The curriculum included a presentation, a discussion linking mechanical properties with biology, and hands-on experiments that demonstrated viscoelastic principles. Pre- and postworkshop surveys assessed students' experiences and understanding of the material. Analysis revealed that students could relate the concepts to their daily lives, gained a basic understanding of mechanical properties, and found at least one experiment enjoyable and interesting.

KEY WORDS viscoelasticity; biomechanics; workshop; active learning; hands-on; K–12; outreach

I. INTRODUCTION

As secondary school students approach graduation, they are confronted with the critical decision of choosing their future career paths. Over the past two decades, a decline in student interest in science and technology has been observed, raising concerns about attitudes toward these fields (1, 2). For those contemplating careers in science and engineering, acquiring theoretical knowledge and hands-on experience is crucial for understanding the field and gaining confidence in their career choices (3–5). Thus, bridging the gap between theoretical understanding and practical application becomes paramount.

Hands-on activities and out-of-school experiences can enhance the understanding of scientific concepts, increase students' interest in science, and improve students' performance (2, 6, 7). This paper serves as a guide for an outreach workshop tailored to middle and high school students. It imparts a foundational understanding of the mechanical properties of materials, with a specific emphasis on viscoelastic properties.

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The biophysical behavior of biological materials under applied loads is governed by their mechanical properties. Characterization of stiffness, hardness, strength, ductility, toughness, elasticity, and viscoelasticity properties is vital in several applications, including engineering and biomedical fields. Viscoelastic behavior, which is categorized by the time-dependent response of a material to loading, is observed in various biological tissues and organs, including the brain (8), skin (9), liver (10), embryonic tissues (11), and cytoplasm of live cells (12). Understanding viscoelastic properties is crucial for designing biomaterials and studying cell mechanics, thereby contributing to our knowledge of cell interactions and diseases (13). Information about the viscoelastic response of cells can aid in distinguishing between healthy and cancerous cells and between healthy and pathological (e.g., diabetes mellitus) red blood cells (14–16).

The value of hands-on experiments for student comprehension of viscoelastic properties is well established in the education literature (17–20). Herein, we describe an outreach workshop designed for middle and high school students with the following objectives:

(a) Introduce students to basic mechanical properties of materials by connecting theory with practice and by providing hands-on experiments with a focus on viscoelasticity and its relevance for biological systems.
(b) Capture students' attention and inspire them to pursue education and careers in science, technology, engineering, and mathematics (STEM).

The content described in this paper was developed for a workshop within a larger summer outreach program, NM PREP Academy, that sought to recruit middle and high school students from southern New Mexico for STEM careers. The outreach program aimed, in part, to address New Mexico's persistently low K–12 education ranking over the last three decades (21). Most recently, the 2023 KIDS COUNT Data Book ranked New Mexico as 50th in the nation in K–12 student achievement and graduation rates (22). The analysis showed that 56% of all young children (ages 3 and 4 years) in New Mexico were not in school, 76% of fourth graders were not proficient in reading, 79% of eighth graders were not proficient in math, and 25% of high school students did not graduate on time (23).

Educational disparities have been documented for students from Hispanic and Native American backgrounds; these populations comprise 60% and 10% of the New Mexico high school population, respectively (18). In 2022, higher numbers of Hispanic and Native American students scored below proficient in fourth-grade reading (83% and 91%, respectively) and eighth-grade math (92% and 95%, respectively) compared with the state population in general. Math and reading proficiencies are a requirement for high school courses and prepare students to attend college. Specifically, students with low math proficiency are at a disadvantage for professions that depend on STEM skills.

The introductory and low-cost experiments for studying viscoelastic properties of materials presented here were crafted by an interdisciplinary team of faculty and graduate students at a Hispanic- and minority-serving land-grant institution in southern New Mexico. It is anticipated that the hands-on learning activities can be implemented as part of the STEM curriculum in several settings to improve educational outcomes for middle and high school students, including those from at-risk communities such as those who participated in the workshop.

II. PARTICIPANTS

The outreach program, conducted during the summers of 2023 and 2024, recruited middle and high school students from southern New Mexico. Forty-four students from 27 schools participated: 23 from middle school (2023) and 21 from high school (13 students in 2023, 8 students in 2024). The gender distribution comprised 12 females and 32 males. The participants self-identified as 55% Hispanic, 23% mixed ethnicity, 16% Caucasian, 5% Black/African American, and 2% Native American. Student recruitment was facilitated by

New Mexico State University's College of Engineering as part of the NM PREP Middle and High School Academy summer program.

III. OUTREACH PLAN

The event took place at New Mexico State University in 2023 and 2024, attracting one middle and two high school student cohorts. The workshop spanned ~2.5 h on separate days for each cohort. The event started with an introductory presentation that explained key theoretical concepts about mechanical properties of materials, followed by engaging hands-on activities.

The workshop was facilitated by two associate professors and three PhD students from the Mechanical Engineering and Chemistry departments. Instructors provided comprehensive guidance, explained experiment directions, observed students during the experimental procedures, and facilitated discussions on hypotheses and results.

IV. INTRODUCTORY PRESENTATION

An introductory presentation on mechanical properties and biomechanical applications was delivered by a PhD student from the Department of Mechanical and Aerospace Engineering. The presentation, complemented with PowerPoint slides, covered fundamental mechanical properties, including elasticity, viscoelasticity, strength, hardness, and stiffness.

The presentation was designed to be comprehensible by learners without prior knowledge of mechanical engineering or biology. The mechanical properties were explained individually, with a deliberate effort to establish connections between the properties and their applications in material science and biological contexts. Examples and pictures were provided to facilitate understanding.

For instance, the presentation elaborated on the structural role of ligaments, which connect bones to one another, and tendons, which link muscles to bones, thereby forming the foundation of the musculoskeletal system (25, 26). Notably, ligaments and tendons demonstrate remarkable resilience against tensile loading, exhibiting viscoelastic behavior characterized by their sensitivity to strain rate and load history. Furthermore, these tissues demonstrate properties such as creep, relaxation, and hysteresis (26). An in-depth comprehension of the mechanical characteristics of ligaments and tendons is pivotal for enhancing the treatment of ruptured ligaments and tendons, thus playing a critical role in the diagnosis, treatment, and rehabilitation of injuries (27).

Concepts of stiffness and strength were explained by using bone as an example. Stiffness was defined as a measure of a bone's resistance to deformation under applied load, whereas strength represented the load a bone could withstand without failure (28). Tooth enamel is the hardest substance in a human body; it provides a prime example of hardness, emphasizing its durability and resistance to wear (29).

The presentation also included a brief overview of a project sponsored by the National Science Foundation, in which an atomic force microscope was used to study the mechanical behavior of live cells. This project provided students with a better understanding of how engineering principles can be applied to study biological organisms.

V. HANDS-ON ACTIVITIES

A hands-on science approach can increase students' knowledge and improve attitudes toward science (30, 31). Recognizing this, our outreach program integrated hands-on activities to complement theoretical learning. Participants were organized into groups that rotated among the experiment stations. All experiments were conducted in parallel, supervised by either a PhD student or a professor. Before conducting the experiments, all students received safety instructions and were required to wear safety goggles and gloves.

The hands-on activities included Silly Putty, viscoelastic creep, and Choositz decision balls. Each experiment lasted ~15–25 min, starting with a brief introduction outlining the purpose of the activity. To emphasize the significance of result consistency, each experiment involved at least three replicate measurements. Comprehensive hands-on instructions are detailed in the Supplemental Material. Students were provided with

Table 1. Hands-on experiment aspects and connection with biology.

Experiment	Material properties aspects	Connection with biology
Silly Putty	A viscoelastic material that exhibits solid-like behavior at high strain rates and fluid-like behavior at low strain rates.	Cartilage is a viscoelastic material; it provides a smooth load-bearing interface between bones (32).
Viscoelastic creep	Polyethylene film is loaded under sustained force over time, exhibiting initial elastic deformation followed by time-dependent viscoelastic creep.	This type of loading is analogous to skin grafting, where the graft must be stretched over time to conform to the dimensions of the wound (33).
Choositz decision balls	Neoprene and polynorbornene rubber balls have different bouncing behaviors; the neoprene ball bounces to almost the initial drop height, and the polynorbornene ball barely bounces because of the conversion of the energy from the fall into heat (34).	The meniscus dissipates energy through damping and fluid flow friction due to its intrinsic viscoelastic molecular arrangement during mechanical loading (35), akin to the behavior observed in the bouncing balls.

preprinted instructions that detailed materials and equipment, experimental procedures, tables for data collection, and formulas or graphs for data interpretation. Each set of instructions also included space for students to formulate hypotheses and record observations. This approach was intended to foster critical thinking and cultivate problem-solving skills among the students.

Safety measures were implemented throughout the experiment. The safety requirements (e.g., personal protective equipment) for each procedure are outlined in the Supplemental Material. In the Silly Putty experiment, all glass containers were placed in hot water exclusively by the instructor, so that students did not directly handle hot water or heated equipment. Students wore safety glasses and gloves to protect against accidental splashes. For added safety, use of containers with cool-touch handles is recommended, although direct student contact with hot materials was minimized.

The purpose and procedure of each experiment were explained to each group before starting the experiment. Table 1 summarizes the principles of the material behavior that were illustrated to students in each experimental activity, along with examples of similar behaviors exhibited by biological materials.

A. Silly Putty experiment

The Silly Putty experiment served as an effective demonstration to illustrate that a material can act as both a solid and a liquid. Studies have shown that liquid droplets of protein and ribonucleic acid behave as an elastic solid at short timescales and a viscous fluid at long timescales, similar to Silly Putty (36).

The introduction of firm and soft putties served a twofold purpose: first, to capture the students' interest and engagement, and second, to lay the foundation for a deeper understanding of the principles to be explored in the upcoming experiment. Students were encouraged to stretch the putty slowly, tear it apart quickly, and then observe the difference in the material's response.

Silly Putty, a silicone-based polymer, features long molecules that intertwine like strands of spaghetti, held together by weak interactions between polymer molecules. When stress is applied rapidly, bonds break, causing the material to behave as an elastic solid. On the other hand, if stress is applied gradually over an extended period, the interactions can re-form, allowing the strands to untangle (37). Providing students with the opportunity to interact physically with the putty—stretching it slowly and tearing it apart quickly—enabled them to observe and experience the variations in material behavior in response to different rates of strain application.

In the main experiment, each group of students was equipped with a timer, a metal ball,

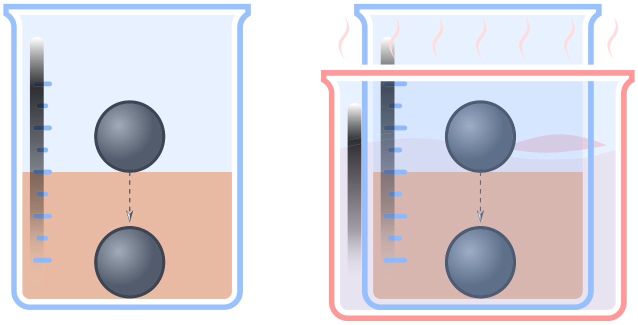

Fig 1. Schematic of the Silly Putty experiment at room temperature (left) and at elevated temperature achieved by placing the cup with the putty in a bigger cup with hot water (right).

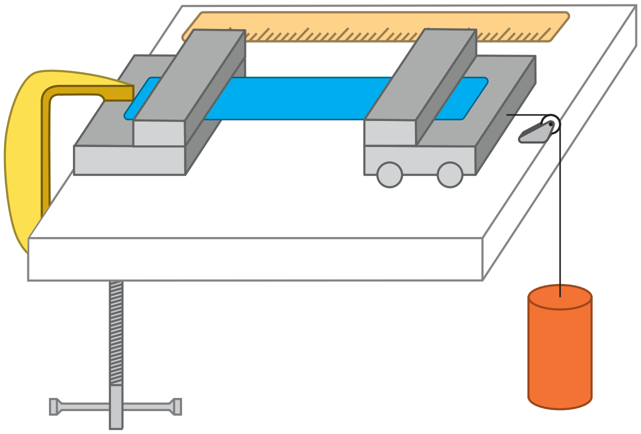

Fig 2. Schematic of the viscoelastic creep experiment setup.

and a glass measuring cup prefilled with putty. Initially, students dropped the metal ball onto the putty surface and observed its bouncing behavior, which demonstrated the material's elastic response. After the ball ceased bouncing, students started the timer and recorded the time it took for the ball to sink through the putty to the bottom of the cup. This sequence was repeated three times.

Students replicated the experiment with the heated putty. To achieve this, a larger cup filled with boiling water was used. The glass cup containing putty was immersed in the hot water (Fig 1). Students then calculated and compared the average times for room temperature and heated putty experiments. The observed outcome revealed a shorter time for the ball to fall through the heated sample. This phenomenon suggests a temperature-dependent behavior of Silly Putty.

This experiment introduced viscoelasticity of Silly Putty and its dependence on temperature to the students.

B. Viscoelastic creep behavior of polyethylene

The creep test characterizes a material's response under a sustained force over time. The viscoelastic creep experiment chosen for the workshop, as outlined by Mano (17), involves the gradual stretching of plastic wrap under a continuous load over time.

To illustrate various stages in a relatively short-duration creep test, we chose polyethylene. To secure the polyethylene in place, two fixtures were prepared by using standard 2 × 6-inch wooden blocks, with the bottom block measuring 15 cm in length and the top block 7.5 cm (Fig 2). One fixture was affixed stationary at the edge of a desk by using a trigger clamp, and the other was mobile, facilitated by 2.5-cm wheels. Rubber strips were adhered to the wooden blocks to stop the polyethylene film from slipping out of the fixture. The two wooden blocks were fastened together by using four bolts each.

The fixtures were positioned 20 cm apart, creating a setup for the experiment. Four layers of polyethylene film, ~50 × 15 cm, were placed between the wooden slabs, securely affixed at both ends. A flexible thread connected to a bucket allowed for the application of weights. A schematic of this experiment is shown in Figure 2.

A ruler aligned parallel to the film facilitated the observation of stretching length over time. Students recorded the displacement of the moving block every 10 s for a duration of 1 min. The collected data were entered into a table and graphed, with the experimental procedure repeated three times.

Through this experiment, students gained insight into the creep behavior of the plastic wrap and acquired experience in interpreting the resulting graphs. The graph exhibited an initial instantaneous elastic response followed by time-dependent deformation. After the removal of the weight, students could observe the recovery behavior of the plastic wrap, wherein an immediate elastic response occurred, although the material did not fully revert to its original shape—a phenomenon attributed to plastic deformation during creep testing (17).

The significance of studying creep extends beyond the laboratory, particularly in engineering, for calculating the bearing capacity and design of structures subjected to constant loading.

C. Choositz decision ball experiment

This experiment is an adaptation of the work previously published by Mano (17). The Choositz decision ball experiment compares the bouncing behavior of two distinct rubber balls: neoprene and polynorbornene. The balls also can be prepared by students as a part of the experiment to better understand the chemical nature of the different mechanical behavior of materials (18).

Although neoprene and polynorbornene rubber balls may appear identical, they exhibit different bouncing behaviors. Before conducting the experiment, students are encouraged to analyze the molecular schematic structure of both balls and formulate predictions about their respective bouncing characteristics (Supplemental Material). No prior background in chemistry is assumed, so we first introduce essential concepts such as weak interactions, double bonds, and molecular rings to ensure students have a foundational understanding.

The bouncy ball is made from neoprene, which is organized in long chains and features prominent chlorine groups and numerous cross links between polymer chains to restrict rotation. These restrictions preclude conversion of energy from the fall into heat. Consequently, at room temperature, the ball bounces back to nearly the same height from which it was dropped. On the other hand, the ball with diminished bouncing capability comprises polynorbornene, incorporating a five-membered ring as part of its chain structure. This structural element restricts movement, and it predominantly absorbs the energy generated during a fall, resulting in reduced bouncing (34).

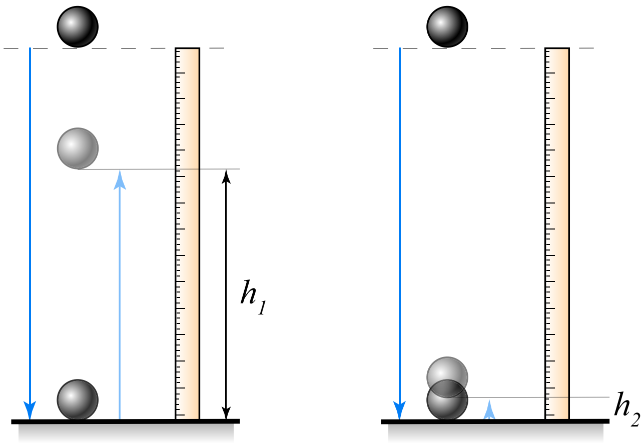

Fig 3. Schematic of the Choositz decision ball experiment.

In the practical aspect of the experiment, two balls are dropped from the same height onto a hard surface, and their bouncing behaviors are observed. Starting height and maximum bouncing height for each ball are recorded. The schematic of this experiment is shown in Figure 3. As an outcome of the experiment, students were asked to calculate the coefficient of restitution. In cases in which frictional forces are negligible and the object falls vertically onto a horizontal surface, the coefficient of restitution can be determined as the square root of the ratio of the bouncing height to the drop height (38). This provides a quantitative measure of the balls' bounciness.

By engaging in the Choositz decision ball experiment, students gain practical insights into material properties, molecular structures, and the complex interplay between elasticity and viscosity in the context of bouncing behavior.

D. Additional activities

For additional simple and engaging activities, we introduced students to properties of Oobleck and close observation of viscoelastic recovery of compressed earplugs (17). Oobleck is a non-Newtonian fluid that received its name from the Dr. Seuss book *Bartholomew and the Oobleck* (39). Oobleck is nontoxic and can be prepared by mixing 1 part of water and 1.5–2 parts of cornstarch (40). After applying various forces with a wooden stick, students observed the material's behavior. Quick presses resulted

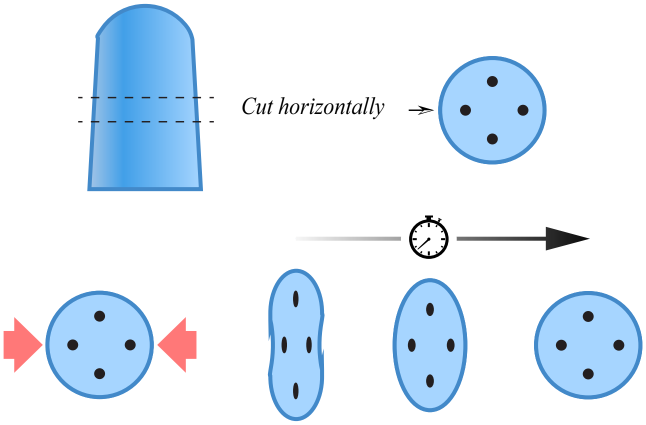

Fig 4. Recovery behavior of an earplug. Cut the earplug and mark the dots. Squeeze the cut part of the earplug, release, and observe the movement of the dots.

in solid-like resistance that prevented stick penetration, whereas slow pressing allowed penetration, revealing liquid-like behavior. This unique phenomenon, known as shear thickening, arises from the intricate interaction between solid cornstarch particles and water molecules (40).

A digital microscope was used to visually illustrate the structure and recovery behavior of earplugs. An earplug was cut horizontally, with four dots marked on its cross-section. Subsequently, the earplug was placed under the microscope, and images of the cross-section were captured and projected onto a computer screen. The earplug was then squeezed and released, allowing students to witness the viscoelastic recovery process back to its original shape and size. The schematic of this experiment is shown in Figure 4.

VI. FEEDBACK AND EVALUATION

The workshop was first conducted in 2023, during which we collected only post-event evaluations and feedback from students. To improve the workshop and better understand student growth during the event, in 2024 we collected pre-workshop evaluations and post-workshop surveys. The post-workshop questionnaire was expanded in 2024 to include more questions to better understand students' interests and satisfaction with the event. The post-event questionnaire aimed to assess the application of concepts learned during the workshop, connecting mechanical principles to real-world situations and examples that covered elastic and viscoelastic materials in various contexts, including biology. The latest versions of the pre- and post-workshop questionnaires used in 2024 are provided in the Supplemental Material.

We received a total of 20 completed post-workshop questionnaires from middle school students in 2023 and eight completed pre- and post-workshop questionnaires from high school students in 2024 (high school students did not participate in the 2023 survey). Regarding their affinity for science, 43% responded "I love it," 28.5% responded "I like it," and 28.5% responded "It is okay"; none of the students responded with "not at all." Comparison of pre- and post-responses from the 2024 data showed that after the workshop, one student changed their opinion from "It is okay" to "I like it," which suggests that the workshop could potentially develop more interest in science.

To assess students' answers to questions focused on conceptual understanding, we used a rubric that categorized responses as excellent, good, or demonstrating minimal understanding. Responses rated as excellent conveyed the fundamental principles by using clear and concise language, often incorporating examples and definitions provided during the workshop. Responses categorized as good demonstrated a solid understanding of the concept but may have lacked some clarity or detail in their explanations. Those categorized as demonstrating minimal understanding exhibited limited or inaccurate understanding, with insufficient explanation or conceptual clarity.

To gauge the practical application of their knowledge, we asked students to explain the difference between a solid and a liquid to someone with visual impairments. The responses were rated as 7% excellent, 30% good, and 63% minimal understanding. For future workshops, more explanations of this difference should be incorporated.

Encouraging students to relate the concepts to their daily lives, we asked them to provide examples of soft and deformable items at home that return to their original shape and those that do not. Additionally, we asked them to identify materials in a human body with elastic and viscoelastic properties. Most of the examples provided demonstrated an excellent understanding (56% and 37%) or a good understanding (40% and 53%), respectively. The responses indicate a strong grasp of the learned concepts among the students. Students could correctly relate material and biological examples mentioned during the workshop.

Notably, for the students who participated in the pre-workshop survey, we asked the same question. A few students could not provide any examples, and some did not know what "viscoelastic" means; however, after the workshop, almost all students could provide good or excellent examples of elastic and viscoelastic materials.

Furthermore, we aimed to understand students' preferences and areas of curiosity. We asked whether there were any areas they wished we had covered but were not able to. According to students' responses, 48% would not change anything, and 11% would enjoy exploring three-dimensional (3D) printing, a topic that may have intrigued them because of its coverage in another part of the NM PREP Middle and High School Academy summer program. Responses from the other participants varied, with some expressing a desire to explore mechanical properties such as elasticity, hardness, and stiffness. Others expressed enthusiasm for the experiments we conducted, including those involving Silly Putty and Oobleck. Furthermore, several students expressed interest in investigating additional topics, such as the effects of temperature, aerospace engineering, the study of space, pores, and even frogs. The interest in frogs may have stemmed from our discussion of the *Xenopus laevis* animal model during the workshop.

We also asked students whether they found any activities or demonstrations particularly exciting or interesting. Some students mentioned multiple experiments that they enjoyed, so we summarized the number of times each experiment was mentioned: Of the experiments, 15 students liked Silly Putty, 7 liked viscoelastic creep, 7 liked Choositz decision balls, and 7 liked Oobleck non-Newtonian fluid activities.

Of the students who participated in the 2024 workshop (the 2023 survey did not include this question), 71% rated the workshop as excellent, and 29% rated it as good; all students stated they would recommend this workshop to their peers. No significant difference was observed in the number of students changing their minds (before and after the workshop) when they answered the question about seeing themselves in a science-related field.

VII. RESULTS AND DISCUSSION

In this paper, we describe outreach activities designed for middle and high school students that focused on mechanical properties of materials and emphasized connections to biological systems. Biophysical lessons and experiments are crucial for inspiring students to study biophysics during their college careers (41). Our event aimed to fulfil this directive and involve more students in STEM education. The workshop was inspired by and designed as part of a National Science Foundation project for multiscale modeling and biomechanical analysis of live cells. The curriculum aligned with Biophysical Society basic concepts for 7–12 education (42) and National Academies of Sciences, Engineering, and Medicine recommendations for integrating physics and biology (4).

We enhanced student engagement by offering various experiments, the application of which can be translated to biophysics through their relevance for the proper function of several biological tissues (Table 1), allowing each student to discover their favorite. From the Silly Putty experiment, students could observe the effects of different external factors (temperature, rate of loading) on the mechanical behavior of materials. The Choositz decision ball experiment provides insights into the effect of molecular structure on mechanical properties. The viscoelastic creep experiment and recovery behavior of an earplug illustrate key principles of time-dependent deformation under a sustained load, and the Oobleck demonstration provides an entertaining example of a non-Newtonian fluid.

Student evaluations can help us better understand specific areas where students have difficulties and can also serve as a valuable tool for comparing knowledge gained throughout the learning experience (43). The workshop received overall positive feedback from students, with the majority expressing a favorable attitude toward science. Engaging in discussions and hands-on activities contributed to an enhanced understanding of the topic. Most students (67%) expressed interest in future learning opportunities, indicating a successful outreach result.

Insights collected from our pre- and post-workshop assessments will be used to tailor future events to better meet the needs and interests of the students. In upcoming workshops, we aim to place additional emphasis on biology-related examples and continue conducting pre-workshop assessments for a comprehensive understanding of how students' knowledge evolves after an event. Learning materials are under development that will explain and demonstrate how biological atomic force microscopy can be used to analyze live biological samples. For example, we plan to incorporate 3D printing to prepare a representation of the surface of *Xenopus laevis* oocytes that were previously obtained via atomic force microscopy (44). The printed object could help address students' curiosity about 3D printing while discussing biomechanical research. Additionally, small 3D-printed frog souvenirs may be given to participants at the end of the event to serve as physical reminders of their experience at the workshop.

This workshop aspired to offer accessible learning experiences that will encourage students from diverse backgrounds to complete STEM high school courses and embark on a STEM career upon graduation. Students who participated in this workshop are educated in New Mexico K–12 public schools, a system that was ranked 49th or 50th in the nation between 2012 and 2023 (21). During the workshop, students were provided with hands-on experiences designed to connect classroom learning in core sciences to real-world biophysics applications. The practical exposure built a foundation for understanding biophysics (42), demonstrated the New Mexico Department of Education's core science standards for middle and high school (45), and integrated cross-cutting concepts across multidisciplinary STEM fields by using these standards (46).

In addition to teaching technical concepts and skills, the workshops can be a great vehicle for addressing the hidden curriculum—the unspoken norms, expectations, and informal knowledge critical to success in STEM—which poses significant challenges for students from underrepresented communities and for students with no history of college education in their families. For example, our workshop emphasized collaborative learning by encouraging peer brainstorming when forming hypotheses and analyzing collected experimental data.

Having discussed potential benefits, it is valuable to recognize the limitations of our workshop. We believe that a single 3-h event probably will not change every participant's future educational interest and career aspirations in favor of STEM. A comprehensive and immersive program may have a better chance of making a significant influence in this regard. In line with this vision, our workshop is offered as part of the New Mexico State University PREP Academy, a 1-wk engineering day camp program that combines several STEM-focused workshops to expose students to various scientific and engineering disciplines, including 3D printing, computer-aided design, programming, and electronic prototyping.

Workshops similar to the one presented here can be incorporated into the middle and high school curriculum as standalone events or integrated into existing outreach programs to provide diverse learners across the nation with a relevant and accessible experience that builds confidence in their STEM identity (47–49).

SUPPLEMENTAL INFORMATION

All Supplemental Material is available at: https://doi.org/10.35459/tbp.2024.000278.S1.

AUTHOR CONTRIBUTIONS

TK, JAP, MRT, EES, and BD developed, designed the outreach and surveys, analyzed overall outreach performance, and wrote the manuscript. TK, JAP, MRT, and BD performed teaching of the workshop. TK, JAP, and BD analyzed pre- and postworkshop surveys.

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INSTITUTIONAL REVIEW BOARD APPROVAL

The protocol received an exemption from the New Mexico State University Institutional Review Board.

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