2026 AAPT

WINTER MEETING

JANUARY 17 -19
Las Vegas

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Special Thanks

AAPT wishes to thank the following persons for their dedication and selfless contributions to the Winter Meeting:

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Committee: Kelli Warble, Aaron Titus, Dawson Nodurft, Bree Barnett-Dreyfuss, and Tony Musumba

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We will be posting updates to Facebook and Twitter prior to and during the meeting to keep you in the know! Participate in the conversation on Twitter by following us at **twitter.com/AAPTHQ** or search the hashtag **#aaptwm26**. We will also be posting any changes to the schedule, cancellations, and other announcements during the meeting via both Twitter and Facebook. Visit our Pinterest page for suggestions of places to go and things to do in the Boston area. We look forward to connecting with you!

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2026 Melba Newell Phillips Medal Recipient is Dwain Desbien

Dwain Desbien

Sunday, January 18
11:30–12:20 p.m.

Platinum Ballroom

The American Association of Physics Teachers (AAPT) proudly announces that Dwain Desbien, will be awarded the Melba Newell Phillips Medal. The award will be presented during the AAPT 2026 Winter Meeting.

This honor recognizes "his pioneering work in Modeling pedagogy, his transformative impact on the professional development of physics educators nationwide, his decades of creative leadership and dedicated service to AAPT, and his work advancing physics education and inspiring generations of teachers and students."

Desbien, Physics Professor at Estrella Mountain Community College, earned his B.A. in Physics from Grinnell College, his M.S. in Physics at the University of Kansas, and his Ph.D. in Curriculum and Instruction (Science Education) at Arizona State University.

Regarding his receipt of this award Desbien said, "I am shocked and humbled at being awarded the Melba Phillips Award. This is such a high honor within AAPT and one that I never really thought I might even be considered for. I would like to thank those that nominated me for thinking I deserved this honor. I strive to continue to provide the kind of service to AAPT those individuals saw in me. I look at the list of previous winners and am proud and excited to be included in that distinguished list of awardees."

Desbien has worked for AAPT's benefit for more than two decades. He served on the AAPT Board of Directors (2006 – 2009) as At Large Two-year College Representative. He has provided significant intellectual leadership in National Science Foundation (NSF) programs in two-year college and high school professional development, and providing personal leadership and intellectual property contributions in creating pedagogical reforms called the "Modeling" process.

The Melba Newell Phillips Medal honors the legacy of Melba Phillips, a physicist, educator, and advocate for science education. The medal is awarded infrequently and only to individuals whose careers reflect Phillips' commitment to advancing physics education.

Meghan DiBacco is the 2026 Doc Brown Futures Award Recipient

Meghan DiBacco

Sunday, January 18
4:30–5 p.m.

Platinum Ballroom

AAPT has announced that the 2026 recipient of the Doc Brown Futures Award is Meghan DiBacco. The Doc Brown Futures Award recognizes early-career members who demonstrate excellence in their contributions to AAPT and physics education and exhibit the potential to serve in an AAPT leadership role. The award will be presented during the 2026 Winter Meeting.

"It is an honor to be selected for this award. The physics community has helped me grow and supported me in my early career as an educator. I look forward to becoming more involved to help the next group of early career educators," said DiBacco.

A member of AAPT since 2019, she earned both her B.S. and M.S. in Geophysics at the University of Houston, where she is also a teachHOUSTON alumna. DiBacco currently serves as an AP Physics 1 & 2 Teacher, AP Physics 1 Team Lead, and AP Physics 1 District Course Co-Lead at Jordan High School, Katy Independent School District, Katy, Texas.

From the very start of her teaching career, DiBacco became an active and engaged member of AAPT. She was introduced through the Texas Section of AAPT, and she quickly immersed herself in the community. She presented at meetings, joined the High School Committee, and worked with the PTRA Program. She also works in other areas of physics as a Leader for Quantum for All and a presenter at the Conference for Advancement in Science Teaching (CAST), the largest science education conference in Texas.

Named in honor of outstanding physicist and teacher, Robert William Brown (Distinguished University and Institute Professor in the physics department at Case Western Reserve University). The Doc Brown Futures Award recognizes early-career members who demonstrate excellence in their contributions to AAPT and physics education and exhibit the potential to serve in an AAPT leadership role

Bruce Sherwood and Ruth Chabay

Monday, January 19

11:30 a.m.–12:30 p.m.

Platinum Ballroom

2026 Oersted Medal Shared by Ruth Chabay and Bruce Sherwood

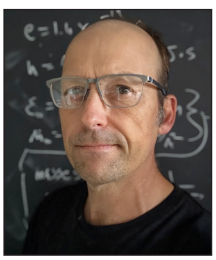
The American Association of Physics Teachers (AAPT) has announced that Ruth Chabay and Bruce Sherwood will share the prestigious Hans Christian Oersted Medal. The Medal will be awarded at a Ceremonial Session of the AAPT Winter Meeting where they will also deliver a plenary lecture. The Oersted Medal citation recognizes “their revolutionary and lasting impact on the teaching of physics through the creation of Matter &Interactions, their work transforming introductory physics to integrate computation and emphasize fundamental principles, their influence on curriculum reform internationally, and their pioneering work which set a new standard for innovation in physics education and inspired generations of educators and students.”

Chabay earned a Ph.D in physical chemistry from the University of Illinois at Urbana-Champaign. She is Professor Emerita in the Department of Physics at North Carolina State University and has also taught at the University of Illinois at Urbana-Champaign, Carnegie Mellon University, High Point University, and the University of North Texas. She is a Fellow of both the American Physical Society and AAPT.

Sherwood’s Ph.D is in experimental particle physics from the University of Chicago. He is Professor Emeritus in the Department of Physics at North Carolina State University. He has also taught at Caltech, the University of Illinois at Urbana-Champaign, and Carnegie Mellon University. He is a Fellow of the American Physical Society, AAPT, and AAAS.

From the early 1970s to 2025, their work on the PLATO system at UIUC, physics courseware (numerous Physics Academic Software titles), the programming language cT, the VPython library and Web VPython, the textbook Matter & Interactions, and numerous influential papers in the *American Journal of Physics* has been foundational to integrating computation and reimagining the content in the introductory, calculus-based physics course. VPython allows students to easily create three dimensional models of physical systems and lets teachers employ computing for instruction in incredibly exciting ways. The influence of Matter & Interactions on physics education cannot be overstated.

Named for Hans Christian Oersted, the Oersted Medal recognizes those who have had an outstanding, widespread, and lasting impact on the teaching of physics. The recipient delivers an address at an AAPT Winter Meeting and receives a monetary award, the Oersted Medal, an Award Certificate, and travel expenses to the meeting. The award was established in 1936.



Rhett Allain

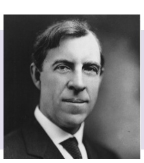
Monday, January 19
4:30–5:30 p.m.

Platiunum Ballroom

Rhett Allain to Receive Richtmyer Memorial Lecture Award

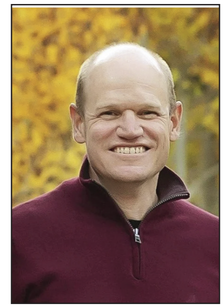
Dr. Allain is recognized “For his exceptional ability to communicate physics to broad and diverse audiences, his innovative use of books, digital media, and public platforms to inspire curiosity about how the world works, and his sustained commitment to mentoring teachers and students while advancing excellence in teaching and scholarship.” Allain joined AAPT in 1997 and has served locally in the Louisiana Section and nationally as a Section Representative, Membership & Benefits Committee member. and on the Annual Meetings Planning Subcommittee. Allain has a popular blog at WIRED.com that focuses on explaining physics concepts to the general public. For more complicated topics with more detail, he also posts regularly on Medium.com. Supplementing his blogs, he creates short form science videos on YouTube, Instagram, and TikTok.

He conveys his passion for physics with his quest to show that science is all around us in the real world and not just in textbooks. Allain also loves to incorporate numerical calculations in introductory physics calculations. His running joke is that he often takes things apart to figure out how they work but he can’t always put them back together. Allain cares about communicating physics to the public and he is preparing the next generation of teachers in his classroom to communicate physics to the current generation of students and the public. At Southeastern Louisiana University he teaches a wide array of physics courses for undergraduates-all year round, including a a general education physics course, some of his students go into elementary or middle school teaching. In this class Allain emphasizes the nature of science: that science is about building models and it is not necessarily about finding the truth that never changes. We build better models to explain the physical world.



Named for Floyd K. Richtmyer, distinguished physicist, teacher, and administrator and one of the founders of AAPT, the Richtmyer Memorial Lecture Award recognizes those who have made outstanding contributions to physics and their communication to physics educators. The recipient delivers the Richtmyer Lecture at an AAPT Winter Meeting on a topic of current significance and at a level suitable for a non-specialist audience and receives a monetary award, an Award Certificate, and travel expenses to the meeting.

Plenary Speaker is Jason Steffen



Jason Steffen

Saturday, January 17
4–5 p.m.

Platinum Ballroom

Dr. Steffen is an Associate Professor of Physics at the University of Nevada, Las Vegas. His work is primarily on the properties, formation, and dynamical evolution of planets and planetary systems. He was a long-time member of the science team for NASA's Kepler mission where he contributed to the discovery and characterization of thousands of planets and planetary systems. Dr. Steffen is the author of the book "Hidden in the Heavens", available from Princeton University Press (Fall 2024). Prior to joining UNLV, he was research faculty at Northwestern University and the Brinson Postdoctoral Fellow at the Fermi National Accelerator Laboratory near Chicago Illinois.

Dr. Steffen received his PhD and MS in Physics at the University of Washington, Seattle, and his Bachelors degree in Mathematics and Physics from Weber State University, in Utah.

The 2026 Winter Fellows are **Clausell Mathis** *and* **Stamatis Vokos***.*
Saturday January 17, 4 p.m. Platinum Ballroom

The 2026 Homer Dodge Citations of Distinguished Service to AAPT are **Krista Wood, Tatsu Takeuchi, David Sturm, Krista Wood, Raeghan Graessle**
Sunday, January 18, 11:30 a.m.–12:30 p.m., Platinum Ballroom

Homer L. Dodge Citations for Distinguished Service to AAPT

Raeghan Graessle

Raeghan Graessle

Raeghan Graessle receives the Homer L. Dodge Citation for Distinguished Service to AAPT during the 2026 Winter Meeting. Graessle is recognized for her exceptional service and leadership to AAPT community members.

Regarding her selection to receive this citation, Graessle said, "I'm delighted and humbled to receive the Homer L. Dodge Citation for Distinguished Service to AAPT and to be a part of the inspirational group of past award winners. Thank you to everyone who's been a part of my community at AAPT and especially thanks to those who nominated me. The AAPT has done so much for me and for my students, it is my honor to give back to such an empowering organization."

Graessle is an associate professor of physics in the Math and Science Division at William Rainey Harper College in Palatine, IL. She graduated from the Massachusetts Institute of Technology with her SB in physics. Her MS in physics was earned at University of Illinois at Urbana-Champaign. She holds an MEd in curriculum and instruction from Loyola University, Chicago, and she is currently an EdD candidate in curriculum and instruction at Northern Illinois University.

A member of AAPT since 2016, Graessle has taught physics first at high school and currently at a community college. She has been extremely active in AAPT at both the sectional and the national levels. She has been Vice President and President of the Chicago Section of the AAPT, shepherding the organization through pandemic lockdown challenges. She has served with dedication, vision, and creativity. As President of the Chicago Section, she expanded community engagement, organized impactful meetings, and introduced innovative teaching workshops. Nationally, she has contributed through the Committee on Physics at Two-Year Colleges, OPTYCs leadership, and mentoring new faculty. She is widely admired for her equity-focused pedagogy, engaging workshops, and tireless mentorship of colleagues and students alike.

David Sturm

David Sturm

David Sturm receives the Homer L. Dodge Citation for Distinguished Service to AAPT during the 2026 Winter Meeting.

David is recognized for "his exceptional service, leadership, and mentorship of AAPT community members. David has encouraged and guided many new and early career members to become leaders in the Association. He has served AAPT with distinction at both the national and section levels, including leadership in the New England Section, on the Board of Directors, and in key roles with PIRA, ALPhA, and PTRA. He has played a vital role in strengthening ties between the national organization and its sections, and his dedicated work on the Nominating Committee has ensured strong leadership for AAPT's future."

Regarding his selection to receive this citation, David said, "Our networking is the most important part of

AAPT, because as allies advancing physics teaching, we all can do more."

David is the instructional laboratory and lecture demonstration specialist for the University of Maine Department of Physics and Astronomy.

A member of AAPT and PIRA since the 1990s, David has a history of distinguished service to AAPT locally and nationally. David's service shows a long-term commitment to the apparatus community, including past and current time as chair. He has been an active leader and officer for PIRA. He has served in various roles in the New England Section. In his role as Section Representative for New England, he served in a variety of leadership positions between 2012 and 2023. He has also served in the communities on Laboratories and Science Education for the Public, and on the Meetings Location and PTRA Oversight Committees. From 2017 to 2021, Sturm served on the AAPT Board of Directors during the pandemic, which was a time when many crucial decisions were made. Since leaving the Board, he stepped into the Nominations Chair role, at a time when declining membership and smaller conference attendance has raised challenges regarding how our committees are filled. He has reached out to members, drawing them into roles that develop their leadership and bringing them solidly into AAPT.

Tatsu Takeuchik


Tatsu Takeuchi

Tatsu Takeuchi receives the Homer L. Dodge Citation for Distinguished Service to AAPT during the 2026 Winter Meeting. Takeuchi is recognized with the Homer L. Dodge citation for "exemplary work in greatly expanding the reach of the Chesapeake Section of AAPT by running extraordinarily successful section meetings and by modernizing the bylaws and administrative status of the section. His work in the Executive chain is a model for all sections of AAPT."

Regarding his selection to receive this citation, Takeuchi said, "I thank the AAPT for this recognition and hope that it will bring attention to the huge potential that the AAPT sections have in serving the needs of the physics teaching community in each state, extending the work of the AAPT to the grassroots level. I invite the other sections to take a close look at what the Chesapeake Section was able to accomplish and adopt what may work for them to boost their respective activities."

Takeuchi is a professor of physics at Virginia Polytechnic Institute and State University, Blacksburg, VA. After earning his BS (1983) and MS (1985) in physics at the University of Tokyo, he went to Yale University, where he earned an MS (1988) and PhD (1989) in physics.

A member of AAPT since 2020, he has been a leader in the Chesapeake Section (CSAAPT), serving as Vice President (2021–2022) and President (2023–2024). Takeuchi works diligently and meticulously for CSAAPT, and for the advancement and convenience of the community.

He sent thousands of announcements and invitation emails to colleagues, created the web pages for the meetings, thoughtfully sent thank you messages to all participants at every meeting, and emailed vendors, institutes, and departments to solicit financial support and attendance. CSAAPT currently holds meetings with well-crafted programs that serve about 100 participants, and is consistently and successfully holding semi-annual meetings in the difficult-to-organize hybrid mode, to increase inclusion and participation.

Takeuchi is well aware of the hardship physics teachers, especially high school teachers, go through. He genuinely strives to advocate for them through CSAAPT. He is consistently able to support the travel of high school teachers to CSAAPT meetings, an impressive achievement for an AAPT section. He not only serves the Chesapeake region but also is currently collaborating with and helping neighboring sections. He had the vision to hold the Fall 2024 CSAAPT meeting jointly with the North Carolina section of AAPT at Jefferson Lab, Newport News, VA.

In 2023, Takeuchi initiated the process of getting CSAAPT incorporated and tax-exempt. He achieved incorporation of CSAAPT, which he announced at the Spring 2024 meeting at Delaware State University, the first time since 1999 that CSAAPT has held one of its meetings in Delaware. He is now working toward updating the section bylaws and tax-exempt status application. He cares so much about CSAAPT that he makes time to visit AIP's Niels Bohr library in College Park, MD, to research the historical records of the section. The documentation he is compiling using that information is going to be a priceless contribution to our community.

Krista E. Wood


Krista Wood

Krista E. Wood receives the association's Homer L. Dodge Citation for Distinguished Service to AAPT during the 2026 Winter Meeting.

"Dr. Krista Wood is recognized with the Homer L. Dodge Citation for her sustained service, mentorship, and vision to the AAPT community. Dr. Wood has provided exemplary leadership at both the regional and national levels of AAPT. As president of the Southern Ohio Section, she revitalized governance, strengthened community bonds, and welcomed new members with generosity and care. Nationally, she served with distinction as Member-at-Large for Two-Year Colleges on the AAPT Board of Directors, as a mentor for new and mid-career faculty, and as a leader in OPTYCs and the New Faculty Development Series."

Regarding her selection to receive this citation, Wood said, "I'm deeply honored and humbled to receive this award. From my earliest days teaching physics, mentors like Dwain Desbien and Tom O'Kuma welcomed me into the AAPT community. Through their encouragement, I found not just professional growth, but a true sense of belonging. AAPT has been my home, filled with passionate people who care deeply about learning and teaching physics. I'm grateful to have grown with and served this incredible community as we work to make physics education better for all."

Wood is a professor of physics at the University of Cincinnati Blue Ash College, Cincinnati, OH. She graduated with her BS in electrical engineering from Kettering University. Her MEd in secondary education is from Xavier University, and her PhD in physics education is from the University of Cincinnati. Wood has been both a thoroughly capable administrator and an insightful leader of the Southern Ohio Section of AAPT. She has focused on strengthening the physics teaching network in the region. In her most recent term on their board, she led a thorough rethinking of their board structure and constitution, brought new members into the community and into the leadership, and instituted new practices for strengthening the bonds within the community. Krista accomplished this work effectively, and in doing so has created for the board an enduring new pattern of keeping on track and in communication. She stands out for her subtle but transformative work in her roles on their board.

A member of AAPT since 1995, Wood has served on numerous committees, including the Committee on Physics at Two-Year Colleges. She was elected to the National AAPT Board of Directors, serving from 2021-2024, as the Member-At-Large Representing Two-Year Colleges (TYCs). Being a member of the National Board of Directors required a tremendous commitment of time and energy. She wrote quarterly reports to the Board on the activities and concerns of TYCs. She solicited information from the community via multiple platforms, including monitoring the TYC Physics Slack Channel and the TYC Physics Google Group, and also getting feedback from the Committee for Teaching Physics at Two Year Colleges and OPTYCs.

Wood has been serving as a mentor to other faculty for many years. She has been an eAlliance Peer Mentor for midcareer physics faculty from TYCs across the U.S. since 2018. She also helped the eAlliance leadership in recruiting TYC women in physics and astronomy and used the eAlliance model to initiate a peer group of faculty at the University of Cincinnati who were applying for promotion.

Wood was also an alumna mentor to the 2016 cohort of the AAPT Two-Year College New Faculty Experience (NFE), cofacilitating and mentoring new physics faculty. In 2017, she hosted the NFE Commencement Conference for the AAPT from July 21 to 23 at the University of Cincinnati Blue Ash College.

While simultaneously engaged in this service, Wood has also been engaged in OPTYCs since its inception. In 2021 she chaired a working group to research and compile ideas for the successful NSF grant, and she is now a part of the OPTYCs leadership team. As the coordinator for both the New Faculty Development Series and the Leadership Institute, she plans activities, schedules program logistics, recruits participants, and disseminates results to the community. She also provides mentorship to new faculty participants and alumni leaders in these programs.

Fellowships Awarded at Winter Meeting

Clausell Mathis

Clausell Mathis is an assistant Professor at Michigan State University, where he has a joint appointment with Lyman Briggs College and the Department of Teacher Education, East Lansing, MI.

Citation: "Dr. Clausell Mathis is recognized as an AAPT Fellow for his extraordinary impact on the physics education community. His scholarship has advanced new ways of understanding how students and teachers engage with physics, shaping both classroom practice and national conversations in physics education research. At Michigan State University, he has developed innovative curricula and mentored learners at all levels, including undergraduates, graduate students, and postdoctoral scholars. He has also worked with high school teachers across the country, extending his influence well beyond AAPT's membership. Through his research, leadership, mentorship, and service, Dr. Mathis has become a role model for effective and meaningful engagement, leaving a lasting mark on AAPT and the broader community of physics educators."

Stamatis Vokos

Stamatis Vokos is a professor of physics at California Polytechnic State University, San Luis Obispo (Cal Poly), where he codirects the STEM Teacher and Researcher Program.

Citation: "Dr. Stamatis Vokos is recognized as an AAPT Fellow for his exceptional scholarship, leadership, and principled service to the physics education community. Through his groundbreaking research on student learning, extensive contributions to teacher preparation, and decades of leadership within AAPT and beyond, he has profoundly shaped physics education and inspired generations of educators. Equally impactful, Dr. Vokos has distinguished himself as a principled advocate for colleagues, especially those in vulnerable or less visible positions. His wisdom, humility, and dedication to equity have made him a trusted role model and champion for others."

Saturday, January 17, 2026 8 a.m.–12 p.m.

Physics with Phones

Using advanced sensors integrated into smartphones, participants will try dozens of experiments with emphasis on fluids, waves, magnetism, and physics for life sciences. Suitable for both high school and introductory university physics courses. Participants will receive a kit with materials for the experiments. Bring a laptop for spreadsheet data analysis. https://st.llnl.gov/sci-ed/Physics-with-Phones

Organizer(s): Dan Burns, Jennifer L. Klay

The Search for Dark Matter: A Masterclass in Data Analysis and Statistics

This workshop will sample activities from a masterclass under development using data from the XENON1T dark matter detector, for high school and undergraduate physics students, with an emphasis on coding and statistical analysis. Experience with coding using CoLab is helpful but not required.

Organizer(s): Peggy Norris

PICUP Workshop: Tools for Integrating Computation into Intro- Spreadsheets, Web Vpython Trinkets, and Google Colab

Focus on the actual implementation of computational physics in the classroom by working on several exercises as a student might do so. These will use spreadsheets and browser-based coding environments, so attendees will not need any software installed, but will need to bring their own laptop computer. Previous programming experience is not required. PICUP will provide a partial reimbursement of $40 of the workshop registration fee to those who attend and complete this workshop. This project is funded in part by the National Science Foundation under DUE IUSE grants 2337049, 2337050, 2337051, 2337052, 2337053, 2337054, 2337055, 2337056.

Organizer(s): Larry Engelhardt

Workshop on the Modern Eddington Experiment 2026,2027,2028

In this workshop, we will show you some ways in which computation can be integrated into your introductory courses. The PICUP partnership has developed a variety of computational activities for introductory physics, and we will show you how you can take these PICUP materials and adapt them to fit your needs. PLEASE BRING A LAPTOP COMPUTER. In this workshop, we will focus on computational activities using spreadsheets and web-based "Trinkets" so you do not need to have any specialized software installed. This workshop is supported in part by OPTYCs, The Organization for Physics at Two-Year Colleges (NSF-DUE-2212807), and NSF IUSE grants DUE-2337054, DUE-2337053, DUE-2337051, DUE-2337049, DUE-2337052, DUE-2337056, DUE-2337055, and DUE-2337050. Price: $75 (Member), $100 (Nonmember)

Organizer(s): Toby Dittrich

Session A01: PER: Problem Solving

Location: Bronze 1 Sponsor: AAPT

Time: 2–3 p.m. Date: Saturday, Jan. 17 Moderator: Sarah McKagan

(2–2:12 pm): What makes a physics problem hard? Research on problem difficulty

Presenting Author: David E. Meltzer, Arizona State Univ At the Polytechnic Campus

Physics problems that are intended to assess students' understanding of specific concepts can, from the students' standpoint, vary greatly in difficulty even in cases where an expert might see little difference. Although it may be obvious that longer problems with additional contextual features or which test multiple concepts will be harder, research has shown that there are numerous more subtle cases in which minor changes in problem properties can strongly impact students' correct-response rate. As examples, I will present data reflecting large differences in problem difficulty associated with use of symbols, minor changes in diagrams or in wording, multiplicity of relevant variables, inclusion of irrelevant information, need for spatial reasoning, dependence on subtle assumptions or terminology, use of quantities with different defining equations in different contexts, and reliance on unfamiliar or infrequently practiced mathematical skills.

(2:12–2:24 pm): Teaching Problem Solving in Undergraduate Physics Courses: An Endorsement for Deliberate Practice

Presenting Author: Olivia C. Miller, Harvard University, Kelly A. Miller

Developing expert-like problem-solving skills is a central goal of undergraduate physics education. In this study, we investigate the impact of teaching explicit problem-solving frameworks, combined with deliberate practice, on students' problem-solving approaches. Using multidimensional scaling to analyze students' decision-making patterns, we compare the similarity of students taught with these methods to physics experts and to students taught with traditional repeated practice. Our results show that students who received structured frameworks and targeted feedback through deliberate practice exhibited problem-solving behaviors significantly more aligned with those of experts. These findings suggest that pedagogies emphasizing explicit strategy instruction and iterative, feedback-rich practice are more effective than rote repetition for fostering expertise. We recommend integration of these approaches into physics curricula to better support the development of skilled and adaptive problem solvers.

(2:24–2:36 pm): Rethinking Physics Instruction: A Tiered Model Bridging Flexibility and Rigor to Empower Diverse Learners

Presenting Author: Kim Nielsen, Utah Valley University

Traditional physics instruction often leaves students with weaker math backgrounds struggling, contributing to attrition and performance gaps. To address this, we implemented a tiered, competency-based model in introductory physics, dividing content into four sequential phases (D–A) aligned with letter grades. Each phase builds in complexity: Phase D emphasizes algebra-based, one-dimensional concepts and key equations; Phase C adds two- and three-dimensional vector analysis; Phase B introduces calculus-based formulations; and Phase A requires advanced, multi-step applications. A central feature is flexible pacing—students may attempt each assessment when ready, up to three times, with clear grade values tied to each tier. This design reduces test anxiety, supports mastery, and fosters motivation. Data collected across multiple semesters indicate strong improvements: failing or D outcomes decreased markedly, while C-or-higher achievement increased substantially. These results suggest that a structured yet flexible tiered framework enhances accessibility, equity, and rigor, offering all students a clear and manageable pathway from fundamentals to advanced problem-solving in physics.

(2:36–2:48 pm): From Group to Solo: Do Group Tests Help on Individual Exams?

Presenting Author: James Addison III, Lamar University, Binod Nainabasti

In our Intro Physics I course at Lamar University, students took six short group tests (open-resource) and three regular individual exams (closed-resource). Two group tests came before each individual exam. We want to know if doing the group tests helps students do better on the next individual exam. We will compare topics that appear on both the group tests and the individual exams. We will look at overall exam scores and how students did on similar question types. We will also check whether the benefits are the same for everyone or bigger for students who started with lower preparation. To analyze the results, we will use basic comparisons and statistical models that account for differences between students and questions. We expect that the group tests will boost learning; especially on conceptual questions and problems that require translating between words, graphs, and equations. All data will be anonymized before we share results.

Session A02: Enhancing Classroom Engagement – Part I

Location: Bronze 2 Sponsor: AAPT
Time: 2–3 p.m. Date: Saturday, Jan. 17 Moderator: Shawn Reeves

(2–2:12 pm): Using Model-Evidence Link Diagrams to Support Physics Learning

Janelle Bailey, PhD, Temple University, Doug Lombardi

Model-evidence link (MEL) diagrams are graphical scaffolds that help students evaluate the connections between lines of evidence and competing explanations about a scientific phenomenon. Students engage in small and large group discussions, along with individual work, to evaluate these connections and make judgments about the plausibility (scientific truthfulness) of the competing explanations. With nearly a dozen topics in Earth and space science, physics teachers can select from multiple MEL activities suitable for their curriculum. In a recent implementation, two physics teachers used MELs relating to climate change, extreme weather, Moon formation, origins of the Universe, and fracking. In this talk, we will discuss how the teachers incorporated these MELs, the connections they made to their traditional curriculum, and what students learned in the process. We will also briefly introduce two newer MEL topics: (1) environmental sustainability of fossil fuels and alternative energy sources and (2) the safety and risks of nuclear energy.

(2:12–2:24 pm): From First to Second Year: Evolving Active Learning and Assessment in Introductory Physics

Jinhyuk Lim, PhD, Eastern Illinois University

In my first year teaching a 17-student calculus-based introductory physics course, I implemented active learning and formative assessment strategies. Each class began with a short recap quiz, followed by new concepts, a self-check quiz, and problem-solving examples. Brief group discussions reinforced understanding and fostered peer learning. In the second year, with 19 students, additional refinements were made. The Force Concept Inventory (FCI) was used as a pre- and post-test to assess conceptual gains. Group discussions were restructured by assigning roles—facilitator, note-taker, challenger, and presenter—to encourage equitable participation and accountability. After each exam, students evaluated both their performance and the instruction, providing feedback that highlighted the differences between their perspectives and those of the instructor. These insights informed targeted adjustments, ultimately enhancing engagement, deepening conceptual understanding, and improving course effectiveness.

(2:24–2:36 pm): SEL in the Physics Classroom

Nadene Klein, Ed.D., Daniel C Oakes High School

Many physics teachers are required to incorporate SEL in their classes, but they were not prepared to do so. This session will give justification and several strategies for using SEL in the science classroom. Participants will experience some of these strategies first hand in thsi interactive session. The strategies not only specifically fit a science setting, but are easy to implement right away.

(2:36–2:48 pm): Typesetting Physics Correctly

Larry Smith, PhD, Snow College

Precision in communicating physics enhances student understanding. Come learn about accepted standards in typesetting physics in a fun quiz format.

Session A03: Intro Labs

Location: Bronze 3 Sponsor: AAPT
Time: 2–3 p.m. Date: Saturday, Jan. 17 Moderator: Bob Brazzle

(2–2:12 pm): Turning Mistakes in Experimental Design into Learning Opportunities

Ali Tuna, St. Edwards School

This presentation explores an approach where students are asked to design their own experiments rather than follow a handout with predetermined questions, procedures, data tables, and graph templates. Allowing students to take ownership of the process encourages them to think more like scientists. Although this method is not always easy, it helps them engage with the scientific method at a deeper level while also making visible the theoretical concepts that remain unclear. A half-Atwood machine experiment using a hanging weight, a PASCO track, and a dynamics cart to measure acceleration that we conducted in class serves as an example. A major discrepancy emerged between the experimental and theoretical values, which was traced to the way the motion was initiated. Addressing this issue not only improved the accuracy of the results but also introduced students to a concept that had not yet been formally covered. This case illustrates how student-designed experiments can reveal hidden challenges, foster problem-solving, and create opportunities for authentic discovery.

(2:12–2:24 pm): Energy Loss and Building Efficiency Laboratory for High School and College Students

Jerry Artz, Hamline University

A highly practical laboratory, appropriate for high school physics students, college non-science majors, and even physics majors, will be presented. This laboratory allows students, usually working collaboratively, to calculate conduction loss, convection loss, and solar gain for a building by making reasonable approximations. Students can then calculate an “evaluation factor” that can be compared to the average value for a building in the state. The lower the evaluation factor, the higher the building energy efficiency. For conduction loss, the students should measure the wall, ceiling, and floor areas. The students then determine R-Values along with the temperature difference between the inside and outside of the building. Convection heat loss, or in this case "infiltration" heat loss, is measured by approximating a reasonable number of air changes per hour for the building, calculating its volume, and using the specific heat of air. And finally for a particular month, the solar gain is determined from students' measurements of window areas while noting the orientation (south, east, west, or north-facing). This presentation will provide an example of heat loss calculations for a room with a single south-facing exterior wall with window for a cold February 10-degree Fahrenheit average temperature day in Saint Paul, Minnesota. Learning objectives for students include increasing their understanding of conduction and infiltration heat loss, R-Values, measuring of window and wall areas, air-changes, solar gain, degree-days, evaluation factors, and the making of "reasonable" approximations. Indirectly, students learn ways of conserving energy in home and building construction and siting.

(2:24–2:36 pm): Photons & Photoelectric Effects: LED-based Student Experiences

Eric Schiff, PhD, Syracuse Univ, Samuel Sampere

Light-emitting diodes (LEDs) can be used to create a student lab experience that memorably illustrates important features of the photoelectric effect. These features are now standard in U.S. courses aligned with the MCAT and AP examinations. The experience is an alternative to implementations of vacuum tube "stopping potential" measurements. While the latter were conclusive for Einstein's photon model, they were not available to him. Einstein relied on threshold frequency measurements. In each material, a photoelectric effect only occurs for light with sufficiently large optical frequency, and its presence is independent of the intensity of that light.The implementation described here is used in the college physics course at Syracuse. Six fixed pairs of LEDs of three colors were used: red-red, red-green, red-blue, green-green, green-blue, blue-blue. An LED can be used both as a source of fairly monochromatic light as well as a detector of incident light. Only the blue diode will create photocurrents in all three colors of LED, and red only makes currents in the red LED. These aspects have been noted previously. We argue that the experience is as important to the photoelectric effect as stopping potential measurements, is more memorable for our students, and has the benefit of introducing an important contemporary technology.

(2:36–2:48 pm): The observation of the absorption of He emission lines by aqueous solutions of $CuSO_4$ and $Co(NO_3)_2$

Kwang Taeg Rim, Maine School of Science and Mathematics, Lochlan O'Conner, Samuel Pike, Samantha Houghton, Abe Han, Brady Bouchard, Yilin Zhang

It is the first year of the multi-year project to build a UV-Visible spectrometer at Maine School of Science and Mathematics (MSSM) to educate optical properties of atoms and compounds to high school students, and investigate physical and chemical properties of CaCO3 dissolved in tap water among other minerals with UV-Visible absorption spectroscopy. Emission spectra from various gas discharge tubes (He, Ne, Ar, Kr) were observed and lines were successfully assigned with 7500 lines/cm transparent grating. He emission lines in red, yellow, green, and blue were photographed to investigate the absorption by aqueous solutions. When 1 M aqueous solution of CuSO4 is placed into the optical path of emission light, red lines (720 nm, 680 nm, 650 nm) are completely absorbed. While 1 M aqueous solution of Co(NO3)2 is placed into the optical path of emission, blue lines (480 nm, 455 nm, 450 nm) are completely absorbed. The absorption of He red and blue bands corresponds to the absorption spectra of CuSO4 and Co(NO3)2, respectively.

Session A04: Conversation with Plenary V Speaker, Rhett Allain

Location: Bronze 4 Sponsor: AAPT
Time: 2–3 p.m. Date: Saturday, Jan. 17

Panel: Rhett Allain *Confirmed Panel Speaker*

Anthony Musumba *Confirmed Session Chair*

Session A05: Interactive: Hands-On Demonstration of Entropy as the Most Statistically Probable Outcome

Location: Palace 3 Sponsor: AAPT
Time: 2–3 p.m. Date: Saturday, Jan. 17 Moderator: Richard Gelderman

(2–2:48 pm): Hands-On Demonstration of Entropy as the Most Statistically Probable Outcome

Richard Gelderman, Western Kentucky University

Most students in an introductory physics or astronomy course will have heard about entropy and the power of the Second Law of Thermodynamics constraining the evolution of our Cosmos. But it is extremely rare for them to understand what that means. During this interactive session, we will lead attendees through a hands-on demonstration of entropy, using coins to show how probability drives a system from a state of low entropy (order) to high entropy (disorder). While entropy is often simplified as "disorder," the core concept is that a system will naturally move towards the most statistically probable arrangement.

Session B01: PER: Assessing Impact

Location: Bronze 1 Sponsor: AAPT

Time: 3–4 p.m. Date: Saturday, Jan. 17 Moderator: Doug Petkie

(3–3:12 pm): Outcomes of an International Year of Quantum Secondary STEM Teacher Leadership Initiative

Angela Kelly, Stony Brook University, Carsten Albert, Tzu-Chieh Wei, Dominik Schneble, Zijian Song

To meet the growing need for quantum information science and technology (QIST) workforce development, precollege students need to be exposed to QIST. However, quantum topics are not often taught in high school classrooms in the United States. This research reports outcomes from a university-based International Year of Quantum Science teacher leadership initiative designed to promote QIST education in U.S. secondary schools. The aim of the conference was to build motivation for middle and high school STEM teachers to incorporate quantum ideas, QIST curricular developments, and the QIST research and workforce landscape in their disciplinary instruction. A one-day conference was held in June 2025, with follow-up 12-hour professional development workshops. Conference participants included 84 New York City and Long Island STEM teachers, who experienced interactive and collaborative lectures from quantum scientists and educators, hands-on activities, and curricular resource discussions. Survey data indicated that teachers felt their schools were supportive of QIST-adjacent topic integration. Although teachers had some familiarity with basic quantum concepts, they were unfamiliar with how to integrate quantum concepts effectively. They expressed the need for professional development in differentiating quantum careers and advising students on QIST academic pathways. This presentation will highlight best practices for facilitating teachers' motivation and QIST pedagogical self-efficacy.

(3:12–3:24 pm): A Tale From Two Datasets: The Connection between Mindset and Physics Outreach

Isabella Oaks, Jonathan D. Perry, Tatiana L. Erukhimova, James K. Hirons, Toni Sauncy, Susan White, Rachel Ivie

Data collected from a national survey of Society of Physics Students revealed a strong link between students who facilitate informal physics outreach programs and possessing a growth mindset. Prior research has shown that students with more of a growth mindset had success in their courses, which can impact retention rates, an important consideration for physics departments. We draw on two data sets to explore the link between facilitation of informal physics outreach programs and mindset development. The first data set comprises open ended responses from the national survey administered in spring 2023. The second data set was collected through 35 semi-structured interviews with students who facilitated one or more programs at a large university with a significant outreach program. Responses were coded for growth or fixed mindset, including a directionality of whether it appeared to be enhanced or caused through formal coursework or outreach. This was followed by a thematic analysis to extract core themes relevant to student mindsets. Key themes were identified including students' recognition that they have more to learn in physics, that they grew more confident in their abilities or their knowledge, and having a realization of their understanding; all related to growth mindset.

(3:24–3:36 pm): Analyzing the Assessment Boundaries of Electricity and Magnetism Concept Inventories and Research Based Assessment Instruments

Mark C. Spraker, University of North Georgia, April A. Nelms, Ph.D.

Concept inventories and Research Based Assessment Instruments (RBAIs) are tools used by educators to measure student knowledge at a given point in their educational development and are ideally used to measure the changes in students' knowledge over time [1,2,3]. They may also be used for diagnostic purposes at the beginning of a course. The goal of our project was to identify and map the assessment boundaries of electricity and magnetism concepts using existing assessments available through PhysPort and the research literature. In this talk, we will present our findings on the current limitations, discuss the rationale for including missing concepts, and open opportunities for multi-institutional collaboration in the Physics Education Research (PER) community.

(3:36–3:48 pm): From Group Collaboration to Co-Authoring: A Case Study Exploring How Students Collaborate In-Person and Digitally

Danielle Bugge, West Windsor-Plainsboro High School South

In classrooms utilizing the Investigative Science Learning Environment (ISLE) approach, students engage in the authentic practices of science every day. They design and conduct observational, testing, and application experiments, and document their findings through written laboratory reports. One key question for educators is: How do students' contributions in the laboratory compare to their contributions on their group laboratory report? To explore this, we first conducted a quantitative analysis of the revision histories in students' Google Documents, tracking individual contributions to their lab reports. Our findings from part one of this study revealed that the level of collaboration was closely linked to the complexity of the task, and that the sequence and timing of student written contributions varied across groups and investigations. We observed different patterns of collaboration—whether students work independently, sequentially, or in parallel. A limitation of this study is that the analysis of written contributions alone doesn't fully capture the collaborative dynamics; hence the need to observe students in the classroom to better understand how their interactions influence their written work. A case study analysis approach will be used to delve deeper into how first-year high school physics students in an ISLE approach classroom collaborate during in-class experiments versus how they co-author their laboratory reports.

Session B02: Enhancing Classroom Engagement – Part II

Location: Bronze 2 **Sponsor:** AAPT
Time: 3–4 p.m. **Date:** Saturday, Jan. 17 **Moderator:** Joel Klammer

(3–3:12 pm): Enhancing Conceptual Understanding of Projectile Motion Through Simultion-Based Function Building

Andrew Sokolowski, Masters in Physics, PhD in STEM Education, The Woodlands Christian Academy

Students frequently struggle with projectile motion because they do not recognize that horizontal and vertical motions are independent. This leads to common errors, such as mixing equations or incorrectly applying gravity to horizontal motion. This session presents a laboratory activity in which students use a PhET simulation to gather data and construct algebraic functions for each component of motion. A case study with AP Physics 1 students showed that the activity improved their understanding of two-dimensional motion. Students recognized the need to formulate position and velocity functions separately, strengthening both conceptual understanding and problem-solving skills.

(3:12–3:24 pm): Student Engagement in an Online and In-Person Introductory Physics Course: Effect on Attendance and Performance

Philomena Agu, Houston Community College

Research evidence suggests that student attendance and engagement have a positive impact on student performance. To change the trajectory of poor attendance and class participation, the instructor introduced Whiteboard/Chat and in-class assignments. The whiteboard was similar to a sandbox where students could make mistakes and correct errors quickly. The students also receive help from the instructor and their peers on whiteboard solutions. Online students use the Chat in the Learning Management System similarly. Additionally, students respond to a discussion prompt and critique each other during class. Most contact hours involve students submitting an in-class assignment, such as a quiz, participating in a discussion forum, or scanning and submitting problems solved on the whiteboard or via Chat. With these engagement strategies, students' participation in the class increases, the attendance rate improves, and fewer students fail or withdraw.

(3:24–3:36 pm): Impact of Open-Access Supplemental Materials on Student Success in an Introductory Mechanics Course

Kaylyn Sitka, James K. Hirons, Tatiana L. Erukhimova, Jonathan D. Perry, Dawson T. Nodurft, William H. Bassichis, Scott Crawford

Student success in introductory physics courses is indicative of retention in STEM majors and fields, as these courses lay foundational knowledge for learning upper-level concepts. Prior literature shows that student utilization of supplemental materials outside of class can have a positive impact on course outcomes. This study investigates the impact of open-access self-study materials on student success in an introductory, calculus-based physics course covering Newtonian mechanics at Texas A&M University. The supplemental materials provided consist of three video resources developed by the Department of Physics & Astronomy, including chapter outlines, conceptual summaries with demonstrations, and detailed problem-solving examples; as well as a decade's worth of prior years' exams. Data were collected from three spring semesters (2022-2024), including course-level, departmental-level, and university-level data. We will present results of regression models indicating which factors were predictive of student performance in the course overall, as well as regression analysis of student performance on specific concepts covered by the supplemental resources. Student perceptions of their supplemental material usage, gathered via anonymous surveys, will also be discussed.

(3:36–3:48 pm): OER: The Only Thing in College That's Actually Free

Arbin Thapaliya, Franklin Coll of Indiana, Jessica M. Mahoney, Amanda Hurford

The adoption of Open Educational Resources (OER) in higher education is reshaping the learning landscape by promoting affordability, increasing access, and fostering student engagement. This study combines insights from faculty and student perspectives at a small liberal arts college (Franklin College, Indiana, USA). Faculty survey results from 70 respondents reveal growing awareness and use of OER, with a core group actively adapting and remixing materials to fit their courses. While faculty view OER quality positively, they identify gaps in subject-specific resources and a need for institutional support through training, peer-led workshops, and incentives. Complementing these findings, student success tracking shows a 2.1% rise in average final grades and more students exceeding an 87% course grade threshold, while student surveys reflect strong approval of OER quality and accessibility. In addition, global usage data from an open-access textbook authored by the lead author demonstrates wide adoption and reach. Together, these results highlight how faculty motivation, collaboration with library faculty, and support from state-wide library consortia can drive OER adoption, offering a roadmap for scaling use while fostering a collaborative, equitable, and innovative academic culture.

Session B03: Computing in the Classroom: AI & PICUP

Location: Bronze 3 **Sponsor:** AAPT
Time: 3–4 p.m. **Date:** Saturday, Jan. 17 **Moderator:** Marie Lopez Del Puerto

(3–3:12 pm): Supporting computational physics education with AI custom chatbots

Larry Engelhardt, Francis Marion University

I have taught a sophomore-level computational physics class "Computational Methods for Physics and Engineering" since 2008. As you know, AI chatbots are now readily available, so this semester (Fall 2025), I allowed — and encouraged — my students to create and use a very specific custom chatbot to help them with this class. I will tell you about the process that I used, and what happened as a result.

(3:12–3:24 pm): Updates from PICUP: The community is growing with SLICEs and DICEs!

Marie Lopez Del Puerto, Univ of St Thomas, Andrew Morrison

Since Fall 2024 PICUP has organized several (1) Distributed Institutes for Computational Education in Physics (DICE) and (2) The Summer Leadership Institute for Computational Education in Physics (SLICE). Come hear a brief report on how the PICUP community is growing, and get information on how to attend a DICE at a city near you and on applying to the SLICE, a week-long summer workshop. This project is funded in part by the National Science Foundation under DUE IUSE grants 2337049, 2337050, 2337051, 2337052, 2337053, 2337054, 2337055, 2337056.

(3:24–3:36 pm): Mapping PICUP resources to the introductory physics sequence

Andrew Morrison, Joliet Jr College

The PICUP project has a large collection of computational exercises and other resources for physics faculty to use in their courses. These resources have been contributed by verified educators in the PICUP community and are organized into what are called PICUP Exercise Sets or PICUP Faculty Commons Items. At the 2025 Summer Leadership Institute for Computational Education in Physics (SLICE) one of the ideas that emerged was the desire to organize the PICUP resources at the curricular level, either across a sequence or major. We present preliminary work to organize the PICUP resources for the introductory calculus-based physics sequence and the opportunities for further contributions. This project is funded in part by the National Science Foundation under DUE IUSE grants 2337049, 2337050, 2337051, 2337052, 2337053, 2337054, 2337055, 2337056.

(3:36–3:48 pm): Integrating Accessible High-Performance Computing into Physics Education

Matthew Heine, Ph.D., Massachusetts Institute of Technology, Alexander Shvonski, Philip Harris

Modern physics research as well as other disciplines in both academia and industry are increasingly using high performance computing (HPC) to solve more complex problems, handle larger data, and increase efficiency. The integration of HPC into physics education, therefore, can not only increase students' authentic engagement with current physics research but also prepare students for careers in physics and beyond. Educators have reported both significant interest to incorporate HPC as well as barriers including lack of curricular materials and lack of access to HPC hardware. [1] We will report on our recent integration of HPC exercises into the "Data Science in Physics" course, including GPU-accelerated machine learning and parallel CPU simulation. To make HPC integrations accessible to all educators, we created a blueprint which leverages cloud computing to remove the requirement of in-house HPC infrastructure. A virtual SLURM cluster in Google Cloud is used to ensure the skills and exercises are directly transferable to common HPC environments students may encounter.

Session B04: Memorial Session for Amber Stuver in Gravitational Waves

Location: Bronze 4 **Sponsor:** AAPT
Time: 3–4 p.m. **Date:** Saturday, Jan. 17

Panel: Margaret Norris *Session Chair*
Ann Schmiedekamp *Session Chair*

Session B05: Conversation with Bruce Sherwood & Ruth Chabay

Location: Palace 3 **Sponsor:** AAPT
Time: 3–4 p.m. **Date:** Saturday, Jan. 17

Ruth Chabay *Panel Speaker*
Bruce Sherwood *Panel Speaker*
Aaron Titus *Confirmed Session Chair*

Session C01: Innovations in Teaching Astronomy

Location: Bronze 1

Time: 9–10 a.m. **Date: Sunday, Jan. 18** **Moderator: Ann Schmiedekamp**

(9–9:24 am): An Updated Review of Astronomy Education Research with Undergraduate and Adult Learners

Molly Simon, Arizona State University – Tempe, AZ, Janelle Bailey, PhD

This presentation will synthesize findings from our comprehensive review of astronomy education research (AER), published in Physical Review Physics Education Research and inspired by Bailey and Slater's seminal 2003 survey [Astronomy Education Review, 2(2), 2]. After examining more than 450 works, we focused on research in undergraduate education settings and with planetarium professionals and adult learners more broadly. Our analysis identified seven research categories, including both continuations of well-studied areas such as student understanding and instructional strategy efficacy and emerging themes like authentic research experiences that reflect the field's evolution over the past twenty years. In this talk, I will present an overview of these research findings while also providing a thorough examination of the current state of astronomy education research. Drawing from patterns identified in our review, I will discuss how the field has expanded, highlight continued gaps, and propose directions for future research.

(9:24–9:36 am): Live Scripts for Astronomy Education

Duncan Carlsmith, PhD, Professor, University of Wisconsin - Madison

Interactive MATLAB Live Scripts can immerse budding astronomers in astronomy data access and analysis techniques. This talk introduces a Live Script for free near-real-time robotic-telescope filtered-image registration and synthesis, and a programmable night-sky viewing app to simulate and annotate an image of the stars from anywhere anytime, and make a movie of Jupiter's moons as seen from Earth as a virtual laboratory in the speed of light ala Romer.

(9:36–9:48 am): OpenSpace: Using Data Visualization to Enhance Formal and Informal Astronomy Education

Matthew Pappas, Suffolk County Community College, Michael Caprio

OpenSpace is open-source interactive data visualization software designed to visualize the known universe through incorporation of datasets resulting from NASA missions and other sources. The user interface is simple enough to allow high school and community college students to create a host of simulations of the cosmos that are limited only by their imaginations. This presentation will highlight the use of OpenSpace as an instructional tool for introductory astronomy courses, as well as students participating in workshops hosted by Suffolk County Community College, in collaboration with the Tesla Science Center at Wardenclyffe, as part of NASA's Space Apps Challenge.

Session C02: Reflections and Support for Early Career High School Teaching

Location: Bronze 2

Time: 9–10 a.m. **Date: Sunday, Jan. 18** **Moderator: Nadene Klein, Ed.D.**

(9–9:12 am): Teaching Physics For The First Time

Jan Mader, Great Falls High School

You received your teaching assignment for the fall, and lo and behold, you are now teaching physics. The previous instructor left no lesson plans, and there is little to no equipment. Sure, you had one semester of physics in college, but that is not your strength. Now what. The contributed talk will present learning cycles to assist both new and seasoned instructors with minimal physics preparation.

(9:12–9:24 am): Split Personalities: A Survival Guide for Teaching Multiple Subjects (and Schools)

Mike Florek, Glenvar High School

A lucky few of us teach the same level of physics all day long. Managing multiple sections of a single subject can be a challenge in itself. However, many of us have been told, asked, or volunteered to teach more than just physics. Navigating multiple preps at a time can be hazardardous, stressful, and frustrating. In this presentation, I'll share strategies and practices you can use to juggle multiple preps (and schools!) and do more than keep your head above water.

(9:24–9:36 am): Molding Physics Educators: Investigating Disciplinary Expertise and Identity Among High School Teachers

James K. Hirons, Texas A&M University, Jonathan D. Perry, Tatiana L. Erukhimova

High school teachers leading physics classes often come from other fields, with backgrounds in chemistry, biology, or engineering. Combined with their frequent role as the sole physics instructor in their schools, this can contribute to feelings of isolation. These aspects of their professional experience can pose challenges, not only in developing subject-matter expertise, but also in forming their identity as physicists and physics educators. Using semi-structured interviews with teachers recruited to the Mitchell Institute Physics Enhancement Program (MIPEP), a program for in-service high school physics teachers, we applied a literature-anchored codebook to explore possible shifts in teachers' physics identity, instructional confidence, and how participants position themselves within the discipline. Preliminary coding indicates that constructs such as empowerment and instructional support may be linked to changes in mindset, pedagogical practice, and community engagement. These emerging patterns suggest that programs like MIPEP may help create university–high school partnerships, foster a sense of accountability to students, peers, and the discipline; and create opportunities for teachers to reconnect with disciplinary communities.

Session C03: Alternative Assessment

Location: Bronze 3

Time: 9–10 a.m. | Date: Sunday, Jan. 18 | Moderator: Ali Tuna

(9–9:12 am): A Reflection on the Implementation of Standards-Based Grading in a HS Physics Course

Debbie Andres, Paramus High School

The Next Generation Science Standards (NGSS) call for teachers to incorporate science practices into the instruction of their students. How can we best assess our students' progress on targeted learning objectives? Teachers can use various assessment techniques to measure student proficiency, such as Standards-Based Grading (SBG). How can we use an SBG model while abiding by a school district's online grading policy? Since 2018, I have integrated Standards-Based Grading (SBG) into my HS freshmen College Preparatory and Honors Physics courses. This shift fundamentally changed my approach to teaching, assessing, and communicating with students. This talk will reflect on the implementation of SBG and the specific adjustments I have made throughout the process. I will also share resources I have developed and used over the years.

(9:12–9:24 am): Empowering Students via Self-Graded Homework: Less Stress, More Learning, and a Reason for Optimism in the Age of AI!

Benjamin Levy, Lafayette College

Self-grading is a technique in which students grade their own course work for credit. It promises enhanced learning, motivation, and accessibility, but adoption has been limited in college physics courses. A key problem appears to be the complicated logistics often required for this approach. Last fall I implemented a simple version of homework self-grading in my 21-student Junior level Classical Mechanics course. Results were encouraging with strong satisfaction and lower stress reported by students, higher exam scores, increased accessibility, and minimal evidence of cheating. Furthermore, I spent significantly less time grading. In this talk I present my experience with self-grading, discuss tips for adoption, describe how I am working to improve on its shortcomings in current classes, and explain why this experience gives me hope in the age of AI. I thank the North Carolina Section of the American Association of Physics Teachers for their generous travel support.

(9:24–9:36 am): Rethinking Assessment in Introductory Physics Labs

M. Jeannette Lawler, PhD, Associate Professor, Brigham Young University, Adam H. Bennion, Nathan D. Powers, Elena Ley

In the Summer and Fall semesters of 2025, a mastery-based grading system was implemented in a stand-alone laboratory course for life science majors taking algebra-based physics. This new system replaced a traditional points-based grading scheme with a framework modeled after professional scientific publishing. Student lab reports received one of three scores: an "Accept" "revise and resubmit" or "reject." Reports that did not meet the "accept" standard were expected to be revised and resubmitted until they reached the desired quality. Creativity was also directly rewarded. To assess the impact of the new grading scheme, trained observers coded student and teaching assistant behaviors during lab sessions. This presentation will discuss the motivation for making the change, the specifics of the new assessment model, and share observations regarding the effects on both students and teaching assistants.

(9:36–9:48 am): Mixing specifications- and standards-based grading for introductory physics classrooms

Jeremy M. Wachter, Ph.D., Wentworth Institute of Technology

I describe my implementation of two popular alternative frameworks for assessment in an introductory university-level mechanics course. Students are assessed, using a qualitative scale, on both general practices of physics as well as their abilities in particular relevant skills. The aim of this system is: to tie assessment more closely to course-wide learning outcomes; to communicate more clearly to students what is expected of them on assignments; and to provide multiple opportunities for feedback and refinement over the course of the semester. I discuss my specific system, including assignments and the overall translation of qualitative scores to a letter grade; lessons learned from different versions of this system I've used; and possible refinements for future versions.

(9:48–10 am): Agency and Analysis: Structuring assignments to suit diverse student experiences

Mitch Powers, PhD, Gettysburg College

In this contribution, we report a structure for homework assignments that allows students to choose a set of problems to complete from a larger pool of problems and the benefits, both for the students and instructor, that this system provides. This structure allows for problems to narrowly tailored to a relatively small portion of a class in addition to less specialized questions with broad appeal. Targetting questions this way helps to make course materials inclusive of the lived experiences of students, and helps students to leverage their existing knowledge, while still providing ample non-specialized problems. Additionally, the choices made by students provides a useful tool for identifying topics which may need to be reinforced based on the analysis of student choices. By analyzing their choices we are able to calculate a quantity similar to a potential of mean force at the level of individual questions. We report the results of employing this system in two introductory non-calculus based physics courses primarily consisting of biology and health sciences students at a small liberal arts college, including the tools used to conduct the analysis and insights drawn from student feedback. This work was originally supported by a grant from the Howard Hughes Medical Institute

Session C04: IPLS (Intro/Integrated Physics for Life Sciences)

Location: Bronze 4
Time: 9–10 a.m. **Date: Sunday, Jan. 18** **Moderator: Bruce Mason**

(9–9:12 am): Fostering relatively deep critical thinking in physics in introductory labs for life sciences students

Wathig Abdul-Razzaq, Ph.D., West Virginia Univ

Subjects like physics and biology often have their own sets of courses with unrelated titles, making it difficult for students to see how these sciences are interconnected. One way to reveal the connection between biology and physics is by exploring material at the atomic level. Every biological system is made up of atoms, and understanding atoms falls within the domain of physics. To highlight this connection, we developed a lab experiment — introduced in the introductory physics lab primarily taken by pre-life sciences students — based on the research work of Gross, Politzer, and Wilczek on quarks. We also developed another experiment inspired by the work of Hodgkin and Huxley who modeled a neuron as an electrical circuit composed of capacitors and resistors. For this, we built a simple circuit that generates a voltage pulse crudely resembles the one produced by the neuron. Experiments like these spark curiosity, creativity, and interest in science. They also help bridge the gap between college learning and professional scientific practice, ultimately boosting students' confidence.

(9:12–9:24 am): Bridging an Intercurricular Gap: How High School Physics Complements Anatomy and Physiology

Duruhan Badrasliogl u, Doctor of Medicine, The Bullis School

Anatomy and Physiology (A&P) classes often focus on body structures and how they work, but many processes can only be fully explained with physics. From how muscles and bones move, to how breathing and circulation rely on pressure, to how nerves send electrical signals and ears detect sound waves, physics helps us understand the body in action. This session will share a slide-based presentation for high school teachers that shows clear, practical examples of physics concepts in A&P lessons. Topics like motion, fluids, electricity, heat, and waves will be connected to body systems in ways that make learning more engaging and relevant for students. By the end, teachers will take away strategies for linking physics with anatomy and physiology—helping students see science not as separate subjects, but as connected tools for exploring the human body.

(9:24–9:36 am): Visualization Skills in Biomechanics

Nancy Beverly, Mercy University

For IPLS students preparing for health careers involving biomechanics, visualizing physics parameters on bodies and visualizing the body changes represented by graphic displays of biomechanics data helps the student to apply physics better in real practice.Students' difficulty in visualizing physics elements for themselves was discovered when students were doing their own biomechanics projects. Providing pictures in instructional materials was not sufficient for building the visualizations skills. Biomechanics digital worksheets have been developed in which IPLS students draw or click-and-drag physics elements such as extended force diagrams, rotation directions, lever arms, center of mass, etc. on real body images to visualize these elements at a variety of moments in body and limb motions. Graphical displays of biomechanics data are also visually annotated. When students take data in class on their own bodies, the data is synchronized with video, so screenshots of interesting moments can be used to integrate visual and quantitative analysis. Visualization skill building is now a part of most of the class activities and homework students do. This also makes the student assignments more AI-proof.

Session C05: Conversation with Plenary Speaker Jason Steffen

Location: Palace 3
Time: 9–10 a.m. **Date: Sunday, Jan. 18**

Jason Steffen, PhD *Confirmed Panel Speaker*
Dawson T. Nodurft *Confirmed Session Chair*

Camp Cosmos is a week-long astronomy camp for middle school students. For several years, we have run this camp on the UNLV campus with excellent reviews from both students and parents. In addition to the experience for participants, the camp provides summer support for students and faculty. Astronomy is a unique gateway to science learning, this camp can bring the wonders of the cosmos to your community, and bring your community to your campus. This discussion will provide information for those interesting in bringing Camp Cosmos to their institution.

Session D01: Beyond the First Year

Location: Bronze 1
Time: 10–11 a.m. **Date: Sunday, Jan. 18** **Moderator: Bradley McCoy**

(10–10:12 am): A comparison of classical and quantum trajectories

Darrell F. Schroeter, Reed College

In this talk we compare the trajectory of a quantum particle, meaning <x> as a function of time, to both the trajectory of a classical particle in the same potential and to the trajectory of the centroid of an ensemble of classical particles. Numerical approaches to finding the trajectory in each of these cases will be presented. In an introductory quantum mechanics course, drawing such a comparison encourages students to think more critically about the implications of Ehrenfets's theorem.

(10:12–10:24 am): A Taxonomy of Magnetostatic Field Lines

Joel Franklin, Ph.D., David J. Griffiths, Darrell F. Schroeter

Magnetic field lines almost never formed closed loops. This truism is well-known in some areas of physics (e.g. plasma and solar physics), and has been written about sporadically over the past hundred years. Yet it is hard to find a discussion of the general properties of magnetostatic field lines in introductory texts on electricity and magnetism. We provide a modern re-advertisement and characterization of some interesting twists to this well-known pedagogical tool.

(10:24–10:36 am): On Stacking Magnets to Increase Field Strength: A Cautionary Note

John Waite, Morehead State University, Jennifer Birriel

We present a "discrepant event" observed in the design of a Faraday free-fall lab for introductory physics courses. Using a commercial Faraday free-fall device, we desired students to observe the effect of increasing magnetic field on the induced voltage by stacking magnets. Naively, we expected staking two of the magnets provided would nearly double the induced voltage and stacking three magnets to nearly triple the induced voltage. Surprisingly, we found that stacking the magnets provided with the device showed no significant increase in the induced voltage. The resolution of this discrepant event lies in the dependence of magnetic field strength as a function of the ratio of magnet length to radius. We discuss the optimal ratio of length to radius using theoretical magnetic field strengths and conclude with recommendations for those who wish to design such an experimental investigation for introductory labs.

(10:36–10:48 am) Heat Transfer with Schlieren and Infrared Therrmography

John Allen, Univ Of Hawaii – Manoa, Alex Ribao

A fundamental understanding of heat transfer can be faciliated by Schileren and infrared thermography measurements. Though used primarlily for research in the past, these technologies are poised to be an intergral part of STEM education at both the secondary and college levels. Microbolmeter based infrared camera have been more accessible and available for educational purposes. Their underlying workng principles have fosters interest in radiative heat transfer topics. Morevoer, these techniques allows for the quantification and visualization of the different modes of heat transfer. Schileren optical systems show the density gradients during convective processes that are invisible to the naked eye. Both traditional and novel experimental examples using a commerical (Edmund Optics) Schlieren system are provided. These include the lighted candles, balloon bursting, hair dryer object levitation and combustion. Infrared Thermography provides for both spatial and temporal temperature measurements. Flow visualization techniques are combined with infrared thermography with a FLIR A655sc IR camera to investigate a variety thermo-buoyancy phenomena. The unique design of the handle of a kyusu, Japanese teapot, is investigated with respect to transient and steady state heat transfer. The hollow handle acts as a fin such that comparisons are made to approximate analytical fin solutions in limiting cases. A convection driven recirculation flow within the handle is highlighted to explain how it remains cool during the tea pouring.

Session D02: Using the AP Physics Science Practices Effectively

Location: Bronze 2

Time: 10–11 a.m. **Date: Sunday, Jan. 18** **Moderator: Jan Mader**

(10–10:24 am): Using the Science Practices for Multiple Choice Questions in AP Physics

Vaughn Vick, Christ Church Episcopal School, Brad Allen

The 3 new Science Practices in AP Physics highlight the need to move beyond a traditional approach to physics instruction, where the focus is mainly on equations and their subsequent numerical answers. The session will explore strategies for effectively incorporating and spiraling the Science Practices throughout the curriculum. Emphasis will be placed on helping students develop the ability to apply multiple representations to their physics reasoning.

(10:24–10:48 am): Assessing the Science Practices on AP Physics Free Response Questions

Brad Allen, Brighton Central School District, Vaughn Vick

We will discuss how the AP Physics Science Practices are assessed on the Free Response section of the AP Physics Exam. In particular, we will thoroughly break down the task verbs used in the questions and outline their correspondence with the required skills. All four of the Free Response Question types will be examined, and the 2025 AP Physics Exam questions will be explored to provide concrete examples.

Session D03: Efforts in Student and Faculty Support at Two-Year Colleges

Location: Bronze 3

Time: 10–11 a.m. **Date: Sunday, Jan. 18** **Moderator: Anthony Escuadror**

(10–10:24 am): Reflections on my OPTYCS Leadership Institute experience: Takeaways, lessons, progress, and challenges

Alexander Bohn, Northern Virginia Community College

I will present on some of the experiences shared at the in-person Leadership Institute at the Winter Meeting '25, how they activated prior experiences in the dynamics and challenges of change projects, and the lessons I took away from the program. In particular, I'll discuss the increased sense of belonging I felt in spaces to lead change in TYC physics as a result of the Institute. I'll report on the challenges faced that may be particular to the TYC context, and the progress made toward completion of deliverables for a change-minded grant-funded project to develop curricular materials. I'll also share some strategies, tips, and resources for leading and navigating change teams and projects generally, and discuss some questions I still have about the best way to leverage my strengths and to assess the strengths of others when assembling teams - and the best way to lead projects during periods of vanishing capacity. After all, extending the conversation beyond the Institute is the best way to ensure the superlative work of the OPTYCs team is recognized and appreciated -- we can all be better leaders!

(10:24–10:36 am): Physics Club at a TYC: What's Worked Well

Rod Milbrandt, Ph.D., Rochester Community & Technical College - RCTC

It's well known that creating a sense of belonging and opening horizons for students can increase motivation and assist them to persevere in physics and engineering. A physics and engineering club can really help with this. This talk will discuss some things that have worked well at our TYC including public demonstration shows, activities in schools, STEM outreach, and tours of academic and industrial labs, including a larger trip each spring.

Session D04: Classic Make and Take

Location: Palace 3

Time: 10–11 a.m. **Date: Sunday, Jan. 18**

Meghan DiBacco *Interactive Speaker*

This session is come and get a variety of ideas for things you can make for a small investment of money and time. Students can make many of these items. These can be used to teach physics concepts at a variety of levels.

Session E01: 21st Century Physics and Astronomy in the Classroom – Part I

Location: Bronze 1

Time: 2–3 p.m. **Date: Sunday, Jan. 18** **Moderator: Marla Glover**

(2–2:12): We Have No Idea: Exploring big questions in physics and astronomy with non-science majors

Kaisa Young, PhD, Nicholls State University

Curiosity about the biggest unanswered questions in modern physics and astronomy is a gateway to science for students that "have" to take a general education science course. "Physics of the Universe" is a survey course focusing on modern physics and astronomy topics taught at a conceptual level using the questions in the popular science book We Have No Idea: A Guide to the Unknown Universe by Jorge Cham and Daniel Whiteson as a springboard to explore fundamental concepts and the latest research. Students engage with topics in particle physics, cosmology, and relativity through in-class and online discussions, hands-on activities, formative assessments, and a final project. The latest news and discoveries are regularly interwoven with course content since the topics are at the frontier of twenty-first century physics and astronomy. The format, activities, and assessments of "Physics of the Universe" could be applied to a variety of courses in physics and astronomy. An article describing the course is scheduled for publication in The Physics Teacher in early 2026.

(2:12–2:24): Bringing Astronomy Down To Earth by Focusing on the Human Experience

Kristen Thompson, Davidson College

Many non-science major astronomy students tend to view events in the heavens as separate from their Earthly lives and struggle to see astronomy as a relevant subject. I have found students to be more engaged in class and enthusiastic about their experience when sufficient time has been allocated to establishing the human connection to astronomy. In this talk, I will highlight some early-semester activities that expose students to the ways in which our human lives and experiences are entangled with astronomy, increasing their buy-in to the course material. These activities include raising awareness of the cultural stories and oral traditions of the first astronomers, discussing how knowledge of the heavens was essential to daily life, hosting deliberations about the importance of preserving our dark skies, and encouraging students to develop personal connections with the stories of real people who have contributed to our understanding of the heavens.

(2:24–2:36): Exploring the Unseen Universe: Dark Matter and Gravitational Waves for Students

Jackie Bondell, University of Melbourne

Cutting-edge research in dark matter and gravitational waves offers powerful opportunities to bring 21st-century physics into the classroom. The ARC Centres of Excellence for Dark Matter Particle Physics and for Gravitational Wave Discovery (OzGrav) lead international collaborations that are uncovering the unseen universe, from detectors operating one kilometer underground in regional Australia to observatories measuring ripples in space-time. These same discoveries provide authentic contexts for teaching core physics concepts such as waves, gravity, particle models, and the nature of science. This interactive session will share classroom-ready, curriculum-aligned activities developed through long-term partnerships with secondary schools in Australia. This talk will introduce hands-on activities and lessons that connect current research to student learning, including activities on dark matter direct detection and next-generation gravitational wave experiments. We will also discuss strategies for embedding these topics in existing units, linking them to inquiry skills and science practices. Participants will leave with links to lesson plans, activity guides, and online resources to confidently bring the latest developments in astrophysics and particle physics into their classrooms, helping students engage with the big questions driving modern science.

(2:36–2:48): Time, Life, and the Mirrorverse

Andrew Ackler

Since the beginning of time, humanity has wondered how and why we exist. I have many answers for you in this theory I will call the "Mirrorverse"! It is a theory that brings many of the unknowns into one big idea! The main idea of the Mirrorverse is an infinitely repeating Universe that repeats all life for an infinite amount of time and infinite repetitions! The idea is that there are two parallel Universe that connect to each other at the same spot that we believe the Big Bang has happened and will happen forever. The Mirrorverse shows that we are always alive to our viewpoint. This shows that life does not exist without time, and time does not exist without life! The Mirrorverse ensures that all life will have infinite repetitions for one simple reason. The best amount of time for something great to last is literally forever! These are the main ideas for why we exist and I will now explain how we exist. CPT symmetry (Charge, Parity, and Time symmetry) and Supersymmetry are excellent reasons that this is more than just a theory, it is true to me. Both symmetries show that having two exact opposing Universes that repeat fit perfectly into this "Mirrorverse" theory! In Supersymmetry, there is a theoretical framework that shows there is a connection between bosons and fermions that has never been seen before. Supersymmetry has never really been proven because the opposing particles are literally an entire Universe apart ensuring we will never see them! CPT symmetry shows that if you were to reverse the charge of a particle, the parity you see which is the way we see opposing properties, and reverse the time dimension, you would have the same exact outcome! This shows that the Mirrorverse is an excellent theory that brings everything together! The last two major physical properties of the theoretical framework of the Mirrorverse are quantum entanglement and that energy is never created nor destroyed. Quantum Entanglement shows that no matter how far two opposing particles are, they always remain exact opposites. Since both sides of the Mirrorverse must remain exact opposites, the total energy in each must remain constant forever!
I have been working on this theory for over a decade now and the further time goes along, the more sure I am of this excellently designed Universe I call the Mirrorverse!

Session E02: Bridging the Gaps – Part I

Location: Bronze 2
Time: 2–3 p.m. **Date: Sunday, Jan. 18** **Moderator: Nina Morley Daye**

(2–2:12): Lessons Learned from the Inaugural GIREP Summer School for PhD students in PER

Stamatis Vokos, California Polytechnic State University - San Luis Obispo, Edit Yerushalmi

Board members of the International Research Group on Physics Teaching (GIREP, girep.org) organized the inaugural GIREP Summer School for mid-degree PhD students in Physics Education Research. The Summer School took place immediately before the GIREP Conference in June 2025 in Leiden, The Netherlands. Twenty-three PhD students from Europe, the Americas, and the Middle East participated in the Summer School, together with more than a dozen senior researchers. The Summer School was organized around four Working Groups, each consisting of five or six PhD students plus senior researchers. Each 75- or 90-minute session of a Working Group focused on the work of a single PhD student. In addition, there were sessions on publishing and on developing different types of professional skills, as well as opportunities for social networking. In this talk, details of the Summer School will be presented, and preliminary results from the evaluation will be outlined. Plans for the 2026 Summer School, which will be held in July 2026 in Rethymno, Greece, will also be described.

(2:12–2:24): "From Bosons to Bridges to Black Holes:" A college-level, introductory physics course before the General Physics sequence

Jeffrey Marx, McDaniel College, Shabbir Mian, PhD

In the Fall of 2023, the Physics Department at McDaniel College introduced a new required course into its major: "From Bosons to Bridges to Black Holes." The purpose of this addition was to provide a course in which all first-year physics majors would be together in a single course, before enrolling in the calculus-based General Physics sequence. Delaying the General Physics sequence until the spring semester would give incoming students who placed below Calculus 1 the opportunity to catch up with the other students in their cohort. Additionally, this new course would expose all of the first-year physics majors to the mathematics and basic physics concepts they would encounter in the General Physics sequence. Finally, as the name suggests, the course would be an avenue to introduce students to advanced topics that often draw them into physics in the first place. In this talk, we will discuss the details of our implementation, our experiences (including things that did not go as we had hoped), and our plans for the future.

(2:24–2:36): Jumpstarting a Physics Teacher Workshop Series for Enactment

Spencer Perry, Indiana University - Bloomington

With support from the Frederick and Florence Bauder fund and from the Indiana Univeristy School of Education Office of Community Engagement, the Indiana section of AAPT (AAPT-IN) embarked on a teacher workshop series for 2025-2026 focused on helping teachers having engaging physics lesson in their classrooms and engaging with their peers. We will discuss workshop design and content as well as the challenges and successes that we encountered.

(2:36–2:48): Connecting Secondary Physics Teachers (Pre-Service) with Physics Teaching mentors, a win, win opportunuty.

Connecting BYU Physics department to local secondary physics teachers.

Duane Merrell, Brigham Young University

Helping preservice physics teachers connect with classroom phyics teachers has always been a bit of a hope and a prayer. Through an effort at Brigham Young Univeristy and with funding from Brigham Young University Physics Department, NASA Utah Space Grant, National Science Foundation, (broader impacts) and AAPT Bauder Fund the creation of the physics breakfast club is in its second year.

Four of Five times a year we invite the physics teachers in the local schools, public and private to campus on a Saturday Morning.
The schedule is
7:30 am to 8:00 am breakfast
8:00 am to 10:00 am Physics and Physics ideas and materials.
10:00 am hard stop and they have the rest of Saturday for themselves.
Last year we tackled.
Sound-wave demonstrators-ruebens tubes-surface vibration speakers
Quantum--games and activities
Projectiles--Paper Rocket Launchers and Bottle Rocket Launchers
Fields--magnetic field activities--making industrial drill generators for classrooms.
Electricity--circuit and batteries and bulbs, resistance, current
Our undergraduate physics teaching majors were with the physics teachers in the community and developed connections that help them with the process of doing field work that is required for their classwork. The public school teachers took home new ideas, lesson, equipment that they could use in there classrooms and that Brigham Young University Physics department cares about them in there physics classroom.
This session is to highlight the approach, the ideas, the excitement and easiness of the funding mechanism for the Physics Breakfast Club.

(2:48–3): Building Bonds Through Physics: Women Students' Emotions in an Inquiry-Based Physics Course

Mihwa Park

Students' emotions in science classrooms play a critical role in shaping their learning processes, outcomes, and developing science identities. Physics, in particular, has been identified as a discipline where women often experience diminished belonging. Emotions influence cognition, behavior, and motivation, and are closely linked to learning and performance outcomes. Pekrun's (2006) framework of achievement emotions distinguishes between state (momentary) and trait (habitual) emotions tied to achievement activities and outcomes. Such emotions can be discipline-specific—for example, physics may evoke recurring responses that become automatic. Achievement emotions are associated not only with success or failure but also with everyday learning activities, and they are shaped by contextual factors such as task structure and instructional clarity. Guided by Pekrun's framework, this study examined the emotions of three undergraduate women enrolled in an inquiry-based physics course. Student interviews served as primary data sources, complemented by classroom artifacts and field notes to capture emotional expressions during group work. Using qualitative thematic analysis, we identified key factors influencing their emotions, including teacher quality and relatability, course design and structure, disciplinary identity, and group dynamics. We found that positive emotions, such as curiosity and enjoyment, often emerged when students experienced instructional clarity, supportive feedback, and collaborative problem-solving. Conversely, anxiety and frustration were triggered by ambiguous task expectations and feelings of isolation. Importantly, when students expressed negative emotions and received validation from peers, they developed stronger bonded group experiences, began cultivating a sense of belonging in physics, and showed greater persistence in engaging with challenging content. These findings highlight the role of social-emotional support in fostering engagement and retention for women in physics learning contexts.

Session E03: Collaborative Labs with AI and Electronic Notebooks

Location: Bronze 3
Time: 2–3 p.m. **Date: Sunday, Jan. 18** **Moderator: Eric Schiff**

(2–2:12): Discovery in Action: Enhancing Communication and Critical Thinking Through Lab Collaboration

Meghan DiBacco, Jordan High School-Katy-ISD

This presentation highlights how collaborative digital spaces can transform physics labs into opportunities for discovery. By enabling students to share their real-world measured data in a common platform such as OneNote, the classroom shifts from isolated group work to a community of learners who compare results, identify trends, and discuss discrepancies. Through this shared space, students engage in authentic scientific practices: collaboration, critical thinking, and scientific communication. They learn to justify conclusions with evidence, pose meaningful questions, and refine their understanding of physics concepts. During this session, I will share strategies for structuring collaborative lab activities that foster student-driven discovery and deeper conceptual learning.

(2:12–2:24): Jupyter Notebooks and Obsidian Vaults for Laboratory Instruction and Student Research

Randall Tagg, Univ of Colorado - Denver

Much of our advanced lab written instruction uses Jupyter notebooks. A key feature is the inclusion of executable python code to run experiments, collect and plot data, and perform deeper analysis. Recently, we have begun using Obsidian vaults for modular instruction on topics like electronics and optics and – importantly – as a platform for students to maintain their own laboratory notes and to expand into a portfolio of skills and research achievements. Key features of Obsidian are a rich assortment of community plugins and the ease with which images, graphics files, and supplemental documents can be contained within the vault structure, all of which is portable and sharable. A hybrid combination of the two systems provides broad functionality for laboratory instruction and student research.

(2:24–2:26): Closing in on a benchmark in classroom physics demonstrations: real-time acquisition, processing and visualization of data from any physics demo

Thomas Loughran, PhD., University of Notre Dame

The widespread accessability of a range of sensors in mobile phones, accessible through tools like Phyphox, together with the emergence of vibe coding in LLMs, have dramatically lowered the barrier to entry into data-based inquiry of physical phenomena in classroom settings. This presentation explores the implications of that ever-lowering barrier for classroom physics demonstrations. Physics demos typically involve equipment where storage, maintenance and practice time all constrain; they are deployed in settings where class time and even instructor expertise are yet further constraning. Removing these limitations amounts to a search for a rich set of sensing equipment, applicable to a diverse set of physical phenomena, processed instantly using a cornucopia of visualization techniques, all immediately at hand and all for free, with precious little instructor training required, perhaps even no instructor at all: something of a Holy Grail for teaching and learning with physics demonstrations. We will cover some recent efforts to tap phone sensors and LLMs in that search, and invite interested explorers into informal communication to share their progress.

Session E04: Purposeful Affirmation: Building Community and Nurturing Physics Identity

Location: Bronze 3
Time: 2–3 p.m. **Date: Sunday, Jan. 18** **Moderator: Bree Barnett Dreyfuss**

(2:00–2:48): Purposeful Affirmation: Recognizing Students In And Out Of The Classroom To Build Community And Nurture Their Physics Identity

Bree Barnett Dreyfuss, Amador Valley High School, Amee Johnson

Practicing the strategies learned in STEP UP's Everyday Actions Guide, hear one teacher's reflection on purposefully recognizing and acknowledging students' contributions to collective learning as a way to build classroom community and nurturing physics identity among students. Come to hear about easy teacher strategies for recognizing students both inside and outside of class, supporting them in taking on new opportunities, and nurturing teacher-student relationships through one-on-one interactions.

Session E05: Share-a-Thon

Location: Palace 3
Time: 2–3 p.m. **Date: Sunday, Jan. 18** **Moderator: TBA**

In this session targeting K-12 teachers, participants will each have a few minutes to share a favorite demo, lab, activity, resource, tool, or anything else that enhances their classroom and their teaching! This session will not have scheduled speakers and instead will be an opportunity for everyone who comes to have a chance to share.

Session F01: 21st Century Physics and Astronomy in the Classroom – Part II

Location: Bronze 1
Time: 3–4 p.m. **Date: Sunday, Jan. 18** **Moderator: Shane E. Wood**

(3:00–3:12): Masterclasses 1: The Facts

Shane E. Wood, QuarkNet

Each year, over 13,000 high school students worldwide become "particle physicists for a day," exploring quarks, leptons, and real data from cutting-edge experiments. This session introduces particle physics masterclasses, showing how students experience authentic scientific discovery and connect with the global physics community. Attendees will gain a clear overview of the masterclass format and how it engages students in authentic particle physics research. This is the first in a sequence of three presentations designed to give attendees an overview of particle physics masterclasses.

(3:12–3:24): Masterclasses 2: The Ten-Minute Wonder

Kenneth Cecire, MA, University of Notre Dame, Shane E. Wood

Can we get the feel of students doing a particle physics masterclass in ten minutes? We are going to try! We will do a very short measurement of authentic events from the Large Hadron Collider based on the ATLAS and CMS experiments at CERN. Bring your cell phone! This is the second in a sequence of three presentations designed to give attendees an overview of particle physics masterclasses.

(3:24–3:36): Masterclasses 3: Student Reasoning Exploration

Marla Glover, Purdue University

Particle Physics is not just for the top students. All students can learn from the Masterclass experience. Let's explore the activities through reasoning skills that the students would use to do the Masterclass activities. The framework for the exploration is the "Styles of Reasoning" proposed by Jonathan Osborne. These styles encompass all the cross-cutting concepts and science practices outlined in the NGSS. This is the third in a sequence of three presentations designed to give attendees an overview of particle physics masterclasses.

(3:36–3:48): Introducing Physics Through Research Themes to First-Year Students

Ramesh Adhikari, Colgate University, Rebecca Metzler, Jonathan Levine

Physics and astronomy undergraduates across the country typically begin their major with an introductory course on mechanics. However, for over three decades, physics and astronomy students at Colgate University have started their major with a course called "Atoms and Waves" during their first semester. These students then take introductory courses on mechanics and electromagnetism in the subsequent two semesters. A major goal of this approach was to introduce more recent groundbreaking ideas in physics to students earlier in their undergraduate years, rather than making them wait until their third semester or later, which could lead to losing a significant number of students. In fall 2025, we decided to replace this first-semester physics course with a new multi-section course called "How Physics Sees the World," with each section themed around a research interest of the associated instructor. We offered three sections with themes on biomechanics, atmosphere and climate, and nanophysics. While maintaining the goal of introducing recent physics ideas early in students' undergraduate years, this course helps build the physics concepts around given research themes so students can see how different ideas in physics are interconnected, rather than existing in silos. In this talk, I will discuss the rationale behind developing this new course, its structure, and student responses.

Session F02: Bridging the Gaps – Part II

Location: Bronze 2
Time: 3–4 p.m. **Date: Sunday, Jan. 18** **Moderator: Thomas Herring**

(3:00–3:24): When Science Subjects Were First Introduced in Universities, They Were Called "Natural Philosophies." This Session Will Discuss How the Teaching of the Philosophical Aspects of Physics Contributes to the Learning of Physics

Joe Wyatt, Jr, BS, MBA, Bayonne HS

In the beginning the sciences were called "Natural Philosophies." A philosophy is just a way of describing the world and relating to it. Physics has not lost its philosophic nature just because it is no longer called "Natural Philosophy." For example, "Nothing is as it seems. The more you are sure it is, the more likely it is not. Question everything,." could be considered as a philosophical statement about Physics. It points to how curiosity and evidence are the cornerstones of Physics and Physics education. Another philosophical statement might be, "The truth and what is so are not the same," which can be used to launch a discussion about what "Truth" is and its place in Physics. The teaching of Physics requires that the student develop what I call a "Scientific Mindset." This Mindset is characterized by the use of a specialized vocabulary, a willingness to surrender to the tyranny of the data, a willingness to admit to being wrong or change your mind, intense curiosity, high integrity and respect for other's ideas and thoughts. To build this mindset the student must be familiar with the philosophical underpinnings of Physics. This session will discuss some philosophical aspects of physics and their impact on the learning, understanding and teaching of physics. The conversation of Physics is not learned in the student's everyday conversion and must be learned in a formal classroom environment. This session will focus on the philosophies of Physics that are most useful in promoting the development of a Scientific Mindset.

(3:24–3:36): Challenges of Teaching College Physics at a High School and Solutions

Dacun Li, Ph.D., Ph.D., Laredo College

Various dual-credit courses have been taught at a high school in Laredo, Texas. In the presentation, various challenges will be discussed and solutions will be shared with the audience. Challenges include lack of knowledge, attitudes, and behavior. Serval methods to tackle the challenges were used at the high school and their effectives will be evaluated. The experience may help other educators who will teach college courses at high schools.

(3:36–3:48): Bridging Disciplines: An Integrated First-Year Seminar for Physics and Engineering Majors

Jolene Johnson, University of Wisconsin - River Falls

First-year seminar courses are a proven, high-impact practice for increasing student retention. At the University of Wisconsin-River Falls, we have developed combined previous separate courses into a two-credit introductory course that serves as a common first-year experience for all incoming physics and engineering majors. This talk explores the benefits and challenges of this integrated model. We will present the course's key content, share critical lessons learned from our initial offering in Fall 2025, and outline our plans for future improvements.

Session F03: Community Outreach and Partnerships

Location: Bronze 3
Time: 3–4 p.m. **Date: Sunday, Jan. 18** **Moderator: Tatiana L. Erukhimova**

(3:00–3:12): How to Effectively Communicate Science and Create a Positive Relationship With STEM Using Social Media Outreach

Caleb Bonyun, MIT

As a science communicator with just over 2 million followers across three platforms I believe that the most important goal of outreach is to create a positive relationship with STEM. Outreach can be educational, however far too often we are far too formal with physics when doing outreach, which can lead to scaring people away, or simply them not being interested at all. Effective outreach can be done on a truly massive scale using social media, however in order for your video to be seen it has to perform well on the platforms algorithm. This raises the problem of "chasing the algorithm" and eventually ending up with more entertainment than education. In my talk I will discuss how I balance keeping a video educational, while also using techniques learned from viewer engagement data to help a video perform well. I will show data from my videos that have tens of millions of views as well as some of my videos that only have a few thousand, and discuss some of the overall trends in short form content that can be used to help a video reach a large audience including watch time, watch percentage, swipe away rate, clickthrough rate, engagement, traffic leverage and more. If done correctly using social media a very large amount of people can be reached from all over the world creating millions of positive relationships with STEM.

(3:12–3:24): A Qualitative Assessment of a High School Science Outreach Event

Patrick Morgan, University of Massachusetts-Amherst

In November of 2025, I trained a group of undergraduate students on effective engagement methods for informal STEM programs. I then had them present for a high school day event in Massachusetts, where they were able to implement what they had learned across four different physics demonstrations. Afterwards, the drawings and notes that were left behind by the high school students were collected and analyzed via the Thank You Letter Survey (TYLES) approach in order to qualitatively look at what was being understood.

Session F04: Interactive: Making Your Physics Program a Part of the Broader Community

Location: Bronze 4
Time: 3–4 p.m.   Date: Sunday, Jan. 18   Moderator: Kathleen Shreve

(3:00–3:48): Making Your Physics Program A Part Of The Broader Community

Bree Barnett Dreyfuss, Amador Valley High School, Kathleen Shreve

How do you leverage the broader school community with your physics programs? How can you engage your local community for the benefit of your physics program? Come to this round table discussion with other physics teachers to hear about what they have done and share ideas you might want to implement. It will be a space to share all of your ideas about advocating and celebrating your physics program outside of your classroom as well as how to bring in community partners and local opportunities to benefit your physics students in learning and pursuing physics.

Session F05: Quantum in K-12

Location: Palace 3
Time: 3–4 p.m.   Date: Sunday, Jan. 18   Moderator: Elizabeth Holsenbeck

Meghan DiBacco   Interactive Speaker

In this session, participants will share ways to incorporate quantum physics concepts in the K-12 classroom.

Session G01: Frontiers in Space Science and Astronomy – Part I

Location: Bronze 1
Time: 9–10 a.m.   Date: Monday, Jan. 19   Moderator: M. Jeannette Lawler

(9:00–9:24): The NASA Dragonfly Rotorcraft Lander mission to Saturn's moon Titan: Landscapes and Habitability to be revealed through Multiflight Surface Campaigns

Jani Radebaugh, Planetary Science, Brigham Young University

Saturn's moon Titan is extraordinarily Earth-like in its terrains, having large sand dunes, mountains, rivers and lakes. The chemistry of Titan, however, is decidedly non-Earth-like, with water frozen solid as rock and making up the lithosphere, with rain and lakes made of liquid methane, and with organic dune sands created by photodissociation of methane in the upper atmosphere and recombination into longer chain molecules. These surface compositions, and the again Earth-like atmospheric composition of nitrogen and pressure of 1.5 bars make Titan a compelling and achievable target for in situ exploration. Drones have significantly advanced technologically in recent years and excel in their stability and range. The Dragonfly mission, selected by NASA under the New Frontiers call and currently being built at the Applied Physics Laboratory, is a 2-rotor quadcopter with an onboard mass spectrometer, a gamma ray and neutron spectrometer, cameras, a deployable seismometer and atmospheric environmental instruments, all contained within an aircraft lander the size of a small car. It will easily fly in the dense (4x Earth), cold atmosphere at Moon-like gravity to carry the instruments to dozens of locations separated by many kilometers over 3 years. The spacecraft will search for prebiotic and biotic chemistry through detailed spectroscopic and imaging analyses, including chemical abundance and chirality. Dragonfly will change the way we do surface science on planetary bodies and will illuminate our understanding of processes on distant worlds and habitability of the outer Solar System.

(9:24–9:48): Through the Kaleidoscope: Supermassive Black Holes

Krista Lynne Smith, Texas A&M Univ

Active Galactic Nuclei (AGN) are galaxies with central supermassive black holes that are actively feeding on tremendous amounts of orbiting gas. The space-time distortion caused by supermassive black holes provides a unique laboratory for violent physical processes like the tidal disruptin of stars, highly relativistic jets of particles and radiation, and turbulent accretion flows. Synthesizing observations across many wavelengths and studying their time variability at slow and rapid timescales promises a new, dynamic, thorough understanding of how black holes form and grow, how they consume material, how they construct powerful relativistic jets, and how they bend the evolution of galaxies to a path that matches our observations of the Universe. I will discuss how both high-resolution radio imaging surveys of outflows and star formation and timing observations with breakthrough instruments like the NICER instrument on the ISS and the TESS exoplanet-hunting missions have provided new intersectional insights into the detailed phenomenology and cosmological implications of active galactic nuclei.

Session G03: Encouraging Student Reflection

Location: Bronze 3

Time: 9–10 a.m. **Date: Monday, Jan. 19** **Moderator: Megan Hayes-Golding**

(9:00–9:12): Homework That Works: Strategies to Foster Engagement and Reflection

Marianna Ruggerio, Hononegah High School

60-75% of high school and college students copy homework. Students know that homework is for practice, but at the end of the day, they simply won't use it as an effective resource. As a consequence many suggest eliminating credit for homework as the cheating is driven by the desire to "earn points". However, many teachers have found that eliminating credit also reduces the number of students who do any homework at all. This talk will suggest a number of strategies to make homework meaningful to drive student engagement. This process culminates in a student feedback form where students self-evaluate their work, consider a common misconception, and then have space to share their needs.

(9:12–9:24): Characterizing the interaction between alternative grading, mindset, and self-efficacy in introductory physics

Christopher Fischer, Department of Physics and Astronomy, University of Kansas, Jennifer J. Delgado, Jessy Changstrom, Sarah J. Rush

The pressures and responsibilities students face inside and outside the classroom can result in a distribution of pathways and rates required to achieve proficiency with course content. Our team has sought to better accommodate this diversity of student experience by implementing standards-based grading in our introductory physics courses. Since both standards-based grading and a growth mindset are focused on positive response to failure and self-regulated effort, it is possible that navigating a class employing standards-based grading might continually encourage a growth mindset in students. Furthermore, since standards-based grading reduces the stress associated with demonstrating proficiency by providing students multiple opportunities to do so, employing standards-based grading has the potential to improve student self-efficacy. To explore these hypotheses, we monitored changes in both mindset and self-efficacy resulting from exposure to standards-based grading using previously validated instruments. We show that standards-based grading has a positive impact on mindset and self-efficacy, and that these connections are further modulated by elements of student identity, such as gender and major.

(9:24–9:36): Teaching Students How to Learn

Aaron Titus, North Carolina State University

Here's a fairly common scenario: students consistently attend lecture, take detailed notes, attempt homework, get stuck on homework, and ask for help. Then, right before a test, they spend many hours reviewing notes and solutions. When they don't do well on the test, they are surprised because they "spent hours studying," and they reach out to you for advice. What advice do you give them? In order to reach this group of students, I now give a workshop based on the book "Teach yourself how to learn : strategies you can use to ace any course at any level" by Saundra McGuire. In this presentation, I'll describe the workshop, the learning strategies, and the positive results.

(9:36–9:48): Looking for Evidence of Student Metacognition in Weekly Formative Quizzes

Kathleen Harper, Case Western Reserve University, Cemantha Johnson, Kurt R. Rhoads

For the past several years, we have incorporated low-stakes formative quizzes in the large lecture section of an introductory course. One of the goals of this activity is to encourage students to reflect on their understanding and to identify concepts that they need to devote additional time to learning. The format of the quiz has gradually evolved in an effort to better meet this goal. The current version of the quiz contains space for students to answer short questions before the lecture begins, space for them to answer the same questions during a class discussion of the quiz, and space for them to identify concepts that they need to review to strengthen their understanding. We share the results of a preliminary analysis of student responses on the quizzes.

Session G04: Lab Recommendations Refresh

Location: Bronze 4

Time: 9–10 a.m. **Date: Monday, Jan. 19**

Steve Spicklemire *Oral Contributed Speaker* *9:00 am - 9:48 am*

The Committee on Labs formed a subcommittee to explore developing an updated version of the Recommendations that could include topics that were not included in the original document, such as teamwork, non-cognitive components, computation, and others. This session provides a chance to update the community on the progress of the subcommittee, and to gather feedback regarding the direction and focus of the updated recommendations.

Session G05: Interactive: Physics with Phones – Waves and Sound

Location: Palace 3

Time: 9–10 a.m. **Date: Monday, Jan. 19** **Moderator: Dan Burns**

(9:00–9:48): Physics with Phones - Waves and Sound

Dan Burns

In this interactive session participants will use the sensors in their phones to perform investigations of oscillations, waves, and sound. These investigations were developed by LLNL scientist Dave Rakestraw for introductory physics classes in high school and college. They require only a phone and a few inexpensive materials. The session is designed to give the participants the knowledge, skills, and confidence to repeat the experiments with their students in the classroom. Participants need to download the free PhyPhox app on their iPhone or Android phone and either SpectrumView (iOS) or Spectroid (Android) before the workshop. All other materials will be provided.

Session H01: Frontiers in Space Science and Astronomy – Part II

Location: Bronze 1

Time: 10–11 a.m. **Date: Monday, Jan. 19** **Moderator: Janelle Baileys**

(10:00–10:24): JWST Peers Into New Strange Worlds

Everett Schlawin

Until the launch of JWST, our picture of planets outside the solar system was largely science fiction. While we are familiar with rocky planets and giant planets in our Solar System, exoplanet science has taught us that there is an abundance of mysterious planets that are in-between the giants and the rocky planets. Often called sub-Neptunes, these planets were only known by their sizes and masses. This allowed them to be shrunken giants, oversized rocks with puffy Hydrogen envelopes or even water worlds. Now, JWST as brought us new insights about these planets with its exquisite precision and infrared sensitivity, that has let us peer into their atmospheres. I will review some of the exciting new findings about these sub-Neptune planets only made possible in the last year or two. I will also introduce the techniques and tools that have enabled these transformative new dives into exoplanets. The majority of known exoplanets are found by the transit method - when planets cross in front and/or behind their host star. This favorable configuration also enables detailed study of their atmosphere when the light of their host star is filtered through a planet's atmosphere or when the star blocks the light of a planet. These effects are exceedingly small (typically less than about 100 parts per million) and therefore require exquisite stability of instruments, as well as infrared wavelength coverage to sense. Despite the extreme precisions for atmospheric study, the search for and the monitoring of existing stars and planets is ripe for participation by students, teachers and citizen scientists who are all contributing to the exciting field of exoplanet science.

(10:24–10:48): The First Decade of Gravitational Wave Astrophysics

Carl-Johan Haster, University of Nevada

For the last decade, astronomers have had access to a new and revolutionary tool for observing the Universe. Instead of relying on light, or other forms of electromagnetic radiation, the ability to directly observe Gravitational Waves, ripples in the fabric of space-time itself, has allowed us to peer deeply into the most extreme portions of the Universe. The premier Gravitational Wave observatory is the US-led LIGO experiment with its two detectors in Hanford, WA and Livingston, LA. Together, they have seen more than 200 astrophysical transients, consistent with the mergers of binaries initially containing black holes or neutron stars. In this talk, I will present LIGO as an experiment and how it's able to make the high-precision measurements required for gravitational wave observations. I will also present the astrophysical implications our observations have provided so far, and what they have told us about the fundamental physics governing our Universe.

(10:48–11:00): Bridging Classical and Quantum Worlds: From Fokker-Planck Kinetics to Open Quantum System Thermodynamics

Michael George,

The quantum-to-classical transition can be studied via transport properties. A classical framework for this comes from the Boltzmann equation and the Fokker-Planck equation. Quantum systems exhibit richer behavior, with quantum phase transitions and non-classical correlations modifying transport coefficients. I will examine this framework in the context of quantum open systems, concerning experimental systems addressing warm dense matter. The talk will focus on the applications of astrophysical and planetary physics.

Session H02: Assessment of Hands-On and Active Learning

Location: Bronze 2

Time: 10–11 a.m. **Date: Monday, Jan. 19** **Moderator: Kenneth Cecire**

(10:00–10:12): Student Experiences and Beliefs in Remote Asynchronous and In-Person Undergraduate Physics Laboratories

Angela Kelly, Stony Brook University, William Alster, Luciana Lombardo, Keith Sheppard, Kristin Visconti, Gaby Treble

Many universities have offered both in-person and remote laboratory options since the global pandemic. This cross-sectional observation case study explored students' beliefs and experiences in traditional in-person and remote asynchronous laboratory classes in introductory undergraduate physics at a U.S. research university. In-person laboratory students reported more positive self-efficacy and beliefs about physics learning than remote asynchronous students. The in-person students were more likely to find the laboratory activities interesting and useful in improving their physics knowledge, and reported higher ability to troubleshoot equipment and perform error analysis. They were also more likely to believe they met the goals of the laboratory course, and they had more positive views of graduate teaching assistant (TA) instruction. The in-person laboratory students were more likely to interact with TAs, value lectures, and view the workload as equivalent to that in a remote asynchronous course. There were no differences between the in-person and remote asynchronous laboratory students in their views about the ease and intuitiveness of using the laboratory equipment for their course. The responses on this factor were correlated to students' self-efficacy and beliefs about their physics learning. Results suggest that remote asynchronous laboratory instruction should provide more structured interactions among students and TAs, which my help students meet the objectives of the course.

(10:12–10:24): Deeper Understanding and Creativity Through Problem Posing

Michael Peterson, Mr., M.S., Science Chair

Active learning has consistently been shown through meta-analytic research to yield moderate gains in student achievement. Yet, classroom studies reveal a persistent challenge: students frequently ask few and often superficial questions, limiting opportunities to build deeper understanding. Problem posing, an approach established in mathematics education, offers a compelling response. Beyond improving content mastery, creativity research demonstrates that problem posing fosters greater curiosity and originality. This study (N = 15) explored the impact of problem posing in an AP Physics C: Mechanics classroom. Students transitioned from solving structured problems to generating their own problems for each unit. Physics understanding was measured using the national AP exam in May, with results analyzed through Bayesian A/B testing. With a 95% probability, the problem-posing group outperformed state-level peers in North Carolina, showing a moderate effect size (0.47). Equally significant, creativity measures rose steadily throughout the course. These findings suggest that student problem posing not only strengthens achievement but also cultivates creativity, two critical outcomes for preparing students as adaptive, innovative thinkers. While preliminary, this work highlights the promise of problem posing as a powerful instructional strategy worth investigating at scale.

(10:24–10:36:) Pre-Lab Exercise Best Practices?

Jason Hyatt, PhD, Mass Maritime Academy

What are the best practices for designing introductory physics pre-labs to enhance student preparedness and engagement? Pre-lab activities are essential for introducing core concepts, familiarizing students with lab procedures, and improving in-lab efficiency. Written assignments can promote critical thinking and conceptual understanding but may burden students if not well-integrated and may be copied. iClicker response questions offer a quick and interactive way to assess understanding and identify misconceptions in real-time but use valuable lab time. Online quizzes provide scalable and immediate feedback, but risk encouraging surface learning without thoughtful design. Let's discuss these methods in terms of learning outcomes, student feedback, and instructor workload.

Session H03: Physics Through Narratives and Roleplaying

Location: Bronze 3

Time: 10–11 a.m. **Date: Monday, Jan. 19** **Moderator: Toni Sauncy**

(10:00–10:12): Teaching Physics as a Narrative

Megan Moggach, B. Math, B.Ed M.MT, The John Cooper School, Bogumila Gierus, Allison Reine

We all face learners who view physics as a disconnected series of abstract concepts, leading to apathy and frustration. Faced with this challenge, we abandoned the traditional topic-by-topic structure and rebuilt our 12th-grade curriculum around a single, compelling narrative: the historical quest to understand the nature of light and how that lead to quantum physics. This storytelling approach allowed us to teach physics on a "need-to-know" basis, with the historical mystery driving the curriculum. To follow the debate from Newton to Huygens, students first had to master wave principles. When the story progressed to Maxwell's unification, we took a necessary "detour" into electrostatics and magnetism—not as isolated units, but as crucial clues needed to solve the central puzzle. Physics concepts were introduced when the narrative demanded them, transforming the learning process from passive reception to active investigation. The result was a palpable shift in the classroom. Apathy was replaced by curiosity, and disconnected facts were woven into a coherent, epic story of scientific discovery. This presentation will provide a roadmap for our narrative-driven curriculum, sharing the specific structural changes, the compelling student performance data that validated our approach, and actionable strategies for implementation. We will argue that this pedagogical model offers a powerful framework for contextualizing complex topics and fostering genuine student inquiry in physics education.

(10:12–10:24): Reacting to the Past Roleplaying Vignettes for Teaching Major Paradigm Shifts in Electricity and Magnetism

Jason G. Giuliani, Ph.D., Nevada State University, Chad Curtis

Physics is an experimental science, yet it is often presented to students as a complete static body of established truths. In reality, physics has evolved through shifting paradigms, competing theories, and active debate. Nowhere is this more evident than in the development of electricity and magnetism during the nineteenth century, which advanced through incremental discoveries and vigorous debate. To bring this dynamic history into the classroom, we have developed a series of short roleplaying vignettes based on The Reacting to the Past framework. Each vignette is set in a nineteenth-century London Mechanic's Institute, a popular venue historically used for disseminating new science. In these sessions, student leaders reenact historical demonstrations in electricity and magnetism, while peers engage as audience members, posing questions and offering critiques grounded in period-specific scientific perspectives. Group-based game mechanics introduce a sense of friendly competition and weave the vignettes into a cohesive historical experience. The current series includes three vignettes: Franklin's one-fluid versus DuFay's two-fluid theory of electricity; Volta and Galvani's rival models of animal electricity and batteries; and Faraday's field theory in contrast with Newtonian action-at-a-distance. This presentation will showcase the pedagogical design, gameplay structure, and educational impact of this immersive, historically grounded teaching approach.

(10:24–10:36): Q-STAR: Development of a Game-Based Quantum Education Program Integrating Historical Narrative, Two-Tier Diagnostics, and Generative AI-Driven Assessment

Hyewon Jang, Sejong University

This study introduces the Q-STAR (Quantum: Sequenced, Two-tier, Artificial Intelligence, and Role-play), a game-based quantum education program designed to address persistent learning challenges in quantum physics. Q-STAR is structured as a quest-based curriculum that incorporates historical narrative and logical sequencing, with each quest embedding two-tier misconception diagnostics. Learners are required to provide both a conceptual answer and a justification, thereby revealing reasoning processes and misconception types, which can be confronted and corrected through peer discussion and feedback. Q-STAR goes beyond a conceptual proposal and is realized as a concrete instructional tool that integrates quest scenarios, misconception items, feedback structures, and teacher guidelines. A distinctive feature is the use of generative AI(Artificial Intelligence) as the assessment agent, which collects and analyzes learner responses, reasoning, and discussion data in real time, classifies misconception patterns, and records each learner's conceptual change trajectory. In this way, learning activities become seamless assessments, eliminating the boundary between instruction and evaluation. Furthermore, Q-STAR leverages LLM-based generative AI to automatically generate quest narratives, diagnostic items, and feedback scripts. By providing prompt templates, it enables teachers to adapt and implement the program more readily in practice. Q-STAR is not only a developed program integrating game-based learning, misconception diagnosis, historical narrative, and AI assessment, but also a manifestation of the teacher's agency as a physics education expert, presenting a viable and actionable strategy for quantum education practice.

(10:36–10:48): Live-Action Problems as High-Quality Assessment

Megan Hayes-Golding, Deerfield Academy, James Perry

Live-action problems are an engaging twist on working textbook-type questions. With a live-action problem, students see the solution tested live in the classroom. For example, how should Wile E Coyote time the release of a boulder rolling down a mountain that will catch Road Runner just as he passes by? A ramp with a dynamics cart can stand in for the boulder & mountain while a constant velocity buggy for Road Runner. Give students initial parameters then send them off to solve the problem analytically. Once done, students test their prediction live. A good live-action problem ends in a satisfying way, where students immediately know how good their work was. And unlike a textbook-only problem, there are very few givens, just tools to measure what they need. In this session, we'll learn what makes a good live-action problem, tips for setting one up, where they fit in a learning cycle, and how to disaggregate individual assessment data from group work. The examples are geared toward a K-12 physics classroom with the meta ideas applicable to all contexts.

Session H04: Tools with Purpose: How to Use the SPS Careers Toolbox to Better Serve Physics Students

Location: Bronze 4
Time: 10–11 a.m. **Date: Monday, Jan. 19**

James Addison III – Confirmed Interactive Speaker

Unlock the power of the SPS Careers Toolbox in this interactive session! You'll get a hands-on experience with the Toolbox's practical worksheets, guided by a dynamic presentation. Learn how to use this versatile resource to help students at any level—from middle schoolers exploring what a physicist is to job-seekers preparing for their careers—and discover inspiring stories from those who have already walked the path. Join us for a session designed to be engaging, effective, and immediately useful for your students and your own professional development.

Session H05: Conversation with Dwain Desbien

Location: Palace 3
Time: 10–11 a.m. **Date: Monday, Jan. 19**

Dwain Desbien	*Confirmed Panel Speaker*	*10:00 am - 10:48 am*
Thomas O'Kuma	*Confirmed Session Chair*	

Session I01: Innovations and Assessment in the Major

Location: Bronze 1
Time: 2–3 p.m. **Date: Monday, Jan. 19** **Moderator: Gillian Ryan**

(2:00–2:12): Early efforts towards evaluation of students' achievement in computational physics

Andrew Gavrin, Indiana University - Indianapolis, Marlann Patterson, David Nolte, Kelly Roos, Steve Spicklemire, Gautam Vemuri, Todd Zimmerman

Recent years have seen increasing efforts to incorporate computational methods in undergraduate physics courses and, in some cases, across the undergraduate curriculum. Unfortunately, well-established tools to evaluate these efforts are not yet available. This talk will present an effort towards the creation of tools to assess student achievement of computational learning goals. We are developing and testing these materials across five varied institutions. Our long-term intent is to develop tools to track students' progress on seven computational learning goals. This requires a system that can be applied consistently to students as they progress through their undergraduate education, and which is sufficiently "calibrated" to enable comparisons across faculty users. To accomplish this, we are developing a set of rubrics that can be used to rate student achievement on each of our learning goals and ancillary materials that will enable faculty to use the rubrics effectively.

(2:12–2:24): Rethinking Exam Corrections: Encouraging Reflection and Deeper Engagement

Arlinda Hill, Ph.D., Associate Teaching Professor, Arizona State University - Main Campus

Exams often serve as the primary measure of achievement in upper-division physics courses, yet they seldom provide opportunities for continued learning. Exam corrections offer one pathway to extend learning beyond the test, but their impact depends on how they are structured. In an Advanced Classical Physics course, exam corrections were implemented over two consecutive years to explore their potential as a pedagogical tool. During the first year, students were invited to submit corrections with minimal guidance, and most responses were limited to mechanically revised solutions. In the second year, a more structured framework was introduced, guided by a simple rubric that encouraged reflection and conceptual reasoning. Student responses demonstrated notable improvement, with clearer explanations and stronger links to fundamental principles. A comparison across the two years illustrates how small changes in structure can dramatically shift student engagement with exam corrections. This presentation will focus on the data collected across both implementations to highlight how the design of exam corrections influences the depth of student engagement.

(2:24–2:36): From Day One to Thesis: A Cohort-Advised, Research-Required Metacurriculum in CCS Physics at UCSB

Tengiz Bibilashvili, University of California Santa Barbara

Unlike most programs that simply encourage undergraduate research, the College of Creative Studies (CCS) Physics program at UC Santa Barbara requires it. Each year we admit about 20 students through a supplemental application that considers academic preparation and research interests. From the first quarter the cohort takes an accelerated general-physics sequence that integrates upper-division elements, and I advise the same students for four years to align course plans with a research path culminating in a senior thesis. Our metacurricular supports include workshops on finding a "right-fit" lab, email templates for contacting PIs, expectation checklists, a research timeline with thesis milestones, and a conference roadmap (many present at APS). I will present outcomes—>75% PhD matriculation and frequent national awards (e.g., Goldwater, NSF GRFP)—and share a practical template that departments can adapt to build a research-centered metacurriculum.

(2:36–2:48): Synthesis and characterization of nanoscale films, carbon nanotubes, and superconductors in the physics classroom

Andra Petrean, Austin College

At a small liberal arts college, both physics teaching and physics researching have their own unique challenges. The number of required courses for majors is relatively small so students can take classes outside of physics; the quality and quantity of research equipment is relatively small compared to what is found at physics departments in larger universities. Incorporating research into courses takes intentional creativity. I have used both our Advanced Instrumentation and Robotics course and our Research Experience course to introduce students to contemporary research topics such as: nanoscale films, carbon nanotubes, and superconductors. Students read peer reviewed research and design and conduct their own experiments. They are encouraged to improve on given experimental setups by adding instrumentation and automation techniques gleaned through research. Course content focuses on current applications of these technologies - for example, the role of superconducting magnets in research done at the Large Hadron Collider at CERN.

Session I02: Belonging and Access

Location: Bronze 2
Time: 2–3 p.m. **Date: Monday, Jan. 19** **Moderator: Robin Bjorkquist**

(2:00–2:12): Gaining confidence in integrating inclusion-related themes into my physics teaching

Scott N. Sawyer, M.S. Physics, Whatcom Community College

I believe physics education can be improved by making classrooms more welcoming. Over time, I've learned about various techniques and activities to create a more inclusive environment, and I've implemented many of them in my teaching. But talking directly about belonging and inclusivity—especially during physics lessons? That was still new to me, until I discovered the Underrepresentation Curriculum (URC). In this talk, I'll share the story of how I began incorporating lessons that explicitly address inclusivity in physics, my initial doubts about whether I could do this effectively, and my fears about how students might respond. The story has a happy ending, and I hope to encourage any physics educators who feel the same hesitation I once did to be brave—and to try teaching directly about belonging in the physics classroom.

(2:12–2:24): Marquette University's new seminars to incorporate non-technical skills and improve a sense of belonging in the physics curriculum

Karen Andeen, Marquette University

At Marquette University in Milwaukee, WI, we have recently revised our physics curriculum. Using the suggestions made in the JTUPP Phys-21 report, we designed six new 1-credit seminar courses, taught one per semester over the three required years of our new curriculum. These seminars focus on explicitly teaching the non-technical skills that our physics graduates need to become successful physicists in a variety of career paths, including working together in teams to develop new ideas, gathering and presenting information to a variety of audiences, applying for jobs, and being strong and inclusive allies for colleagues from all backgrounds. Perhaps most importantly, these seminars seek to develop a strong culture of belonging within our department. We present the structure of these seminars and gauge their present level of success.

(2:24–2:36): Challenges in Transforming Small Liberal Arts STEM Culture – What have we learned?

Toni Sauncy, Texas Lutheran University, Elizabeth Woods

With funding from NSF IUSE:HSI program, Texas Lutheran University (TLU) STEM faculty have worked to transform the student experience with a multidisciplinary collaboration. The project included a two-pronged approach with student-focused co-curricular programs and faculty-focused professional development. The primary student program was a robust multidisciplinary faculty-mentored undergraduate research program for summer for the past five years. The faculty focus centered on developing expertise in practicing a culturally relevant approach to faculty-student interactions both inside and outside the classroom/lab setting. The project began in the midst of a global pandemic, causing unanticipated challenges and requiring re-thinking of the originally planned project components to respond to those challenges. As the project comes to an end, results have been positive for both student participants and faculty mentors and have been transformative for all involved, even in view of not achieving all the goals as they were originally planned.

Session I03: Laboratories: Advanced Intro to Modern

Location: Bronze 3

Time: 2–3 p.m. **Date: Monday, Jan. 19** **Moderator: Nathan D. Powers**

(2:00–2:12): Faraday's law of induction, a harmonic oscillating magnet

Shalva Tsiklauri, CUNY/BMCC, Gabriel Burbridge, Enshun Zhang

We propose a simple yet effective experiment to investigate the fundamental principles of electromagnetic induction. The primary objective of this activity is to offer students at both two- and four-year colleges a direct experimental framework for observing how the oscillatory motion of a permanent magnet induces an electromotive force (emf) and current in a solenoid. Such demonstrations are particularly valuable in bridging theoretical models of Faraday's law with practical, observable phenomena. For the implementation, we utilized a PASCO Science Workshop data logger system, equipped with a voltage sensor to record the induced electromotive force (emf) and a force sensor to monitor the magnet's motion. The experimental apparatus consists of a bar magnet suspended on a spring, a solenoid, and sensors connected to a computer-based graphing tool for real-time acquisition of the magnetic flux variations. This configuration enables the systematic study of the conversion of mechanical energy into electrical energy, allowing students to compare input and output quantitatively through power and efficiency calculations. By emphasizing the interplay between mechanical oscillations and induced electrical response, this experiment provides an accessible platform for engaging students in the study of energy conversion processes and electromagnetic induction. In addition, its low-cost and modular design makes it particularly suited for integration into undergraduate laboratory curricula, where the conceptual clarity of Faraday's law and Lenz's law can be reinforced through direct measurement and analysis

(2:12–2:24): Using 3D-printed Laboratory Components to Incorporate Student Design into Lower- and Upper-Level Laboratory Experiments

Keller Andrews, Illinois Wesleyan University

The integration of 3D printing technology into undergraduate physics labs offers transformative opportunities for hands-on learning and experimental design. Custom-printed apparatus components enable students and instructors to construct specialized equipment tailored to specific experiments. After the upfront expense, this approach reduces equipment costs while allowing for rapid prototyping of experimental setups that might otherwise require expensive or complex machining. Students gain valuable experience in considering design and manufacturing together while deepening their understanding of lab design principles through the construction process. 3D printed parts have been used at IWU to facilitate several experiments. Introductory students print parts to explore rotational dynamics. Advanced lab students have printed parts that allowed for a steppingstone spectroscopy lab that sits between handheld spectroscopes and research-grade spectrometers. Finally, research students can quickly build and test custom optical setups. By combining traditional physics education with modern manufacturing techniques, 3D printing changes students from passive observers to active participants, fostering innovation and practical problem-solving skills essential for future scientists.

(2:24–2:36): Measuring Three Fundamental Constants in the Introductory Modern Physics Lab

Patrick Polley, Ph.D., Professor

Measuring the value of fundamental constants provides more than simple mind-numbing repetition of experiments performed by previous legions of students. Here are two expoeriments that determine the value separately of the ratio of Planck's constant h to the electron charge q, and the ratio of the electron charge q to Boltzmann's constant k. Together with the experiment previously reported for the Stefan-Boltzmann law1 these three experiments allow the student to determine values for h, k, and q. Students work with circuits that they construct from discrete components which is a useful laboratory skill. The procedure for determining h/q avoids the N-ray-like problems associated with other such experiments using light-emitting diodes. The students study error propagation to determine how well their measured values agree with the standard values for these constants.

(2:36–2:48): Is Light a Wave or a Particle? A Sophomore Level Experiment

Matthew Wright, Adelphi University, Aleeza Ahmed, Katherine Gifford, James St. John, Carissa Giuliano, Luis Rodriguez

We present a modern physics lab that integrates hands-on experimentation, collaborative learning, and an exploration of wave particle duality. In this experiment, students study the operation of an Acousto-Optical Modulator (AOM). An AOM is an electro-optical device that uses sound waves in a crystal to alter the pathway of a light beam and has numerous practical applications. In this lab, students explore how the light's output deflection angle and frequency depend on the drive frequency of the sound waves. At the beginning of the lab, students in the class are physically divided into two teams, Team A and Team B. Team A is provided with an interactive worksheet explaining the theory of the experiment using a "light as a wave" perspective. An instructor facilitates the student's learning as they work through the theory. Team B, follows a similar method, only they use a "light as a particle" approach. Both groups conduct the experiment, analyze the data, and prepare written reports with a theory section. At the conclusion, reports from team A are given to team B (and vice versa) and the students are asked to conduct a peer review. The exercise concludes with a debate on the central question: Is light a wave or a particle? Results indicate that students successfully completed the experiments, produced high-quality reports, and engaged effectively in peer review. However, presenting the theory from opposing perspectives generated less controversy than anticipated.

Session I04: Capstone Research Projects and Astronomy Online Labs with NASA Open Data & Micro-Observatory

Location: Bronze 4
Time: 2–3 p.m. **Date: Monday, Jan. 19**

Mojgan M. Haghanikar, Confirmed Interactive Speaker

Session I05: Discover Teaching Physics with Simphy

Location: Palace 3
Time: 2–3 p.m. **Date: Monday, Jan. 19**

Themis Chronis, Confirmed Interactive Speaker

Simphy is a unique software that enables the visualization and simulation of real physics experiments, spanning from mechanics, E/M (some combination of the two is also possible) as well as geometrical optics. Simphy's abilities allow the user to design any experiment from scratch, control all included variables, with zero coding. More experienced users can further add Java code to create even more advanced simulations. Simphy's graphical capabilities allow the user to read and export real-time data but also fit basic functions. Simphy empowers the Physics instructor advance their teaching skills, in person or online/remote, as it encapsulates a powerful virtual lab with sharing capabilities such as embedded HTML widgets, regular Simphy files and more. Visit us at https://Simphy.com

Session J01: Quantum Education Promotion: Initiatives and Challenges

Location: Bronze 1
Time: 3–4 p.m. **Date: Monday, Jan. 19** **Moderator: Jeffrey Marx**

(3:00–3:12): How to teach what a photon really is

Jim Freericks, Ph.D., Georgetown University, Jason Tran, Leanne Doughty

In undergraduate curricula, the concept of a photon is usually discussed through a combination of black-body radiation, the photoelectric effect, and the Compton effect. But these discussions really focus only on the fact that a photon has particle-like properties. In this talk I will emphasize only one of these approaches, the photoelectric effect, because it usually is taught incorrectly. For example, it is not true that a classical description cannot explain the need for a minimal photon frequency to photo-emit, it is not true that the experiment measures the workfunction of the emitter, and it is not correct to say it establishes the particle-nature of the photon. What is does do is provide us with single photon sensitivity if photons indeed do exist. Using the photoelectric effect, we can then create a photomultiplier tube, which is capable of measuring individual photons. Then, by conducting a G2 experiment, we can verify if it truly is a single-photon source. Data are readily available for classical light sources, such as dim lasers or dim leds, and from true single-photon sources, such as the calcium cascade light source. By examining the statistics of how photons are detected when the source beam is passed through a beam splitter, we can clearly see the difference between quantum light and classical light. The result of instruction based on this paradigm is that students are exposed to the correct notion that a photon can be measured once and only once, and that quantum light sources require significant work to create and verify. Once such sources are available and certified, they can then be used to show single-photon experiments that display inteference effects, illustrating the effects of superposition on experimental results. Having a firm base of understanding of the concept of a photon then allows the student to coherently examine more complex experiments, such as quantum seeing in the dark, or delayed choice experiments, where the results vary according to how the experiment is conducted. In this fashion, we can modernize instruction to properly explain how the second quantum revolution applies to light. This work is part of a project to revamp the sophomore quantum sequence. Further details are available at https://quantum.georgetown.domains.

(3:12–3:24): Building the Quantum Workforce: An Experiential Learning Pipeline in Semiconductor Quantum Technologies

Vitaliy Dorogan, New York City College of Technology - CUNY, Ivana Radivojevic Jovanovic, Wenli Guo

The rapid advancement of Semiconductor Quantum Technologies, encompassing microelectronics, photonics, and quantum information science, is driving an urgent need for a skilled workforce in the US. We introduce the QUEST for Quantum Future initiative, which creates a comprehensive, experiential learning pipeline for associate and bachelor-level STEM students to address this demand. Our program leverages a powerful cross-sector partnership involving two City University of New York (CUNY) institutions — New York City College of Technology (City Tech) and Queensborough Community College, a CUNY research center — the Advanced Science Research Center, and two industry leaders — Global Foundries Inc., a chip manufacturer, and Quantum Computing Inc., an emerging quantum computing company. The one-year structured cycle immerses students in all stages of the novel technology development: (i) research and discovery, (ii) commercialization, and (iii) large-scale manufacturing. The program includes a seminar on semiconductor fundamentals, professional development workshops, virtual sessions with partner companies, industry visits, bootcamps, micro-internships, and internships, with separate tracks for associate and bachelor students. By connecting academic training — including City Tech's new Quantum Technology specialization curriculum — with industrial practices, the QUEST for Quantum Future is establishing clear pathways from undergraduate degrees to high-demand careers. The initiative aims to serve over 45 students within three years while creating a sustainable and replicable model for industry-aligned education.

(3:24–3:36): Examining Student Understanding of the Mach-Zehnder Interferometer

Jason Tran, Georgetown University, Jim Freericks, Ph.D., Leanne Doughty

In quantum mechanics instruction, it is essential to establish connections between the abstract quantum concepts learned in lecture and actual, physical experiments. This study investigates how advanced undergraduate physics students reason about the Mach–Zehnder interferometer, a canonical experiment in quantum mechanics that demonstrates the role of superposition and interference in measurement outcomes. Analysis of their responses highlights both the strategies students employed and the conceptual challenges they encountered in relating formal quantum mechanical calculations to the physical behavior of the apparatus. Students examined this quantum optical setup through two mathematical tools, one through an operator mechanics-based approach using second quantization and a second through a simplified Feynman path integral approach. This talk presents our results from analyzing student interviews, where students were asked to determine the probability of detection at one of the interferometer's output detectors under two conditions: when the optical paths have equal lengths and when a path difference is introduced.

Session J02: Educational Technologies for the Classroom

Location: Bronze 2
Time: 3–4 p.m. **Date: Monday, Jan. 19** **Moderator: Michael Gallis**

(3:00–3:12): Expanding Project STEMinAR: Augmented Reality Physics Simulations

David Rosengrant, University of South Florida St. Petersburg, Karina Hensberry, Rachel Cacace, Kelly Navas, Gerald Woods

We have developed an augmented reality app called Project STEMinAR for mobile devices to be used in the classroom and laboratory setting. Within this app users will find simulations for Newton's Cannon, Newton's Laws, Rotational Motion, Thermodynamics, Optics, Lenses, and Electromagnetism. We integrated the simulations into multiple introductory algebra-based Physics 1 lab sections in two different capacities. First was completely using the app for the lab, second was integrating the app into a traditional lab setting and then compared it with results from the traditional lab. In this presentation we will talk about the results of those integrations. Furthermore, we are wanting to expand this simulation to other universities to create collaborations on a future grant proposal and will discuss opportunities for that. Support for this work is provided by an IUSE grant from the National Science Foundation. More information can be found at https://www.usf.edu/education/faculty/rosengrant-virtual-stem-laboratory/augmented-virtual-reality-projects/.

(3:12–3:24): IonoScope: An Educational Android App to Demonstrate Real-time Ionosphere Measurements

Kevin Filip, United States Military Academy, Steven Vitale

It is challenging to introduce accessible demonstrations of ionospheric physics into the secondary education or undergraduate classroom. Here we present an Android application, available free through the Google Play Store, which allows students to take real-time measurements of ionospheric electron density via the Global Navigation Satellite System (GNSS) receivers embedded in their personal smartphones. Recently, smartphone manufacturers have begun integrating more sophisticated receivers capable of processing multiple GNSS frequencies from a given satellite; the IonoScope application exploits the differential pseudorange measurements between L1 and L5 signals to estimate ionospheric electron density. IonoScope records signal arrival time differences, computes the corresponding slant total electron content (STEC), and applies a slant range correction to compute vertical total electron content (VTEC). Validation against "truth data" from geodetic grade GNSS receivers allows us to both quantify the sensitivity of the app and to discuss the effect of antenna size and other noise sources with students. Though designed as an educational tool, the app can be used to support undergraduate research in ionospheric physics as well. It displays real-time GNSS data and provides interactive explanations of the underlying physics, making abstract concepts, such as signal propagation through the ionosphere, accessible to students. The app can be incorporated into high school or undergraduate physics lessons covering satellites, atmospheric science, or electromagnetic wave propagation. It also can support small experiments with its ability to record and export satellite timing, slant range, azimuth, data for further analysis. We will also present the results of a small-scale physics education research study to evaluate the app's effectiveness as a learning aid to assess how engaging with authentic, smartphone-based GNSS data enhances student understanding of both modern technology and core physics concepts.

(3:24–3:36): Video-MCQ: A Lightweight, Self-Hosted Alternative to Video Quiz Platforms

Jennifer Klay, PhD, Physics, Professor and Chair, California Polytechnic State University - San Luis Obispo

Interactive video makes flipped classroom instruction more engaging, but many commercial tools are costly, closed, or tied to a Learning Management System. Video-MCQ is an open source, educator-led project that delivers the essentials—timed overlays, multiple-choice and free-response prompts, progress gating, and attempt exports—without the overhead. Built with a small, auditable stack (Flask + SQLite on the back end; a simple HTML/JS front end), it runs comfortably on a tiny VM and can be deployed in an afternoon behind Nginx with HTTPS. Quizzes are authored from a clear CSV → JSON flow (with templates) and served publicly, while the instructor dashboard is key-protected. The codebase is released under GPL-3.0 so others can reuse, adapt, and extend it for non-commercial teaching—no student accounts required, and data stays with you. In this talk I will present the project's features, describe the AI-assisted development process, and review the customizable components for making the tool fit individual instructor needs.

Session J03: Using AI in the Physics Classroom

Location: Bronze 3

Time: 3–4 p.m. **Date: Monday, Jan. 19** **Moderator: James Clarke**

(3:00–3:12): Taming AI in the Physics Classroom with Structured Student Input

James Moore, University of Nebraska At Omaha

Large Language Models (LLMs) hold promise for supporting physics learning, but their tendency to hallucinate and the high costs of open-ended queries limit their effectiveness. We present a new approach that scaffolds student input into structured formats that both constrain the AI and deepen conceptual engagement. Our system combines a semantic diagram editor, where students construct vector-based representations of forces, motion, and fields with required tagging, with an equation editor that outputs JSON-based math aligned with the diagram. Unlike image uploads, these diagrams are converted directly into text-based, machine-readable JSON, eliminating the need for expensive image processing. The paired inputs create a precise description of the student's reasoning that can be processed reliably by the AI, reducing hallucinations and significantly lowering computational cost. For students, the act of tagging and structuring diagrams makes their own thinking explicit, reinforcing representational fluency and sense-making in physics. For instructors, the system generates consistent, analyzable data to support formative assessment and feedback at scale.

(3:12–3:24): Harnessing Generative AI for Physics Research and Teaching

Abebe Kebede

Generative-AI workflows were applied across physics instruction, lightweight research prototyping, and outreach to reduce time-to-insight and improve reproducibility. The effort centered on analysis for XRD, XPS, and XAS; rapid creation of learning-management assets; and packaging of programs and scholarly artifacts. Small, purpose-built applications were produced with AI assistance. Examples include: an XAS-PCA pipeline for spectral feature extraction and comparison; a desktop XPS tool supporting Gaussian, Lorentzian, and Voigt ROI fits with trace overlays; a "Form-Factor Lab" for structure-factor calculations and Miller-index instruction; a Magneto-Raman dashboard for field- and temperature-dependent peak shifts; and an affordable spectrometer plan demonstrating absorbance mode (A(λ) = −log10(I_sample/I_ref)) with a Streamlit GUI. Development followed a repeatable pattern: specify minimal outcomes, scaffold code and UI, document assumptions, separate mock from real data, use config-driven runs, and package releases with READMEs. Versioned folders and lightweight automation supported reuse and iteration. In the classroom, AI accelerated generation of multiple-choice banks and concise explanations for solid-state topics and formatted outputs for direct LMS upload. Research artifacts were translated into interactive learning objects and low-cost labs to increase authentic engagement. Outreach and scholarly packaging benefited from AI-assisted templates and checklists, including journal issue preparation and technology planning for an in-flight STEM downlink. Guardrails emphasized verification, provenance notes, plain-language documentation, and equitable access through browser-first tools and tiered tasks. The session demonstrates a runnable, localhost Streamlit folder containing the abstract, a mapping from AI uses to classroom outcomes, and a 15-slide narrative. The approach reallocates effort from boilerplate coding to interpretation, mentoring, and iterative improvement.

(3:24–3:36): Artificial Intelligence and Mathematical Skills (AIMS) program at UCLA

Alexander Kusenko, University of California - Los Angeles (UCLA)

Many introductory science courses require basic understanding of calculus and other quantitative skills. Due to varying levels of prior math preparation among students, there are large grade disparities in these courses. In this project, we will build on promising results from a project funded by UCLA's Teaching and Learning Center (TLC), described in more detail in our publication, Lu et al., Phys. Rev. Phys. Educ. Res. 21, 010160 (2025).

The interventions are:

1. Supplemental Math assignments designed to address gaps in students' mathematical knowledge, using scaled incentives to encourage less prepared students to complete supplemental assignments, without introducing the "gifts for the gifted" problem;
2. State-of-the-art AI tools in a safe and equitable environment, without any extra cost to the student, helping students with the supplemental assignments and enriching the overall learning experience in the course.

Together, these components form the AI and Math Skills (AIMS) program. Our prior research shows that these interventions support student learning and reduce inequities in exam performance.

(3:36–3:48): Student-centered approaches to address generative AI usage in the classroom

Patti Hamerski, Oregon State Univerisity

Given the option, many physics majors choose to use generative AI as a tool when solving physics problems. This practice marks a change in the problem-solving processes we typically see as educators. This change has been significant in a junior-level computational physics course at Oregon State University, where students were often tasked with writing code to model physics phenomena. I will give an overview of findings from research and curriculum development aimed at addressing generative AI usage in this setting. These efforts were carried out under the influence of ongoing student input and class discussions about generative AI. Takeaways from this work include the importance of drawing on student input, changes to computational problem-solving that were observed, and ongoing issues for research and practice in this course context.

Session J05: Conversation with Meghan DiBacco

Location: Palace 3

Time: 3–4 p.m. **Date: Monday, Jan. 19**

Meghan DiBacco	*Panel Speaker*	*3:00 pm - 3:48 pm*
Bree Barnett Dreyfuss	*Session Chair*	

K-12 Lounge

RELAX REFLECT CONNECT

THE K-12 LOUNGE OFFERS A WELCOMING SPACE FOR K-12 EDUCATORS TO UNWIND, REFLECT ON THEIR EXPERIENCES, AND ENGAGE IN MEANINGFUL CONVERSATIONS AND COLLABORATION WITH COLLEAGUES.

Saturday

2:00-2:30	AAPT Winter Meeting 101: Making the Most of Your Conference Experience for K-12 Educators	Make the most of the AAPT Winter Meeting! Learn how to navigate sessions, network with peers, and use AAPT resources to boost your teaching.

Room: Palace 4/5

Sunday

7:45-8:45	Community on Physics in Pre-High School & HS Education	An open community to stay connected and learn what's happening in pre-high school and high school physics education.
9:00-10:00	Topical Discussion: From Frustration to Fascination: Motivating Students Who "Hate Physics"	Swap ideas for reigniting student interest and addressing common misconceptions about physics.
10:00-11:00	PTRA: The Physics of Toys	Create simple toys and explore how connecting play with physics principles can boost student engagement and understanding.
12:30-2:00	Lunch in the Lounge	Enjoy a laid-back bring-your-own lunch in the K–12 Lounge! Connect, share ideas, and chat with colleagues in a friendly, informal setting.
2:00-3:00	Topical Discussion: All About AP Physics	An informal Q&A with AP Physics Development Committee members on course design, resources, and the AP exam process.
3:00-4:00	Open Lounge	Take a break, make connections, and spark new ideas in the K–12 Open Lounge—a place to relax, collaborate, and celebrate the creativity of physics teaching.

Monday

9:00-10:00	PTRA: Bringing Physics to Life Through Literature	Share and discover ways to use literature to enrich physics instruction and make concepts more meaningful for students.
10:00-11:00	Topical Discussion: Teacher Wellness and Sustainability: Avoiding Burnout While Staying Inspired	Create space to talk about managing workload, setting boundaries, and finding joy in teaching physics.
12:30-2:00	Lunch in the Lounge	Enjoy a laid-back bring-your-own lunch in the K–12 Lounge! Connect, share ideas, and chat with colleagues in a friendly, informal setting.
2:00-3:00	Pathways to Leadership in AAPT	Interested in getting more involved with AAPT? Sit down with current leaders to hear their stories, ask questions, and explore pathways to leadership through AAPT committees, sections, and programs.
3:00-4:00	Open Lounge	Take a break, make connections, and spark new ideas in the K–12 Open Lounge—a place to relax, collaborate, and celebrate the creativity of physics teaching.