2024 AAPT UT-ID MEETING CONTRIBUTED PRESENTATIONS

Saturday, 4/13/24	**Parallel Session 1A (Science Building 132)**	**Parallel Session 2A (Science Building 136)**
10:30-10:45	Rethinking physics labs for life science majors, Jeannette Lawler, BYU.	Using the Planetarium to do Inquiry Based Activities, Maureen Hintz, UVU (in Planetarium, Pope Science 206).
10:45-11:00	Visible and near IR Spectroscopy labs using a compact USB Spectrometer, Tensor Elmikawy, UVU.	
11:00-11:15	From ray to Fourier: Building optics intuition for the lab, Nathan Powers, BYU.	
11:15-11:30	Quantum Journey in a Box: Tangible Activities on Quantum Concepts for Secondary Students, Jean-Francois Van Huele, BYU.	break
11:30-11:45	Quantum Journey in a Box: Let's do it! (with audience participation), Charlotte Whiteside, Salem Hills High School.	Great Basin Observatory Research with College, High School, and Middle School Students, Cameron Pace, SUU.
11:45-12:00	When Physics Meets Music: Project Based Learning in a Descriptive Acoustics Class, Bonnie Andersen, UVU.	Dark Skies Advocacy, Larry Smith, Snow College
12:00-1:00	Lunch, Science Building Atrium	
1:00-1:30	Poster Session, Science Building Atrium	
	Parallel Session 1B (Science Building 132)	**Parallel Session 2B (Science Building 136)**
1:30-1:45	Impact of Student Created Homework Problems in Physics Classrooms, Eliza Ballantyne, UVU.	Benefits of a Student Physics Club to the students and the department, Tamara Young, UofU.
1:45-2:00	Memorize: Not just a bad word, Matt Zachreson, BYU-Idaho.	
2:00-2:15	A competency grading and programming approach to introductory physics, Kim Nielsen, UVU.	
2:15-2:30	MyOpenMath a great LMS for Physics, Chris Bronson, Spanish Fork HIgh School.	
2:30-2:45	break	break
2:45-3:00	Ten Years of Physics Demonstration Success, Clark Snelgrove, BYU.	Solar Eclipse Outreach, Jonathan Pugmire, Snow College.
3:00-3:15	PHUNNY PHYSICS, Steve Hart, Snow College.	The shape of the atomic nucleus, Ray Walsh, CWI
3:15-3:30	Trends in Physics 2210--In-Person and Online, Samuel Jones, SLCC.	A Course to Support Math Skills for Physics, Kelby Hahn, UofU.
3:30-3:45		Gradescope, an AI-assisted grading tool for managing student assignments, Rhett Zollinger, UofU.

Parallel Session 1A, 10:30-12:00, Science Building 132

Title: Rethinking physics labs for life science majors
Author(s): Jeannette Lawler and Nathan Powers
Presenting Author Affiliation: BYU
Abstract: Over the last year, we have been working to restructure our laboratory course associated with algebra-based physics to emphasize experimental design and modeling. This class primarily serves life science students on a pre-professional track for one of the medical-related fields. In this talk, I will discuss the reasons for this change, what we are doing to emphasize experimental design and modeling, our progress to date, and preliminary student outcomes. This program draws heavily on work done by Kathleen Koenig et. al. from the University of Cincinnati.

Title: Visible and near IR Spectroscopy labs using a compact USB Spectrometer
Author(s): Tensor Elmikawy, Alexander Panin and James Miles
Presenting Author Affiliation: UVU
Abstract: Recently an inexpensive visible band USB spectrometer was introduced by Thunder Optics. We tested it and found it useful not only for basic optics experiments, but for experimental activities accompanying more advanced classes - such as modern physics class, quantum mechanics and laser physics. This spectrometer offer quite robust performance: good spectral resolution (~2 nm in 380-850 nm range), good sensitivity, high dynamic range (S/N > 1000), fast shutter speed (1 - 500 ms), student-friendly interface, ease of use, combined with accompanying free software - which allows spectrometer calibration and basic processing of spectra (such as wavelength and intensity measurements, adding/ subtracting spectra/ background, saving and printing, etc.). In this talk we will show what exiting experimental activities with this spectrometer students can do in quantum mechanics, atomic and molecular physics, plasma physics, physics of lasers, etc.

Title: From ray to Fourier: Building optics intuition for the lab
Author(s): Nathan Powers, David D. Allred, Richard L. Sandberg, J. Nicholas Porter and Dallin S. Durfee
Presenting Author Affiliation: BYU
Abstract: In the advanced lab at BYU, we teach several techniques for imaging, including brightfield, darkfield, phase contrast, and diffraction imaging, and interferometry. Students in the class have previously been introduced to ray optics, diffraction, and Fourier transforms in theory classes. In this talk, I will present conceptual discussions that I have found useful in building intuition and bridging the gap between the classroom and the lab.

Title: Quantum Journey in a Box: Tangible Activities on Quantum Concepts for Secondary Students
Author(s): Jean-Francois Van Huele and Charlotte Whiteside
Presenting Author Affiliation: BYU

Abstract: Quantum Journey in a Box is a unique offering to broaden access to quantum physics. It is an introductory experience designed for high school students. It consists of several hands-on (paper and scissors) activities allowing students to discover and interact with concepts from quantum information and an explanatory booklet, giving the physics and math background needed for each activity. The topics cover light polarization, cryptography, cloning and teleportation, and the activities include an optical investigation, detective work, card game and shape matching. In this first contribution, we motivate and introduce the box and the quantum informational concepts used.

Title: Quantum Journey in a Box: Let's do it! (with audience participation)
Author(s): Charlotte Whiteside and Jean-Francois Van Huele
Presenting Author Affiliation: Salem Hills High School
Abstract: Quantum Journey in a Box is designed to be distributed to and used by a variety of audiences with special focus on secondary students. It is currently being tried out in a high school science club and will be the topic of a workshop for teacher participants at the AAPT 2024 Summer meeting in Boston in July. In this second part of our contribution, we will discuss and illustrate the implementation of the quantum box with audience participation. We will focus on the cryptography game and find out if an eavesdropper intercepted the key sent between audience participants.

Title: When Physics Meets Music: Project Based Learning in a Descriptive Acoustics Class
Author(s): Bonnie Andersen
Presenting Author Affiliation: UVU
Abstract: Project Based Learning (PBL) is where a class is structured around learning the subject through a significant project that serves a community need. PBL fosters skills which will help students be successful in other classes and their future career. It also helps them be more excited to learn the subject because they see how it can apply in the real world. This project was a collaborative effort of the Music Department and my course, Physics 1700 Descriptive Acoustics. Specifically, I worked with the head of the orchestra. My students accompanied the musicians at an educational public event at the end of the semester. My students explained physical principles behind how different types of musical instruments work though demonstrations, computer applications, and presentations. The students used their own creativity on how they presented their type of instrument. Physics 1700 lends itself well to four teams as there are about 20 students in the class. Each team was responsible for (1) string instruments (2) woodwinds (3) brass instruments, and (4) percussion. The music instructor invited ensembles of music students to perform after each description. The event was free and open to the public so friends, families, and others in the community could attend.

Parallel Session 2A, 10:30-12:00, Science Building 136

Title: Using the Planetarium to do Inquiry Based Activities
Author(s): Maureen Hintz, M. Jeannette Lawler, Emma Rasmussen and Adam Bennion

Presenting Author Affiliation: UVU
Abstract: The use of a planetarium during Astro 101 courses, tends to more passive for the students. While they do enjoy it, the inactive nature can be problematic. Inquiry based planetarium activities are being developed and implemented in the Astro 101 courses at UVU and BYU. We will be demonstrating one or two of the activities in UVU's planetarium. ***(NOTE: This presentation will take place in the UVU Planetarium, Pope Science 206.)***

Break to reconvene in Science Building 136.

Title: Great Basin Observatory Research with College, High School, and Middle School Students
Author(s): Cameron Pace and Richard Plotkin
Presenting Author Affiliation: SUU
Abstract: The Great Basin Observatory is located in Great Basin National Park just across the state line in Nevada. It is operated in partnership with the Park, University Nevada-Reno, and Southern Utah University. The Observatory supports a variety of research projects, from monitoring active galaxies and supernovae, to double-star astrometry. These projects involve undergrads, grad students and faculty, as well as postdocs. In addition to supporting university research projects, the Observatory provides opportunities for rural students in the Great Basin to engage in real science and interact with scientists. Students from 3 high schools and 1 middle school in the Great Basin have engaged in double-star research that has resulted in peer-reviewed publications. This research is genuine and original, and exposes the students to all of the successes and frustrations inherent in scientific research. The students' experience with these projects helps deepen their interest in science, sharpen their writing skills, and improve their problem-solving abilities.

Title: Dark Skies Advocacy
Author(s): Larry Smith, Jon Pugmire and Steven Hart
Presenting Author Affiliation: Snow College
Abstract: Light pollution disrupts ecosystems, hampers astronomy, and affects human health. We'll explore its physics, including its sources and impacts. Practical strategies for advocacy, such as promoting responsible lighting and supporting legislation, will be discussed. We aim to inspire action and preserve the beauty of the night sky for future generations.

Lunch, 12:00-1:00, Science Building Atrium

Poster Session, 1:00-1:30, Science Building Atrium

Title: A Simple Laboratory Experiment in Computed Tomography for Pre-Med Students
Author(s): Nathan Woolley, Jared Roth, Isadora Hubner Cavinatto, David D. Allred and Nathan D. Powers
Presenting Author Affiliation: BYU

Abstract: Mylott, et al. describe an idea for a laboratory exercise to introduce the concept of computed tomography using a photogate. One limitation of their methods is that it does not allow the user to image with concavity. We are developing a similar exercise that uses radioactive isotopes and a Gieger counter as a potential laboratory for pre-med students. We describe our design and the principles behind computed tomography. The new design will allow us to provide an interesting application for students to apply principles of radioactivity that are investigated in a previously developed lab at our institution.

Title: 2-D Resonant Oscillator Demonstration Bowls
Author(s): Cheryl Davis, Clark Snelgrove and Robert Davis
Presenting Author Affiliation: BYU
Abstract: In junior level classical mechanics we teach 2-D resonant oscillators but lack good physical demonstrations of this phenomenon. These oscillators are usually represented in textbooks using springs in x and y directions with different spring constants but connected to the same central mass. If a physical demonstration is made using springs, the stretching of the springs couples the x and y motion except at very small amplitudes, limiting our ability to observe the phenomenon clearly. We have developed a demonstration of 2-D oscillators using machined bowls with different curvature in the x and y directions to producing different effective spring constants without coupling the x and y motion. When ky = 4kx, this creates a resonant frequency in the x direction twice that in the y direction and a ball can be rolled in the bowl in a figure-8 pattern as predicted by the 2-D oscillator equations.

Parallel Session 1B, 1:30-3:30, Science Building 132

Title: Impact of Student Created Homework Problems in Physics Classrooms
Author(s): Eliza Ballantyne and Dustin Shipp
Presenting Author Affiliation: UVU
Abstract: Over the last year, we explored the impact of student created homework on student attitudes towards physics and their performance on assessments. In the first semester of our research, students in an introductory physics course solved traditional problems from the OpenStax physics textbook. In the second semester, students were responsible to create and solve their own homework problems. In both cases, we had dedicated homework help days each week to provide support and help whenever students needed it. Students with increased ownership of homework problems reported enjoying problem solving more and recognized physics more outside of the classroom. While we found no measurable difference in student performance on assessments between the two classes, students who created their own problems were less confident in their understanding of physics concepts and didn't recognize the problem-solving strategies they developed in homework assignments. We discuss here benefits we observed from student created problems, potential solutions to address this confidence gap, as well as how student created homework problems impact traditionally underserved minority groups and first-generation students.

Title: Memorize: Not just a bad word
Author(s): Matt Zachreson
Presenting Author Affiliation: BYU-Idaho
Abstract: Physics education reform efforts tend to focus on improving conceptual understanding and shifting away from rote memorization. However, students in my introductory physics classes actually improved their conceptual understanding when they were required to memorize (via twice-a-week quizzes) certain physics facts and basic equations but only when they memorized them before we covered the concepts in class.

Title: A competency grading and programming approach to introductory physics
Author(s): Kim Nielsen
Presenting Author Affiliation: UVU
Abstract: In this presentation I will present a work in progress approach to implementing competency based grading into introductory physics courses. The presentation will also show an example of how to expose students to basic programming practices through the course material.

Title: MyOpenMath a great LMS for Physics
Author(s): Chris Bronson
Presenting Author Affiliation: Spanish Fork High School
Abstract: I will start by introducing the website to those of our organization who are unfamiliar with it. I will then show the problem libraries, the problem types available, and how it can LTI integrate with other LMS sites like Canvas. Lastly I will demonstrate how problems are written and answer any questions from those who interested/curious. This isn't a sells pitch, MyOpenMath is a free to use LMS. I'm not associated with Lumen Learning in anyway (the company that hosts the servers for the site). I'm just a high school physics teacher who thinks others who teach physics might be interested in this free to use resource.

Break

Title: Ten Years of Physics Demonstration Success
Author(s): Clark Snelgrove
Presenting Author Affiliation: BYU
Abstract: During my ten years at Brigham Young University I have had many successes updating old physics demonstrations and in creating new ones. I will present some of these successes and ideas about how these demonstrations are used to teach physics better.

Title: PHUNNY PHYSICS
Author(s): Steve Hart
Presenting Author Affiliation: Snow College
Abstract: This is meant to be a light-Harted (ba dum tss) presentation of physics and astronomy humor. I'll present a smorgasbord of bad puns, funny and educational comics, and jokes that may produce a small but finite quantity of amusement. A slight exhalation from the nostrils may be experienced occasionally throughout the presentation. Groaning is

to be expected and will be appreciated. I'll avoid chemistry jokes - where stronger reactions are expected.

Title: Trends in Physics 2210--In-Person and Online
Author(s): Samuel Jones and Jonathan Barnes
Presenting Author Affiliation: SLCC
Abstract: SLCC offers 'Physics for Science and Engineering I' in both in-person and online modalities. We present statistical insights from enrollment and grade data spanning 2018-2023. During this period the demand for the online delivery has increased by over 50% so that it now outnumbers the demand for the in-person class. However, the online classes have consistently had a 10% gap in pass rate compared to the in-person classes. We explore student performance data by demographics and previous academic performance. Our goal is to develop strategies to narrow the performance gap between the two modalities.

Parallel Session 2B, 1:30-3:30, Science Building 136

Title: Benefits of a Student Physics Club to the students and the department
Author(s): Tamara Young and Sunny Joy Rasmussen
Presenting Author Affiliation: UofU
Abstract: SLCC offers 'Physics for Science and Engineering I' in both in-person and online modalities. We present statistical insights from enrollment and grade data spanning 2018-2023. During this period the demand for the online delivery has increased by over 50% so that it now outnumbers the demand for the in-person class. However, the online classes have consistently had a 10% gap in pass rate compared to the in-person classes. We explore student performance data by demographics and previous academic performance. Our goal is to develop strategies to narrow the performance gap between the two modalities.

Break

Title: Solar Eclipse Outreach
Author(s): Jonathan Pugmire
Presenting Author Affiliation: Snow College
Abstract: In Oct 2023, Snow College hosted a large solar eclipse party for the Annular Eclipse in Richfield, UT. I'll share our outreach and science experiment efforts and their results.

Title: The shape of the atomic nucleus
Author(s): Ray Walsh
Presenting Author Affiliation: College of Western Idaho
Abstract: The atomic nucleus is typically portrayed using spherical protons and neutrons hard-packed within a globular, roughly spherical shape. Well, this portrays, many salient, features of nuclear reactions, including stoichiometry, the spherical depiction generally deviates from the empirical evidence for the size and shape of nucleons and nuclei. The root mean squared (RMS) charge radius of most stable (and many unstable) nuclides have been

experimentally determined. If the nucleus is assumed to be spherical, an approximate relationship between nuclear radius and mass number arises above A=40 from the formula R=RoA-1/3 with Ro = 1.2 ± 0.2 fm. For light nuclides below A=40, the smooth curvilinear spherical radius plot contrasts with the erratic experimental radius-to-mass. Multiple model-dependent analyses of the proton's intrinsic quadrupole moment suggests that the ground-state nucleon shape conforms to a prolate spheroid shape, and spin – spin forces relegate like – flavored quarks to opposite ends of each prolate nucleon. Other factors affecting nuclear shape include the distance between nucleons (the nucleon-nucleon potential), and the radial charge density distribution, which indicates a soft core for the light nuclides which generally contrasts the uniform nuclear density of medium and heavy nuclides. The unusual cosmic abundance of alpha nuclides has inspired geometric arrangements of alpha particles as possible solutions to nuclear shapes, although resulting structures demonstrate loose correlation (at best) with experimental charge radii. The atomic nucleus generally assumes a prolate spheroid shape. Nuclides can also be discus-shaped (oblate deformation), triaxial (a combination of oblate and prolate deformation) or pear-shaped.

Title: A Course to Support Math Skills for Physics
Author(s): Kelby Hahn
Presenting Author Affiliation: UofU
Abstract: This talk will focus on the ways we support students in developing mathematical and sensemaking skills in a new freshman course at the University of Utah, "Problem-Solving in Physics & Astronomy." This course is intended to jumpstart their physics trajectory, enabling students to take the first semester of calculus-based physics concurrently with calculus 1. In this talk I will introduce the course, outline some of the key pedagogical choices, and relate those to the physics education literature that inspired them. Attendees should leave with ideas about how to support mathematical reasoning and physics sensemaking in any course.

Title: Gradescope, an AI-assisted grading tool for managing student assignments
Author(s): Rhett Zollinger
Presenting Author Affiliation: UofU
Abstract: Modern teachers have many electronic tools to help them run their courses. I recently became acquainted with Gradescope, which offers online and AI-assisted grading tools for higher education. Gradescope allows students to receive faster and more detailed feedback on their work, and it provides detailed assignment and question analytics to instructors. It is an easy way to take submissions digitally in order to preserve the original work and allow for quick and easy viewing from anywhere. The grading software has been particularly useful in my large enrollment introductory physics courses. In my presentation I will give a short overview of the software and provide some examples of its features. The talk is intended as an introduction for instructors who have not previously used the software.