2022 Nebraska Physics & Astronomy Fall Summit
(Abstracts of Plenaries, Breakout Sessions, and Longer Sessions)

Plenaries

Simplifying Pulsar Timing Array Science for Students – Michael Lam (RIT)

The North American Nanohertz Observatory for Gravitational Waves (NANOGrav) collaboration is working toward the detection and study of low-frequency gravitational waves using an array of rapidly rotating, highly stable radio pulsars distributed across the galaxy as accurate and precise clocks. A significant amount of research is driven by students from the high school to the graduate level. Students new to the field find themselves engaging with a large cross-section of many fields of astronomy, learning about stellar evolution, compact objects, galaxy evolution, gravitational waves, the interstellar medium, and more, and we strive to make our science accessible to them. I will describe our research program and specifically highlight the efforts within the collaboration to make our science more accessible to new students at many levels, getting them involved in cutting-edge science as quickly and easily as possible.

Climate Change Resilience in Nebraska – Clint Rowe (UNL)

Human-caused climate change is threatening the lives and well-being of billions of people and the vast majority of ecosystems via more frequent and severe weather, ocean warming and acidification, extended periods of drought and extreme temperatures, and other deleterious impacts. Many climate-induced hazards will be unavoidable regardless of the mitigation pathway humanity pursues. To prepare for, adapt to, and recover from these climate impacts while pursuing economic growth and development, society will have to engage in climate resilient development. Fewer than half of US states have, or are currently developing, a climate adaptation plan. These adaptation plans are notably absent in the Great Plains states.

Breakout Sessions

Experiences In Flipping – Kirill Belashchenko (UNL), Michael Sibbernsen (UNL)

This will be a discussion of experiences in implementing the flipped classroom format of active learning. Specific approaches in introductory-level astronomy and graduate-level physics classes will be briefly described by the discussion leaders, allowing ample time for questions and discussion.

Ultra-high energy neutrino detection – *Pawan Giri (UNL), Robert Tabb (UNL)*

Neutrinos are chargeless subatomic particles with nearly zero mass. Because of their rare interaction with matter, neutrinos typically pass-through normal matter unimpeded and undetected, making neutrino detection extremely difficult. There are several detectors throughout the world searching for neutrinos originating from different sources. One of these is the IceCube Observatory at the South Pole which looks for high energy neutrinos originating from cosmic sources. We will discuss the difficulties in neutrino detection, the role of neutrino detectors, and will provide information on available mobile apps, games, and other tools which are useful for teachers and students.

Smartphone Interactions – *Barney McCoy (UNL)*

National research has found significant levels of student classroom distraction caused by smartphones and laptops. Those distractions levels were found to be even greater when students switched to remote learning during the COVID-19 pandemic. We will discuss: "What should instructors do to minimize digital learning distractions in their classrooms?"

NGSS in Action: Zipline Engineering – *Deepika Menon*

This hands-on session is designed to engage middle/secondary school science teachers in a model lesson on building and testing ziplines using an *engineering design process* as advocated by the Next Generation Science Standards. We will also explore zipline physics (statics), the forces involved, and an example of calculating the tension in the wire with a hanging weight (zipline). The experience within the session will help teachers develop a shared understanding of NGSS in action.

Randomization in Web Assessment – *Francine Mace*

Randomized questions within web-based assessments move students away from simply memorizing content and push them to think critically. When taking a web-based assessment, randomized exams allow students to receive a unique version of the test that grades their performance and delivers feedback instantly. In this breakout session, we will interact with real examples of randomized questions, explore non-summative uses for this type of assessment, and learn about different methods of implementing this system in classrooms.

Earth-Like Planets – *Emily Petermann (Grand Island HS), Mike Edmundson (Millard South HS)*

EARTH-LIKE is an interactive website that allows students to investigate how an Earth-like planet's land fraction, volcanism, and location in the habitable zone changes the planet's average global temperature and habitability. This activity demonstrates for students how minor changes in planetary properties can result in large changes to the planet's surface environment. Students will gain a better understanding of Earth-like planets and what it means for a planet to be habitable. Session participants are encouraged to bring a laptop. The EARTH-LIKE site is a project from the ELSI Origins Network Planetary Diversity Workshop.

Cultivating Attention – *Manda Williamson* (UNL)

After reviewing what attention is, what it does and what it doesn't do well, we'll view three frameworks we might use to capture attention within the classroom. The remainder of the workshop will be spent in collaborative reflection as we create specific attention-capturing classroom activities to incorporate within your courses.

Digitalis Mobile Planetarium Show – *Jack Northrup (Rolling Bluffs Planetarium)*

Using an immersive experience to connect astronomy concepts to your students. These concepts include classics like rotation and revolution from a variety of perspectives and Earth's place in a three dimensional universe. There will also be a short tour of constellations from around the world.

Online Homework: Access and Barriers – *Brian Couch (UNL)*

Instructors use a variety of online activities to support learning outside of class. Previous studies have revealed barriers for students in online courses, but less is known about the barriers students experience when completing online assignments. Understanding these barriers to access is critical to fostering more inclusive learning for all students. This session will explore student perceptions with respect to five barrier categories: technical resources, instructor organization, social interactions, personal engagement, and learning environment. We will share a survey instrument used to collect data from over 1200 undergraduate science students at two-year and four-year institutions. Session participants will consider potential differences between high school and college homework barriers and brainstorm ways that instructors might help students overcome salient challenges.

Teaching Physics in a Biomedical Context – *Steve Ducharme (UNL)*

An Introductory Physics for Life Sciences (IPLS) course is a splendid opportunity for physics instructors to engage STEM students from the life sciences who have traditionally stayed away from physics because they perceive it as mathematically complex and minimally relevant to life sciences. About 25 years ago National Academy of Sciences began issuing a series of reports entitled Vision and Change in Undergraduate Biology Education that spell out the need for students of the life sciences to learn quantitative reasoning, modeling, and analysis that are now widely used in biology and medicine. These skills are necessary to take advantage of tools used to study and model complex systems from physics, chemistry, mathematics and nanoscience that are now being applied successfully to make biosciences in medicine much more quantitative and predictive. The purpose of IPLS courses is to prepare these students to take advantage of these advances as their careers will require. I will give an overview, with examples, of how principles and methods of physics can be taught in a biomedical context, thus preparing the students to meet the goals of Vision and Change, and give their teachers a glimpse into how physicists can make major contributions to biomedicine.

Disengaged Students – *Kate Marley (Doane)*

Many teachers found teaching in the pandemic to be uniquely difficult. My experience lies in teaching at the college and university level, where many observed deepening student disengagement to a real low in Fall 2021. Entirely new behaviors were described from never attending class, to attending all class sessions but never completing any assignments or exams. In this session, I will share concrete strategies for increasing student engagement that foster inclusivity while maintaining rigorous standards. Concurrent with the student disengagement, faculty are also experiencing burnout and disengagement. Additional strategies to address faculty burnout and disengagement will be explored. Please come, share your experiences with the group, and consider the potential for a new and positive classroom experience.

Applications of High-Altitude Ballooning – *Derrick Nero (UNO)*

High-altitude ballooning (HAB) is a great platform to perform near-space experiments (NSEs, up to 30 km). Physics and astronomy are common topics for NSEs spanning elementary, secondary, and post-secondary STEM academic standards and their applicable science and engineering practices. An example of HAB NSE application will be NASA's Nationwide Eclipse Ballooning Project. This project will be a highlight of this session as it invites science and engineering ideas for the October 14, 2023 annular and April 8, 2024 total solar eclipses.

Sorting Tasks in HTML5 – *Chris Siedell (UNL), Sukaina Al-Hamedi (UNL)*

Sorting task questions require students to classify items by some characteristic. In this session we will introduce a new tool for creating interactive, online sorting tasks. Participants will learn how to make their own sorting tasks, which students will be able to use on their smartphones. This is a new feature of the Interactives Editor (found on the astro.unl.edu website), which already has the ability to create ranking tasks.

Lab Activities in IPLS – *Keith Foreman (UNL), Joshua Beck (UNL)*

Laboratory activities in Introductory Physics for the Life Science (IPLS) courses are uniquely challenged to not only engage students with much of the same, important fundamental physics found in other introductory courses, but do so in a biological context meaningful to life science students. This session will showcase several recently implemented laboratory activities in the IPLS courses offered at UNL. These new labs use much of the same equipment other in introductory physics labs. Participants will be able to perform the lab activities with the same equipment UNL students use. The accompanying lab manuals, along with the conceptual questions students must answer about the lab activities, are also available. Participants are encouraged to discuss and share ideas to adapt other introductory lab activities for IPLS courses.

AR Using Hololenses – *Herman Batelaan (UNL)*

We will have two hololenses for you to try and will present a short recording of an AR activity we programmed. We would like to discuss how augmented, mixed and virtual reality can be used in the classroom. Can we identify an AR demo or activity that may help your curriculum? How do we make resources (perhaps hold Hololenses in a library of things) available to you, if you want them? Our work is funded by UNL's Grand Challenges Program and includes funding for teachers to experiment with this technology in the classroom. Our team includes faculty from the Johnny Carson Center for Emerging Media Arts, from Physics and Chemistry Education Research, and includes two Quantum Scientists.

Building Solar Telescopes – *Larry Browning (SDSU)*

The Oct. 14, 2023 solar eclipse should be a great partial solar eclipse to observe from Nebraska. Get ready to watch it unfold from outside your school with a Safe Solar Viewer originally designed by T.R. Richardson of the College of Charleston. This construction will use laminate flooring and lenses from Surplus Shed to make a Galilean telescope which projects the sun's image on a screen. By looking down (instead of up) you will be able to safely watch the eclipse unfold and search for sunspots at other times. Materials for 16 telescopes will be provided.

Longer Sessions

Climate Change Modeling – Mindi Searls (UNL), Cambelle Johnson (UNL)

The En-ROADS Climate simulation is set up to be used as an interactive group learning experience where people work together to test solutions for addressing climate change. Participants propose climate solutions such as energy efficiency, carbon pricing, fossil fuel taxes, reducing deforestation, and carbon dioxide removal. The different approaches can be tested in the En-ROADS Climate Solutions Simulator, so participants can see the impact on global temperature and other factors in real-time. The goal is to create a scenario that limits global warming to well below 2°C and aims for 1.5°C above pre-industrial levels, the international goals formally recognized in the Paris climate agreement.

Inclusive Science Teaching – Elizabeth Lewis (UNL) & Noyce Master Teaching Fellows – Ethan Van Winkle (Lincoln Southeast), Alison Klein (Kearney HS), & Jolyne Zigler (Grand Island HS)

This 75-minute interactive session will focus on engaging participants for the purpose of: (1) increasing their understanding of equity and inclusion at the intersections of gender, culture/race, disability, socioeconomic status in physics and STEM education; (2) evaluating their current learning environment for equity issues, and (3) discussing productive ways to address recruiting and retaining historically marginalized groups in secondary and higher education. Examples of effective and equitable lessons, instructional strategies, and rubrics will be provided. Participants will leave having identified one or more goals to address their major concern(s) about broadening participation in physics, astronomy, and/or physical sciences education.

Furthering Computational Goals with Spreadsheets – Jennifer Delgado (UKansas)

This workshop will discuss attempts to develop "pre-simulation" skills for non-major students in introductory astronomy and physics courses. In particular I will show some work from a first semester, algebra-based physics course. As part of their weekly work, students were asked to create a calculator for homework questions using excel. They were asked to make their calculators such that the value of the variables in problem could be changed but the calculator would still produce the correct answer. The goal of this was to get students to solve the question using variables first. Students preforming better in the course did better on these exercises. Examples of calculators for physics and astronomy will be demonstrated.