This panel focuses on educational opportunities around running a planetarium facility on a college campus. The session will feature presentations on a) results from local research efforts to characterize higher education learning in IPS planetariums, and b) integration of problem-based learning into introductory undergraduate astronomy courses.

Faculty, staff, and graduate students at the University of Colorado Boulder are exploring approaches and strategies for enhancing active learning and interaction in introductory undergraduate astronomy courses. Here, we present a) a project-based learning activity using a celestial navigation challenge to motivate learning about terrestrial and celestial coordinate systems as well as motion of the Sun and stars in the sky, and b) results from a survey effort of IPS planetariums affiliated with higher education institutions in the United States.

Planetarium Usage Survey (PLUS)

During Fall 2018 and Summer 2019, Astrophysical and Planetary Sciences graduate student Daniel Everding has developed and administered a Planetarium Usage Survey (PLUS) to representatives from planetariums located on higher education campuses within the United States. Out of 261 planetariums invited to participate, 77 responses were received. Followup interviews involving 11 respondents were conducted in Summer 2019. A comparison of response frequencies compared to the invitation pool indicates that we received a representative sampling based upon planetarium size, although a higher percentage of digital theaters responded compared to analog theaters. We will share findings from this survey to
highlight findings specific to higher education planetariums with regards to audiences served, subject matter being taught, instructional styles being used, and frequency of use. Findings from this study are forthcoming in a manuscript that has been accepted for publication in *Physical Review Physics Education Research*.

Survivor Challenge

The “Survivor Challenge” is a project-based learning activity developed and tested at Fiske Planetarium over the past four years. Prior to the planetarium learning module, undergraduate students have received background instruction about sky coordinates (altitude, azimuth, right ascension, declination, zenith, meridian, etc), sidereal motion of the stars, and daily and seasonal motion of the Sun. Within the planetarium, the class is divided into smaller groups of 3-4 students and each group is given an Earth globe annotated with latitude and longitude (Figure 1). The planetarium is set to an undisclosed latitude, longitude, and day of the year, and student groups are asked to determine these parameters. Students are also provided with the corresponding local time at the home location of the planetarium (but not the local time at the mystery location being shown on the dome). Student groups can ask the theater navigator to conduct various actions (e.g., rotate the dome over a 24 hour period, or view a snapshot of the sky one month prior to, and one month after, the mystery date) to provide additional data to help determine their location and the time of year. Students are asked to use portable whiteboards to present and justify their estimates to other groups in the class (Figure 2). At the end of the activity, students are lifted off of the Earth and shown the actual location and date that was used.

At Fiske Planetarium, the Survivor Challenge activity is facilitated by an undergraduate navigator and a graduate teaching assistant (TA) and/or an undergraduate learning assistant (LA; an undergraduate who has already completed the course in question and works with the faculty for the course to guide student learning). The TA and/or LA check in with student groups throughout the activity, and the navigator responds to student requests to manipulate the dome as desired. Observations of student interactions and discussions during the activity have demonstrated enhanced student engagement compared to traditional lecture within the dome. While facilitation by the TA and/or LA has been helpful, undergraduates have demonstrated their ability to make reasonable and justified estimates of position and time. Formative and summative assessment has shown learning gains in student understanding of sky position and motion resulting from this activity. Students report that they find the lab experience using the planetarium much more engaging and helpful to learn the material than in a standard lecture environment.
Figures

Should be in jpg or gif format & include a caption in the narrative text file.

Figure 1 - Undergraduate learning assistant facilitates a group of students engaged in Survivor Challenge.
Figure 2 - Whiteboard sample showing student reasoning about position and location based on dome observations made during Survivor Challenge.