

**IMPROVING INCLUSIVITY AND ACCESSIBILITY IN PLANETARY SCIENCE IN REMOTE FIELD COURSES.** M. L. Meier<sup>1</sup>, S. Thatcher<sup>2</sup>, J. L. Piatek<sup>3</sup>, A. Marshall<sup>1</sup>, Y. Arroyo<sup>1</sup>, S. Leon<sup>1</sup>, A. J. Williams<sup>1</sup>, T. Collins<sup>4</sup>, E. Gallant<sup>5</sup>, S. Elardo<sup>1</sup>, and D. A. Williams<sup>6</sup>. <sup>1</sup>University of Florida (mckaylameier@ufl.edu), <sup>2</sup>The City University of New York, <sup>3</sup>Central Connecticut State University, <sup>4</sup>The Open University, <sup>5</sup>University of Hawai'i at Hilo, <sup>6</sup>Arizona State University

**Introduction:** As an evolving and dynamic field, planetary science is structured for both research and education of our Solar System. It is key to concentrate on universal design and pedagogy strategies to improve the field's accessibility, diversity, and inclusivity. As an approach to advance the education and research tools of the field, we focus on the innovations of accessible field courses. GeoSPACE, a NSF-funded (award #2023124) field course through the University of Florida, offers pioneering methods to teaching planetary and earth sciences.

As a multi-organization program with a variety of expertise, our 14-day field course spans multiple topics and exposes students to varied techniques and modern research through a dual-participation structure. In particular, GeoSPACE focuses on teaching concepts in volcanology and geophysics with a planetary perspective. The dual participation approach is structured similar to crewed space missions, with "astronauts" (in-person students) and "mission control" (virtual students). Virtual students utilize remote sensing techniques to observe planetary bodies, including Earth, the Moon, and Mars, in preparation for astronaut exploration. In-person students explore the San Francisco volcanic field (SFVF) in Arizona with objectives and context from mission control. All students have the opportunity to explore Earth analogs and planetary datasets while utilizing real-world research methods.

GeoSPACE is designed to teach planetary science using real-world applicable tools for students to carry on into their careers. With this, we teach students a wide range of open access tools that are compatible with most computer operating systems. We investigate Earth's and other planetary bodies using Google systems, as well as JMARS. On JMARS, we have created a shareable database of image products from multiple sensors for our students to access. Additionally, we utilize user-friendly web browser applications, such as NASA Trek and LROC Lunar Quickmap, that provide a diverse abundance of datasets. The objective of teaching these tools is to provide 1) a variety of information and choices for students and 2) platforms options for those with limited computer resources.

**Virtual Activities and Methods:** The objective of mission control activities is to utilize a variety of remote sensing datasets to observe geologic features of Earth and other planetary bodies through different lenses. The

goal of each assignment is for students to make their own observations and questions about Earth, the Moon, and Mars. Each activity aims to look at a specific Earth feature and address how that geology plays a role on a planetary scale. Students observe the Earth location with an assigned dataset, and as a group, they interpret the site's history and formation. Additionally, the mission control group identifies aspects of the sites that could be better understood with the help of in-person astronaut investigation. With these interpretations and questions, mission control prepares a briefing for each geologic site of the field course.

**Structuring Accessible Virtual Field Courses:**

The key components to organizing accessible and inclusive field courses are communication and organization (figure 1). Communication includes a platform (such as Discord) that is user-friendly, and readily accessible on phone and computer. Students and faculty should be able to directly communicate with each other, whether through text messages or video calls (e.g. Discord or Zoom). It is highly important that faculty thoroughly communicate plans, questions, and concerns throughout the field course.

Organization of field courses, especially with the inclusion of a virtual participation method, is essential to

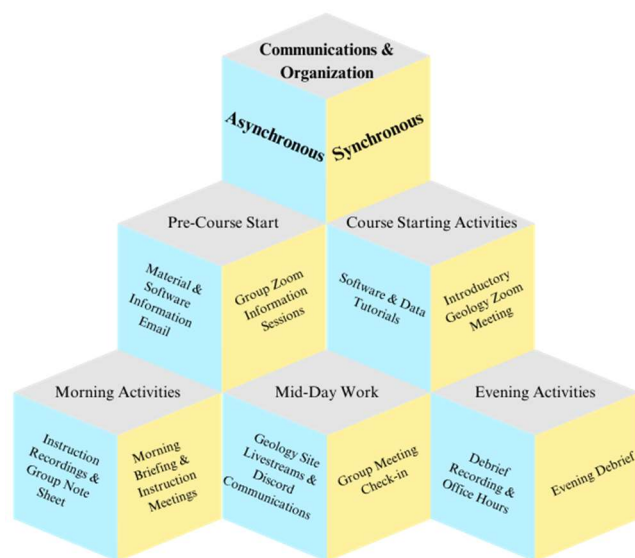


Figure 1. Structural diagram of the components of accessible virtual field course from GeoSPACE.

providing students an impactful experience and mitigating anxiety. GeoSPACE's mission-based approach creates structure for students, with mission control preparing a briefing for each in-field location and astronauts having a set of goals for each site they visit. The field course is based on having inclusive activities that they can build upon throughout the course, such as improving site briefings or refining a measurement technique.

*Involved and Individual Work.* GeoSPACE has identified, in particular to virtual participation, the need for asynchronous and synchronous work time. We focus on having regular daily instructional meetings over Zoom to create objectives for the students. Students are encouraged to work together on activities while each having their own dataset(s) to interpret. In these meetings, we go step-by-step on teaching remote sensing techniques as well providing introductory material for the geologic sites. As these meetings are held live, it allows virtual students to ask questions and engage in the activities; for students that are not able to attend, all meetings are recorded and made readily available within a short timeframe. The field course is structured to accommodate students with responsibilities outside of education. Asynchronous work allows students the flexibility to participate in the field course in a way that works for their schedule. As students work throughout the day, faculty members are available on Discord and Zoom continuously to address concerns, and questions. An innovative improvement we have found is the use of inclusive note taking, where every virtual student has access to an ongoing collaborative group note sheet..

*Pre-Course Preparation.* Before the field course begins, we have found pre-course meetings and material orientation to be vital to a smooth onboarding. For all students, we have Zoom meetings (that are also recorded) to go over the structure of the course, provide resources, and answer any questions. For the virtual students that will be working with a variety of software, we direct them to where and how to download the programs beforehand. In addition, we provide the students with tutorials specific to the techniques and datasets used in the course. As the course begins, we also go over the information provided in the tutorials for every student to be prepared.

*Daily Structure.* GeoSPACE utilizes a semi-repetitive daily schedule based around mornings, mid-day, and evenings. In the mornings, all faculty and students meet as a group, where an agenda is set for the day based on the mission control briefing of the analog site. Mission control also meets in the mornings for instructions for their day's task, including assigning particular roles for the activity. Each activity has a 24 to 48 hour due date to allow for varied student schedules. During the mid-day, we have a group meeting as a check-in on the

assignment. In addition, there is typically a livestream from the astronauts' location or optional activities around planetary exploration. In the evenings, mission control and the astronauts meet to go over their findings of the day. Additionally, faculty host evening office hours for students who weren't able to access earlier meetings due to prior commitments. The daily structure is built to engage students without a demanding and overwhelming schedule.

**Inclusivity and Accessibility of GeoSPACE:** The GeoSPACE field program provides opportunities for undergraduate and early graduate students to explore their planetary aspirations in an accessible and inclusive environment. The program provides an educational fulfilling experience while tailoring to the needs of students.

The virtual participation option creates the flexibility and adaptability to accommodate student's lifestyles and requirements. For many students, traditional field courses aren't compatible with their outside-of-education responsibilities. Students can be restricted by their health, finances, care-giving responsibilities, other courses, and a multitude of other reasons that make standard field courses inaccessible. The virtual portion of GeoSPACE is intentionally flexible to accommodate students with a combination of synchronous and a synchronous group work,. The faculty also works toward creating an inclusive environment for each cohort, including consistent communication on Discord and office hours on Zoom. We aim to have students make their own observations and work together as a group to form their own interpretations, with faculty managing the balance of each cohort.

**Conclusions:** The GeoSPACE field program works toward developing techniques for creating accessible, diverse, and inclusive field course studies. The mission control model is a structured method for teaching students about planetary volcanology and geophysics. Students have the opportunity to learn about Earth, Mars, and the Moon while gaining applicable skills to carrying into their future careers. When designing virtual field course studies, the communication and organization based around synchronous and asynchronous procedures is imperative to providing an informative and inclusive experience. For more information on GeoSPACE, see <https://sites.google.com/ufl.edu/geospace-field-program>.

**Acknowledgments:** Appreciations to the National Science Foundation for funding the GeoSPACE field course program (NSF Award 2023124) through the University of Florida. Thank you to all faculty, collaborators, and students who have participated over the two years of the GeoSPACE program.