PLANETARY SCIENCE TRAINING FOR ARTEMIS MISSIONS. C.A. Evans[1] and K.E. Young[2], T. G. Graff[3], J. Gross[1], J. Heldmann[4], N. Petro[2], J. Richardson[2], T. Stubbs[2], S. Noble[5], J. Bleacher[5], C. Trainor[3], A. Garcia[3], S. Jacob[3], [1]NASA Johnson Space Center, Houston, TX, cindy.evans-1@nasa.gov; [2]Goddard Space Flight Center, Greenbelt, MD; [3]Jacobs Engineering, NASA JSC, Houston TX; [4]Ames Research Center, Moffertt Field, CA; [5]NASA HQ, Washington , D.C.

Introduction: Planetary geology training for Artemis crews and mission support teams is well underway. We recently reported on the development of our geology/planetary science training flow, and the cross-agency coordination efforts necessary for implementing the training [1, 2]. We discussed our progressive geology training program that starts with incoming astronaut classes, offers opportunities to maintain the geology proficiency between flight assignments, and trains the broader Artemis engineering-operations-management community in geology and basic field methods [3, 4]. In this abstract, we outline and discuss our 2023 accomplishments and near-term plans for continued development of lunar science classroom content, field training objectives, and the delivery of geology training to astronauts and the Artemis mission engineers.

Results: In the past year, our team had several notable accomplishments, including training Artemis II astronauts for their observations of the Moon and providing planetary science training across all 3 phases of our geology training flow (Figure 1) [5]. Key training milestones included the development and delivery our baseline lunar science curriculum, Lunar Fundamentals to the Artemis II crew and 25 other members from NASA flight operations, and 2 weeks of planetary science and field training to the 2021 Astronaut class [5, 6, 7]. Planning and definition of lunar science training for assigned crews, the development of key field objectives for 5 field training sites [8, 9], crew training and site reconnaissance at Kamestastin impact crater, and integration of the geology and planetary science curriculum with the exploration Extra Vehicular Activities (xEVA) training plan rounded out the 2023 achievements for NASA's Artemis geology training team.

By the numbers, we trained 89 students, including the Artemis II crew; the 2021 Astronaut Class; and several flight directors, mangers, and engineers from the Artemis mission management and operations community [9]. We conducted training or testing at 4 field sites in northern Arizona; Kilbourne Hole, New Mexico; Nevada National Security Site; and Kamestastin (Mistastin) Crater, Labrador. We refined field objectives, collected samples, and evaluated logistics; and we tested surface EVA concepts and field methods through simulated traverses.

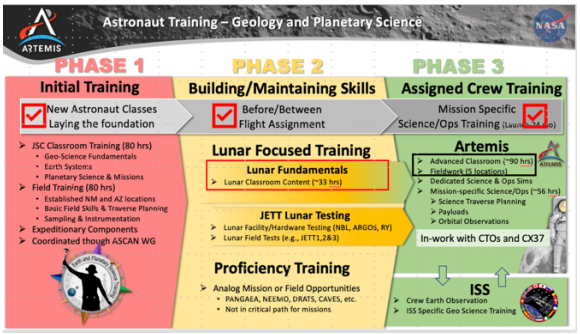

Figure 1. In 2023, NASA's Geology Training Team provided planetary science and field content to astronauts in all three phases of our training flow.

Figure 2. Artemis II crew members learning about the Moon in Lunar Fundamentals.

Discussion: In spring 2023, NASA announced the Artemis II astronauts; their mission will be the first opportunity since Apollo for humans to directly observe and document the lunar surface from a few thousand kilometers. The initial lunar science training for the Artemis II crew was Lunar Fundamentals (Figure 2), a week-long class that combines basic geographic and geologic information about the Moon, discusses the outstanding science questions about the Moon [10], introduces the major geologic processes, the lunar environment, lunar volatiles, and sample science; provides historical context of our growing knowledge about the Moon; and introduces new lunar data sets and tools for exploring the lunar surface. In late summer, half of the Artemis II crew joined our team at the Kamestastin Crater to learn about impact crater processes and products (Figure 3).

Ongoing Work. We continue building lunar science training content to support the Artemis II crew observations of the Moon (including observations of the lunar far side). The Artemis II orbital flight products and procedures for lunar imaging and observations are also in work, in partnership with the crew and the Flight Operations Directorate (FOD) at JSC.

Figure 3. Exploring impact melt and breccias at Kamestastin Crater, Labrador, Canada.

Another ongoing effort is growing the collaborations needed for integrated science, surface operations, and training across the Artemis mission teams. Building on the Lunar Fundamentals foundation, we continue development of the advanced planetary science classroom content for the Artemis III crew, together with field science training objectives and plans. We are constructing an integrated training plan for lunar science, exploration field methods, and operational skills with our colleagues in FOD's xEVA Training Office to ensure that the Artemis astronauts exploring the Moon will have the necessary foundation in geology, lunar science, and EVA skills to achieve mission success.

The Artemis geology training team also collaborates with and leverages the efforts of other groups, including the Joint EVA Test Team (JETT) [11, 12]. Lessons from the JETT integrated tests such as JETT 5 (reported at this meeting) are integrated into the training content, with a focus on the lunar surface science operational concepts that are developed and tested. Finally, we will coordinate with the larger Artemis Science Team to ensure that the surface mission science objectives are included in the training for Artemis missions.

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