GEOSCIENCE TRAINING FOR NASA ASTRONAUT CANDIDATES

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After being selected to the astronaut office, crewmembers go through an initial two year training flow, astronaut candidacy, where they learn the basic skills necessary for spaceflight. While the bulk of astronaut candidate training currently centers on the multiple subjects required for ISS operations (EVA skills, Russian language, ISS systems, etc.), training also includes geoscience training designed to train crewmembers in Earth observations, teach astronauts about other planetary systems, and provide field training designed to investigate field operations and boost team skills. This training goes back to Apollo training and has evolved to support ISS operations and future exploration missions.

HISTORICAL ASTRONAUT TRAINING

Apollo Mission Training

Historically, each Apollo astronaut received extensive geologic training prior to each of the six lunar surface missions. Specifically, the astronauts who flew on Apollo 15, 16, and 17 each had over 550 hours of geologic training prior to their missions [1, 2]. This training included both classroom and field training in relevant analog environments to what the astronauts would see at each selected landing site. Field training also included hands-on time with sampling and data collection technologies in these relevant terrains.

Space Shuttle Training

After the Apollo era, geoscience training evolved into preparing each crewmember for Earth observation, as that was one of their major science tasks while on the Shuttle or on ISS. Crews were trained to identify geologic features of interest and record these features from orbit. Current geoscience astronaut candidate training has evolved past the basic Shuttle training to incorporate field training as well as team skills learned in other training flows.

CURRENT GEOSCIENCE TRAINING

Our current geoscience training program was first implemented for the 2009 astronaut class. It was clear starting with this class that these crewmembers were selected for ISS operations, as the Shuttle program had ended. Priorities for geoscience training now centers around Earth observations, an up-to-date understanding of current and future planetary science missions to prepare crew for public outreach events, as well as an understanding of lunar, martian, and small body targets to prepare for future exploration. The current training program is therefore a hybrid between Apollo and Shuttle training that is under continued development for each new astronaut class.

The 2009 and 2013 astronaut classes were trained in both the classroom and the field, though the curriculum evolved between the two classes. A similar flow is planned for the incoming 2017 class. Classroom training includes Geoscience Fundamentals (i.e. tectonics, geophysics, remote sensing, geomorphology, volcanism, etc.), Earth Systems (i.e. land cover and land use, oceanography, atmospheric and climate sciences, etc.), and Planetary Science and Missions (i.e. Moon, Mars, small bodies, astrobiology, etc.). Field training includes travel to Galveston Bay, the Rio Grande Rift in New Mexico, and Meteor Crater and volcanic destinations in Arizona. Our training team is currently refining the training flow for the 2017 astronaut class to both refine classroom and field training plans as well as to incorporate more team skills and Space Flight Resource Management (SFRM) training components.

TRAINING POST CANDIDACY

While astronaut candidacy lasts for two years and then each class moves on the other assignments, the geoscience training team offers training opportunities to the other members of the astronaut office. We offer several Field Assistantship opportunities annually to the astronaut office, where crewmembers can accompany active research teams in the field to embed themselves into the team. This teaches them about ongoing scientific research as well as builds team skills while giving field scientists and research teams increased operational fidelity.

REFERENCES

[1] Evans, C.A. et al. (2011) *Geol. Soc. Of Am*, Special Paper 483, 67-73. [2] Phinney, W.C. (2015) *NASA Special Pub.*, SP-2015-626, 318 p.