

**FINESSE SPACEWARD BOUND – TEACHER ENGAGEMENT IN NASA SCIENCE AND EXPLORATION FIELD RESEARCH.** A. J. P. Jones<sup>1,2</sup>, J. L. Heldmann<sup>3</sup>, T. Sheely<sup>4</sup>, J. Karlin<sup>5</sup>, S. Johnson<sup>6</sup>, A. Rosemore<sup>6</sup>, S. Hughes<sup>7</sup>, S. Kobs Nawotniak<sup>7</sup>, D. S. S. Lim<sup>3</sup>, W. B. Garry<sup>1</sup>, <sup>1</sup>NASA’s Goddard Space Flight Center (8800 Greenbelt Road, Greenbelt MD 20771; andrea.j.jones@nasa.gov), <sup>2</sup>Planetary Science Institute), <sup>3</sup>NASA’s Ames Research Center, <sup>4</sup>Palouse Discovery Science Center, <sup>5</sup>Lewiston High School, <sup>6</sup>NASA Idaho Space Grant Consortium, <sup>7</sup>Idaho State University.

**Introduction:** The FINESSE (Field Investigations to Enable Solar System Science and Exploration) team of NASA’s Solar System Exploration Research Virtual Institute (SSERVI) is focused on a science and exploration field-based research program aimed at generating strategic knowledge in preparation for the human and robotic exploration of the Moon, Near Earth Asteroids, and the moons of Mars. The FINESSE science program is infused with leading edge exploration concepts since “science enables exploration and exploration enables science.”

The FINESSE education and public outreach program leverages the team’s field investigations and educational partnerships to share the excitement of lunar, Near Earth Asteroid, and martian moon science and exploration locally, nationally, and internationally. The FINESSE education plan is in line with all of NASA’s Science Mission Directorate science education objectives, particularly to enable STEM (science, technology, engineering, and mathematics) education and leverage efforts through partnerships [1].

**FINESSE Spaceward Bound:** The FINESSE Spaceward Bound program engages teachers in authentic science research experiences on field excursions with NASA scientists. It is part of NASA Spaceward Bound: a program designed to train the next generation of science explorers by including students and teachers as participants in exploration of scientifically interesting but remote and extreme environments on Earth as analogs for human exploration of the Moon and beyond. NASA Spaceward Bound has offered immersive field experience opportunities to students and teachers worldwide since 2006 [e.g. 2].

Through a partnership with the Idaho Space Grant Consortium, we bring students and teachers into the field to conduct science and exploration research in Craters of the Moon National Monument and Preserve with the FINESSE science team. They work side-by-side with NASA researchers, hiking with them through lava flows, operating field instruments, collecting data, and participating in science discussions. Before the field experience, teachers meet with the science team to learn about the science questions the team is investigating and that the teachers will help address in the field. The teachers are also briefed on the physical rigors of fieldwork and what they should do/bring to

prepare and stay safe. Once teachers return to the classroom, they share their experiences and enhanced science content/process knowledge with their students and can continue to deepen their understanding of and stay current on FINESSE/NASA planetary science research and exploration, with support from educational activities and resources we recommend, opportunities we suggest for continued engagement (e.g. International Observe the Moon Night), and sustained contact with the FINESSE team, including Skype visits from scientists to classrooms.

This immersive hands-on approach to educating educators provides training, insight, and a comprehensive knowledge of fieldwork and research investigating volcanism as it relates to solar system exploration.



Figure 1. FINESSE scientist Scott Hughes explaining geology concepts in the field with elementary school teacher Deirdre Bingaman.

**Teacher Involvement in Field Activities:** The Spaceward Bound teachers were engaged in all aspects of the FINESSE field campaign. Throughout the expedition, the teachers rotated through different sub teams in order to gain exposure and experience with various facets of the geology research. For example, teachers assisted with sample collection and learned and implemented the FINESSE sampling protocol for geologic samples. Teachers assisted with differential global positioning system (dGPS) data collection and thereby learned to collect high-resolution topographic data from a lava field. Teachers also were trained and used various hand-held field portable instruments including

an FTIR (Fourier transform infrared) spectrometer and Terra XRD (X-ray powder diffraction) instrument. Teachers assisted with LiDAR (Light Detection and Ranging) scanning of lava surfaces, and participated in scouting and site selection activities. The teachers even participated in the FINESSE Media Day, being interviewed by various media outlets and sharing the excitement of their research with visitors to the park.

**2015 Program:** Five K–12 teachers participated in FINESSE Spaceward Bound in 2015 (alongside 31 scientists), including one out of the two alumni from 2014. Feedback from both the scientists and the teachers who participated in this program was overwhelmingly positive. Example comments from the science team include: “It was awesome”; “The teachers were phenomenal”; “All five teachers were excellent: energetic, interested, and helpful. They became integrated in the team.”

Teacher surveys from immediately after the field experience indicate that all of the teachers planned to share what they learned with their students. Every teacher who participated in the 2015 program wants to return.



Figure 2. Educator Tiffany Sheely collects rock samples at Craters of the Moon National Monument and Preserve, August 2015.

**Samples of Detailed Teacher Feedback and Reach:** Jeff Karlin, a FINESSE Spaceward Bound participant in 2014 and 2015 and a science teacher recognized by Idaho in 2015 as one of the top four instructors in the state, reports: “I have been a part of NASA education programs for the last 6 years. Spaceward Bound placed me in active planetary field science studies sidelong with the scientists that ultimately publish the work. Watching active scientific process has been exhilarating. As an educator embed, I learn the science being done, confer upon the data with the scientists, and ultimately bring these experiences, concepts, and scientific techniques back to my students. I

would say that my association with Spaceward Bound has helped to transform my classroom into a haven for STEM education.”

Upon completion of the August 2015 FINESSE Spaceward Bound program, Tiffany Sheely, Education Director of Palouse Discovery Science Center (PDSC), developed curriculum and programming to be used in informal science education impacting over 20,000 elementary students, teachers, families, college students, and community members throughout Northern Idaho and Eastern Washington. This curriculum was inspired by and comprised of information gathered on geochemical analysis, dGPS, and spectroscopy through FINESSE fieldwork. The curriculum included materials intended to disseminate information about NASA FINESSE research to the public in conjunction with PDSC field trips, daily lessons, Family Science Saturdays, Astronomy Day events, and Science Pub events held at local breweries. Additionally, Sheely also developed presentations for teachers to utilize in educating students about Science, Technology, Engineering, and Mathematics (STEM) careers.

**Inclusion of a high school student:** The 2015 FINESSE deployment also featured the inclusion of Chanel Vidal, a 15 year old high school student. She embedded with the teachers and scientists in the field, participating in all of the same activities. Chanel has written about her experiences for her high school newspaper, kept a photojournal of her field work, and has begun work on blogs and video entries about FINESSE, helping us to reach more students. She writes, “There is so much more to science than completing a lab and learning a lesson from it. The mixture of science and the optimistic, fun attitude of every person there made the field deployment into the two best weeks ever.”

**Next Steps:** Detailed evaluation of the 2015 FINESSE Spaceward Bound program is underway. We will present evaluation results indicating the impact participating in FINESSE Spaceward Bound had on all five 2015 teacher participants, and how their participation further impacted their students, colleagues, administrators, and communities. We will also present feedback from FINESSE science team. Teacher and scientist recommendations will inform preparations for FINESSE Spaceward Bound 2016.

**Additional Information:** For additional information about the FINESSE Spaceward Bound program, visit: <http://spacescience.arc.nasa.gov/finesse/outreach/>

**References:** [1] NASA SMD Science Education CAN (2015) Solicitation: NNH15ZDA002J. [2] McKay C. P. et al. (2007) *LEAG Workshop on Enabling Exploration*, 3028.