

**Summary of the Student Collaboration for the Icebreaker Discovery 2015 Proposal.** H.D. Smith. <sup>1</sup>, C.P. McKay and the Icebreaker Proposal Team, <sup>1</sup>Space Science and Astrobiology Division, NASA Ames Research Center, Moffett Field, Ca. Corresponding Authors E-mail: Heather.D.Smith@NASA.gov.

**Introduction:** In this presentation we describe the student activities proposed for the Icebreaker mission and opportunities for involvement should the mission be selected. The Icebreaker Mission utilizes the student collaboration incentive to train the next generation of explorers during phases B-E of the mission. We provide hands-on experience at every level of the mission process. We describe the following student collaboration activities below to be completed within the 1% (4.0 to 4.6 Million) SMD allocated budgeted incentive.

Eligibility: All activities listed are open to students at any level (high school, undergraduate, graduate) or teams of students who are students at the time of the Phase 2 proposal submission at a U.S. institution or consortium of institutions.

1. Supplemental Mission: Our launch vehicle faring (Atlas V, Delta IV, or Falcon 9) has enough mass and volume to accommodate a hitchhiker payload of roughly 150 kg mass. This additional space will be filled with a cubesat sized Icebreaker piggyback mission competed, led, built, and operated by students. This activity will take up the majority of the student collaboration budget (3.65M of the 4.6 M) and will have a 4 year mission development process similar to the Icebreaker mission. We envisage that most designs will be for CubeSats that are deployed in Earth orbit. However we will encourage CubeSat concepts that can ride along-side Icebreaker on the Earth-Mars trajectory. Low-level requirements for power and data can be handled by the Icebreaker cruise phase. There is no option for carrying any CubeSats to the surface of Mars.

Implementation of the Supplemental Mission:

The student led payload will be competitively selected by a panel comprised of members of the Icebreaker Science Team and the Technical Advisor Group in coordination with NASA HQ PSD and Education Office, the Discovery Program Office, the Executive Council, and the Standing Review Board when requested. Table 1 shows the Supplemental Mission schedule beginning with Icebreaker Phase B (August 2016) until the launch date (July 2020), also listed is the 10% schedule margin and the 20% cost margin, bold items indicate a cost associated with the activity. Resources will be provided to each team for the Phase II proposal development.

2. Student Research and mentoring Program: This program will be an opportunity to participate in research with a Co-I. Opportunities will include both science and non-science rolls. Research opportunities will include a list of science enhancement activities that can be completed by students, are useful data, but not critical to the mission. Our main science enhancement opportunity is to determine the water abundance in the soil using the imaging system. Our camera has the capability to determine water soil abundance, while this data is interesting it is not a bio-molecular measurement, which is the science goal of this mission. Other science en-

hancement opportunities identified by each the Co-I's will also be listed for competition. Non-science students will learn an aspect of the Icebreaker mission and from a team member by shadowing the "mentor" for a particular phase of the mission. We will use the NASA One Stop Shop Initiative (OSSSI) ([intern.nasa.gov](http://intern.nasa.gov)) for the applicant pool. Students from minority institutions will be encouraged to apply for these science research and mentoring opportunities.

3. University Rover Permafrost Challenge: This is an annual science and engineering robotic competition, analogous to the current University Rover Challenge, operated in the heat and wind of the Moab Desert. The Permafrost challenge will provide students with the engineering challenges of working in the cold with the tasks specifically tailored to tackle an Icebreaker science question.

4. ICE School: An ICE school is an elementary and middle school selected to participate in the Icebreaker Mission. These classrooms will have the opportunity to operate the drill and instruments remotely during the development phase (B-D). Schools targeted for this are rural America and other underrepresented populations.

Student Activity	Mission Phase	Target Audience
Supplemental Mission	Phases B-E	Undergraduate, Graduate, and H.S.
Science Research and Mentor program.	Phases B- E	Undergraduate, Graduate, High School
University Permafrost Rover Challenge	Phases B-E	Undergraduate and graduate students
ICE Schools	Phases B-D	Middle and high school classrooms in Rural America
Student Collaboration Margin (~10%)	Phases B-E	
Total ISC	Phases B-E	