

Spaceward Bound India 2016: Education and Outreach Activities on the first International Astrobiology Expedition to the Himalayas. S. Pandey^{1,5}, R. Mogul^{2,5}, R. Bonaccorsi^{3,4,5}, J. G. Blank^{3,5}, A. Phelps⁶, S. Som^{3,5} and the team of SB India 2016⁷ ¹Director, Mars Society Australia 43 Michell St, Monash Australia (sidd@bmsis.org), ²California State Polytechnic University, Pomona, CA 91768, USA ³Space Sciences Division, NASA Ames Research Center, Moffett Field, CA USA, ⁴SETI Institute- 189 Bernardo Avenue, Mountain View, CA USA, ⁵Blue Marble Space Institute of Science, 1001 4th Ave, Suite 3201, Seattle, WA USA ⁶Quality International School, Baku, Azerbaijan ⁷(<http://spacewardbound.astrobiologyindia.in/participants/>)

Introduction: We recently conducted the first formal astrobiology expedition in research and education in India. Our diverse, international team of scientists and educators explored the high altitude region of Ladakh, in the Indian Himalayas, with the broad goals of (A) recommending Ladakh as a site of astrobiological significance to the global community, (B) developing a framework for hands-on science learning programs in village-based and nomadic small primary schools in India, and (C) establishing similar expeditions as a reoccurring program for Indian scientists and students.

Expedition Plan: Spaceward Bound India (SBI) is a part of the NASA Ames Research Center's Spaceward Bound program, which brings teachers and astrobiology discipline scientists together in planetary analog field settings. Given the success of prior Spaceward Bound expeditions, we organized an international team of 31 scientists, faculty, teachers, and graduate students from India, Australia, Sweden, Spain, Italy, and the US. Given the nascent nature of astrobiology research and education in India, our expedition served as an exploratory mission focused on the potential for integrating hypothesis-driven research with the education of primary school students within the Indian educational system. The program, packed with both research and education work, involved field and evening discussions and hands-on activities that helped connect students, teachers, and educators to work together in astrobiologically relevant remote extreme environments in the region.

Ladakh: Ladakh is located in the eastern region of the state Jammu and Kashmir in northern India, situated on the Tibetan plateau in the Himalaya, and intrinsically related to Tibetan geography and culture. The Ladakh terrain encompasses very high altitude (3500-5700 m above sea level) astrobiologically relevant environments like cold arid regions, alkaline hot springs, circumneutral springs, dune ponds, glacial sediments, and permafrost regions. These geographically diverse terrains are all technically accessible *via* 1-3 day excursions from the city of Leh. Interspersed between these extreme environments are primary schools that serve local villages, nomadic families from all regions of Ladakh. Accordingly, the expedition purposefully in-

cluded both excursions to the described extreme sites and focused visits to 4 schools.

Education Outcomes: We interacted with students aged 5-17, in groups averaging 20-50, from 4 differing schools in the cities of Leh, Panamik, Puga, and Rengdum. During these visits, our activities included constructing and launching paper rockets, space talks, Mars videos, and discovery exercises using magnifying lenses and compasses. Local teachers were incredibly welcoming and passionate about obtaining new ideas and materials for hands-on learning exercises. Additionally, students were excited to learn, especially about Mars and space-related subjects. From our observations, most students were able to follow the broad concepts despite the domestic and international language barriers. All of the schools we visited were lacking in basic stationery and resources. Hence, sustainable and straightforward hands-on projects would have the highest impact in these remote regions. Our observations and future plans will be discussed.



Figure 1: Dr Wing of Sir Francis Drake High School (CA USA) teaching students about life under translucent rocks in arid regions (hypoliths).



Figure 2: Ladakhi school boy inspecting his paper rocket prior to launch.

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