

# LESSONS-LEARNED FROM THE MARS STUDENT IMAGING PROJECT: ELEMENTS FOR SUCCESS IN CREATING AN AUTHENTIC RESEARCH EXPERIENCE FOR K-12 STUDENTS

S. L. Klug Boonstra<sup>1</sup>, P. R. Christensen<sup>1</sup>, J. L. Swann<sup>1</sup>, L. Manfredi<sup>1</sup>, J. A. Zippay<sup>1</sup>

<sup>1</sup> Arizona State University Mars Space Flight Facility, 201 E. Orange Mall, Moeur Bldg. Rm. 131, Box 876305, Tempe, AZ 85287-6305, sklug@asu

**Background:** The Mars Student Imaging Project (MSIP) began in 2002 and uses the Thermal Emission Imaging System (THEMIS) camera onboard the Mars Odyssey spacecraft.

To date, nearly 40,000 students have participated in MSIP. With a focus on Mars, which appeals to many students, MSIP is an immersive and transformational way (1, 2) for students in grades 5 through early college to learn the scientific process through authentic research experiences (3).

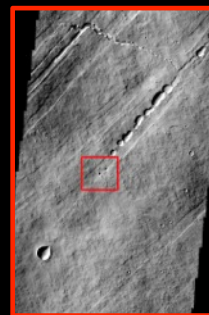
MSIP is inquiry-based and student-centered, which means that students create and investigate their own research question about the martian surface. This project engages them in the real process of science, replacing traditional worksheets with the collection and analysis of actual data from their own, targeted image of Mars. Students learn the scientific process by *being the scientist!*



Students practicing 21<sup>st</sup> Century Skills during the Mars Imaging Analysis activity



7<sup>th</sup> Graders Discover Cave on Mars



## Lessons-Learned for Authentic Research in K-12 Classrooms:

### For Teachers:

- Lesson goals and instructional objectives need to be mapped to learning outcomes to meet stakeholders' needs;
- Materials must be strongly aligned to curriculum standards;
- Implementation Guide a must! (Time commitment and pacing guide, what resources (e.g., consumables, technology access are needed, assessment rubrics, etc.);
- Materials must be scaffolded to provide teachers needed background information that is easy to understand;
- Just-in-time training available to teachers to build their self-efficacy;
- Curriculum design needs to be iterative and data driven to respond to audience needs and user feedback determined through rigorous evaluation.

### For Students:

- Lesson materials must be scaffolded to help build student understanding;
- Project data is easily accessible and easy to use;
- Students are the essential workers – define own questions and conduct own research



<http://marsed.asu.edu/msip>

### References:

1. S. R. Singer, M. L. Hilton, H. A. Schweingruber, Eds., America's Lab Report: Investigations in High School Science (National Research Council, National Academies Press, Washington, DC, 2006).
2. R. W. Bybee et al., The BSCS 5e Instructional Model: Origins and Effectiveness (Biological Sciences Curriculum Study, Colorado Springs, CO, 2006).
3. R. W. Bybee et al., The BSCS 5e instructional model and 21st century skills (National Academies of Science, Washington, DC, 2009); [www7.nationalacademies.org/bose1Bybee\\_21st%20Century\\_Paper.pdf](http://www7.nationalacademies.org/bose1Bybee_21st%20Century_Paper.pdf).