BURIED WATER ICE ON MARS: MARS ODYSSEY DATA-DRIVEN LESSONS. S. R. Buxner[1], J. M. Keller[2], H. L. Enos[1], and W. V. Boynton[1], [1]Lunar and Planetary Laboratory (Univ. Arizona, Tucson, AZ 85721, sanlyn@lpl.arizona.edu), [2]Physics Department, Cal Poly San Luis Obsipo (SLO, CA 93407, jmkeller@calpoly.edu).

Introduction: In 2001, the 2001 Mars Odyssey spacecraft discovered significant amounts of water ice buried in the high latitude regions of Mars. This exciting discovery was based upon data from the Mars Gamma Ray Spectrometer and has been a primary motivation for the development of the Mars Phoenix Lander, which plans to land in the northern high latitudes of Mars in 2008 and investigate this buried water ice.

The Mars Gamma Ray Spectrometer science team has worked with a diverse group of educators to develop five classroom activities related to this exciting discovery. These field-tested activities involve both guided and open inquiry activities using real data from Mars to investigate and learn about processes occurring on the planet. The activities address items found in all seven of the National Science Education Content Standards.

The lessons are targeted towards middle and high school students enrolled in earth and physical science classes. Each of the lessons has been developed as a stand alone activity, although it is also possible to sequence these activities into a unit regarding water ice on Mars. Each lesson includes a teacher guide, student guide, and multimedia presentation(s).

Description of Lessons:

Why Follow the Water. A key component of NASA's Mars Exploration Program is to "Follow the Water" to better understand the geology, climate, and potential for life on the planet. Students investigate several physical properties of liquid water to better understand why we think water is important for life. An extension activity investigates the connection between liquid water and plant productivity on Earth. This lesson is targeted at grade levels 6–10 for Life Science, Physical Science and Earth Science classes.

Remote Sensing Ices on Mars. Students analyze data collected by Mars spacecraft using three different energies of light – visible light, infrared light, and gamma rays – to investigate the composition and distribution of ices at the high latitude regions of Mars. This Socratic-Dialogue Inducing activity guides students to understand that seasonal carbon dioxide ice covers buried water ice during the winter season and that the permanent ice caps in the northern and southern hemispheres are made of different types of ice. In an extension activity, students use the "Online Gamma Ray Production Simulator" to understand how gamma rays can be used to determine the composition of the Martian surface. The "Online Gamma Ray Production Simulator" is an interactive online tool that lets students investigate how gamma rays and neutrons are produced on the Martian surface, how these particles can be used to determine the elemental composition of a surface, and the detection of gamma rays by the Mars Odyssey spacecraft. A selection of soil samples allows students to see variation in elemental composition and discuss the importance of integrating spectra over a number of orbits. This lesson is targeted at grade levels 8–10 for Earth Science and Physical Science classes.

Dirty Ice or Icy Dirt. Large amounts of water ice appear to be buried at high latitudes on Mars. In this activity, students make physical models using Earth samples to investigate whether it is more likely that these regions of Mars are composed of icy dirt (with ice filling the pore space of soils) or dirty ice (with dust sprinkled through a mostly icy surface). This lesson is targeted at grade levels 6-10 for Earth Science and Physical Science classes.

Mars Exploration Debate. Students are challenged to conduct research regarding the future of Mars exploration. They then conduct a student debate in which they discuss the future ways we might explore Mars and benefits and challenges associated with Mars exploration. This lesson is targeted for grades 6-10 for Earth Science and Physical Science classes.

Mars Image Analysis Extension Activity. The 2001 Mars Odyssey spacecraft carries two primary instruments, the Thermal Emission Imaging System (THEMIS) and the Mars Gamma Ray Spectrometer (GRS). This extension activity provides data regarding the global distribution of hydrogen on Mars determined by GRS to complement an image analysis activity developed around images collected by THEMIS [1]. This lesson is targeted for grade levels 6-10 for Earth Science and Physical Science classes.

Field Testing: Curriculum has been evaluated by mission scientists for content and field tested by E/PO staff and external evaluators in classrooms, teacher workshops, and summer camps.

Lessons and "Online Gamma Ray Production Simulator" will be on display and distributed on CD.

References: [1] http://msip.asu.edu/

Additional Information: Individuals interested in the GRS outreach products are encouraged to contact the E/PO Team at the following address:
Sanlyn Buxner <sanlyn@lpl.arizona.edu>
Lesson and information about GRS can be accessed on our website at: http://grs.lpl.arizona.edu/