Mars GRS Formal and Informal Educational Products. 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: The Mars Odyssey GRS (Gamma Ray Spectrometer) Education and Public Outreach (E/PO) team has developed a set of educational products that support the mission goals of teaching about Mars globally and introducing fundamental physics concepts related to gamma ray production and detection. Additionally, GRS educational products are designed to leverage on existing NASA and mission products to help communicate a complete picture of Martian exploration and an understanding of water on Mars. Educational products include: a set of lessons that are useful in formal classrooms, teacher workshops, and camp settings, hands-on activities useful for ice-breakers and engaging the public during short intervals, and online products specific to mission science. These products have been field tested in both formal and informal settings and will be demonstrated and distributed during this session.

Description of E/PO Products:

Curriculum. The curriculum includes a set of five lessons appropriate for middle and high school that guide students through inquiry based exploration and include hands-on investigations, data collection and analysis, evaluation of results, community reporting, and debate. The lessons are: "Why Follow the Water" in which students consider some of reasons why water is important for life on Earth and may be important for life on Mars, "Remote Sensing Ices on Mars" in which students use the online gamma ray simulator to explore how scientists use remote sensing to gain evidence about the physical composition of Mars and use actual optical, infrared, and gamma ray data to come to conclusions about the composition of the high latitude regions of Mars, "Dirty Ice or Icy Dirt" in which students create physical models to assess whether the near-surface water ice detected by GRS in Martian polar regions is more like dirty ice or icy dirt, "Mars Image Analysis Extension" in which students use GRS data in the form of water maps to add to their understanding of the Martian surface geology gained by looking at images taken by THEMIS building on MSIP activities [1], and "Mars Exploration Debate" in which students debate whether the future of Mars exploration should be continued with robotic missions and/or human missions.

Each lesson contains background material on science content, materials needed, how the lesson aligns with National Science Education Standards, and suggestions for implementation. Additionally, student worksheets and PowerPoint presentations are included to help deliver content in the classroom. All documents are in fully editable forms so that teachers can change them to meet their needs.

Informal Hands-On Activities. "Dirty Snow Cones" is an engaging activity used to discuss GRS water maps with the public in a relatively short amount of time. Additionally, frozen soil samples help communicate a tangible nature of frozen water on Mars and works well as a talking point for discussing frozen water on Mars. These activities have been used very successfully in public booth settings and are helpful in drawing people in to talking about Mars. These activities will be demonstrated and directions for implementation and talking points will be available.

Online Products. "Sonification of Gamma Ray Production on Mars" is a web animation that is a musical composition created from actual Mars GRS data. Currently users can listen to "false-pitch" and "false-color" gamma ray and neutron data collected from ten latitude regions through part of a Martian year. Users are able to both see and hear seasonal variations of the hydrogen signal detected by the GRS instrument to help them gain a better understanding of the distribution of water ice on the Martian surface as well as seasonal variations in the carbon dioxide ice polar caps which mask the hydrogen signal. [2] The "Online Gamma Ray Production Simulator" is an interactive online tool that lets users investigate different methods of gamma ray formation and includes a self-guided evaluation. The simulation demonstrates 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 users to see variation in elemental composition and discuss the importance of integrating spectra over a number of orbits to build up sufficient detection statistics.

Field Testing: Curriculum has been evaluated by mission scientists for content and field tested by E/PO staff in classrooms, teacher workshops, and summer camps. The online Sonification of Gamma Ray Production has been tested with university students for its effectiveness in helping students better understand the elemental composition of Mars [3]. It was found that the auditory display was helpful in conjunction with the physical display in helping students gain a better

understanding of the chemical composition of the Martian surface.

All products, including interactive web programs will be on display, demonstrated (if appropriate) and distributed on CD.

References:

[1] http://msip.asu.edu/ [2] Keller et al. (2003) LPSC XXXIV. [3] Keller et al. (2003) Intl Conf on Auditory Displays.

Additional Information: Individuals interested in the GRS outreach products are encouraged to contact the E/PO Team at the following address:

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All products and information about GRS can be accessed on our website at:
http://grs.lpl.arizona.edu/