Mars GRS Curriculum Materials Educational Products. S. R. BuxnerP[1,] J. M. Keller[1], H. L. Enos[1], and W. V. Boynton[1], [1]Lunar and Planetary Laboratory, Univ. Arizona, Tucson, AZ 85721 (sbuxner@as.arizona.edu) .

Introduction: The Mars Odyssey GRS (Gamma Ray Spectrometer) team has developed three main components as part of its overall Education and Public Outreach efforts. The GRS E/PO goals involve both teaching about Mars globally and introducing fundamental physics concepts related to gamma ray production and detection. These products include six curriculum activities that have been field tested in both formal and informal settings and two interactive web educational products that we will demonstrate during this session.

Description of E/PO Products:

Curriculum. Six lessons have been developed to help students explore Mars using inquiry based learning, hands-on investigations, data collection and analysis, community reporting, and scientific debate. These six lessons include: 1) "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 2) "Introduction to Remote Sensing" in which students explore how scientists use remote sensing and direct sensing to gain evidence about the physical composition of planets 3) "Ices at the Martian Poles" in which students investigate how scientists use remote sensing data to draw conclusions about the physical composition of a planet. 4) 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, icy dirt, or something else 5) "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 and 6) "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 for the teacher on science content, materials needed, how the lesson aligns with National Science Education Standards, and implementation of the lesson as well as student worksheets.

Sonification of Gamma Ray Production on Mars. The sonification web animation 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. [1]

Online Gamma Ray Production Simulation. The Gamma Ray 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 and how these particles can be used to determine the elemental composition of a surface and also the importance of integrating spectra over a number of orbits to build up sufficient detection statistics.

Evaluation of Educational Products: The curriculum has been evaluated by mission scientists for content, as well as students and teachers for clarity, effectiveness of content, and grade level appropriateness. Formal teacher evaluation of the curriculum revealed that 70% of the teachers felt that all six lessons fit into their existing curriculum and over 90% felt that at least half of the lessons would fit into their existing curriculum. Feedback from both formal third party evaluation and informal testing in classroom and camp settings has been used to revise the lessons.

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 [2]. 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.

Samples of the curriculum and both online tools will be present to explore during this session.

References:

[1] Keller et al. (2003) LPSC XXXIV. [2] 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 addresses:

Sanlyn Buxner <sbuxner@as.arizona.edu>

John Keller <jkeller@as.arizona.edu>

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