**MARS CURRICULUM FOR K-12 SCIENCE EDUCATION, 2ND EDITION, *MAKING TRACKS ON MARS TEACHER RESOURCE AND ACTIVITY GUIDE***

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**Introduction:** Planetary missions provide a natural link and a ready-made audience for successful science education. Although all missions are exciting, rover missions in particular generate special interest among teachers, students and the general public. A curriculum that was first developed to accompany Museum exhibit and educational activities based on the Mars Exploration Rover Mission has now been adapted to be equally valuable in using the upcoming Mars Science Laboratory mission to teach students.


The curriculum has been approved for distribution by the NASA educational materials adoption review and is now 508 compliant to ensure accessibility for people with disabilities.

Mars has been a focus of innumerable science fiction stories and an object of scientific interest since the beginning of the space age. With the amazing science returned from exploration missions such as Mars Exploration Rover, Phoenix, Mars Global Surveyor, Mars Odessey, Mars Reconnaisance Orbiter and Mars Express, students' interest in Mars can be used as a "hook" to teach a wide range of topics. Mars Science Laboratory, due to arrive at Mars later this year, will be an opportunity to use a newsworthy event and an exciting mission to reach students of all ages.

Mars-related science and Mars missions were used as the basis of this curriculum, created by the New Mexico Museum of Natural History and Science (NMMNHS) and classroom educators, that includes all of the sciences, mathematics, social studies (history and exploration), science and society, career readiness, language and literacy, and visual arts. The curriculum was initially developed during the 2004-2006 time period [1] when a MER exhibit was also created by the Museum; and the 1st edition curriculum was tested extensively in both formal and informal education settings. Now this curriculum has been taken to the next step to be a stand-alone curriculum with a long and useful life regardless of ongoing or active missions.

**The Museum-Mars Connection:** The New Mexico Museum of Natural History and Science is a statewide institution, part of the New Mexico Department of Cultural Affairs, and serves a regional population that includes 38% Hispanic and 9% Native American, as well as a high percentage of rural communities, and therefore reaches an audience traditionally underrepresented in science. Because of this museum's direct connection to the extremely successful MER mission through a Museum Curator who is a science team member of MER, we were able to act as the local source in New Mexico for information about the mission and about Mars. We provided a complete range of MER-related outreach and educational programs targeted to K-12 teachers, students, family-learning, and the general public. Many of the Mars public events were "standing-room only," the *Making Tracks on Mars* exhibit has been viewed by 200,000 visitors per year, and Mars-themed educational programming has reached an additional 2000-4000 participants each year. The Mars exhibit, with full-scale, detailed replica of the Spirit/Opportunity rover, and other elements created and produced in-house, has been so popular and successful that it is now part of a larger long-term exhibit entitled "Space Frontiers: New Mexico's Place in the Exploration of Space."

**For Teachers:** One of the results of this educational programming is a permanent educational product: a complete teachers' guide and curriculum entitled "Making Tracks on Mars: Teacher Resource and Activity Guide."

This Guide is now available in a 2nd edition, 508 compliant version on DVD and is designed for classroom and science teachers, home school parents, and informal science educators working with museums or

after-school programs. For teachers of all grades, it includes content information and 20 new or adapted hands-on activities for students. Because many teachers know little about our ever-increasing current knowledge of Mars, the Guide includes basic information about the physical properties of Mars surface, and atmosphere. Because many teachers may not know the difference between flyby, orbiter, lander, and rover missions, and why or how landing sites are chosen, the Guide includes information about past, current and future missions to Mars. One section includes the basic information about the MER and MSL missions written by our local New Mexico scientists. Because many teachers may not know how or where to acquire Mars images, or what those images show, the DVD includes two annotated powerpoint presentations. Because many teachers may not know that there are other local or regional resources for Mars and mission information, an appendix is included that lists web sites, other educational products, and field trip locales.

**For Students:** The "Making Tracks on Mars Teacher Resource and Activity Guide" is designed to enable teachers to use their students' interest in Mars as a "hook" to teach a wide variety of science topics. While the activities and material directly relate to Mars, and students will certainly learn about Mars, the activities themselves cross the curriculum and can be used to address many different content standards in science, and also incorporate National [2] and State of New Mexico standards and benchmarks in areas such as earth and space science, scientific inquiry, science and society, technological design, history and nature of science, language arts, fine arts, mathematics, social studies (history), and career readiness. Every activity in the Guide has been tested either in family or student workshops at the museum or by teachers in the classroom. Relevant National and New Mexico educational standards are listed for each activity.

The information and activities in the Guide are predominantly targeted toward grade levels 3-9; however, many of the activities can be adapted for the complete range of K-12 grade levels; information on this is included in each activity. The activities are designed for team or group learning by students. Groups of activities relating to a specific theme could accompany a thematic unit on a specific topic; suggestions are included in the relevant activities. Many of the activities could also be used for a family-day or science club-type learning experience, for example during an open house at a university or research facility, outside of the traditional formal classroom.

While many of the activities are new, some have been adapted from the excellent NASA and ASU Mars Education Office resources available, and are referenced as such. Because place-based links to science have been shown to be extremely effective, especially with Native American students [3], the Guide makes use of comparisons between Mars and New Mexico whenever possible; however, the activities in the Guide are adaptable to any region and can be used nationwide. Preliminary or 1st Edition versions of the curriculum have been used by teachers in New Mexico, Texas, Virginia, Louisiana, Florida, and Bermuda. With the new 508 compliant version, the curriculum is now ready for national distribution and inclusion in any Mars-related workshop offered to teachers, students, or families. The Museum has been honored to partner with the ASU Mars Education Office to offer teacher workshops that include activities from the Guide, and give teachers the tools they need to effectively teach science. [4].

**References:**

[1] Aubele, et al, 2006, LPSC37; [2] National Research Council (1986) *National Science Education Standards.* [3] Semken, S. (2005) Sense of place and place-based introductory geoscience teaching for American Indian and Alaskan Native, *Journal of Geoscience Education 54(3)*. [4] Toson, T. (2000) *School Science and Mathematics 100(7),* 374-379.