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The Marslink Project focuses on the development, dissemination, and evaluation of instructional materials about the composition, structure, and dynamics of the martian atmosphere, surface, and interior. A multi-year effort is underway so that middle and high school students can follow a full martian year of seasonal changes using data from NASA's Mars Observer spacecraft, and the Mars Observer Project has time to process and release the appropriate data sets. Monthly activity packets for students, teacher enhancement sessions, a teacher resource center, an on-call Mars data specialist, daily SPACELINK electronic bulletin board updates, and semi-annual NASA Select TV broadcasts will constitute the basis of the Marslink Project. Marslink would take advantage of: (a) the excitement of keeping abreast of activities within NASA's Mars Observer Mission from 1993 through 1996 and working with data acquired by Mars Observer and Viking spacecraft; (b) science expertise and involvement in the Mars Observer Mission at Washington University; (c) Development Team of middle and high school teachers, and research scientists who would work jointly at their home institutions and at summer writing workshops to construct activity packets; (d) dissemination capabilities associated with The Planetary Society and a number of supporting institutions; and (e) formal evaluations led by James Barufaldi, University of Texas. Monthly packets would be designed using a theme-oriented, hands-on approach for use primarily in earth science, physics, and chemistry courses. Selected material would also be of use in physical sciences and biology courses. Packets, where appropriate, would include comparisons between Mars and Earth. The Marslink Activity Book would be published by the National Science Teachers Association at the end of the project and would include background discussions, instructional materials, and project evaluations.

The nation must increase science and technology literacy among the public and the flow of students into science and engineering careers. Further, new learning methodologies are required and need to be tested. In Marslink the first major objective is to capture student interest in science on a national scale by allowing them to follow the progress of Mars Observer as it explores the red planet. Using activity packets developed as part of Marslink, they will participate in the analyses of data from the spacecraft, share in the excitement and discovery of Mars exploration, and learn basic scientific concepts in the process. Results will be related back to a better understanding of Earth by comparisons of the nature and dynamics of the atmosphere, surface, and interior of the two planets. A second major objective is to use and test the effectiveness of constructivist and theme-based learning methodologies in which students advance from concrete concepts to abstract ideas. The evaluation component of Marslink will test the impact of this learning paradigm on the ability of students to develop and understand scientific concepts from middle to high school level, in addition to probing the extent to which their interest levels have increased.

As shown in Figure 1, Marslink activities will be designed using a specific set of learning paradigms or guidelines. The paradigms are:

1. Constructivist Approach: Numerous studies (and common sense) demonstrate that students learn more efficiently when lessons or exercises build on what they already know [1].
2. Hands-on Learning: Marslink packets will feature exercises that will enable students to be active participants in the learning process as opposed to passive listeners.
3. Concrete to Abstract: Marslink will utilize the National Science Teachers Association Content Core concept [2] that students learn best when they initially encounter concepts, principles, and laws at a concrete level through direct experience. This phase will be followed by activities that present higher levels of abstraction.
4. Theme Oriented: Students learn more efficiently when ideas and concepts are placed in the context of themes [3]. Themes also overcome the encapsulation of information within the traditional scientific disciplines and associated courses. Mars Observer data will be used to address themes in weather, climate, volcanism and tectonism that cut across traditional discipline boundaries while at the same time introducing basic concepts in earth science, physics, and chemistry.
5. Phased Approach: Marslink will use California's recommendation of a three-tiered approach to

learning [4]. The first phase will begin with Scale and Structure, in which students explore sizes, shapes, and characteristics of the martian atmosphere, surface, and interior and comparisons with Earth. The second phase is called Change and Evolution, where variations in characteristics are tracked as a function of time. The third phase is Systems and Interactions and probes underlying physical and chemical processes and how they interact to make systems, e.g., current terrestrial martian climate systems. In fact, analysis of Mars Observer data by the mission science teams will be very much structured along this approach and Marslink activities will be able to "piggy-back" on their research efforts.

References Cited:

[1] Yager R.E. (1991) The Science Teacher, Vol. 58, no. 6, pp. 52-57.

[2] Aldridge B. (1992) Scope, Sequence and coordination of Secondary School Science, Volume 1, The Content Core, a Guide for Curriculum Designers. A Project of the National Science Teachers Association, 152 pp.

[3] Rutherford F.J. and Ahlgren A. (1990) Science for All Americans: A Project 2061 Report on Literacy Goals in Science Mathematics and Technology. Oxford University Press, 240 pp.

[4] Sachse T. (1990) Science Framework for California Public Schools: Kindergarten through Grade Twelve. California Dept. of Education, Sacramento, pp. 28-36.

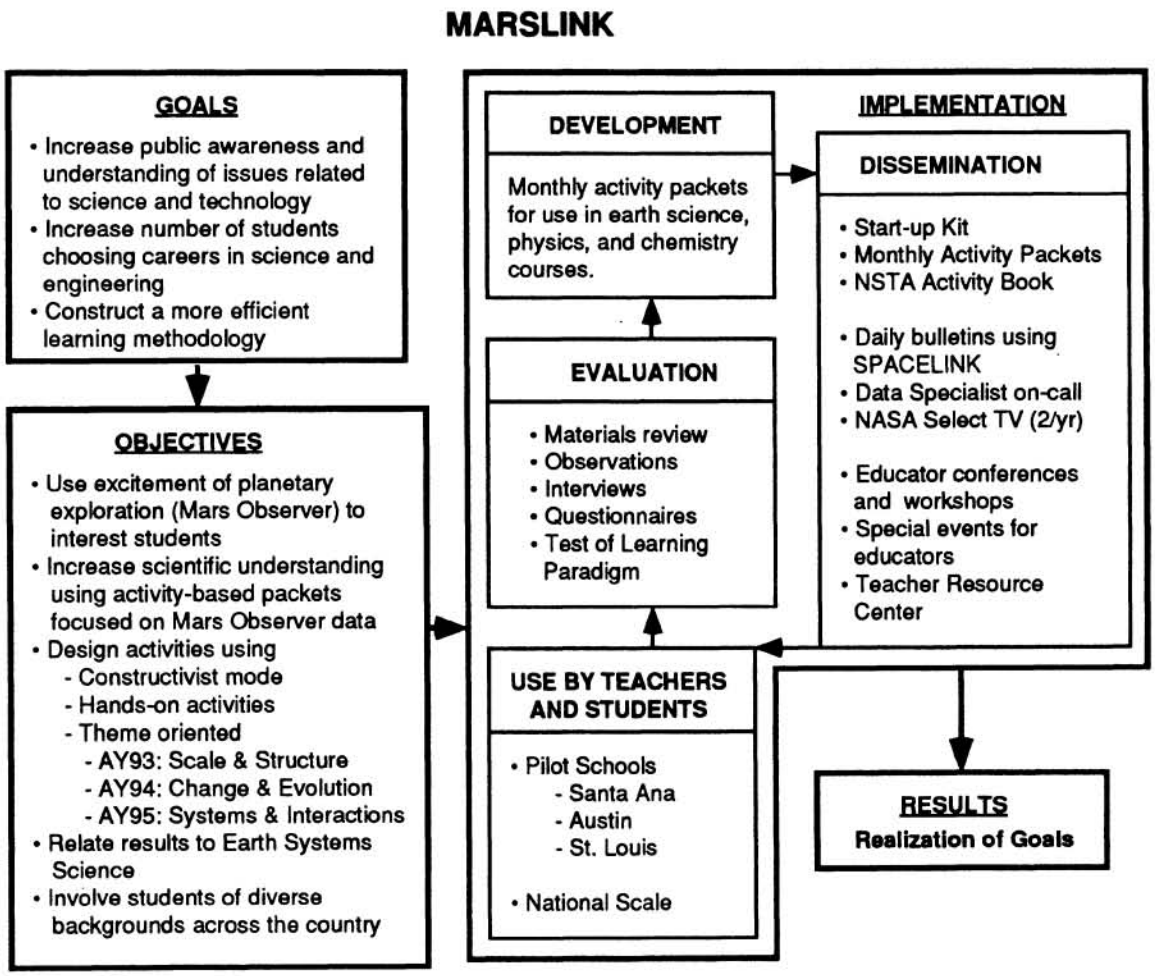

Figure 1 - Flow chart illustrating goals, objectives, and implementation of Marslink.