# TEACHING FROM MARS

**Gabriel F. Rshaid**

**Mars Academy Coordinator (http://www.marsacademy.com). E-mail: grshaid@marsacademy.com.**

A few months ago I attended an educational pre-conference that took place before a NASA workshop. One of the sessions dealt with how to organize teacher workshops and implement successful space related educational activities. Although some of the points were well made (activities had to be complete, easily integrated, enjoyable, involving experimentation, everybody likes quality handouts and classroom posters, etc.) I was somewhat shocked to see explicitly listed in the presentation some of the general principles that I had managed to detect in space education during my many years of browsing through educational brochures and guides. "Successful" activities should take no longer than one or two class periods, be low cost and easy to set up, and definitely not include homework, technical details about missions and spacecraft, or involve multi-week curricula. They should be designed bearing in mind that teachers have a weak math background and in some cases math phobia altogether, possess few computer skills, cannot assimilate too much science too fast, are easily lost by technical jargon and have no research experience.

Beyond the mere anecdote of this workshop, and understanding that any generalization is intrinsically unfair, after working in space education for more than five years, participating in several conferences and being in contact with many teachers that have introduced space in the classroom, I have to admit that the great majority of space related educational activities are designed with these principles in mind. With some exceptions, most space education projects target elementary and middle school students and can easily be implemented by the kind of teacher described above.

Hold on. I am not here to defend teachers or challenge the above profile of an average teacher. Like in any other profession, there are good, mediocre and bad teachers, and it would certainly be hard for me to tell whether the majority of them respond to those characteristics. And I do not deny the validity or usefulness of short, easy to set up, understandable activities that can help introduce space in the classroom at the elementary and lower middle school level. But I think we have to ask ourselves what our goal is in trying to introduce space in the classroom. It depends on which way you look at it. From the perspective of a space agency or space corporation, instructing the upcoming generations helps establish a conscience of what space exploration means, and thus ensures sustained support from years to come.

From my own point of view as a teacher, I am not so much interested in space exploration per

se, but in what it does to my students. Through the study of space I want them to see humankind attempting the almost impossible, teaming up to solve the most difficult problems; I want them to witness the adventure and the drama of space exploration, to encourage them to pursue their own challenging careers in the light of the inspiration of our contemporary space pioneers. I like to see them amazed at the complexity and order of the Universe, perplexed at its mysteries, their imagination stretched to the limits.



And it is hard to do that with single lesson "successful" activities that have no Math or computers. Simply because I cannot fool my students: they know that space is just not like that. A successful activity is perhaps not the most popular, the one that every student participates in. In my own quite unauthorized opinion, a successful educational activity is one in which some students are willing to go the extra mile on their own. When you tell them to stay after class or come in during the holidays and they do not complain. When they study seemingly difficult topics from a new perspective without any prompting.

What kind of activities are those? I have found them to be quite the opposite of the prescribed paradigm. Semester long activities, that involve intensive use of computers and other high tech equipment, generally requiring long hours of work and extensive research on the part of both teachers and students. Sometimes they are not even almost zero cost. Just a few examples of such projects are high fidelity mission simulations, design and construction of spacecraft simulators, analysis of real time data from spacecraft, design of space colonies and settlements, interactive Web sites, etc.

Mars Education: the key area in space education today. The choice of topic is also essential to the success of a project. Most space related topics are interesting and attractive to students, but not all of them engage them in the same way and ensure continuity. There are many options available to the educator, starting with current systems (Space Shuttle, International Space Station), and going on into the near foreseeable future (manned Mars exploration, lunar and Martian colonies) or directly to the realm of quasi science fiction (terraforming, giant orbital space settlements, intergalactic travel) Speaking again from my own experience, at this point in time, Mars is the ideal subject of choice.

I have worked extensively in Space Shuttle simulations and, sure enough, the Shuttle is quite a sexy machine and has the undoubted flair of a current transportation system. But after an initial tantalizing effect on students it is difficult to keep them hooked up in follow up activities. Their imagination is not captured by Earth orbit space operations and they know that it is, to say the least, a controversial issue in the space community as to its effectiveness as a spacecraft system and it cannot compare to the deeds of the past (namely the Apollo program). Lunar missions and lunar bases are more attractive, but again to a young mind there is always the stigma of we-did-it-before that somehow undermines their incentive. On the other hand, the almost futuristic projects like orbital space settlements or terraforming are exciting and charming for students in that the lack of technical constraints imposed by the limits of current and foreseeable technology helps materialize the vision that everybody has of a space faring civilization and

makes them more free to dream their projects before designing them. But the drawback of this kind of activity stems from its own virtue. The fact that they will materialize so much ahead in time, probably not even in the lifetime of the students makes them more science fiction than science. Onward to Mars. Manned exploration of the Red Planet is foreseeable, and what we always say never fails to ring a note in their young minds: that they are the Martians, that their generation will be the one to physically make the trip. The road to Mars is challenging enough to compare and even surpass the Apollo days, providing the adventure and drama that is always needed to make the topic exciting, and it is current in that manned missions to Mars are currently being designed. The study of human exploration of Mars is also ideal in that it will remain as the main focus of the space program for decades to come and in that it is not limited in any way. Students can start by designing pioneer missions, then regular transportation systems, Mars colonies, Martian cities and even terraform the planet. So the (pink) sky is the limit.



The Mars Society: teaching from Mars. This convention will give birth to a new and unique organization whose focus is to promote exploration of Mars. A strong Mars education program is, in my opinion, one of the ways in which it can achieve its objectives. At a general level, such an education program should be based on activities that have the following characteristics:

* Officially sponsored programs: Whatever the project or activity, it must be officially sponsored and if possible bear an attractive, self explanatory name that says everything about it. The life cycle of an educational project at the school level, especially if it involves spending money on it, starts with the interested teacher who wants to participate because of the educational value of the project itself. But when the educator needs to ask for administrative support and perhaps even funding, it becomes crucial to be associated with a prestigious space organization. In that way the school administration can in turn justify the support given in terms of the impact on the community of such activities. In many cases, high tech space projects in which local students participate generate favorable media repercussions.

* Internet based projects: It is unnecessary to stress here the fundamental impact that the Internet has had on education. However, it is still difficult to find applications that make full use of the Internet's potential for communication. Internet based collaborative projects where students interact with their peers from all across the world add the excitement of the multicultural environment and mutual enrichment as well as provide an ideal media for research and collaboration. In the coming years, more and more schools will be connected and an increased bandwidth available to share video and audio.

* Provide opportunities for exceptional students and teachers: Although not all activities have to be of a competitive nature, it is always a good incentive, especially for teachers who are the ones to initiate participation in Mars programs at the school level, to recognize exceptional educators and student projects by means of internships, field trips, privately sponsored awards, etc. Again the element of prestige is a powerful driver for administrative support and funding.

* Active participation: It is essential, even if the task involved is somewhat trivial, that the participating schools be active in some way in the project. It makes a world of difference for the students if they feel that even in some minor way they are contributing actively to the task and not just reading or receiving information.

All this is easier to say than to do, but here is a list of suggested activities for such a program, targeted to fill in the mentioned void for this type of projects:

* High fidelity mission simulations: One of the most exciting, fun and challenging activities for students and teachers alike is performing high fidelity mission simulations. There are various ways to do this, either via the use of a specially designed hardware simulator or by running software simulations. The emerging programming tools that enable almost full fledged networked applications over the Internet can help develop an online collaborative mission simulation where students can control a Mars mission and role play astronauts and mission controllers. An example of a similar web based Space Shuttle simulation was developed by the author at *http://www.sptschool.com/sim/pub* and we are currently in the process of designing a Java based simulation of a manned mission to Mars through the Mars Academy *(http://www.Marsacademy.com)*. The use of the Internet for collaborative mission simulations can add to the natural excitement of a role playing adventure by enabling students to interact in real time with their peers from all over the world.



* Mission outreach activities: Another very interesting possibility is the relaying of data directly from spacecraft for analysis by the participating school. This has been done already in the Moonlink program by Space Explorers, Inc. together with NASA Ames Research Center following the progress of Lunar Prospector. On top of performing a 2 hour launch simulation with 13 computers simultaneously connected to the Internet, each of the schools was able to select a 150 km square on the Moon and receive data for all the spacecraft's instruments. For this type of program to be effective, however, comprehensive tutorials and technical support must be readily available for participants to help them sort out a complicated real life problem.

* Assistance from the experts: Many scientists, engineers and other space experts generously volunteer their time to participate in web chats with students and teachers. These chats are invaluable opportunities for students to interact with them and gain insight into high tech careers. But many times, due to the general nature of the chats, the questions and consequently the experts' answers cover the whole range in terms of complexity and it is difficult to extract any content learning from them. It would be much better to organize these interactions within the context of a specific project so that the students and teachers can ask questions directly related to a certain problem or area. Our own experience in this matter has been very positive. During the design stage of our Mars Academy project we held several web chats with experts who helped our students gain insight in, for example, how to adequately formulate the mission goals, choose the landing site or define the number and functions of crewmembers.

* Contests: Prizes (especially if they involve field trips) and prestige are very powerful drivers

for participation. Existing contests, like NSTA's SSIP program and the two ongoing space settlement design competitions have every year an increased number of entries.

* A Mars teacher workshop: There are a good number of teacher training programs in space education but most of them, in order to be open to all levels of teachers with diverse backgrounds are not specific or intensive enough to provide a solid foundation for the kind of projects suggested. An annual one week intensive Mars teacher workshop can be organized to instruct participating educators in Martian geology, spacecraft systems, orbital mechanics and various other related topics. It can also provide them with hands-on experience and even certification for ongoing simulations and other projects as well as printed materials, curriculum guides and direct contact with experts, professionals and fellow teachers interested in Mars education.

The preceding list of activities does not obviously preclude simpler projects of the type described initially targeted at lower grade levels (although most of the above activities can be implemented at any grade level if the teacher is able to scale down the technical content appropriately).

For most of the above proposals an affordable fee should be charged to participants, in order to help the organizing institution cover costs and thus improve quality and service and also to discourage discontinuous participation. Schools are generally able to pay a few hundred dollars for a semester long program and there are always ways in which an educational community can raise funds.

Can we get there?

Mission design papers generally conclude with a succinct feasibility study of the proposal. Although our educational mission will not physically get us anywhere in space, it is nevertheless pertinent to perform a similar analysis in this case. This radical approach to Mars education with a stress on high tech medium and long term activities can undoubtedly be carried out without too much strain taking advantage of emerging technologies, widespread use of the Internet and faster and cheaper communications. In particular, the advent of Java as a cross platform Internet programming language can make possible what only a few years ago was considered little more than science fiction: real time graphical applications that can be executed coherently regardless of operating systems and system architectures. The flaw in the plan is self evident: the majority of the suggested programs involve a great deal of dedication, some technical knowledge and essentially the desire to study on the part of the teacher. This obviously limits participation to educators willing to accept the challenge. But our goal in teaching space is precisely the challenge itself. In the same way as surely almost nobody working in space exploration would be doing so if it were commonplace and routine, I would not be interested in teaching Mars if it was not challenging and difficult. I have said before that the young generations will be the Martians, and that any of them, even my own daughter, might one day be making the trip. However, whether they go or not is not important to me. What I really care about is that through learning Mars they will realize, especially in their teens; at that age when their eagerness and natural curiosity are slowly and subtly eroded by doubts and skepticism; that whenever we set ourselves any goal in life and work hard to achieve it, even if it is as seemingly impossible as traveling to another planet, nothing can stop us from making

our dreams come true. And I do not think we can teach this particular lesson in a short time or without a great deal of effort. It is up to us to communicate this vision and inspire educators to reach out to Mars. It is quite far out, but very much worth the trip because, at least in Education, the road is much more important than the destination.