Using the Web to Bring Space Science and Technology Down to Earth

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At JPL, the World-Wide Web has become an invaluable educational outreach mechanism. In the area of space flight mission operations, for example, we have been able to make publicly accessible two workbooks found to be of much wider interest than their original internal training purposes would have suggested. These electronic documents, by using simple language and illustrations, and focusing on pithy content and good writing style, have met with great success not only in disseminating important scientific and technological concepts to a society pitifully behind the curve in these areas, but also in promoting understanding and enthusiasm for NASA's unmanned space exploration programs.

A MANDATE TO EDUCATE

The National Aeronautics and Space Administration (NASA), for whom the Jet Propulsion Laboratory (JPL) conducts robotic space exploration, is increasingly concerned with its responsibility to keep the taxpaying public informed of its missions and their results, as well as to foster interest and education in the physical sciences, especially space science and technology. We realize that much of what we do is beyond the ken of the ordinary person. However, the work is all predicated on basic science and engineering concepts that any motivated person could understand and appreciate to at least some degree if only anyone would take the trouble to explain them in ordinary language.

I will describe two projects I have worked on as a technical writer and editor that began in response to an internal need, but evolved into valuable educational tools that allowed JPL and NASA to give back something of tangible value to the public that supports **our** missions. The first is a workbook to introduce our new mission controllers to the basic physics and astronomy concepts that would give context to their work, as well as the basic engineering design principles that go into building and operating robotic spacecraft for planetary space exploration. The second is a workbook in support of training to prepare teachers and volunteers in a public school system to operate a remote radio telescope.

THE DOCUMENTS

The *Story* of *Basics of Space Flight*

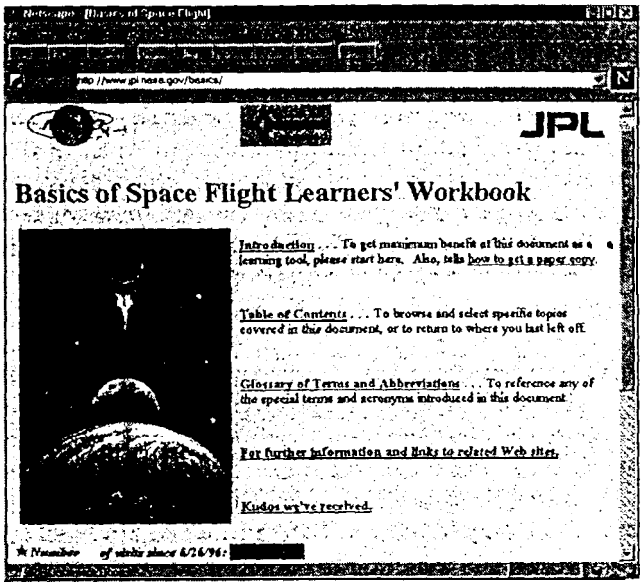
In the mission operations section of JPL, we have developed a sequence of training modules to prepare personnel to become mission controllers. A mission controller monitors in real time the telemetry data being transmitted back to Earth from a spacecraft. If any abnormal measurements appear, the mission controller contacts the appropriate people who decide what, if anything, needs to be done. Mission controllers also transmit software command sequences to the spacecraft. Although most of the mission controllers have college degrees, not all of them are highly technical. Even if they have engineering degrees, they may need to be refreshed on some of the fundamentals of physics and astronomy as relevant to space flight missions. They also need to understand the basics of spacecraft design and mission life cycles.

Before 1993, there was no single document that could give them even the spacecraft and mission basics for deep space missions, much less the physics and astronomy basics. So we developed a tutorial workbook with the specific objective of giving mission controllers a context for the task- and mission-specific training they would receive later. The resu It was the *Basics of Space Flight Learners' Workbook,* first published internally at JPL in August 1993.

The supervisor of the training group, recognizing the general educational value of the workbook, showed it to his daughter's science teacher at La Cañada High School near JPL. The teacher immediately wanted to adopt parts of it for use in his classes. The document was quickly cleared for public release, and we created a hypertext markup language (HTML) version and placed it on the World-wide Web for public access in April 1994. Although a few projects and organizations had home pages, it was the first complete document to be put on the Web at JPL.

Three years later, we have revised the workbook, and interest in it continues to accelerate as the World-wide Web version (http: //www.jpl.nasa.gov/basics) becomes internationally known and commended. We have found that

it has been of educational value to students from the third grade through university level.



Home Page for JPL's Internet-accessible Mission Controllers' Training Document

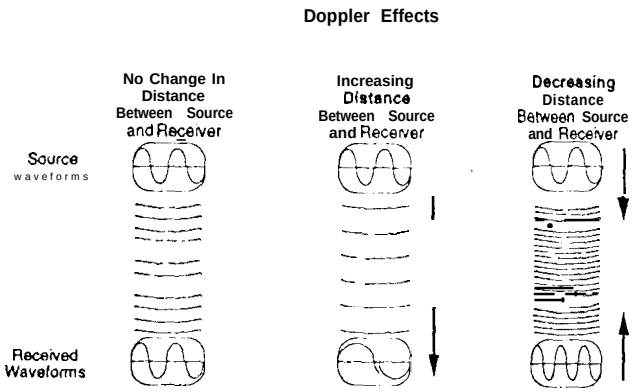
What began as a solution to an internal gap in training has become a valuable bridge between NASA's and JPL's hyper-technical missions and the people who are ultimately paying for them. It has also made a valuable contribution to NASA'S mission "to advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe . ."

And on to *Basics* of Radio Astronomy

The second workbook was developed when one of the 34-meter antennas at NASA/JPL's Goldstone Deep Space Communication Complex (in the Southern California desert) was converted for use as a radio telescope and donated to the Apple Valley Science and Technology Center (a resource of the Apple Valley Unified School District), along with the necessary computer hardware and software to operate it remotely. The students plan observations and operate the telescope from the Apple Valley location using Sun workstations. In addition, plans are under way for students and teachers in 10,000 classrooms across the country to be able to register with the center's Web site and operate the telescope from their own classrooms.

Our operations training group very early grabbed the opportunity to be part of this project by developing and delivering the radio telescope training to the teachers and volunteers who would in turn be training and supervising the students. The most we could assume about our least "initiated" audience was a high school level understanding of physics and chemistry, and even that, for some, occurred 50 years ago! One thing they all had in common, however, was enthusiasm.

Radio astronomy is, for most people, an esoteric subject. It involves the observation and study of something that you can't even see or feel—that is, radio frequency electromagnetic radiation. So the first part of the training had to introduce the physical phenomena to provide some context and meaning for the training that would follow on the actual operation of the telescope. Basing our training format on the successful *Basics of Space Flight* workbook, we developed a self-teaching workbook, *Basics of Radio Astronomy*. From the beginning, we envisioned that it could attract public interest if put on the Web and become another ambassador for NASA, while again "advancing and communicating scientific knowledge . . . " As of this writing (January 1997), we have completed the workbook, but have not yet begun the training. By May 1997, we will have trained the first teachers and volunteers and have had the workbook accessible on the Web for at least a couple of months. The Web workbook will be used not only by the Apple Valley Science and Technology Center, but also by both teachers and students in the potentially 10,000 classrooms.



Example of Simple Concept Drawing used in both Basics of Space Flight *and* Basics of Radio Astronomy

PUTTING THE EMPHASIS ON CONTENT

The Web has far greater potential for education than is being realized. I would like to suggest that not only government-sponsored research centers such as JPL, which have an obligation to provide information of value to the taxpayer,

but also technical companies of many kinds can benefit by providing some actual *valuable content* on their Web sites.

For example, I've looked at numerous camera manufacturers' sites, and, as one would guess, they all offer copious praise for their products and their dealers. None of them, however, takes the opportunity to give something back to the visitor by offering tips on taking better pictures, or a simple explanation of how some of these high-tech (or even low-tech) cameras work. They often have a gallery of nice photographs (presumably) taken with their cameras, but I haven't seen anything about how the photo was achieved in terms of exposure, aperture, film type, lens length, etc.

Also, many Web sites have to do with computer technology itself. The underlying assumption of these sites seems generally to be that the visitor is a prime candidate for the products being hawked. I submit that more often the visitor is in a state of total information overload, feeling overwhelmed by the pace of technological change, and confused about what this (or any other) new product might have to do with himself or herself, but afraid to assume it is safe to ignore the product. I would beg these high-tech Web-keepers to give the poor guy a break and backup a minute! Instead of dishing out glittering promises about the product, stop and explain exactly what it is, does, is good for, and maybe even a little on how it works.

Slick, animated pictures and other multi-media bites are attention-getting, novel, and impressive. But they are usually more entertaining than elucidating. By providing well-written educational content, geared to an appropriate reading and technical level, companies will keep Internet users coming back to their sites, and they will find that their sites are being linked from other sites and Internet indexing services in recognition of their contributions to education (focusing on youth, adults, or both), and not just free-enterprise.

THE TECHNICAL COMMUNICATOR'S ROLE

I would also like to suggest that developing such educational material for the Web is a challenging new career direction for technical writers. Although much material may already exist on the topic selected for a Web site, it will probably need to be focused, abbreviated, illustrated, and re-written at a layperson's level. The task is not unlike writing a research paper for school (except this time you get paid for it!).

As technical communicators, we maybe able to put ourselves in a position to help determine the direction the Internet will take. At this point, it looks like commercialism is going to totally swamp the network in a short time. 'I'here may be nothing, we can do about that, but if we can promote the idea of providing some valuable content, even if it is only to attract more consumers, then we will have helped slow the 'Net's downward slide into the same pit where television now wallows.

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Ms. Miller, with a B.A. in English (and potentially in general science, if there were such a degree), has been a technical communicator of one sort or another for about 25 years. Partly for the work described above, she is a recipient of NASAS 1997 Space Flight Awareness Launch Honoree Award.