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Paper Session I-C - Making Space a Part of General Education

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MAKING SPACE PART OF GENERAL EDUCATION

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ABSTRACT

General education reform is on-going at many universities to, in part, make undergraduate students more technically literate. The space program provides an area of study that is still exciting to students, provides technical content, and can incorporate the other goals. Additionally, human space activity contains international and interdisciplinary dimensions that can reach students outside of the technical disciplines. The development and contents of a space education course to become part of the university's general education program open to all students is presented. Included in the presentation is a listing of the course materials to be used by the students.

GENERAL EDUCATION REQUIREMENTS

New Mexico State University (NMSU), as in many universities, is in the process of re-defining the contents and philosophy of the core curriculum to be taken by all students in all majors. NMSU has a strong tradition in the agricultural and engineering disciplines while recognizing the vale of a broad liberal education for all students in all academic majors. The university's general education requirements for all students include the following mix of courses:

a) 7 hours in English composition,
b) 3 hours in mathematics,
c) 6 hours in critical thinking/analysis,
d) 16 hours in liberal studies, and
e) 6 hours in viewing a wider world.

Courses from various departments can be designated by a university-wide review committee as fulfilling the general education requirements in the various categories. In particular, we are interested in the "Viewing a Wider World" category. This category is to contain courses at the junior or senior level and students are to choose them from outside their major college. The courses in this category are to emphasize the international, interdisciplinary, political, and/or multi-cultural aspects of intellectual inquiry. Additionally, general education courses in this category are to have aspects of critical thinking, quantitative thinking, library re-

search, writing skills, and oral presentation skills.

In the rest of this paper, we will describe a course titled "Living and Working in Space" which has become part of the general education structure at NMSU as part of the "Viewing a Wider World" category. We will describe the process of integrating the course into the structure and the contents of the course.

SPACE COURSE DEVELOPMENT ACTIVITY

As part of the proposal for the New Mexico Space Grant Consortium submitted to NASA for the Space Grant College and Fellowship Program, a new course for NMSU to be titled "Living and Working in Space" was suggested. This course was to be made part of the NMSU Honors Program rather than including it within the College of Engineering, for the following reasons:

a) NASA was seeking to develop interdisciplinary, that is, non-departmental, educational efforts in aerospace studies,
b) the Honors Program is, by definition, university-wide and not tied to single college within the university,
c) making the course part of the Honors Program gives it immediate visibility university-wide and make it appear accessible to non-science and non-engineering students which would not be possible in the instructor's home college, and
d) the Honors Program classes are known to have flexible formats and non-traditional activities which students are more open to in the Honors setting than in the traditional classroom setting.

The first step in the process of bring the course to reality was to present a proposal for the course to the Honors Program director during the summer and fall of 1990. The program director approved the course for offering during the spring semester of 1991. Upon successful completion of the first offering, Honors Program director requested that we consider including the course in the NMSU general education program under the classification of "Viewing a Wider World". This process included a formal proposal to the general education oversight committee stating how the course would fulfill the general education goals and requesting that it be given such a designation. The proposal is then reviewed by this university-wide committee and the dean of the sponsoring college (engineering in this case). This process was completed in the fall of 1991 and the course will be listed as fulfilling the general education requirements from the fall of 1992 onward.

We based the inclusion of the course as part of the "Viewing a Wider World" component of the general education program on the observation that space exploration by humans provides several cultural windows on modern society. This includes viewing how high-technology processes work, the science and engineering results of missions, and the public perceptions of both as a function of the mission itself and the concurrent events in society. This produc-

es a multi-disciplinary environment that provides opportunities for students to become participants in, and observers of the process - and sometimes even both. The specific general education requirements of the university are met in the following manner:

a) the hands-on activities, especially, require the students to work with numbers, algorithms, and thinking in three-dimensional space and to begin to become literate in several aspects of a technical activity in society;
b) the study of space missions in this class is from the point of view that they are multi-faceted, international cultural activities with public reactions to the missions and that in order to understand how space programs are planned, financed, and understood, one needs to take these cultural forces into account;
c) the students are required to write and present a paper outlining an aspect of how the space program fits with their major thereby helping the student to understand how their program fits into a larger society and how a cultural activity, which is often perceived to be a closed science and technical culture, is really a more broad-based activity and contains many related connections; and
d) the course is eligible for enrollment by students from all colleges at the university and not just the college of engineering and not just those students enrolled in the formal Honors Program; this allows students to see how other majors and an engineering faculty member approach the cultural, applications, and process components to the national and international space activities.

In the following section, we present the details of the course based upon the course syllabus.

COURSE DETAILS AND HISTORY

The "Living and Working in Space" course was designed to have the student understand the following concepts:

a) the basic technology required to support human space activity,
b) the processes necessary to keep humans alive in space and to work in space,
c) the ways in which space is part of the overall culture of modern society and the drivers from society that shape space policy and missions,
d) the ways in which space has affected society by the mission and the technology spinoffs to the non-space sector, and
e) the ways in which the student's major field of study can be part of human activities in space.

The course meets nominally for two 1.5-hour blocks per week during the semester. Alternate class times are arranged for hands-on activities and field trips. The course provides for three types of learning experiences: instructor-lead discussions based on current text or film contents, student-lead discussions based on oral paper presentation, and interactive experiences based on hands-on activities and field experiences. Classroom discussions are based upon

questionnaire sheets that the student are required to answer based on assigned reading and film contents. The films used are listed in Table 1. Hands-on activities will have preparation work prior to the activity start and specific tasks to be completed during the activity. The preparation work and activity work sheets will be turned in together. Hands-on activities are listed in Table 2. Students are also required to write and orally present papers with grades given for both components. The contents of the papers are discussed below. Course grade is determined by the oral and written presentation grades and quality of completion of the hands-on activities.

Class Text: We chose Thomas D. Damon's *Introduction to Space: The Science of Spaceflight* (Orbit Book Company:Malabar, Florida, 1989) as the class text. This is a very readable book for students of all majors and is quite current. Other materials listed in the bibliography are on library reserve as a supplement.

Space Mission Paper: Each student will be assigned a particular space mission from the totality of the U.S. or Soviet human space exploration history. The student should have as a goal of this assignment to see how space activity is to be integrated as part of the overall cultural environment. The student is to use materials from the library to answer the following questions:

1) what were the goals of the mission in particular, and how it met the overall program goals, e.g., the Apollo program, in which it was a part;
2) at the time of the mission, what was the contemporary public reaction as documented in the contemporary media; and
3) what were the major contemporary issues and events in the months surrounding the mission, how did the mission become (or not become) part of those events.

Space Applications Paper: Each student will be required to select a product, technology, or application that has been developed, in whole or in part, from the national space program effort and is now used in the private sector as a space "spinoff". This selection should be related to the student's major field of study or a personal experience. The student is to use library research to determine the answers to the following questions:

a) the basic operational principal(s) of the product, technology, or application,
b) the source (mission, NASA field center, etc.) of the product, technology, or application,
c) the way(s) in which the produce has been used or is currently being used in non-space environments including who markets the product (if appropriate) and the approximate economic volume (if any) associated with the "spinoff", and
d) the way(s) in which the student's major is involved in this activity either in the design, production, or marketing of the "spinoff".

CONCLUSION

The development of the "Living and Working in Space" class represented an effort to bring many aspects of what many consider to be a purely science and engineering activity to a wider audience. We were able to present our case that space is a broad intellectual activity in the general sense by emphasizing the multi-cultural and interdisciplinary aspects and not just the "hardware". Students outside of the science and engineering disciplines do enjoy finding out that parts of the space program can involve their academic majors. To make a course such as this part of a general education program, all of these aspects will need to be addressed at some level.

ACKNOWLEDGEMENTS

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Table 1. Film List for Living and Working in Space

Film Title and Date	Source	Description
The Dream is Alive (1985)	Smithsonian Institution/ Lockheed Corporation	Working on the Space Shuttle by astronaut crews
The Russian Right Stuff: The Dark Side of the Moon (1991)	NOVA broadcast	The history of the Soviet lunar program and some of the flights leading to it
The World Was There (1965)	NASA	A description of the open press coverage of the Mercury missions
The Legacy of Gemini (1967)	NASA	A summary of the missions and goals of the Gemini program
The Time of Apollo (1975)	NASA	A summary of the missions and goals of the Apollo program
Four Rooms, Earth View (1975)	NASA	A summary of the missions and goals of the Skylab program
Space Shuttle - A Remarkable Flying Machine (1981)	NASA	The flight of STS-1
Space Shuttle Challenger Accident Investigation and Report (1977)	NASA	Official accident report for STS-51L

Table 2. Software and Hand-On Activities for Living and Working in Space		
Activity	**Type of Activity**	**Goals**
Model Rocket Construction	Students design, build, and fly a model rocket to lift a weight to a specified height	(a) construct model to specifications and (b) verify specifications are met
Orbital Workbench	Software "spreadsheet" and simulator for orbital analysis	(a) see how parameters in orbits are related and (b) view orbital motion relative to the earth
Body Telemetry	Students calibrate and use an electronic thermometer	To see how electronic instrumentation can be used for body function monitoring
Moon Rocks	View lunar samples.	To see actual lunar samples from the Apollo missions and compare the appearance of lunar material with earth material.
Field Trip	Visit a space-related facility*	(a) to view actual space artifacts and to gain an appreciation of the elements of human spaceflight

* - past field trips have included the Space Center in Alamogordo and NASA's Johnson Space Center in Houston.