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"How can we increase the number of students majoring in science?"
That question was raised by Veda Veach, Assistant Director of Undergraduate Admissions at the University of California, Los Angeles at a meeting of the Transfer Alliance Program (TAP), the guaranteed transfer program between UCLA and 15 area community colleges. For fall 1992, UCLA received 7900 applications from students planning to transfer from community colleges. Of that number, only 1313 were Life Sciences majors and even fewer 536 were Physical Sciences majors. "But, more specifically," continued Dr. Veach, "how can we increase the number of women and underrepresented students majoring in science?" Both questions struck a responsive chord at Pasadena City College (PCC) which is part of TAP. Consequently, on January 10, 1992, 25 PCC faculty and department chairs from English, Social Sciences, Life Sciences, and Physical Sciences met at a retreat to discuss "The Leaking Science Pipeline." That discussion, however, soon led to deeper issues including the critical need for fundamental change in the way that science and liberal arts are taught, particularly in introductory or survey courses. Today's traditional natural science courses often leave students with incomplete or incorrect knowledge of scientific principles, underdeveloped intellectual skills, and little awareness of the influences of science on their lives. Because of poor introductory natural science classes and the lack of integration of basic scientific and technical knowledge into liberal arts courses, more and more undergraduates are dismissing or never even considering a career in the sciences. Many Americans, even those who are otherwise well educated, have little understanding of science or how it affects their standards of living. Nor do they possess the intellectual skills to act effectively on scientific matters that they encounter in their personal, professional, or civic experiences. The project for which funding is requested in this proposal is part of a larger three-part project designed to address the problems and concerns outlined in this proposal.

(1) The first part is a "Technology and Ethics" lecture series, supported with private funding from GTE (see Appendix). This series addresses scientific issues that raise ethical questions and brings these issues to public attention.

(2) The second part is the present grant proposal. PCC requests $13,650 from FII to link science and humanities/social science courses in order to increase student understanding of the
interrelatedness of these areas of human knowledge. This interdisciplinary project would initially target 10 faculty from science and humanities and 350 students in our Scholars Program, but if successful, would be offered by more faculty to all transfer students.

(3) The third part of the project would follow careful evaluation of part two and would link humanities/social science to natural science courses. Future local, state, or federal funding would be sought to support this extension of the project.

In May 1990, the American Association for the Advancement of Science issued a report in which they indicated that "higher education institutions must encourage more women and members of minority groups to major in science and pursue science-related careers." PCC’s ISO project is designed to offer precisely that kind of encouragement. The ISO project may not be able to "plug the science pipeline," but it can help to stem the leakage at community colleges.
Pasadena

Impact on Systemwide Need

[No information provided in this document for this section.]
FII Eligible Programs: Although this proposal addresses all three eligible areas, the primary focus is Nontraditional Instruction--Interdisciplinary courses.

Board of Governors Basic Agenda: Student Access and Success --- Intensify efforts to increase the number and success of underrepresented students in transfer programs.
Science education in the United States must undergo "radical reform" if people are to understand science and its influence on their lives according to a report recently released by the American Association for the Advancement of Science (The Liberal Art of Science: Agenda for Action). According to this report, the need for fundamental change is most critical in the undergraduate natural sciences curriculum. The report urges natural science faculty to take the initiative in redesigning science education, but says professors in the humanities, social sciences, practical and fine arts and other disciplines should help with the undertaking. This is echoed in a recent National Science Foundation report which recommends that curricula should be developed "to emphasize cross-disciplinary, philosophical and historical discussions of engineering, mathematics and the sciences."

It goes on to say that "introductory-level courses must emphasize scientific concepts more than isolated facts, including the development of courses that are more interdisciplinary, discovery-oriented, involve teamwork, and employ problems of interest and relevance to the students themselves."

Although integrating science and humanities/social science courses would benefit all students by helping them understand the interrelatedness of the disciplines and the need for them to develop a more thorough understanding of each, PCC believes an interdisciplinary approach can also help address the more specific problem of the "leaking science pipeline."

In spring 1991, UCLA Magazine published an article on "Stemming the Flight and Fright of Undergraduates in Science" which discussed some efforts by UCLA to "stem the drain of undergraduates who are dismissing or never even considering a career in the sciences." Table 1 shows the "leaking pipeline" nationwide while Table 2 shows the decline at UCLA. The UCLA article continues:

"The crisis is in the economic well-being of the country. If we don't have the engineers and scientists working on new types of materials, new ways of propelling our vehicles and our spaceships, technologically we will become a third world nation."

The situation is even more acute for those traditionally underrepresented in science. According to Dr. Elma Gonzalez, Associate Professor of Biology at UCLA who has been developing ways to improve retention and recruitment of minorities and women into the sciences, "There are a lot of complex things going
on with underrepresented students ... For example, science is seen as a 'Waspy' kind of activity, something you can indulge yourself in, but what do you do to make a living? It's not perceived as having anything to do with real life, except for medicine, and there are few avenues to educate students about other professions in the sciences." In an article in The Los Angeles Times (May 9, 1991), Dr. Gonzalez, a plant cell biologist who serves as a role model for students, points out that "innovative approaches are necessary in all aspects of science teaching, and are particularly crucial for recruiting women and minority students into scientific careers .... We need to take things that are obscure and inaccessible and make them accessible."

In an effort to make science courses more accessible, expose more students to science, and end some of the anxiety and fear associated with science, PCC proposes a project involving 10 faculty and approximately 350 students.

The ten faculty, five from science and five from humanities/social science, would meet during fall 1993 to develop five linked courses --- five Interdisciplinary Scholars Options (ISOs) in science (Chemistry, Geology, Physiology, and Biology) linked to five English, History, and Political Science courses.

Background on Pasadena City College:
PCC is the ideal community college to carry out this project, since it is located in the same community as the California Institute of Technology and the Jet Propulsion Laboratory, both institutions with outstanding scientists. Many students enter PCC after graduating from some of the excellent high schools in the area, and these students go on to transfer to the University of California and other colleges and universities, giving PCC one of the highest transfer rates (24%) in the state. PCC students in the humanities/social sciences as well as those in the natural sciences/engineering are very successful after transferring to 4-year colleges and universities.

At the same time, PCC's enrollment today is predominately nontraditional. Over 60% of our students are ethnic minorities and primarily first generation college students who would not be able to attend college without the services available at PCC. Many PCC students are underrepresented minorities (in fall 1992 PCC enrolled 9.1 % black and 29.6% Hispanic) some of whom come from poorer high schools where their educational skills have not been well-developed. Although many of these students ultimately do transfer, very few of them study science or consider majoring in the natural
sciences. Thus PCC, like other colleges throughout the state, sees a decreasing number of women and underrepresented minorities in the natural sciences. With the increasing number of jobs requiring specialized education in science, unless more women and minorities choose to concentrate in the natural sciences, many jobs may go unfilled. It is our expectation that the proposed project will help PCC achieve a larger proportion of women and minorities being exposed to scientific principles and methodologies, taking natural science courses and transferring with majors in science or engineering.

Background on Interdisciplinary Programs at PCC:
Unlike any colleges which have difficulty crossing disciplinary boundaries, PCC has been a leader in developing interdisciplinary courses and study programs including:

(1) two interdisciplinary Humanities Block Programs

(2) an interdisciplinary (life sciences and physical sciences) environmental sciences course,

(3) a variety of paired courses, including several involving the natural sciences,

(4) an interdisciplinary scholars option (ISO) --- geology option in an English composition course offered in fall, 1992,

(5) a new interdisciplinary "critical thinking" course combining English composition and study of the scientific method.

Interdisciplinary humanities courses have been taught at PCC since the early 1980's, e.g., in 1980 Humanities 1 (Introduction to the Humanities) was taught by three faculty (Philosophy, Literatures, Biology). In 1984 PCC was awarded a $57,000 grant from the National Endowment for the Humanities to develop an interdisciplinary team-taught Humanities Block Program ("Connections: Individual and Community" --- see Appendix). The grant provided reassigned time for 11 faculty from English, History, Political Science, Psychology, Philosophy, and Linguistics to develop an integrated nine-hour block of courses (History 3B, English 1A, Humanities 1). That interdisciplinary block is currently in its eighth year and has included 18 faculty from a variety of disciplines. The college continues to support the Humanities Block Program with reassigned time for a coordinator, retreats for the faculty, and stipends for new faculty to prepare materials.
In addition, interdisciplinary projects such as the GTE lecture series (see Appendix) and the recent lecture hosted by the PCC Scholars Program in conjunction with UCLA's Center for Medieval and Renaissance Studies and Center for the Health Sciences (funded by NEH Public Programs --- see Appendix) attest to the continued commitment to interdisciplinary programs.

Background on PCC's Scholars Program:
In 1984 the Humanities Block Program became the core of our Scholars Program which is designed to facilitate the transfer to university of highly motivated students. In 1986 a grant from the Fund for Instructional Improvement of the California Community Colleges enabled us to develop interdisciplinary paired courses for the Scholars Program (see Appendix). The success of the Scholars Program has led to our participation since 1985 in the Transfer Alliance Program, a guaranteed transfer agreement with the University of California at Los Angeles; since 1990 the Transfer Scholars Partnership with the University of Southern California; and since 1991 Wavelink, guaranteed transfer to Seaver College of Pepperdine University. Because of the increasing number of students participating in the Scholars Program (approximately 350 in 1993), additional enriched courses have been needed. Consequently, new paired courses (e.g., Introduction to Literature and Geography) and a new Humanities block program (American Cultures) have been created.

In addition, in 1991 we created Scholars Options --- enriched components joined to regular transfer courses (see Appendix). The Scholars Option offers Scholars students taking regular transfer courses more sophisticated work and an opportunity to work in small groups with a teacher and peers. Scholars Program students receive no additional course credit for the extra work involved in the Scholars Option; taking the Option enables them to count the transfer course as part of the Scholars Program.

The PCC's Scholars Program, unlike honors programs at many community colleges, does not offer "exclusive" honors courses, i.e., courses available solely to honors students. Although many PCC students are high achievers and take their first two years with us for solely financial reasons ($120/year tuition vs. $1200 or more at the state colleges and universities), many of our students have never envisioned the possibility of transfer to a 4-year institution. Once these students experience the challenge and excitement of interdisciplinary, often team-taught courses, however, many become enthralled with learning and begin to develop higher aspirations. This is particularly
true for many of our underrepresented students (particularly African-American and Chicano/Latino). For this reason, all PCC Scholars Program courses are open to all students.

III. PROPOSED PROJECT:

PERSONNEL:
Co-Project Directors and Faculty:
Dr. David Douglass, Associate Professor, Geology
Dr. Judith Branzburg, Assistant Professor, English

Faculty in Science:
Dr. Claudia Barner, Assistant Professor, Chemistry
Dr. Christine Bilicki, Assistant Professor, Chemistry
Dr. Marion Pavlovitch, Professor, Physiology
Dr. Judith Greenlee, Professor, Biology

Faculty in Humanities/Social Sciences:
Dr. Judith Branzburg, Assistant Professor, English
Dr. Ellen Shockro, Associate Professor, History
Mr. Dan Meier, Professor, English
Dr. Teri Keeler, Assistant Professor, English
Ms. Margaret Worley, Associate Professor, Political Science

PROPOSED LINKED COURSES FOR SPRING 1993:

3-unit transfer course ISO
English 1A (Reading and Composition) Geology
English 1A Chemistry
English 1B (Reading and Composition) Physiology
Political Science 1 (Intro to American Gov) Chemistry
History 7B (U S History From 1876) Biology

The faculty would meet once a month as a group of ten to discuss readings and issues in the sciences. The overall theme for the project would be: "Ways of Knowing in Science and Humanities/Social Sciences--Similarities and Differences." In addition, faculty would meet in pairs to develop the specific ISOs to be taught in the spring. Each ISO would be the equivalent of a 1-unit (18 hour) course. Because the combinations differ, each ISO would be different, but each would be designed to introduce non-science students to scientific methods, ideas, and issues. Teaching methods for the ISO part of each course might include traditional lectures, but would emphasize seminars, hands-on laboratory work, field work and other interactive learning formats. A sample ISO (Geology and English Composition) is enclosed (see Appendix).
The students signing up for the ISO would be drawn from the 350 currently participating in the Scholars Program, PCC's honors program that includes guaranteed admission to UCLA (the Transfer Alliance Program). PCC's Scholars Program includes (1) two interdisciplinary Humanities Block Programs, (2) linked or paired courses, and (3) scholars options, which are enriched components attached to a transfer course.

Up until now, Scholars Options have usually been offered by the same teacher and in the same discipline as the transfer course, e.g., a philosophy option as an adjunct to a philosophy course, an economics option as an adjunct to an economics class. Interdisciplinary scholars options (ISOs) would differ in that they would offer students a natural science option as an adjunct to a humanities or social science course (at a later date--a humanities or social science option as an adjunct to a natural science course). Since more students take humanities and social science courses, a larger pool of students who might typically avoid natural science courses would be exposed to scientific concepts.

ISOs would be available to Scholars Program students in any section of selected multi-section transfer courses. Each option would be taught by an instructor from a completely different field but would consist of material from that field which added breadth and understanding to the selected course. The college has supported development of Scholars Options with stipends, but because the present proposal requires more extensive meetings of a larger number of faculty, PCC is requesting external funding.

PCC currently enrolls over 4,000 students in life science courses with approximately 2300 majors, but very few of these students are women and minorities. Consequently, a special target population for this project is the student who is typically underrepresented in the sciences, i.e., women, African-Americans, and Latinos. In order to encourage these students to consider taking more science courses and perhaps majoring in science, three outside speakers will participate in the program. Dr. Elma Gonzalez (Biology, UCLA); Dr. Joseph Graves, Jr. (Ecology and Evolutionary Biology, UC Irvine); and Dr. Margaret Ryan (Physical Chemist, Jet Propulsion Laboratory) will meet with the Scholars Program students. Representing a Latino, an African-American, and a woman in industry, these three will serve as role models as well as offer students additional perspectives on the sciences. In addition, PCC currently supports two
programs designed specifically to recruit and retain African-Americans and Chicano/Latinos. Consequently, the directors of those programs (Ana Ogaz, PCC’s Puente Project Counselor and Jim Gonzalez, PCC’s Mentor Coordinator) will also offer their services and guidance to students and facilitate the transition of these students into the Scholars Program courses.

Because project faculty would be meeting to link their courses, this project would also be an excellent source of faculty development. Science faculty would learn more about the humanities and social sciences while humanities/social sciences faculty would learn more about the sciences. Consequently, material from the other discipline would be integrated into other courses taught by those teachers.

Because instructors will need to work closely together, building bridges between instructors in different disciplines will increase the strength and cohesiveness of the faculty at Pasadena City College. This is particularly valuable now that PCC has hired over three dozen new faculty during the past two years. At the January retreat when 25 faculty from sciences and humanities met to discuss interdisciplinary courses, the opportunity to meet with faculty from other disciplines was described as one of the major advantages of such a gathering.

Although this project would initially serve the approximately 350 students currently in the Scholars Program, since this project can be replicated for all transfer students, it will eventually serve many more. For example, typical enrollment for spring 1993 for the target classes is English 1A (1740), English IB (660), Political Science 1 (1260), and History 7B (585) for a total of 4245 students. Once the project results have been evaluated and disseminated, many more PCC faculty will become involved in an interdisciplinary approach to teaching science and humanities. Materials developed in the ISOs will be distributed to all instructors of the particular courses, and should result in integration of interdisciplinary materials into all sections of these courses.
1. Create 5 Interdisciplinary Scholars Options connecting science and humanities/social sciences.

2. Increase understanding of science issues among humanities/social science teachers, and understanding of humanities/social science issues among science teachers.

3. Increase by 50% the number of science courses taken by Scholars Program students and increase by 50% the number of science courses taken by women and underrepresented students in the Scholars Program.

4. Increase by 50% the number of Scholars Program science majors transferring to 4-year colleges and increase by 50% the number of women and underrepresented students in the Scholars Program majoring in science and transferring to 4 year institutions.
August 1993: Co-coordinators confirm faculty participants, guest lecturers, readings, schedules.

September 1993: Day long retreat with all project faculty to discuss ways in which science, humanities, and social science intersect. Discussion will include selections from Rose, Hilary and Steve Rose, ed. Ideology of/in the Natural Sciences 2-person faculty teams meet to begin development of ISO

October 1993: All project faculty meet for 3 hour workshop to discuss Kern, Stephan, The Culture of Time and Space 2-person faculty teams meet to work on development of ISO

November 1993: All project faculty meet for 3 hour workshop to discuss Barbour, Ian, Issues in Science and Religion 2-person faculty teams meet to work on development of ISO

December 1993: All project faculty meet for 3 hour workshop to discuss Harding, Sandra, Whose Science, Whose Knowledge and selections from Crow, L.ed., Enhancing Critical Thinking in the Sciences 2-person faculty teams meet to work on development of ISO

January 1994: New ISOs taught Faculty teams continue to meet to refine ISOs

February 1994: Dr. Elma Gonzalez meets with project students and faculty Retreat for project faculty to assess project.

March 1994: Dr. Joseph Graves, Jr. meets with project students and faculty Campus-wide dissemination retreat (funded by PCC Staff Development)

April 1994: Dr. Margaret Ryan meets with project students and faculty Area-wide dissemination conference (hosted by CAIP at UCLA)

Fall 1994: Area-wide dissemination conference (hosted by UCLA Center for Academic Interinstitutional Programs --- CAIP (see support letter in Appendix)

Results of project presented by two faculty at Community College Humanities Association (CCHA) regional conference
Results of project shared with other community colleges at TAP meeting (see support letter in Appendix)
In addition to achieving the stated objectives, the project anticipates achieving the following goals:

1. More students will become interested in the sciences and scientific issues, and, consequently, become more responsible citizens.

2. More students will lose their fear of science and consider science as a possible career choice.

3. More women and underrepresented students will view science as a viable major and possible career choice.

4. More students will develop mentor relationships with scientists in the community.

5. Science and humanities/social science faculty will exchange ideas, materials, teaching techniques --- leading to more interdisciplinary courses, paired or linked courses, and team-taught courses.

6. PCC's ISO project will become a model for TAP as well as for other community colleges in the state.

Potential for continued support:

1. PCC currently supports the Scholars Program (faculty developing paired courses and teaching Scholars Options) through institutional funds and will continue to do so. The proposed project, however, involves so many faculty and courses that the college is seeking FII support to get it started.

2. PCC has an excellent track record of institutionalizing grants. A grant received in 1984 from the National Endowment for the Humanities to develop an interdisciplinary humanities block program (the core course for the TAP program at PCC) has been incorporated into the ongoing college budget.

Funds support reassigned time for the program's coordinator, stipends for new faculty in the program, and retreats for program faculty. A grant received in 1990 from the Fund for Instructional Improvement to support integration of race, gender, and ethnicity into the curriculum is also institutionalized.

The college has created a reassigned time position for a multicultural
coordinator to oversee continuation of that project and has committed faculty development funds for replication of the project.

Potential for adaptation to other institutions or programs
Because all community colleges (and community college: 4-year institution transfer programs) are experiencing problems similar to those outlined in the Introduction to this proposal, there would be widespread interest in the results of this project (not only for Honors/Scholars programs but also for all transfer programs in the state).
1. Data will be collected at the beginning and end of the project regarding the number of Scholars Program students enrolling in science courses.

2. Data will be collected at the beginning and end of the project regarding the number of Scholars Program students majoring in science.

3. Data will be collected at the beginning and end of the project regarding the number of women and underrepresented students in the Scholars Program enrolling in science courses.

4. Data will be collected at the beginning and end of the project regarding the number of women and underrepresented students in the Scholars Program majoring in science.

5. Pre- and post-ISO questionnaires on attitudes towards science will be given to students in the project.

6. Interviews will be conducted with selected students to assess change in attitude towards science (science courses, majoring in science)

7. Interviews will be conducted with faculty to assess any change in attitudes, teaching methods.

8. A 2-year follow-up will be conducted to determine how many Scholars Program students successfully transferred as science majors to a 4-year college.

9. A 2-year follow-up will be conducted to determine how many women and underrepresented students in the Scholars Program successfully transferred as science majors to a 4-year college.
1. A booklet of materials developed through the project will be disseminated at a retreat for all PCC faculty.

2. Project faculty will present their findings at a meeting of the Life Science and Physical Science Alliance of CAR (Center for Academic and Interinstitutional Programs, UCLA)

3. Project faculty will present their findings at a fall TAP meeting.

4. Project faculty will present their findings at state and national conferences.
Total Project Costs $18,770; $5120 in local funds; $13,650 requested from the Fund for Instructional Improvement.