

The University of Texas at Dallas

PROPOSAL REGARDING THE ADMISSION OF  
FRESHMAN AND SOPHOMORE STUDENTS

House Bill 42 (Texas Education Code, Section 70.08) as passed by the 71st Legislature, First Called Session, provides for the admission of freshman and sophomore students at U.T. Dallas effective with Summer Session 1990 and with the prior approval of the Texas Higher Education Coordinating Board. At its meeting on July 14, 1989, the Coordinating Board requested the submission of a proposal for the expansion of U.T. Dallas as described in House Bill 42. The proposal is to address all of the matters of quality, need, costs, and other topics usually required in proposals submitted for new degree programs and major administrative changes. The questions and responses below follow the format of the questions related to new degree programs and incorporate several additional questions requested for administrative changes.

Section 5.92 DESCRIPTION OF PROPOSED PROGRAM

1. What is the title and nature of the proposed degree program?

No new degree programs will be required to implement the enrollment of freshmen and sophomores at The University of Texas at Dallas; consequently, no change will be necessary to UTD's approved Table of Programs and only minor editorial changes will be necessary to the Coordinating Board's approved Role and Mission Statement for UTD (see Appendix A).

Currently, U.T. Dallas offers the following baccalaureate degrees:

	<u>Degree</u>
ARTS AND HUMANITIES	
Arts and Humanities	BA
Arts and Humanities -- Art and Performance	X
Arts and Humanities -- Historical Studies	X
Arts and Humanities -- Literary Studies	X
ENGINEERING AND COMPUTER SCIENCE	
Computer Science	BS
Electrical Engineering	BSEE
Electrical Engineering -- Microelectronics	X
Electrical Engineering -- Telecommunications	X
Engineering Science	BSES
Engineering Science -- Electronic Mech. Program	X
Engineering Science -- Manufacturing	X
GENERAL STUDIES	
American Studies	BA
General Studies	BA

Degree

HUMAN DEVELOPMENT

Psychology	BA
Speech-Language Path. & Aud.	BS

MANAGEMENT

Business Administration	BS
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NATURAL SCIENCES & MATHEMATICS

Biology	BS, BA
Chemistry	BS, BA
Geosciences	BS, BA
Math. Sciences	BS
Math. Sciences -- Applied Math	X
Math. Sciences -- Statistics	X
Physics	BS, BA

SOCIAL SCIENCES

Anthropology	BA
Economics & Finance	BS, BA
Government & Politics	BA
Public Administration	BS
Sociology	BA

2. List the course offerings to comprise the program. Which of these courses will be new ones?

It will be necessary to add lower-level courses to the University's approved course inventory. Based on the remediation requirements of the Texas Academic Skills Program, it may also be necessary to add funded remedial credit hour courses in mathematics (maximum of six credit hours), writing (maximum of three credit hours), and reading (maximum of three credit hours).

New lower level and remedial courses and core curriculum requirements will be submitted for review and approval under the Coordinating Board's existing procedures for course inventory and core curriculum review. The core curriculum will include courses in English, history, mathematics, and the sciences that are appropriate to freshmen and sophomore instruction.

3. Outline a semester-by-semester curriculum for the proposed program, if applicable.

A faculty curriculum advisory committee has been established and will make recommendations for a lower level curriculum that will complement the University's existing authorized baccalaureate degree programs. This committee has been charged with the design of a lower level curriculum that emphasizes preparation for majors in the natural sciences, mathematics, and engineering while also being attentive to meeting Coordinating Board guidelines for core curriculum.

4. What special requirements are included in the degree plan? Describe any innovative changes in degree requirements.

Any special requirements or innovative changes in undergraduate degree plans resulting from the recommendations of the University's curriculum planning committee that affect core curriculum will be submitted to the Coordinating Board for review and approval.

5. Is the proposed program entirely new to the institution? Is it an extension of a minor field?

As an upper-level, graduate research institution, The University of Texas at Dallas has never enrolled freshmen or sophomores. Lower division students would be admitted to the currently authorized degree programs listed in question 1. As required by House Bill 42 (Texas Education Code, Section 70.08), emphasis would be given to the admission of lower division students who intend to major in the natural sciences, mathematics, and engineering. The current faculty is fully prepared to provide the first two years of instruction.

6. How many similar programs are offered elsewhere in Texas, and where? What is the nearest institution offering a similar program?

Of the 37 Texas public senior universities and centers, ten currently are limited to upper-division course offerings at the undergraduate level. House Bill 42 authorizes the removal of this restriction for U.T. Dallas and similar legislation provides such authorization for Corpus Christi University.

U.T. Dallas is the only doctoral granting institution in the nation that does not also offer admission to freshman and sophomore students.

The general academic institutions in the North Texas area that offer baccalaureate degrees in the natural sciences, mathematics, or engineering include U.T. Dallas, U.T. Arlington, Dallas Baptist College, Southern Methodist University, University of Dallas, University of North Texas, and Texas Woman's University. Dallas is the only major city in the nation that does not have a public four year baccalaureate degree granting college or university.

7. Describe current manpower needs for graduates of the program. Also describe how the proposed program strengthens the total academic program of the institution.

Providing a lower division at U.T. Dallas increases the instructional options for all U.T. Dallas students, including those who transfer after receiving the two-year associate degree. In the absence of a lower division, juniors and seniors do not have the opportunity to take such lower-division elective courses as a foreign language or an introductory fine arts course. Also, students who wish to change majors (a common practice at four year institutions) are prohibited from completing lower-level prerequisites at U.T. Dallas. Similarly, individuals who plan to become upper-division students at U.T. Dallas by enrolling in a community college are currently precluded from taking any upper-division courses for which they may be qualified until they have completed at least fifty-four hours of lower-division course work. This curricular rigidity is particularly bothersome for engineering and science students who may need to start the upper-division part of a mathematics or science sequence before having completed all of the lower-division social science and humanities requirements.

The need for more graduates in engineering, mathematics, and the sciences has been well documented at the national and state level (see Appendix B). Much of the testimony on House Bill 42 during the 71st Legislative Session dealt with the question of manpower needs as well as the need for strong economic development in Texas. As the home for much of the State's high technology business and industry, Dallas and its business leaders have experienced the shortages in engineers and scientists.

The passage of House Bill 42 by the 71st Legislature and the actions of the 70th Legislature in establishing the Texas Academy of Mathematics and Science at the University of North Texas reflect the need for higher education in Texas to recruit actively those students who are prepared for and interested in engineering and the sciences.

As an upper-level institution, UTD has been unable to recruit high school graduates. Four year undergraduate programs will result in a dramatic increase in the numbers of students enrolled in the natural sciences, mathematics, and engineering. Admission requirements will result in the enrollment of a substantial number of high quality undergraduate students who might otherwise leave the State of Texas.

8. Has the proposed program been approved by the institution's governing board? Give date of action.

At their meeting on August 10, 1989, the Board of Regents of The University of Texas System endorsed the provisions of House Bill 42 (Texas Education Code, Section 70.08) as passed by the 71st Legislature, First Called Session, authorizing the admission of freshman and sophomore students at U.T. Dallas effective with Summer Session 1990.

Section 5.93 PROJECTED ENROLLMENT

9. Project the enrollment for the proposed program for the next five years. Explain the basis for this projection. Include majors and minors in separate columns.

Pursuant to House Bill 42 (Texas Education Code, Section 70.08), the enrollment of freshman and sophomore students at U.T. Dallas would provide for maximum enrollments as shown in the table below.

MAXIMUM PROJECTED ENROLLMENTS

	<u>Fall 1990</u>	<u>Fall 1991</u>	<u>Fall 1992</u>	<u>Fall 1993</u>	<u>Fall 1994</u>
Freshmen			2,000	2,000	2,000
	1,040	1,040			
Sophomores			3,000	3,000	3,000
Collin/Dallas Sophomore Transfers			200	200	200
Maximum Targeted Number*	<u>1,040</u>	<u>1,040</u>	<u>5,200</u>	<u>5,200</u>	<u>5,200</u>
* Includes Minimum 5% Reserve for Minority Students	52	52	260	260	260

It should be noted that the figures in the table are the maximum numbers specified by statute. The actual number of lower division students enrolled during the start-up years very likely will be less than the number allowed by law. The University does not intend to reach the maximum enrollments in the short run. Rather, the expectations for enrollments in the first five years are shown in the table responding to question 34(a) on page 14. These projections are based on the controlled growth that will result from a selective degree profile and high admission standards with an emphasis on engineering, mathematics, and the sciences.

10. Describe the likely source of students who will enroll in this program. Will they come from existing programs or will they be attracted to the institution to enroll in the proposed program?

The enabling legislation in House Bill 42 specifies that "... the admission criteria for entering freshmen and for transfer students with less than 54 semester hours of college credit (shall) be no less stringent than the criteria for admission to the University of Texas at Austin for those students." The adoption of U.T. Austin or more stringent admissions criteria will serve to attract the more highly qualified of the State's high school graduates.

In addition, given the University's longstanding reputation for the quality of its research and instructional programs in the sciences and the excellence of its newly established engineering program, expectations are high that U.T. Dallas will be successful in designing a lower division curriculum that will attract many of the bright and talented Texas high school graduates who now leave Texas for highly regarded institutions in other states, as well as students who tend to make U.T. Austin, Texas A&M, or Rice University their first choice. The expense of private higher education as well as the recent trend to establish enrollment limits for a number of the leading public universities in Texas are additional factors suggesting that a four year U.T. Dallas could attract future engineers, scientists, and potential graduate students who would otherwise leave the state.

#### Section 5.94 FACULTY

11. Give the number of persons presently on the faculty who will be most directly involved in the proposed program. List name, rank, highest degree, present course load, and estimated course load in the proposed program for each. Do present faculty meet minimal criteria for the requested program?

The faculty most involved in the proposed instruction of freshmen and sophomores would be the present tenured/tenure track faculty. As of the Fall semester of 1989, U.T. Dallas had 198 individuals in this category. It should be understood that this faculty is also heavily involved in graduate instruction at the Master's and Doctoral levels as well as presently involved in instruction at the upper undergraduate level.

The average course load for faculty at U.T. Dallas for the Spring semester of 1989 was the equivalent of 13.819 hours per week of which approximately the equivalent of 9.00 hours per week were for instruction in organized classes. The balance was a combination of individual instruction, research supervision, and thesis and/or dissertation supervision. Since this teaching responsibility is already quite high, the University does not envision allowing the average course load for faculty to rise substantially over its present value.

The present faculty is well qualified to teach at the undergraduate lower-level, indeed it is well qualified to teach at any level. Approximately 95.6% of the faculty hold the terminal degree in their area (91.16% holding the Ph.D.). In addition, most of the faculty are drawn from the major U.S. research universities as well as the major international research universities.

12. Calculate the present student-faculty ratio in the subject matter fields or departments in which the proposed program will be offered. (Divide full-time equivalent students by full-time equivalent faculty.) Also give the average teacher-student ratio in the courses given by the department (planned number of students per class.)

According to the "Statistical Supplement, Fiscal Year 1988", published by the Texas Higher Education Coordinating Board, p. 81, U.T. Dallas had a full-time student equivalent of 4,715 students for the Fiscal Year 1988. From the same source, page 76, the equivalent teaching faculty was 377.25 less 121.55 TA's who at U.T. Dallas are not allowed the sole responsibility for a course. This gives a net FTE faculty of 255.7 faculty. The student teacher ratio is then

$$4715/255.7 = 18.43 \text{ to } 1.$$

In the new lower-level program, the average number of students per class is planned to be no larger than approximately 47.5. This, of course, will vary by subject discipline, being much lower in courses such as English composition and higher in subjects wherein effective learning can occur in a larger lecture environment.

13. Project the need for new faculty required for the proposed program for the next five years. If the teaching responsibilities for the proposed program will be absorbed in part or in whole by the present faculty, describe how this will be done.

The number of state-funded new faculty required to teach freshmen and sophomores at U.T. Dallas will be no greater than if those students had enrolled at another Texas public university. Since growth in freshman and sophomore enrollment at UTD will follow freshman and sophomore growth in the region, the new faculty required for this activity will be only a portion of the new faculty required to serve the region.

The algorithm for the projected need for new faculty is simple: one FTE faculty for every 19 FTE students. Since it is impossible to predict the exact number of students who will enroll at U.T. Dallas in the lower-level program, shown below is the maximum that would be allowed under the present legislation:

**MAXIMUM PROJECTED ENROLLMENTS  
AND FTE FACULTY**

	<u>1990- 1991</u>	<u>1991- 1992</u>	<u>1992- 1993</u>	<u>1993- 1994</u>	<u>1994- 1995</u>
Total FTE Lower-Level Students	1,040	1,040	5,200	5,200	5,200
Total New FTE Faculty	54.7	54.7	273.7	273.7	273.7

All faculty, new and continuing, will participate in the instruction of lower-level students. It is anticipated that the present faculty will initially provide not only part of the instruction at the lower-level, but also the planning, leadership, and curriculum development for this activity. Since U.T. Dallas has a research mission, however, we do not intend to establish a separate "non-graduate" faculty. Rather, both new and present faculty will continue to teach at both the graduate and undergraduate levels, in both organized and research supervision courses.

14. Will acquisition of new faculty for the program require an additional outlay of funds? Explain in detail.

The formula funding for faculty salaries generated by lower level instruction at U.T. Dallas will be no more than the cost of conducting this instruction at any other four year institution in the state. U.T. Dallas does not intend to hire a "lower division" faculty, but rather it is the intent to maintain the same mix of tenured/tenure-track faculty, part-time faculty, and teaching assistants as faculty are added. All members of the faculty will be expected to teach at all levels, and tenured/tenure-track faculty will be encouraged to teach lower division classes. Accordingly, the University will seek funds from local sources to meet the anticipated difference between formula funding for faculty salaries and that required to maintain the current faculty mix.

15. Describe the involvement of the faculty, present and projected, in research, extension, correspondence, and other activities related to the proposed program. Will this program decrease or increase the course load of present faculty?

The thrust of this question is obviously toward an expansion of the University into a new discipline. That is not the case in this situation. Here, U.T. Dallas seeks no new degree or program authority, nor does the University seek any changes in administrative structure. Rather, U.T. Dallas seeks authority to offer instruction at the lower-level, the level that has been heretofore prerequisite to entering the University. The faculty at U.T. Dallas are already involved at the national and international level in the research areas of their disciplines.

Planning for the implementation of House Bill 42 at U.T. Dallas is well underway. Committees composed of faculty, staff, and students have been appointed to make recommendations to the President for preferred policies and procedures regarding curricula, admissions and recruitment, facilities, computing and registration, library, advising, minority recruitment, and student life and services.

The addition of lower-level students will in no way diminish the research and scholarly activities of the faculty. Providing lower-level students access to this faculty will have the beneficial societal effect of attracting more students to the scientific, mathematical, and engineering areas, all areas of critical state need.

The addition of the lower-level program would have a minimal effect on the course load of the present faculty.

Section 5.95 LIBRARY

16. Are present library holdings in relevant fields adequate to begin the proposed program? How will the library have to be improved to meet program needs in the next four years?

The library collection of UTD has been assembled with the specific purpose of supporting graduate education for Master and doctoral students and upper division undergraduate students. As such, the library holdings emphasize primary research reports designed to assist state-of-the-art investigation of a subject for a

researcher who is working on the growing outer edge of new knowledge. Thus, the collections are quite specialized and targeted towards the fields where doctoral work is in progress.

The best illustration of this fact is that the library standard work for the evaluation of undergraduate library collections is Books for College Libraries (BCL), a collection of 50,000 titles recommended for an undergraduate library. These books are selected from faculty reviews from the journal called Choice, a journal whose purpose is to review books for academic libraries. UTD libraries presently contain less than 60% of these books for almost all areas of the curriculum. We estimate that approximately 21,000 titles from BCL will need to be acquired to serve freshman and sophomore students adequately.

UTD libraries also have specifically avoided material that is treated from a strictly instructional point of view such as freshman or sophomore level textbooks, laboratory manuals, syntheses of research reports, or any kind of remedial education books. We estimate that the library would need to acquire approximately 4,000 additional volumes that address material of this type.

17. What are the institutional surpluses or deficiencies as measured by the Clapp/Jordan formula?

Presently, as of August 31, 1989, the UTD library is deficient in volume holdings measured by the Clapp/Jordan formula by 78,963 volume equivalents. At current levels of spending for acquisitions and at current enrollment levels, these deficiencies will be eliminated by August 1991.

18. How will approval of the program alter this situation?

The Clapp/Jordan formula will require adding 15 volumes per student for each lower-level undergraduate admitted. If 1,000 students are added, then 15,000 volumes are required; if 2,000 are added, then 30,000 volumes are required; 5,000 students will require 50,000 volumes in addition to the 25,000 volumes mentioned in question 16 to meet the Clapp/Jordan standard.

19. Do faculty and students now use the libraries of other institutions? Could they do so in the proposed program?

The present policies of the Association for Higher Education, a North Texas consortium with library resource sharing arrangements, permits undergraduate students in-building use only of member libraries. It does not permit undergraduate students to circulate books from other libraries -- only Master and doctoral students and faculty can withdraw books. Also, the present national Interlibrary Loan Code (ILL) that governs the resource sharing arrangements in libraries does not permit undergraduates to use ILL.

20. Estimate the total expenditure for the last two complete fiscal years for library acquisitions in the departments or subject matter fields in which the proposed program will be offered, or in fields which are closely related to the proposed program.

The library spent no money for acquisitions related to lower-level instruction in the last two fiscal years.

21. Project library expenditures to be budgeted annually for the next five years in supporting this program.

1990	\$540,000
1991	\$540,000
1992	\$540,000
1993	\$540,000
1994	\$540,000

Total \$2,700,000 for materials and processing.

Section 5.96 FACILITIES AND EQUIPMENT

22. Describe existing facilities that are available for the proposed program. Describe the present utilization of these facilities.

In Fall 1989, UTD's student body will number approximately 8,000. Historically, half of the students attend class in the evening only and more than 75% attend at least one class in the evening. Consequently, classroom capacity is filled from 5:00 to 10:00 p.m. The University does have excess classroom space during the hours of 8:00 a.m. to 5:00 p.m., the more traditional time for scheduling lower division courses. Laboratory space to accommodate lower division requirements is limited. It appears, however, that through a combination of careful scheduling and renovation of existing space, adequate space for lower division labs will be available during the start-up years.

23. What new facilities will be needed in the near future? Specify what special facilities and equipment will be needed and estimate their cost. From what sources do you anticipate obtaining needed facilities and equipment?

The initial increment of students admitted as freshmen and sophomores at U.T. Dallas will attend classes in the day time, during periods when classrooms are currently available. However, at the present time, U.T. Dallas is projecting the need for additional classroom and laboratory space. This need arises from increased enrollments, overcrowding during the evening, and incompletd plans for the Erik Jonsson School of Engineering and Computer Science, rather than from a need to accommodate lower division students. Enrollment growth will lead to the need for additional facilities in five years and beyond. Renovation costs necessary to the accommodation of freshmen and sophomores are estimated to be \$120,000. We would anticipate funding these renovations from Permanent University Fund bond proceeds and/or private resources.

24. Will the approval of this program result in planning for the addition of new facilities?

The University will be studying the need for additional auxillary space for student housing and student services, as well as additional instructional and research space.

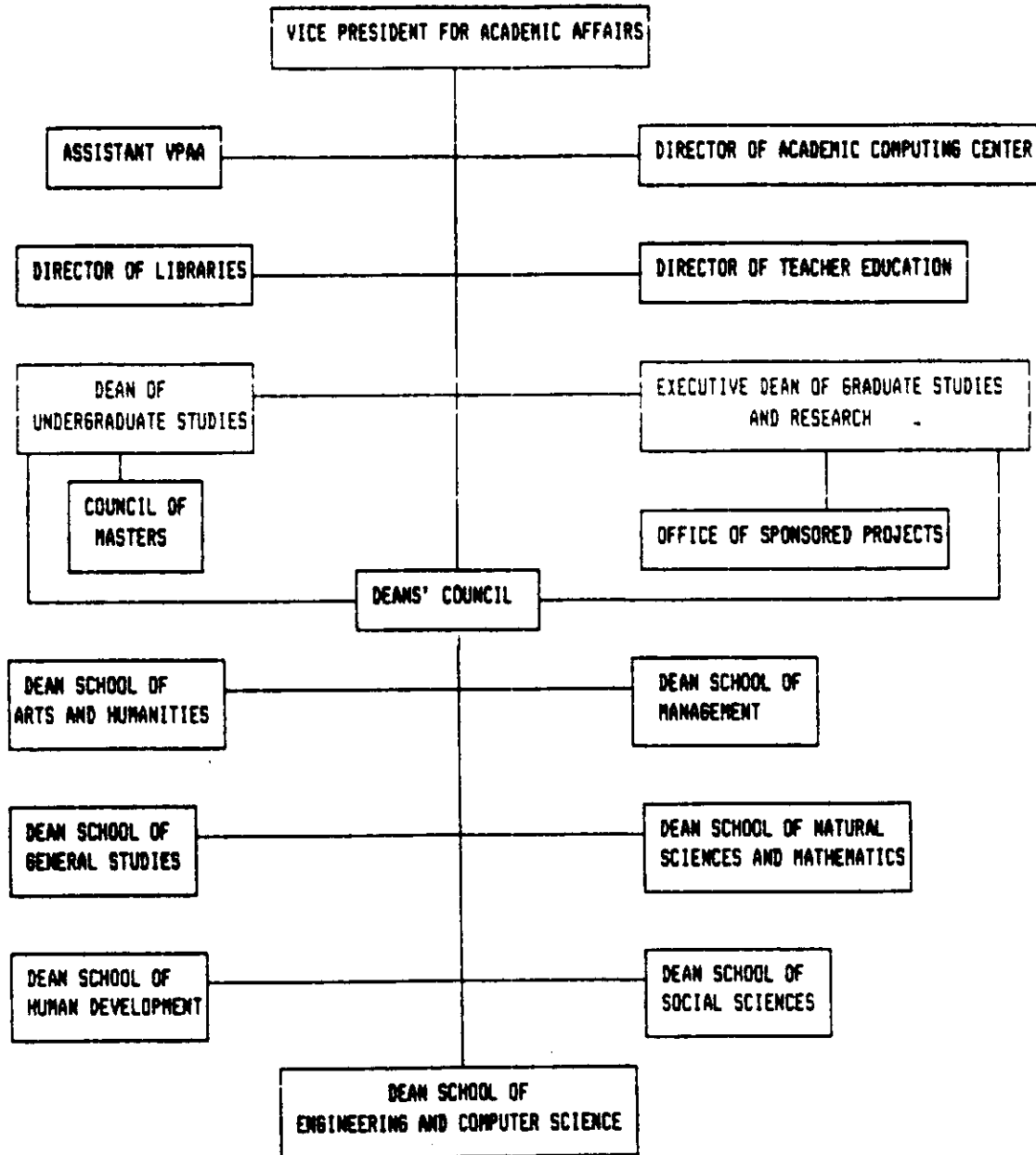
Section 5.97 ADMINISTRATION OF PROPOSED PROGRAM

25. Will the proposed program affect the administrative structure of the institutions? If yes, describe how.

No, the addition of freshman and sophomore students will not necessitate a change in the administrative structure at U.T. Dallas. In fact, it appears that the current structure is well suited for the needs of lower division students.

26. In what department, division, school, or college will the proposed program be administered? If the program is to have interdepartmental or interunit administration, explain in detail.

From its beginning, U.T. Dallas has utilized the concept of colleges in each School. The college serves as the undergraduate student's intellectual, cultural, and social home on campus. Each college is headed by a College Master who is responsible for academic advisement as well as programs and activities designed to fulfill the student's personal and educational goals. The Dean of Undergraduate Studies is Head of the Council of Masters, supervises certification of undergraduate degrees, and is charged with the design and conduct of interdisciplinary studies in conjunction with the Council of Masters. The academic organization at UTD is shown below:



Section 5.98 ACCREDITATION

27. Describe the requirements for accreditation, if the program is eligible to be accredited. What is the name of the accrediting agency? What will be the initial costs of accreditation and the subsequent annual costs to maintain it? Identify basic criteria for accreditation and describe how well these are presently being met.

The University of Texas at Dallas received reaffirmation of its accreditation by the Southern Association of Colleges and Schools in December, 1988. The addition of lower division students would not necessarily alter the University's accredited status, but would call for notification to SACS and their determination of the need for further review.

Section 5.99 SUPPORTING FIELDS

28. The request shall include information on supporting fields as follows: Evaluate the subject matter fields at the institution which may be considered as necessary, or valuable, in support of the proposed program. Will these fields need improvement or expansion? If so, how, to what extent, and at what cost? Be specific.

Supporting subject matter fields are present in the University's current degree profile. While the faculty size will need to be increased to provide lower-level instruction, no new subject matter courses are anticipated. The exact mix of new faculty will be determined when the lower-level curriculum is developed.

Section 5.100 COSTS OF PROPOSED PROGRAMS

29. Estimate the initial (first year) costs of the proposed program. If this is an extension of an ongoing program, what will be the cost differential?

Annual operating costs to the state for serving projected increases in the number of freshman and sophomore students will be the same at U.T. Dallas as if those students had been enrolled at any other senior college or university in the state. The state formula funding procedures ensure that students generate the same state support regardless of the institution which they attend.

Because the expansion into the lower-level will require no new degree programs or changes in the degree profile of U.T. Dallas, all costs shown are differential costs. An enrollment of a maximum of 600 lower-level students is estimated for the first year in the table below. This estimate is probably high given the short time frame in which lower division status would be implemented.

SUMMER 1990 TO SUMMER 1991

Estimated Number of Students	600
Estimated Credit Hours	18,000
Formula Funding	\$0
Estimated Tuition Revenue	\$324,000
Costs:	
Faculty/Lecturers/TA's	\$1,759,140
Library	\$540,000
Equipment	\$124,000
Renovations	\$120,000
Operations	<u>\$254,895</u>
TOTAL	\$2,798,035

The total estimated cost for the first year is \$2,798,035. These costs are to be met with local resources including any additional gifts or grants donated for the purpose of adding the lower division to U.T. Dallas. The University has already received gifts of \$550,000 to defray a portion of these costs and an additional \$1,000,000 has been pledged for a minority scholarship program.

30. Estimate the annual cost of the program for the three years following its first year. (Use current formulas in arriving at the estimate.) Explain the rationale for the estimate. If this is an extension of an ongoing program, what will be the cost differential?

No general revenue funds were appropriated for the implementation of House Bill 42 and no public funds may be expended for that purpose prior to approval by the Coordinating Board except for expenditures related to presentations to the Coordinating Board regarding implementation of lower division levels at UTD (Texas Education Code, Section 3(a) and (b)).

Enrollment limitations during the start up years for freshmen and sophomores at U.T. Dallas, which include the base year for funding for the 1992-1993 biennium, will result in minimal additional general revenue funding for the third and fourth years that freshmen and sophomores would be enrolled at U.T. Dallas (i.e., 1992-93 and 1993-94). The statute does provide that for the 1992-1993 biennium, U.T. Dallas is entitled to continue to receive upper-level formula funding for its junior and senior undergraduate enrollments while also receiving funding, based on the regular general academic institution formulas, for the maximum of 1,040 freshman and sophomore level students who may be enrolled prior to the 1992-1993 academic year.

Cost estimates are based on current formulas and estimated enrollments for each of the three years. All figures represent differential costs.

	<u>1991-1992</u>	<u>1992-1993</u>	<u>1993-1994</u>
ENROLLMENT (Maximum)	1,040	2,000	2,500
ACADEMIC COSTS (Maximum*)			
Faculty Salary	\$ 997,045	\$1,917,394	\$2,396,743
Departmental Operating Expenses	90,891	174,791	218,489
Library	<u>87,194</u>	<u>167,680</u>	<u>209,600</u>
Sub-Total	\$1,175,130	\$2,259,865	\$2,824,832
OTHER COSTS (Maximum*)			
Genrl. Admin. & Student Serv.	\$ 82,326	\$ 158,320	\$ 197,900
Genrl. Institutional Expenses	26,208	50,400	63,000
Instructional Administration	19,803	38,083	47,604
Research Enhancement	14,109	27,132	33,915
Plant Support	11,202	21,542	26,927
Campus Security	21,817	41,955	52,444
Building Maintenance	0	0	0
Custodial Services	0	0	0
Grounds Maintenance	<u>1,482</u>	<u>2,851</u>	<u>3,563</u>
Sub-Total	\$ 176,947	\$ 340,284	\$ 425,354
TOTAL	\$1,352,077	\$2,600,149	\$3,250,186

\*Costs will be proportional to actual enrollments

31. Show the departmental operating expenditures for the last two fiscal years for the departments which will contribute significantly to the support of the proposed program. How will the proposed program affect the allocation or distribution of these funds?

Since the expansion into the lower-level will affect all segments of the University, the relevant figures are the total DOE expenditures for the University. These were:

FY 88	\$2,805,556
FY 89	\$3,249,117 (est.)

It is not anticipated that the addition of a lower-level will have a significant impact on the distribution of these expenditures.

32. What additional funds for research will be needed to support the proposed program? Explain.

No additional research funds will be required to implement lower division instruction at U.T. Dallas.

33. How many graduate assistantships are considered desirable to begin the program? Estimate the amount of funds required for these assistantships over the next four years. What sources are available to support these assistantships? Will student aid funds be needed for undergraduates other than those provided for all undergraduates? Explain in detail.

Current levels of graduate assistantship funding will be adequate to meet the needs of lower-level instruction.

U.T. Dallas will explore the impact that four year status may have on the University's eligibility for increased federal and state financial aid funds. Opportunities for private funding for scholarships and fellowships appear to be favorable once four year status has been established. The University of Texas System has been notified by the Peter O'Donnell Foundation that a minority scholarship fund of one million dollars will provide support to assist in recruiting minority freshmen to U.T. Dallas.

34. Describe briefly the sources of financial support for this program and evaluate the adequacy of funds for the inauguration and support of the program. Does the program give indications of becoming self-supporting within three years in terms of formula generated income?

House Bill 42 (Texas Education Code, Section 2(a) and 2(c)), specifies that the enrollment of freshmen and sophomores be limited to 1,040 for the first summer session of 1990 and for the academic year 1990-1991. During these start up years, funding for lower division courses would be provided by local resources and private funds. Beginning with the 1991-1992 biennium, House Bill 42 provides that funding

for lower division instruction will be based on the regular general academic institution formulas as well as the incremental funding provided by the formula for upper division instruction. The data below specify the cost differential assuming the estimated enrollments shown for each year.

(a) Instructional Data  
(Incremental)

	<u>1990- 1991</u>	<u>1991- 1992</u>	<u>1992- 1993</u>	<u>1993- 1994</u>	<u>1994- 1995</u>
Student Headcount	600	1,040	2,000	2,500	3,000
Faculty	32	55	105	132	158
Student/Faculty Ratio	19.00	19.00	19.00	19.00	19.00
SCH/Student	30	30	30	30	30
Semester Credit Hours	18,000	31,200	60,000	75,000	90,000

(b) Projected Academic Cost Based on Formula Generated Funds  
(Incremental)

	<u>1990- 1991</u>	<u>1991- 1992</u>	<u>1992- 1993</u>	<u>1993- 1994</u>	<u>1994- 1995</u>
Faculty Salaries	\$575,218	\$997,045	\$1,917,394	\$2,396,743	\$2,876,092
Dept. Operations	\$52,437	\$90,891	\$174,791	\$218,489	\$262,187
Library	<u>\$50,304</u>	<u>\$87,194</u>	<u>\$167,680</u>	<u>\$209,600</u>	<u>\$251,520</u>
Total	\$677,960	\$1,175,130	\$2,259,866	\$2,824,832	\$3,389,799

As indicated previously in question 14, it is technically possible to provide lower division instruction at U.T. Dallas totally funded by formula within three years. However, the University will seek additional funding from local resources to maintain the quality of instruction.

35. Add any comments which would be helpful to the Coordinating Board in evaluating this program request.

The addition of freshmen and sophomores will not alter the degree profile or the administrative structure at The University of Texas at Dallas. As an upper-level, graduate research institution, the University has established programs of excellence with emphasis in the natural sciences and engineering. It is the apparent will of the Legislature that admissions to these programs be made available to high school graduates. Notwithstanding the enrollment limitations set forth in the enabling legislation, it is timely that UTD admit lower-level students as neighboring public institutions are faced with enrollment limitations.

Texas is a dynamic, growing state. Consequently, the public higher education system must be changed and enlarged almost continuously to adapt that system to new needs. Authorizing U.T. Dallas to enroll freshmen and sophomores can be seen as one of many such adaptations. Some of the external forces which are shaping this and other higher education system decisions are:

- As it has in the past, Texas population will continue to grow dramatically. By the year 2020 the Texas Water Resources Board projects state population will increase over 11 million, the equivalent of adding the current population of Louisiana, Arkansas, Oklahoma, and New Mexico.
- Texas is increasingly becoming an urban state. Of the over 11 million additional Texans expected by the year 2020, 1.7 million will reside in the four metroplex counties, Collin, Dallas, Denton, and Tarrant.
- The metroplex has reached the size of many states and requires a range of services equal to those provided in many states. The total population of the four metroplex counties in the year 2020 (5.1 million) is expected to equal the current statewide population in such states as Wisconsin, Maryland, Louisiana or Tennessee. In fact, only 15 states currently have a larger population than is projected for these four counties.
- Texas does not produce a large number of undergraduates who ultimately receive doctorates in science and engineering. Of the 30 leading institutions from which the 1984 science and engineering doctoral recipients received bachelor's degrees, only U.T. Austin is in Texas. Four of the thirty are in California, three in New York, and two in Massachusetts:
- The Texas economy is becoming increasingly complex and diversified, with a corresponding requirement for a highly skilled labor force. Only 12.2% of the 1986 Texas Gross State Produce was derived from farming and mining (oil).
- College attendance rates in Texas are below the national average and well below the leading industrial states, thus requiring Texas to make extra efforts to strengthen its labor force. In 1986, the U.S. average was 51.9 college students per 1000 population, while Texas' average was 46.5 college students per 1000 population, and economic competitors such as California, Michigan, and New York were 64.2, 56.9, and 56.6, respectively.

36. Attach the letter of Certification of Adequacy of Financing to the completed copies of the application for the new degree program.

Not applicable. As has been indicated previously, this proposal does not involve a request for a new degree program or administrative change. Rather, it concerns providing an alternate delivery site for the education of the state's future freshmen and sophomores. Based on the funding formula used in Texas, these costs to the state will be the same regardless of the four year institution attended by future lower division students.

APPENDIX A

## The University of Texas at Dallas

### Mission Description

The University of Texas at Dallas, defined by state law as a "general academic institution" of The University of Texas System, is committed to pursue high standards of achievement in instruction, student performance, research, and scholarship.

U. T. Dallas believes the purpose of any university is the advancement of knowledge and the education of its students and recognizes that the quality of a university is measured by how well it accomplishes these purposes. To those ends, U. T. Dallas is committed to excellence in the conduct of research and instruction. In addition, the University's destiny is inextricably linked with the fortune of the Dallas metropolitan area. The University believes a partnership with the knowledge-based businesses and industries of this area will enhance the University's opportunity to become the first-class institution it aspires to be.

The principal mission of The University of Texas at Dallas is to be responsive to the educational and research needs of the nation as exemplified by the technologically-sophisticated and managerially-intensive economy of the Dallas metropolitan area. A unique portion of the mission of U. T. Dallas, which is met through the Callier Center for Communication Disorders, is the provision of clinical services, educational services, cultural and social activities, and the conduct of research to serve the needs of those with communication disorders.

To support the social, cultural, and economic development of the Dallas region, U. T. Dallas has defined its principal mission, designed its programs, and assembled its faculty with an aim toward the conduct of graduate education and research to meet the needs of business, industry, and government, as well as to continue to enhance its national academic reputation by the placement of some of its doctoral graduates at major universities.

At the undergraduate level, U. T. Dallas emphasizes the admission of lower division students who intend to enroll in academic programs leading to degrees in natural sciences, mathematics, or engineering. At the upper division, U. T. Dallas emphasizes serving those students who have received freshman-level and sophomore-level instruction at community colleges located in the Dallas metropolitan area.

U. T. Dallas is a doctoral-granting university with a strong research tradition which can be traced back to its origin as the Southwest Center for Advanced Studies. [~~It offers undergraduate instruction to juniors and seniors, only.~~] At the core of the U. T. Dallas curriculum, as shown in section I, Table of Programs, are the arts and the sciences, those academic disciplines common to most colleges and universities in the United States. Degree programs are offered in these disciplines to

## The University of Texas at Dallas

### Mission Description - continued

support a general liberal education, within an interdisciplinary context, at the baccalaureate level. Master's level courses and degree programs also are offered in many of these disciplines, and offerings at the doctoral level exist in three of the Arts and Sciences discipline categories.

Degree programs and course offerings beyond those in the Arts and Sciences core reflect the specific needs of employers and citizens in the Dallas region and the distinctive character of U. T. Dallas as a graduate research institution. U. T. Dallas currently offers baccalaureate and master's level programs and courses in eight professional or other disciplines (Business Administration, [Education,] Engineering, Health Sciences, Public Affairs, Communication, Computer and Information Sciences, Multi/Interdisciplinary and Liberal/General Studies. In addition, baccalaureate level programs in Area/Ethnic Studies [~~and-baccalaureate~~] and master's level programs in Education [Engineering] are authorized. Doctoral level work in five professional discipline categories is offered at the present time with a sixth, Engineering, to be implemented during 1989-90.

### Mission Supplement

U. T. Dallas inherited from the Southwest Center for Advanced Studies a distinguished and well recognized program of research which has been maintained and expanded. Since becoming a state institution, U. T. Dallas has ranked among the top academic institutions in Texas in sponsored research per full-time faculty equivalent, consistently outranking most older and more traditional Texas state universities. The nature of this research has focused on scientific and technological disciplines and has ranged from the instrumentation of outer space exploration to problems in the neurosciences.

While U. T. Dallas draws students from throughout the world, more than 80 percent of the student body come from the North Dallas region and surrounding area, an area with approximately two million people. A majority of the students are employed, many of them full time, and over 75 percent of the students attend evening classes. As the only public institution of higher education located in the Dallas metropolitan area, U. T. Dallas is committed to providing undergraduate and graduate educational opportunities at times that are convenient to its place-bound constituents.

A distinguishing feature of U. T. Dallas is its academic organization and programmatic structure. The academic structure reflects programmatic function rather than disciplinary departmentalization. The schools have been constituted to serve as budgetary and management centers for all academic activities: graduate and undergraduate programs, undergraduate colleges and

The University of Texas at Dallas

Mission Supplement - continued

research centers. The academic organization at U. T. Dallas supports the programmatic requirements of graduate research and instruction in many nontraditional fields of study, including industrial chemistry, applied mathematics, [environmental sciences,] communication sciences and disorders, political economy and international management. In addition, U. T. Dallas conducts its programs in teacher education in a comparatively unorthodox, but successful, manner. Students seeking teacher certification are required to meet the same requirements of their discipline as are non-teacher education students. U. T. Dallas has no separate department or school of teacher education.

The Table of Programs approved by the U. T. Board of Regents recognizes degree programs in some discipline categories for future planning purposes and generally does not restrict the University's efforts within a broad discipline category and level even though the table currently approved by the Coordinating Board is restricted by footnote. The U. T. Board of Regents does recognize that approval of new programs which lie outside the currently approved role and scope cannot be implemented without prior approval of both the program and a change in the role and scope. Program areas approved by the U. T. Board of Regents but not by the Coordinating Board include doctoral level programs in the following discipline categories: Education, [Engineering,] Letters, Psychology, and Social Sciences.

## The University of Texas at Dallas

### Historical Statement

The University of Texas at Dallas was founded in 1962 as a private research institute for graduate studies and became a part of The University of Texas System in 1969 by an Act of the 61st Legislature. From September 1, 1969, to September 1, 1975, U. T. Dallas operated as a graduate institution only, offering master's and doctoral level programs primarily in the sciences. The first degree awarded by U. T. Dallas was a Ph.D. in Physics in 1972-73.

In September 1975, U. T. Dallas admitted its first junior and senior level students. As an upper level institution, the University did [~~does~~] not admit freshmen and sophomores. From fall 1974 to fall 1975 enrollment grew from 700 graduate students to 3,333 students, 45 percent of whom were graduate students. That high proportion of graduate to undergraduate students has remained relatively constant over the years [~~decade~~] the University has operated [~~under-its-full-mandate-~~] without lower-division students.

Also in September 1975, the Callier Center for Communication Disorders became a part of U. T. Dallas. Callier serves the needs of children and adults with all types of communication disorders. Clinical services include audiology, speech pathology, and psychological counseling. Educational services include preschools for normal and hearing impaired children, a parent education program for hearing impaired children and their parents, and a school program for multihandicapped deaf children. Callier serves as a focal point for research and instruction in the School of Human Development where faculty in communication sciences, developmental psychology, and [~~special education~~] neurosciences are collaborating in [~~the implementation-of~~] an innovative new doctoral program in Human Development and Communication Sciences.

The School, headed by a dean, is the smallest academic and budgetary unit within the academic structure at U. T. Dallas. Currently, there are seven [~~five-ether~~] schools in the academic organization of U. T. Dallas: Arts and Humanities, Engineering and Computer Science, General Studies, Human Development, Management, Natural Sciences and Mathematics, and Social Sciences. [~~Pending-approval-by-the-Coordinating-Board-of certification-of-adequate-financing-and-the-fulfillment-of-other conditions,-a-new-School-of-Engineering-and-Computer-Science will-be-established-to-house-existing-degree-programs-in computer-sciences-and-recently-authorized-programs-in engineering.--The-school,-headed-by-a-dean,-is-the-smallest academic-and-budgetary-unit-within-the-academic-structure-at-U-T-Dallas.-~~]

TABLE OF PROGRAMS

INSTITUTION: The University of Texas at Dallas

DATE: December 15, 1989

<u>Academic Disciplines</u>	<u>Categories</u>	<u>Assoc</u>	<u>Bacc</u>	<u>Mast</u>	<u>Doct</u>
Agriculture	(01, 02, & 03)				
Architecture & Environmental Design	(04)				
Area & Ethnic Studies	(05)		3A		
Business	(06, 07, & 08)		1	1	1
Communication	(09 & 10)		*	*	
Computer & Information Sciences	(11)		1	1	1
Education	(13)			3B	*
Engineering	(14)		3C	3C	3C
Engineering Related Technologies	(15)				
Foreign Language	(16)		2		
Allied Health	(17)		2D		
Health Sciences	(18)		3E	3E	3E
Home Economics	(19 & 20)				
Law	(22)				
Letters	(23)		1	2	*
Liberal/General Studies	(24)		1	2	
Library & Archival Sciences	(25)				
Life Sciences	(26)		1	1	1
Mathematics	(27)		1	1	1
Multi/Interdisciplinary Studies	(30)		3F	3G	3H
Parks & Recreation	(31)				
Philosophy	(38)		1	2	
Physical Sciences	(40 & 41)		1	1	1
Psychology	(42)		1	3I	*
Protective Services	(43)				
Public Affairs	(44)		3J	3K	3L
Social Sciences	(45)		1	2	*
Trade & Industrial	(46, 47, 48, & 49)				
Visual & Performing Arts	(50)		3M	*	

THE UNIVERSITY OF TEXAS AT DALLAS  
Table of Programs: Footnotes

- A: American Studies
- B: Science Education, Mathematics Education, and Humanities
- C: Electrical Engineering (Microelectronics and Telecommunications, only) and Engineering Science (electronic mechanisms design; and electronics manufacturing systems, only)
- D: Programs for the diagnosis and remediation of handicapped children related to the Callier Center
- E: Speech/Language Pathology & Audiology, B.S.; Communication Disorders, M.S.; Human Development & Communications Sciences (including Neurosciences), Ph.D.; and other programs for the diagnosis and remediation of handicapped children and related to the Callier Center
- F: Arts and Humanities, and combinations of previously approved programs
- G: Humanities (Aesthetic Studies, History of Ideas, and Studies in Literature), Human Development, Applied Cognition and Neuroscience, Interdisciplinary Studies, and Science Education
- H: Humanities (Aesthetic Studies, History of Ideas, and Studies in Literature)
- I: Human Development and Early Childhood Disorders and other Cognitive (42.03), Developmental (42.07), and Experimental (42.08) Psychology, only.
- J: Public Administration
- K: Public Affairs
- L: Political Economy
- M: Art and Performance
- \*: The institution's governing board has recognized that some degree programs in this discipline category are appropriate to consider in future planning at the institutional level. If a program proposal is submitted under this category, the Coordinating Board must approve both the proposal and a Role and Scope change.

**APPENDIX B**

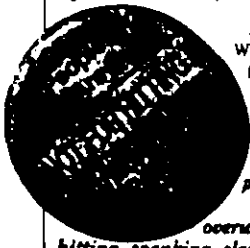
# WINGSPREAD

## THE JOURNAL

The Johnson Foundation, Inc., Racine, Wisconsin ■ Volume 10, Issue 4 ■ April 1989

### "No Physical Punishment of Children" Says National Group

by Susan J. Poulsen, The Johnson Foundation



At the conclusion of a February Wingspread conference, the following position statement was released:

*A group of national experts issues a call to stop parental use of physical punishment.*

*Numerous studies have overwhelmingly proved that hitting, spanking, slapping, or other forms of physical punishment are harmful methods of changing children's behavior. Alternative forms of discipline are more effective.*

*The use of physical punishment is deeply ingrained in American society and will be difficult to eliminate. Nevertheless, convincing evidence of the detrimental effects of physical punishment on children indicates that the time for action is immediate and urgent.*

*The group agreed to begin a national campaign to convince parents to stop hitting or using other forms of physical punishment on their children.*

Some would call it discipline; some would call it spanking, striking, hitting, a "good licking;" schools call it corporal punishment; some people even call it assault. But by any name, many experts now agree that physical punishment of children, by their parents or any other

continues on page 3

### Shortage of Scientists, Engineers, and Mathematicians Looms in Next Decade

by Susan J. Poulsen, The Johnson Foundation

The United States will soon face a shortage that threatens to affect all areas of its international competitiveness, economic stability, and technological independence.

A 25 percent decline in the pool of 18-year-olds, (1980 to mid-1990s) predicted by a recent U.S. Bureau of Census' study will mean, among other things, that the future supply of scientists and engineers in this

startling statistics presented to members of a National Advisory Group which met at Wingspread in January to explore the nature and quality of undergraduate education in science, mathematics and engineering, and to identify significant topics and issues that should be addressed in charting policy for undergraduate education in these critical fields.

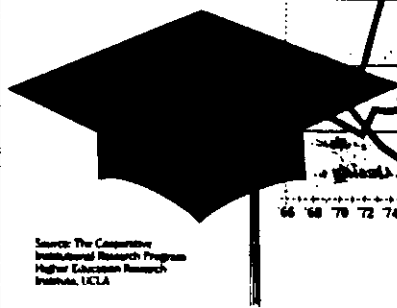
process to be enjoyed and experienced. Treating science education as a "training" exercise requires that students learn the "what" of scientific information rather than ask the question "why." Consequently, students fail to experience the sense of wonder and excitement which true science can bring, and are turned off to the prospect of advanced studies in the sciences long before they make the college major selection.

With a steadily declining portion of American young people choosing science, mathematics, engineering or computing as a field of study, the future strength of these important disciplines is seriously threatened. Academic declines point to potential problems in the future supply of newly trained engineers and computer professionals entering the labor market in the 1990s. Furthermore, these declines will have important consequences for the pool for future graduate students and secondary school teachers.

The National Advisory Group, assembled by Sigma Xi - The Scientific Research Society, under a grant from the National Science Foundation, identified seven key topics which need to be addressed in the area of undergraduate education in science, mathematics and engineering. Their concerns related not only to those students majoring in these subjects or planning to major in them in advanced study, but also to those in other major areas who need to develop a level of competence, understanding, and appreciation for the sciences. The seven topics identified were:

- Quality of Teaching Instruction
- Quality of the Curriculum
- Quality of the Human Environment
- Quality of the Physical Environment
- Accessibility and Flexibility of Curricula Essential for Student Mobility
- Attitudes and Perceptions of Students, Faculties, Administration and the Public
- The Promises and Special Needs of

#### Freshman Interest in Science Majors



Source: The Cooperative Institutional Research Program Higher Education Research Institute, UCLA

country will be inadequate to meet national needs. Adding to the impact of the declining pool of students is the alarmingly declining rate at which college students are choosing majors in science, mathematics, technology and engineering.

According to the Cooperative Institutional Research Program (CIRP), overall interest in science majors has dropped by half between 1966 and 1988 (from 11.5 to 5.8 percent). Between 1966 and 1988, the proportion of freshmen math majors in U.S. colleges and universities dropped from 4.6 percent to 0.6 percent. After recording big increases during the late 1970s, the popularity of engineering careers has dropped by almost one-third between 1982 and 1988 (from 12.0 percent to 8.6 percent). And a disproportionate number of those students who do choose these majors are foreign students who plan to take their training with them to other countries when they graduate.

These were just a few of the

Where are all the would-be scientists, mathematicians, engineers and teachers of these subjects going? According to Kenneth C. Green, associate director of the Higher Education Research Institute at UCLA, they are majoring in business. "Business is now the most popular major and career choice among college freshmen, having doubled since the late 1960s," according to Green. One-fourth of all 1988 college freshmen plan to pursue careers in business, up from 19.3 percent in 1978 and 11.6 percent in 1968. The proportion of freshmen women planning to pursue business careers has increased by a factor of more than six over the past 23 years, from 3.3 percent in 1966 to 21.1 percent in 1988.

The decision to reject the study of science comes early in life. Unfortunately, science, as it is generally taught in high schools and grade schools today, is often presented as a set of facts to be memorized rather than a creative

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## Shortage of Scientists, Engineers, and Mathematicians Looms in Next Decade

*With a steadily declining portion of American young people choosing science, mathematics, engineering or computing as a field of study, the future strength of these important disciplines is seriously threatened.*

Traditionally Under-represented Groups (women, minorities, the disabled) in Science, Mathematics and Engineering

According to a summary report presented by conference chair Anna Harrison, professor emeritus in Chemistry at Mount Holyoke College, these seven topics require broad, systematic, and immediate consideration.

### 1. Quality of Teaching Instruction.

Despite the talent and capacity that many scientists, mathematicians and engineers have for teaching their subjects, relatively few have the good fortune of being able to devote sufficient time, energy and creativity to excellence in teaching without significant psychological and monetary penalties. The undergraduate infrastructure that rewards those who do research and denies those rewards to teachers, contributes to the shortage of quality in teaching of science, mathematics and engineering.

### 2. Quality of the Curriculum.

Students and faculty perceptions of curriculum in these areas are often not the same. Students often see entry level science, mathematics and engineering courses as inaccessible, unrewarding, irrelevant, or too difficult; at the same time, these courses are the "watersheds" that determine the place of science, mathematics and engineering in the future lives of college students as well as in the vitality of undergraduate programs.

### 3. Quality of the Human Environment.

Large classes, high student/faculty ratios, inaccessible faculty, and lack of support systems may all lead students to view the human environment in early science, mathematics and engineering classes as hostile. A supportive and positive environment is valuable to all students, but particularly for women, minorities,

and the physically disabled, many of whom have been conditioned to believe that these subjects are beyond their grasp.

### 4. The Quality of the Physical Environment.

Opportunities for hands-on experience with the investigation of phenomena — with adequate library holdings, laboratory facilities, and instrumentation accessible to all students — are critical to a positive introduction to the sciences.

Through such hands-on experimentation, students learn critical thinking, planning, analysis and synthesis, and the opportunity to discover the integrity of data, the uncertainty of measurements, and the powers and limitations of science and engineering.

### 5. Accessibility and Flexibility of Curricula Essential for Student Mobility.

Faculty and students may view the undergraduate major and its related sequencing program to be either a facilitator or a roadblock to students' goals. Students want to participate in charting their own educational course on the basis of experience and developing interests — things that can rarely be predicted for all students at the beginning of an academic journey. Accessibility to upper level courses in multiple disciplines for adventurous and capable students can provide the needed challenge to retain the potential lost interest.

### 6. Attitudes and Perceptions Held by Students, Faculties, Administrations and the Public.

Attitudes and perceptions about science, mathematics and engineering play a significant role in the process of selecting and retaining successful students. As such, attitudes and perceptions must be considered carefully as changes in education policy are planned.

### 7. Promises and Special Needs of Traditionally Under-represented Groups — Women, Minorities and the Physically Disabled.

This significant talent pool for the sciences, mathematics, engineering, and technology must be considered in any effective policy plan for changing undergraduate education.

### Unified Approach is Essential for Change

Addressing these seven topics, and ultimately fulfilling the missions of undergraduate education in these key fields, requires the participation and leadership of many communities, organizations, and institutions. Colleges and universities will not meet the challenge alone; they must be supported and informed by the community of scientists, mathematicians and engineers, professional societies, government agencies, industries and foundations,

each of which has much to gain by the improvement of the education process, and everything to lose by its failure.

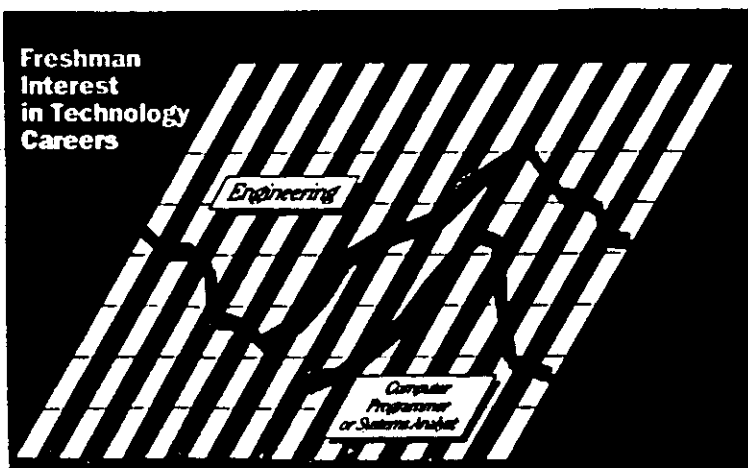
Among the conclusions of the Wingspread conference were specific requests from the Sigma Xi National Advisory Group to the National Science Foundation (NSF) Directorate for Science and Engineering Education. They called for NSF to facilitate:

- open and forthright discussion and evaluation of the factors that make the reward system for excellence in undergraduate education non-competitive with other professional activities of scientists, mathematicians and engineers;
- scholarly research related to education at the undergraduate level;
- the development of more appropriate entry level undergraduate courses;
- the development of process-oriented laboratories for all students at all levels;
- the participation of majors in science, mathematics and engineering in student research;
- the entry and sustained professional development of women, minorities and persons with disabilities;
- the exchange of information among those developing innovative undergraduate curricula.

A seminal report on potential shortages in the fields of science, mathematics, technology and engineering released in mid-1988 by the Office of Technology Assessment of the United States Congress<sup>2</sup> concluded that a shortage is not inevitable, provided that strategies for recruitment and retention of young people in these fields are developed promptly. These complementary measures, the report states, include vigorous steps to "prepare a cadre of versatile scientists and engineers for research and teaching, invest in an educational system that creates a reservoir of flexible talent for the work force, and ensure opportunities for participation by all groups (e.g., women, minorities and the disabled) in science and engineering."

In the coming years, Sigma Xi will place increased emphasis on encouraging this process, according to Tom Malone, the Society's president. The fact that Sigma Xi, a society of research scientists, has chosen to confront this situation and to focus on the educational issues surrounding it, serves as a dramatic underscoring of the urgency of the need to encourage Americans to study science. Other key professional societies and scientific entities, both in the U.S. and in other countries, also must focus on this need if society is to have the trained minds to survive in the technology-driven world of the future.

<sup>1</sup> Current Population Reports, Series P-25, No. 952, U.S. Bureau of Census, 1988.  
<sup>2</sup> Educating Scientists and Engineers: Grade School to Grad School, OTA-SIET-377, Office of Technology Assessment, United States Congress, June 1988.



# American Scientist

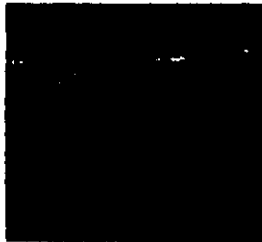
Volume 77, No. 5, September-October 1989

Published by Sigma Xi, The Scientific Research Society

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with a special report  
on supercomputing.



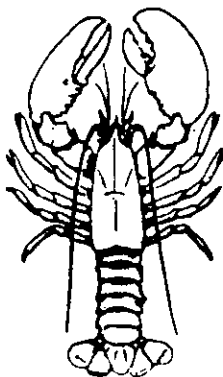
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## The Scientists' Bookshelf

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## Cover

An Ache hunter takes careful aim at a capuchin monkey (*Cebus apella*) in the forest of eastern Paraguay. Until recently, many of the Ache were nomadic foragers; today they continue to return for several days at a time to the primary forest, where they gather insects and edible plants and hunt mammals for meat. See the article by Kim Hill and A. Magdalena Hurtado on p. 436. (Photograph by A. M. Hurtado.)

# A Profile of Undergraduates in the Sciences

Kenneth C. Green

The largest and oldest empirical study of higher education in the United States indicates that the nation's science resources, as represented by the students who are planning undergraduate work in the sciences, have suffered serious erosion over the past two decades. Since 1966 early indicators of undergraduate interest in the sciences have been tracked by the annual survey of entering college freshmen conducted by the American Council on Education and UCLA's Cooperative Institutional Research Program (CIRP). The CIRP freshman and follow-up surveys are a rich source of data about the students who pursue higher education in the United States. In recent years more than 300,000 students attending some 600 two-year and four-year colleges and universities across the country have participated in the CIRP freshman survey annually.

The evidence from the CIRP surveys reveals a number of disturbing trends (Astin et al. 1987). Interest in fundamental undergraduate science majors among college freshmen has dropped dramatically over the past 23 years. Freshman interest in technology careers has experienced an abrupt decline in just the past six years. And more than half the students who enter college planning to pursue science majors change their intended major to nonscience fields. CIRP data also show that the science training of secondary school science and mathematics teachers has deteriorated dramatically over the past two decades.

These findings may sound alarmist, but they must be viewed together with a series of recent national reports that bemoan the increasing scientific illiteracy of Americans and the poor scientific performance of American students in international comparisons. Given this

broader picture, the declines in science capacity reflected in the CIRP data raise serious questions about the ability of the nation's labor market to respond to the scientific, technological, and economic challenges of the 1990s and the twenty-first century.

Between 1966 and 1988 the proportion of college freshmen planning to major in the sciences and mathematics fell by half, from 11.5 to 5.8% (fig. 1, see Astin et al. 1988 for details about the CIRP survey methodology). The largest portion of this decline occurred in mathematics (from 4.6 to 0.6%) and in the physical sciences (from 3.3 to 1.5%). Only the biological sciences have retained freshman interest; however, the seemingly stable interest in the life sciences primarily reflects aspirations for medical careers rather than any intrinsic interest in the biological sciences themselves.

The CIRP trends for women in science are surprising. Conventional wisdom might suggest that interest in the sciences among freshman women should have increased over the past two decades as women presumably were encouraged to pursue majors and careers traditionally dominated by men. However, the CIRP data suggest that women's interest in the sciences actually declined by more than two-fifths during this period (from 8.8 to 5.1%). Although this decline is substantially less than the decline among men (from 13.8 to 7.0%) during the same period, it should be particularly distressing given the range of government, institutional, corporate, and philanthropic efforts to encourage young women to pursue training and careers in the sciences.

The dramatic drop in freshman interest in mathematics should concern us for several reasons. In 1966 roughly equal proportions of the men and women entering college—about 5% of each—planned to pursue mathematics majors. By 1988, interest in math majors among both sexes had fallen to less than 1%. Two decades ago the women who earned undergraduate degrees in mathematics often took teaching jobs in secondary schools and thus played a pivotal role in high school mathematics education. These women represented a large part of the teaching pool in mathematics and served as important role models for adolescent girls who might otherwise be all too willing to forgo the sciences despite their talents. However, as women's career aspirations and options expanded beginning in the late 1960s, their

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*The flight of students from science raises serious doubts about the nation's ability to respond to future scientific challenges*

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interests moved away from mathematics and out of teaching. The erosion of this pool of potential math teachers has been an important factor in the deterioration of secondary school instruction in math and science. It has also affected the science pipeline from secondary schools into college.

The CIRP data reflect how student perceptions about

### *Between 1966 and 1988 the proportion of college freshmen planning to major in science and mathematics fell by half*

the job opportunities for engineers and computer specialists have shifted. Freshman interest in engineering careers fell precipitously during the early 1970s, following the termination of funding for large government projects such as the supersonic transport and the subsequent crash of the job market for engineers. The rising interest in engineering careers beginning in 1975 reflects both the return of men and a growing (if still small) number of women coming into engineering. The gains in engineering during this period were stimulated by the economic upheavals of the time: given the dire state of

the economy in the late 1970s and early 1980s, science and technology were safe choices for students concerned about job options and financial security. Over the past six years, however, the CIRP data show a surprising decline in freshman interest in engineering careers and even more dramatic declines in interest in computing. This plummeting interest in computing careers, which follows almost geometric gains between 1977 and 1982, represents the fastest and most significant shift in college majors and career preferences documented over the 23 years of the CIRP data. Surprisingly, there has been no drop in demand for entry-level engineers to prompt the falling interest in engineering majors and careers.

Like the concurrent decline in engineering, the declining interest in computing careers runs against conventional wisdom about the job market and the job prospects for students with technical training. The only bright spots in the economy during the last recession and even during the high inflation that preceded it seemed to be in technological areas. During this period the economy underwent a major transition from manufacturing to service industries, technology, and information systems. These areas became very attractive to many young people. Moreover, high schools and grade schools greatly expanded computer instruction. Paradoxically, the declining freshman interest in computer science seems in part to be a consequence of increasing familiarity with the technology. As more students had contact with computers, the focus of instruction shifted from programming to applications, students came to view the technology as a means to an end (i.e., a job) rather than an end in and of itself (i.e., a job as a programmer).

Our analysis of the declining interest in technology careers in recent years points to a dramatic shift of interest to nonscientific fields. However, the shift has occurred primarily among B students rather than among the most academically able, science-oriented freshmen—students who earned A or A- high school grade-point averages. The distressed economy of the early part of this decade prompted many B students to consider technical careers. However, as employment options improved in other sectors, many of these B students moved into other fields.

In general, the sciences continue to attract a disproportionate pool of academically able students. In 1988, 45.3% of the aspiring science and engineering majors in four-year colleges and universities reported high school grade averages of at least A-, compared to 26.3% for students planning other majors. Indeed, the proportion of these top students increased between 1978 and 1988 in engineering (14.1 to 17.4%) and the

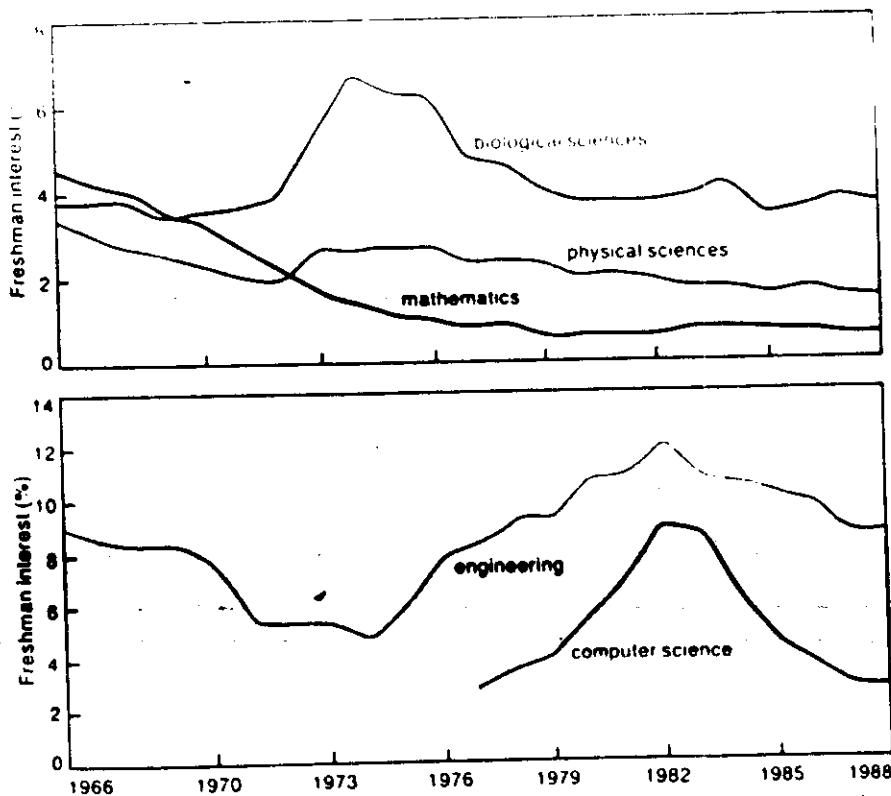


Figure 1. The annual CIRP survey of college freshmen indicates that interest in science and engineering has dropped precipitously over the past two decades. The number of students indicating an interest in science majors (top) shows the greatest decline in mathematics and the physical sciences; only the biological sciences have held their own, and they too show a steep decline from a high point of popularity in the early 1970s. Interest in careers in technology (bottom) has followed the same downward path, with both engineering and computer science experiencing sharp declines following high interest in the early 1980s.

social sciences (8.8 to 9.8%) and remained steady among the life sciences (at 7.9%). Unfortunately, the proportion declined in the physical sciences and among pre-med majors (by 18.2 and 10.5%, respectively).

Also somewhat encouraging are the CIRP data on interest in the sciences among minority students. Preferences for engineering, physical science, and life science majors among black and Hispanic freshmen all increased over the past decade. Moreover, in some cases these gains pushed minority students past many of the commonly used measures of parity often employed to assess representation and progress. For example, whereas blacks represented 9.8% of the first-time, full-time freshmen enrolled in the nation's four-year colleges and universities in 1988, they accounted for 11.5% of the freshmen planning to pursue physical science majors. Similarly, Hispanic students represented 1.8% of the first-time, full-time freshman population this past fall and 2.1% of the aspiring freshman engineering students. In short, these data suggest that the long-term institutional, governmental, philanthropic, and corporate investments designed to counter the traditional underrepresentation of black and Hispanic students in the sciences are beginning to yield some real rewards. Of course these data reflect only shifts in preferences among freshmen and do not take into account the extent to which students remain steadfast in their choice of majors through graduation. And this will be an issue of growing importance given the predicted demographic declines of the 1990s and the small likelihood of any real gain in freshman interest in science in the next five or even ten years.

### Where have the students gone?

Paralleling the declining interest in the sciences has been a bull market in business (Fig. 2). Between 1972 and 1988, the proportion of freshmen planning to pursue business careers more than doubled (from 10.5 to 23.6%). Although interest in business has declined slightly in recent years, it is still the most often cited career preference and intended major of today's freshmen. Currently about one-fourth of the college freshmen surveyed plan to major in business. Similarly, business now accounts for about one-fourth of all undergraduate degrees awarded (Center for Education Statistics 1987, p. 105).

Figure 2 highlights the particularly dramatic changes in women's career preferences over the past two decades. The proportion of freshman women planning to pursue business careers exploded by a factor of more than six. Indeed, in some business specializations women now outnumber men. For example, for the past few years more freshman women than men have indicated their preference for accounting majors and careers. For women, of course, the shift in majors over the last 20 years has occurred mainly from education to business.

The rising popularity of business seems to reflect students' efforts to prepare themselves for the job market they envision in the future. Freshman interest in business remains high, despite the rising chorus of corporate leaders who say they want their organizations to hire well-read, well-trained people prepared in the liberal arts. That students do not accept this message seems to

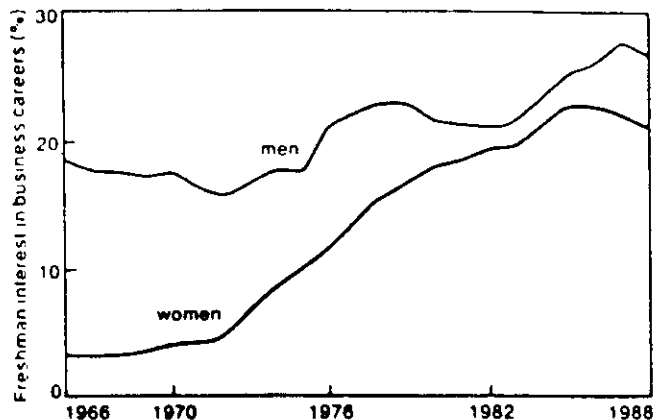


Figure 2. The marked decline of interest in science and technology among college freshmen over the last twenty years has been paralleled by an equally marked increase in interest in business careers. The dramatic increase in women planning business careers is particularly disturbing in a period in which the number of women entering the sciences has declined despite extensive efforts at recruitment.

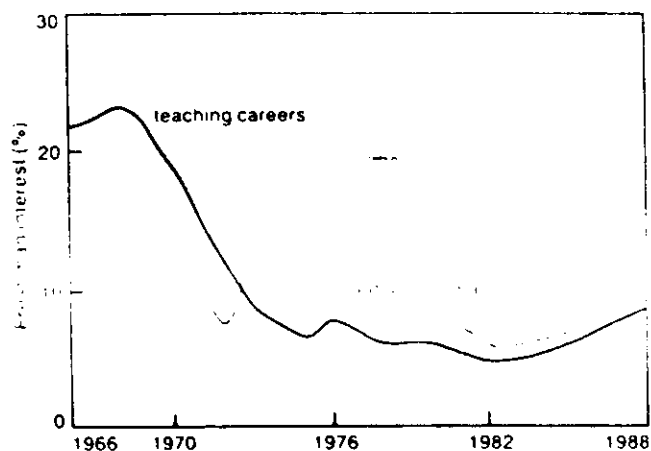


Figure 3. Interest in teaching careers has declined drastically since the late 1960s. The fact that interest in education majors has remained relatively steady over the same period suggests that future science teachers are far more likely to be trained in education than in the scientific disciplines they will be teaching.

be their way of saying they know that CEOs do not work the campus recruitment circuit. Moreover, the irony here is that students do not recognize the role of science as a resource for business careers. For example, undergraduate business majors will not be effective representatives for pharmaceutical companies, whose sales and marketing representatives need a strong background in the biological sciences and chemistry, along with strong writing, presentation, and interpersonal skills. Similarly, environmental policy analysts need a strong background in science and public policy.

An equally significant trend is highlighted by changes since the 1960s in freshman interest in teaching careers (Fig. 3). Although the interest in teaching has risen recently, the current levels are still far below those recorded in the late 1960s and well below the levels needed to meet future needs (see, for example, Carnegie Forum 1986 and National Commission on Excellence in

Teacher Education 1985). Moreover, even with the recent gains in student interest in teaching careers, the CIRP data indicate that comparatively little of that interest is in secondary school assignments (just 3.2% in 1988, as compared to 14.4% in 1968). This should be particularly distressing for science educators, because science and mathematics courses in junior high school and high school stimulate student interest in these fields and provide the academic foundation for subsequent undergraduate work.

Figure 3 also points to another distressing trend. Whereas 20 years ago a significant proportion of aspiring teachers planned to pursue majors in academic disciplines—English, chemistry, and mathematics, for example—today virtually all freshmen currently planning teaching careers will major in education rather than in an academic discipline. The concern, of course, is that future science and mathematics teachers may not have an adequate disciplinary base for the demands of the secondary school curriculum. The teaching profession is now struggling with various proposals to enhance the disciplinary requirements for teaching certification (for example, by requiring training beyond a bachelor's degree). Until these debates are resolved, future secondary school science teachers may continue to earn more upper-division college credits in pedagogy than in physics.

### Abandoned science majors

Our longitudinal studies of freshman preferences indicate that a large proportion of aspiring science majors ultimately abandon the sciences for other fields (Fig. 4). Indeed, not only do the sciences have the highest deflection rates of any undergraduate major, they also have the lowest rates of recruitment from other fields. In short, science departments lose a huge proportion of their potential clients—the academically able and intellectually

motivated students who enter college with a genuine interest in studying science.

Science departments themselves are partly to blame for these low retention rates. Many science departments take great pride in the number of students who fail to complete key courses in the lower-division sequence or who ultimately change majors. There seems to be an informal competition on many campuses to see which science classes have the lowest average grades or which programs have the lowest mean grade-point averages. Certainly organic chemistry has been a traumatic if not a career-shaping experience for hundreds of thousands of aspiring pre-med and science students over the years. However, any organization or enterprise that loses half or more of its potential clients may be in trouble. Moreover, these data should be especially troubling given that the sciences attract a disproportionate number of academically superior freshmen.

Science students, in general, have higher degree aspirations than their peers in other majors. In addition, freshman interest in the doctorate among science students in four-year institutions has been rising over the past ten years, although in some instances this increase has been slower than the overall gains posted for all four-year college and university freshmen. Between 1978 and 1988, the proportion of aspiring engineering majors planning to obtain a doctorate increased by almost one-fifth (from 15.8 to 19.5%); similar gains occurred among aspiring bioscience majors (17.5 to 24.3%), social science majors (20.9 to 27.5%), and even physical science and math majors (11.3 to 14.5%). These gains are impressive given the steady drop in freshman interest in these fields over the past two decades and the declining enrollment of US citizens in graduate science and engineering programs over the past 10 to 15 years.

These recent gains in freshman interest in the doctorate may mark the beginning of the return of American citizens to graduate science and technology programs. Admittedly, we are dealing with freshman data that have many limitations; it is a long way from undergraduate registration to graduate school matriculation. In addition to the other reasons for the deflection from science, the prospects of a low-paying assistantship and the arduous path through graduate school, which increasingly leads to a postdoctoral appointment rather than directly to a faculty position (Zurmeta 1985), will also channel many science and engineering graduates into the well-paying jobs increasingly available to graduates with bachelor degrees in technical subjects.

The CIRP data profiling science-oriented freshmen in four-year institutions suggest that despite the growing interest in the doctorate, there has been a slight decline in student interest in research careers over the past decade, coupled with very slight increases in teaching ca-

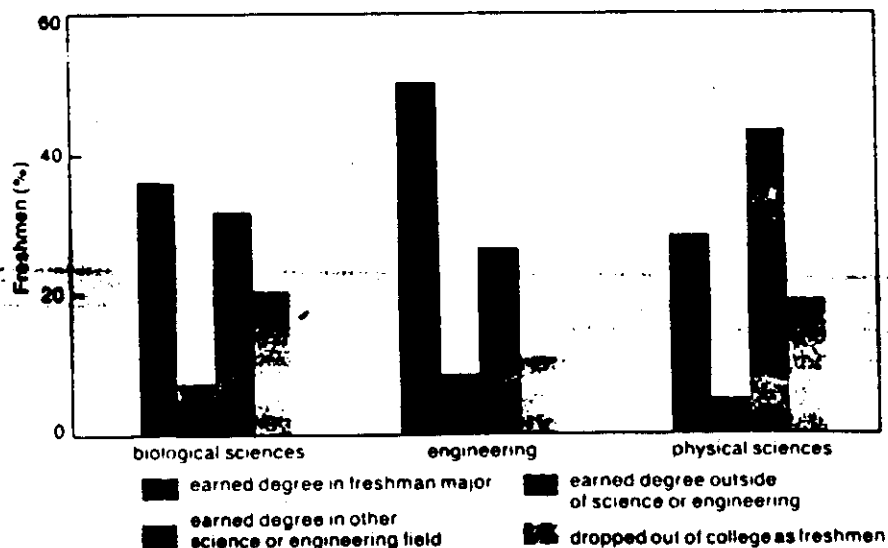


Figure 4. A CIRP 1986 follow-up survey of students who entered four-year colleges and universities as freshmen in 1982 suggests that less than half of those who intend to major in science or engineering go on to earn degrees in those fields. This high deflection rate may be related to the failure of science departments to create hospitable conditions for academically able students who enter college with a genuine interest in studying science.

reers. Of course, these are difficult distinctions in the sciences, in which many faculty are engaged in research. When the teaching and research career preferences are aggregated, we find virtually no change in the proportion of science-oriented freshmen planning to pursue such careers. However, the seemingly steady state of career aspirations among science students is not entirely good news, because the *proportion* of students planning to major in science has declined, as has the size of the freshman age group. Taken together, the decline in these two key values offsets any stability or gain and still means fewer people in the pipeline.

## Student values

A common pastime in the academic community is to compare today's students to those of the past and, in general, to find today's students guilty of a number of sins of omission and commission. Faculty who began their careers around the time of World War II often speak fondly about the more dedicated GI Bill students who populated the nation's colleges in the late 1940s and early 1950s. More recently, those of us who were on college campuses as undergraduates, graduate students, or faculty during the tumultuous period of the late 1960s and early 1970s engage in our own version of this game.

The charge against today's students is that they are greedy and materialistic, preoccupied with making money and making it fast; that they are intellectually docile, demonstrating more concern about their grades than about challenging intellectual issues, and that they are apathetic about pressing social issues and commonweal concerns, devoting more time to making life better for themselves and doing little that might benefit others. The CIRP surveys do provide some support for this perspective. More than three-fourths of today's freshmen identify "being very well-off financially" as an "essential" or "very important" life goal, up from less than two-fifths in 1970. And a record 72.6% of the 1988 freshmen indicated that "making more money" was a "very important" factor in their decision to attend college (Fig. 5).

Science students are not very different from their peers on these issues. Aspiring business students are the most likely to cite money as a key factor in the decision to attend college, but engineering majors are not far behind (Fig. 6). Moreover, aspiring engineering students, like their peers in business, are less interested in the educational value of college than are students in other majors. **Freshmen planning to pursue other science majors seem to be less concerned about money than are aspiring engineers and somewhat more interested in traditional notions of a liberal arts education.**

Yet despite the CIRP data and other indicators, it may be uncharitable and premature to dismiss today's students as greedy materialists. Their expressed values reflect, in part, the fact that they are the children of economic upheaval who came into adolescence and early adulthood during the high inflation of the late 1970s, the severe recession of the early 1980s, and the current restructuring of the American economy. Their sense of opportunity—of the possibility of attaining if not surpassing their parents' economic accomplishments, own-

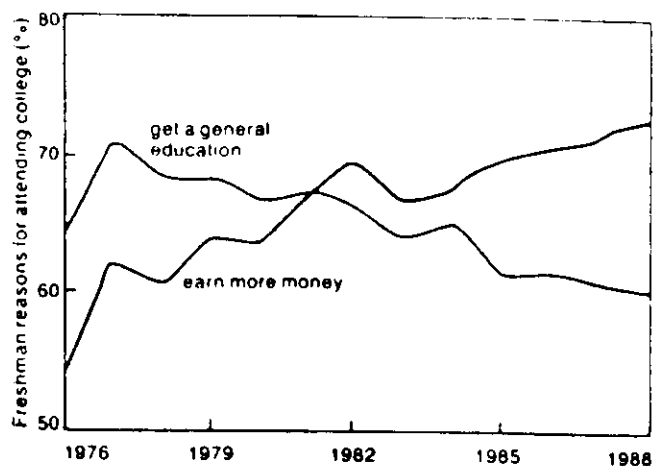


Figure 5. The declining interest in science and the growing interest in business careers have been paralleled by a significant shift in the values expressed by college freshmen. Whereas interest in getting a general education has declined sharply over the past decade, interest in earning a higher salary shows a sharp increase.

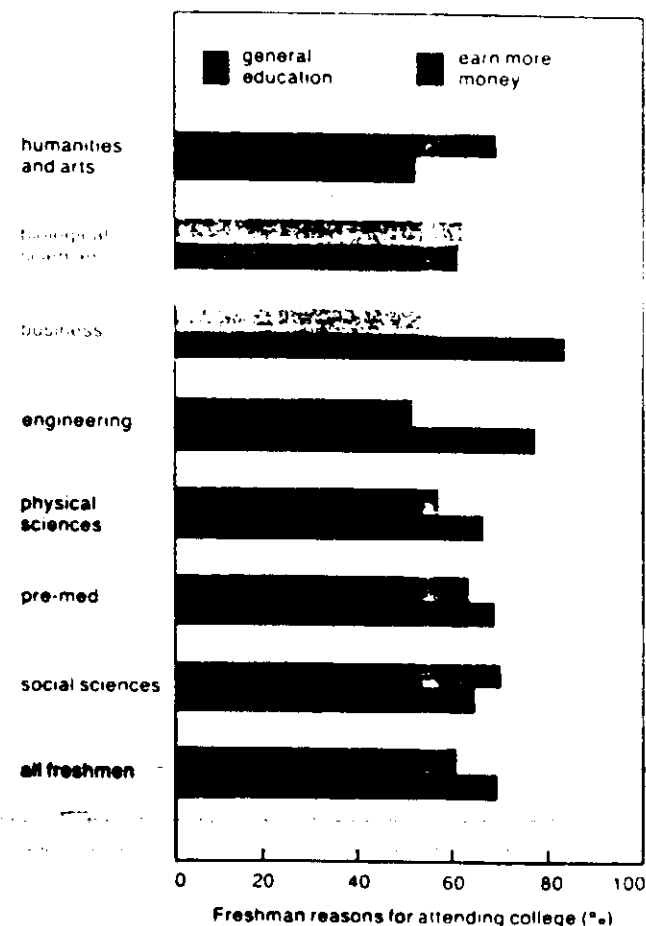


Figure 6. The 1988 CIRP survey of freshmen entering four-year colleges and universities shows that the value placed on making more money in most cases exceeds the value placed on getting a general education. Although interest in making more money is highest among prospective business majors, engineering majors rank second among groups endorsing this issue as a key factor in the decision to attend college. Interest in a general education is still the predominant concern among students planning to major in the biosciences and the social sciences.

ing a home, and sending their children to college—is severely threatened. From their perspective, these goals seem to be the prerogative of those perceived to possess “real wealth.” And today’s students implicitly acknowledge that it will take the efforts of two working parents to provide the comforts and security that they may have experienced as children in families in which only one parent worked. The world view of today’s students is more like that of their grandparents, who experienced

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the depression of the 1930s, than that of their parents, who grew up during the economically prosperous 1950s and 1960s.

The irony of the growing concern with money and preoccupation with financial security is that demographic forces bode well for these “baby bust” students: they will enter the best job market the nation has seen for the past 30 years. We already see indicators of this in the “help wanted” posters in most shops, fast-food restaurants, and department stores. Yet their outlook and behavior seem unaffected by the rational presentation of demographic and economic data. In short, today’s students are scared, averse to risk, and insecure.

### Challenges for undergraduate science education

The CIRP data point to four fundamental issues which should concern science educators and policymakers. The first is the critical issue of talent development. Each year thousands of academically able and well-motivated students who enter college planning to pursue science careers abandon science for other disciplines. This represents a tremendous loss of talent that institutions and programs need not incur—and that the nation can no longer afford. Although the sciences have long experienced high defection rates, the added decline in the number of students initially planning to major in science makes this loss of talent critical. The solution is not, of course, to pander to students by reducing expectations about academic performance. But we should recognize that departments and programs must develop an environment that encourages students to pursue the sciences, one that is perceived as encouraging rather than hostile.

The second issue that ought to concern science educators is the need to provide more opportunities and encouragement for nonscience students in the sciences. Science is a key resource for people in a variety of different sectors—the demand by pharmaceutical companies for people who understand biochemistry is one example—and we need to forge links between science training and public policy.

There are a number of different options that campuses and programs could pursue. Some options may

not necessarily require the traditional science major. For example, 20 years ago most campuses offered a recognized minor—a separate upper-division concentration in an academic discipline other than the student’s major. This is only one possibility; certainly there are others. Most important, however, is that these new options involve more than students working their way through (or around) a lower-division curriculum model based on distribution requirements. And part of the responsibility for expanding these opportunities falls on science departments and faculty, who must be genuinely willing to make the opportunity available.

A third issue in science education is the need to know more about the relationship between undergraduate science students and undergraduate science faculty. The Oberlin reports (Currier and Davis-Van Atta 1985, 1987) about the “science productivity” of small teaching colleges have highlighted the key role of faculty in the process of developing talent. Unfortunately, most research about talent development focuses exclusively on students and rarely on the key role of faculty behavior and attitudes. Consequently, we know very little about the interaction between faculty and students within individual disciplines. We have some fairly conclusive data about large-scale interaction at the institutional level; we know that contact with faculty is a very important factor in career choice, satisfaction with college, persistence, and academic performance. But we know comparatively little about how this factor plays itself out in the individual disciplines.

The fourth crucial issue confronting science education is the pressing need to bring science—and science students—back into secondary school classrooms. We need to explore various program alternatives, degree structures, curricular options, certification procedures, and financial incentives to encourage undergraduate science majors to pursue careers as science and mathematics teachers in the junior high and high schools. We desperately need this talent back in our classrooms if we are to rebuild the system of science education that has contributed to the nation’s research capacity and economic development during the postwar era.

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