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AUTHOR	Friedlander, Jack
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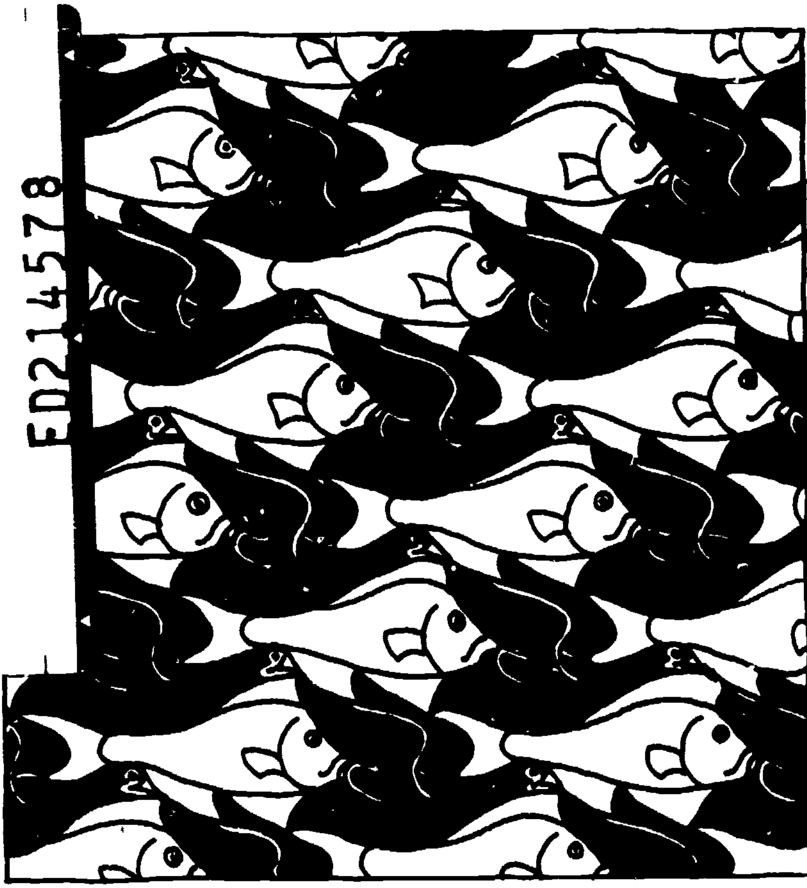
ABSTRACT

In an effort to promote greater student participation (especially among women and minorities) in science courses and programs, a study of science education in the Los Angeles Community College District was conducted. The primary objectives of the study were, first, to describe students' course-taking patterns, science background, and attitudes toward science; second, to identify institutional patterns that enhance science enrollments and course completion; and third, to describe intervention strategies that will increase student participation in science. Information for the study was gathered through an analysis of 8,873 student transcripts; a survey of 6,425 students in 268 courses; a survey of 268 instructors; a curriculum analysis; and interviews with 65 administrators, science faculty, and counselors. Selected findings from these activities include: (1) just over 40% of the students completed one or more science courses; (2) withdrawals accounted for 32% of student grades in their first science course; (3) the majority of student respondents had not been encouraged to enroll in science classes in high school or college; and (4) there were large discrepancies between students' career objectives and the courses in which they enrolled. Based on the study, expanded recruitment efforts, redesign of curricula to reflect student objectives and abilities, increased retention efforts, and improved faculty development programs were recommended. (Survey instruments are appended.) (Author/HB)

SCIENCE EDUCATION FOR WOMEN AND MINORITIES IN AN URBAN COMMUNITY COLLEGE



Center for the Study of Community Colleges
and
ERIC ® Clearinghouse for Junior Colleges

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by

Jack Friedlander

Topical Paper Number 75

1981

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and

ERIC Clearinghouse for Junior Colleges

University of California

Los Angeles 90024

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The manuscript was typed by Linda Smith and Pamela Inaba. Gayle Byock, Associate Director of the ERIC Clearinghouse for Junior Colleges, coordinated the preparation and distribution of the monograph.

The project was conceived by Arthur M. Cohen. He, along with Florence B. Brawer, were responsible for overseeing the entire project. In addition to these people I would like to thank our project monitor, Raymond Hannapel, of the National Science Foundation for his support. To these people, as well as to the students, faculty, and adminstrators whose responses to the surveys and interviews form the basis of this monograph, my thanks. Thanks to Bill Cohen for the cover design.

J.F.

SUMMARY

This study assessed factors related to student participation and success in science and social science courses. Science courses included agriculture, the biological sciences, engineering sciences and technologies, mathematics, the physical sciences (chemistry, earth and space sciences, physics), and the social sciences (anthropology, economics, psychology, and sociology).

Transcripts of 8,873 students enrolled in the Los Angeles Community College District were examined. Data analyses based on all courses in which these students were enrolled between Fall 1974 and Spring 1979 revealed that:

Just over 40 percent of the students completed one or more college science courses.

Students completed 52 percent of the science courses in which they enrolled.

Forty-five percent of the students received a grade of D, F, I (incomplete), or W (withdrawal) in their first science course. Withdrawals alone accounted for 32 percent of the grades students received in their first science course.

The higher the grade students received in their first science course the more likely they were to enroll in and complete subsequent science courses.

Students who withdrew or who received an incomplete in their initial science class completed a much smaller percentage of their subsequent science courses than students whose initial grade was C, D, or F.

Results of surveys completed by 268 faculty and 6,426 of their students showed that:

The more high school courses students had taken in a particular area of science (e.g., biology, physical science) the more likely they were to have taken a college course in that area.

Seventeen percent of the students who were below the sample average in the number of high school science courses taken were above the sample average in the number of science courses completed in college. However, 23 percent of the students went from being above the sample average in their participation in high school science courses to below average in the number of college science courses taken.

The majority of students in the sample reported that they had not received encouragement to enroll in college science courses or science-related programs at either high school or college.

There were large discrepancies between the science-related career objectives of students and the types of courses they enrolled.

The consensus among students and their instructors was that a high percentage of students, in most instances over 50 percent, have some difficulty in performing activities that require reading, writing, computing, independent inquiry, and a commitment of time to complete course assignments.

Science faculty were being asked to teach their courses to groups of students whose skills run the gamut from poor to excellent.

Of those students who did not feel confident in a skill, less than 30 percent took advantage of support program designed to assist them in that skill.

Over 40 percent of the students who were deficient in a basic skill and who did not seek assistance from the college support programs reported that they did not have time to use the service, or the service was offered at an inconvenient time. This factor of time also was cited by over half of the faculty members as the primary reason students do not take advantage of ancillary services to improve their basic skills.

The reasons cited by over 40 percent of the science faculty for why most students at their college avoid science courses, programs, and careers were as follows: poor background in mathematics, poor study habits, limited preparation to comprehend course materials, and poor skills in reading.

An analysis of science class sections offered in the Los Angeles Community College District for the academic year 1979-80 revealed that:

One-fourth of the class sections offered in the District in 1979-80 were in science.

There was a near absence of courses in the agricultural, biological, engineering, physical, and social sciences designed especially for students who needed some assistance with their reading, writing, mathematics, science, and/or study skills.

Forty-three percent of the class sections in mathematics presented material at a level below college algebra.

Conclusions and recommendations are discussed with respect to the following topics:

Recruitment activities. Recruitment efforts need to be expanded at both the high school and college levels. These efforts need to be directed towards the full range of students--from those who have not done well in science or mathematics in high school to those who have shown a high aptitude and interest in those areas. Recruitment efforts should not be left entirely in the hands of counselors. In order to be effective, these recruitment activities need to be organized and carried out at the level of the science department.

Curricula. Science faculty need to design distinctive courses which accurately reflect the range of their students' educational objectives and abilities. Targeting courses to specific groups (e.g., transfer, occupational, academically underprepared personal interest) should help alleviate many of the problems associated with having students of greatly varied abilities and interests in the same class.

Course retention and support services. Several options are available to community college educators for increasing course retention rates in the sciences while at the same time maintaining high academic standards: (1) Establish course entrance requirements. Students who do not possess the necessary competencies to succeed in the course would be directed to an appropriate program to strengthen the skills in which they were deficient. (2) Allow all students to enroll in any introductory science course but limit the number of courses that the poorly-prepared students can take in any term and mandate that those students take advantage of the available support services. (3) Integrate remediation into college-level science courses.

Faculty development. Many of the science faculty noted that they did not feel they had the proper training needed to teach students who are academically underprepared. In order for faculty to respond effectively to the changing backgrounds, educational objectives, and abilities of students attending the urban community college they will need training and assistance.

Monitoring student progress. A system of monitoring student progress in their science programs would enable faculty to identify students experiencing difficulty in their courses and then to provide the necessary assistance to overcome the problem. The provision of faculty attention and support should greatly increase the number of students who complete science-related programs.

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Chapter I
INTRODUCTION

In proportion to their numbers in the population of the United States, women and minorities are underrepresented in science careers. Many reasons have been advanced in the literature to account for this fact, and various inducements to increase participation in the sciences amongst these groups have in recent years been introduced. We know that high intensity, high cost, special interventions are effective in stimulating small groups of students to enroll in and complete science courses. We do not know how college policies and general procedures affect the different student groups.

The two-year college seems a most logical place to conduct a study of inducements and inhibitors to science study for women and minorities. The 1,250 community colleges in America offer a broad range of curricula, including the first two years of undergraduate studies, adult education, and remedial studies designed to reduce academic deficiencies. Of their 4.8 million students--40 percent of all students in American higher education--a sizable proportion includes women and minorities. Women make up 53 percent of community college enrollments. More than half of the students from minority groups who enroll in postsecondary institutions enroll in community and junior colleges. In 1979-1980, 27 percent of full-time and 20 percent of part-time students in community colleges were from minority groups (American Association of Community and Junior Colleges, 1981). These colleges have undertaken to reduce barriers to enrollment by allowing for part-time studies in most of their programs; they are easily accessible to most students; and they are considerably less expensive than other forms of postsecondary education.

Given these conditions, why do so few women and minority students complete science courses and science career-oriented programs in community colleges? The answer to this question is needed because there is a lack of knowledge about what actually goes on in the colleges themselves. The literature provides information on the outcomes, (e.g., how many minority students graduate, how many women enter the sciences), but it is not clear how these results come to be.

The study. In an effort to learn how to promote the participation of more students (especially women and minorities) in science courses and science career-oriented programs, the National Science Foundation funded the Center for the Study of Community Colleges to conduct a study of science education in the Los Angeles Community College District. The three primary objectives of this study were: (1) to describe the course-taking patterns, science background, and attitudes of students towards science; (2) to identify institutional patterns that enhance science enrollments and course completions, and (3) to describe intervention strategies that will allow colleges to remove barriers to and develop incentives for the participation of students in science. The District was selected as the site of this study for the following reasons: it is the largest community college district in the nation (125,000 students), a high proportion of the students in the district are ethnic minorities; and the ethnic composition of students varies substantially in the nine colleges of the District.

Information for this study was gathered through the following five activities: (1) an analysis of 8,873 student transcripts; (2) a survey of 6,425 students in 268 courses; (3) a survey of 268 instructors; (4) a curriculum analysis; and (5) staff interviews with 65 administrators, science faculty, and counselors. Results and recommendations emanating from each of these components of the study are reported in this monograph.

Chapter 2

STUDENT PARTICIPATION IN SCIENCE COURSES

Two major objectives of community college science programs are to increase students' literacy in science as part of their general education and to prepare them for careers in science, engineering, or technology. To increase the likelihood that these objectives will be met, students may be required to complete science courses successfully before they are granted an associate of arts or science degree, occupational certificate, or entrance into upper division courses in four-year colleges or universities. Thus for many students, achievement of their educational objectives rests on the successful completion of one or more required courses in science--including mathematics. Since the first science course that students enroll in often serves as a prerequisite for enrollment in the more advanced courses that are part of a degree or certificate program, it is important to have information on the extent that performance by the students in their initial college science course relates to their subsequent course-taking patterns and success in science courses.

Objective of transcript study. The primary purpose of this part of the study was to obtain answers to the following questions:

1. In which science courses do students enroll?
2. How successful are students in completing courses in different areas of science?
3. Is student performance in their first science course a good indicator of enrollment and performance in subsequent science courses?

4. What is the relationship between student grades in science courses and their grades in non-science courses?

Method. Answers to these questions were based on an analysis of 8,873 transcripts (a seven percent random sampling) of students enrolled in the Los Angeles Community College District in Spring 1979. The data analyses were based on all courses in which these students were enrolled and were on record during the first census week (fourth week of the term) between Fall 1974 and Spring 1979. The transcripts were obtained on magnetic tape from the district's data processing center. Data analyses were conducted by staff members of the Center for the Study of Community Colleges.

The science curriculum, as defined in this study, consisted of courses in agriculture; the biological sciences, engineering sciences and technologies; mathematics and computer science (mathematics); chemistry, earth and space sciences, physics, integrated natural sciences (the physical sciences); and anthropology, economics, psychology, sociology (the social sciences). These courses all fell within the definition of the sciences as articulated by the sponsoring agency, the National Science Foundation.

In which science courses do students enroll? Overall, 58 percent of the students in the sample had at one time enrolled in a science course in the Los Angeles Community College District. The area in which the greatest percentage of students enrolled in one or more courses was social science (35%). This was followed by mathematics-computer science (31%), physical science (24%), biological science (15%), engineering technology

Table 1
Percentage of Students Who Enrolled in One
or More Courses in a Science Area
(N=8,873)

Student Group	Total Science	Social Science	Mathematics	Physical Science	Biological Science	Engineering	Agriculture
Total Sample	58	35	31	24	15	7	1
Male	61	31	35	28	13	13	1
Female	55	38	27	21	17	2	1
American Indian	57	37	29	25	17	4	0
Black	59	37	34	17	15	6	0
Hispanic	57	31	36	21	14	8	0
Asian	56	24	38	26	13	14	0
White	56	33	26	27	15	6	2

and science (7%), and agricultural science (1%). Males were much more likely than females to enroll in mathematics, physical science, and engineering technology courses. A higher percentage of females than males enrolled in courses in the biological and social sciences.

Which science courses do students complete? Just over 40 percent of the students in the sample completed at least one science course. The percentage of students who completed a course in an area of science is in descending order: social science (35%), mathematics (20%); physical sciences (16%); biological sciences (11%); engineering (4%); and agriculture (1%).

A greater percentage of males than females completed a course in mathematics (23% vs. 17%), physical science (19% vs. 14%), and engineering technology (8% vs. 1%). Females were more likely than males to complete a course in social science (28% vs. 22%) and biological science (12% vs. 9%).

Asian students were much more likely than students in the other ethnic groups to complete courses in mathematics and engineering technology. In general, while there were differences in the percentage of students in the ethnic/race groups who completed courses in the different areas of science, the differences were not great.

How successful are students in completing courses in different areas of science? Students in the Los Angeles Community College District completed 52 percent of the science courses in which they enrolled (Table 3). The area of science in which students completed the highest percentage of their courses was agriculture (72%). This was followed by social science (56%), biological science

Table 2
Percentage of Students Who Completed
One or More Courses in a Science Area
(N=8,873)

Student Group	Total Science	Social Science	Mathematics	Physical Science	Biological Science	Engineering	Agriculture
Total Sample	43	35	20	16	11	4	1
Male	44	22	23	19	9	8	1
Female	41	28	17	14	12	1	1
American Indian	39	26	14	14	10	1	0
Black	39	25	20	9	9	2	0
Hispanic	38	20	18	13	9	4	0
Asian	45	17	29	18	9	9	0
White	42	24	17	19	11	4	2

Table 3
Percentage of Science Courses Completed
(N=8,873)

Student Group	Total Science	Social Science	Math-matics	Physical Science	Biological Science	Engineering	Agriculture
Total Sample	52	56	48	49	54	54	72
Male	51	54	47	49	53	55	67
Female	53	57	48	49	55	42	76
American Indian	44	51	46	33	44	0	0
Black	45	49	41	41	46	38	0
Hispanic	48	50	46	43	52	49	0
Asian	53	53	53	48	55	61	0
White	56	59	49	55	57	63	72

(54%), engineering (54%), physical science (49%), and mathematics (48%). The course completion rates for males and females were similar in all science areas except engineering where the completion rate of males was substantially higher than that of females (55% vs. 42%).

Among the ethnic groups, White (56%) and Asian (53%) students completed a greater proportion of their science courses than did Hispanics (48%), Blacks (45%), and American Indians (44%) Black students had a much more difficult time than Whites, Asians, and Hispanics in completing courses in mathematics, engineering technology, physical science, and biological science.

What grades do students earn in their initial science courses? Fifty-five percent of the students earned a grade of C or better in their first college science course. The remaining 45 percent received a grade of D, F, I (incomplete), or W (withdrawal). Withdrawals alone accounted for 32 percent of the grades students received in their first science course.

Is student performance in the initial science course a good indicator of enrollment in subsequent science courses? The higher the grade students received in their Fall 1978 science courses, the more likely they were to enroll in another science course the following semester (Spring 1979) About 68 percent of the students with grades of C or better in their Fall 1978 science course enrolled in another science course in the following semester; this figure dropped to 52 percent for those students who received a W in their Fall 1978 science course. Only ten percent of the students who did not participate in a science course in Fall 1978 did so the following semester.

Table 4
Student Performance in Their First Science Course
(N=4,760)

Grade in First Science Course	Number of Students in Grade Category	Percentage of Students Enrolled	
A	745	16	
B	805	17	
C	1,081	22	55%
D	333	7	
F	188	4	
I	88	2	
W	1,520	32	45%

Table 5
Relationship Between the Grades
Students Received in Their Fall 1978
Science Course and the Percentage
of Students Enrolled in a Science
Course the Following Semester
(N=1,550)*

Grade in Fall 1978 Science Course	Percent Enrolled in a Science Course in Spring 1979
A	68
B	66
C	67
D	67
F	59
I	68
W	52
Did not enroll	10

*Note: Average grade was used for students who enrolled in more than one science course in a semester.

Is student performance in the initial science course a good indicator of performance in subsequent science courses? Students who earned a high grade (A or B) in their first science course were much more likely to complete their subsequent science courses than students who received a low grade in their initial science course. The percentage of science courses completed by students ranged from a high of 67 percent for those who earned an A in their initial science course to a low of 27 percent. It is important to note that students who withdrew or who received an incomplete in their initial science class completed a much smaller percentage of their subsequent science courses than students whose initial grade in science was C, D, or F. The fact that students who received a grade of I or W in their first science course enrolled in an average of three additional science courses suggests that many of these individuals needed to complete several science courses to achieve their educational objectives.

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Table 6
Average Number of Science Courses Enrolled in
and Completed by Grade in First Science Course
(N=4,760)

Grade in First Science Course	Ave. Number of Science Courses Enrolled	Ave. Number of Science Courses Completed	Percentage of Science Courses Completed
A	5.4	3.7	67
B	5.1	3.4	67
C	4.7	3.0	63
D	4.9	2.9	58
F	4.1	2.2	54
I	4.3	1.4	34
W	4.2	1.1	27

As shown in Table 7, the grade students received in their first science course was a good indicator of their performance in subsequent science courses. Those who earned an A, B, or C in their first science course maintained about the same average in their subsequent science courses. Those who received a grade of D or F in their first science course continued to perform poorly (D average) in their other science classes. Students who withdrew from their first science course but who later completed one of more science courses had a science grade point average of C.

The information summarized in Table 7 also reveals that there were close correspondences between student grades in their initial science courses and with their grades in general. Two exceptions to this pattern were as follows: Students whose initial grade in science was a D had a GPA of C for all of their courses as well as for their non-science courses, and those whose first grade in science was an F had a GPA of C in their non-science courses and an overall GPA of D.

Table 7
Comparison of Students' Grade(s) in Their First Science Course with Their Overall GPA, GPA in Science, and GPA in Non-Science Courses
(N=8,873)[a]

Grade in First Science Course	GPA in Science	GPA in Non-Science	Overall GPA
A	3.6	3.3	3.4
B	2.9	3.0	2.9
C	2.1	2.6	2.4
D	1.4	2.4	2.0
F	1.4	2.3	1.7
W	2.3	2.6	2.5
I	2.0	2.5	2.3
Did not enroll in a science course	---	2.9	2.9

Chapter 3

FACTORS AFFECTING ST DENT SUCCESS IN SCIENCE SES

A survey s administered to students and instructors in 13 percent of all class sections offered at 10 a.m. and 7 p.m. on Wednesday of the fifth week of the Fall 1980 term. Completed surveys were obtained from 268 of the instructors (72% response rate) and 6,426 of the students in their classes. It is difficult to know what the response rate for students was since many were not present on the day the survey was administered. The classes used in this study represent a cross section of the subject areas taught in the multi-campus district. A copy of the Student Survey is provided in Appendix A.

Student responses to the survey were analyzed to address the following questions:

- o Does student interest in science change from high school to college?
- o What factors are associated with increased participation in science from high school to college?
- o To what extent are students encouraged to enroll in science-related programs?
- o What is the relationship between student career objectives and participation in science courses?
- o How confident are students in completing activities needed to succeed in science courses?
- o To what extent do students take advantage of support services from which they could benefit?

Sample. Students in this study were reasonably representative of those in the District in terms of their sex and ethnic backgrounds. The sample was almost equally divided among men (51%) and women (49%). The ethnic composition of the sample was: White (44%), Black (20%), Asian (11%), Chicano (11%), Other Hispanic (9%), American Indian (1%), and other (5%). Fifty-seven percent of the sample were 22 years of age or younger.

Results of Student Survey

Does student interest in science change from high school to college? The data were examined to determine the extent to which student participation in science courses increased, remained constant, or declined from high school to college. Students were categorized as below average (one-half standard deviation below the mean), average (within one-half standard deviation of the mean), or above average (one-half standard deviation above the mean) on the basis of the number of science courses they completed in high school and on the number of science courses they had finished in college. Only students who completed 30 to 60 college units (10 to 20 courses) were considered in this analysis. Students who completed fewer than 30 units may not have had ample time to enroll in college science courses while many of those who had completed over 60 units already possessed a baccalaureate degree.

The data presented in Table 8 demonstrate that 36 percent of the students who completed a below average number of science courses while in high school were also below average in the number of science courses they completed in college. At the other end of the

Table 8
Relationship Between the Number of Science Courses Completed in High School and the Number of Science Courses Completed in College
(N=1,302 students who completed 30 to 60 college units)

	Level of Student Participation in Science Courses in High School (HS) and in College (Col.)			
	% Above Ave. HS Science & Above Ave. Col. Science	% Below Ave. HS Science & Below Ave. Col. Science	% Above Ave. HS Science & Below Ave. Col. Science	% Below Ave. HS Science & Above Ave. Col. Science
Total	24	36	23	18
Females	20	42	22	16
Males	28	29	23	19
Asian	35	27	24	14
Black	20	38	27	15
Chicano	18	42	25	15
Other Hispanic	25	32	23	20
White	25	35	20	20

participation continuum, 24 percent of those students who were above average in the number of science courses taken in high school were also above the sample average in the number of science courses completed in college.

A sizable percentage of the students who were below the sample average in the number of high school science courses taken were above the sample average in the number of science courses completed in college (18%). There was, however, a greater percentage of students (23%) who went from being above the sample average in their participation in high school science courses to below average in the number of college science courses taken.

Males were more likely than females to be above average in the number of science courses they completed in high school and college (28% vs. 20%), while females were much more likely than males to have been below average in their participation in high school and college science courses (42% vs. 29%). There was much similarity in the percentages of men and women whose participation in science courses increased or decreased from high school to college.

Among the ethnic groups, participation in science courses in both high school and college was highest for Asian (35%), Other Hispanic (25%), and White (25%) students and lowest for Blacks (20%) and Chicanos (18%). Chicanos (42%) and Blacks (38%) were much more likely than students in the other ethnic groups to be below average in the number of science courses they completed in both high school and college. The percentage of students whose participation in science courses increased from high school to college was greatest among Other Hispanics (20%) and Whites (20%), while the percentage of students whose participation in science decreased from high school to college was highest among Blacks (27%) and Chicanos (25%).

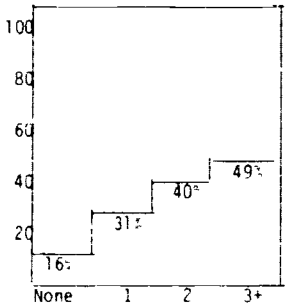
What factors are associated with increased participation in science courses from high school to college? Students whose participation in science courses rose from below average in high school to above average in college were much more likely to have: been encouraged by a college counselor or faculty member to take a science (27% vs. 17%) and/or math course (30% vs. 23%); discussed career opportunities in science with a faculty member or counselor (27% vs. 16%); received materials that were designed to interest them in science courses and careers (27% vs. 18%); participated in developmental math (22% vs. 14%) and/or science courses (12% vs. 7%); or received tutoring in mathematics (22% vs. 13%) and/or science (11% vs. 7%). Whether students received these forms of encouragement before or after they enrolled in their college science courses cannot be determined from these data

What is the relationship between the type of science courses taken in high school and type of science courses taken in college? In general the more high school courses students had taken in a particular area of science (e.g., biology, physical science) the more likely they were to have taken a college course in that area. For example, the percentage of students who reported that they completed a course in the physical sciences in college rose from 43 percent among those who had not taken a high school course in that area to 61 percent for those who had completed one high school course in the physical sciences to 70 percent among those students who had taken three or more high school courses in the physical sciences. These findings, along with those for the other science areas considered, are illustrated in Figure 1.

<u>To what extent are students encouraged to enroll in science-related programs?</u> One of the items on the Student Survey asked respondents to indicate whether or not they were involved in various activities designed to heighten their interest in science. The majority of students in the sample reported that they had not received encouragement to enroll in science or science-related programs at either high school or college. On the high school level, a very low percentage of the respondents noted that someone (counselor, teacher, college recruiter) spoke to them about science programs and courses offered in college (13%), or about career opportunities available in the sciences (24%). On the college level, about one-third of all students sampled reported having seen announcements advertising science classes or special programs on some aspect of science. A fifth of the students noted that they were encouraged by a counselor or faculty member to take a science or math course. A similar number of students indicated that they discussed career opportunities in science with a faculty member or counselor at their college. Not surprisingly, students who were encouraged to participate in science courses or who had discussions about science with members of the college staff were more likely to participate in science courses than those who did not engage in these activities (5.6 courses vs 4.6 courses)

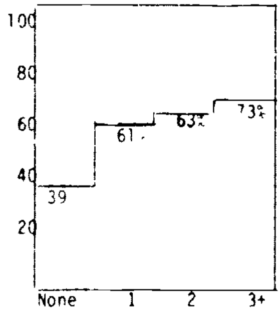
Figure 1
Percentage of Students Completing One or More College Science Courses by Number of High School Science Courses Taken.
N=1,302 Students Who Completed 31 to 60 College Units*

BIOLOGY
N=383



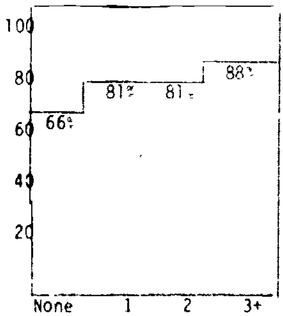
H.S. Biology Courses

MATH
N=888



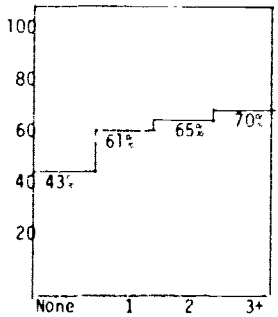
H.S. Math Courses

SOCIAL SCIENCE
N=954



H.S. Social Science Courses

PHYSICAL SCIENCE
N=731



H.S. Physical Science Courses

*Note: Data on engineering is not presented since these courses are not typically offered in high school.

The encouragement students received to participate in science was also examined with respect to sex and ethnicity. Although the differences were not large, a greater percentage of males than females were involved in each of the 14 activities designed to heighten student interest in the sciences. Comparisons among the ethnic groups showed that Asian students were more likely than those in the other categories to have participated in 10 of the 14 activities.

Student interest in science careers. Information on student interest in the sciences was obtained from an item on the Student Survey which asked respondents to indicate whether they were attending college to prepare for or advance in each of 14 career areas. Responses to this item are presented in Table 9.

The data in Table 9 reveal that a high percentage of students in the sample said they were attending college to prepare for or advance in a science-related career. The greatest percentage of the students who expressed an interest in a science career were attending college to prepare for or advance in engineering/architecture (16%). This was followed by computer programming and mathematics (15%), the health professions (14%), social science research (9%), medicine (6%), science research (4%), and farming or forestry (3%).

As expected, a greater percentage of males than females were interested in careers in engineering/architecture (26% vs. 5%) and computer science/ mathematics (18% vs. 11%); while a greater percentage of females than males were pursuing careers in the allied health professions (23% vs. 7%) and social science (12% vs. 6%). There was a high degree of similarily in the percentage

Table 9
Percentage of Students Pursuing
Career Objectives by Ethnicity and Sex
(N=6,426)

Career Objectives	Asian/ Filipino	Black	Chicano	Other Hispanic	White	Male	Female	Total
Allied Health Professional	13	17	13	12	14	7	23	14
Medical Doctor	6	6	6	6	5	6	6	6
Business	27	31	25	25	29	29	28	28
Secretary	4	7	4	6	5	.4	10	5
Comp. prog./mathematician/ statistician	23	16	12	14	13	18	11	15
Engineer/architect	27	11	13	19	15	26	5	16
Elem. or second. school educator	7	12	13	9	7	5	13	9
College teacher or educator	5	8	8	5	6	6	7	6
Farmer/forester	2	2	2	2	4	4	2	3
Research scientist	5	3	3	4	5	5	2	4
Artist	9	11	10	9	16	12	14	13
Social Scientist	6	10	10	8	10	6	12	9
Lawyer	4	9	6	7	6	8	5	6
Skilled Trades	15	14	15	13	12	20	6	13

of males and females interested in the other areas of science.

The findings reported in Table 9 show that the Asian students were much more likely than students in the other ethnic groups to be interested in careers in computer science/mathematics and engineering/architecture. Otherwise, there was much similarity in the science career aspirations of students in the various ethnic/race groups.

<u>What is the relationship between student career objectives and their participation in science courses?</u> One of the objectives of this study was to determine the extent to which students who are attending college to prepare for or advance in a science-related career take college science courses needed to achieve those stated objectives. Data on the college courses students had taken were obtained from an item on the Student Survey which asked them to indicate the courses they had taken in each of 13 areas of science. Only students who had completed 30 to 60 hours of college credit were included in this analysis. The percentages of students in each of the career objective categories who had <u>not taken any course</u> in an area of science are given in Table 10.

Here we find some discrepancies between the career objectives of students and the types of courses they completed. To illustrate, of those students who were attending college to prepare for or advance in a career in the allied health professions, 48 percent had not taken a course in biology, and 38 percent had not completed a course in the physical sciences while 33 percent had not completed a course in mathematics or computer science. Of those students who aspired to become

Table 10
Percentage of Students in
Career Objective Categories Who Had
Taken No Courses in Science Areas
(N=1,302 Students Who Completed 31 to 60 units of College Credit)

Career Objectives	Science Course Areas: Biology	Engineering	Mathematics	Physical Sciences	Social Science
Health Professional	48	99	33	38	18
Doctor	57	96	29	42	29
Business	80	94	25	44	20
Secretary	81	97	46	60	37
Comp. prog./mathematician/ statistician	83	84	12	38	30
Engineer/architect	81	55	13	37	48
Elem. or second. school educator	61	95	40	52	29
College teacher or educator	66	94	41	44	19
Farmer/forester	63	94	31	38	50
Research scientist	65	87	19	19	41
Artist	77	93	46	45	24
Social Scientist	63	97	36	48	12
Lawyer	72	97	30	37	19
Skilled trades	82	79	24	46	45

medical doctors, 57 percent had not taken a biology course, 42 percent had yet to complete a course in the physical sciences, and 29 percent had not completed a course in mathematics or computer science.

Among students who desired a career in engineering technology/architecture, 55 percent had not included a course in engineering science or technology as part of their 30 plus hours of college and 37 percent had not taken a course in physical science. However, only 13 percent had not taken a course in mathematics/computer science. Of those who expressed interest in the social sciences, only 12 percent had not taken a social science course. However, over 36 percent of the students had not completed a course in mathematics/computer science, physical science (48%), or biology (63%).

Nearly all of the careers listed in Table 10 require at least an associate degree. The attainment of a college degree is contingent on students completing courses in mathematics, the biological and physical sciences, and the social sciences. The finding that such a high percentage of students who had completed 10 to 20 college courses had not taken a course in one or more of these areas suggests that mathematics and science may be operating barriers to the realization of the students' educational and career objectives. Put another way, the students' career objectives are totally at variance with their course-taking patterns. Many of them may have untowardly delayed taking the courses they must eventually have.

How confident are students in completing activities needed to succeed in science courses? Science instructors were asked to indicate how important each of 14 activities were in terms of students' succeeding in their course. The responses of science instructors are reported in Table 11. Also shown in Table 11 is the percentage of their students who felt confident in performing the same 14 activities

Table 11
Percentage of Science Faculty Who Indicated That a Skill Was Important for Success in their Courses and the Percentage of Their Students Who Felt Confident in Performing Those Skills

Student Skill Area	Science Faculty (N=99)	% of Students in Science Classes who Felt Confident in Skill Area (N=4,711)
Have time to complete course assignments	81	59
Understand course reading assignments	80	68
Spend a concentrated period of time studying	71	51
Summarize major points in reading	63	52
Solve problems that require arthmetic	56	65
Express self in writing	47	54
Learn on own--independent inquiry	44	64
Work on lab exercises by following directions	42	60
Solve problems that require algebra or geometry	35	26
Understand science developments	33	43
Express self verbally	25	49
Integrate various parts of course	23	51
Identify biases in research reports	18	38
Solve problems that require statistics	17	19

Over 50 percent of the science instructors indicated that in their classes it was important that students be able to handle the following activities: complete course assignments in the time allotted (81%), understand course reading asssignments (80%), spend a concentrated period of time--two hours or longer--studying for the course (71%), summarize major points in class readings (63%), and work on problems or assignments that require arithmetic (56%). With the exception of math skills which were stressed primarily in engineering and mathematics courses, there was much similarity in the types of competencies faculty in each of the six science courses felt students needed to succeed in their courses.

As illustrated in Table 11, there was a sizable discrepancy between the percentage of science instructors who rated a skill as important to do well in their course and the percentage of their students who felt confident in their ability to perform that activity. For example:

> While 81 percent of the science faculty indicated that it was important that students have the necessary time to complete course assignments, only 59 percent of the students felt confident that they would be able to devote the time needed to complete their course assignments;
>
> While over 80 percent of the instructors noted that understanding course reading assignments was important for succeeding in their classes, only 68 percent of the students felt confident in performing this activity;
>
> While 71 percent of the science instructors stated that spending a concentrated period of time

studying for the course was important in their classes, only 51 percent of the students felt confident in their ability to do this.

The percentage of students in each of the sex and ethnic background categories who felt they were confident in their ability to perform various activities is reported in Table 12.

A much greater percentage of males than females expressed confidence in their ability to work on problems or assignments that required arithmetic (68% vs. 56%), algebra (44% vs. 27%), statistics (22% vs. 13%), or analytic geometry/calculus (17% vs. 9%), and in understanding science and technical developments and their uses in society (48% vs. 30%). The differences in the self-ratings of males and females in the other competency areas did not exceed five percentage points.

Among the ethnic groups, Asians were most confident in working on problems that required some form of mathematics, while White students felt most confident in working on assignments involving reading. Although there were differences among students in the ethnic groups in the self-ratings of their skills, no clear pattern of group strengths and weaknesses was evident.

To what extent do students take advantage of support services from which they could benefit? A major objective of this study was to determine the percentage of students who felt they were weak in a skill which was needed to succeed in science courses and who took advantage of a college assistance program designed to correct that deficiency. Two of the items on the Student Survey were used to satisfy this objective. One of the items had students rate their skills on a three-point

Table 12
Percentage of Students in Sex and Ethnic Group Categories Who Rated Their Skills as Confident

Student Skill Area	Percentage Rating Skill as Confident							
	Male (N=3246)	Female (N=3098)	American Indian (N=51)	Asian (N=721)	Black (N=1215)	Chicano (N=714)	Other Hispanic (N=530)	White (N=2710)
Understand course reading assignments	65	67	67	52	68	63	61	70
Learn on own--independent inquiry	64	62	70	54	69	56	49	65
Solve problems that require arithmetic	68	56	57	64	61	49	61	64
Have time to complete course assignments	58	59	58	53	63	57	56	60
Work on lab exercises by following directions	60	57	58	47	60	51	51	64
Express self in writing	53	55	59	46	60	48	52	54
Summarize major points in reading	51	49	52	41	49	43	45	54
Integrate various parts of course	51	49	54	40	53	44	47	52

Table 12 Continued

Student Skill Area	Percentage Rating Skill as Confident							
	Male (N=3246)	Female (N=3098)	American Indian (N=51)	Asian (N=721)	Black (N=1215)	Chicano (N=714)	Other Hispanic (N=530)	White (N=2710)
Spend concentrated period of time studying	48	52	47	44	51	47	49	52
Express self verbally	51	46	54	32	58	47	47	48
Understand science developments	48	30	48	36	40	32	41	40
Identifying biases in research reports	39	44	52	30	42	32	36	37
Solve problems that require algebra	44	27	38	53	30	27	35	35
Solve problems that require statistics	22	13	30	26	18	14	17	16
Solve problems that require geometry or calculus	17	9	17	28	14	7	15	9

scale ("confident," "somewhat confident," "not confident") in a variety of areas. These included reading, writing, arithmetic, algebra, and understanding science. The other item used in this analysis had students indicate which, if any, of nine support programs they had taken advantage of at their college.

The data presented in Figure 2 show that of those students who did not feel confident in a skill area, less than 30 percent took advantage of a support program designed to assist them in that skill area.

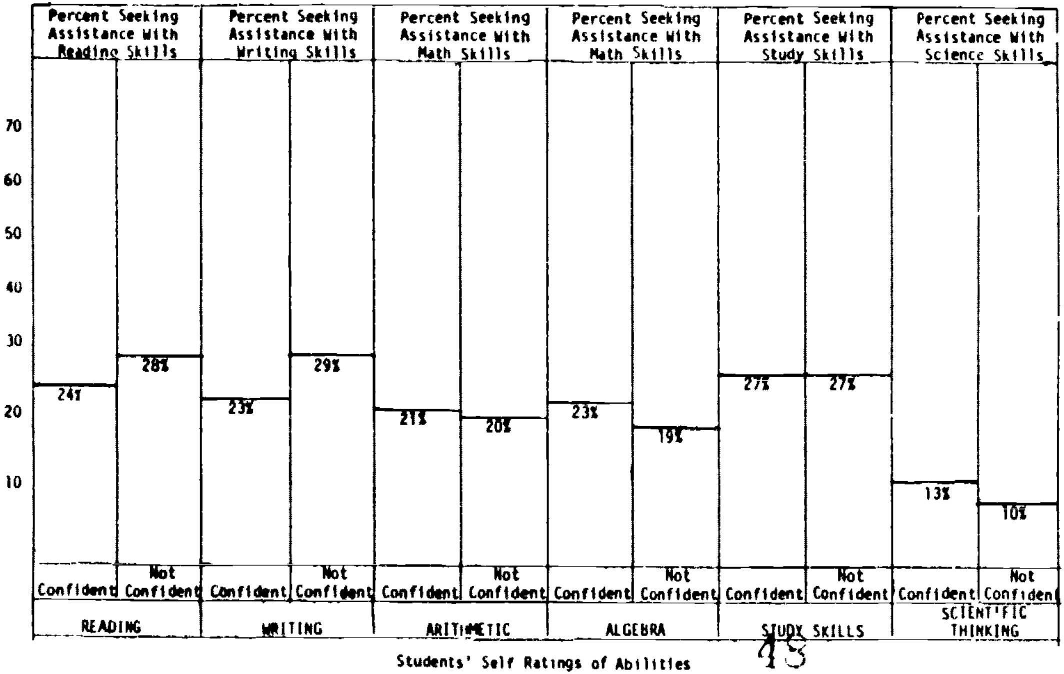
For example, of the students who did not feel confident in their reading ability, 28 percent took advantage of the college's support programs to improve reading; of those students who did not feel confident in their ability to solve problems that require arithmetic, 20 percent received assistance from a college support program in developmental mathematics; of those students who did not feel confident in their ability in science, 10 percent took advantage of the college support program in that area.

These findings indicate that despite the efforts to provide students with the support programs and assistance they need to succeed in college-level courses, the majority of those who can profit most from the assistance provided are not taking advantage of these programs. The information reported in Figure 2 also shows that there is little or no difference in the use of support services by students who are confident and those who are not confident in their abilities. These results were true for men as well as for women and for members of each of the ethnic/race groups.

Figure 2

CONFIDENCE OF STUDENTS IN THEIR ABILITIES

AND THEIR USE OF SUPPORT SERVICES



Reasons students give for not using support services. One of the items on the Student Survey asked respondents who did not use a particular support service to indicate the primary reason they had for not doing so. The response categories were as follows: "I do not need it;" "I have no time for it;" "Service is offered at an inconvenient time;" "I have heard that this service is not very helpful." The data presented in Table 13 are based on only those students who reported a lack of confidence in a skill area and who did not take advantage of a support program designed to correct that deficiency.

The reason most students had for not using a support service from which they could benefit was that they did not feel a need for the service. The second most frequently cited reason was that they had no time. The third most mentioned reason was that it was offered at an inconvenient time. Less than four percent of the students noted that they did not use a support service designed to improve a skill in which they were deficient because they heard that the service was not very helpful.

A surprising finding which is noted in Table 13 was the high percentage of students--in most instances over 50 percent--who felt they did not need assistance from a support service designed to improve a skill deficiency. Possibly, this response resulted from students' belief that a particular skill in which they were weak was not really needed to succeed in the courses in which they were enrolled. A possible explanation is that students may not see a direct connection between the difficulties they encounter in a course and the services offered by an academic support program.

Table
Reasons Students Who
in a Skill Gave
Support Service from
(In

	Not Confident (NC) in Skill and Did Not Seek Assistance	Do Not Need Service	No Time for Service
1-	NC in reading and no help in reading	50	30
2-	NC in reading and no basic skills course	50	28
3-	NC in writing and no help in writing	44	35
4-	NC in writing and no basic skills course	58	25
5-	NC in arithmetic and no basic skills course in math	61	23
6-	NC in arithmetic and no tutoring in math	61	22
7-	NC in algebra and no basic skills course in math	67	20
8-	NC in algebra and no tutoring in math	67	19
9-	NC in science and no basic skills course in science	73	17
10-	NC in science and no tutoring in science	72	17
11-	NC in study skills and no help with study skills	44	32

50

13
Were Not Confident
for Not Using a
Which They Could Benefit
Percentages)

	Service Offered at Inconvenient Time	Heard Service Was Not Helpful
1-	18	3
2-	20	3
3-	18	3
4-	14	2
5-	14	3
6-	14	3
7-	12	2
8-	12	2
9-	8	2
10-	9	2
11-	20	4

These findings demonstrate that the factor of time--(1) no time for service and (2) service offered at an inconvenient time--was cited by over 35 percent of the students as the primary deterrent preventing them from improving their skills in the ability areas upon which education is based--reading, writing, arithmetic, and study skills. For example, of those students who were not confident in their writing ability and who did not seek assistance to improve their writing, 53 percent stated that they did not do so either because they did not have time to use the assistance services provided (35%), or the service was offered at an inconvenient time (18%).

Chapter 4

SURVEY OF SCIENCE INSTRUCTORS

What about the instructors? To what extent do they help students advance in science? To gain information that would help answer these questions, we surveyed the instructors of 268 class sections. The sample was drawn by taking every thirteenth class section from a list of those offered on all nine campuses on Wednesday of the fifth week of the Fall 1980 semester at 10 a.m. and 7 p.m. Responses were obtained from 99 science instructors and 169 instructors of other-than-science courses. The number of instructors teaching a course in each of the science areas was as follows: mathematics (32), social sciences (23), physical sciences (18), engineering sciences (13), biological sciences (11), and agricultural sciences (2). A copy of the Instructor Survey is reproduced in Appendix B.

The ratio of full-time to part-time faculty was about 5 to 1. The science faculty as a whole tended to be an older group: 60 percent of them had taught in a community college for more than ten years. Most held either a master's degree (64%) or a doctorate (24%). Most of the instructors with less than a master's degree were teaching engineering technology courses.

Additional information on institutional factors affecting student participation in science was obtained from interviews held at each of the nine District Colleges with the Dean of Instruction, an average of five science faculty (including science division chairpersons), and a college counselor. A total of 65 separate interviews were conducted. Each was 30 to 60 minutes in length.

Questions asked in these interviews pertained to such topics as recruitment activities, curriculum innovation, course retention rates, student use of support services, and opportunities for faculty development. A copy of the interview format is provided in Appendix C.

Recruitment of students into science courses. Just over one-half of the science faculty had tried to recruit students to their courses in the past two years. Science instructors were less likely than those teaching other courses to have taken active steps to recruit students (55% vs. 64%). Less than 40 percent of the science faculty had encouraged the counselors to advise students to take courses in their field (35%), tried to make their courses relevant to students' occupational interests (34%), or attempted to advertise their classes on campus (30%). Only a small percentage of the science faculty generated interest in their subjects by engaging in such out-of-class actitivies as advertising their courses at a local high school (12%), developing extra-curricular offerings (forum, exhibit, lecture) in their subject area (20%), or meeting with groups of students in college-sponsored organizations (e.g., women's resource center, EOPS) to discuss career opportunities in their field (14%). The findings of the Instructor Survey also reveal that only a small percentage of the science faculty had made a special effort to recruit women or minority students into their classes. Thus, by their own admission, nearly half of the instructors had done nothing about student recruitment, tending instead to wait for the students to appear

Factors affecting student recruitment. Interviews with science faculty revealed that most instructors assumed that the college's written documents, counselors, and informal network of student interaction would propel students towards their courses. The counseling staff was wed as having primary responsibility for recruiting. However, counselors at each of the colleges reported that their recruiting efforts were of a general nature, without specification to science and mathematics. Recruitment efforts by science and mathematics departments were minimal in number, and what efforts were made to attract students into science courses were initiated independently by individual faculty members.

Most science instructors indicated that faculty in their department had no difficulty in filling their courses and as such did not see the need to recruit. One Dean of Instruction recommended that staff development and training was needed since most faculty are unfamiliar with the recruiting process.

<u>Instructor ratings of their students' skills</u>. Instructors were asked, "How do you rate the abilities of most of the students in your class?" The response categories were as follows. (1) most of my students are able to do this adequately, (2) most of my students have difficulty in doing this, and (3) most of my students are unable to perform this skill adequately. Responses to this question are presented in Table 14.

The information reported in Table 14 shows that about half of the instructors noted that most of their students were able to do the following activities adequately: express themselves when speaking (57%), summarize major points in class readings (54%), work on problems or assignments that require arithmetic (50%), work on laboratory exercises by following a set of written

Table 14
Science Faculty Ratings of Their Students' Skills
(N=99)

Most of my students:	Are Able To Do This Adequately	Have Difficulty In Doing This	Are Unable To Perform This Adequately
Express themselves when speaking	57	38	5
Summarize major points in class readings	54	40	6
Work on problems or assignments that require arithmetic (e.g., multiplication, division)	50	41	9
Work on laboratory exercises by following a set of written directions	49	42	9
Have the necessary time to complete course assignments	48	48	5
Understand course reading assignments	47	52	1
Understand the uses of science-technical developments and uses in society	40	50	10
Spend a concentrated period of time--two hours or longer--studying for this course	35	59	6
Work on a paper or a project in which students have to put together ideas from various parts of the course	32	53	15
Express themselves in writing	23	63	14
Learn on their own, pursuing ideas, and finding needed information	20	65	15
Work on problems or assignments that require college algebra, analytic geometry, or calculus	18	49	34
Identify biases that might have influenced the findings of a research report	15	58	26
Work on problems or assignments that require statistics (proportions, probabilities)	9	59	33

directions (49%), have the necessary time to complete course assignments (48%), and understand course reading assignments (47%) Less than 30 percent of the science instructors felt that most of their students were able to perform the following activities adequately: express themselves in writing (23%); learn on their own, pursue ideas, and find needed information (20%); identify biases that might have influenced the findings of a research report (15%); work on problems or assignments that require college algebra, analytic geometry, or calculus (18%), or statistics (9%).

These findings show that a high percentage of the science instructors--over 40 percent--noted that most of the students in their classes had difficulty or were unable to perform each of the basic skills considered. According to the instructors, students were weak in the very skill areas which the faculty regarded as important in terms of students' success in their courses--mathematics, writing, understanding course reading assignments, identifying biases in research reports, independent inquiry, and devoting the necessary time to preparing for the course.

Student need of support services in basic skills. Science instructors were asked to indicate the percentage of their students who could benefit from basic skills programs provided by the college. The response categories were as follows 0-25 percent; 26-50 percent; 51-75 percent, and 76-100 percent.

Over one-half of the instructors felt that 50 percent or more of the students in their classes could benefit from basic skills courses in reading and writing and in the sciences Over 40 percent of the science faculty noted that most students in their courses could profit from a basic skills course in mathematics and also from some tutoring in science and mathematics.

<u>Faculty perceptions on why students don't use support services</u>. Science instructors were asked, "If students do not use a needed service, why do you think this is so?" The response categories were as follows: (1) students are not aware of the service; (2) students do not believe they can benefit from the service; (3) students are not willing to devote the extra effort, and (4) students do not find services available at a convenient time. Responses to this question are presented in Table 15.

According to 44 percent of the science faculty, the reason that most students who are weak in reading and writing do not take basic skills courses in those areas is because they are not willing to devote the extra time or effort needed to receive assistance from the services. Over one-third of the instructors felt that the major reason students who need to improve their skills in mathematics or science do not enroll in basic skills courses offered in these areas is because they are not willing to devote the extra time or effort to these services.

An additional 10 to 17 percent of the faculty felt the major reason students do not take advantage of needed support programs is that the services are not available at a convenient time. Thus, the factor of time--(1) not willing to devote the extra time and (2) services offered at an inconvenient time--was cited by over 50 percent of the science faculty as the primary reason students do not take advantage of a support

Table 15
Reasons Science Faculty Gave for Why Students Do Not Use a Needed Support Service
(N=99)
(In percentages)

Support Services	Not Willing to Spend Time or Effort	Service Offered at Inconvenient Time	Do Not Need Service	Not Aware of Service
Basic skills courses in Reading and Writing	44	11	12	9
Basic skills courses in Math	39	10	12	9
Basic skills courses in the Sciences	36	10	8	8
Tutoring in Math	34	17	12	15
Tutoring in Science	29	13	12	13

service designed to improve skills in which they are deficient.

More diagnostic information on why students do not take advantage of much needed support programs was obtained in the inteviews. The observations are summarized as follows:

1. Students simply schedule more activities than they can handle. They are employed, have families, and enroll in several courses for which they may not be adequately prepared. Since support services require the expenditure of additional time, few of these students are able to use them.
2. Students want credit (transfer credit, better grades) for what they do, and they feel that remedial courses and use of support services are a waste of time.
3. Some students are convinced that they can't do the work required in math and science courses and they reason, "Why should I embarrass myself by asking for assistance when I can remain anonymous in class?" Students who feel unable to perform are often reluctant to admit they need help--particularly when they are beyond the traditional college age of 18 to 22.
4. Some of the academically underprepared students are not sufficiently committed to their education to take the steps necessary to improve their skills.

Instructional Practices

The findings of this study show that there was much variation in the educational abilities of students enrolled in science courses. The consensus among students and their instructors was that a high percentage of students--in most instances over 50 percent--have some difficulty in performing activities that require reading, writing computing, independent inquiry, and a commitment of time to complete course assignments. On the other hand, a sizable number of students enrolled in the same courses were quite capable of performing these activities adequately. How then are science faculty teaching their courses to groups of students whose skills run the gamut from poor to excellent? This question becomes even more important in light of the finding that most students with deficiencies in their basic learning skills do not seek assistance from the programs designed to strengthen those skills.

Selection of course materials. Just over one-third of the science faculty noted that their instructional materials were at a level that was appropriate for the diverse backgrounds of students taking their courses. However, 29 percent of them said their instructional materials were chosen to be similar to those used in parallel courses at the state collleges and universities. About 12 percent of the science faculty selected their course materials so that the presentations would be at levels that students with limited reading and comprehension skills could understand.

Organization of course. We asked a question about the instructional approaches used in science classes (Table 16) and found the overwhelming majority of

Table 16
Instructional Approaches Used in Science Classes
(N=99)

	Percentage
All students study the same material at the same time	77
Self-paced but finish by a specified date	10
Students assigned to study different material according to their progress in the course	2
Complete self-pacing	0
Students assigned to different material according to scores on a pretest	0
Other	11

faculty saying that all students study the same material at the same time (77%). Only ten percent of the science faculty reported that they used self-paced instruction in their classes, and just two percent assigned students to study different material according to their progress in the course. Complete self-pacing and assignment of students to different material according to scores on a pretest were not used in any of the science courses.

Grading practices. More than half of the science faculty said that students' grades were determined relative to a fixed performance standard but one-fourth admitted to grading on a curve. Assigning grades on the number of objectives mastered was used in nine percent of the science classes. Many of the remaining instructors noted that if they based their grades on a curve, fixed performance standard, or number of objectives mastered, a high percentage of the students would not pass the course. Therefore, they employed a combination of grading techniques.

Relatively few of the science instructors based 25 percent or more of their students' grades on workbook completion (7%), participation in class discussions (6%), laboratory exams (13%), research/laboratory reports (17%), regular class attendance (12%), or on the students' preparing displays, models, or artwork (2%). Most used quick score objective tests (69%) and essay exams (40%) and 20 percent said that written assignments counted 25 percent or more toward student grades.

Faculty perceptions of why women and minority students are underrepresented in science. There was no concensus among faculty members as to why women and minorities tended to be underrepresented in science. In

Table 17
Science Faculty Perceptions on Why Women and Minorities
Are Underrepresented in Science Courses, Programs, and Careers
(N=99)

Reason	Most students at this college	In percentages Women	Minorities
Poor background in mathematics	51	29	48
Poor study habits	49	15	36
Limited preparation to comprehend course material	44	21	40
Poor skills in reading	43	13	38
Inadequate background in the sciences	42	27	44
Lack of knowledge about careers in the sciences	36	33	39
Difficulty in meeting course requirements	27	13	29
Limited inclination to think along scientific lines	26	27	27
Lack of interest in the sciences	24	28	31
Science careers are typically closed to these populations	10	16	17
Faculty advise these students against pursuing science courses and careers	8	12	11

fact, the reasons faculty gave for low participation in science were characteristic of all students at their college.

The reasons cited by over 35 percent of the faculty for why most students at their college avoid science courses, programs, and careers were as follows: poor background in mathematics (51%), poor study habits (49%), limited preparation to comprehend course material (44%), poor skills in reading (43%), limited background in the sciences (42%), and lack of knowledge about careers in the sciences (36%).

<u>Recommendations for increasing student success in science courses</u>. The science instructors were asked first to indicate which of 16 activities were provided at their college and then note which of these same activities they felt should be provided. Instructor responses to these items are presented in Table 18.

These findings suggest that a high percentage of the science faculty would like to see their college move away from developmental education. Over 90 percent of the science instructors thought there should be an entrance exam for students wishing to enroll in their courses, whereas only about 50 percent felt that their college should provide special mathematics courses (51%), study skills classes (51%), tutors (32%), and resource persons (e.g., counselor, faculty member) to assist students with personal problems (38%).

Most faculty felt that successful women and minority scientists should be invited to campus to meet with students. The instructors also recommended that faculty members from four-year institutions be invited to discuss their academic programs with community college students.

Table
Activities Promoted by
Faculty Felt Should

This college provides:
1- Resource persons (e.g., counselor, faculty member) who are willing to assist students with personal problems
2- Tutors to help students who desire extra help in my course
3- Special mathematics courses to help students succeed in my course
4- Seminars, programs, or lectures on career opportunities related to my discipline
5- High school students with information about programs, courses, or careers in my field
6- Opportunities for students to meet representatives from companies that employ people in my field
7- Information about special skills needed to succeed in my courses
8- Lectures, demonstrations, or exhibits (not part of a course) on some aspect of this discipline
9- An exam for students wishing to enroll in this course
10-Special courses to help students improve their study skills (notetaking, test taking, writing)
11-Invitations to faculty members from four-year institutions to discuss their academic programs with students at this college
12-Counselor who are knowledgeable about offerings and career opportunities in my field
13-Advertising courses in my area through flyers, posters, newspaper articles
14-Women who are successful in my field are invited to campus to meet with students
15-Members of minority groups who are successful in my field are invited to campus to meet with students

18
College and Activities Science
be Provided at Their College
(N=99)

	This college promotes this activity (%)	This college should provide/ increase this activity (%)
1-	83	38
2-	80	32
3-	79	51
4-	73	63
5-	70	67
6-	69	63
7-	68	48
8-	68	75
9-	66	91
10-	65	51
11-	62	73
12-	62	59
13-	60	76
14-	57	84
15-	49	89

Other activities which over 70 percent of the science faculty indicated they would like to have promoted at their college are lectures, demonstrations, or exhibits (not part of a course) on some aspect of their field and advertisement of their courses through flyers, posters, and newspaper articles.

Attempts to increase retention rates in science and math courses. Deans of instruction, science faculty, and counselors who were interviewed were asked to indicate what was being done at their college to increase the completion rates in science and math courses. The most commonly mentioned institutional responses to this problem were providing support services such as tutoring, basic skills classes, and mathematics labs, and, at a few colleges, an occasional prompting by the Dean of Instruction. Although course attrition was perceived as a major problem, none of the respondents stated that a formal campus-wide retention program had been instituted at their college. Nor did any of the persons interviewed mention retention program designed specifically by or for a science department. The science faculty noted that they responded to attrition in their courses in an individual way and that there was little, if any, administrative direction.

Poor academic preparation of students was identified as the main reason for high attrition in science and math courses. Some faculty members reported that many of their students had not developed adequate reading levels in order to do college level work. They noted that students were reading at the sixth to eighth grade level when they needed to have attained a minimum of a tenth grade reading level in order to comprehend any of the science texts Along these lines, one Dean of Instruction wondered if it is possible to have both high standards and high retention. Another questioned whether it is possible to have open admissions and high retention, given the basic skill level of the community college student.

Faculty development. Since the early 1970s there has been a steady increase in the percentage of students entering the community college with weaknesses in basic skills, especially those needed for success in mathematics and science courses College staff members interviewed were asked to describe the attempts that were being made at their institutions to help faculty adjust to these changes in the educational backgrounds of their students

The consensus among the deans of instruction, science faculty, and counselors at most of the District Colleges was that there were no training programs to help faculty respond effectively to the changing nature of students attending their institution. Some faculty did note that occasionally in-service training opportunities are made available to them by the District.

The Dean of Instruction at one of the colleges stated that his institution was the only one in the District to regularly budget money for staff development. While minimal ($4,000 in 1981), the money was used to bring in speakers and to organize faculty workshops. At the suggestion of the faculty, the focus of the program has been on the lowered basic skill level of students The Dean observed that, in general, faculty are failing in their efforts to work with these students, and this has made them receptive to new ideas about instruction. The Dean of Instruction at another District College noted that his institution was given $4,900 to initiate a modest faculty development program in the Fall of 1981. The staff development programs that were offered were intended for all faculty. None of those interviewed cited specific programs designed for those teaching courses in math or science.

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Chapter 5

ANALYSIS OF THE SCIENCE CURRICULUM

Two factors that must be taken into account in evaluating the appropriateness of a community college's curriculum are students' educational objectives and abilities. Responses to the Student Survey revealed that over half of the students attending college at the District were doing so for one of the following occupational-related reasons: to prepare for a new career; to gain new skills necessary for advancement in their career; or to prepare for immediate employment upon completing their college program. Twenty-five percent of the students were attending college to prepare for transfer to another institution while close to 20 percent were doing so for general knowledge and personal enrichment. A small percentage of the students were interested primarily in improving their basic learning skills.

The educational abilities of District students can be best described as diverse. Findings from the Student and Instructor Surveys revealed that students were divided about fifty-fifty between those who are able and those who either experience difficulty or are unable to perform adequately such basic educational skills as reading, writing, computing, studying, and independent learning. Given these findings, it seemed useful to gather information on the extent to which science courses are being offered for students in each of the various educational objective and ability groups.

One component of the NSF-sponsored study of science education in the Los Angeles Community College District involved an analysis of class schedules for the

1979-80 academic year to document the number and variety of courses offered in the District in agriculture, the biological sciences, engineering sciences and technologies, mathematics and computer science, the physical sciences, and the social sciences. Data from this analysis were gathered to address the questions listed below

1. What percentage of the total curriculum is devoted to science?
2. What percentage of the class sections offered in the sciences were designed for students. Desiring a general introductory course? In science-related occupational programs? Majoring in an area of science? With weak backgrounds in areas typically covered in high school?
3. What organizational formats are used to present science courses (e.g., lectures, laboratories, self-paced)?

Method. Catalogs for the academic year 1979-80 and class schedules for Fall 1979 and Spring 1980 were obtained from each of the nine District Colleges. The college catalogs were consulted in order to obtain descriptions of the courses in terms of their prerequisites, contents, and students served. The class schedules were examined to gain a more accurate count of what courses were being offered than could have been ascertained from the college catalogs alone.

Information for this study was obtained by counting all science class sections in the nine District College class schedules for Fall 1979 and Spring 1980 for each of the science disciplines. All courses appearing in the class schedules were placed into one of four categories on the basis of their content and intended audience (e.g., major field, educational background of students in that area). Descriptions of the four course orientation categories are presented below.

General introductory courses. The courses included in this category are designed to introduce students to subject areas in science. These courses may be taken to fulfill a general education requirement and are not intended for students in science programs. Courses in this category differ from those designed for science majors in the following respects: (1) they are not prerequisites for any other course; (2) practical applications are stressed more than theory; and (3) the college's curriculum includes a more intensive course in the same area.

Courses for science majors. These courses are designed to satisfy lower division science requirements for students in science programs. The introductory courses are for introducing science majors to scientific principles and concepts and are prerequisites for more advanced courses. Those courses specifically designed for science majors are designated by an introductory science prerequisite and they treat subject matter in depth.

Courses for students in science-related occupational programs. Courses in this category are designed for students intending to complete programs in science-related occupational and technology programs Major scientific principles related to an occupational field as well as scientific terminology are introduced.

Preparatory courses. This category consists of courses to prepare students for introductory college-level courses in science. They are designed for students with inadequate backgrounds in some area of science. These courses provide students with the knowledge and skills needed in the introductory college-level science courses.

Results

What percentage of the total curriculum is devoted to science? Nearly one-fourth (24%) of the class sections offered in the District in 1979-80 were in the sciences. A greater proportion of the curriculum was devoted to science at the predominantly White suburban District colleges than at the urban campuses with high minority enrollments

What percentage of the classes offered in science was designed for students desiring a general introductory course? Overall, 48 percent of the class sections in the sciences were presented as a general introduction to a discipline. The proportion of class sections offered as general introductory courses in each of the areas of science was as follows: social science (75%), physical science (60%), mathematics and computer science (37%), biological science (34%), agricultural science (11%), and engineering science and technology (3%).

What percentage of classes offered in the sciences was designed for students in science-related occupational programs? The proportion of the class sections in the sciences that was intended for students in science-related occupational programs ranged from a high of 97 percent in engineering to 66 percent in agriculture to less than 20 percent of the offerings in the biological sciences (17%), mathematics (12%), and the physical sciences (10%) None of the social science courses was designed specifically for students intending to complete programs in science-related programs.

What percentage of class sections offered in the sciences was designed for students majoring in an area of science? Nineteen percent of the class sections in the sciences were intended for science majors. The proportion of class sections designed for science majors ranged from a high of 50 percent in the biological sciences to 25 percent in the social and agricultural sciences to less than 20 percent in the physical science (18%) and mathematics (8%).

What percentage of the class sections offered in science was designed for students with weak backgrounds in areas typically covered in high school? Just over 43% of the class sections in mathematics were designed for students with weak backgrounds in areas of mathematics typically covered in high school. The only other science area which offered developmental courses was the physical sciences where 13 percent of the class sections were geared for students needing preparation in the physical sciences before entering the introductory courses.

Summary. As shown in Table 19, close to 50 percent of all class sections in the sciences were designed as general introductory courses. Courses intended for students majoring in the sciences and courses developed for students intending to complete programs in science-related occupational programs each accounted for 19 percent of the class sections in science. Of the science offerings 14 percent were designed for students needing preparation in the sciences before entering introductory courses in which a fundamental background in science was assumed

Table 19
Percentage of Science Class Sections
Offered for Different Groups of Students

Area of Science	Orientation of Course: General Introduction/ Non-Science Students	Science Majors	Science-Related Occupational Programs	Preparatory
Social Sciences	75	25	0	0
Physical Sciences	60	18	10	13
Mathematics	37	8	12	43
Biological Sciences	34	50	17	0
Agricultural Sciences	11	24	66	0
Engineering Sciences	3	0	97	0
All Science Areas	48	19	19	14

What organizational formats are used to present science courses? Sixty-eight percent of all science class sections offered in the District were presented through a lecture section format. A combination lecture-laboratory section was used for 24 percent of the class sections. Other course formats were: laboratory section only, six percent, independent study, two percent; and television, videotape, or self-paced courses offered in a learning center, less than one percent.

What factors affect the development of innovative curricula? When asked about innovative curricula in science and mathematics, persons interviewed at each of the colleges cited one or more programs that have been developed to assist students--especially those who were weak in their basic skills. These included beginning courses in biology and chemistry to introduce the student to scientific terminology, math anxiety workshops, auto tutorial programs in the sciences, computer-assisted instruction, and modularized courses lasting from four to six weeks, in which students are permitted to enter at any time during the year. However, with a number of notable exceptions, there was not much effort being made to develop innovative science curricula and courses designed to accommodate students in the various educational objectives and ability groups attending the community college.

Many of those interviewed expressed the need to develop innovative curricula, but in the next sentence noted that such changes would be difficult to carry out in the face of budget cutbacks. One Dean of Instruction characterized this period of tight budgets as a "poor season for innovation." Some felt that the benefits of any innovative program seemed to diminish over time. Others were not convinced that innovative curricula were effective in increasing student learning. They felt that what students learn is determined by the amount of effort they put into their studies and "there is no substitute for hard work."

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

A number of conclusions can be drawn from this study. They will be discussed with respect to the following topics. recruitment activities, curriculum, course attrition, and support services. Recommendations on how community college managers can increase student participation in science will also include the subjects of faculty development and the monitoring of student progress.

Recruitment activities. The majority of students in the sample reported that they had not received encouragement to enroll in science courses at either the high school or college level. Much of the staff efforts that were made to encourage students to consider science programs were directed towards those who had exhibited a high degree of interest in science.

As for the faculty, recruiting women and minority students seem not to have been among their most pressing concerns. Relatively few of the science instructors saw a need for restructuring what they were doing to accommodate these special student groups. Actually, recruiting any students to science seemed of little import to the faculty. By self report, only one in eight instructors had even gone into a high school seeking students, talking about science classes with the high school teachers, or discussing the possibilities of science education for incoming students.

Curriculum. The science instructors were realistic. They were aware of the various reasons students have for attending college, and they were especially aware of their students' educational abilities. Science instructors and their students agreed that about half of the students have some difficulty or are unable to perform adequately activities that require the use of basic learning skills which both groups identified as important for success in their science courses. Yet, in spite of this awareness, the diversity of student educational objectives and abilities were not reflected in the types of science courses offered or in the manner in which they were taught.

There was a near absence of courses in the agricultural, biological, engineering, physical, and social sciences designed especially for students who needed some assistance with their reading, writing, mathematics, science, and/or study skills. Thus students who were weak in one or more of these ability areas and who wished to take a science course would have no choice but to enroll in one for which they were not adequately prepared A consequence of this practice was that students in most of the science classes were divided about fifty-fifty between those who were able and those who experienced difficulty or were unable to perform activities that the instructors noted were important for success in their courses.

A number of the science instructors noted that by being asked to provide instruction to groups of students whose reading, writing, computational, and study skills ran the gamut from poor to excellent placed them in a situation where neither they nor their students have much opportunity to succeed. This concern is not limited to faculty in the Los Angeles Community College District. Results of nationwide surveys (Cohen and Brawer, 1977, Brawer and Friedlander, 1979; Cohen and

Friedlander, 1980) of instructors teaching courses in the humanities, sciences, and social sciences showed that over half of the faculty said their courses could be made better if they had "students who were better prepared to handle course requirements." Over one-fourth of the instructors noted that their courses could be made better if there were "stricter prerequisites for admission to classes."

Not only is the practice of permitting students to enroll in a science course regardless of their academic abilities or likelihood for success in that course undermining the instructor's ability to effectively conduct the class, but it is also having an adverse effect on the students--especially those with weak academic backgrounds and those who plan to transfer to four-year colleges and universities. Results of the transcript analyses showed that students in the District completed about one-half of the science and mathematics courses in which they enrolled. These high course attrition rates are not limited to the District or, for that matter, to the sciences. Studies show that course attrition rates in many community colleges across the country are often as high as 30 percent to 50 percent and that much of their attrition is a consequence of student difficulty in keeping up with the course (Friedlander, 1981).

As for transfer students, Russell and Perez (1980) explained the high attrition rate among community college transfers to UCLA--many of whom were from the District --as being primarily associated with academic difficulties. The attrition was especially high in the physical sciences, mathematics, and engineering courses. In separate studies conducted at the University of Illinois (Anderson,

1977) and at UCLA (Menke, 1980), the average GPA of the community college transfer students was found to be lower than that of the students who began their post-secondary education at the universities. Transfers to the physical sciences, mathematics, and engineering courses were found to have the most difficulty, and transfers in those fields often changed their majors (Cohen and Brawer, 1982) Such findings are typically attributed to the increase in the number of students with deficiencies in basic academic skills who enter community college transfer courses This in turn has forced many of the community college science faculty to lower the level at which their courses are presented.

Over 50 percent of the students in the sample were attending college to prepare for or advance in a career. An additional 19 percent were attending classes for personal interest n spite of these figures, only a small percentage of the courses in the biological, physical, and social sciences were designed especially for these groups of students On the other hand, nearly all the course offerings in the engineering sciences and technologies were intended for students who were majoring in those areas These findings indicate that the science curriculum as it is now presented is not likely to appeal to the majority of students attending college in the District. A similar conclusion was reached in a nationwide study of the science and social science curriculum in the community college (Brawer and Friedlander, 1979; Friedlander, 1979).

Course attrition. Students in the Los Angeles Community College District completed 52 percent of the science courses in which they enrolled. Course completion rates ranged from a high of 72 percent in agricultural sciences to a low of 48 percent in mathematics and computer science. Nearly half of the students attempted no science courses, of those who did, 45 percent received an unsatisfactory grade (D or F) or failed to complete the first science course in which they enrolled; students who earned a grade of A, B, or C in their first science course were much more likely to enroll in and complete additional science courses than those with grades of D, F, or W; students who withdrew from their first science course were likely to withdraw from most of their other science courses; and the grade students received in their initial science course was a good indicator of the grades they earned in subsequent science courses. Results obtained in this study as well as in others clearly demonstrate that a high percentage of students do poorly in introductory science courses and that grades in the first science course are strongly associated with enrollment, completion, and success in future science courses

Attainment of such educational objectives as an associate degree, occupational certificate, and preparation for a career in science, technology, or engineering are often contingent upon students successfully completing two or more courses in science (including mathematics). Of the extraordinarily high percentage of students who do not successfully complete their first science course, there are likely to be many who reassess their educational goals in an effort to avoid taking additional courses in science. To the extent that this occurs, the introductory science courses may actually serve to inhibit rather than promote attainment of two basic goals of community college science education programs--increasing students' understanding of scientific and technical developments and their applications in society, and heightening students' awareness and interest in career opportunities in science-related fields.

Poor academic preparation of the students--especially in the areas of reading, writing, and studying--were identified by those interviewed as the primary reason for the high attrition rates in science courses. Faculty seemed to accept high rates of attrition as a fact of urban community college life, and several noted that they prepared for it by oversubscribing their courses. Although some faculty employed a variety of methods to increase student retention in their courses, there was a near absence of formally organized efforts to do so at the department, college, or District levels. Few of the science faculty knew what happened to students who dropped out of their classes. Most assumed that these individuals either enrolled in a lower-level course in their field, sought assistance from a college support program to strengthen a basic skill in which they were deficient, or came to the realization that they lacked the abilities and/or interest needed for success in the sciences

<u>Support services</u>. The primary approach used by the science faculty to respond to the large numbers of students experiencing difficulty in their classes was to recommend that they seek assistance from one or more of the college's support programs. Tutors, individualized instructional programs available in the learning center, mathematics and learning skills laboratories, developmental courses, and counselors were all readily accessible to

students. Most of the faculty members relied on student initiative to seek assistance from the appropriate college resources

Despite these efforts to provide students with the support programs and assistance they need to succeed in their courses, only a small percentage of the students who could profit most from the assistance provided took advantage of these programs. The factors of time--not willing to devote the extra time or effort needed to receive assistance and services offered at an inconvenient time--were cited by a high percentage of students and their instructors as the primary reasons they did not take advantage of a support program from which they could benefit. Since the necessary remediation needed to assist students experiencing difficulty with their work was not typically provided as part of the in-classinstruction, the decision not to seek much needed help was often associated with high course attrition rates, lowered career expectations, and low rates of program completion.

Recommendations. Several suggestions can be made for increasing participation in the sciences by women and minorities. First, recruitment efforts need to be expanded at both the high school and college levels. Furthermore, these efforts need to be directed towards the full range of students--from those who have not done well in science or mathematics in high school to those who have shown a high aptitude and interest in those areas. A number of promising recruitment activities have been implemented by District faculty and counselors. These have included: going to local high schools to discuss science programs and careers with counselors and students, advertising courses through announcements in newspapers, posters, and on the radio and; inviting women and minority scientists to the campuses to talk about their careers. Attempts to generate interest in the sciences also took place in such off-campus locations as prisons, hospitals, county affirmative action centers, government agencies, department stores, industry, and union halls. However, for the most part, these recruitment activities were carried out by counselors acting on behalf of the entire college In order to be effective, these recruitment activities need to be organized and carried out at the level of the science department. Recruitment efforts should involve counselors and science instructors in both the high school and the community college, members of professional science associations, employers, and representatives of civic organizations.

With respect to curriculum, science faculty need to design distinctive courses which accurately reflect the range of their students' educational objectives and abilities To achieve this objective, science faculty will need to identify the aspects of their subjects that students in each of the colleges' constituency groups (transfer, occupational, personal interest) would find valuable and then determine the level at which the courses should be presented. Targeting courses to specific groups should help alleviate many of the problems associated with having students of greatly varied abilities and interests in the same class.

Several options are available to community college educators for increasing course retention rates in the sciences while at the same time maintaining high academic standards. The first involves defining exactly the competencies required to enter and succeed in each science course Only students who possess the necessary competencies to succeed in the course would be permitted to enroll; those who did not would be directed to an appropriate program to strengthen the skills in which they were deficient. A major drawback of this approach is that the pool of well-qualified students is small A large percentage of students, especially women and minorities, would be segregated into remedial programs.

A second option is to allow all students to enroll in any introductory science course but to limit the number of courses that the poorly prepared students can take in any term and mandate that those students take advantage of the available support services. Under this approach the students might take only one science or mathematics course at a time and participate in tutorial and learning laboratory sessions on the basis of three hours for each credit hour attempted (Cohen and Brawer, 1982).

A third option is to integrate remediation into college-level science courses. Reports published in the journal literature and the ERIC files show that it is quite possible to teach functional literacy in college-level courses (Barshis 1979; Chausow, 1979). Many of these efforts involve presenting basic skills to students as part of their regular courses, as by incorporating reading skills into an introductory biology course, requiring students in a college-level course to complete learning modules on particular skills in a learning center as part of their assigned work (Maxwell 1980), or by offering adjunct skills courses that parallel the work in a given subject and focus on the skills needed throughout the term (Bergman, 1977, Maxwell, 1980). In such an arrangement the skills instructor would use the actual texts, class lectures, and tests from the content course as the study skills course materials.

Many of the science instructors noted that they were finding it very difficult, if not impossible, to maintain quality instruction when a number of students lack proficiency in basic skills. In addition, many instructors did not feel they had the proper training needed to teach students who are academically underprepared. In order to respond effectively to the changing backgrounds, educational objectives, and abilities of students attending the urban community college they will need training and assistance. College administrators need to expand their efforts greatly in order to help science faculty develop effective strategies for recruitment, advisement, course development, and delivery of instruction.

A final recommendation to be made concerns the need to monitor students who express an interest in science. A large percentage of the students who expressed interest in pursuing a science career had not completed courses needed to achieve their objectives. Much of this discrepancy was due to student difficulty in completing basic mathematics and science courses. A system of monitoring student progress in their science programs would enable faculty to identify students experiencing difficulty in their courses and then to provide the necessary assistance to overcome the problem. The provision of faculty attention and support should greatly increase the number of students who complete science-related programs.

In conclusion, some of the especially tailored, highly publicized programs to recruit and retain women and minority students in science courses have had dramatic results with a few students. But, in the main, most community college students find faculty in classrooms trying to get them to learn science and mathematics in traditional ways. Few students take advantage of the special support services that are provided. Most seem destined to get what instruction in and encouragement toward science they will receive from their classroom teachers (Cohen, 1981). For a growing number of urban community college students these traditional methods of instruction are not effective in high school nor do they appear to be effective in college. A variety of effective strategies are available for presenting science education to the diversity of students attending urban community colleges. They now need to be implemented.

Appendix A

STUDENT SURVEY

LOS ANGELES COMMUNITY COLLEGE DISTRICT

AND

CENTER FOR THE STUDY OF COMMUNITY COLLEGES

STUDENT SURVEY

Dear Student

This survey part of a study sponsored by the *National Science Foundation* is designed to determine how well community colleges serve their students The information it will provide is confidential Your identity will not be revealed in any way The survey information will not become part of your college record However it will help in planning programs and in designing courses that are meaningful to students who like you are enrolled in community colleges

Please complete this survey as accurately as possible according to the directions given for the various items Thank you very much for participating in this important project

DIRECTIONS. Your responses will be read by an optical mark reader. It is important that you follow a few simple rules

- Use **only** a number 2 lead pencil (not ballpoint or ink pen)
- Make heavy black marks that fill the oval
- Erase cleanly any response you wish to change
- Make no stray markings of any kind

EXAMPLE: Will marks made with ballpoint or felt tip pens be properly read?

⬭ Yes
⬬ No

---

1 **Your instructor will tell you the survey number for this class. Please fill in the appropriate ovals to indicate that number**

2. **Are you.**

⬭ Male
⬭ Female

3 **How old are you?**

⬭ 18 or younger
⬭ 19 - 22
⬭ 23 - 29
⬭ 30 - 39
⬭ 40 - 59
⬭ 60 or older

4 **What is your racial/ethnic background?**

⬭ American Indian/Alaskan
⬭ Asian Pacific Islander Filipino
⬭ Black Afro-American
⬭ Chicano
⬭ Other Hispanic
⬭ White Caucasian
⬭ Other

5 **Approximately what was your average grade in high school? In college?**

High School		College
⬭	A	⬭
⬭	A-	⬭
⬭	B+	⬭
⬭	B	⬭
⬭	B-	⬭
⬭	C+	⬭
⬭	C	⬭
⬭	C- or lower	⬭
⬭	No GPA established	⬭

6 **In this academic term, how many hours per week, on the average, are you employed for pay?**

⬭ None
⬭ 1 - 10 hours
⬭ 11 - 20 hours
⬭ 21 - 30 hours
⬭ 31 - 40 hours
⬭ Over 40 hours

7 **At this or any other college, how many units have you completed?**

- ⬭ 0
- ⬭ 1 - 3
- ⬭ 4 - 15
- ⬭ 16 - 30
- ⬭ 31 - 60
- ⬭ Over 60

8. **For how many units are you enrolled this semester?**

- ⬭ 11 or fewer
- ⬭ 12 or more

9 **In the columns below, please mark the number of courses that you have completed in each area in high school and in college. Next, please mark the average grade you received in these courses.**

	High School										College									
	No of Courses					Average Grade					No of Courses					Average Grade				
	0	1	2	3	4 or more	A	B	C	D	F	0	1	2	3	4 or more	A	B	C	D	F
Biology																				
Arithmetic																				
Geometry																				
Algebra																				
Trigonometry Calculus																				
Statistics																				
Computer Science																				
Chemistry																				
Engineering/Engineering Technology																				
Physics																				
Anthropology/Psychology/Sociology																				
Economics																				
Astronomy/Earth Science/Geology/Geography																				

10 **Which of the following have you completed? (Mark all that apply)**

- ⬭ Some high school
- ⬭ High school diploma
- ⬭ Some community college no degree
- ⬭ Community college degree (A A A S)
- ⬭ Occupational certificate at a community college
- ⬭ Some four-year college university (no degree)
- ⬭ Four-year college/university degree
- ⬭ Some graduate school
- ⬭ Graduate degree

11 **What is the highest academic degree you expect to obtain?**

- ⬭ Certificate in an occupational area but no degree
- ⬭ Associate (A A A S) or equivalent
- ⬭ Bachelor s (B A B S)
- ⬭ Master s (M A M S)
- ⬭ Doctorate or professional (Ph D Ed D M D LL D)
- ⬭ Undecided
- ⬭ Not interested in degree

12. **What is the primary reason that you are attending college? (Mark one only)**

- ⊂⊃ To prepare for immediate employment upon completing my college program
- ⊂⊃ To prepare for a new career
- ⊂⊃ To gain new skills necessary for advancement in my career
- ⊂⊃ To prepare for transfer to another institution
- ⊂⊃ To increase my general knowledge and level of education
- ⊂⊃ To develop basic learning skills (for example English, reading, math)
- ⊂⊃ I had nothing better to do
- ⊂⊃ I am not sure why
- ⊂⊃ Family pressure to attend college

13 **What is your most important reason for taking THIS course? (Mark one only)**

- ⊂⊃ It fulfills a general education or breadth requirement
- ⊂⊃ It is required for my major
- ⊂⊃ Personal interest/self-enrichment
- ⊂⊃ To acquire or improve occupational skills
- ⊂⊃ Develop basic learning skills (for example English reading, math)
- ⊂⊃ As an elective

14 **How confident are you in your ability to do each of the following activities? How important are these activities in determining whether a person can successfully complete this course?**

	Confidence In Your Ability			Needed To Succeed In This Course		
	Confident	Somewhat Confident	Not Confident	Important	Somewhat Important	Not Important
a Summarizing major points in class readings	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
b Spending a concentrated period of time—two hours or longer—studying for this course	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
c Having the necessary time to complete course assignments	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
d Working on laboratory exercises by following a set of written directions	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
e Working on a paper or a project in which I have to put together various parts of the course	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
f Identifying biases that might have influenced the findings of a research report	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
g Expressing myself when speaking	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
h Expressing myself in writing	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
i Solving problems that require arithmetic (e g multiplication division)	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
j Solving problems that require college algebra	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
k Solving problems that require statistics (proportions probabilities)	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
l Solving problems that require analytic geometry or calculus	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
m Learning on my own, pursuing ideas, and finding needed information	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
n Understanding course reading assignments	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃
o Understanding science and technical developments and their uses in society	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃	⊂⊃

15. **Listed below are a number of career areas. In the first column please indicate whether or not you think you could succeed in that field. If you do not think you could do well in a particular career area, in the next coulmn please indicate why not.**

Career Area	Successful	Not Successful	Not Interested	Too Much Math	Lack Skill Needed	Too Much Time Needed to Prepare	Employer Prejudice Against People Like Me
			If You Answered Not Successful, Why Not? Please Check All That Apply				
a Health professional (dietitian or home economist lab technician or hygienist therapist-physical, occupational speech, nurse)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
b Doctor (dentist, physician, veterinarian)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
c Business (accountant executive owner or proprietor salesperson or buyer real estate)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
d Secretary	⬭	⬭	⬭	⬭	⬭	⬭	⬭
e Computer programmer/mathematician/statistician	⬭	⬭	⬭	⬭	⬭	⬭	⬭
f Engineer/architect	⬭	⬭	⬭	⬭	⬭	⬭	⬭
g Elementary or secondary school educator (teacher school counselor, administrator)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
h College teacher or educator	⬭	⬭	⬭	⬭	⬭	⬭	⬭
i Farmer/forester (conservationist or forester farmer or rancher agriculture specialist)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
j Research scientist	⬭	⬭	⬭	⬭	⬭	⬭	⬭
k Artist (actor, or entertainer, artist, interior decorator-designer, musician writer or journalist)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
l Social scientist (psychologist, economist, social welfare or recreation worker)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
m Lawyer	⬭	⬭	⬭	⬭	⬭	⬭	⬭
n Skilled trades (automotive, building, drafting electrical printing etc)	⬭	⬭	⬭	⬭	⬭	⬭	⬭

16. **Are you attending college to prepare for or advance in any of the career areas listed in question 15? If so, please mark the appropriate ovals below:**

- ⬭ Health professional
- ⬭ Doctor
- ⬭ Business
- ⬭ Secretary
- ⬭ Computer programmer/mathematician/statistician
- ⬭ Engineer/architect
- ⬭ Elementary or secondary school educator
- ⬭ College teacher or educator
- ⬭ Farmer/forester
- ⬭ Research scientist
- ⬭ Artist
- ⬭ Social scientist
- ⬭ Lawyer
- ⬭ Skilled trades

How can more students be attracted to science courses and science careers? In the first column please indicate how important each of the following would be in encouraging students to enroll in science courses. In the next column, indicate whether or not you already make use of this information or service.

		Very important	Important	Somewhat important	Not important	I already have this information or make use of this service: Yes	No
a	Having more information about careers in science	⬭	⬭	⬭	⬭	⬭	⬭
b	Having more information about skills needed to succeed in science	⬭	⬭	⬭	⬭	⬭	⬭
c	Knowing that there are special financial grants for students interested in science	⬭	⬭	⬭	⬭	⬭	⬭
d	Having information on how science courses can help me solve practical everyday problems	⬭	⬭	⬭	⬭	⬭	⬭
e	Having information on how math courses can help me solve practical everyday problems	⬭	⬭	⬭	⬭	⬭	⬭
f	Having special mathematics courses to help me develop skills needed to succeed in science	⬭	⬭	⬭	⬭	⬭	⬭
g	Knowing that tutors are available in science courses to help me with academic problems	⬭	⬭	⬭	⬭	⬭	⬭
h	Having special courses to help me improve my study skills (notetaking, test taking, writing)	⬭	⬭	⬭	⬭	⬭	⬭
i	Having information on what courses I should take to prepare for a career in a science-related field	⬭	⬭	⬭	⬭	⬭	⬭
j	Having special remedial science courses available	⬭	⬭	⬭	⬭	⬭	⬭
k	Having information about women, minorities and/or the handicapped who are working in the sciences	⬭	⬭	⬭	⬭	⬭	⬭
l	Being able to talk with women, minorities and/or the handicapped who are working in the sciences	⬭	⬭	⬭	⬭	⬭	⬭

18. **Have you come in contact with or have you participated in any of these activities? (Please respond to each item.)**

	Yes	No
a I have seen announcements (flyers posters newspaper articles) advertising science classes on this campus	⬭	⬭
b I have received materials (pamphlets flyers etc) that were designed to interest me in science courses and science careers	⬭	⬭
c I spoke to a counselor about mathematics and science programs at this college	⬭	⬭
d A counselor or faculty member at this college encouraged me to take a **mathematics** course	⬭	⬭
e A counselor or faculty member at this college encouraged me to take a **science** course	⬭	⬭
f I discussed career opportunities in science with a faculty member or counselor	⬭	⬭
g I met a representative from a company that employs scientists at a college-sponsored career day	⬭	⬭
h I attended a seminar program or lecture on career opportunities available in the sciences	⬭	⬭
i I attended a lecture demonstration or exhibit (not part of a course) on some aspect of science	⬭	⬭
j I have seen announcements on this campus (posters flyers, newspaper articles) advertising a special program club lecture or exhibit on some aspect of science	⬭	⬭
k I was asked to take an exam testing my science/math skills before enrolling in a science or math course	⬭	⬭
l A counselor faculty member or college recruiter told me about the science programs available at a four-year college or university	⬭	⬭
m Someone in my high school (counselor teacher college recruiter) told me about the science **programs and courses** at this college	⬭	⬭
n Someone in my high school (counselor teacher college recruiter) told me about **career opportunities** available in the sciences	⬭	⬭

Which of the following services have you used at this college? If you have not used a service, why not? Please mark each item in the appropriate column

	I have used this service	If you have not used service—why?			
		I have no need for it	I have no time for it	Service is offered at inconvenient time	I have heard that this service is not very helpful
a Academic counseling	⬭	⬭	⬭	⬭	⬭
b Assistance with reading skills	⬭	⬭	⬭	⬭	⬭
c Assistance with study and or test taking techniques	⬭	⬭	⬭	⬭	⬭
d Assistance with writing skills	⬭	⬭	⬭	⬭	⬭
e Basic skills courses (reading writing)	⬭	⬭	⬭	⬭	⬭
f Career counseling	⬭	⬭	⬭	⬭	⬭
g Child care facilities	⬭	⬭	⬭	⬭	⬭
h Faculty advising	⬭	⬭	⬭	⬭	⬭
i Financial aid	⬭	⬭	⬭	⬭	⬭
j Personal counseling	⬭	⬭	⬭	⬭	⬭
k Remedial developmental math courses	⬭	⬭	⬭	⬭	⬭
l Remedial developmental science courses	⬭	⬭	⬭	⬭	⬭
m Services for handicapped students	⬭	⬭	⬭	⬭	⬭
n Tutoring in math	⬭	⬭	⬭	⬭	⬭
o Tutoring in science	⬭	⬭	⬭	⬭	⬭
p Student organizations	⬭	⬭	⬭	⬭	⬭
q Women s resource center	⬭	⬭	⬭	⬭	⬭
r Individualized instruction	⬭	⬭	⬭	⬭	⬭

Appendix B

INSTRUCTOR SURVEY

LOS ANGELES COMMUNITY COLLEGE DISTRICT AND THE CENTER FOR THE STUDY OF COMMUNITY COLLEGES

INSTRUCTOR SURVEY

Dear Faculty Member

This survey, part of a study sponsored by the National Science Foundation, is designed to determine why women, minorities, and the handicapped are generally underrepresented in courses, programs, and careers in the sciences. Whether or not you are teaching in the sciences, you have information about students and courses that is valuable to this project. Therefore we would appreciate your participation. Would you please complete this questionnaire and return it to the project representative at the end of this class period? Your responses will be kept anonymous, but we do need to know where the data came from and that is why each questionnaire has a number.

Thank you very much

---

1. **Course Identification Number** ________

2. **Are you.**
   Male ________ Female ________

3. **What is your racial/ethnic background?**
   a. American Indian Alaskan ____
   b. Black Afro-American ____
   c. Chicano ____
   d. Other Hispanic ____
   e. Asian Pacific Islander Filipino ____
   f. White Caucasian ____
   g. Other (Specify) ____

4. **What is the highest degree you hold?**
   a. Technical certificate ____
   b. Associate degree ____
   c. Bachelor's ____
   d. Master's ____
   e. Doctorate ____

5. **Do you have any of the following handicaps? Mark those that apply**
   a. None ____
   b. Hearing ____
   c. Visual ____
   d. Speech ____
   e. Orthopedic ____

6. **Are you a**
   a. Full-time faculty member ____
   b. Part-time faculty member ____
   c. Department or division chairperson ____

7. **How many years have you taught at any community college?**
   a. Less than 1 year ____
   b. 1-2 years ____
   c. 3-4 years ____
   d. 5-10 years ____
   e. 11-20 years ____
   f. Over 20 years ____

8. **If transportation and distance were not factors, at which college in the district would you most prefer to teach?**
   a. East ____
   b. Harbor ____
   c. LACC ____
   d. Mission ____
   e. Pierce ____
   f. Southwest ____
   g. Trade Tech ____
   h. Valley ____
   i. West ____

9. **What is the primary reason that most of your students are taking this course?**
   a. It fulfills a general education or breadth requirement ____
   b. It is required for the student's major ____
   c. Personal interest self-enrichment ____
   d. To acquire or improve occupational skills ____
   e. Develop basic learning skills (for example English reading, math) ____
   f. As an elective ____

10a. Have you tried to recruit students to your courses in the past two years?

Yes ____ No ____

10b If yes, what have you done to recruit more students to your courses? Please check all items that apply.

a Advertised my classes on campus ____

b Encouraged counselors to advise students to take more courses in my field ____

c Went into the local high schools to advertise courses in my discipline ____

d Changed the format or content of my course(s) to attract more women and minority students ____

e Tried to make my course relevant to students' occupational interests ____

f Developed and/or presented an extra-curricular offering in my subject area (forum, exhibit, lecture) ____

g Met with groups of students in college-sponsored organizations (e g , women's resource center, Spanish club, EOPS) to discuss career opportunities in my field ____

h Developed special instructional strategies for teaching handicapped students ____

i Obtained information about career opportunities for *handicapped* students in fields related to my discipline ____

j Obtained information about career opportunities for *women* students in fields related to my discipline ____

k Obtained information about career opportunities for *minority* students in fields related to my discipline ____

l Other (please specify)

11. **How important are these activities in terms of students' success in this course? Please indicate how you would rate most students in this class in their ability to do each of the following.**

		How important is this activity in this class?			Most of my students		
		Important	Somewhat Important	Not Very Important	Are Able To Do This Adequately	Have Difficulty In Doing This	Are Unable To Perform This Adequately
a	Summarize major points in class readings						
b	Spend a concentrated period of time—two hours or longer—studying for this course						
c	Have the necessary time to complete course assignments						
d	Work on laboratory exercises by following a set of written directions						
e	Work on a paper or a project in which students have to put together ideas from various parts of the course						
f	Identify biases that might have influenced the findings of a research report						
g	Express themselves when speaking						
h	Express themselves in writing						
i	Work on problems or assignments that require college algebra, analytic geometry, or calculus						
j	Work on problems or assignments that require arithmetic (e g , multiplication, division)						
k	Work on problems or assignments that require statistics (proportions, probabilities)						
l	Learn on their own, pursuing ideas, and finding needed information						
m	Understand course reading assignments						
n	Understand the uses of science technical developments and uses in society						

12. **What percentage of your students could benefit from each of the special services listed below? Would you recommend it to your students? If students do not use a needed service, why do you think this is so?**

	Percent of students needing service				Would you recommend this service?		Students do not take advantage of this service because			
	0-25%	26-50%	51-75%	76-100%	Yes	No	They are not aware of the service	They do not believe they can benefit from service	They are not willing to devote extra time or effort	They do not find services available at a convenient time
a Academic counseling										
b Career counseling										
c Basic skills courses in reading and writing										
d Basic skills courses in math										
e Basic skills courses in the sciences										
f Tutoring in math										
g. Tutoring in science										

13. **On what basis were the primary instructional materials (e.g., textbook, laboratory manual) for this course selected?**

a Materials are similar to those used in parallel courses at state colleges and universities ____

b Presentations are at levels that students with limited reading and comprehension skills can understand ____

c Materials are presented at a level that is appropriate for the diverse background of students taking this course ____

d Other ______________________
Please indicate

14. **Which of the following instructional approaches do you use in this class?**

a All students study the same material at the same time ____

b Complete self-pacing ____

c Self-paced but finish by specific date ____

d Students assigned to different material according to scores on a pretest ____

e Students assigned to study different material according to their progress in the course ____

15. How are students' grades determined in this class?

a On a curve ____

b Relative to a fixed performance standard ____

c Number of objectives mastered ____

d Other (Please indicate) ________________________

16. Please indicate the emphasis given to each of the following student activities in this class.

	Not included in determining student's grades	Included but counts less than 25% toward grade	Counts 25% or more toward grade
a Written paper assignments	____	____	____
b Quick-score/objective tests exams	____	____	____
c Essay tests/exams	____	____	____
d Workbook completion	____	____	____
e Regular class attendance	____	____	____
f Participation in class discussions	____	____	____
g Research/laboratory reports	____	____	____
h Displays, models, art work etc	____	____	____
i Laboratory exams	____	____	____

17. In this course how much emphasis is given to student achievement of the following goals? (Check one box for each item)

		Considerable emphasis	Some emphasis	Little emphasis
a	Mastery of a skill	___	___	___
b	Acquaintance with concepts of the discipline	___	___	___
c	Recall of specific information	___	___	___
d	Understand the significance of certain work, events, phenomena, and experiments	___	___	___
e	Ability to synthesize course content	___	___	___
f	Relationship of concepts to student's own values	___	___	___
g	Increased literacy in the field	___	___	___

18. Nationwide, women, members of ethnic minorities, and the handicapped tend to be underrepresented in science courses, programs, and careers. Why do you think this is so? Please check all that apply.

		Women	Minorities	Handicapped	Most students at this college
a.	Science careers are typically closed to these populations	___	___	___	___
b	Faculty advise these students against pursuing science courses and careers	___	___	___	___
c	Limited inclination to think along scientific lines	___	___	___	___
d	Inadequate background in the sciences	___	___	___	___
e	Lack of interest in the sciences	___	___	___	___
f	Lack of knowledge about careers in the sciences	___	___	___	___
g	Physical barriers	___	___	___	___
h	Poor background in mathematics	___	___	___	___
i	Limited preparation to comprehend course material	___	___	___	___
j	Poor skills in reading	___	___	___	___
k	Poor study habits	___	___	___	___
l	Difficulty in meeting course requirements	___	___	___	___

19. **Which of the following activities are promoted by this college? Which activities do you think the college should provide and/or increase? Please check all responses that apply.**

	This college provides	This college promotes this activity	This college should provide/increase this activity
a	Information about special skills needed to succeed in my courses	___	___
b	Special mathematics courses to help students succeed in my classes	___	___
c	Tutors to help students who desire extra help in my course	___	___
d	Special courses to help students improve their study skills (notetaking, test taking, writing)	___	___
e	Lectures, demonstrations, or exhibits (not part of a course) on some aspect of this discipline	___	___
f.	Advertising courses in my area through flyers, posters, newspaper articles	___	___
g	Resource persons (e g , counselor, faculty member) who are willing to assist students with personal problems	___	___
h	Opportunities for students to meet representatives from companies that employ people in my field	___	___
i	Seminars, programs, or lectures on career opportunities related to my discipline	___	___
j	Invitations to faculty members from four-year institutions to discuss their academic programs with students at this college	___	___
k	High school students with information about programs, courses, or careers in my field	___	___
l	An exam for students wishing to enroll in this course	___	___
m	Counselors who are knowledgeable about offerings and career opportunities in my field	___	___
n	Members of minority groups who are successful in my field are invited to campus to meet with students	___	___
o	Women who are successful in my field are invited to campus to meet with students	___	___
p	Handicapped persons who are successful in my field are invited to campus to meet with students	___	___

Thank you very much for completing this survey

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