DOCUMENT RESUME

ED 188 709 JC 800 406

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TITLE Science Education in Two-Year Colleges: Biology.
INSTITUTION California Univ., Los Angeles. ERIC Clearinghouse for Junior Coll. Information.: Center for the Study of Community Colleges, Los Angeles, Calif.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.: National Science Foundation, Washington, D.C.
PUB DATE May 80
CONTRACT 400-78-0038
GRANT NSF-SED-77-18477
NOTE 116p.

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Activities: Advanced Courses: *Biology: College Curriculum: College Faculty: *College Science: *Community Colleges: Course Objectives: Courses: Educational Attainment: Grading: Institutional Characteristics: Instructional Materials: Introductory Courses: Learning Modules: Literature Reviews: National Surveys: *Science Curriculum: Science Education: *Science Instruction: Science Laboratories: *Science Teachers: Student Characteristics: Teacher Characteristics: Teaching Experience: Teaching Methods: Textbooks: Two Year Colleges: Work Environment

ABSTRACT

One in a series of 12 publications on two-year science education, this four-part monograph examines biological education as revealed by a literature review, a study of the catalogs and class schedules of 175 representative two-year institutions, and survey responses of 160 biology instructors. Part I first presents the findings of a review of the literature on biology curricula, focusing on core curricula; course content: introductory courses: prerequisites: and courses for biology and non-biology majors, and allied health and remedial students. Next, the catalog and schedule analysis is presented, covering biology course offerings, target student groups, prerequisites and course sequences, institutional characteristics, and introductory courses. Part II examines instructional practices revealed in the literature and in the instructor survey. The literature review assessed the use of modules, laboratories, and textbooks, while the instructor survey considered student characteristics, instructional modes, use of class time and instructional materials, grading practices, desired student competencies, course goals, and out-of-class activities. Part III looks at the biology faculty in terms of degree attainment, employment status, teaching experience, selection of course materials, use of support services, and working conditions. The final section summarizes findings and presents recommendations for improving biological education. A bibliography and the questionnaire are included. (AYC)

ED188709

SCIENCE EDUCATION IN TWO-YEAR COLLEGES: BIOLOGY

by

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May 1980

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JC 800 406

The material was prepared with the support of National Science Foundation Grant No. SED 77-18477. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of NSF.

The monograph was distributed pursuant to a contract with the National Institute of Education, U.S. Department of Health, Education and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication, the manuscript was submitted to the Chair of the Excellence in Biological Education Committee of the National Association of Biology Teachers for critical review and determination of professional competence. This publication has met such standards. Points of view or opinions, however, do not necessarily represent the official view or opinions of either the Excellence in Biological Education Committee or the National Institute of Education.

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This publication was prepared with funding from the National Institute of Education, U.S. Department of Health, Education, and Welfare under contract no. 400-78-0088. The opinions expressed in this report do not necessarily reflect the positions or policies of NIE or HEW.

PREFACE

This monograph is one of a series of twelve publications dealing with the sciences in two-year colleges. These pieces are concerned with agriculture, biology, chemistry, earth and space sciences, economics, engineering, integrated social sciences and anthropology, integrated natural sciences, mathematics, physics, psychology, and sociology. Except for the monograph dealing with engineering transfer programs, each was written by staff associates of the Center for the Study of Community Colleges under a grant from the National Science Foundation (#SED 77-18477).

In addition to the primary author of this monograph, several people were involved in its execution. Andrew Hill and William Mooney were instrumental in developing some of the procedures used in gathering the data. Others involved in tabulating information were Miriam Beckwith, Jennifer Clark, William Cohen, Sandra Edwards, Jack Friedlander, and Cindy Issacson.

Field Research Corporation in San Francisco, under the direction of Eleanor Murray, did the computer runs in addition to printing the instructor survey employed in that portion of the project dealing with instructional practices. Bonnie Sanchez of the ERIC Clearinghouse for Junior Colleges and Janice Newmark, Administrative Coordinator of the Center for the Study of Community Colleges, prepared the materials for publication. Carmen Mathenge was responsible for manuscript typing. Jennifer Clark did the final compilation of the various bibliographies for each monograph.

Florence B. Brawer coordinated the writing activities and edited each of the pieces. Arthur M. Cohen was responsible for overseeing the entire project.

In addition to these people who provided so much input to the finalization of this product, we wish to thank Martin D. Brown of Fresno City College who reviewed the manuscript and Ray Hannapel and Bill Aldridge of the National Science Foundation, who were project monitors.

Arthur M. Cohen
Project Director

Florence B. Brawer
Publications Coordinator

SCIENCE EDUCATION IN TWO-YEAR COLLEGES:

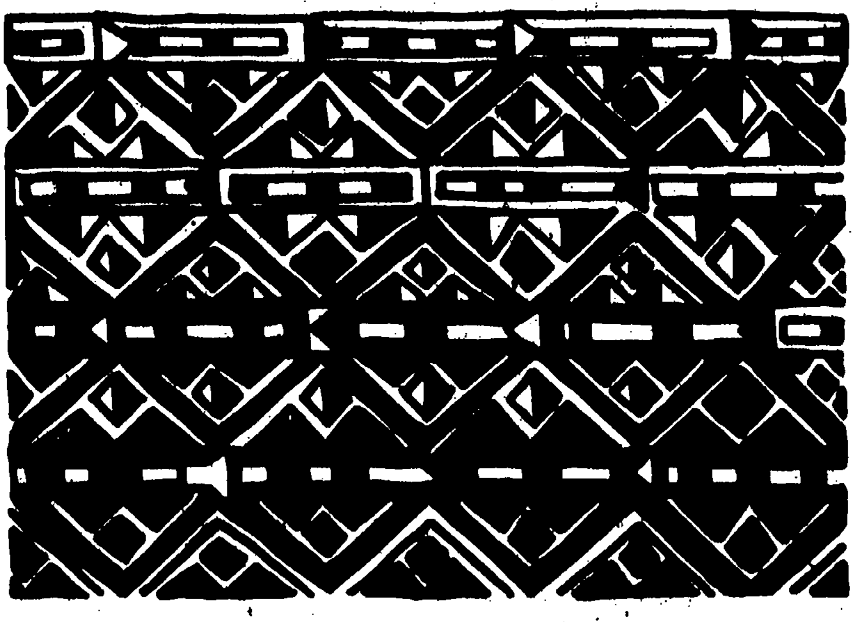
BIOLOGY

Two-year colleges enroll one-third of all students in higher education--more than four million people. According to most recent figures, 40 percent of all first-time, full-time students attend these institutions. When part-time students and students enrolling in the two-year college concurrently with or subsequent to their enrolling in a senior institution are taken into account, the number of first-year students taking two-year college courses approximates two-thirds of all freshmen.

In response to its open-door policy, an extremely diverse student population attends the community college, enrolling in a wide range of courses and programs (transfer, occupational, remedial, community service, and terminal degree). This size and diversity have implications for biological science education, for structuring the biology curriculum, and for presenting biological material to students.

This monograph, as part of a National Science Foundation (NSF) sponsored study of Science Education in America's community, junior, and technical colleges, explores biological education. The study, conducted by the Center for the Study of Community Colleges, was designed to provide a comprehensive picture of science curriculum and instruction. A literature review of the most important studies of two-year colleges' science education was conducted to determine what was already known about curriculum and instruction in the sciences. Curriculum data (e.g., programs, course offerings, and prerequisites) from the 1977-1978 academic year were gathered from the catalogs and class schedules of a representative national sample of 175 colleges. A random sample of science instructors in the 175 colleges were surveyed to determine instructional practices and to obtain some information on the science faculty. This information was collected to serve as a bases for investigating the developing trends in science education and to document the current college efforts in various fields of study.

This monograph begins with a look at biology curriculum followed by examinations of instructional practices and by a discussion of the faculty. Each section will review the pertinent literature and report the data collected by the Center for the Study of Community Colleges. Part IV will discuss the significant implications of the literature and data and offer recommendations for strengthening biological education.



PART I

BIOLOGY CURRICULUM IN TWO-YEAR COLLEGES

Several features distinguish the comprehensive community college from four-year institutions and any consideration of curriculum must take them into account. The first characteristic concerns the multiple missions of the two-year college. Besides programs for students transferring to four-year colleges, programs are provided for terminal students interested in general education, for students in occupational or vocational fields, for students requiring remedial work to prepare to enter transfer or occupational programs, and for non-degree students desiring cultural, recreational, or community interest courses.

A second distinctive characteristic of the community college is the transformation in its student body. For example, the number of students enrolled in occupational programs has increased from 13 percent in 1965 to 50 percent in 1976 (AACJC, 1976) and Lombardi (1978) even notes that "it is not unusual to find colleges, even entire state systems, where occupational enrollments exceed transfer enrollments" (p. 1). The number of students participating in non-credit courses or programs has increased over 100 percent in one year (1.5 million in 1975 to 3.2 million in 1976). The fact that in 1976 as many students enrolled in non-credit as credit programs (Lombardi, 1978) provides evidence of the phenomenal changes occurring in community college programming.

Changes in the composition of the student population itself include increases in the number of part-time students, students over twenty-five, women returning after extended absence, senior citizens, students from minority groups, and academically "underprepared" students (Knoell, 1973). Traditional full-time students entering the community college directly from high school account for only 20 percent of the enrollments.

A third distinctive characteristic of the community college concerns the non-traditional course-taking pattern of its students. The community college curriculum no longer reflects the classical coherent integrated planned programs; students drop in and stop out, change majors, and begin programs without finishing them (Cohen, 1979).

These characteristics pose dilemmas for the biology curriculum. Who should the curriculum serve? Should separate introductory courses be offered for biology majors and non-majors? Should biology courses be geared toward the transfer institutions or be adjusted for less academically prepared students? The literature begins to indicate how biology has addressed these questions.

THE LITERATURE

The most comprehensive look at the biological sciences was undertaken by the Commission on Undergraduate Education in the Biological Sciences (CUEBS). CUEBS assembled panels of leading authorities in biology to review various aspects of biological curricula, e.g. the core curriculum, the laboratory, and the use of modules. The panels then formulated recommendations for biological education which they generalized from important issues and trends they had experienced and observed in selected biology programs. Several panels also undertook research endeavors, such as a survey of health sciences programs to determine biology prerequisites (Roos, 1969).

Although most reports generated by CUEBS on curriculum and instruction included two-year institutions, one panel was convened for the express purpose of looking at biology in the two-year college (Hertig, 1969). The report of this panel provides a good foundation for an examination of what has happened to biology in the last ten years. The panel intended to be prescriptive, rather than descriptive; so while it provides a framework for understanding the data in our study, it does not provide descriptive data as a basis of comparison.

While no study has examined biology in the context of the general two-year college science curriculum, research has been undertaken to describe various aspects of biology curriculum (e.g., Kormondy, Kastrinos, & Sanders, 1974; Schechter, 1970; Thornton, 1960, 1966, 1972; Whitaker, 1968). Major sources of information on biological sciences education are The American Biology Teacher, Bioscience, and The Journal of College Science Teaching. Bioscience until 1971 had a section devoted to education, mainly reporting CUEBS activities. The Journal of College Science Teaching's "How I Do It" section provides descriptions of innovative teaching approaches. Two-year colleges do not, however, have their own biology education forum.

About the Curriculum

The literature reflects both the interest and changes in biology curriculum, which appear to have reached their peak in the late 1960s with the existence of the Commission on Undergraduate Education in Biological Sciences (CUEBS). Descriptive studies of biology offerings have been undertaken on a state level (Condell, 1965; Coston, 1969; Knight, 1973; Schechter, 1970; Williams, 1971), on a regional level (Loftin, 1968), and on a national level (NSF, 1969; Thornton, 1960, 1966, 1972). Studies focusing on the introductory course (Anderegg & Keller, 1968; Kormondy, Kastrinos, & Sanders, 1974; Moore, 1965) primarily consider samples of four-year colleges making them less reflective of two-year colleges' distinctive character.

Biological sciences accounted for 14 percent of two-year college science courses in a National Science Foundation (NSF) study of science faculty conducted during the 1966-1967 academic year with biology ranking second behind mathematics in number of offerings (NSF, 1969). Since the NSF study focused on faculty, it provided only limited information on the curriculum. No more recent data updates the NSF figures to indicate the trends in biological course development over the last ten years.

Cox and Davis (1972), in a CUEBS publication entitled The Context of Biological Education, raise the consciousness of their fellow biologists concerning the inflexibility of the traditional biology curriculum. They indicate that the education of a diverse student population in the two-year college is adversely affected by the rigidity of a linear curriculum. In Loftin's (1968) survey of administrators and instructors from 83 community colleges in the North Central Association, college personnel recommended that life science requirements should vary according to the student's curriculum.

The most important curricular issues center around the various student groups served by the biology curriculum. Therefore, after considering some general curricular concerns--e.g., the core curriculum, course content, the introductory course, and prerequisites--the literature review will treat ~~each~~ student group served by biology.

The Core Curricula

The introduction of the core curriculum concept was stimulated by the sharp increase in biological information following World War II (Cox & Davis, 1972). Core courses, as a basis for later specializations, allow students to acquire necessary skills and competencies without a commitment to a major or a specialty (Klopfenstein, 1973). Duggins (1971) defines core curriculum as: "a sequence of courses common to a number of related career programs that have been instituted for the purpose of making it possible for a student to move from one level or career to another with a minimum of lost time and without having to duplicate related courses" (p. 2).

The biology literature dealing with health-related occupational programs most frequently discusses the issue of a core curriculum (see p.11 of this monograph). In their study of colleges with enrollments above 4,000 students, Anderegg and Keller (1968) found 48 percent of their sample had core programs, listing a definite course sequence for a biology major. Most of the departments surveyed claimed to offer a core, but did not have specific listings.

The CUEBS Report The Content of Core Curricula in Biology supports the use of the core concept for biology major curricula. Coston (1969), surveying biology instructors in Texas colleges, found they preferred a uniform core curriculum for lower division students. The CUEBS panel, which based its recommendations on observations of a sample of four four-year colleges, suggests that the core take the form of a fixed sequence extended over a minimum of two years and include courses in mathematics and the physical sciences which complement the biology component. This recommendation does not make provisions for the flexibility that Duggins' (1971) definition implies, and thus, makes it less applicable to the particular characteristics of the two-year college.

Course Content

Another result of the increase in biological knowledge that manifested itself after World War II was a change in the emphasis of the content of biological courses. The new biological information was at the molecular and cellular level and, thus, course emphasis moved to an organizational level approach and away from the traditional morphology, taxonomy, and phylogenetics (Cox & Davis, 1972; CUEBS, 1972; Moore, 1965). Anderegg and Keller (1968) noted that this organizational level approach extended to botany and zoology, as well as the biology courses they surveyed.

Some writers express concern over the basis on which curricular decisions, concerning both content and structure, are made (Cox & Davis, 1972; Moore, 1965; UNESCO, 1977). Personal opinions of faculty seem to prevail

(UNESCO, 1977). Cox and Davis (1972) write that decisions are made "almost in total absence of information about . . . entering students, or about what happens to students after they leave a department" (p. 27). Community surveys are not conducted as a matter of policy (Mason, 1971).

Currently the American Institute of Biological Sciences (AIBS) is considering a proposal to deal with the lack of interaction between biologists and health educators in adequately meeting the biology needs of students in health-related occupations (Brown, 1979). The AIBS proposal, which includes action programs to improve the biological instruction in allied health programs, serves as an example of an approach to more rational decision-making about course content and curricular structure.

The Introductory Course

One major issue with respect to introductory biology offerings is whether separate courses should be conducted for major and non-major students. The CUEBS panel on Liberal Education, recommending a single course for majors and non-majors, cited three reasons for the recommendation: (1) when separate courses exist side-by-side, non-major courses often become a watered down version of the course for majors; (2) should a non-major student become interested in biology, he/she must take an introductory course in the sophomore year; and (3) many small colleges do not have the staff or facilities to offer two different courses. The studies that assessed the number of colleges that offered one course found one introductory course in approximately one-third of the surveyed institutions (Kormondy, Kastrinos & Sanders, 1974; Schechter, 1970).

The CUEBS panel on the Two-Year College did not define its position on whether a college should have separate introductory offerings for majors and non-majors. Instead the panel suggested that each institution should make this decision taking into consideration local conditions, needs, views, and capabilities (Hertig, 1969).

Along with the changing emphasis in course content already reported, the type of first course usually offered has tended away from botany and zoology and towards more biology offerings. This movement is consistent with Loftin's (1968) report that respondents to his survey of community college personnel thought that a year of integrated biology principles was more appropriate than general zoology or botany. Thus, botany and zoology are perceived as more specialized courses.

Prerequisites

The influence of high school biology training on college biology curriculum has been the subject of some discussion (Bennett, 1975; Carter, 1969; Moore, 1965; Tamir, 1969). College biology achievement appears to be related to high school biology achievement (Tamir, 1969), but the influence of the Secondary School Biological Science Curriculum Study (BSCS) approach on student's college achievement has not been fully determined (Bennett, 1975; Tamir, 1969). Carter (1969) maintains that BSCS was not designed to prepare students for college, although he notes that the process approach of BSCS will result in students' expecting participation, rather than passivity, in college biology. This factor may be one influence on Moore's (1965) conclusion that college biology instructors will need to make changes as more and more students enter college with a BSCS background.

Bennett (1975) noted that high school chemistry did produce greater student achievement in high school biology, and Kormondy, Kastrinos, and Sanders (1974) reported that courses for majors did often require chemistry. Introductory biology generally serves as a prerequisite for any further specialized biology undertaking (Kormondy, Kastrinos & Sanders, 1974; Schechter, 1970). Non-major courses, as expected, tend to demand fewer prerequisites (Schechter, 1970).

Roos (1969) looked at biology as a prerequisite for health-related programs. Doctoral-level professional schools expect less preparation at the molecular level, and baccalaureate-level schools require a broad general background with no particular emphasis. Roos's study raises the issue of articulation between two- and four-year colleges. The CUEBS panel on the two-year college recommended that, since articulation problems are specific to particular institutions, they be handled on a local level. Communication between two- and four-year college biologists, the panel maintains, should be in terms of content elements rather than course titles or general course outlines (Hertig, 1969).

The Biology Major

The CUEBS panel on core curricula recommended a structured two-year core for biology majors, as mentioned previously. The CUEBS panel on the two-year college concurs with the necessity for biology majors to complete chemistry, physics, and mathematics before transferring. This recommendation precludes the two-year college from needing biology offerings beyond the introductory level. Most of the division heads in Schechter's (1970) study of California community college biology programs agree with this recommendation. The emphasis on the cognate requirements is meeting the expectations of biology graduate schools (Cox & Davis, 1972) and underscores the fact that in designing curricula for biology majors who wish to transfer, two-year colleges resemble the four-year college.

The NSF study of two-year college faculty reports that in academic year 1966-1967, 92 percent of the biological science courses were transfer. With the current data that only 20 percent of two-year college students are transfer students, the emphasis toward transfer curricula in biology has undoubtedly diminished, and, indeed may hardly be relevant.

The Nonbiology Major

The CUEBS panel on Biology for the Non-major (1968) reports an estimate that "seven out of eight students in introductory biology courses across the country are taking a course designed for the one out of eight who will take a second biology course" (p. 2). While the biology major views introductory biology as a foundation for a specific course of study, the non-major student takes biology to satisfy general education needs. The problem then becomes to design a stimulating biology offering for non-majors that will spark their interest through its relevancy to the student.

Calandra (1972) proposes a curriculum of very short one-credit courses on subjects relevant to the student to avoid "time-consuming, specialized irrelevancies for which they (non-science majors) had minimal aptitudes and training" (p. 36). The CUEBS panel on Biology for the Non-major (1968) conducted a survey that elicited several suggestions about the content of a non-major course: it should focus on human biology, adopt an in-depth, rather than a broad-based approach, and integrate that biology course content with its historical and philosophical implications. Studies show that non-major courses do cover a large range of subjects, including "topical" (e.g., genetics, ecology, microbiology) and "relevant" subjects (e.g., drugs, man and environment) (Kormandy, Kastrinos & Sanders, 1974).

One specific non-science major group of students that biology curriculum planners need to consider are education majors (Cornish, 1970). Anderegg and Keller (1968) found a declining trend in teacher training with schools with large enrollments. They also noted that botany departments, along with their service to liberal arts divisions, consider training elementary and secondary teachers a priority.

Allied Health Students

Reflecting the increased emphasis on occupational programming, allied health programs have recently assumed a prominent place in two-year college curricula (Dubay, 1977). It is no surprise, then, that curriculum concerns center around the course relevance to the labor market or service needs (Appel et al., 1977; Gordon, 1975). In view of this occupational trend the CUEBS panel on the two-year college recommended that two-year biologists and "specialists in biology-based occupational programs should identify groups of biology-occupational programs and should construct appropriate content blocks" (Hertig, 1969, p. 15).

For the associate degree allied health occupational programs usually require a combination of general education, specialized occupational courses, and courses that are supportive or related to the specific occupation. The latter group of courses includes biology. The distribution of units among the different types of requirements varies by program. For example, 16 nursing associate degree programs studied by Anderson (1966) ranged in their physical and biological science requirement from nine to 13 credit hours.

The core curriculum concept has been widely implemented in allied health programs (AAJC, 1970; Duggins, 1971; Klopfenstein, 1973). One feature of core programs, as exemplified by a core-cluster program at Kellogg Community College, is to provide students with an opportunity to enroll in health-related subjects for exploratory purposes without commitment to a specific curriculum. Since the courses are applicable to several curricula, once the students opt for particular programs they do not risk loss of time or money through course repetition (Duggins, 1971; Cox & Davis, 1972).

Although a core curriculum of subjects related to the health curriculum has support, a nursing faculty in Florida found that without specialized courses for nurses, certain science content necessary for nursing was not covered (Anderson, 1966). Thus, a core that meets the needs of allied health programs must be well-articulated with each program.

A core curriculum composed of programmed components can also accommodate academically-deficient students who may require different amounts of time to master subject matter (Duggins, 1971). Another approach to assist nursing students with science deficiencies, described by Zubiari (1973), is an interdisciplinary Introduction to Life Sciences.

Remedial Biology

The literature points to the need to remedy science deficiencies of students embarking on allied health careers. Programmed core courses (Duggins, 1971) and interdisciplinary offerings (Zubiari, 1973) provide two approaches to remediation. Berry, Gillet and Didato (1976) describe a remedial biology course for urban students who fail traditional examinations based on the Biological Science Curriculum Study (BSCS) approach for secondary school students. Berry et al. select non-traditional biological topics to study from a conceptual or process focus de-emphasizing vocabulary. The course is offered at an 8th-10th grade reading level and devotes three hours per week to experienced-based learning. Although a few remedial programs described in the literature include a science component (Beitler, 1976; Tuosto & Beitler, 1975), most concentrate on basic reading, writing, and mathematics skills.

Related Biological Topics

Pratt (1971) described the state of environmental science in the two-year college both in its role in general education and as part of environmental technology programs. He provided the most comprehensive treatment of this area to date. The environmental education movement spawned other two-year college courses, such as urban ecology (Berry, 1974, 1975), offerings for allied health students (Gratz, 1969), and community programs (Valdes, 1974). Data on environmental science in the two-year college are reported by Edwards (1979).

Further discussion of ecology and environmental science has not been restricted to the two-year college. Mangum and Mertens (1971) surveyed general ecology courses. CUEBS also published Environmental Education: Academia's Response (Aldrich & Kormondy, 1972). Several publications reported a variety of programs, courses, seminars, symposia, institutes, and centers, all responding to the mandate of the Environmental Education Act of 1970: CUEBS News, March, 1970; the February, 1975 issue of The American Biology Teacher; and publications of the ERIC Center for Science, Mathematics, and Environmental Education (see McCabe, 1977; Schoenfeld & Disinger, 1978).

Marine biology (DeAnza College, 1974; Philp, 1978; Teel et al., 1966) and genetics (Straney & Mertens, 1970) are specialized areas of biology that have received treatment in the literature. Nutrition can appear in the curriculum as part of allied health programs, but often constitutes part of the home economics curriculum.

METHOD FOR THE CURRICULUM STUDY*

Sample

The first step in studying the curriculum in two-year colleges was to assemble a representative sample of colleges. The technique used in this study produced a balanced sample of 175 two-year colleges (see Appendix A for a list of participating colleges). An earlier study conducted for the National Endowment for the Humanities by the Center for the Study of Community Colleges had already assembled a sample of colleges (balanced by

*For a complete methodology of this study, see Hill and Mooney, 1979 (ED 167 235).

college control, region, and size). Using this sample as the initial group, the presidents of these colleges were also invited to participate in the National Science Foundation funded study. Acceptances were received from 144 of the 178 colleges.

At this point a matrix was drawn with cells representing nine college size categories for each of six regions of the country. Using the <u>1977 Community, Junior and Technical College Directory</u> (AACJC, 1977), the ideal breakdown for a 175-college sample was calculated. The remaining 31 colleges were selected by arraying all colleges in the under-represented cells and randomly selecting the possible participants. The following table shows how close our sample is to the percentage of the nation's two-year college population.

Table 1

Percentage Breakdown of 175-college Sample Compared to National Percentages by Size, Region and Control

	Size by Enrollment								
	1-499	500-999	1,000-1,499	1,500-2,499	2,500-4,999	5,000-7,499	7,500-9,999	10,000-14,999	15,000 plus
National %	15	18	13	17	17	8	5	5	4
Sample	13	16	13	17	19	9	5	6	4

	Region					
	North-east	Middle States	South	Mid-west	Mountain Plains	West
National %	7	13	32	21	10	17
Sample	6	12	31	22	13	16

	Type of Control	
	Public	Private
National %	84	16
Sample	84	16

Procedure

College catalogs and class schedules for the 1977-78 academic year were obtained from each of the 175 participating colleges. The curriculum phase of the project utilized a unique system for analyzing, classifying and reporting the course offerings. The Course Classification System for the Sciences (CCSS)* in Two-Year Colleges was developed specifically for this project to deal with science courses in terms of both the unique features of the two-year colleges and the traditional science disciplines.

The general structure of this system and the procedure for classifying a course are briefly described here as a preface to the detailed description of the categories within biological sciences. Based upon the catalog course description, each science course listed in the catalog was placed into one of six major curriculum areas: Agriculture, Biological Sciences, Engineering Sciences and Technologies, Mathematics and Computer Sciences, Physical Sciences, Social and Behavioral Sciences. These areas were chosen because they closely reflect the instructional administrative organization of two-year colleges as well as the organization of national and international science agencies, such as the National Science Foundation.

The second level of classification was executed primarily by the major subject field disciplines within the broad area. Courses were included within this classification scheme based on their content and intended audience (e.g., major field, degree objective). The biology category consisted of the following subject categories:

- Biology - Introduction
- Biology - Advanced
- Botany
- Zoology
- Human Biology
- Microbiology
- Entomology
- Ecology and Environmental
- Related Topics

(Appendix B contains more detailed descriptions of each classification). Independent study courses and courses not carrying college credit were omitted from this study.

*See Hill and Mooney, 1979, for complete CCSS description.

After all the science courses were classified, class schedules for the 1977-1978 academic year were inspected, and the number of sections offered (day, evening, and weekend credit courses) for each term were determined. Prerequisite requirements and instructional mode (e.g., lecture, lecture-laboratory) were also ascertained from the catalogs.

RESULTS OF THE CURRICULUM STUDY

Biology Course Offerings

Biological science courses account for 13 percent of the total science curriculum in the 1977-1978 academic year, compared to 14 percent of science courses reported in the National Science Foundation study (1969) conducted in the 1966-1967 academic year. Ten years ago biology was the second largest science area next to mathematics; in our study biology ranks third behind mathematics and engineering (see Table 2). Human biology accounts for 35 percent of the biological science courses. Introductory biology is the next largest area, followed by microbiology and then zoology (see Table 3). This finding represents a relative change in emphasis among the biology specialties. Table 4 compares community college offerings in the various biological sciences during the period between 1960 and 1978.

A shift in emphasis away from zoology and botany has occurred with a shift towards more colleges offering general biology, anatomy and physiology, and microbiology. Colleges offering bacteriology have decreased markedly. The increase in anatomy and physiology reflects the growth of occupational programs that has occurred in the two-year college, since this aspect of biology predominates in allied health programs. The movement away from zoology and botany and towards biology and microbiology may be a reflection of the change from an emphasis on morphology, taxonomy, and phylogenetics to an organizational level approach (Cox & Davis, 1972), although the content of botany and zoology in the Anderegg and Keller study (1968) did not differ significantly from biology offerings.

Table 2

Science Instruction in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Science Courses Listed on Schedule (n=15,084)	Percent of Total Science Sections Listed on Schedule: Lecture (n=49,275)	Percent of Total Science Sections Listed on Schedule: Laboratory (n=16,550)
Agriculture and Natural Resources	67	61	6	3	6
Biology	100	100	13	11	33
Engineering	87	86	20	11	30
Mathematics and Computer Sciences	99	99	22	33	
Chemistry	97	97	8	5	17
Earth and Space	84	79	5	4	4
Physics	91	89	6	3	10
Interdisciplinary Natural Sciences	93	89	4	3	
Anthropology and Interdisciplinary Social Sciences	79	67	3	3	
Psychology	100	99	6	12	
Sociology	100	100	4	8	
Economics	99	99	4	6	

Table 3

Biology in the Two-Year Colleges, 1977-78 Academic Year*

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Biology Courses Listed on Schedule (n=1,955)	Percent of Total Biology Sections Listed on Schedule: Lecture (n=5,189)	Percent of Total Biology Sections Listed on Schedule: Laboratory (n=5,524)
Introductory	93	90	18	36	40
Advanced	33	25	3	1	1
Botany	72	62	9	6	6
Zoology	73	64	10	7	8
Human Biology	96	91	35	31	31
Microbiology	87	79	12	9	10
Entomology	15	8	1	(1)	(1)
Ecology & Environmental	60	39	6	5	4
Related Topics	55	47	7	6	(1)

Notes. 1. 175 colleges (100% of sample) list one or more biology courses in the college catalog.

2. 175 colleges (100% of sample) list one or more biology courses in schedules of classes.

*See Appendix C for more detailed information on each biology field.

Table 4

Percentage of Two-Year Colleges Offering Biological Sciences as Reported in Studies from 1960-1978

Studies*	Zoology	Botany	Biology	Anatomy-Physiology	Bacteriology	Microbiology
Thornton, 1960 N=30	100	93.3	83.3	70	50	33.3
Thornton, 1966 N=30	100	83.3	90	90	26.7	73.3
Schechter, 1970 N=80	82.5	87.5	98.8	96.3	35	72.5
Thornton, 1972 N=40	90	77.5	100	92.5	20	85
Center for the Study of Community Colleges, 1977-1978 N=175	73	72.0	94	96	9	77

*Note all the studies are national samples, except Schechter (1970) which includes all California public community colleges.

Which Students Biology Courses Are Intended For

Science majors still represent the largest intended audience for biology courses (44%), but more than one quarter (27%) of the courses are designed for occupational students (see Table 5). Over one-half (59%) of human biology courses are specifically designated for occupational, allied health, and/or pre-professional students. More than one-third (36%) of the microbiology courses are also designed for these special groups. Agriculture, horticulture, or farm management students are the target groups for 36 percent of the entomology courses. As expected, non-science majors are served primarily by introductory courses (35%) and environmental and ecology courses (41%) (see Appendix C).

Table 5

Biology Courses By Students for Whom Courses Were Intended

Type of Student	Percentage of course offerings
Non-science majors	11%
Occupational students	27
Science majors	44
Occupational students or non-science majors	2
All students	5

These findings illustrate a change from the NSF study in 1966-1967, which found that 92 percent of the biological science offerings were designed for transfer students (NSF, 1969). They reflect an acknowledgement by biology curriculum planners of the student diversity in the two-year college.

Prerequisites and Course Sequences

Thirty-six percent of the introductory biology courses in our sample require a prerequisite (see Table 6). This percentage can be attributed to introductory biology sequences. Nearly half (48.5%)* of the introductory biology offerings are part of a sequence, most of which must be taken in a specific order; 42 percent of the introductory courses for non-majors were part of a sequence. This explanation indicates that only 10 percent of the introductory courses actually have prerequisites. Kormondy, Kastrinos, and Sanders (1974) report that 34 percent of the four-year colleges in their sample had prerequisites, which are largely chemistry prerequisites. Since the Kormondy et al. study consists of four-year colleges, it appears that introductory courses in our two-year sample may be less demanding of prerequisites. The role of course sequences (42.8 percent of the courses) also inflates the percentage of human biology courses, which frequently are introductory courses in allied health programs, that carry prerequisites.

The area of related topics, which includes mainly nutrition and pharmacology courses, also has a small number of prerequisites. These consist primarily of admission to a special program (52.6%) and courses that are part of a sequence (31.6%).

As expected, advanced biology has the highest proportion of prerequisites (93%) and introductory biology is the most common requirement. The number of introductory biology prerequisites required by botany and zoology indicate that these are not as prevalently considered introductory courses as the literature indicates (Anderegg & Keller, 1968). Again with these areas some of the prerequisites are attributable to their inclusion in a prescribed sequence; 14.9 percent of the botany courses are part of a sequence, 24.7 percent of the zoology courses. Microbiology is the only area with a sizeable chemistry prerequisite (28.4%).

Region, Size, and Control

Table 7 shows the distribution of biological science courses by college region, size, and control (the states included in each region can be found

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*The percentage of sequence courses approximates the 55% of introductory sequences in four-year colleges found in the Kormondy, Kastrinos, and Sanders study (1974).

Table 6

Prerequisites

	Number of Courses	% of This Type Course Having Prerequisite	Introductory Biology	Co-requisite	High School Lab Science	Chemistry	Admission to Special Program	Any Previous Biology Course	Examination	Consent of Instructor	Mathematics	Microbiology	Other Course of Same Type (Member Series)	Zoology	Botany	Previous Science	Other
Intro. Biology	355	36	74	12	11	5	2	1	4	2							2
Advanced Biology	54	93	76.1	4.3	2.2	10.9				2.2	2.2	2.2	8.7				
Botany	175	58	72		5.4	3.2				1.1			28	1.1			2.2
Zoology	186	68	59.1		2.4								35.4		2.4	2.4	3.1
Human Biology	689	59	17.6	7.6	6.9	7.6	7.6			1.4		3.3	56.5				13.3
Micro-biology	230	66	45.4	5.7	5.0	28.4	6.4	22					19.1		2.8		
Entomology	14	43	60		20									60			
Ecology & Environmental	118	36	63.4	2.4	2.4	2.4							7.3		7.3	19.5	2.4
Related Topics	134	26				5.3	52.6		2.6	2.6			31.6	2.6			21.1

Table 7

Percentage of Courses Offered by College Region, Size, and Control

	N	Region						Size			Control	
		North-east	Middle States	South	Mid-west	Mountain Plains	West	Small 1499	Medium 1500-7499	Large 7500+	Public	Private
Distribution of Sample	Total 175	11	21	54	38	73	28	72	78	25	147	28
Introductory Biology	162	100	85.7	92.6	89.5	95.7	89.3	90.3	92.3	100	95.2	78.6
Advanced Biology	58	27.3	57.1	31.5	31.6	21.7	35.7	22.2	35.9	60	35.4	21.4
Botany	126	45.5	66.7	70.4	78.9	69.6	85.7	52.8	79.5	84	76.9	46.4
Zoology	127	54.5	90.5	63	73.7	65.2	85.7	59.7	76.9	100	78.2	42.9
Human Biology	168	90.9	95.2	88.9	100	95.7	100	87.5	96.2	92	96.6	92.9
Microbiology	152	81.8	76.2	87	81.6	91.3	92.9	73.6	91	96	91.2	64.3
Entomology	27	--	4.8	11.1	7.9	26.1	39.3	8.3	19.2	32	18.4	--
Ecology and Environmental	87	36.4	42.9	44.4	52.6	34.8	71.4	26.4	59	84	55.1	21.4
Related Topics	97	27.3	38.1	59.3	55.3	52.2	64.3	47.2	53.8	88	58.5	39.3

in Appendix A). Both size and control appear to have a direct relationship with the number of colleges offering a specific type of biological science. Larger colleges are more likely to have offerings of every type than smaller colleges, with the exception of human biology. Human biology, however, is offered by virtually all colleges in the sample. Public colleges tend to have more offerings in all areas with the least discrepancy in human biology.

When region is considered, particularly striking differences do not emerge. Colleges in the West do offer the most botany, microbiology, entomology, ecology, and related topics (nutrition and pharmacology) and these colleges have among the highest offerings in the other areas. This effect may result more from the predominance of large colleges in the West (52%) as much as from regional differences.

Introductory Biology

The form of introductory biology was the subject of discussion in the literature. Do colleges offer one introductory biology course for majors and non-majors? Our study indicates that 58.9 percent of the two-year colleges list more than one introductory biology course in their catalogs. Most of these colleges (82.9%) direct one introductory course toward science majors and one toward non-science majors. The remainder of the introductory courses were designed for occupational students or special groups of non-science majors. Eight percent scheduled no introductory biology and the remaining 33.1 percent scheduled one introductory course. Fifty-six percent of the colleges scheduling 0-1 introductory biology were small colleges (which comprise 41% of the sample).

Catalog-Schedule Discrepancy

From our data we are able to determine the percentage of colleges that list a course in their catalog but do not actually schedule that course. In the biological sciences it appears that the catalog does accurately reflect offerings. Only three percent of the introductory biology courses listed in the catalog were not scheduled. The greatest discrepancies occurred in botany (10% not scheduled) and ecology (11% not scheduled). This finding indicates fairly precise curriculum planning.

PART II

INSTRUCTIONAL PRACTICES IN TWO-YEAR COLLEGE BIOLOGICAL SCIENCES

In 1972 Cox and Davis commented that "In our opinion it is no great exaggeration to state that variety in teaching methodology in undergraduate biological education is conspicuous by its absence" (p. 45). This indictment of biology instruction is especially scathing when directed at the two-year college, which has an exceptional responsibility to provide instruction to students with varied academic backgrounds, abilities, educational goals, and attitudes toward learning.

Questions regarding the types of instructional methodologies that are most effective for various types of students are not adequately answered in the biology literature. Studies describing or comparing the effectiveness of instructional methodologies (e.g., modules, audiotutorials) are more abundant. The following section reviews the available literature and presents data collected in the Center for the Study of Community Colleges' national survey of instructional practices of two-year college biology instructors.

THE LITERATURE

CUEBS has advocated a variety of instructional approaches from modules and audiotutorials to television courses, and the efficacy of these approaches has been discussed in the literature (see Appendix D for listing of references discussing instructional methodologies). Research in instruction tends to be localized, which may reflect the necessity for colleges to make determinations about instructional methods based on their specific student populations. Yet, only through a more global view, a national perspective, will instructional options be identified and the strengths and weaknesses of those options be determined.

Modules

Individualizing biology instruction has become a growing issue that culminated in the CUEBS publication on modules (Creager & Murray, 1971). Postlethwait and Russell (1971) trace the origins of minicourses (or modules) to the programmed instruction in the 1950s and the development of the audiotutorial system in the 1960s. This self-instructional approach offers a way of reducing curricular inflexibility; as Cox and Davis (1972) maintain, there is "no inherent reason why the educational experience must be defined in terms of courses" (p. 54).

Modularizing a course increases flexibility in course content; that is, instructors can choose from a collection of typical modules to create a unit worth a specified number of credits. Students can also meet their specific educational, vocational, or personal needs by selecting appropriate modules. Programs conducted through a modular approach can be developed through contractual arrangements (Cox & Davis, 1972). Postlethwait (1969) enumerates the advantages of the minicourse to include not only more flexibility for students to meet their needs and instructors to organize their courses, but as an aid to more specific diagnosis of student weaknesses, as portable to allow interchange among schools, and easily updated to accommodate additions to biological knowledge.

Project BIOTECH, sponsored by the American Institute of Biological Science, has created teaching materials and modules for two-year colleges. The modules, developed by experts in the particular content area, require minimal teacher involvement and emphasize technical skill development (Busser, 1972; Dodge, 1974; Glazer, 1974).

A successful use of modules in biology has been the Biological Science Curriculum Study (BSCS) in the secondary schools. BSCS biology consists of modular, nonlinear minicourses organized around a problem. Activities in the modular unit reinforce reading, mathematics, and other communicative skills (Hurd, 1976, 1978).

The modular approach to learning may also have drawbacks. In considering individualized instruction Davis and Farrand (1977) question the adequacy of community college students' motivation, or communication and study skills to cope with an instructional approach that requires self-discipline. Creager and Murray (1971) note that the modular approach may require additional "bookkeeping" to record which modules students complete and also increase the need for laboratory personnel to set up and maintain equipment for several modules simultaneously.

The Laboratory

Modules can meet laboratory needs, as well as provide the subject content generally obtained in the lecture portion of a course. Thornton (1972), however, indicates that laboratories are "almost exclusively illustrative in nature" (p. 26), and notes that "the investigative laboratory experience advocated by CUEBS was almost universally neglected" (Thornton, 1972, p. 26). Some discussion in the literature points to a trend toward an individualized laboratory approach (see references in Appendix D). Kormondy, Kastrinos, and Sanders (1974), despite some ambiguity over the term "investigative work," ascertained that 55 percent of the colleges in their sample included 50 percent or more investigative work within their introductory biology laboratories. Colleges that offered only one introductory biology course were less likely to include an investigative component in laboratories.

The CUEBS panel on Biology in Liberal Education recommended the use of laboratories as "integral and indispensable for non-major students" (CUEBS, 1972, p. 7), although no data were available to determine if a difference existed in laboratory offerings between courses for majors and courses for non-majors. But a problem that looms larger is the inadequacy of labora-tory facilities (Condell, 1965; Knight, 1973; Williams, 1971). Williams (1971) found one-third of the laboratories in Alabama's two-year colleges overcrowded, and he and Condell (1965) report deficiencies in the labora-tory equipment.

Textbook Use

Occasionally studies of biological sciences list textbooks that are used (Mangum & Mertens, 1971; Straney & Mertens, 1970). In 1967 NSF found that 73 percent of biology faculty were satisfied with their textbooks, four percent thought their textbooks were too advanced, and eight percent felt they were too elementary. Only one percent did not use a textbook. Although the studies reviewed did provide limited information on frequency of textbook use, they did not assess textbook use in light of the much dis-cussed decline in student reading abilities.

In short, the literature does not provide a complete picture of in-structional practices. Questions such as "how instructors utilize class time" and "what abilities biology instructors expect their students to achieve" need further discussion. Some of our findings, reported in the following section, address these deficiencies.

METHOD FOR THE INSTRUCTOR SURVEY

The same random sample of 175 colleges employed in the Curriculum Study was used in the study assessing instructional practices in the sci-ences. Each college president who agreed to participate in the study was also asked to name a contact person at the school, who was given the title "on-campus facilitator." All communication and correspondence between the Center for the Study of Community Colleges and the sample schools were conducted through the 175 on-campus facilitators. Once the college catalogs were obtained from each school, Center staff read each course description in the catalog and put courses in the appropriate category according to the Course Classification System for the Sciences.

The next step in the process involved counting the science course offerings in the Fall, 1977, day and evening schedules of classes. Each college's schedule was reviewed one section at a time. Using the course list developed from the college catalog, research assistants could determine which courses were properly categorized as science courses for inclusion in the study. Each science course section was then underlined. A list was developed for each college showing the courses that were offered and the number of sections of that course listed in the schedule of classes.

Individual class sections were selected by drawing every thirteenth section in each of the six major science areas. After randomly selecting the first college, the system was automatically self-randomizing. Every thirteenth section pulled off the schedule was recorded on a checklist for the facilitator at each school. This checklist included the name of the instructor listed as teaching the section, the course title, section number, and the days and time the class met. A copy of this checklist was kept at the Center to tally the surveys as they were received.

A survey form (Appendix E) for each instructor was mailed to the campus facilitator, together with instructions for completing the questionnaire and a return envelope addressed to the same facilitator. The return envelope had the instructor's name listed as the return address and was clearly marked "Confidential." This enabled the on-campus facilitator to keep an exact record of who had responded without opening the envelope. This technique guarantees confidentiality to the respondent while also enabling the facilitator to follow up on the retrieval of surveys from nonrespondents.

Questionnaires were mailed to 1,683 instructors. Because the surveys were mailed between February 20 and April 10, 1978 (after the completion of the Fall term being surveyed), 114 surveys were not deliverable due to faculty dismissal, retirement, death, etc. An additional 77 sections had been cancelled. Of the 1,492 deliverable surveys, 1,275 were returned, a response rate of 85.5 percent. Questionnaires were retrieved from 100 percent of the faculty samples at nearly 69 percent of the colleges. Table 8 shows the relationship between completed surveys in the different disciplines and the total number of class sections offered in these disciplines in the 1977-78 academic year.

RESULTS

Of the 1,275 responses to our Instructor Survey, 160 were from biology instructors. None of the 77 cancelled sections were biology sections. The relationship between the distribution of biology sections in academic year 1977-1978 and the responses of biology instructors to our class section survey among the biology specialties is shown in Table 9.

Students

According to the Instructor Survey, biology enrolls the highest number of students per section, 38.6 students, and an average of 31.4 students complete biology courses. These figures are higher than the median class size of 28 in the National Science Foundation (NSF) study of the 1966-1967 academic year (NSF, 1969). Creager and Ehrle (1971b), in their study of two-year college biologists, found that biology instructors had an average of 45 students in each lecture section and 22 students in each laboratory section. The Instructor Survey shows that biology has more large classes than any other discipline (23% of the sections, compared to 7% of the total science sections, enrolled more than 29 students). Both in the Instructor Survey and in the previous NSF study (1969) biology enrollment levels were comparable to enrollments in the social sciences rather than in the natural sciences.

The Instructor Survey indicated more female (25.6) than male students (13.0) enrolled in the average biology section. The number of biology sections directed towards allied health students (42.5% of the sections), including nursing students, probably accounts for this predominance of female students. Eighty-seven percent of sections designated for students in health-related occupational programs enrolled more women than men.

Table 8

Percentage of Instructor Surveys Returned from Each Discipline Compared to the Percentage of Courses Offered in that Discipline

Discipline	Returns on the Class Section Survey--% of Total (n=1,275)	77-78 Academic Year--% of Total Lecture Sections (n=49,275)
Agriculture	3.0	3.0
Biology	12.5	10.5
Engineering	11.3	11.0
Math/Computer Science	30.8	32.5
Chemistry	6.4	5.1
Earth/Space	3.6	3.6
Physics	3.5	3.2
Interdisciplinary Natural Science	2.3	2.7
Anthropology and Interdisciplinary Social Science	2.4	3.0
Psychology	11.2	11.6
Sociology	7.4	8.1
Economics	5.4	5.6

Table 9

Percentage of Instructor Surveys Returned from Biology Instructors Compared to the Percentage of Course Offerings in Biology

	Percentage of Lecture Sections in 1977-78 Academic Year	Distribution of the Biology Sample Percentage of Responses to Instructor Survey
Introductory Biology	36	41.3
Advanced Biology	1	0
Botany	6	4.4
Zoology	7	8.1
Human Biology	31	34.4
Microbiology	9	6.9
Entomology	1	0
Ecology & Environmental	5	2.5
Related Topics	6	2.5

Male students, however, have a higher completion rate (87%) than the female students (79%).

Seventy percent of the faculty respondents indicated that their course paralleled a lower-division four-year college course. This figure was similar to the average response from all the science faculty. Approximately half the respondents reported their courses were for transfer students majoring in natural resources or health (52.5%) or physical/biological sciences (49.4%). As indicated previously, 42.5 percent of the faculty responded that their course was designed for occupational students in allied health areas.

Instructional Mode

Our data, reported in Table 10, corroborate the lack of variety in instructional modes reported by Cox and Davis (1972). This information was obtained from catalogs and schedules, which may not have listed all nontraditional modes utilized. Of the modes designated, the lecture-laboratory combination appears to be the predominant mode in biological sciences. Courses in advanced biology, dominated by genetics, and related topics, such as nutrition and pharmacology, more often restrict instructional mode to lecture only. Field components may occur in botany (16.9%) and zoology (9.4%) courses, but are most likely to occur in the field of ecology (50.4%). The latter figure is lower than the 65 percent of ecology faculty who indicated they "require at least one extensive field trip" in Mangum and Mertens' survey of introductory ecology courses (1971, p. 488).

The variation in duration of laboratory time required in lecture laboratory courses can be seen in Table 11. Three-hour laboratories appear to be most common, except in entomology, with two-hour laboratories the next most frequently required. More specialized courses, such as microbiology, botany, and zoology may require a four-hour laboratory, but the introductory courses (introductory biology and human biology) are least likely to include a laboratory of this duration.

Table 10

Distribution of Instructional Modes for the Biological Sciences (by Percent)

	N	Lecture Only	Lecture-Laboratory	Field Course	Lecture with Field Experience	Lecture-Lab with an Individualized Component	Other
Introductory Biology	355	11.7	75.1		3.4	1.7	4.5
Advanced Biology	54	40.8	44.9		4.2	4.2	6.2
Botany	175	3.5	77.2	2.9	14.0	1.2	
Zoology	186	3.3	87.8	1.1	8.3	1.1	
Human Biology	689	26.8	70.8	.1	.3	1.3	.3
Microbiology	230	14.9	80.4		2.6	1.3	.9
Entomology	14	7.0	78.6	7.0	7.0		
Ecology & Environmental	118	17.7	31.9	11.5	38.9		
Related Topics	134	90.8	8.5				.8

Table 11

Laboratory Hours Required in Lecture-Laboratory Courses in Biology (by Percent)

	Number of Lecture-Lab Courses	Duration			
		2-Hour Labs	3-Hour Labs	4-Hour Labs	Other*
Introductory Biology	266	44.4	44.7	7.0	3.9
Advanced Biology	24	22.2	55.6	11.1	11.1
Botany	135	28.6	37.1	20.0	14.3
Zoology	163	29.4	30.6	23.8	16.3
Human Biology	486	36.5	42.0	12.4	9.1
Microbiology	185	27.5	31.7	25.1	15.6
Entomology	11	41.7	33.3	16.7	8.3
Ecology & Environmental	38	29.0	56.5	10.1	4.3
Related Topics	11	27.3	54.5	--	18.2

*Consists mainly of one-hour labs and six-hour labs.

Use of Class Time

The Instructor Survey delved deeper into the use of instructional techniques. The faculty were asked what percent of class time they devoted to certain activities. Virtually all the biology respondents used their own lectures (96.9%) and spent nearly half of their class time lecturing (45.3%). Biologists' use of lecture does not differ significantly from the use of this instructional approach by other science instructors responding to the survey.

Nearly three-quarters (73.1%) of the total group of instructors devoted class time to laboratory experiments by students. The average amount of time designated for this activity was 31.3 percent. Chemistry (37.5%), physics (30.9%), and engineering (43.2%) instructors allotted a similar amount of time to laboratory experimentation. In the course survey biology accounted for one-third (33%) of all laboratory sections, followed closely by engineering with 30 percent of the laboratory sections. Seventeen percent of the laboratory sections were chemistry sections, 10 percent physics sections.

The use of other classroom activities by biology instructors, in comparison to their social and physical* science colleagues, is delineated in Table 12. A large proportion of the biology respondents used class discussions (70.6%) and media (73.8%) which aligned them more closely to the social scientists than to the physical scientists. The time devoted to quizzes and examinations and, as previously discussed, their use of laboratory, was closest to time allocated to these activities by the physical science faculty. More than half of the biology instructors (58.1%) used laboratory practical examinations and quizzes representing the greatest use of this activity among the science disciplines. Yet, the biologists surveyed did not devote more class time to these exercises than others who used this form of student evaluation. Biology instructors are more likely to include field trips in their course than the average science instructor.

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*Social science includes anthropology, economics, psychology, and sociology; physical science includes chemistry, physics, and earth and space science.

Table 12

Allocation of Class Time Reported by Science Instructors

	Biology (n=160)	Physical Sciences (n=173)	Social Sciences (n=337)
Devoted class time to:			
Their own lectures	96.9%	96.5%	99.7%
Guest lectures	11.3	9.2	25.5
Student verbal presentations	19.4	12.7	39.8
Class discussion	70.6	19.1	94.7
Viewing/listening to media	73.8	51.4	71.8
Simulation and gaming	6.9	2.9	18.7
Quizzes and examinations	88.8	90.8	60.8
Field trips	18.8	10.4	8.6
Lecture/demonstration experiments	38.8	52.0	19.9
Laboratory experiments by students	73.1	70.5	7.4
Laboratory practical examinations and quizzes	58.1	24.3	3.3

Use of Instructional Materials

Three-fourths or more of the biology respondents used the following instructional materials: films, slides, overhead projected transparencies, maps, charts, illustrations, displays, three-dimensional models, scientific instruments, natural, preserved, or living specimens. Except in their use of films and slides, biology instructors are similar to physical science instructors in their use of these materials. The biology respondents use slides more than any other science faculty group and are closer to social science faculty in their use of films.

The Instructor Survey asked science faculty about their use of reading materials. Biology was no exception among the science disciplines in its heavy reliance on textbooks; virtually all the biology respondents (96.4%) used them. The number of pages biology instructors expect students to read (340) falls between the expectations of social science and physical science instructors. Nearly three-quarters of the biology instructors (74.4%), compared to 62 percent of the other science faculty, use handouts. The biology instructors are similar to social scientists in their use of journal and/or magazine articles. Reference books are included among reading materials of close to 40 percent of the biology instructors, compared to 21.5 percent of the entire science sample. With their physics and chemistry colleagues, most biologists (80%) use laboratory materials and workbooks, which is consistent with the curriculum data indicating the centrality of laboratory in the biology programs.

Grading Practices

The standard ABCDF grading system is most often used by biology instructors (71.3%), but 21.3 percent employ ABCD/no credit, which is more than average among science faculty (15.3%). We also surveyed the instructors to determine the basis of their grade assignments.

Not much emphasis is given to papers written in class or out of class. Biology instructors use both quick score and essay exams. Laboratory reports were counted in grading by over half the biology respondents (53.8%) and nearly half (46.9%) included laboratory unknowns or practical exams in grade determinations. Other types of student evaluation were not particularly emphasized, e.g., field reports, oral recitations, research reports, workbook completion, participation in class discussion, regular class attendance, individual discussion with the instructor, or nonwritten reports. Even homework was not considered part of students' grades by 60 percent of the biology instructors.

Desired Student Competencies

Since biology faculty emphasize tests to evaluate students, it is important to understand what student abilities they evaluated. The emphasis is not on mastery of a skill, as it is for chemistry and mathematics instructors; only 24.4 percent of the biologists consider this "very important" compared to 70.7 percent of the chemists and 87.5 percent of the mathematicians. Biology instructors indicated a higher than average concern that their students demonstrate acquaintance with concepts of the discipline; 90.6 percent of the biologists considered this "very important" compared to 83.1 percent of the total science faculty. The recall of specific information is important to virtually all of the biology respondents; it is very important to 62.5 percent of them, the highest percentage among faculty from any science discipline.

Understanding the significance of certain works (59.4%) and synthesizing course content (50.6%) are reported as very important. Understanding the relationship of biology concepts to values is only of moderate importance with nearly one-third (31.3%) indicating it as "not important." The latter result typifies the physical sciences, mathematics, and engineering more than the social sciences.

Multiple response (94.4%), completion (84.4%), and essay (77.5%) questions are the predominant types used by biology instructors. While they align more with the social scientists in their use of multiple response and essay questions, their use of completion is among the highest of any of the science disciplines. Mathematics, the physical sciences, and engineering make more use of mathematically-related problems and the "construction of graphs, diagrams, chemical type equations, etc." than biology does.

Course Goals

The Instructor Survey attempted to ascertain instructors' course goals by asking them to select qualities they want their students to achieve. Table 13 presents the responses of biology instructors in comparison with their social science and physical science colleagues. Biologists share a concern for their students' ability to relate science to the world with social scientists. Their interest in preparing their students for further education is closer to the physical scientist's than the social scientist's. Overall, however, no striking parallels between biology instructors and either of the other two faculty groups emerge.

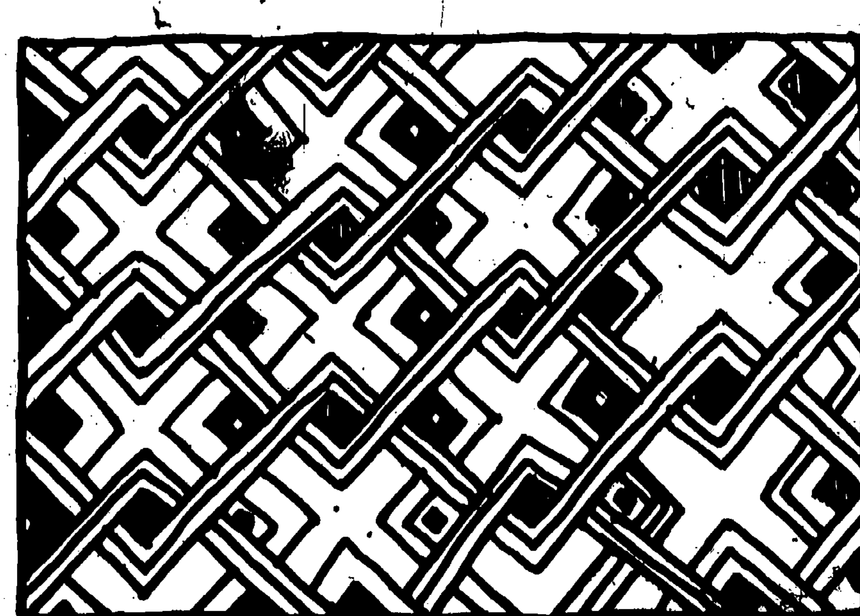
Out-of-Class Activities

When asked about the role of out-of-class activities in their class sections, 60 percent of the biologists reported that students were asked to watch television in conjunction with their courses; nearly half encouraged students to attend films or outside lectures, and nearly 30 percent recommended museum exhibits to their students. Not surprisingly, 29.4 percent of the biology instructors, compared to 11.3 percent of the total science faculty, suggested students take field trips to "natural formations or ecological areas." Not more than 10 percent of the biology faculty required any out-of-class activities.

Table 13

Response to Question: Instructors may desire many qualities for their students. Please select the one quality in the following list of four that you most wanted your students to achieve in the specified course (by percent).

	Biology	Physical Sciences	Social Sciences
First Group of Four:			
Understand/appreciate interrelationships of science and technology with society	48.0	31.8	43.6
Be able to understand scientific research literature	.6	--	3.9
Apply principles learned in course to solve qualitative and/or quantitative problems	42.5	57.8	48.4
Develop proficiency in laboratory methods and techniques of the discipline	6.9	8.7	1.2
Second Group of Four:			
Relate knowledge acquired in class to real world systems and problems	61.3	38.7	71.8
Understand the principles, concepts, and terminology of the discipline	35.5	51.4	18.7
Develop appreciation/understanding of scientific method	1.3	5.2	.9
Gain "hands-on" or field experience in applied practice	.6	4.0	1.5
Third Group of Four:			
Learn to use tools of research in the sciences	1.3	9.2	3.0
Gain qualities of mind useful in further education	40.0	36.4	22.6
Understand self	8.8	1.2	32.6
Develop the ability to think critically	47.5	52.0	43.3



PART III

TWO-YEAR COLLEGE BIOLOGY FACULTY

THE LITERATURE

Most of the information available on biology faculty in community colleges comes from data collected by the National Task Force of Two-Year College Biologists under the Commission on Undergraduate Education in the Biological Sciences (CUEBS). The Task Force surveyed 1,255 biologists in April 1970 (Creager & Ehrle, 1971a). Several members of the Task Force have used the data to comment on two-year college biologists' priority on teaching (Gunstream, 1971), professional needs (Hurlburt, 1971), and attitude toward the two-year college (Dodge, 1970). A quotation from Gunstream (as quoted by Dean, 1970) synthesizes the issues that pervade discussions of two-year college biology faculty: "Basically the desirable fundamental teacher qualities are the same regardless of level of instruction or type of institution, but teachers in the two-year college must really want to teach and interact with students, and their biological training must be broad based" (p. 67).

Gunstream indicates the emphasis given to discussions of faculty training and educational needs in the literature. Some statistics collected by CUEBS, although a bit dated, present a perspective on biologists' training. Between 1963 and 1967, 1,843 Ph.D.s were granted in biological fields by 94 leading universities. Sixty-nine percent of these doctorates became college teachers; 73 percent taught a beginning course. Among the 94 universities 66 percent provided no special training to teaching assistants and 80 percent offered no special course or seminar in any aspect of college teaching (Dean, 1969). Since 75 percent of the two-year college biology instructors have master's degrees* (Creager & Ehrle, 1971a, b), presumably from graduate institutions comparable to those surveyed by CUEBS, the nature of graduate training has important implications on their ability to teach.

CUEBS Panel on the Two-Year College recommended that "programs for pedagogical training for all college biologists should be mobilized" (Hertig, 1969, p. 27). The Panel found special programs for two-year college biology instructors "untenable" and recommended they be discontinued. Dean (1970), in the CUEBS publication Preservice Preparation of College Biology Teachers: A Search for a Better Way, presents model preservice programs which include pedagogical training and an internship component (see also Wallace, 1974).

Once two-year college biologists are teaching, they most often cite excessive teaching load as the major impediment to doing a better job (Creager & Ehrle, 1971a, b; Gunstream, 1971; Hanes, 1967). In addition, faculty complain of inadequate technical and secretarial assistance (Hanes, 1967) which, combined with a heavy teaching load, prevents them from reading journals or involving themselves in professional science societies. This information and Dodge's (1970) characterization of two-year biology

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*Sixteen percent of the two-year biology instructors have Ph.D.s according to the Creager and Ehrle report (1971a, b).

faculty need augmentation to allow a better understanding of faculty attitudes.

RESULTS OF INSTRUCTOR SURVEY REGARDING FACULTY CHARACTERISTICS

The Center's Instructor Survey received 1,275 responses from science instructors; 160 biology instructors responded to questions concerning faculty demographics, activities, and working conditions. The development and distribution of the Instructor Survey are described in the preceding section.

Degree Attainment

Seventeen percent of two-year college biology instructors have earned doctorate degrees, which represents little change from the 16 percent who reported having doctorates in the CUEBS study conducted in 1970 (Creager & Ehrle, 1971a, b). Although doctorate attainment among biologists is higher than the average among science faculty (14.5%), it does not reach the number of earned doctorates among physical science faculty (30%). Most of the remaining biology faculty have master's degrees (75%) (see Table 14).

Employment Status

Nearly three-quarters of the biology respondents teach full-time; 13 percent teach part-time and 2.5 percent are division/department chairpersons. The percentage of biology instructors teaching full-time is slightly less than the number of full-time physical science instructors. The social sciences are taught by somewhat more part-time instructors than biology (see Table 14).

Teaching Experience

Over half (53.8%) of the biology faculty have been teaching at the community college between three and ten years, and one-third have taught more than ten years. Biologists appear to have more experience than their social science colleagues, but are not as seasoned as the physical science faculty (see Table 14).

Table 14

Percentage of Teachers at Each Level of Degree Attainment, Employment Status, and Teaching Experience

	Biology (n=60)	Physical Sciences (n=173)	Social Sciences (n=337)
Degree Attainment			
Bachelor's	5.6	2.3	4.2
Master's	75.0	66.4	77.8
Doctorate	17.5	30.0	16.9
Employment Status			
Full-Time	73.8	79.8	73.3
Part-Time	13.1	9.8	16.0
Chairperson/Administrator	2.5	4.0	3.9
Teaching Experience			
0 - 2 years	11.9	12.1	12.5
3 - 10 years	53.8	49.7	60.2
Over 10 years	33.2	37.5	20.8

Course Materials

Instructors were asked to indicate the extent to which they participated in the selection of instructional materials used in their courses (see Table 15). Nearly half of the biology faculty had "total say" about selection of textbooks (45.5%) and laboratory materials and workbooks (53.1%). Close to 15 percent had no involvement in the selection of textbooks and the selection of laboratory materials. More than 95 percent of the biology

Table 15

Faculty Satisfaction and Degree of Influence in the Selection of Instructional Materials (in percent)*

Instructional Material	Satisfaction: Number Using Material	Well Satisfied	Would Like to Change	Influence in Selection: Total Say	Some Say	Someone Else Selected Them
Textbooks	154	64.9	33.7	45.5	39.6	14.9
Laboratory Materials and Workbooks	128	50.8	45.3	53.1	31.3	14.8
Collections of Readings	24	70.8	25.0	91.7	8.3	--
Reference Books	63	84.1	7.9	84.1	12.7	3.2
Journal and/or Magazine Articles	61	82.0	13.1	85.2	6.4	4.9
Newspapers	18	83.3	5.6	94.4	5.6	--
Syllabi and Handout Materials	119	72.3	21.8	82.4	12.6	3.4
Problem Books	10	100.0	--	50.0	10.0	30.0

*Percentages are based on the number of instructors who used the material in question. The percentages do not add up to 100 percent due to missing responses.

respondents had some involvement in the selection of all other materials (except problem books, which were hardly used).

Biologists' levels of dissatisfaction with textbooks, laboratory materials, reading collections and syllabi and handout materials are among the highest of any faculty group. The level of satisfaction with textbooks has decreased since the NSF Study conducted in 1966-1967, which indicated that 73 percent of the faculty were satisfied with their textbook; 64.9 percent of biology respondents to the Instructor Survey reported satisfaction. The dissatisfaction does not appear attributable to faculty control of the choice of materials.

Textbooks may be unsuitable for a number of reasons: reading levels are declining and this may affect students' abilities to read existing textbooks, student backgrounds may not match textbook materials, and the increase and changes in biological information may render old textbooks obsolete.

Use of Support Services

Does the availability of support services and their use by biology faculty substantiate Gunstream's (1971) assertion that inadequate technical and secretarial assistance presents a barrier to course improvement? Biology instructors generally appear to have more assistance available to them than instructors in other science disciplines, and, compared to other science faculty, they make more use of most of these resources (see Table 16). Over 85 percent had clerical help available, and over three-fourths made use of this help. Library assistance and media production were readily available to most biology faculty and over half took advantage of these services. Further investigation would be necessary to determine if the available assistance was appropriate for faculty needs. The discrepancy between availability of services and their use indicates that the services provided may not have been entirely suitable.

Table 16

Availability and Use of Support Services (percentages)

Support Service	Assistance Available			Assistance Utilized This Term (Fall 1977)		
	Biology (n=160)	Physical Sciences (n=173)	Social Sciences (n=337)	Biology (n=160)	Physical Sciences (n=173)	Social Sciences (n=337)
Clerical Help	86.3	83.8	87.2	76.9	72.3	76.3
Test Scoring Facility	66.9	59.5	56.7	38.1	23.7	33.8
Tutors	55.6	54.9	40.1	37.5	42.8	24.6
Readers	11.3	13.3	19.6	3.8	7.5	4.7
Paraprofessionals	24.4	21.4	5.6	18.8	13.9	7.4
Media Production	76.3	69.4	73.0	54.4	39.3	49.6
Library/Bibliographic Assistance	80.0	69.4	74.5	52.5	39.9	50.1
Laboratory Assistants	57.5	48.0	7.7	49.5	43.9	5.9

Working Conditions

Faculty were asked to indicate what it would take to improve their courses. Table 17 lists the responses to this question. Over 50 percent (53.8%) of the biologists indicated that they desire students who are better able to handle course material. The next most prevalent concern was the availability of more media (48.1%). These responses provide further evidence of the need to realign biology instruction to meet diverse student abilities, learning styles, motivations.

More than 40 percent of the instructors indicated that instructor release time would contribute to course improvement. This response substantiates the problem of excessive teaching loads cited in the literature, (Creager & Ehrle, 1971a, b; Gunstream, 1971). Thirty percent or more of the biology instructors also desired better laboratory facilities (30.6%), professional development opportunities for instructors (35.0%), and stricter prerequisites (36.9%).

Table 17

Percentage of Responses to Items in Question: Although This Course May Be Very Effective, What Would Make It Better? (Check all that apply.)

Item (in rank order)	Biology (n=160)	Physical Sciences (n=173)	Social Sciences (n=337)
Students better prepared to handle course material	53.8	59.5	53.1
Availability of more media	48.1	32.4	45.7
Instructor release time	41.9	45.7	40.9
Stricter prerequisites	36.9	30.1	22.8
Professional development opportunities for instructors	35.0	26.0	31.2
Better lab facilities	30.6	37.0	12.2*
Smaller classes	26.9	20.2	38.0
More interaction with colleagues/ administrators	18.1	18.4	22.6
More clerical assistance	18.1	21.4	19.3
More reader/paraprofessional aides	8.8	18.4	15.7
More freedom to choose materials	7.5	8.6	13.9

Less than 10 percent selected the following items:

- Less interference from colleagues/administrators
- Larger classes
- Changed course description
- Different goals/objectives

*Mostly attributable to psychology.

PART IV

CONCLUSION

This section includes a summary of the most important findings concerning biology from the Center for the Study of Community Colleges study. Several recommendations are made that bear on the implications drawn from the data.

SUMMARY

The Center for the Study of Community Colleges undertook its study of science education in the two-year colleges to document the current curricular structure and instructional practices in the various fields of study. Data were obtained through a curriculum study that provided analysis of courses offered in the 1977-1978 academic year, including a classification scheme and information on frequency of course offerings, course prerequisites, and instructional modes. In addition, an Instructor Survey provided data on the types of instructional methodology and materials utilized by two-year college biologists.

Biology constitutes a significant portion of the two-year science curriculum. All of the colleges in our sample offered at least one course in biological sciences, regardless of college emphasis. Biology accounted for 13 percent of all the science courses considered in the study.

The Biology Curriculum

In considering the state of biology curriculum in the two-year college, an important question emerges. Do the biological sciences respond to the unique characteristics of the community college? At the outset of this monograph the distinctive features of the two-year college were identified as the diversity of college missions, the heterogeneity of the student population, and the nontraditional student course-taking patterns. A number of findings indicate that the biology curriculum has kept pace with the community college's movement away from its predominant role as a transfer institution that provides an academic program directed at traditional college students.

Human biology accounts for 35 percent of the biology curriculum, the largest segment; this reflects the centrality of allied health in the occupational curriculum. When compared to data in the literature, our findings indicate a trend towards more anatomy and physiology and microbiology, which are needed by allied health students, and less emphasis on the more traditional botany and zoology.

The Curriculum Study yielded the information that size relates to the number of biology offerings. Large colleges tend to offer more variety, thus making them better able to meet varied needs of student clientele. These data suggest that smaller colleges may have difficulty responding to a heterogeneous student body with appropriate offerings. Smaller colleges, however, may be more homogeneous, thus alleviating them of the necessity of offering a wide range of courses.

Over one-fourth (27%) of the biology courses had catalog descriptions designating them for occupational students. Nearly one-half of the biology respondents to the Instructor Survey indicated that their courses were designed for occupational students. These data further demonstrate the impact of the two-year college's emphasis on occupational programs on biology curriculums. Yet, over 70 percent of the biology instructors maintain that their course parallels a lower-division course at a transfer institution, and over half (52.5%) report that their course is designed for transfer students. Since data show that only approximately 20 percent of the current community college student population is transfer-oriented, the predominance of the transfer course indicates that the vestiges of the traditional view of the two-year college student still exist.

A significant group of students attending the community college are academically deficient. Although our data show that very few introductory biology courses require prerequisites, which encourages enrollment of academically deficient students, faculty reported in the Instructor Survey that their course would be improved by students better able to handle course requirements (53%) and stricter prerequisites (36.9%). These findings indicate the dilemma between open access to biology and the need to maintain the integrity of college level biology offerings.

A barrier to nontraditional community college students may be found in the number of course sequences in introductory biology (48.5% of introductory courses; 42.8% of human biology courses). Sequences particularly directed at terminal and non-major students may need review to determine the extent to which they accommodate unorthodox course-taking patterns that may consist of students "dropping in" and "stopping out."

<u>Instructional Practices</u>

Although the Curriculum Study did not suggest that biology faculty utilize a variety of instructional modes (most conduct courses in a lecture-laboratory format), the Instructor Survey indicates the use of various media, e.g., films, slides, overhead transparencies. In addition, nearly half the biology respondents want more media available to them for course improvement. This finding does represent faculty awareness of the importance of varied teaching methodologies to address the different learning styles their students may possess.

Although one would expect biology instructors to align themselves more closely with their physical science colleagues than the social scientists, this expectation was not unequivocally the case. In use of class discussion, films, and in concern over relating biology to real world systems and society, biologists were more like the social scientists. Biology instructors resembled the physical science instructors in their use of instructional materials and media, with the exception of slides and films. One area of difference between biology instructors and either group was in their use of field trips; they devoted more class time to field trips and encouraged more extracurricular field trips, especially in relation to ecology, than either of the other groups.

The laboratory comprises an important dimension of biology instruction. Biology accounts for one-third of all laboratory sections in the science curriculum, followed closely by engineering. The Commission on Undergraduate Education in the Biological Sciences (CUEBS) endorsed the model of the investigative laboratory in lieu of the illustrative laboratory. Nearly three-fourths (73.1%) of the biology respondents devoted time to lecture-demonstration experiments. Nearly one-third (31.3%) of class time was devoted to the laboratory experiments by students with an average of 8.9 percent of class time spent in lecture-demonstration experiments. These data indicate that biology instructors do emphasize the laboratory approach. The data are limited since the sampling of instructors was conducted on the basis of lecture sections taught.

The Biology Faculty

As part of the Instructor Survey, biologists were asked to assess their working conditions through their responses to questions about satisfaction with available instructional materials, use of support services, and opinions of what factors would improve their courses. A high proportion of biology instructors, relative to other science instructors, express dissatisfaction with textbooks (64.9% are "well satisfied," a decrease from 73% reported in a NSF study published in 1969), laboratory materials, collections of readings, and syllabi and handout materials. Most faculty reported that they had at least "some say" in the selection of these materials. Thus, one explanation for faculty dissatisfaction may be the inadequacy of available materials for student background or reading ability. Further investigation is needed to determine the reasons behind this finding.

The literature suggests that lack of clerical and laboratory assistance may be a problem for two-year college biologists (Gunstream, 1971). Our data indicate that many biology instructors in our sample had these services available (86.3% had clerical help; 57.5% had laboratory assistance), but that they were not utilized to their fullest (76.9% utilized clerical help; 49.5% utilized laboratory assistants). Neither the reasons for lack of wider availability of these services nor the adequacy of the available services were studied. However, only 18.1 percent of the biology instructors noted "more clerical assistance" as important to their class improvements. This item ranked eighth on a list of 15 possible areas to enhance course quality.

Several items that biology faculty considered crucial to making their course better have already been mentioned as they relate to meeting the needs of a diverse student clientele; biology instructors ranked "students better prepared to handle course" first (53.8% marked this item) and "availability of more media" second (48.1%) as needed changes. The third item of the ranking is "instructor release time" (41.9%), which may reflect the heavy teaching loads noted to be a problem in the literature (Creager & Ehrle, 1971a, b). Since our data also indicate large section size in biology, it is not surprising that over one-fourth (26.9%) of the biology respondents desired smaller classes. Professional development opportunities, stricter prerequisites, and better laboratory facilities were also chosen by over 30 percent of the biology instructors as factors that would improve their course.

The profile of two-year college biology emerging from the Center's study is biology coping with the student diversity and multiple missions of the community college through varied course offerings with some emphasis shifting away from the traditional transfer program towards occupationally-related courses, through use of media that may appeal to students with nontraditional backgrounds and learning styles, and through a limitation of barriers (prerequisites) to student enrollment in introductory courses. Meanwhile, two-year college biologists must keep pace with the increase in biological knowledge and the challenge of the investigative laboratory. The combination of the community college setting and the changing biology discipline provide two-year college biology with a formidable task.

RECOMMENDATIONS

In light of the findings of the Center's study, the following recommendations are made for college administrators, curriculum planners, counselors, researchers, and policy makers to support the faculty course developer in addressing two-year college students' needs for biological education.

1. Types of students who enroll in biological sciences should be identified and courses concomitant with their aspirations and needs designed.

2. Further research on instructional materials suitable to different learning approaches and to students with academically-deficient skills is needed.

3. Replication of transfer courses, which tend to be technical, theoretical, and somewhat abstract should be supplanted by more nontechnical, applied, and relevant courses for students not majoring in biology.

4. Textbook publishers need to produce materials consistent with student objectives and competencies.

5. Biological themes can be included in nonbiology courses in the form of modules or short courses.

6. Biologists should undertake joint curriculum planning sessions with vocational instructors in biology-related fields, especially allied health (e.g., Brown, 1979).

7. Noncredit courses can serve as a vehicle to present biological topics of community interest. (Noncredit courses were not considered in our study but must be considered in light of the growth of this area in the community college.)

8. The factors that contribute to faculty meeting the needs and objectives of two-year college students include a combination of relevant preservice pedagogical training, professional development opportunities, and faculty initiative. The college administration can encourage the latter two items through offering faculty fellowships, instructional development grants, summer pay, release time, and/or sabbatical time.

9. The professional development of faculty should be promoted in order to keep them current about new developments in the field of biology. The CUEBS Panel on the Two-Year College emphasized the role of the disciplinary associations in providing information, planning programs, and informing instructors about special events, new teaching methodologies, and training opportunities (Hertig, 1969). A two-year college forum may be needed, but, meanwhile, other publications can continue to provide faculty with current information, e.g., The American Biology Teacher, Journal of College Science Teaching, and Bioscience.

Recommendations, such as those listed here, are often ignored because of fiscal constraints. Yet, the centrality of biology in the science curriculum demands creative attempts to improve its offerings. Studies, such as the one reported here, need to be replicated to keep biology practitioners aware of the salient issues that need in-depth treatment. The Center's study can be judged successful if it stimulates new efforts by biologists to address the unique and challenging demands of the two-year college.

REFERENCES

Aldrich, J. L., & Kormondy, E. J. Environmental education: Academia's response. Washington, D.C.: Commission on Undergraduate Education in the Biological Sciences, 1972.

American Association of Community and Junior Colleges (AACJC). Fact sheets on two-year colleges. Washington, D.C.: American Association of Community and Junior Colleges, 1976.

American Association of Community and Junior Colleges. 1977 community, junior, and technical college directory. Washington, D.C.: American Association of Community and Junior Colleges, 1977.

American Association of Junior Colleges. Grossmont College conference on biomedical technology and manpower. Washington, D.C.: American Association of Junior Colleges, 1970. (ED 047 146)*

Anderegg, D., & Keller, E. C. A survey of introductory biology courses and staffing in departments of biology, botany, and zoology. Journal of Biological Education, 1968, 2, 137-150.

Anderson, B. E. Nursing education in community junior colleges. Philadelphia: J. B. Lippincott, 1966.

Appel, G. L., et al. Evaluating three allied health training programs: Exploratory research into curriculum relevance and labor market conditions. Journal of Allied Health, 1977, 6 (2), 46-54.

Beitler, L. The development, implementation, and evaluation of an innovative science reading program for use in the community college. (Unpublished doctoral dissertation, Nova University, 1976). (ED 142 259)

Bennett, R. M. Effects of previous high school programs on achievement in college biology. Journal of College Science Teaching, 1975, 4(4), 242-244.

Berry, J. Community colleges and urban ecology: Alternatives for learning in man-dominated ecosystems. Community College Frontiers, 1974, 3 (1), 13-15.

Berry, J. A different kind of learning about urban man. Community and Junior College Journal, 1975, 45 (6), 24-25.

Berry, J., Gillet, L., & Didato, T. A remedial course in college biology? Journal of College Science Teaching, 1976, 5 (3), 177-179.

Biology for the non-major. CUEBS News, 1968, 4 (3), 1-3.

Brown, M. D. Personal communication, 1979.

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*A number in parentheses, preceded by "ED," refers to an Educational Resources Information Center (ERIC) document available from the ERIC Document Reproduction Service, Box 190, Arlington, Virginia 22210, or viewed in any library that has the ERIC collection.

Busser, J. H. Biotech. Bioscience, 1972, 22, 292-293.

Calandra, A. Science for nonscience majors. Journal of College Science Teaching, 1972, 1 (4), 35-37.

Carter, J. L. The impact of new curricular programs on college and university students and professors. Bioscience, 1969, 19, 345-348.

Cohen, A. M. Issues in curriculum formation. New Directions for Community Colleges, No. 25, 1979, 7 (1), 101-111.

Commission on Undergraduate Education in the Biological Sciences. CUEBS, 1963-1972: Its history and final report. CUEBS News, 1972, 1 (special issue), 6-12.

Condell, Y. C. A study of the biological science curriculum in the junior colleges of Minnesota (Doctoral dissertation, University of Connecticut, 1965). Dissertation Abstracts International, 1965, 26, 6526A. (University Microfilms No. 66-832)

Cornish, S. F., Jr. A community college and the core curriculum in biology. CUEBS News, 1970, 6 (4), 15-16.

Coston, L. P. A survey of the attitudes of Texas public college biology teachers toward a uniform curriculum in biology (Doctoral dissertation, East Texas State University, 1969). Dissertation Abstracts International, 1969, 30, 5224A. (University Microfilms No. 70-11283)

Cox, D. D., & Davis, L. V. The context of biological education. Washington, D.C.: Commission on Undergraduate Education in Biological Sciences, 1972.

Creager, J. G., & Ehrle, E. B. Attributes of biologists in two-year colleges. Bioscience, 1971, 21, 124, 129-134. (a)

Creager, J. G., & Ehrle, E. B. Some attributes of two-year college biologists. The American Biology Teacher, 1971, 33, 163-164. (b)

Creager, J. G., & Murray, D. L. (Eds.). The use of modules in college biology teaching. Washington, D. C.: Commission on Undergraduate Education in the Biological Sciences, 1971.

Davis, R. M., & Farrand, E. A. A modified system of individualized instruction in biology: Rethinking individualized instruction at the community college level. Journal of College Science Teaching, 1977, 6 (3), 152-153.

Dean, D. S. Our role as teaching fellow is to point out the spleen and to show the students the drawer where the pipettes are kept. CUEBS News, 1969, 6 (2), 1-2.

Dean, D. S. Preservice preparation of college biology teachers: A search for a better way. Washington, D.C.: Commission on Undergraduate Education in the Biological Sciences, 1970.

DeAnza College. DeAnza Summer College "By the Sea": Evaluation report, 1974. Cupertino, Calif.: DeAnza College, 1974. (ED 100 469)

Dodge, R. A. People we meet in two-year colleges. CUEBS News, 1970, 7 (2), 8-12.

Dodge, R. A. Project BIOTECH - modules for teaching biological skills and techniques. Bioscience, 1974, 24, 310.

Dubay, C. The community college and its role in allied health education. In C. W. Burnett (Ed.), The Community and Junior College. Lexington, Kentucky: University of Kentucky, 1977. (ED 149 815)

Duggins, O. H. The development of health care areas - development of the concept. Associate degree education for nursing - current issues, 1971. New York: National League of Nursing, 1971.

Edwards, S. Science education in two-year colleges: Environmental Sciences. Los Angeles: Center for the Study of Community Colleges, 1979.

Glazer, R. B. Project BIOTECH: Use of modules in technician training. The American Biology Teacher, 1974, 36, 292-293.

Gordon, R. D. Associate degree nurse preparation and nursing service needs: An incidental paper. Unpublished paper, 1975. (ED 101 817)

Gratz, P. Human ecology: Science teaching in junior colleges. The American Biology Teacher, 1969, 31, 570-571.

Gunstream, S. E. The two-year college biologist and his academic environment. The American Biology Teacher, 1971, 33, 226-227, 236.

Hanes, T. L. Problems related to biology in the junior college. The American Biology Teacher, 1967, 29, 639-640.

Hertig, W. H., Jr. Biology in the two-year college. Publication No. 26. Washington, D.C.: Commission on Undergraduate Education in the Biological Sciences, 1969.

Hill, A., & Mooney, W. Methodologies employed in a study of science instructional programs in two-year colleges. Los Angeles: Center for the Study of Community Colleges, 1979. (ED 167 235)

Hurd, P. D. An exploratory study of the impact of BSCS secondary school curriculum materials. The American Biology Teacher, 1976, 38, 79-85.

Hurd, P. D. The BSCS human sciences curriculum project. Bioscience, 1978, 28, 36-38.

Hurlburt, E. M. Goals of the task force of two-year college biologists. The American Biology Teacher, 1971, 33, 161-162.

Klopfenstein, T. D. The core is not the part you throw away: Allied health education. New Directions for Community Colleges, No. 4, 1973, 1 (4), 35-43.

Knight, E. L. An investigation of the biological science curricula in the public and private junior colleges of North Carolina (Doctoral dissertation, University of Southern Mississippi, 1973). Dissertation Abstracts International, 1973, 34, 4912A. (University Microfilms No. 74-03940)

Knoell, D. (Ed.). Understanding diverse students. New Directions for Community Colleges, No. 3, 1973, 1 (3), whole issue.

Kormondy, E. J., Kastrinos, W., & Sanders, G. G. A survey of first-year college biology courses. The American Biology Teacher, 1974, 36, 217-220.

Loftin, L. H. A survey of the zoological course offerings in the two-year colleges of the North Central Association compared to the courses recommended by a panel of judges, with implications as to future trends. Stillwater, Oklahoma: Oklahoma State University, 1968.

Lombardi, J. Resurgence of occupational education. Topical paper no. 65. Los Angeles: ERIC Clearinghouse for Junior Colleges, 1978. (ED 148 418)

Mangum, T. E., & Mertens, T. R. Introductory ecology courses in college: A survey. The American Biology Teacher, 1971, 33, 484-488.

Mason, H. J. Community college programs in the life sciences. The American Biology Teacher, 1971, 33, 165-166.

McCabe, R. H. (Ed.). Current issues in environmental education - III: Selected papers from the sixth annual conference of the National Association for Environmental Education. Columbus, Ohio: ERIC Center for Science, Mathematics, and Environmental Education, 1977. (ED 150 018)

Moore, M. R. A survey of college biology departments regarding introductory course curricula and advanced placement practices. Journal of Research in Science Teaching, 1965, 3 (3), 235-245.

National Science Foundation. Junior college teachers of science, engineering, and technology, 1967. Washington, D.C.: Government Printing Office, 1969. (ED 028 768)

Philp, M. J. Learning on the big bay. Community and Junior College Journal, 1978, 48 (6), 30-33.

Postlethwait, S. N. Time for minicourses? CUEBS News, 1969, 5, 4-6.

Postlethwait, S. N., & Russell, J. D. Minicourses--the style of the future? In J. G. Creager & D. L. Murray (Eds.), The use of modules in college biology teaching. Washington, D.C.: The Commission on Undergraduate Education in the Biological Sciences, 1971.

Pratt, A. L. Environmental ecological education 1970. Junior College Journal, 1971, 41 (4), 8-9.

Roos, T. B. Biological prerequisites for education in the health sciences. Washington, D. C.: Commission on Undergraduate Education in the Biological Sciences, 1969. (ED 125 899)

Schechter, A. J. Biology in California public junior colleges (Doctoral dissertation, University of Southern California, 1970). Dissertation Abstracts International, 1971, 31, 1098A. (University Microfilms No. 70-16 887)

Schoenfeld, C., & Disinger, J. (Eds.). Environmental education in action - II: Case studies of environmental studies programs in colleges and universities today. Columbus, Ohio: ERIC Center for Science, Mathematics, and Environmental Education, 1978. (ED 152 557)

Straney, M. J., & Mertens, T. R. A survey of introductory college genetics courses. CUEBS News, 1970, 6 (5), 1-5.

Tamir, P. High school preparation and college biology. Bioscience, 1969, 19, 447-449.

Teel, W., et al. The need to establish a marine sciences technology program at Shoreline Community College. Seattle, Washington: Shoreline Community College, 1966. (ED 011 781)

Thornton, J. W., Jr. The community junior college (1st ed.). New York: John Wiley and Sons, Inc., 1960.

Thornton, J. W., Jr. The community junior college (2nd ed.). New York: John Wiley and Sons, Inc., 1966.

Thornton, J. W., Jr. The community junior college (3rd ed.). New York: John Wiley and Sons, Inc., 1972.

Tuosto, A. A., & Beitler, L. Facilitating the learning and teaching process through an allied health learning center at New York City Community College: A multi-media presentation. Paper presented at the Annual Meeting of the Association of Community and Junior Colleges, Seattle, Washington, 1975. (ED 114 136)

United Nations Educational, Scientific and Cultural Organization. New trends in biology. Volume IV. Paris: UNESCO Press, 1977.

Valdes, P. B. Project LECA final report, 1973-1974. Tampa, Florida: Hillsborough Community College, 1974.

Wallace, D. C. A functioning program for the preparation of community college biology teachers. The American Biology Teacher, 1974, 36, 99-101.

Whitaker, C. A study of the extent to which twenty-five small community colleges are providing suitable courses in the biological sciences as part of their general education offerings. Northern Illinois University Abstracts of Graduate Studies on the Community (Junior) College, 1966-1968. DeKalb, Illinois: Northern Illinois University, 1968. (ED 022 434)

Williams, B. J. General biology as an area of instruction in the junior colleges of Alabama (Doctoral dissertation, Auburn University, 1971). Dissertation Abstracts International, 1971, 31, 5227A. (University Microfilms No. 71-09045)

Zubiari, M. Y. Science education for nursing and other paramedical students. Journal of College Science Teaching, 1973, 3 (1), 58-60.

APPENDIX A

Region 1 NORTHEAST

Connecticut

Greater Hartford
Mitchell
Quinebaug

Massachusetts

Bay Path
Bunker Hill
Mt. Wachusett

Maine

University of Maine/
Augusta

New Hampshire

New Hampshire Tech.
White Pines

New York

Cayuga County
Genesee
Hudson Valley
North Country

Vermont

Champlain
Vermont Col. of
Norwich U.

Region 2 MIDDLE STATES

Delaware

Delaware Tech. and C.C./
Terry Campus
Goldey Beacom

Maryland

Dundalk
Hagerstown
Harford
Howard
Villa Julie

New Jersey

Atlantic
Middlesex County

Pennsylvania

Allegheny County/Boyce Campus
Delaware County
Harcum
Keystone
Northampton County
Northeastern Christian

West Virginia

West Virginia Northern
Potomac State

Region 3 SOUTH

Alabama

James Faulkner State
John C. Calhoun State
Lurleen B. Wallace State
Northwest Alabama State

Arkansas

Central Baptist
Mississippi County
Westark

Florida

Brevard
Edison
Florida
Palm Beach
Seminole
Valencia

Georgia

Atlanta
Bainbridge
Clayton
Floyd
Georgia Military
Middle Georgia
South Georgia

Kentucky

Southeast

Mississippi

Itawamba
Mary Holmes
Mississippi Gulf Coast/
Jefferson Davis Campus
Pearl River
Southwest Mississippi
Wood

North Carolina

Chowan College
Coastal Carolina
Edgecombe Tech.
Halifax City Tech.
Lenoir
Richmond Tech.
Roanoke-Chowan Tech.
Wake Tech.

South Carolina

Greenville Tech.
University of South Carolina/
Lancaster

Tennessee

Jackson State
Martin
Morristown
Shelby State

Texas

Angelina
Lamar University/Orange Branch
San Antonio
Vernon Regional
Weatherford

Virginia

Central Va.
Northern Va./Alexandria
New River
Southern Seminary
Tidewater
Thomas Nelson
Wytheville

Region 4 MIDWEST

Illinois

Central YMCA
Danville
Highland
Kishwaukee
Lincoln Land
Oakton
Waubonsee
William Rainey Harper

Iowa

Clinton
Hawkeye Institute of Technology
Indian Hills
Iowa Lakes
Marshalltown
Southeastern

Michigan

Bay de Noc
Delta
Kalamazoo Valley
Kirtland
Monroe County
Oakland
Suomi

Minnesota

Austin
North Hennepin
Northland
University of Minnesota Tech.
Willmar

Missouri

St. Paul's
Three Rivers

Nebraska

Metropolitan Tech.
Platte Tech.

Ohio

Edison State
Lorain County
Northwest Tech.
Shawnee State
Sinclair
University of Toledo
Comm. and Tech.

Wisconsin

District One Tech.
Lakeshore Tech.
Milwaukee Area Tech.
University Center System/Sheboygan
Western Wisconsin Tech.

Region 5 MOUNTAIN PLAINS

Colorado

Arapahoe
Community College of Denver
Auraria Campus
Morgan
Northeastern

Kansas

Barton County
Central
Coffeyville
Hesston
St. John's

Montana

Miles

North Dakota

North Dakota St. Sch. of Science

Oklahoma

Connors State
Hillsdale Free Will Baptist
Northern Oklahoma
South Oklahoma City
St. Gregory's

South Dakota

Presentation

Utah

College of Eastern Utah
Utah Tech.

Wyoming

Central Wyoming

Region 6 WEST

Alaska

Ketchikan

Arizona

Cochise
Pima

California

American River
Butte
Citrus
College of San Mateo
College of the Desert
College of the Sequoias
Fresno City College
Hartnell
Lassen
Los Angeles Pierce
Mendocino
Merced
Mt. San Jacinto
Saddleback
San Bernardino Valley
San Diego Mesa
Santa Rosa

Nevada

Clark County

Oregon

Chemeketa
Mt. Hood
Umpqua

Washington

Green River
Lower Columbia
Peninsula
South Seattle

APPENDIX B

BIOLOGY - INTRODUCTION

The subcategories of this classification cover the various levels of introductory biology. Major biological principles and concepts are introduced with respect to the student for whom intended. Major topics of the cell, reproduction, homeostasis, genetics, ecology, biochemistry, and energy are covered in varying detail by each sub-category. Independent study and courses focusing on specific biological problems are excluded. More advanced treatment of these principles is covered in Biology - Advanced.

Non-Science Major Courses
Occupational Service Courses
Science Major Courses
Specialized Courses (Non-Science Majors)

NON-SCIENCE MAJOR COURSES

The basic biological processes underlying life are covered by the courses in this category. The cell, energy, reproduction, homeostasis, genetics, and ecology are covered to introduce the non-science major to major fields of biology, and to satisfy general education requirements.

OCCUPATIONAL SERVICES

Courses in this category are designed specifically for students in Occupational Health programs. Major biological principles related to health and disease as well as scientific terminology are introduced. Course content may vary with different program orientations.

SCIENCE MAJOR

Cell function and structure, genetics, related disease, microbiology, bacteriology, physiology, and chemistry are within the scope of this category. These courses are intended to introduce science majors to biological principles and concepts and are prerequisites for more advanced courses. Courses covering these principles in greater depth may be found under specialized classifications that follow.

SPECIALIZED COURSES - NON-SCIENCE MAJORS

These courses tend to be general education science courses for non-science majors. Elementary school science teaching methods and introductory courses in heredity are examples of courses included in this category. There are no prerequisites for these courses and they do not carry credit for science majors.

BIOLOGY - ADVANCED

This classification embodies specialized courses examining important biological principles in detail. Techniques and quantitative evaluation methods are also introduced in advanced study of cellular biology, genetics, embryology/developmental biology, microtechniques, and population biology/evolution. These courses are open to science majors only and unless otherwise stated, have an introductory biology prerequisite. Independent study and special topics courses are excluded.

- Molecular/Cellular
- Genetics
- Embryology
- Microtechniques
- Population Biology/Evolution

MOLECULAR/CELLULAR

The courses in this category describe the cell as the basic unit of all living systems in terms of structure, function, and biochemistry. Differentiation, metabolism, reproduction, and specialization are among the major topics covered. These courses are designed for science and health science majors of advanced standing.

GENETICS

These courses present an overview of Mendelian and population genetics with emphasis on genetic inheritance, mutation, influence on cell function, DNA and RNA. Genetic probability computation and disorder causes and effects are also included. Courses in this category are intended for science majors only.

EMBRYOLOGY/DEVELOPMENTAL BIOLOGY

The development of the human embryo and other organisms is studied from conception through major cell differentiation stages and prenatal development. Each developmental phase is examined in terms of growth, environmental influences, and biochemical changes. These courses are intended for science majors only.

MICROTECHNIQUES

Techniques for preservation and preparation of animal tissue for microscopic study are the focus of this category. Photomicrography, tissue staining, microtomy, tissue embedding and florescence are among topics covered. These courses are intended for science and health students of advanced standing.

POPULATION BIOLOGY AND EVOLUTION

Courses in this category cover the origins of life and the organic evolution of species. They expand into examination of population genetics, energy cycles, population dynamics, and the community as it interacts with the physical environment. These courses are intended for science students of advanced standing.

BOTANY

This classification consists of subcategories that examine the major aspects of Botany. The courses are assigned to subcategories with respect to the student for whom intended. Botanical principles of morphology, phylogeny, classification, ecology, physiology, and evolution are presented within each category with varying degrees of detail and specialization. More detailed ecological and environmental aspects of Botany are discussed under Ecology and Environmental. Independent study and special topic courses are excluded.

- Non-Science Major
- Occupational Services
- Science Major
- Field Botany

NON-SCIENCE MAJOR COURSES

The courses in this category generally focus on regional flora and offer students an introduction to plant science. Family characteristics of vascular plants, phylogeny, and classification are studied with reference to evolution, ecology, pathology, and economic importance to man. These courses may be taken to fulfill general education science requirements. Courses of this type are not intended for students in science programs.

OCCUPATIONAL SERVICE COURSES

Occupational service courses are pre-professional introductory botany courses for occupational students in agriculture, forestry, range management, conservation, and horticultural science programs. Course content includes plant propagation, an introduction to the plant kingdom, morphology, and ecology. These courses may also fill general education requirements for non-science students. Courses of this type are not acceptable for science majors.

SCIENCE MAJOR COURSES

Introductory survey of taxonomy, morphology, phylogeny, physiology, ecological and evolutionary constructs are topics covered by courses in this category. Understanding the physiological processes of osmosis, respiration, transpiration, photosynthesis, reproduction and metabolism of vascular/nonvascular plants and their ecological relevance are primary course goals in order to prepare science majors for more advanced study. Practical field courses are discussed under Field Botany.

FIELD BOTANY

Practical field experience and the examination of local flora as part of a functional ecosystem are within the scope of courses in this category. Collection, identification, and examination techniques as well as discussion of population dynamics are included in course content. Courses in this category are intended for science and non-science majors. Those courses specifically for science majors are designated by an introductory biology or botany prerequisite and treat the above topics in greater depth.

ZOOLOGY

The students for whom intended determine the categories of this classification. Basic animal biology, taxonomy, anatomy and physiology, behavior, relationship to man, and terminology are presented to non-science and occupational students at various levels of detail. Introductory topics with additional emphasis on vertebrate and invertebrate biology, gross and microscopic anatomy and physiology, and orientation to phylogenic classification are within the scope of courses for science majors. Specialized courses in gross and microscopic animal anatomy and physiology are categorized for advanced biological science students. Elective general education courses in ornithology are also included in this classification.

Non-Science Major Courses
Occupational-Service Courses
Science Major Courses
Animal Anatomy and Physiology

NON-SCIENCE MAJOR COURSES

These courses, an introduction to local fauna, survey basic animal biology, taxonomy, natural history, relationship to man, anatomy, physiology, animal behavior, genetics, and animal ecology. Students are also acquainted with major phyla of the animal kingdom. The courses of this type fulfill general education requirements and are not intended for science majors.

OCCUPATIONAL SERVICES

Basic biology, anatomy, physiology, and behavior of animals are covered by courses of this type. Zoological terminology and technique are introduced to students in agriculture, animal science, forestry, range management, and environmental programs. These courses are not intended for science majors.

SCIENCE MAJOR

Principles of vertebrate and invertebrate biology are presented in courses of this type. Topics considered are gross and microscopic anatomy, embryology, classification, geographic distribution and relationship to man and environment. Courses of this type are designed for pre-med, pre-vet, allied health, and other science students.

ANIMAL ANATOMY/PHYSIOLOGY

These courses present a comparative study of evolutionary development of vertebrates. Microscopic and gross anatomical systems as well as their physiological function are considered. The courses are intended for science students who seek more advanced and detailed treatment of animal biology.

ORNITHOLOGY

Courses in this category are general education courses that discuss evolution, geographic distribution, territoriality, migration, and field identification. These courses are intended for all students and carry elective credit.

HUMAN BIOLOGY

Human biology, anatomy and physiology are the topics covered across the subcategories of this classification. Course content and depth are determined by the students enrolled and are reflected here by each subcategory. Courses in human biology are intended for all students, and survey the relationships between body structure and function and the principles of health and disease. General anatomy and physiology acquaint the science major with human body structure and function on cellular, molecular, and biochemical levels. The courses for allied health should cover major anatomical systems and their physiological functions from a medical standpoint. More advanced courses for allied health students teach hematology, serology, blood banking and urinalysis, and include clinical practice and procedure. Specialized courses for pre-med, medical laboratory technicians, pre-dental, dental assistant and hygiene students are treated in their own subcategories. Courses in clinical internships, laboratory equipment orientation, diagnostic procedure, and medical office/hospital orientation are excluded.

Human Biology
Anatomy and Physiology - General
Anatomy and Physiology for AHS
Specialized Anatomy and Physiology
Medical
Dental

HUMAN BIOLOGY

A general overview of anatomy, physiology, genetics and evolution is presented in courses of this type. The relationship between structure and function is stressed, and principles of health, disease prevention and control are introduced. These courses are intended primarily for students in paramedical careers, such as medical assistant, medical secretary, nursing assistant or for students seeking to fill general education requirements.

HUMAN ANATOMY AND PHYSIOLOGY - GENERAL

These courses examine the human body on cellular, molecular, structural, and functional levels. Physical and chemical principles are introduced with relation to major organ systems and their physiological processes. These courses are intended for science majors only.

ANATOMY AND PHYSIOLOGY FOR ALLIED HEALTH STUDENTS

These courses are a comprehensive survey of major anatomical systems and their physiological function. Integumental, skeletal, muscular, circulatory, digestive, respiratory, urogenital, sensory, nervous, and endocrine systems are examined in terms of physical, chemical, and medical aspects. The courses are intended for allied health, nursing, and other health program students. Medical terminology courses are excluded.

ANATOMY AND PHYSIOLOGY - SPECIALIZED

The courses in this category are designed for allied health and medical laboratory technology students. Hematology, immuno-serology, blood banking, and urinalysis are the major areas covered by these courses. Proficient clinical practice and preparation for state licensing are among course goals. Internships for credit and technical orientation courses are not included in this category.

ANATOMY AND PHYSIOLOGY - MEDICAL

The human body and disease process are examined by courses in this category. Basic anatomical organization, structure, organ systems, common pathological conditions, their causes and effects related to these systems, are major elements of course content. Heredity, environmental factors, and pharmacology are also included. These courses are specifically intended for pre-medical, medical-laboratory technology, operating room assistants, and nursing students. Clinical seminars, medical terminology, diagnostic procedure, and orientation to monitoring equipment are excluded.

ANATOMY AND PHYSIOLOGY - DENTAL

Oral anatomy, physiology, head and neck anatomy, oral pathology, disease, inflammation, repair, terminology, prosthesis, hygiene, tooth morphology, preventative dentistry, peridontology are covered by courses in this category. These courses are intended for dental assistant, hygiene, and pre-dental students only. Technical orientation, equipment, and clinical practice are excluded.

MICROBIOLOGY

General characteristics of micro-organisms, bacteria, and parasites are covered by the categories in this classification. Introductory microbiology emphasizes basic microbiology principles and techniques and is intended for all science students. Bacteriology introduces the science and health students to bacteria as they pertain to the disease process. Microbiology for special groups focuses on the needs of special groups in the presentation of basic microbiological principles, parasitology and bacteriology. Technical orientation, clinical procedure, and clinical practice courses are not included.

Microbiology
Bacteriology
Microbiology for Special Groups

GENERAL MICROBIOLOGY

Courses in this category survey general characteristics of major microorganisms. Virulence, morphology, physiology, control methods, and microbial techniques are the main emphasis of these courses. Courses of this type are intended for science and health occupation students and require a general biology course.

GENERAL BACTERIOLOGY

Basic techniques, terminology, principles, and medical applications are introduced by courses in this category. Staining, culturing, isolation, and identification of bacteria are studied in relation to infectious diseases. These courses are intended for science students of advanced standing as well as students in medical technology programs.

MICROBIOLOGY FOR SPECIAL GROUPS

The principles and techniques of microbiology, parasitology, mycology and bacteriology are combined in courses of this type. The students for whom intended determine the course content. Examples of courses in this category include microbiology for biomedical, pre-veterinary, allied health, food science, and agriculture students. Technical orientation and clerical procedure courses are excluded.

ENTOMOLOGY

The two categories in this classification cover the principles of entomology, classification, and identification of major insect species. Entomology is an introductory survey course for science students.

More specialized study of entomology is considered by courses in Entomology for Special Groups.

Entomology
Entomology for Special Groups

ENTOMOLOGY

Biology and classification of insects are the focus of courses in this category. Evolution and control of major species are also considered. These courses generally require a course in general zoology and are intended for science majors.

ENTOMOLOGY FOR SPECIAL GROUPS

The courses in this category examine insect classification, structure, ecology, economic importance and control. The beneficial as well as hazardous aspects to animals, plants, and man are considered. These courses are generally directed to agriculture, horticulture, and farm management students.

ECOLOGY AND ENVIRONMENTAL

Ecological principles of environmental biology are presented to science and non-science students in the subcategories of this classification. Populations, ecosystems, energy concepts communities, pollutants, homeostasis, and marine biology are primary concerns of these categories. Field study, collection techniques, and quantitative analysis of these topics are also included. Most courses included in these categories require an introductory biology course. Independent study, special topics, and travel seminars are not included.

Non-Science Major Courses
Science Major Courses
Field and Nature Courses
Marine Courses

NON-SCIENCE MAJOR

These courses introduce ecological principles of environmental biology, populations and communities. The sources and effects of pollutants, the relationship of plants, animals, and man to the environment, and the concept of ecosystems are considered. Courses of this type are intended for all students.

SCIENCE MAJOR COURSES

The courses in this category survey major ecological themes and are intended for science majors as well as for students in horticulture, fire science, range management and forestry. Population regulation, community structure, and ecosystems are included in course content. The effect of ecological systems on homeostasis, energy concepts, and the integration of living organisms is also discussed.

FIELD AND NATURE

Field analysis of specific ecosystems, natural history of the community, population analysis, field data collection, including transects, quadrats, collection methods, and taking of field notes, are surveyed by these courses. They are designed for science majors and students in forestry, parks and recreation, fire science, horticulture and range management.

MARINE COURSES

These courses focus on hydro- and marine biology. Hydrobiology includes study of aquatic habitats, chemical analysis, and organism collection and analysis. Marine biology examines ocean environments in terms of the living organisms that habitate them, field study, collection methods, and analysis techniques are also included. Courses of this type are intended primarily for science students.

RELATED TOPICS

The categories in this classification present an overview of principles of nutrition, pharmacology, radiation, environmental pollutants, and biological science teaching methods. Courses in clinical application, clinical procedure, and special equipment orientation and function, are excluded.

Nutrition
Pharmacology
Radiation Effects and Environmental Pollutants
Teaching Methods

NUTRITION

Courses of this type offer comprehensive analysis of nutrition principles and health. Nutrients, their function, digestion, absorption, metabolism, and human needs are discussed. These courses are intended for all students.

PHARMACOLOGY

These courses examine principles of pharmacology for students in various health occupations. Drug types, usage, dispensing, contra-indications, and federal regulations are the primary topics covered. Actual course content is dependent on the students for whom intended. Some courses require chemistry and biology background.

RADIATION EFFECTS AND ENVIRONMENTAL POLLUTANTS

Courses studying the biological effects of radiation, measurement of radiation, hazards, and protection methods are included in this category. They are primarily intended for students in radiation therapy and X-ray technician programs. Also included in this category are courses examining environmental pollutants and their effects on man and environment. These courses are intended for all students.

TEACHING METHODS

These courses focus on methods of teaching biological science in elementary schools. Courses of this type are intended for child study and education students.

APPENDIX C

Table C1

Introductory Biology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Intro. Biology Courses Listed on Schedule (n=355)	Percent of Total Introductory Biology Sections Listed on Schedule: Lecture (n=1859)	Percent of Total Introductory Biology Sections Listed on Schedule: Laboratory (n=2217)
Non-Science Majors	55	49	35	32	26
Occupational Services	6	3	1	1	1
Science Majors	73	71	57	65	72
Specialized Courses (Non-Science Majors)	12	9	6	2	1

Notes. 1. 162 colleges (93% of sample) list one or more introductory biology courses in the college catalog.

2. 157 colleges (90% of sample) list one or more introductory biology courses in schedules of classes.

Table C2

Advanced Biology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Advanced Biology Courses Listed on Schedule (n=54)	Percent of Total Advanced Biology Sections Listed on Schedule: Lecture (n=65)	Percent of Total Advanced Biology Sections Listed on Schedule: Laboratory (n=40)
Molecular/Cellular	6	3	13	12	25
Genetics	25	16	56	51	38
Embryology	3	2	7	8	13
Microtechniques	7	4	17	20	18
Other	4	2	7	9	8

Notes. 1. 58 colleges (33% of sample) list one or more advanced biology courses in the college catalog.

2. 43 colleges (25% of sample) list one or more advanced biology courses in schedules of classes.

Table C3

Botany in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Botany Courses Listed on Schedule (n=175)	Percent of Total Botany Sections Listed on Schedule: Lecture (n=286)	Percent of Total Botany Sections Listed on Schedule: Laboratory (n=310)
Non-Science Majors	10	9	9	9	5
Occupational Services	10	7	13	11	13
Science Majors	66	57	71	72	75
Field Botany	13	6	7	8	6

Notes. 1. 126 colleges (72% of sample) list one or more botany courses in the college catalog.

2. 109 colleges (62% of sample) list one or more botany courses in schedules of classes.

Table C4

Zoology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Zoology Courses Listed on Schedule (n=186)	Percent of Total Zoology Sections Listed on Schedule: Lecture (n=352)	Laboratory (n=420)
Non-Science Majors	6	4	4	4	3
Occupational Services	5	3	6	5	5
Science Majors	67	59	77	82	85
Animal Anatomy and Physiology	12	9	10	7	7
Ornithology	5	2	2	1	0

Notes. 1. 127 colleges (73% of sample) list one or more zoology courses in the college catalog.

2. 112 colleges (64% of sample) list one or more zoology courses in schedules of classes.

Table C5

Human Biology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Human Biology Courses Listed on Schedule (n=689)	Percent of Total Human Biology Sections Listed on Schedule: Lecture (n=1585)	Percent of Total Human Biology Sections Listed on Schedule: Laboratory (n=1726)
Human Biology	18	14	5	7	4
Human Anatomy and Physiology, General	85	78	42	55	64
Human Anatomy and Physiology, Allied Health Students	38	30	15	17	15
Anatomy and Physiology, Specialized	35	29	17	9	7
Medical	17	15	8	5	6
Dental	23	19	13	7	4

Notes: 1. 168 colleges (96% of sample) list one or more human biology courses in the college catalog.

2. 159 colleges (91% of sample) list one or more human biology courses in schedules of classes.

Table C6

Microbiology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Microbiology Courses Listed on Schedule (n=230)	Percent of Total Microbiology Sections Listed on Schedule: Lecture (n=468)	Laboratory (n=578)
Microbiology	77	70	59	66	73
Bacteriology	9	6	5	3	3
Microbiology for Special Groups	37	31	36	31	24

Notes. 1. 152 colleges (87% of sample) list one or more microbiology courses in the college catalog.

2. 139 colleges (79% of sample) list one or more microbiology courses in schedules of classes.

Table C7

Entomology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Entomology Courses Listed on Schedule (n=14)	Percent of Total Entomology Sections Listed on Schedule: Lecture (n=16)	Percent of Total Entomology Sections Listed on Schedule: Laboratory (n=13)
Entomology	12	5	64	63	62
Special Groups	5	3	36	37	38

Notes. 1. 27 colleges (15% of sample) list one or more entomology courses in the college catalog.

2. 14 colleges (8% of sample) list one or more entomology courses in schedules of classes.

Table C8

Ecology and Environmental Biology in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Ecology/Environ. Courses Listed on Schedule (n=118)	Percent of Total Ecology/Environ. Sections Listed on Schedule: Lecture (n=242)	Percent of Total Ecology/Environ. Sections Listed on Schedule: Laboratory (n=206)
Non-Science Majors	30	25	41	57	55
Science Majors	10	7	11	6	6
Field and Nature	22	13	31	23	23
Marine	12	9	17	14	16

Notes. 1. 87 colleges (50% of sample) list one or more ecology and environmental biology courses in the college catalog.

2. 69 colleges (39% of sample) list one or more ecology and environmental biology courses in schedules of classes.

Table C9

Biology-Related Topics in the Two-Year Colleges, 1977-78 Academic Year

Type of Course	Percent of Colleges Listing This Type Course in Catalog (n=175)	Percent of Colleges Listing This Type Course in Class Schedule (n=175)	Percent of Total Related Topics Courses Listed on Schedule (n=134)	Percent of Total Related Topics Sections Listed on Schedule: Lecture (n=316)	Percent of Total Related Topics Sections Listed on Schedule: Laboratory (n=14)
Nutrition	49	41	68	79	79
Pharmacology	23	15	29	19	14
Radiation Effects and Environmental Pollutants	4	2	2	1	7
Teaching Methods	1	1	1	1	0

Notes. 1. 97 colleges (55% of sample) list one or more biology-related topics in the college catalog.

2. 82 colleges (47% of sample) list one or more biology-related topics in schedules of classes.

APPENDIX D

The following listing of references includes articles and studies of instructional practices in two-year college biology courses.

ASSESSING THE USE OF AUDIO-TUTORIAL METHODS IN BIOLOGICAL SCIENCE COURSES

Arnwine, J. E., & Juby, B. An objective evaluation of the success of audio-tutorial course in general biology. Unpublished paper, 1969. (ED 037 207)

Ballou, W., & Filteau, W. Anyone can start an AT biology program. The American Biology Teacher, 1971, 33, 480-483, 492.

Bish, J. T., Bowman, B. L., & Sarachek, A. Lecture-laboratory vs. structured audiotutorial approaches: Student achievement. Journal of College Science Teaching, 1978, 7 (3), 168-171.

Darnes, G. R. (Ed.). Proceedings: Annual Illinois Junior College Conference. Springfield, Ill.: Illinois Junior College Board, 1972. (ED 073 754)

Decker, R. C. Cuyahoga Community College. Junior College Journal, 1969-1970, 40 (4), 15-18, 56, 58, 60, 62.

Elliott, W. D., & Montgomery, R. J. The integration of audiotutorial mini-courses with the conventional biology lecture and laboratory. Unpublished paper, 1974. (ED 092 198)

Hahn, T. C. Audiotutorial instruction: A case study. Bioscience, 21, 814-819.

Lyon, J. D. The relative effectiveness of individualized script and audio instruction in junior college biology (Doctoral dissertation, University of Maine, 1977). Dissertation Abstracts International, 1977, 38, 2025A. (University Microfilms No. 77-21852)

Muzio, J. N., & Others. Audio-tutorial project: An audio-tutorial approach to human anatomy and physiology. Brooklyn, N.Y.: Kingsborough Community College, 1974. (ED 097 911)

National Science Teachers Association. Association for the education of teachers of science, compilation of papers and reports from sessions held in conjunction with the Convention of the National Science Teachers Association. Washington, D.C.: National Science Teachers Association, 1966. (ED 017 471)

Opacinch, C., & others. Research in instructional methods. Catonsville, Maryland: Catonsville Community College, 1974. (ED 092 185)

Quick, C. L. An analysis and evaluation of an audio-tutorial approach in the biology laboratory at the University Community and Technical College, the University of Toledo (Doctoral dissertation, The University of Toledo, 1971.) Dissertation Abstracts International, 1971, 32, 3871A. (University Microfilms No. 72-02161)

Seal, C. W. Two methods of teaching a general biology course in a community college: Audio-tutorial with conventional lecture-laboratory (Doctoral dissertation, Auburn University, 1976). Dissertation Abstracts International, 1977, 37, 5729A. (University Microfilms No. 77-04317)

Sparks, P. D., & Unbehaun, L. M. Achievement of audiotutorial and conventional biology students: A comparative study. Bioscience, 1971, 21, 574-576.

COMPUTER USE IN BIOLOGY

Crovello, T. Computers in biological teaching. Bioscience, 1974, 24, 20-23.

Hyatt, B. W., Eades, D. C., & Tenczar, P. Computer-based education in biology. Bioscience, 1972, 22, 401-409.

Manteuffel, M. S. Implementing PLATO in biology education at three community colleges. (CERL Report X-47.) Urbana: Illinois University, 1976. (ED 128 173)

Zimmer, A. L. (Ed.). Community college users' report, Fall 1975. Urbana: Illinois University, 1976. (ED 122 901)

USE OF MEDIA IN BIOLOGY COURSES

Belzer, T. J. A comparative study of a traditional lecture method and a group-paced, multimedia, non-lecture method used in teaching college biology. Unpublished paper, 1976. (ED 133 026)

Brady, E. R. The effectiveness of field trips compared to media in teaching selected environmental concepts (Doctoral dissertation, Iowa State University, 1972). Dissertation Abstracts International, 1972, 33, 4196A. (University Microfilms No. 73-3860)

Carlson, E. A. Teaching by television: A critique. Journal of College Science Teaching, 1973, 2 (3), 15-17.

Kinsinger, R. E. Education for health technicians--An overview. Washington, D.C.: American Association of Junior Colleges, 1966. (ED 011 779)

MacQueen, P. An evaluation of the educationally disadvantaged students' performance in the Biology 101 multi-media approach at Polk Community College. Practicum, Nova University, 1973. (ED 094 827)

Rosen, M. J., & Cohen, A. M. An evaluative study of the University of California, Irvine/Golden West College Cooperative Science Improvement Project. Los Angeles: Evaluation and Research Associates, 1972. (ED 092 325)

INSTRUCTIONAL OBJECTIVES FOR BIOLOGICAL SCIENCE COURSES

Capper, M. R. Instructional objectives for a junior college course in zoology. Los Angeles: ERIC Clearinghouse for Junior Colleges, 1969. (ED 033 718)

Capper, M. R. Instructional objectives for a junior college course in physiology (first semester). Los Angeles: ERIC Clearinghouse for Junior Colleges, 1969. (ED 033 711)

Capper, M. R. Instructional objectives for a junior college course in biology (first semester). Los Angeles: ERIC Clearinghouse for Junior Colleges, 1969. (ED 033 686)

Dunbar, M. O. An analysis of the relationship which exists between cognitive and affective educational objectives in selected community college biology classes in southeastern Michigan. (Doctoral dissertation, University of Michigan, 1976). Dissertation Abstracts International, 37, 777A. (University Microfilms No. 76-19122)

Herrick, K. G. Community college biology lesson catalogue. Urbana: Illinois University, 1976. (ED 138 451)

Maffett, J. E. Instructional performance objectives for a course in general biology. Bradenton, Florida: Manatee Junior College, 1967. (ED 016 482)

Purdy, L. (Compiler). Instructional objectives for a junior college course in introduction to biology. Unpublished paper, 1972. (ED 067 078)

Purdy, L. (Compiler). Instructional objectives for a junior college course in human anatomy-physiology. Unpublished paper, 1972. (ED 067 076)

Putnam, S. L., & others. Major systems of the human body (a programmed text for allied health service trainees). Downey, California: Rancho Los Amigos Hospital, 1970.

Starkweather, A. Instructional objectives for a junior college course in introduction to physiology. Los Angeles: ERIC Clearinghouse for Junior Colleges, 1971. (ED 049 753)

Starkweather, A. Instructional objectives for a junior college course in general biology. Los Angeles: ERIC Clearinghouse for Junior Colleges, 1971. (ED 049 748)

INDIVIDUALIZED INSTRUCTION

Cornelius, M. E. Individualized instruction in college anatomy-physiology. The American Biology Teacher, 1974, 36, 41-43.

Geisert, P. Individualization of student rate, goals, and instructional methods for an introductory biology program. Journal of College Science Teaching, 1974, 4 (2), 107-110.

Glick, D. M. PSI . one semester later. Unpublished paper, 1973. (ED 089 624)

Glick, D. M. PSI . two semesters later. Unpublished paper, 1973. (ED 089 625)

Rakitan, R. W. Comparison of conventional junior college biology program versus a mastery junior college biology program (Doctoral dissertation, Northwestern University, 1976). Dissertation Abstracts International, 1977, 37, 4257A. (University Microfilms No. 77-01336)

Richard, J. A tool for independent study in biology. Corvallis, Oregon: Oregon State University, 1965. (ED 015 741)

Strickland, W. R. A comparison of a program course and a traditional lecture course in general biology (Doctoral dissertation, University of Southern Mississippi, 1971). Dissertation Abstracts International, 1971, 32, 2510A. (University Microfilms No. 71-28849)

INSTRUCTIONAL APPROACHES TO THE LABORATORY

Gray, R. C., & Olsson, F. J. Open laboratory in biology. Journal of College Science Teaching, 1975, 4 (5), 332-333.

Kampwirth, R. G. A comparison of a conventional junior college biology laboratory versus a research project laboratory (Doctoral dissertation, Northwestern University, 1972) Dissertation Abstracts International, 33, 2784A. (University Microfilms No. 72-32474)

Norberg, A. M. Individualizing instruction in large undergraduate laboratories; II. Computers and investigations. The American Biology Teacher, 1975, 37 (8), 470-472.

Von Blum, R. Individualizing instruction in large undergraduate biology laboratories; I. Development of the model. The American Biology Teacher, 1975, 37 (8), 467-469.

For further references on the audiotutorial method and on individualized instruction, see bibliographies compiled by D. L. Murray and E. B. Kurtz in Creager, J. G., & Murray, D. L. (Eds.). The use of modules in college biology teaching. Washington, D.C.: The American Institute of Biological Sciences, 1971.

460-006

Center for the Study of Community Colleges

INSTRUCTOR SURVEY

Your college is participating in a nationwide study conducted by the Center for the Study of Community Colleges under a grant from the National Science Foundation. The study is concerned with the role of the sciences and technologies in two-year colleges — curriculum, instructional practices and course activities.

The survey asks questions about one of your classes offered last fall. The information gathered will help inform groups making policy affecting the sciences. All information gathered is treated as confidential and at no time will your answers be singled out. Our concern is with aggregate instructional practices as discerned in a national sample.

We recognize that the survey is time-consuming and we appreciate your efforts in completing it. Thank you very much.

1a. Your college's class schedule indicated that in Fall, 1977 you were teaching:

(Course) ____________ 11-13 (Section) ____________

If this class was assigned to a different instructor, please return this survey to your campus facilitator to give to the person who taught this class.

If the class was not taught, please give us the reason why, and then return the uncompleted survey form in the accompanying envelope.

b. Class was not taught because: (explain briefly) ____________

____

____

Please answer the questions in relation to the specified class.

2. Approximately how many students were initially enrolled in this class?

Males ____________ 14-16

Females ____________ 17-19

3. Approximately how many students completed this course and received grades? (Do not include withdrawals or incompletes.)

Males ____________ 20-22

Females ____________ 23-25

4. **Check each of the items below that you believe properly describes this course:**

a. Parallel or equivalent to a lower division college level course at transfer institutions . . . ☐ 1 26

b. Designed for transfer students majoring in one of the natural resources fields (e.g., agriculture, forestry) or an allied health field (e.g., nursing, dental hygiene, etc.) . . . ☐ 2

c. Designed for transfer students majoring in one of the physical or biological sciences, engineering, mathematics, or the health sciences (e.g., pre-medicine, pre-dentistry) . . . ☐ 3

d. Designed for transfer students majoring in a non-science area . . . ☐ 4

e. Designed for occupational students in an allied health area . . . ☐ 5

f. Designed for occupational students in a science technology or engineering technology area . . . ☐ 6

g. Designed as a high school make up or remedial course . . . ☐ 7

h. Designed as a general education course for non-transfer and non-occupational students . . . ☐ 8

i. Designed for further education or personal upgrading of adult students . . . ☐ 9

j. Other *(please specify)*: ______________ ☐ 0

5a. **Instructors may desire many qualities for their students. Please select the one quality in the following list of four that you most wanted your students to achieve in the specified course.**

1) Understand/appreciate interrelationships of science and technology with society . . . ☐ 1 27

2) Be able to understand scientific research literature . . . ☐ 2

3) Apply principles learned in course to solve qualitative and/or quantitative problems . . . ☐ 3

4) Develop proficiency in laboratory methods and techniques of the discipline . . . ☐ 4

b. **Of the four qualities listed below, which one did you most want your students to achieve?**

1) Relate knowledge acquired in class to real world systems and problems . . . ☐ 1 28

2) Understand the principles, concepts, and terminology of the discipline . ☐ 2

3) Develop appreciation/understanding of scientific method . . . ☐ 3

4) Gain "hands-on" or field experience in applied practice . . . ☐ 4

c. **And from this list, which one did you most want your students to achieve in the specified class.**

1) Learn to use tools of research in the sciences . . . ☐ 1 29

2) Gain qualities of mind useful in further education . . . ☐ 2

3) Understand self . . . ☐ 3

4) Develop the ability to think critically . . . ☐ 4

6a. **Were there prerequisite requirements for this course?** Yes ☐ 1 No ☐ 2 30

b. **IF YES: Which of the following were required? (CHECK AS MANY AS APPLY)**

1) Prior course in the same discipline taken in high school ☐ 1 . . college ☐ 7 31

2) Prior course in any science taken in high school ☐ 2 . . college ☐ 8

3) Prior course in mathematics taken in high school ☐ 3 . . college ☐ 9

4) Declared science or technology major . . . ☐ 4

5) Achieved a specified score on entrance examination . ☐ 5

6) Other *(please specify)*: ______________ ☐ 6

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7. Over the entire term, what percentage of class time is devoted to each of the following?

a. Your own lectures	______%	32/33
b. Guest lecturers	______%	34/35
c. Student verbal presentations	______%	36/37
d. Class discussion	______%	38/39
e. Viewing and/or listening to film or taped media	______%	40/41
f. Simulation/gaming	______%	42/43
g. Quizzes/examinations	______%	44/45
h. Field trips	______%	46/47
i. Lecture/demonstration experiments	______%	48/49
j. Laboratory experiments by students	______%	50/51
k. Laboratory practical examinations and quizzes	______%	52/53
l. Other *(please specify)*: ______	______%	54/55

Please add percentages to make sure they agree with total

TOTAL: 100 %

8. **How frequently were each of the following instructional media used in this class?**

Also check last box if you or any member of your faculty developed any of the designated media for this course.

	Frequently used	Occasionally used	Never used	Developed by self or other faculty member	
a. Films	☐ 1	☐ 2	☐ 3	☐ 4	56
b. Single concept film loops	☐ 1	☐ 2	☐ 3	☐ 4	57
c. Filmstrips	☐ 1	☐ 2	☐ 3	☐ 4	58
d. Slides	☐ 1	☐ 2	☐ 3	☐ 4	59
e. Audiotape/slide/film combinations	☐ 1	☐ 2	☐ 3	☐ 4	60
f. Overhead projected transparencies	☐ 1	☐ 2	☐ 3	☐ 4	61
g. Audiotapes, cassettes, records	☐ 1	☐ 2	☐ 3	☐ 4	62
h. Videotapes	☐ 1	☐ 2	☐ 3	☐ 4	63
i. Television (broadcast/closed circuit)	☐ 1	☐ 2	☐ 3	☐ 4	64
j. Maps, charts, illustrations, displays	☐ 1	☐ 2	☐ 3	☐ 4	65
k. Three dimensional models	☐ 1	☐ 2	☐ 3	☐ 4	66
l. Scientific instruments	☐ 1	☐ 2	☐ 3	☐ 4	67
m. Natural preserved or living specimens	☐ 1	☐ 2	☐ 3	☐ 4	68
n. Lecture or demonstration experiments involving chemical reagents or physical apparatus	☐ 1	☐ 2	☐ 3	☐ 4	69
o. Other *(please specify)*: ______	☐ 1	☐ 2	☐ 3	☐ 4	70

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9. **Which of the following materials were used in this class? CHECK EACH TYPE USED. THEN, FOR EACH TYPE USED, PLEASE ANSWER ITEMS A-D.**

	A.	B.			C.		D.			
		How satisfied were you with these materials?			**Did you prepare these materials?**		**How much say did you have in the selection of these materials?**			
Check Materials Used	**How many pages in total were students required to read?**	Well-satisfied	Would like to change them	Definitely intend changing them	Yes	No	Total say	Selected them but had to verify with a chairperson or administrator	Was member of a group that selected them	Someone else selected them
☐ 1 Textbooks	______ 13-15	16 ☐ 1	☐ 2	☐ 3	17 ☐ 1	☐ 2	18 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 2 Laboratory materials and workbooks	______ 19-21	22 ☐ 1	☐ 2	☐ 3	23 ☐ 1	☐ 2	24 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 3 Collections of readings	______ 25-27	28 ☐ 1	☐ 2	☐ 3	29 ☐ 1	☐ 2	30 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 4 Reference books	______ 31-33	34 ☐ 1	☐ 2	☐ 3	35 ☐ 1	☐ 2	36 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 5 Journal and/or magazine articles	______ 37-39	40 ☐ 1	☐ 2	☐ 3	41 ☐ 1	☐ 2	42 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 6 Newspapers	______ 43-45	46 ☐ 1	☐ 2	☐ 3	47 ☐ 1	☐ 2	48 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 7 Syllabi and handout materials	______ 49-51	52 ☐ 1	☐ 2	☐ 3	53 ☐ 1	☐ 2	54 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 8 Problem books	______ 55-57	58 ☐ 1	☐ 2	☐ 3	59 ☐ 1	☐ 2	60 ☐ 1	☐ 2	☐ 3	☐ 4
☐ 9 Other *(please specify)* ______	______ 61-63	64 ☐ 1	☐ 2	☐ 3	65 ☐ 1	☐ 2	66 ☐ 1	☐ 2	☐ 3	☐ 4

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

	Not included in determining student's grade	Included but counted less than 25% toward grade	Counted 25% or more toward grade	
a. Papers written outside of class	☐ 1	☐ 2	☐ 3	67
b. Papers written in class	☐ 1	☐ 2	☐ 3	68
c. Quick-score/objective tests/exams	☐ 1	☐ 2	☐ 3	69
d. Essay tests/exams	☐ 1	☐ 2	☐ 3	70
e. Field reports	☐ 1	☐ 2	☐ 3	71
f. Oral recitations	☐ 1	☐ 2	☐ 3	72
g. Workbook completion	☐ 1	☐ 2	☐ 3	73
h. Regular class attendance	☐ 1	☐ 2	☐ 3	74
i. Participation in class discussions	☐ 1	☐ 2	☐ 3	75
j. Individual discussions with instructor	☐ 1	☐ 2	☐ 3	76
k. Research reports	☐ 1	☐ 2	☐ 3	77
l. Non-written projects	☐ 1	☐ 2	☐ 3	78
m. Homework	☐ 1	☐ 2	☐ 3	79
n. Laboratory reports	☐ 1	☐ 2	☐ 3	80
o. Laboratory unknowns and/or practical exams (quantitative and qualitative)	☐ 1	☐ 2	☐ 3	12
p. Problem sets	☐ 1	☐ 2	☐ 3	13
q. Other *(please specify)*: ______	☐ 1	☐ 2	☐ 3	14

11. **Examinations or quizzes given to students may ask them to demonstrate various abilities. Please indicate the importance of each of these abilities in the tests you gave in this course. (CHECK ONE BOX FOR EACH ITEM)**

	Very important	Somewhat important	Not important	
a. Mastery of a skill	☐ 1	☐ 2	☐ 3	15
b. Acquaintance with concepts of the discipline	☐ 1	☐ 2	☐ 3	16
c. Recall of specific information	☐ 1	☐ 2	☐ 3	17
d. Understanding the significance of certain works, events, phenomena, and experiments	☐ 1	☐ 2	☐ 3	18
e. Ability to synthesize course content	☐ 1	☐ 2	☐ 3	19
f. Relationship of concepts to student's own values	☐ 1	☐ 2	☐ 3	20
g. Other *(please specify)*: ______	☐ 1	☐ 2	☐ 3	21

12. **What was the relative emphasis given to each type of question in written quizzes and examinations? (PLEASE RESPOND BY CHECKING ONE OF THE THREE BOXES FOR EACH ITEM.)**

	Frequently used	Seldom used	Never used	
a. Multiple response (including multiple choice and true/false)	☐ 1	☐ 2	☐ 3	22
b. Completion	☐ 1	☐ 2	☐ 3	23
c. Essay	☐ 1	☐ 2	☐ 3	24
d. Solution of mathematical type problems where the work must be shown	☐ 1	☐ 2	☐ 3	25
e. Construction of graphs, diagrams, chemical type equations, etc.	☐ 1	☐ 2	☐ 3	26
f. Derivation of a mathematical relationship	☐ 1	☐ 2	☐ 3	27
g. Other *(please specify)*: ______	☐ 1	☐ 2	☐ 3	28

13. **What grading practice did you employ in this class?**

- ABCDF . . . . . . ☐ 1 — 29
- ABCD/No credit . . ☐ 2
- ABC/No credit . . ☐ 3
- Pass/Fail . . . . ☐ 4
- Pass/No credit . . ☐ 5
- No grades issued . . ☐ 6
- Other ______________ (*please specify*) . ☐ 7

14. **For each of the following out-of-class activities, please indicate if attendance was required, recommended or neither.**

	Attendance required for course credit	Attendance recommended but not required	Neither required nor recommended	
a. On-campus educational type films	☐ 1	☐ 2	☐ 3	30
b. Other films	☐ 1	☐ 2	☐ 3	31
c. Field trips to industrial plants, research laboratories	☐ 1	☐ 2	☐ 3	32
d. Television programs	☐ 1	☐ 2	☐ 3	33
e. Museums/exhibits/zoos/arboretums	☐ 1	☐ 2	☐ 3	34
f. Volunteer service on an environmental project	☐ 1	☐ 2	☐ 3	35
g. Outside lectures	☐ 1	☐ 2	☐ 3	36
h. Field trips to natural formation or ecological area	☐ 1	☐ 2	☐ 3	37
i. Volunteer service on education/community project	☐ 1	☐ 2	☐ 3	38
j. Tutoring	☐ 1	☐ 2	☐ 3	39
k. Other (*please specify*): ______	☐ 1	☐ 2	☐ 3	40

15a. **Was this class conducted as an interdisciplinary course?**

- Yes . . . . ☐ 1 — 41
- No . . . . ☐ 2

b. **IF YES: Which other disciplines were involved?** ______________________________ (*please specify*)

____

____ 42
43

16. **Were instructors from other disciplines involved . . .**

	YES	NO	
. . . in course planning?	☐ 1	☐ 2	44
. . . in team teaching?	☐ 1	☐ 2	45
. . . in offering guest lectures?	☐ 1	☐ 2	46

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17a. **Which of these types of assistance were available to you last term? CHECK AS MANY AS APPLY.**

b. **Which did you utilize? CHECK AS MANY AS APPLY.**

	a. Assistance was available to me in the following areas	b. Utilized
a. Clerical help	47- ☐ 1	48- ☐ 1
b. Test-scoring facilities	☐ 2	☐ 2
c. Tutors	☐ 3	☐ 3
d. Readers	☐ 4	☐ 4
e. Paraprofessional aides/instructional assistants	☐ 5	☐ 5
f. Media production facilities/assistance	☐ 6	☐ 6
g. Library/bibliographical assistance	☐ 7	☐ 7
h. Laboratory assistants	☐ 8	☐ 8
i. Other *(please specify)*: ________________	☐ 9	☐ 9

18. **Although this course may have been very effective, what would it take to have made it better? CHECK AS MANY AS APPLY.**

- a. More freedom to choose materials . . . ☐ 1 49
- b. More interaction with colleagues or administrators . . . ☐ 2
- c. Less interference from colleagues or administrators . . . ☐ 3
- d. Larger class (more students) . . . ☐ 4
- e. Smaller class . . . ☐ 5
- f. More reader/paraprofessional aides . . . ☐ 6
- g. More clerical assistance . . . ☐ 7
- h. Availability of more media or instructional materials . . . ☐ 8
- i. Stricter prerequisites for admission to class . . . ☐ 9
- j. Fewer or no prerequisites for admission to class . . . ☐ 1 50
- k. Changed course description . . . ☐ 2
- l. Instructor release time to develop course and/ or material . . . ☐ 3
- m. Different goals and objectives . . . ☐ 4
- n. Professional development opportunities for instructors . . . ☐ 5
- o. Better laboratory facilities . . . ☐ 6
- p. Students better prepared to handle course requirements . . . ☐ 7
- q. Other *(please specify)*: ________________ ☐ 8

Now, just a few questions about you . . .

19. How many years have you taught in any two-year college?

a. Less than one year . . . . ☐ 1 — 51
b. 1-2 years . . . . ☐ 2
c. 3-4 years . . . . ☐ 3
d. 5-10 years . . . . ☐ 4
e. 11-20 years . . . . ☐ 5
f. Over 20 years . . . . ☐ 6

20. At this college are you considered to be a:

a. Full-time faculty member . . . . ☐ 1 — 52
b. Part-time faculty member . . . . ☐ 2
c. Department or division chairperson . . . ☐ 3
d. Administrator . . . . ☐ 4
e. Other *(please specify)*:

____________________ . . . ☐ 5

21a. Are you currently employed in a research or industrial position directly related to the discipline of this course?

Yes ☐ 1 — 53
No ☐ 2

b. IF YES: For how many years? ______________ — 54/55

c. If previously you had been employed in a related industry or research organization, please indicate the number of years: ______________ — 56/57

22. What is the highest degree you presently hold?

a. Bachelor's . . . . ☐ 1 — 58
b. Master's . . . . ☐ 2
c. Doctorate . . . . ☐ 3

IMPORTANT INSTRUCTIONS

Thank you for taking the time to complete this survey. Please seal the completed questionnaire in the envelope which is addressed to the project facilitator on your campus and return it to that person. After collecting the forms from all participants, the facilitator will forward the sealed envelopes to the Center.

We appreciate your prompt attention and participation in this important survey for the National Science Foundation.

Arthur M. Cohen
Principal Investigator

Florence B. Brawer
Research Director

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