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AN EVALUATION OF BIOLOGICAL SCIENCE COURSES OFFERED FOR GENERAL EDUCATION IN SELECTED PREDOMINANTLY NEGRO COLLEGES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Hunter Douglas Hamlett, B.S., M.S.

*** *** ***

The Ohio State University
1967

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CHAPTER I

INTRODUCTION

In recent years, the institutions of higher education in America have added courses in general education to their curricula to meet the various needs of an increasing number of youth. It is believed that there is a core of knowledge afforded by certain courses which should have value for all students. Such courses comprise the general education curricula of colleges and universities and are placed among requirements for graduation.

During the past fifty years, general education courses have been introduced into the curricula of a majority of the institutions of higher education in this country. Various reasons have been given for the creation of such courses. Dressel and Lorimer state:

The purposes of general education are to prepare men and women for a satisfying personal life, happy family and social relationships, and responsible citizenship in a free society by acquainting them with our common cultural heritage, by helping them to integrate the subject matter of related disciplines, and by developing skills, abilities, attitudes, and values which will enable them to cope more effectively with their personal problems and those of the society in which they live.¹

Caliver states:

As the speed and complexity of our civilization increases, the need for a high degree of literacy increases. As the means of transportation and communication grow in speed, population becomes increasingly mobile, intermingled, and interdependent—demanding facility in the arts of communication (reading, writing, speaking, listening, interpreting, and thinking). Wise and understanding communication among people of all stations of life, at home and abroad, will contribute greatly to the peace, prosperity and happiness of mankind.2

Definitions for general education are many and varied; also, attempts have been made to differentiate between general education and liberal education. Judson Butler listed several criteria for general education and stated that it represents "no mere reshuffling of traditional content—but a rebuilding of the basic pattern of instruction."3 No single philosophy has been accepted on which a program of general education could be based. The emerging programs of general education vary in their underlying philosophies from the Great Books versions to the "functional needs" approaches.

College and university catalogs list various purposes, aims, and objectives of general education. Concerning the aims and objectives of general education, Dressel and Lorimer state, "Catalog statements of educational objectives are typically impressive and vague; their effect on the curriculum


is usually negligible. Accordingly, many college faculties have attempted clarification of the precise meaning of general education through a careful formulation of goals."  

They further state:

The real problem of American education is that the role and nature of education in a democratic society have not been determined. General education and the associated reconsideration of the objectives of education represent one attempt to cope with the problem. It is for this reason that attempts to define objectives of general education have been developed in terms of behaviors desirable for an educated citizenry in a democracy. Social and emotional maturity, difficult as they are to define and promote, are just as important as knowledge. The difficulties in defining such objectives, and in planning such educational experiences related to their development have made evaluation an important phase of general education. A dynamic educational process can only grow out of new insights into the nature of goals and of the problems of teaching for these goals.  

There is a consensus among educators concerning the broad goals set forth for a program of general education; however, there is less agreement among them concerning the content these courses should include in order to reach these goals. The methodology used in attempting to reach certain goals and the selection of course content constitute two continuing problems in general education. Thus many authors have attempted to point out the relationship between specialized and general courses on the undergraduate level. A

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4Dressel and Lorimer, op. cit., p. 570.

5Ibid.
third of the 109 institutions Stickler studied expressed a
great concern about this problem; another half indicated that
they were seeking acceptable solutions.6

General education courses are offered at the various
levels in American colleges. There seems to be a lack of
consistency in their placement. A majority of the colleges,
however, offer general education courses in the freshman and
sophomore years leaving the junior and senior years for
specialized course work. Many different arrangements are
being explored, such as omitting general education from the
undergraduate program to offering it throughout the four
years. One may infer from the many studies that the formal
structuring of a program may not affect the students' achieve-
ment as much as the quality of instruction and the expected
outcomes set for student performance.

In recent years, there has been a tremendous increase
in the accumulation of scientific knowledge, creating a need
for specialization. Organizing and making use of this vast
amount of data constitute other pressing problems for general
education whether it is concerned with the non-science major
or the science major. The non-science major must have a
level of understanding in the field to communicate effec-
tively with the scientists; that is, he must be scientifically

6 Hugh W. Stickler, Organization and Administration of
General Education (Dubuque, Iowa: W. C. Brown Company,
1951), p. 393.
literate. Are there basic requirements for scientific literacy? Can these requirements be met through general education science courses? What scientific knowledge, if any, should be regarded as essential information for all people?

The types and durations of general education science courses vary. There are survey courses covering sequentially materials from the biological and physical sciences which are considered as being of value for the layman. Block-and-gap types are also being extensively used in order to add depth to courses. An increasing number of courses are stressing the nature of science and the methods of science through the use of the historical and problem approaches. Many courses are making use of current periodicals covering topics of a scientific nature. It is believed that such materials will afford a continuing contact with the field for the non-science major.

There are many problems and issues regarding general education science. The effectiveness of student laboratory work as opposed to teacher demonstrations is a controversial issue. Experimentation with a variety of methods and materials for science courses in general education has been widespread, and the continuing accumulation of scientific knowledge tends only to create additional problems for curriculum makers.
A number of major studies have been made relating to the several phases of general education science. In the predominantly Negro colleges, however, such studies are few. These colleges have not participated actively in such studies but have benefited along with others from the studies in the formulation or reorganization of their individual programs for science in general education.

Statement of the problem

The fact that the terminal or general students in science far outnumber the others is an indication of the importance of this phase of the college curriculum. This study has been designed in an effort to ascertain what has been done throughout the United States in selected predominantly Negro colleges to fulfill this obligation to the general student in the area of the biological sciences.

It is the purpose of this study to (1) determine and appraise the status of biological science courses for general education purposes in predominantly Negro colleges in the United States, and (2) to utilize certain significant trends, as indicated from an analysis of the data, to develop a concept of biological science for general education which may be used as a guide line by participating schools and others in the development or reorganization of their biological science courses offered for general education.
Hypotheses

This study will be carried out on the basis of two hypotheses:

1. The findings of the study will reveal a general weakness in the biological science courses offered for general education in predominantly Negro colleges in regards to established criteria in the study.

2. Inadequate physical facilities are not the primary factors contributing to the general weakness of biological science courses offered for general education in predominantly Negro colleges.

Definition of terms

Biological science for general education: a biology course of collegiate level designed especially for the non-science major.

General education: (1) those phases of learning which should be the common experience of all men and women; (2) education gained through dealing with the personal and social problems with which all are confronted.7

Liberal arts college: (1) an institution of higher education that maintains a four-year curriculum leading to the bachelor's degree, with a central program of liberal arts and in many cases with one or two closely associated professional schools, such as schools of music or fine arts; (2) one of the major divisions of a university, comprising the various departments offering the liberal arts or now

professional subjects; referred to by various local names, such as arts college, college of arts and sciences, or college of science, literature and arts.\(^8\)

**Junior college:** a post high school educational institution offering a two-year program either of a terminal nature or as preparation for further training in college or university; grants an associate in arts degree in most cases.\(^9\)

**Public college:** a college maintained by a state; often used within a state to designate the land grant college offering technical curricula in agriculture, home economics, and engineering, as distinguished from the state university.\(^10\)

**Predominantly Negro college:** an institution of higher education with a student body and staff composed mostly of members of the Negro race.

**Teachers college:** a teacher education institution supported by a state, county, or municipality or by private funds that offers a four-year curriculum leading to a standard bachelor's degree.\(^11\)

**Assumptions basic to the study**

There are many assumptions concerning general education which are held in common by educators. The writer's desire to know the extent to which these assumptions may have

an effect on the predominantly Negro college curricula has, to a great degree, motivated this study of the actual status of biological science courses offered for general education in these institutions.

1. The writer assumes that general education is a valid educational arrangement at the college level.

2. Most students seem to have a natural curiosity about the physical and biological world.

3. A degree of scientific background is both desirable and essential and should contribute to the attainment of general education objectives.

4. Every school has certain unique needs for science experiences in general education.

5. General education courses in science will help produce a scientifically literate citizenry.

6. The overall objectives of general education are the same for any racial group.

7. No separate standard of measurement should be used for evaluating predominantly Negro colleges as opposed to others.

8. Findings of the study will have external validity.

Importance of the study

The importance of scientific training in the development of a genuine appreciation on the part of the student for the vast technical and scientific heritage that is his has been illustrated by Ayers. He states, "With the tremendous scientific implications of our complex modern industrial civilization, it seems unthinkable to me that the scientific
area should be ignored in the education of any student."\(^{12}\)
That some scientific background is both desirable and essential is a fact commonly accepted among educators and the general public. The following are a few selected opinions and comments of authors and educators regarding science education that have been incorporated as basic assumptions upon which the need for a study of this type is based.

The following is an excerpt from the preface to a textbook written a number of years ago but illustrative of an attitude and philosophy quite appropriate to the present:

"Every time the research staffs of industry announce a new synthetic product and every time a scientist in his university laboratory reports a discovery, the average person marvels at the wonders of science. Science is not mysterious. A person who understands what causes his automobile to move possesses sufficient ability to go a step further and comprehend the principles of physics. One who is alert enough to observe the effect of a layer of fertilizer on the soil of his garden can fathom the wonders of soil chemistry. He can learn to understand the movements of the stars and planets, the nature of the atom, compounds, and bacteria, and the place of mathematics in the logic of science.\(^{13}\)

The average individual has a strong natural curiosity about the nature of the universe which surrounds him. However, this child-like eagerness and enthusiasm for science is


quickly deadened in the classroom, according to McGrath who has stated that a few years of well meant but inadequate classroom teaching builds a wall around science—"a stupid antagonistic wall of ignorance and prejudice."¹⁴

Social factors may directly or indirectly affect the problems of general education, since education is concerned with understanding the social patterns in which it operates. Perhaps one of the most characteristic features of social change is its steadily increasing tempo, which places citizens under the difficulty of getting any sort of adequate understanding of their world in order to adjust themselves to it. This situation is responsible for the phenomena of "social lag." Inventions and scientific knowledge are advancing so rapidly that our social institutions cannot keep pace, and we are, therefore, confronted with one of the serious social problems of the age. Anastasi states:

Culture is distinctly a human phenomenon. From the viewpoint of the developing individual, the culture in which he is reared comprises all man-made aspects of his environment. There is, in fact, little in his surroundings which has not been influenced by the action of his predecessors. The domain of culture is extremely varied, covering not only physical aspects, but also language, customs, skills, attitudes and beliefs which are transmitted from generation to generation by social contacts.¹⁵


Moreover, Anastasi states:

Minority groups within a broad, heterogeneous American culture provide familiar examples of subcultures. It is apparent that group differences tend to become progressively smaller as the cultural unit decreases in magnitude. Nevertheless, the essential nature of cultural differences remains the same as we proceed from whole civilizations down to the individual town, the particular neighborhood, and the single family unit.16

The cultural diversification of mankind is paralleled more or less closely by racial differentiation. It is theoretically much more likely that behavioral differences between human populations result from culture rather than from racial differences. Any educational program should be based upon the needs of the group which it is designed to serve. Predominantly Negro colleges must be aware of this fact. It is essential that they pattern their general education programs around the social realities of our American culture.

A majority of the Negro college students do not major in the natural sciences; therefore, this large group of students has terminal formal exposure to science in general education courses as requirements for graduation. Because of the emphasis on science and technology in our society and the increasing opportunities in which the Negro has to participate more fully in our social complex, he must be adequately prepared to function responsibly and productively.

16 Ibid.
Also, he must continue to develop patterns of behavior which are personally satisfying and socially acceptable.

There are approximately 129 institutions of higher education in the United States which are predominantly Negro. These institutions have enrolled more than half of the estimated 185,000 Negro students attending colleges and universities. The number of students and institutions involved represents an important part of the total picture of higher education in America.

The area of science in general education in predominantly Negro colleges needs to be thoroughly investigated. There is very little research, and especially current research, regarding experiences of Negro institutions with the problems of science in general education. A study by Goins points out glaring weaknesses in the general education science courses in predominantly Negro colleges. His study also indicates that certain favorable trends are apparent due to the reorganization or redesigning of these courses. 17

Since Goins made his study, two specific events have had a direct influence on the overall programs of predominantly Negro colleges which should have resulted in positive gains: (1) the racial integration of staff and student bodies of many of the predominantly Negro colleges, and

(2) the availability of federal funds for laboratory equipment.

There have been no recent critical studies of the quality of these science courses in regards to their expected outcomes. To use innovations, which have been found effective in other institutions, may not have a similar value for the predominantly Negro college. Because of the problems peculiar to this type of institution, studies of an investigative and evaluative nature should be carried on among these schools to find solutions to common problems in order to bring these schools in line with acceptable standards of performance.

Due to a lack of such studies dealing with science for general education in predominantly Negro colleges, it is highly desirable that a follow-up study of this type be undertaken. The results of such a study may serve as guide lines for institutions with common problems by sharing experiences that each has had with science courses offered for general education.

Formulation of list of institutions included in the study

The initial list of predominantly Negro colleges was formulated from data contained in the College Blue Book. It lists 129 colleges located in nineteen states and the District of Columbia. This total is made up of tax-supported or public colleges, non-profit private colleges, and denominational institutions.
Data were also obtained from the "Directory of Negro Colleges and Universities," January 1966. A total of ninety-four institutions is listed in this data source, with the location, names of chief administrative personnel, current enrollment, degrees offered, and affiliations given. Two professional schools and one university were eliminated because no undergraduate programs were offered at these institutions. Several other institutions were also eliminated since they had discontinued their programs.

The list of institutions compiled from the above two sources was checked against the listing of colleges in Accredited Institutions of Higher Education, published by the American Council on Education, 1964, and the Education Directory, 1965-1966, Part 3, Higher Education, United States Office of Education. Only those institutions from the initial list which were included in the two publications listed were retained. This delimitation resulted in an eligible group of seventy-seven accredited colleges and universities (Appendix A).

The primary purpose of including only accredited institutions was to insure a degree of quality in the courses being investigated. In many of the non-accredited colleges and others with a very limited enrollment, one may assume that some course offerings under such conditions are severely restricted to the needs and minimum requirements of the
transfer students and usually consist of traditional courses in biology only.

For the purpose of this study, the institutions were placed in the following categories: public colleges, private liberal arts, teachers colleges and junior colleges.

An inquiry card was devised (Appendix B) containing a return postal card on which certain information concerning general biology courses was requested. The cards were sent to the Dean of the colleges of all institutions on the original list. The purpose for using the inquiry card was twofold: to see if general education biology courses were offered and to obtain the names of the course coordinators or some person directly responsible for the course. It was thought that by communicating directly with persons involved in such courses a better response would be obtained from future correspondence; this proved to be true. Sixty-six replies were received from the inquiry cards, representing an 86 per cent return. College catalogs were examined thoroughly to obtain data to supplement the information obtained from the inquiry cards since 14 per cent of the cards were not returned.

In order to acquire the data necessary for a nationwide study of biological science courses in predominantly Negro colleges, the writer felt that the possibility of personal contacts or interviews with science instructors in each of the seventy-seven institutions was neither
geographically nor financially feasible; the need, then, for a reliable questionnaire was obvious. A questionnaire was developed with the cooperation and approval of the writer's graduate committee (Appendix C). The questionnaire was developed under four broad headings: (1) Enrollment and Administrative Organization, (2) Instructional Policies and Procedures, (3) Instructional Personnel, Qualifications, Opinions, and (4) Course Content. The questionnaires were then circulated with a letter of explanation concerning the study (Appendix D).

Of the seventy-seven accredited institutions included in the study, thirty-eight initial responses were received from the questionnaire, representing approximately 50 per cent response. Since the completed and returned questionnaires were the paramount source of data for studying the general education biology courses, a greater response was desirable. After a period of two months, a follow-up letter (Appendix E) was sent to those institutions from which no response had been received. This follow-up letter resulted in ten additional returns, making a total of forty-eight of seventy-seven institutions responding, or 62 per cent returns.

Five institutions were visited and personal interviews were held with instructors directly involved with the courses. Results from these interviews are given in Chapter IV. A Student Opinionnaire (Appendix F) was administered to 200 students enrolled in general education biology courses
at Virginia State College, the investigator's institution. The same opinionnaire was administered to representative samples of students enrolled in similar courses in four other institutions included in the study to obtain a sampling of student opinions concerning these courses.

In summary, the following sources of data were used in this study: college catalogs and bulletins, completed questionnaires, personal interviews with instructors at their institutions and professional meetings, student opinionnaires, education authorities, science education literature, course syllabi, and college texts in biological science for general education.

The sources and procedure for collection of data

There are certain colleges which do not offer biological science for general education as a specific part of the curriculum; rather, a single course is offered for majors and non-majors alike. For this reason, it was apparent that a large number of institutions had to be contacted in order to obtain adequate information concerning the biological science courses offered for general education, to justify the claim that the resulting data would present a true and representative picture of actual conditions. Therefore, it was decided to make the study nationwide in scope, including all predominantly Negro colleges meeting certain standards and qualifications as described below and appropriate to the purpose of the study.
Treatment of data and organization of study

As the questionnaires were received from the respondents, they were assigned a code number and were placed in one of the categories previously established. The criteria which were formulated were applied where applicable to groups of schools to determine the validity and effectiveness of the biological science courses under investigation for comparative purposes. The criteria were formulated in accordance with the questionnaire used for the collecting of data and show those characteristics peculiar to the general pattern of general education science courses in the United States.

Since there is no standard for evaluating general education science courses, a scale was devised to convert qualitative levels of courses into quantitative terms. This procedure is comparable to translating student achievement from the qualitative letter grade into quantitative "quality point" numbers. All of the terms used to describe the courses are relative to the population being studied. The following scale was used to compare characteristics of courses in school categories:

4—Superior
3—Good in this respect
2—Average in this respect
1—Poor in this respect, no basis for comparison
The completed questionnaires were examined critically, and a record of responses made to individual items were made. All tabulations and calculations were rechecked to assure proper precaution against error. The comparisons made among categories of schools listed, trends shown, conclusions drawn, and recommendations made are presented in the following chapters.
CHAPTER II

REVIEW OF RELATED LITERATURE

Numerous studies have been made concerning science in general education. The studies may be variously categorized. A review of the following categories seems pertinent to the present investigation: status studies, evaluative studies, and Negro studies. Each will be reviewed in turn.

Status studies

In one of the earlier status studies, Winokur surveyed ninety-eight colleges offering generalized science courses. He was primarily concerned with course objectives and methods. Data from the study indicated that the most frequently cited objectives in these courses were (1) to give the student a general knowledge of science subject matter, (2) to acquaint him with the main generalizations of science, and (3) to teach him to understand his environment. Course durations were not uniform. These periods ranged from one semester to one year. Little laboratory work was offered; the emphasis was placed on lecture and discussion methods.¹

Hard and Jean made a nationwide survey of natural science survey courses. The purpose of the study was to determine the number of such courses that were being offered, the nature, content, and methods of organizing and conducting them. Twenty-nine per cent indicated that they were planning to establish a science survey type course in the immediate future.2

A comprehensive study, edited by McGrath, of the general education science programs in twenty-two prominent colleges was published in 1948. Detailed information concerning these courses was presented along with basic philosophies. This study presented data on both biological and physical science courses.3

A follow-up study designed to update the report by McGrath was published in 1950 and was edited by Haun. A large number of the original institutions was included in this study. One is able, therefore, to review changes which have occurred in a number of the original programs.4

Van Deventer reported the findings of the Research Committee on Junior College Science. This study was spon-

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sored by the National Association for Research in Science Teaching. The purpose of the study was to determine the present status of general education science teaching on the junior college level, the types of courses offered, the methods used, the extent of research in progress, and the degree to which new developments are incorporated into teaching.

Four-year institutions were later included in this study. Negro colleges were mentioned specifically in the report as a group not participating actively in the general education movement. It was stated also that the majority of these schools offered only traditional-type courses. Only about 20 per cent of them offered any kind of general science survey course, and 10 per cent had committees studying the problems of curriculum reorganization or integration.

The member institutions of the N.A.R.S.T. were singled out as being a picked group with regards to the development of research and experimentation in science teaching. The report also pointed out that interest in integrated science courses of various kinds was on the increase in all kinds of institutions; a large number of institutions have committees studying the problem of establishing new types of courses; most schools are using lecture-laboratory techniques. Fewer than half of the institutions surveyed are concerned with problems raised by the development of atomic power. Of the various types of courses offered, the survey is by far the
most widely known and the best established.\textsuperscript{5} Weaver, a member of the committee, gave a report on meeting the needs of Negro teachers. The study was concerned with cultural factors affecting science education in Negro colleges.\textsuperscript{6}

Arnold Grobman in a related vein believes that the colleges are now faced with a difficult problem in the reorganization of their biological science courses in light of the new content study programs on the secondary school level. He offers three propositions for consideration, the first two of which can now be easily demonstrated:

1. The new BSCS high school biology courses are as sophisticated, and more significant, than a great many current introductory collegiate courses.

2. More than three-quarters of high school sophomores are able to master BSCS biology.

3. Student retention of BSCS biology, from the sophomore year of high school to the freshman year of college, is not significantly less than for other biology courses.

The implications for colleges are clear. Campuses will soon have as freshmen, first, a small number of students who have not studied biology in high school as well as a far larger number who have. Among the latter will be, second, some who have studied conventional biology courses and third, others who have studied one of the three versions of the new


\textsuperscript{6}Edward K. Weaver, "Meeting the Needs of Negro Teachers" (unpublished doctoral dissertation, Columbia University, New York, 1938).
BSCS biology courses. Colleges will need to concern themselves with these three populations, and it is suggested that the difference between the first two and the third will be of great significance. College biology departments will need to prepare for these students. It is certain that the continuation in offering the standard introductory courses will not be the solution.\(^7\)

**Evaluator studies**

A study by Bullington pointed up the purpose of science in general education. He believes these courses should be designed to meet the needs of the individual in his life as a citizen of a democratic society. This is attempted by giving an understanding of the scientific method and facility in its use in connection with a knowledge of the facts, principles and concepts of science that are of value to the individual. His study also pointed out that the common methods of subject-matter presentation are in order of frequency: (1) the survey of subject matter of the area covered, (2) the more intensive study of selected units from the subject matter area, (3) the study of selected problems, and (4) the historical approach.\(^8\)

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As stated by McGrath, the function of science in general education for non-science majors should constitute a general preparation for living in a science-dominated world. For science majors it should furnish a basis for a broad integration of scientific knowledge. Also, science in general education should provide rich and meaningful experiences in the basic areas of living.\(^9\)

Rush described a systematic logical process of setting up objectives for a general education physical science course and outlined a method of implementing it.\(^10\)

Under Conant's leadership, the historical approach to the teaching of science in general education has been highly developed. Reporting on a physical science course offered for general education, Conant stated as a basic assumption that a study of the way in which certain scientific ideas have developed will lead to an understanding of the processes by which the experimental sciences have advanced and are advancing. In this type of course the emphasis is on methods; therefore, materials for various fields may be considered.

Experience with the case study method has indicated that there is no inconsistency between this approach and a


treatment of scientific topics in a continuous pattern. The student should, therefore, recognize that science is both a historical growth and an exploration of natural phenomena.\textsuperscript{11}

A criticism of Conant's historical approach is that it does not capitalize adequately on "the potentialities inherent in a freshman's desire to explore those problems that lie at the interface between epistemology or metaphysics on the one hand and physical science on the other."\textsuperscript{12}

Objecting to Conant's approach, Van Deventer included as a major goal of general education biology the teaching of concepts which would show the interrelatedness of all of the factors that go into the making of man, physically and mentally, with one another and with the external situations which constitute his total environment. He believes also that the teaching of science in relation to man's thinking is an area of genuine interest and real need on the part of freshmen and sophomore students in college. Historical materials are used when needed to illustrate, extend, and clarify ideas.\textsuperscript{13}

Nash, in discussing Conant's work at Harvard, pointed out that the case study approach calls attention to the

\begin{footnotes}
\item[12]Ibid., p. 135.
\end{footnotes}
factors that delay, as well as to the factors that promote, the progress of science, namely, an important awareness on the part of laymen in the modern world.\textsuperscript{14}

Blanchet's study was designed to determine the subject matter topics found in textbooks for use in general survey courses in the natural sciences. He concluded that "there is a lack of agreement among authors of textbooks concerning the content which should be discussed in survey courses in the natural sciences."\textsuperscript{15}

Bullington, making recommendations concerning the selection of subject matter for general education science courses, states:

There is as yet no "traditional" subject-matter for general education science courses. There is no universal agreement that any specific topics are absolutely necessary, although some are included in most courses. Before content can be chosen, course objectives must be determined that are in full agreement with the philosophy of general education and with the policies of the school. The content should be chosen in terms of the objectives. The content must be gauged to the needs and interests of the particular group of students concerned. The selection of content should be related to the preliminary training of the students and to their general ability. There is a need for research studies in the area of subject-matter content for general science courses.\textsuperscript{16}


\textsuperscript{15}W. W. E. Blanchet, "Subject-Matter Topics Contained in Textbooks for Use in Survey Courses in the Natural Sciences," Science Education, XXXII (March, 1948), 88.

\textsuperscript{16}Robert A. Bullington, "The Subject-Matter Content of General Education Science Courses," Science Education, XXXVI (December, 1952), 292.
Entriken lists three problems which are outstanding in the successful execution of a science program in general education. The laboratory was of primary concern. He states:

The problem of laboratory work for general education in science is one on which there is great divergence of opinion. In the majority of the courses some type of laboratory work is offered. In any event, the laboratory work for such courses must be realistically incorporated into the type of course that is being taught. It must be a definite implement used to reach the objectives set up for the course, not just "busy work" to consume the allotted time.17

Van Deventer noted a trend in the development of general education college science courses which has to do with the use of the laboratory. He believes that "one possible solution to the laboratory question has been the substitution of demonstrations, partly or wholly, for laboratory work."18

Concerning instructional procedures in general education science courses, McDonald believes:

There will be more attention to application of the things learned to the life of the student in his own out of class environment. On the whole, teaching method will move more in the direction of the socially significant, the functional, the sharply realistic way of doing things. Audio-visual aids will come prominently into the teaching-learning situation. The democratic give-and-take, which is characteristic of our free


society at its best, will become the dominant feature of the classroom atmosphere. Group dynamics will supercede the traditional lecturer-listener relationship.\(^9\)

A questionnaire study by Adams was concerned with some of the critical teaching problems and controversial issues resulting from past practices in general chemistry laboratory work. The data received indicated that teachers of chemistry are interested in new and improved evaluative devices, especially those designed to measure laboratory achievement.\(^{20}\)

Van Deventer poses a question regarding the conduct of general education science courses. He asks, is subject matter primarily what our general education students need or should subject matter constitute a tool to be used in teaching attitudes? He concludes:

There is a need for tests and other methods of evaluation which will locate ideas, attitudes and understandings, without at the same time emphasizing the subject-matter in terms of which things are taught. Much work and thinking has been done in this area, but we certainly do not yet have a complete answer to the problem.\(^{21}\)

Regarding methods of evaluation, McDonald asks and answers the question: How shall we estimate the effectiveness


\(^{20}\)Clyde S. Adams, "The Importance of Laboratory Work in General Education at the College Level," Journal of Chemical Education (June, 1942), 266-270.

\(^{21}\)Van Deventer, op. cit., p. 190.
of the general education program? He says:

The ultimate test of the success of general education can be had only in the evidence of constructive living on the part of those who have been reached by the program. During the interim, however, a continuous and critical evaluation process is essential. The best approach is through the group. In addition to group evaluation techniques by students and faculty, the available instruments for measuring individual progress can be helpful.22

Loud, in evaluating general education science courses, estimates what he believes to be the most significant evaluation device. He writes:

The collection of evidence that those who have participated in the experiment continue it thereafter, wherever they go, beyond the college years, as they seek to continue their education and to make their appropriate contribution, in other communities, with other associates, to the solving of problems.23

The foregoing review of literature indicates a trend away from highly specialized courses. The evidence indicates a concern to use science to bring about a new and better culture. There is an increasing tendency to plan curriculum experiences that foster the proper emotional development of the individual. The movement to provide an adequate orientation for all college students is gaining momentum, especially in teachers colleges. However, there is a need for much improvement in this regard. Much additional

22 McDonald, op. cit., p. 32.

23 Oliver S. Loud, "Designing Science Courses for General Education on the College Level," School Science and Mathematics, L (April, 1950), 394.
research is needed to improve instructions in the area of science for general education.

Negro studies

A review of the literature reveals few studies and investigations treating specifically the problems of higher education of Negroes. A few of the significant ones having value for the present study will be presented here.

Thomas Fraser investigated science survey courses in accredited Negro colleges. His purpose was to identify and describe the science survey courses in the curricula of these colleges. The selection of schools was based on their membership in regional or national accrediting associations. He examined critically the 1938 catalogs of the institutions giving special attention to course descriptions and the number and kinds of courses offered. His findings revealed the following: thirty-eight of the senior colleges included in this study offered science survey; only seven of the institutions made no provisions for science surveys and one was a graduate school; even excluding general biology as a survey, twenty-seven of these institutions offered science surveys.24

The inauguration of these courses in predominantly Negro colleges has been quite rapid since 1935. The situation then, according to Havighurst, was that there were six Negro colleges known to give science survey courses, and variations in

both educational philosophies underlying these courses and in practices in conducting them differ markedly. Variations exist as to whether or not these courses should be required within the student's program of general education. There is a need for cooperative planning in both courses of study construction and construction of newer instruments of evaluation. Such cooperative effort on the part of teachers connected with these courses will probably make for greater unity in philosophy and practice.\textsuperscript{25}

An earlier study by Harold Woodson was concerned with the chemistry curricula in Negro colleges. His purpose was to describe the status of undergraduate chemistry training in thirty-eight Negro colleges as determined by an examination of the catalogs and bulletins of these colleges. The courses were considered from the points of content, quality, and type. The faculties were considered relative to academic preparation, number involved, and sex.\textsuperscript{26}

Evaluative studies of science programs in Negro colleges were made by Turner, DuValle, and Weaver. Turner was interested in the quality of college science teaching, whereas DuValle was concerned with evaluating the instruction in chemistry courses in Negro colleges. On the other hand, Weaver's interest lay with the cultural factors which have

\textsuperscript{25}\textsuperscript{25}Havighurst, op. cit., pp.97-101.

operated to the detriment of science education among Negro colleges. The results of Weaver's study showed that the subject matter of science education should emphasize the major areas of social living and that two types of courses should be offered, one for science majors and one for the non-science major. He concluded that courses should be reorganized to afford teachers experiences in relating the school and community. Also, he believed that the professional preparation of teachers should be centered around the functional aspects of living with stress on cultural factors and social implications of science.27

Derbigny made a study of general education in the Negro colleges. He stated, "The present study is not an attempt to rate general education programs of Negro colleges in terms of some standard. In fact, no such generally accepted standard exists."28 Comparisons with these programs have been made frequently throughout the study. The study, therefore, seeks to describe the general education programs of these colleges, to compare these programs with other programs, and on this basis to suggest ways in which to improve them.


In regard to the biological science courses offered for general education. Derbigny concluded that the typical biology course is a pure science course designed primarily for specialization and for transmitting the cultural heritage in this area. For those students who plan to specialize in biology, medicine, or in allied fields, this course pattern is of inestimable value. It is questionable, however, whether these courses, with their highly specialized vocabularies, justify the effort on the part of students whose interests are different. 29

In a report prepared by the Research Committee on Junior College Science of the N.A.R.S.T., it was stated that Negro colleges have shown least progress in developing good science courses for general education. Weaver, a member of the original Research Committee, made a follow-up study (1950) of Negro colleges. His findings coincided with those of the original committee. 30

Goins made a comprehensive evaluative study of science courses offered for general education in selected Negro colleges based on specific recommendations made by Weaver. The study, national in scope, was concerned with 108 Negro colleges with a total enrollment of 91,208 students. The

29 Ibid., p. 145.
purpose of his study was to evaluate, in light of certain
criteria, the science courses offered for general education
in a selected group of Negro colleges. Certain conclusions
resulting from the study are listed in Chapter VI.

A paper read by Weaver at a meeting of the American
Association for the Advancement of Science had as its purpose
to identify some of the factors which have operated to
structure science education program in educational institu-
tions attended predominantly by Negroes and to give the
implications for the programs for preparing science teachers.
He stated:

There is no such thing as science education for
Negroes as contrasted with science education for
whites. Many of the short-comings associated with
science education programs for Negroes are also
associated with American schools in general and
especially those which have been "poor," "southern,"
and "small." He further stated:

The philosophy and objectives for science educa-
tion programs for all Americans are reflected in
science education programs for Negroes. The struc-
ture of science education programs for Negroes has
been skewed from the prevailing patterns by the re-
strictions placed on the degree of Negro partici-
pation in the various phases of American life, and
the inferior status of schools for Negroes. Thus,
the problem of initiating and developing programs
of science education in institutions attended pri-
marily by Negroes has been unsatisfactorily resolved

\[31\text{Ibid.}\]

\[32\text{Edward K. Weaver, "Development of Science Curricula in Negro Schools," A paper read at the AAAS meeting in Atlanta, December 28, 1955, pp. 29-30.}\]
when seen in the light of the general philosophy, objectives, and programs postulated in the literature.\textsuperscript{33}

Weaver believes also that there are a number of inconsistencies and contradictions apparent when one examines science education programs in schools for Negroes. He concludes that the basic factors responsible for inhibiting development of science education programs in Negro schools have been inadequate financial support, limited competence, clouded uncertain values and standards, and limited vocational opportunities for Negroes in areas of science and scientific research. These factors, many of which Negroes have had little control over, have made clear, sound planning next to impossible.

In a study by Fraser concerned with student opinion on college general education, he stated that it is recognized that there is a trend toward student responsibility for evaluating courses of instruction in general education on the college level. Some of the principles supporting this trend are (1) students that participate in the evaluation of courses give useful suggestions which may be used in improving courses, (2) evaluation should be a cooperative endeavor involving students and teachers, (3) the process of evaluation is in itself a valuable learning experience and (4) out of the process of evaluation should grow leads for improving

\textsuperscript{33}Ibid.
courses and the teaching-learning situation. He concluded that the systematic collection of student opinion on the improvement of instruction may be used as a factor in determining and improving the content of courses and in facilitating the teaching-learning situations.\(^{34}\)

In a related study, Fraser and King investigated the opinions of some members of the alumni of Morgan State College on certain topics which might be included in two general education courses in science. The results directed attention to the preference expressed by the alumni, as contrasted with the opinions of students and the general faculty, concerning what topics of study should be incorporated into courses of this kind. Comparisons between the alumni and students showed that they were fairly closely related in the rank-order of preferences. The comparisons between the alumni and faculty showed a low but positive relationship in the rank-order of preferences.\(^{35}\)

Some evaluators attribute failure to attain social recognition to the lack of depth and inadequate general education of Negroes. Palmer believes that general and liberal education are as important in the training of a person to prepare him for his life's work, whether one is Negro or

\(^{34}\)Fraser, op. cit., pp. 213-219.

\(^{35}\)Thomas P. Fraser and John W. King, "Alumni Opinions on General Education Science," Science Education, XLI (February-December, 1957), 11.
white, just as it is in other professions. He states, "It is my firm conviction that young Negro men and women attending our colleges and universities should receive a different type of academic general education." Moreover, he postulates:

Our problem, however, with the profession-bound Negro student is to provide the needed experiences and knowledge he may have missed from the day he first entered elementary school. Much of this encompasses his grasp and appreciation of the world around him as well as facts in books he studies. His complacency and satisfaction with the mediocre must be replaced with a liberal spirit and quest for a set of values which he may or may not have formulated for himself. These intangibles can become outcomes in general education courses.  

Palmer further reports:

We cannot ignore the enormous impact which the natural sciences have made on our society and promise to continue to have in this space age. And, while I am not sure how much of the content of science that the profession-bound Negro student must have in order to make certain that he is well educated, I am convinced that he must be aware of the nature of the philosophy of science, something of its history, its methods, its uses, and above all, its limitations when applied to problems it was never intended to solve.  

Goins suggested that additional studies in this area be concerned with the total population of Negro colleges as a means of checking the reliability of conclusions drawn from


37 Ibid., p. 88.

38 Ibid.
his study. Also, his insistence that "in a subsequent study of the same area, the problem, principles involved, and the interpretations to be drawn will be in all essential respects, identical with those which have entered the present study" served as motive forces for the present study.

\[39\text{Goins, op. cit., p. 104.}\]
CHAPTER III

A PHILOSOPHY OF GENERAL EDUCATION

General education is a relatively new curriculum innovation at the college level. It is mainly a product of the twentieth century. Being new, it has no traditional background to help shape or mold its form. Of the many forms which have evolved, some have withstood the pragmatic test of working satisfactorily; others have not. Among those which may be termed successful, there is great diversity. To a great extent, the underlying concepts of general education accepted by a given institution are the sources for the apparent variability. However, differences in organization and administration of specific school programs may account for various notions about general education in institutions professing the same general concepts. It may seem that these differences are but symbols of confusion from which can come no good; however, in many instances, this variability has proved to be good because it indicates the experimental nature of a new process and satisfactory programs of general education may be derived from such experimentation.

The complex system that is American education has been interpreted by many writers, and they have drawn attention to
the many diverse forms of formal education. During the last few decades, there has been a continuous expansion of programs for general education. There have been errors in direction, changes in objectives, and criticism by many educators; still, the general education movement has pushed forward, until now nearly every institution in the land has some provision for general studies. The general education movement in America has been largely spontaneous; that is, no particular group has afforded directions for its development. For this reason the general education movement has been slow in defining itself, and there is still uncertainty about its limits. Some people have confused general education with education in the liberal arts. Frequently, it is equated with survey courses and is denounced as everything that is undemanding and superficial in modern education.

There are educators who believe that education for youth should still be strict and disciplinary as it was in the earlier years in this country. Then, there are those who claim that formal training should be more liberal and should allow the youth greater freedom of choice in decision making. It is the belief of some that education should train youth to be "gentlemen" as in the times when education was an expected privilege of the few. It is the belief of others that education should prepare youth for specific vocations which will permit each youth to make his own niche in life. The perpetuation of "culture" is also a claim of some; they believe
that education should be liberal and should be concerned with the finer things of life which can be found in such areas as art and literature. Finally, it is believed by some that formal training should be generally introductory to the many areas of man's knowledge and should foster among students a free exchange of ideas and views.

We have been slow in recognizing that general education has been created as a protest, partly unconscious, against specialization in modern life and education. We are recognizing also that general studies are concerned with a somewhat different kind of person than are the liberal arts --they are truly designed for a different public. Philosophically, one may say that this movement represents a groping for the concrete in methodology and materials of instruction. There are, therefore, many diverse interpretations pertaining to the purpose of education and the actual value of formal educative efforts. Many studies attesting these various interpretations have been made. Actually, these studies have had as their main intent the working toward maximum utilization of intelligence in social situations as well as in academic circles.

Many questions related to general studies still remain unresolved. What is the current status of existing conditions in general studies? What is the purpose of education and the function of science in American culture? How are decisions made concerning curriculum and method? What are
effective methods for conducting a natural science course? What are the essential subject-matter areas of a natural science course?

If one is to do an effective job of instruction in the natural sciences or in any of the other disciplines in general education, a thorough understanding of existing conditions of the modern educational science is essential. It has been previously mentioned that there exists a diversity of educational forms in American education. We may account, in part, for this diversity when we attempt the task of developing an educational program which will be appropriate for all groups of people. Today, mass education can no longer be termed liberal education.

In recent decades, determined efforts have been made to reliberalize education. These efforts collectively are called general education. General education is a modern institutionalized means for developing student understandings and abilities. In attempting to describe general education and make an assessment of the present state of affairs, I believe it is necessary to elaborate further on the overall task of education and specifically on the functions of science in American culture.

In our modern society, a fragmented social complex exists. This fragmentation is due to the division of labor, race, and socioeconomic status of our citizenry. It is in this type of environment that our formal educational institu-
tions must function. A primary function of the school is to develop in youth socially acceptable patterns of behavior. Yet, this is not adequately done since the schools, in many instances, are not an integral part of the community. We are still not thoroughly convinced that the school should or should not be a force for social change in a community.

If we assume that induction is a primary function of education, it would seem then that science could be considered a special area of mediation in formal education. Some basic notions concerning the function of science in a modern society may be gained by determining the social implications of science and considering also the interactions of science and society. In recent decades, the scientist has arisen to a position of authority. The products of science are of primary concern. The creation of such products has led to specialism on the part of many scientists, resulting in neglect of the social role which they should play as members of society. The production and use of the products of science cannot be divorced from the responsibility to society for their creation.

It would seem then that in the undergraduate training of the professionally-bound student, as well as in others, a broad program of general studies should be considered essential. Many times the attitudes developed during graduate training are often reflected in methods of instruction on the college and secondary school levels. Students are too
often required to play the roles of apprentice graduate stu-
dents, and teachers are neglecting their roles as mediating
agents in stressing the social role of science. Professional
requirements cannot be required of all students, and the
science specialist should not inject specialism into a gen-
eral studies course.

Scientific knowledge during the last century has in-
creased exponentially, and it has become impossible for the
individual to keep abreast of current discoveries in this
discipline. This vast accumulation of knowledge is primarily
responsible for the segmentation of science into many sub-
disciplines. Most people look today to the special discip-
lines for the kind of knowledge which will help society to
solve its problems of health, material, welfare, and even
political and cultural dilemmas. The specialist is in demand
everywhere. Such specialists do not pretend to have a grasp
of the whole situation. Their competence ends with that knowl-
dge which is essential in order to achieve limited results.

A knowledge of subject matter is a way of developing
socially significant meanings; it must be presented in a
social environment. The selection of subject matter should
be made according to the criterion of social worth. Those
experiences shared by the largest number of persons should be
considered primary, whereas professional specialism comes
second. A general studies curriculum, therefore, should in-
volve social relationship so that in group processes social
insight and interest may be developed. Scientific knowledge differs from mere information; that is, conclusions reached or stated may be validated. The subject matter of science may therefore act as a special medium for mediation of that part of the culture which guards against practices of premature acceptance and superficial application of knowledge.

Effective instruction in general education takes into consideration the interests of students to keep them sensitive to their environment; it makes use of value orientations to bring students to examine their own ideas; thus, it encourages emergence of understandings and significant meanings. The purpose of the students should always be in the forefront; they should not be considered apprentices as the medical student, and every attempt should be made to meet the needs of the students so as to help them gain social balance.

If the objectives or goals of general studies are realized as a result of instruction, the learner should be devoted to the democratic way of life; he should have a character that is integral, socialized, and objective. Also, he should be able to recognize his twofold responsibilities: to be integral in outlook and self-objective, to participate in group activities and to be socialized. These behaviors should lead to convictions and emergence of self-consciousness. Thus, an effective learning situation in general studies must provide for the development of democratic character in the learner. A teaching-learning situation demands inspection of
value orientations and should stimulate one to make personal commitments. The acquisition of factual data is also essential. There must also be as a part of these situations methods of evaluating behaviors and validating objectives.

In our modern society, we are not so much interested in knowledge as truth, but in knowledge essential for transforming our natural environment to an instrument of social control. Our present-day science, therefore, has a pragmatic, technological orientation and is becoming more and more specialized and abstract. The same spirit has infected our humanistic studies as well.

The academic discipline is the area in which the teacher-learner interacts. The field of science is a means by which the learner is initiated into a part of the present social matrix. In general studies it is not expected that the learner becomes an expert to the same degree as a medical student serving as an apprentice in the field of medicine. This would not be desirable for the general education students for whom the social implications of science are essential. An acceptable alternative to the emphasizing of facts in science teaching would involve a greater utilization of social-ethical-moral generalizations. Such a curriculum should develop social insight and interest in possible solutions to social-scientific problems.

Dissatisfaction with the products of our earlier educational methods served as an impetus to the general education
movement. A greater distinction was needed between a genuine education and mere training. There are undoubtedly values to be accrued from specialization; however, commensurate changes in character and behavior are not brought about by a proficiency in these disciplines. There appears to be little transfer of learning. The character of specialization today tends to leave its possessors segmented and incapable of participating fully and effectively in our democratic society. In the teaching profession, it is a depressing experience to witness the relative inability of learned men to communicate with each other about the common task: education of the young. There is also the failure to understand the position of someone who has spent his life in a different specialty. We seem to communicate well only with colleagues of our specific disciplines. Among specialists, as in society, communication seems to be a lost art, resulting in a loss of essential community.

Snow's book on the Two Cultures and the Scientific Revolution has caused educators to be concerned greatly with the kind and amount of science instruction that should be given to non-science college students. This concern is evidenced by the popular phrase "Science and the separation between the two main elements of traditional culture." There are those who are urging changes in curricula to make more science available in a more meaningful way. Snow's book is not only a plea for the intellectual betterment of
non-scientists, but also for closing the "gap" between scientists and others. He believes that the "gulf of mutual incomprehension" between the two polar groups, "literary intellectuals at one pole and scientists at the other, is disastrous for a living culture."¹

In general education, it is not the specialists we want, but the fluent "generalists." Whether scientist or educator, we must accept the recommendation to increase the scientific literary of non-scientists. By so doing, we should not expect to bring about global changes, but rather, achieve a more realistic goal, the alleviation of individual ignorance.

Of the many philosophies written concerning general education, no positive philosophy has yet won wide acceptance. Dissatisfaction with existing conditions of educational programs has been listed as a chief reason for the initiation of the general education movement. Even this, in my judgment, is not enough on which to found a movement. It is becoming more and more evident that there is a difference between education and training, and it has been demonstrated that intelligence can be sharpened while conscience is blunted. General education, like many other movements in our day, seems to have worked out the rationale ex post facto.

Analytical thought develops along with specialization, and with analysis as a constant method, certain other powers tend to atrophy, as Darwin realized too late in his well-known lament about his not being able to enjoy poetry after too many years of research. Ideally, therefore, a general education course should attempt to combine the analytical, imaginative, and relational in its approach to any subject area and not separate experience into facets which may be considered as a whole.

There is no special curriculum for the academic preparation of teachers of general education. At present nearly all those who teach general education courses are specialists. Perhaps, a person with specialized training will be able to do a better job with the general studies courses than one lacking breadth and depth in training. The development of curricula for the preparation of general education specialists should be a concern of colleges and universities.

Structure in general studies courses represents a search for wholeness and concreteness through reflective thought, whereas content is of secondary importance as long as it is of a nature to engross the student by relating itself to his own experience. Proponents of general education are notmistaking wholeness for inclusiveness; they do believe that in such courses attention should be directed toward ideas which are objectively important and relevant to student and teacher alike. These ideas are best illuminated
when the discussant is at the same time emotionally involved and striving for objectivity. The primary motive force should be the satisfaction of intellectual curiosity and the acquisition of knowledge however slight.

An obvious question which may be asked proponents of general education is what type of person should represent the end-product of the general education process. Answers to such a question would probably be confusing and even contradictory. Do we aim to increase the individual's literacy in the disciplines other than his specialization? Are we attempting to create better individualists or better communalists? Are we trying to produce men equipped to make significant social and political decisions? We may ask another question: Is the general education movement intended to be conservative or revolutionary in American society? Answers to this question may run the whole spectrum of opinion concerning present and future goals of general education; however, few persons seem really clear about what is desired as the outcomes of general education. Scant attention has been paid to the pragmatic outcomes of general education; as a matter of fact, some educators would deny that there are any ways of living that are clearly preferable for all or even most men. If such ways do exist, they have not been found. There is less indecision concerning the purposes of general education when we think in terms of individual goals instead of group goals. There seems to be
a consensus that the end product of general education should have developed patterns of behavior which are personally satisfying and socially acceptable.

Teaching a general education course effectively is a difficult task; however, its rewards are correspondingly great. Many general education teachers contend that experiences in such courses are more satisfying than in more specialized types of courses. The reason seems to be that in general education courses we get more easily a sense of involvement and participation in our students and ourselves.

What, then, can be our valid reason for presenting science to the non-scientists, and what are the consequences that follow from these reasons? Basically, there are two general functions of science: first, an increased knowledge of science helps us to orient ourselves as individuals and as social groups to our external environment, to one another, and to our own internal capacities. Secondly, an increased knowledge of science may enable us to change our external environment, our relationships, our capacities, and our deficiencies. A primary concern of classroom instruction should be with the first of these functions. A characteristic of the generally educated man in today's society is that he possesses a knowledge about the forces which are changing and dominating his life and affecting culture in all its aspects.

The college graduate emerging from a formal program of training and orientation should have realized at least four
goals: he should be able to recognize his own talents; he should know how to have a fruitful relationship with his fellowmen; he should have a functional knowledge of the physical universe; he should know what the past means and what the probable future may be. It should be obvious that a study of general education science could not possibly contribute equally or even significantly to each of these goals. It is my belief, however, that the non-science major can have science courses designed to contribute positively, to some degree, to each of these general goals of education. The structure of such courses cannot be superficial, but should have both depth and breadth thereby making taxing demands on both student and teacher if such ambitious goals are to be realized.

It would seem, therefore, that the overall task of general education is to search for relationships existing between individuals and their environments. Students should have an awareness of their dependence on nature by recognizing the independent existence of other living beings. We must continue to reverse the notion of the relationship between man and nature which has come to prevail. John Dewey put it aptly in his book *Experience and Nature* some years ago when he wrote:

> We cannot separate organic life and mind from physical nature without also separating nature from life and mind. The separation has reached a point where intelligent persons are asking
whether the end is to be catastrophe, the
subjection of man to the industrial machines
he has created. 2

The methods of science cannot be used solely to find
a solution to this split between man and nature. More subtle
procedures must be used. It is obvious that no one course in
general education, regardless of its structure, can make so
radical a change in orientation. If the task is to be
recognized as a therapeutic one, an all-important start can
be made, since the reformation is accomplished individually
over a period of years, even a lifetime.

Evaluative criteria for
general education

A survey of the literature and related research has
made it apparent that there are no uniform standards or
policies regarding the establishment and maintenance of
biological science courses for general education. In a study
of this type, however, there is an obvious need for the estab-
ishment of certain standards with which existing conditions
may be compared for purposes of assessing effectiveness if not
for formal evaluation.

Criteria of general education were formulated for this
study by developing a philosophy of general education, re-
viewing, integrating and synthesizing a list of clarified
statements from the literature. The technique used by the

2 John Dewey, Experience and Nature (New York: W. W.
The investigator was to formulate criteria which emphasized a specific clarified statement. These criteria were compared with the ten major objectives of general education that appeared in *A Design for General Education*, published by the American Council on Education. The ten objectives are as follows:

Health, written and oral communications, social adjustment, family and marital adjustment, active and intelligent citizenship, interpreting natural phenomena, using scientific methods, self-expression and appreciation of literature, music, arts and crafts, clear thinking about the meaning and value of life, choosing a proper vocation. These objectives are subdivided into specific objectives that are classified into categories of knowledge and understanding, skills and abilities, attitudes and appreciations.  

General education, as the President's Report emphasizes, should enable the student to identify, interpret, select and build into his own life those components of his own cultural heritage that contributed richly to understanding and appreciation of the world in which he lives.  

Excerpts from the Report include the following statements:

The purpose of general education should be understood in terms of performance, of behavior, not in terms of mastering particular bodies of knowledge. It is the task of general education to provide the kinds of learning and experience that will enable a student to obtain certain basic outcomes, among them the following:

---


1. To develop for the regulations of one's personal and civic life a code of behavior based on ethical principles consistent with democratic ideals.

2. To participate actively as an informed and responsible citizen in solving the social, economic, and political problems of one's community, state, and nation.

3. To recognize the interdependence of the different people of the world and one's personal responsibility for fostering international understanding and peace.

4. To understand the common phenomena in one's physical environment, apply habits of scientific thought to both personal and civic problems, and to appreciate the implications of scientific discipline for human welfare.

5. To understand the ideas of others and to express one's own effectively.

6. To attain a satisfactory emotional and social adjustment.

7. To maintain and improve his own health and to cooperate actively and intelligently in solving community health problems.

8. To understand and enjoy literature, art, music and other cultural activities as expressions of personal and social experiences, and to participate to some extent in some form of creative activity.

9. To acquire the knowledge and attitudes basic to a satisfying family life.

10. To choose a socially useful and personally satisfying vocation that will permit one to use to the full his particular interests and abilities.

11. To acquire and use the skills and habits involved in critical and constructive thinking.  

The following list represents the criteria for general education utilized in this study. These criteria are not

\(^{5}\text{Ibid.}\)
listed in their order of importance. The criteria of general education is to provide students with the necessary knowledge, skills and attitudes in order that they may:

1. Develop scientific, philosophic and ethical values which are socially acceptable.

2. Communicate effectively through oral and written expression and be able to recognize the communication arts in their broader setting of the various disciplines.

3. Recognize and understand problems facing citizens in adapting to the environment in terms of the culture in which they live.

4. Be able to understand and interpret natural phenomena while gaining an increased appreciation of the physical and biological world.

5. See the interrelationships existing between the social, economic and spiritual forces operating in our society and to develop as a result a sense of social responsibility.

6. Develop habits of reflection, morality, and aesthetic appreciation.

7. Put forth maximum efforts in formulating a philosophy of life that is both personally satisfying and socially effective.

8. Become actively involved in seeking solutions to problems confronting our society.

9. Understand and appreciate certain beliefs and practices which have been inherited by our present society and are a part of our cultural heritage.

10. Be alert to existing educational opportunities which may be utilized for continuous self-improvement.

11. Develop an emotionally stable personality while adjusting socially to his society.

12. Develop the ability to think critically in seeking solutions to problems.

13. Be an intelligent consumer of the products of science.
14. Perform responsibly as a member in a family group.
15. Make a positive contribution to society through vocational training.
16. Recognize and cultivate one's own abilities, aptitudes and interests.
17. Work toward international understanding by recognizing the interdependence of the peoples of the world and being informed on national and international affairs.

Criteria applicable to science courses for general education

There is no standard list of existing criteria for the singular purpose of evaluating science courses for general education purposes. For this reason a list of criteria was formulated after a survey of related research articles in educational journals and textbooks concerned with activities in biology for college students. Books dealing with science education were most helpful.

The following quotes are from prominent science educators and research investigators with regard to developing criteria for selecting experiences and objectives for a modern program of science instruction at the college level designed for general education.

Richardson believes that:

The scientifically literate person has a knowledge of science adequate to an understanding of his environment. This knowledge helps him examine the world about him with respect to its rational explanations and to the processes by which the explanations have been derived.

The scientifically literate person also possesses objectivity: he is open minded, critical, and skeptical
to the degree that he questions the validity of even his own conclusions.

Scientific literacy requires an awareness of separate, identifiable entities in the universe—matter, energy, and life—and of the essential relationships among the three. The scientifically literate person thus must be able to read and to discuss scientific information found in common literature and to interpret common scientific phenomena with facility and confidence. He must also be able to interrelate and to differentiate between science and applied science.

Science is a creation of man's intellect. Scientific literacy is based upon a growing understanding of the relation of man's intellect to the structure of those processes and products of thinking which constitute science.⁶

Sleeman at New York University (1955) utilized the evaluation of Castleton Teachers College by the American Association for Teacher Education as the basis for general education for the people of Vermont, and for providing firsthand experiences for students, with more attention to the social implications for the student. He concludes, "The objectives of science can best be met by presenting problems in relation to the life of the people of the community rather than around subject matter."⁷

The following statement by Evans represents the desired emphasis for science instruction and objectives in terms of selecting experiences:

Will the learning experiences being provided now, will what is being taught, make any contribution to an

---

individual's ability to live more competently, more satisfactorily, more effectively in a community? If the answer to this question is not known, then we must ask, what are the competences that young people need to develop in order to live fully and in order to participate effectively in the community?  

Bayles, in commenting upon the present dilemma of science instruction, states, "The basic difficulty in our science teaching is our great lack of adequate consideration for theory. Without theory our instruction on any matter becomes a case of the blind leading the blind." He further says, "Science must keep forever in the foreground the objective of learning how to get knowledge and enhancing the capacity to be independent in so doing. We cannot be content with the assurance that if we teach children what to think they will learn how to think."  

In a similar summary statement, Correll concludes that "general education science should strive to impart to students not only knowledge about the natural world but also some appreciations and understandings of the process of inquiry whereby such knowledge came into being."  

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10 Ibid.  
Expressing the kind of instructional emphasis needed in science, Conant says:

Science students need to be educated in the strategy and tactics of science rather than simply to be taught a mass of facts. They need to know about the social responsibilities of science, and a further understanding of the significance of science in everyday life. More emphasis on science and technological development will affect the daily living of students.  

Franks believes, "The objectives of a course are determined by the change it is intended to produce in students, rather than by the subject matter peculiar to the department. Subject matter is a means to an end. Changes in behavior is the end."

Brandwein, in agreement with Franks, states:

The objectives of science can best be met by organizing its problems, its methods of instruction around problems of living and around needs of the individual rather than around subject matter. Emphasis is not placed on subject matter, but it is to be learned only as it serves the personal, socio-personal, socio-civic, and socio-economic needs of the individual.

Apparently these science educators would consider it psychologically sound to organize science experiences in

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14 Paul Brandwein, "Four Years of Science," *Science Education* (February, 1945), p. 31.
harmony with the form in which the learner finds it of "use." The usefulness of scientific facts, information, nature of evidence, and skills in making life more effective, are apparently considerations which these writers would favor in the development of science learning experiences and the formulation of objectives.

A review of these expressed opinions and other studies of certain prominent science educators reveals a point in educational theory upon which there is apparently basic agreement.

The concept of science education which exposes science students to a rigid body of theoretical subject matter as adequate preparation for future living is, to these science educators, unsound. They apparently would favor those objectives and teaching procedures which provide opportunities for meeting needs in the daily aspects of living. They would support a procedure that emphasizes the methods of science, one that stresses the development of problem-solving skills in the lives of the learner. They would support a procedure that integrates principles, facts, concepts that are associated with everyday activities and community resources. Also, they would favor a procedure that educates in the strategy, tactics and history of science while emphasizing clear and logical thinking regarding scientific and technological development affecting the daily lives of the student.
These science educators evidently would suggest the abandonment of objectives and teaching procedures that organize group instruction in the sense of requiring a fixed amount of subject matter to be covered by all students. They would favor a procedure of instruction, characterized by such general factors as the problems, concerns, wishes, needs and future plans of the students involved.

Inherent in their statements are the implications that the meaningful science experiences are those that ramify most widely into human affairs and they may be stated as objectives of the curriculum and hence used as criteria for determining subject matter content, instructional procedures, and course organization for general education science.

In an earlier publication Science in General Education, edited by Earl J. McGrath, an attempt was made to bring together descriptive statements of science courses for general education from various selected colleges and universities throughout the country therefore offering a somewhat composite picture of the status of science for general education at that time. It was believed that an interchange of experiences of this sort among institutions would be advantageous to all. The volume resulting from this compilation of data has been widely used by institutions with existing programs in general education science as well as those attempting to design such programs peculiar to the needs of their specific groups.
In a more recent publication Science in General Education, edited by R. Ray Haun, the original publication has been updated and represents changes which have taken place in many of the original programs. Descriptive statements of new and promising programs have been added. The contributors to the above-mentioned volumes are or have been actively involved in teaching a general education science course in one of the major science disciplines.

Of the many publications treating general education science, the two volumes described above may be considered highly significant contributions to this discipline. Teachers of general education science wishing to gain an overview of the various philosophies and practices of general education in the natural sciences will find these volumes useful.

Haun states in his introductory chapter "Changes Within the Decade":

It is hoped therefore, that the volume will give a rather representative picture of science in general education throughout the country at the present time, although it is frankly admitted that there are many institutions which are giving general education courses now and there may be innovations or special developments in some of these which did not get into this book, and would have contributed equally as well to its story.\(^\text{15}\)

In the present investigation the data collected, compiled and interpreted relating to biological science courses in general education have been evaluated to a great extent

by using the text *Science in General Education*, edited by Haun, as an acceptable standard of comparison.

According to Carter V. Good, a criterion is "A standard, normal or judgment selected as a basis for quantitative comparison."\(^{16}\) Therefore, the following criteria reflect desirable characteristics of science courses at the college level designed for general education. These criteria do not represent absolutes to which courses must ascribe, but represent desirable directions in which courses should show progress if they are to be effective in meeting objectives of science in general education as postulated in the literature. These criteria will be presented under two headings: general and instructional.

I. General

1. An effective general education course in science should be structured around the needs of students involved.

2. The block and gap type of course seems to be the most effective course design to accomplish the objectives of general education science.

3. Broad underlying themes should form the basis for course content selection in general education science.

4. An effective general education science course should have associated laboratory experiences which permit students to test principles and hypotheses and to make qualitative and quantitative measurements.

5. The effective general education science course should be so designed as to afford benefits to both science majors and non-science majors alike.

6. General education science courses have been offered most profitably at the freshman and sophomore levels.

7. A year sequence of general education biological science should prove adequate in meeting the needs of the non-science major; however, a one-semester course may be considered as an acceptable minimum.

8. An effective general education science course should be structured and coordinated by a person whose academic preparation shows breadth, depth and educational experiences at the various levels of instruction, as well as in related fields.

II. Instructional

1. Both teachers and students should participate actively in the design of course experiences.

2. Community resources should be utilized in the conduct of general education science courses.

3. A variety of strategies and techniques should be used in the conduct of the course.

4. Evaluative instruments used to measure course outcomes should be varied and continuously applied.

5. The general education science course should contribute significantly to meeting student needs in the areas of personal living, social relationships, civic responsibility, and economic relationships.

6. Developing the power of reflective thinking should be a goal of general education science.

7. Group work in the science course should provide for the development of a spirit of cooperativeness in student relations.

8. The general education science course affords opportunity for creativity.

9. General education science courses may contribute to the development of social sensitivity and self-direction in students.
Comparisons among colleges

The investigator analyzed the data obtained from the colleges and noted that there exist many patterns of administrative organization and instructional procedures and policies among the biological science courses offered for general education. There are, however, certain course characteristics which lend themselves to comparison. For comparative purposes the schools were grouped into the following categories: public colleges, private liberal arts, junior, and teachers colleges.

The investigator evaluated the colleges on two basic aspects. For each college group the average rating on each aspect and the average total scores were computed. These averages were used to make categorical comparisons. Tables 1 and 2 represent the tabulated data in regards to the two aspects under comparison.

Group comparisons on administrative organization

The average total scores on administrative organization indicate that the junior colleges have the highest rating, followed by equal ratings for the public and teachers colleges. The lowest group, the liberal arts colleges, has a rating which differs from the middle groups by one point and the highest group by only two points. There is, however, no significant difference among any of the four groups as indicated by the average total score.
TABLE 1
AVERAGE RATINGS OF COLLEGE GROUPS ON ADMINISTRATIVE ORGANIZATION

<table>
<thead>
<tr>
<th>Areas of Comparison</th>
<th>Public</th>
<th>Liberal Arts</th>
<th>Junior</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Course</td>
<td>2.8</td>
<td>3.0</td>
<td>3.3</td>
<td>3.1</td>
</tr>
<tr>
<td>Integrative Themes</td>
<td>3.0</td>
<td>3.6</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Courses Required for all Students</td>
<td>3.4</td>
<td>3.0</td>
<td>3.7</td>
<td>3.4</td>
</tr>
<tr>
<td>Duration of Course</td>
<td>3.6</td>
<td>3.3</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Course Offered on Freshman or Sophomore Levels</td>
<td>3.7</td>
<td>3.7</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Average Total Scores</td>
<td>17</td>
<td>16</td>
<td>18</td>
<td>17</td>
</tr>
</tbody>
</table>

The average ratings of individual areas of comparison show only minor differences among categories of colleges. Thus, the junior colleges rate highest with respect to the type of general education science courses offered. The liberal arts and junior colleges show a small advantage over others regarding integrative themes underlying their course structure. The public and teachers colleges rank equally on the courses being required for all students, but are not significantly superior to the lowest category. A slight edge is held by junior colleges in this area. Public and teachers colleges ranked equally on the duration of courses,
while no significant difference is noted among these scores and the other two categories. With emphasis on the level at which the courses are offered, the public and liberal arts colleges match, while the junior and teachers colleges match with a very minor edge in rating. Generally speaking, for this area of comparison, all categories are equal.

For clarity of interpretation, it should be pointed out that the junior and teachers college groups contain fewer schools than do the public and liberal arts groups; therefore, the range of representative course characteristics is not as extensive as that of the latter two groups. With average values being used for comparison, this smallness may afford a slight advantage to the junior and teachers college groups. If such an advantage exists, there seems to be no difference worth noting on most items among the four groups on the administrative organization of their programs.

Group comparisons on instructional procedures and policies

The college categories were compared with respect to instructional procedures and policies. The method of comparison was similar to that used for comparison of administrative organization.

The average total scores from the following table show the teachers college groups somewhat superior to the other three groups, while the public and liberal arts groups are
TABLE 2

AVERAGE RATINGS OF COLLEGE GROUPS ON INSTRUCTIONAL PROCEDURES AND POLICIES

<table>
<thead>
<tr>
<th>Areas of Comparison</th>
<th>Public</th>
<th>Liberal Arts</th>
<th>Junior</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision for Student Needs</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Laboratory Experiences</td>
<td>2.9</td>
<td>3.0</td>
<td>2.0</td>
<td>2.9</td>
</tr>
<tr>
<td>Student-Teacher Planning</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Varied Assignments</td>
<td>2.6</td>
<td>3.2</td>
<td>3.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Use of Community Resources</td>
<td>1.0</td>
<td>1.4</td>
<td>1.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Use of Instructors</td>
<td>3.3</td>
<td>2.7</td>
<td>2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Textbooks and Syllabi</td>
<td>3.0</td>
<td>3.1</td>
<td>2.0</td>
<td>3.1</td>
</tr>
<tr>
<td>Instructional Materials</td>
<td>3.0</td>
<td>2.7</td>
<td>3.3</td>
<td>3.0</td>
</tr>
<tr>
<td>Teaching Approaches</td>
<td>3.3</td>
<td>3.0</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Adequacy of Testing Procedures</td>
<td>3.3</td>
<td>3.3</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Average Total Scores</td>
<td>24</td>
<td>25</td>
<td>22</td>
<td>30</td>
</tr>
</tbody>
</table>

substantially equal with the junior colleges having the lowest rating on instructional policies and procedures.

An analysis of individual areas of comparison shows some differences among the groups. The teachers colleges
are superior to all groups in provision for student needs. There is a difference of 1.5 between the teachers colleges and public colleges which rate the lowest in this regard.

Public, liberal arts and teachers colleges rank somewhat equally in provision for laboratory experiences with the junior colleges falling in a lower level. The teachers college group is superior in making provisions for student-teacher planning. There is a difference of 1.6 between the teachers college group and the public college group which ranks lowest. The public and teachers colleges are about equal, and the liberal arts and junior colleges have a similar relationship on provisions for varied assignments. All categories ranked low on use of community resources. This point will be discussed further in the Summary Chapter.

Public and teachers colleges were equally matched on use of instructors; this rating, however, was not significantly superior to the other two categories. On the adequacy of textbooks and syllabi, public, liberal arts, and teachers colleges were about equally ranked, junior colleges having the lowest rating in this respect. For instructional materials, public and teachers colleges were equally ranked in the upper level of ratings. In evaluating teaching approaches, the investigator found that public, liberal arts, and teachers colleges are essentially the same with a slight edge over junior colleges. Testing procedures for all
categories are about evenly matched with no one school group showing a decided advantage over any other.

The group comparisons on the two aspects of the general education biology courses which were evaluated indicate that all college categories are essentially equal.
CHAPTER IV

PRESENTATION OF THE DATA

Initial requests for data were sent to nineteen states and the District of Columbia. Responses were received from institutions located in fifteen states which were rated by four of the six Regional Accreditation Associations. There was a 75 per cent response from institutions by states. The kinds of institutions responding show distribution in size and in type with representation from both large and small colleges, private and public, with many patterns of organization from the junior college to the large university.

Individual courses were not evaluated separately, but were placed in categories based on school types previously established. By using this approach, the investigator derived a composite picture of rating for all courses included in the study. It is the consensus that is important. The results obtained from this approach, in my judgment, would be of greater significance to institutions desiring to make use of it in designing or reorganizing biological science courses for general education.

The courses included in this study were evaluated on the basis of five major sources of information: evaluation of
individual courses by coordinators or teachers of the courses, the opinions expressed by respondents, a student opinionnaire, personal interviews, and college catalogs. Each will be discussed separately.

Enrollment and administrative organization

Questionnaires requesting data concerning biological science courses for general education were received from forty-eight accredited institutions from an eligible group of seventy-seven. The current regular day student enrollments of these forty-eight institutions totaled approximately 131,137 students. A majority of the courses offered (70 per cent) were included in the curricula of the Biology Departments. Twenty-seven per cent were in the Divisions of Natural Science and 3 per cent were in the Departments of Science Education. It was also noted that course titles fell under approximately four general headings: biological science, general biology, natural science, and science survey. All courses were offered on either the freshman or sophomore level. During several personal interviews it was mentioned that some upperclassmen were enrolled in these courses, but the numbers were insignificant, therefore, creating no additional problems regarding levels of instruction. From the data received, it is not possible to indicate specific student categories for which these courses are required or elective. There appears to be, however, three broad groups
into which all students enrolled in the courses fall: All non-science majors, all students, and elective for all students. Some institutions with small enrollments require all students to take a single course which is offered in general biology whereas institutions with large enrollments may offer several alternatives from which student groups can meet science requirements.

Science requirements for non-science majors vary from one institution to another and for different majors within these institutions. From the data received, it was found that biological science courses were used by a majority of the institutions to enable the non-science majors to partially fulfill their total science requirements. Some of these courses were one year in duration; others were either one semester or two-quarter courses. In some cases those courses with a one-year duration were divided into two independent semester courses; in others, the enrollment in the second semester was dependent upon successful completion of the first semester course. One institution required one semester of botany and one semester of zoology, whereas two others had a single biology course available for all students, science and non-science majors alike. It was pointed out during several interviews that the approach used in conducting the course would, in some cases, determine the duration and types of courses being offered.
In comparing courses according to duration, the investigator noted that all courses studied run more than one quarter; three schools spend at least two quarters; seventeen run one semester, and over one-half (28) have a duration of one year. Thirty-six schools are conducting survey types of courses, whereas only seven of them are using the block-and-gap approach.

Table 3 presents tabulated data concerning types and duration of courses under investigation.

<table>
<thead>
<tr>
<th>Duration of Course(s)</th>
<th>Survey</th>
<th>Block and Gap</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Quarter</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 Quarters</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>1 Semester</td>
<td>13</td>
<td>2</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>1 Year</td>
<td>21</td>
<td>4</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>7</td>
<td>5</td>
<td>48</td>
</tr>
</tbody>
</table>

The following comments represent policies concerning course design, types and duration of courses at institutions which have made extensive studies of general education science courses. At Colgate University, it is believed that "the weakness of limited coverage could be diminished if each course were extended to a year in length allowing more
areas of science to be explored."\(^1\) A descriptive statement of the Boston University course reads, "Although designed as an introductory biology program for freshmen without previous science training, the course is taken by prospective non-science and science majors alike."\(^2\) In attempting to decide which student groups should be required to take the course, the University of Louisville made the following decision:

It is clearly recognized in our College that two types of basic instruction in science are necessary to meet student needs, various curricula and instructional requirements. One type includes basic laboratory courses in the different science departments with emphasis upon minute details and laboratory skills which are prerequisites for advanced courses in a department, or as interdivisional courses in the various departments for degrees. The second type consists of introductory courses for non-science majors which are not prerequisites to any advanced courses taken by non-science majors.\(^3\)

Concerning course duration, the following comments are typical.

Antioch has for the most part rejected the kind of course that is usually designated as a "survey" course and is all too frequently characterized by superficiality. So too we have abandoned the illusory objective of "completing" a student's general education by the time of his commencement exercises; rather a "gap and block" design has been conceded.\(^4\)


\(^2\)Ibid., p. 43.

\(^3\)Ibid., p. 160.

\(^4\)Ibid., p. 32.
The coordinator at Harvard writes, "Encyclopedic coverage—the great stumbling block in elementary courses—has been discarded; instead of giving a general (and therefore perhaps shallow) survey, I have elected to spend the time on a more careful study of a number of key topics."\(^5\)

A summary statement from Oregon College seems to register a strong point for general education biology courses:

> It can be science education for the non-scientist at its best once we have overcome the confusion of emphasis on quantity or coverage of the earlier survey type course in favor of quality of fewer select topics with the emphasis on fundamental background and with a historical perspective.\(^6\)

The distribution and types of courses evaluated appear in Table 4.

**A study of course syllabi**

In order to gain a deeper insight into the courses under study, the investigator requested syllabi if such materials had been prepared. Ninety-five per cent of the respondents indicated that course syllabi had been prepared; however, only 41 per cent forwarded these materials to the investigator. It was indicated by two respondents that the descriptive material sent did not represent a true picture of the course organization since the courses were presently

\(^5\) Ibid., p. 124.
\(^6\) Ibid., p. 218.
TABLE 4

DISTRIBUTION OF FORTY-EIGHT SCIENCE COURSES IN COLLEGES AND UNIVERSITIES CLASSIFIED BY ENROLLMENT

<table>
<thead>
<tr>
<th>Type of Course</th>
<th>College-University Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less Than 500</td>
</tr>
<tr>
<td>1. One quarter</td>
<td>0</td>
</tr>
<tr>
<td>a. Survey</td>
<td>0</td>
</tr>
<tr>
<td>b. Block and Gap</td>
<td>0</td>
</tr>
<tr>
<td>c. Other</td>
<td>0</td>
</tr>
<tr>
<td>2. Two Quarters</td>
<td>1</td>
</tr>
<tr>
<td>a. Survey</td>
<td>1</td>
</tr>
<tr>
<td>b. Block and Gap</td>
<td>1</td>
</tr>
<tr>
<td>c. Other</td>
<td>1</td>
</tr>
<tr>
<td>3. One Semester</td>
<td>1</td>
</tr>
<tr>
<td>a. Survey</td>
<td>1</td>
</tr>
<tr>
<td>b. Block and Gap</td>
<td>1</td>
</tr>
<tr>
<td>c. Other</td>
<td>1</td>
</tr>
<tr>
<td>4. One Year</td>
<td>1</td>
</tr>
<tr>
<td>a. Survey</td>
<td>1</td>
</tr>
<tr>
<td>b. Block and Gap</td>
<td>1</td>
</tr>
<tr>
<td>c. Other</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
</tr>
</tbody>
</table>

being reorganized. The syllabi included loose leaf outlines, bound syllabi, reading lists, laboratory outlines, and several teaching aids. These materials proved very valuable by furnishing a check upon the accuracy of some of the information obtained from the questionnaires. Not only were the syllabi used for this purpose, but they also provided valuable sources of additional information concerning the courses.
The following descriptive statements from syllabi studied are significant:

Course 1--An extensive course outline was prepared for each chapter with a bibliography which included book titles, authors, and library call numbers.

Course 2--This syllabus included an extensive list of collateral readings from Scientific American magazine. Readings were listed for each semester and were related to individual topics in the course.

Course 32--It was indicated in this syllabus that ten-minute quizzes could be expected during any lecture period. These quizzes were given in addition to the regularly scheduled tests. All additional reading assignments were taken from the list of Suggested Readings at the end of each chapter in the text.

Course 60--Films related to topics covered in the course were listed by dates. A special period, other than class time, was used weekly for the showing of films only.

Course 42--An assembly was held for the first class meeting to introduce the staff and give an orientation lecture regarding the course. Topical outlines were passed out indicating which staff members would be responsible for the various topics to be covered. This was a staff-run course in which persons from the various science disciplines covered areas of the course in which they had a high degree of competence.

Course 67--The following outline included in one course syllabus would seem to be an excellent means of keeping the students apprised of their progress during the tenure of the course.
### Key to Determination of Letter Grades

<table>
<thead>
<tr>
<th>Examination</th>
<th>Maximum Score</th>
<th>Mid-Semester Averages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number 1</td>
<td>60</td>
<td>216-240 ............ A</td>
</tr>
<tr>
<td>Number 2</td>
<td>60</td>
<td>192-215 ............ B</td>
</tr>
<tr>
<td>Mid-Semester Lab</td>
<td>60</td>
<td>168-191 ............ C</td>
</tr>
<tr>
<td>Mid-Semester Lec</td>
<td>60</td>
<td>144-167 ............ D</td>
</tr>
<tr>
<td><strong>Total Points Mid-Semester</strong></td>
<td><strong>240</strong></td>
<td>Below 144 ........... F</td>
</tr>
<tr>
<td>Number 4</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Number 5</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Final Lab</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Final Lec</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Total Points</strong></td>
<td><strong>280</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### Mid-Semester Averages
- 216-240 ............ A
- 192-215 ............ B
- 168-191 ............ C
- 144-167 ............ D
- Below 144 ........... F

#### Final Averages on Grades
- 468-520 ............ A
- 416-467 ............ B
- 364-415 ............ C
- 312-263 ............ D
- Below 312 ........... F

---

**Course 55**—Teaching approaches: Since survey courses run the risk of becoming mere verbal chit-chat, or worst still, dry verbalism, the student can expect an unannounced round of variations, from a stereotyped classroom atmosphere, as taught by the entire Biology Department staff: visual aids in various forms apropos to topic discussions, new information gleaned since the publication of the textbook, question and answer periods, class discussions, demonstrations, probably some outside readings (though limited), and frequent tests.

---

**Course 33**—The following comment was included in the Foreword of a course syllabus and seems indicative of a basic understanding of the philosophy of general education. "It is believed that this course will make it possible for the student to be able to interpret more intelligently and evaluate biologic information as encountered in newspapers, radio, television, magazines, and other communication media."
As indicated previously, the total of the enrollments of the schools responding to the questionnaire was approximately 131,137 students. The total of the enrollment in the biological science courses offered for general education for the academic year 1966-67 was 12,365 students, or about 9 per cent of the total student population. According to sex, the classes were approximately 40 per cent female and 60 per cent male; these percentages are applicable to co-educational institutions. Relating the number of students enrolled in the course during the academic year 1966-67 to the total college enrollment for the individual schools, the investigator found that there was a high of 55 per cent and a low of 6 per cent of the students involved in these courses.

The number of students enrolled composing lecture groups varied from 220 to 10. Discussion groups were required in some schools, but not in others; the number of students involved in these groups coincided closely with the number in the related lecture sections. Seventy-eight per cent of the courses had associated laboratory sections and/or lecture demonstrations. Twenty-two per cent of the courses offered no laboratory. Table 5 presents the tabulated data concerning class size.

All respondents did not furnish data for each of the class size categories, but rather gave a single response representative of their actual situation. For the number of students in a lecture section, the greatest frequency for
### TABLE 5

**SIZE OF CLASSES**

<table>
<thead>
<tr>
<th>Number of Students in a Lecture Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
</tr>
<tr>
<td>Size</td>
</tr>
<tr>
<td>Smallest</td>
</tr>
<tr>
<td>Average</td>
</tr>
<tr>
<td>Largest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Students in a Discussion or Quiz Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
</tr>
<tr>
<td>Size</td>
</tr>
<tr>
<td>Smallest</td>
</tr>
<tr>
<td>Average</td>
</tr>
<tr>
<td>Largest</td>
</tr>
</tbody>
</table>
### TABLE 5 (Contd.)

**Number of Students in a Laboratory Section**

<table>
<thead>
<tr>
<th>Size</th>
<th>Frequency</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-5</td>
<td>6-10</td>
</tr>
<tr>
<td>Smallest</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Average</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Largest</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Number of Students in a Laboratory Team**

<table>
<thead>
<tr>
<th>Size</th>
<th>Frequency</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Smallest</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Largest</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Mean
the smallest class falls in the range of 21-40 students, for
the largest class the greatest frequency is in the 41-60
student range. The mean for all categories was obtained from
raw scores representing the number of responses to a given
item. The mean for the largest class was ninety-four students.
This would be expected since lecture technique is used most
often in general education courses.

Data concerning discussion or quiz groups indicate
forty-five students as representing the mean for the largest
group. For quiz purposes, this number would present no
problems provided adequate space is available. For class
discussions, however, a group of forty-five students would
not permit this teaching technique to be used effectively, for
there would be little opportunity for verbal exchanges between
the instructor and an appreciable number of students.

It may be seen from Table 5 that the upper limits for
numbers of students in laboratory sections are in the 41-50
range. This would represent an undesirable number for effec-
tive laboratory instruction. Only four schools, however,
are in this range.

The number of classes in the average smallest groups
seems to bunch between the 16-35 range, which may be consid-
ered acceptable provided space, facilities and materials are
adequate.

With only four schools reporting laboratory teams
consisting of six or more students, the bulk of responses
indicates that laboratory teams fall within the range of 2-5 students, which would constitute effective working groups.

Although most general courses in science seem to have fairly large enrollments, especially in lecture sections, the consensus of the majority of the instructors involved seemed to be expressed by a statement made concerning the program at Antioch College. At Antioch College, preference for small classes and various teaching styles are shown because it is believed that "presumably a course has greater vitality if in design and conduct it is the creation of the individual teacher."  

Questionnaire returns of four respondents indicated that the general education biology courses were currently being organized, and much of the data requested by the investigator was not available. These returns were considered incomplete and were not tabulated with other data received. Table 6 presents data regarding the time periods general education biology courses have been offered in the various institutions.

Fifty per cent of the schools as indicated have had courses in operation more than ten years, and about 74 per cent more than five years. It could be assumed then that most of the schools would now have courses which are well organized provided there have been continuous reorganization, when needed, and study based on current trends.

---

TABLE 6

LENGTH OF TIME BIOLOGICAL SCIENCE COURSES OFFERED FOR GENERAL EDUCATION HAVE BEEN IN EXISTENCE IN VARIOUS INSTITUTIONS

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 Years</td>
<td>13 - 26%</td>
</tr>
<tr>
<td>Between 5 - 10 Years</td>
<td>11 - 24%</td>
</tr>
<tr>
<td>More than 10 Years</td>
<td>24 - 50%</td>
</tr>
</tbody>
</table>

It is generally agreed that the main differences between the basic biology courses taught for science majors as opposed to those designed for non-science majors are the selection of course content and the approach used. Table 7 indicates the teaching approaches used in the general education biology course. The respondents were asked to check more than one approach where applicable. Nine per cent of the respondents indicated that the basis for the adoption of the methods checked was determined by administrative recommendation; thirty-nine per cent made their selections on instructor preference based upon personal opinion and study; forty-three per cent checked instructor preferences based upon personal experience and research, and nine per cent listed other, but made no specific statements.

It would seem significant to note in Table 7 that 58 per cent of the instructors indicated subject matter survey as an approach used, whereas 51 per cent used an integrated
### TABLE 7

**TEACHING APPROACHES USED IN THE COURSES**

<table>
<thead>
<tr>
<th>Approach</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Units</td>
<td>33</td>
</tr>
<tr>
<td>Subject Matter Survey</td>
<td>58</td>
</tr>
<tr>
<td>Study of Selected Problems</td>
<td>0</td>
</tr>
<tr>
<td>Historical Approach</td>
<td>15</td>
</tr>
<tr>
<td>Current Periodical Materials</td>
<td>25</td>
</tr>
<tr>
<td>Taught as Integrated Science Course</td>
<td>51</td>
</tr>
<tr>
<td>Combination of Above</td>
<td>18</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
</tr>
</tbody>
</table>

Science approach. No respondents utilized the selected problems approach. A concern for the proper approach to be used in general science courses is evidenced by a statement from Stockton College. It reads:

> Once the three-unit course had been decided upon the question then arose as to the best approach for such a course. . . . As we understand it such an approach emphasizes a few basic principles in sufficient detail to provide an understanding of the way in which scientific knowledge evolves.  

An average of three to four semester hours credit was given by most colleges for the course. Forty-one per cent allowed this credit as a minimum science requirement for non-science majors; 4 per cent allowed three credits as an elective for non-science majors only; 14 per cent of them allowed these credits as an elective for any students, and 41 per cent required these credits for graduation for non-science majors.

---

The teaching loads of instructors involved in the courses were areas of concern. Table 8 gives the tabulated data from respondents.

**TABLE 8**

THE TEACHING LOAD OF INSTRUCTORS INVOLVED IN GENERAL EDUCATION BIOLOGICAL SCIENCE COURSES

<table>
<thead>
<tr>
<th>Sections</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Instructors Teaching Various Sections</td>
<td>20</td>
<td>17</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Clock Hours Per Week

<table>
<thead>
<tr>
<th>Hours</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>27</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Laboratory</td>
<td>7</td>
<td>4</td>
<td>27</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

It should be understood that the responses represent the respondents' involvement in the courses. Of the forty-eight responses received, twenty instructors were responsible for only one lecture section; seventeen taught two sections with an average of two lecture sections for the total group. No instructors were responsible for more than four lecture sections. Clock hours devoted to lecture per week were bunched between one and four hours; only three persons lectured more than four clock hours per week with an average of three. For the laboratory, seven respondents indicated no laboratory responsibilities. Laboratory hours
were bunched between one and four for all respondents, with an average of two clock hours per week.

One hundred and forty-seven persons were involved in some instructional aspect of the forty-eight courses studied. Of this total, 64 per cent worked full time with the course, whereas 36 per cent worked part time. Those instructors working part time usually had additional teaching responsibilities for upper level courses; the number engaged in research was negligible.

Additional lecture hours for part-time instructors are bunched between 0-11 clock hours per week, with only four persons carrying from 12 - 20 additional clock hours per week. Additional laboratory hours per week are bunched between 0-14 with only one person being responsible for 15-17 hours. It was stated by many respondents that a major portion of the laboratory responsibilities listed was supervisory in nature. Table 9 points out the additional instructional responsibilities of respondents other than those concerned with general education biological science.

Instructional procedures and policies

The selection of a text, if used, for a general education biological science course would take into consideration the backgrounds of the students involved as well as other factors. Therefore, a request was made of respondents to list the titles, authors, and publishers of the texts used in
TABLE 9
ADDITIONAL INSTRUCTIONAL RESPONSIBILITIES OF RESPONDENTS
TEACHING LECTURE AND/OR LABORATORY SECTIONS OF
GENERAL EDUCATION BIOLOGICAL SCIENCE

<table>
<thead>
<tr>
<th>Persons Involved</th>
<th>Hours Per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2</td>
</tr>
<tr>
<td>Number of Instructors Involved in Lectures</td>
<td>10</td>
</tr>
<tr>
<td>Number of Instructors Involved in Laboratory</td>
<td>8</td>
</tr>
</tbody>
</table>

the course along with principal supplementary readings assigned during the course. Texts and supplementary readings are found in Appendix G. Table 10 summarizes the tabulated data concerning the use of textbooks in the courses.

TABLE 10
INSTRUCTIONAL MATERIALS USED IN THE COURSES

<table>
<thead>
<tr>
<th>Use of Textbooks</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Text Only</td>
<td>25</td>
</tr>
<tr>
<td>One Recommended Text Along with Other References</td>
<td>72</td>
</tr>
<tr>
<td>No one designated Text but Through Reference Books and Materials</td>
<td>3</td>
</tr>
</tbody>
</table>

All courses studied had regularly-scheduled lecture sessions. Responses from 22 per cent of the colleges which did not have associated laboratory sections indicated that the lecture-demonstration method was frequently used to com-
pensate for a lack of laboratory experiences. Tables 11 and 12 represent the overall relationship between lecture and laboratory based on responses received.

**TABLE 11**

**LABORATORY EXPERIENCES ASSOCIATED WITH COURSES**

<table>
<thead>
<tr>
<th>Laboratory Work Is:</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Required</td>
<td>22</td>
</tr>
<tr>
<td>On a Regular Work Schedule</td>
<td>67</td>
</tr>
<tr>
<td>Provided as Needed at the Direction of the Instructor</td>
<td>7</td>
</tr>
<tr>
<td>Provided as Need Arises Through Student Problems or Initiative</td>
<td>4</td>
</tr>
</tbody>
</table>

**TABLE 12**

**THE MANNER IN WHICH LABORATORY EXPERIENCES WERE CONDUCTED**

<table>
<thead>
<tr>
<th>Performance of Laboratory Work</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Basis</td>
<td>32</td>
</tr>
<tr>
<td>Pairs or Groups of Students</td>
<td>46</td>
</tr>
<tr>
<td>Demonstrations by Instructor or Students</td>
<td>22</td>
</tr>
</tbody>
</table>

Several institutions which have had considerable experience with general education science courses over a long period of time have statements in their course descriptions concerning the laboratory which seem significant. At Colgate University, it is believed, "The very limited use of
laboratory has been criticized by a number of teachers, particularly in the biological science courses. They feel that direct observation of materials keeps the student from letting his mental constructs wander too far from reality."  

A Northwestern University coordinator thinks, "The laboratory is an important part of the course and the experiments are chosen with the idea of giving the students experimental contact with the theories discussed in the course."  

At Western Michigan University, the course description reads:

This course attempts to set forth a related series of areas and units, in which teachers and students may find problems which are sufficiently challenging to be worthy of exploration. These are set forth with the idea that the laboratory experiences rather than the textual readings will constitute the heart of the course. The readings are related to the laboratory experiences rather than the opposite.  

Finally, a statement from the University of Florida reads:

A laboratory period has never been a part of biological sciences course per se. From the beginning there has always been a division of opinion as to whether there should not be a laboratory. This problem has been thoroughly studied and discussed by the staff. Assuming that practical difficulties (time, space and funds) could be mastered, it seems to be the prevailing opinion today that laboratory experience might well be a legitimate part of general education and would tend to strengthen and augment the goals of the biological sciences in this area. To be effective, however, such laboratory experiences would need to be very different from those given in the regular first year biology courses.

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9 Ibid., p. 92.  
10 Ibid., p. 215.  
11 Ibid., p. 250.
The dissection of earthworms and the superficial anatomy of the starfish would not suffice. No published laboratory manuals would be satisfactory.\textsuperscript{12}

Audio-visual materials were used by instructors in nearly all courses. One respondent, Coordinator of Course 23, made the comment that he had strong doubts about the effectiveness of the audio-visual teaching methods.

Only 15 per cent of the forty-eight schools indicated limited use of audio-visual materials. They gave the following reasons for this limited use: a lack of funds, a lack of time and facilities, and materials not readily available. Regarding the use of available materials from industrial firms, 25 per cent of the respondents stated that they were never used; 37 per cent made use of these materials regularly, and 38 per cent considered these materials of little value. As a part of the regularly-scheduled class work, individual or group projects were not required in 55 per cent of the courses; in 22 per cent of the courses such projects were required, whereas 23 per cent considered this type of activity as being optional. For out-of-class related activities, such as field trips, 40 per cent of the courses do not include field trips as a part of their course activities. Of the courses which use field trips as class related activities, 20 per cent make at least one trip per term, 29 per cent at

\textsuperscript{12}Ibid., p. 120.
least twice per term, and 11 per cent three or more field
trips per term. Table 13 shows the frequency of some audio-
visual devices used for instructional purposes in the courses.

TABLE 13

AUDIO-VISUAL MATERIALS USED FOR INSTRUCTIONAL PURPOSES

<table>
<thead>
<tr>
<th>Audio-Visual Materials</th>
<th>Frequency of Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Sound Motion Pictures</td>
<td>40%</td>
</tr>
<tr>
<td>Silent Motion Pictures</td>
<td>0</td>
</tr>
<tr>
<td>Film Strips</td>
<td>8</td>
</tr>
<tr>
<td>Slides</td>
<td>15</td>
</tr>
<tr>
<td>Opaque Projector</td>
<td>6</td>
</tr>
<tr>
<td>Radio</td>
<td>0</td>
</tr>
<tr>
<td>Television</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
</tr>
</tbody>
</table>

The overall purpose of a course, its aims and objectives are of primary concern in the conduct of a course as well as in the selection of course content. A list of course objectives based upon those suggested by the 46th Yearbook Committee was included in the questionnaire sent to prospective respondents. The objectives were checked in order of importance based on the judgments of individual respondents. They were as follows:

1. To understand the important scientific laws, principles, and theories.
2. To make accurate observations.
* To appreciate the contributions of science to civilization.
* To understand scientific procedures.

3. To understand cause and effect relationships.

4. To be willing to change opinion when justified by ample evidence.

5. To attain factual information.

6. To appreciate the possible future development of science.

7. To be able to form workable hypotheses.
* To be able to distinguish between fact and theory.

8. To be free from superstition.

9. To understand the characteristics of scientists.

Course objectives other than those listed were requested from respondents. Data taken from the questionnaires, college catalogs, and course syllabi resulted in the following list of additional objectives:

1. To develop an appreciation for biological science in daily life.

2. To give students an understanding of the concepts of biology by using the molecule as the basic physiological and morphological unit for discussion.

3. To bring to the student a comprehensive survey of the biological sciences and point out his place as a human being in the natural scheme of the world and its existence.

* Equal emphasis placed on objectives.
4. To show, explain, compare, illustrate, and emphasize biological discoveries and their applications to modern life; facts, rather than superstitions, prejudices and biases; the importance of relying upon established truth; the proper order for the student's own life; scientific approaches, attitudes, and procedures; generalizations and understanding in biological sciences so as to influence significantly the beliefs, philosophies, behavior patterns, and attitudes of the citizens and those they may influence, as teachers, parents or both.

5. To give to students a basic idea of the subject matter of biology and its applications to modern living and to expose students to various functions, ecology, and systematics of different plant and animal forms, with most emphasis placed on human biology.

6. To present a survey of biological science in which the major principles are presented with an approach which is molecularly oriented.

7. To acquaint the student with certain specific functions or activities of the living organism with emphasis upon the animal body, using man as a prototype.

8. To acquaint the student with some of the fundamental biologic principles related to heredity and evolution.

9. To acquaint the student with concepts of biology which are applicable to all living organisms; to help the student become "scientifically literate"; to acquaint the student with the way in which the scientist approaches and solves problems.

10. To prepare students for analytical biological thinking.

11. To understand the nature and structure of the living substance.

12. To understand the molecular basis of life.

13. To impart to the student academic discipline through the study of a science, to provide a broad fundamental knowledge of biology, and to acquaint the student with the features of the organic world to include a study of representatives of the major
phylla, with no intention of specializing in any branch of biology.

14. To instill in the student a knowledge of and respect for scientific authority and method.

15. To give the student an understanding of human biology and man's relation to other organisms and to his environment.

16. To furnish the student with a large body of facts fundamental to a proper interpretation of the important principles and problems of biology.

17. To make the student aware of important biological principles and problems, to demonstrate the relationship of biology to other sciences and other areas of endeavors, and to acquaint him with various social, economic, and scientific problems which may depend on a knowledge of biology for some aspect of their solution.

18. To aid the student in formulating a personal philosophy with the hope that he will become a better and more useful citizen.

19. To introduce the student to the concepts of the living world and to cope with a growing body of scientific knowledge.

20. To help the student understand and appreciate the nature of science of the twentieth century.

21. To help the student gain in power to realize and to comprehend the facts that man has evolved from other beings and that he is continually evolving into something higher.

22. To have the student make some gain in appreciating what man is doing to adapt himself to his environment so that he may continue to exist and to reproduce his kind.

In regards to the objectives listed above, reference should be made once again to the statement of Dressel and Lorimer, included in the review of the literature concerning catalog statements of educational objectives.
Respondents were asked to check certain instructional and evaluative procedures which were listed in the questionnaire. More than one answer could be checked if appropriate. Of the eighty responses concerning short quizzes, two respondents indicated that they were never used; twenty-one used short quizzes once or twice per week; twenty-one respondents announced such quizzes in advance; three instructors used short quizzes for evaluative purposes only; one person used such quizzes for teaching devices only, and thirty-two respondents stated that they were used for both teaching and evaluative devices. Table 14 lists the types and frequencies of major tests given in the courses.

TABLE 14
FREQUENCY AND TYPES OF TESTS GIVEN IN GENERAL EDUCATION BIOLOGICAL SCIENCE COURSES

<table>
<thead>
<tr>
<th>Major Test(s) Are:</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given Once Per Term</td>
<td>11</td>
</tr>
<tr>
<td>Given Twice Per Term</td>
<td>33</td>
</tr>
<tr>
<td>Given More Than Twice Per Term</td>
<td>56</td>
</tr>
<tr>
<td>Primarily Objective</td>
<td>63</td>
</tr>
<tr>
<td>Primarily Subjective</td>
<td>0</td>
</tr>
<tr>
<td>Combination of Objective and Subjective</td>
<td>37</td>
</tr>
</tbody>
</table>

In regards to major tests given in the courses, 52 per cent of the respondents returned such tests to the students for discussion and as further study guides; 34 per cent
returned major tests for review purposes and re-collected them, whereas 14 per cent did not return major tests to students. When good major tests were developed, approximately three-fourths of the respondents reused such tests with minor revisions; one-fourth indicated that major tests were never reused. The weighing of scores on tests, daily work, and laboratory for grading purposes resulted in the following responses: 25 per cent of the respondents based their scores on a fixed formula; 49 per cent used a flexible formula, whereas 26 per cent based scores purely upon the judgment of the instructor. A majority of the instructors (92 per cent) compared their course grades to the normal curve for reference only, departing from it at their discretion. Additional comments concerning instructional and evaluative procedures will be commented on in the Summary Chapter.

Instructional procedures used in classes usually fall into several broad categories: lecture, discussion, recitation, testing, and others. It may be noted from the data that none of the instructors spent less than 20 per cent of a class period for lecturing, with the largest number using from 50-69 per cent of a class period for lecture purposes. For classroom discussion, more than 90 per cent of the instructors utilized from 0-39 per cent of a class period; recitations were restricted to the 0-29 per cent range along with testing. The "other" category shows a scattering of responses with a concentration in the 0-9 per cent range.
Such activities as laboratory exercises, field trips and instructor demonstrations were included in this area. Table 15 lists the frequencies of responses received for each category.

**TABLE 15**

**DISTRIBUTION OF APPROXIMATE PERCENTAGE OF CLASS TIME DEVOTED TO INSTRUCTIONAL PROCEDURES**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>0-9</th>
<th>10-19</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
<th>70-79</th>
<th>80-89</th>
<th>90-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>9</td>
<td>10</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Discussion</td>
<td>16</td>
<td>17</td>
<td>12</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Recitation</td>
<td>32</td>
<td>13</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Testing</td>
<td>25</td>
<td>20</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>25</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Instructional personnel, Qualifications, opinions**

Obtaining qualified and interested staff members to conduct general courses in institutions of higher learning has posed problems for administrative officials. The unique qualifications for teaching the general education type of course are not obtained from the usual graduate school training. Both breadth and depth in many related areas and
a basic understanding of the philosophy of general education are needed in order for an instructor to function effectively in such courses. Table 16 lists 147 instructors associated with the forty-eight courses under investigation, their status and degrees.

**TABLE 16**

THE NUMBER OF FULL-TIME AND PART-TIME INSTRUCTORS TEACHING BIOLOGICAL SCIENCE FOR GENERAL EDUCATION PURPOSES, THEIR RANKS AND DEGREES ATTAINED

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Rank</th>
<th>Assoc.</th>
<th>Prof.</th>
<th>Ass't</th>
<th>Prof.</th>
<th>Instr.</th>
<th>Ass't</th>
<th>Instr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>17</td>
<td>19</td>
<td>21</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-Time</td>
<td></td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>20</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree Attained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctorate</td>
<td></td>
<td>28</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masters</td>
<td></td>
<td>7</td>
<td>19</td>
<td>25</td>
<td>36</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelors</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In staffing general education science courses, specialists from the many scientific disciplines must be utilized. Four areas of specialization were listed in the questionnaire sent to prospective respondents on which they were to list the areas of competence of staff members involved in the instructional phases of their courses. Table 17 presents tabulated results from this questionnaire item.
### TABLE 17

**INSTRUCTORS FROM AREAS OF SPECIALIZATION RESPONSIBLE FOR INSTRUCTIONS IN GENERAL EDUCATION BIOLOGICAL SCIENCE COURSES**

<table>
<thead>
<tr>
<th>Areas of Specialization</th>
<th>Number of Instructors</th>
<th>Percentages of Instructors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td>39</td>
<td>27</td>
</tr>
<tr>
<td>Zoology</td>
<td>40</td>
<td>27</td>
</tr>
<tr>
<td>Human Biology</td>
<td>27</td>
<td>18</td>
</tr>
<tr>
<td>Science Education</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td>Other Areas</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>147</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td><strong>Employed Specifically to Teach Courses</strong></td>
<td><strong>75</strong></td>
<td><strong>51</strong></td>
</tr>
</tbody>
</table>

Of the 147 persons involved in instructional phases of the courses, 51 per cent were employed specifically to teach the courses. Instructors in the areas of botany and zoology were about equal in numbers, with 18 per cent in human biology and 14 per cent in science education. Fourteen per cent of the instructors were from other areas, such as chemistry, geology, and agriculture. It is apparent, therefore, that specialists are employed in large numbers to instruct general education biology courses. It was reported that during the tenure of the course, the student had contact with one to two instructors involved in the courses. About two-thirds of the respondents reported student contact with only one instructor. When several persons were responsible for
instruction in the courses, 63 per cent of the schools reporting held regular staff meetings to evaluate the progress of the course, whereas 37 per cent held no such meetings.

In tabulating data concerning the professional experience of instructors involved in the courses, the investigator determined that 76 per cent of them had had teaching experience on the college level only, whereas 26 per cent had worked in secondary schools previously. Four instructors had had experience in industry, one in government service, three in research, one in dentistry, and one in journalism.

The following statements concerning instructional personnel, qualifications, and opinions found in the course descriptions of several colleges are worth repeating in order to place the foregoing data in the proper perspective. A descriptive statement in the write-up of the general education biology course at Western Washington College lists the strengths and weaknesses involved in the role of the teacher. It reads:

His insight and attitude toward the function of science courses for general education purposes. His willingness, ability and capacity to effect creativeness in teaching. His capacity to adapt specialized training in subject matter fields to the purposes of general education objectives.13

Colgate University states:

Staff for these courses is drawn from the regular science departments with occasional assistance from a man in some other area who had adequate

13Ibid., p. 269.
background. Each instructor carries his section throughout the entire semester, a policy which may be hard on the instructor at first, but essential, we believe, for good teacher-student relations and for effective teaching.14

The University of Florida believes that:

If general education is a body of knowledge that every educated person should know, it is hardly defensible to divide it up and allow selection. There is also a strong tendency for a divided general education course to degenerate into a number of specialized courses, each reflecting the particular training of the specialist in charge.15

Opinions of respondents

In categorizing the respondents, the investigator found that 73 per cent were coordinators of the courses, whereas 27 per cent of the courses were coordinated by persons other than the respondents. According to positions held by the respondents, 56 per cent were Chairmen of Departments; 11 per cent were full professors; 8 per cent were associate professors; 11 per cent were assistant professors, and 14 per cent were instructors. It was determined from answers to another item in the questionnaire that these persons have had considerable teaching experience and their proximity to the courses under investigation permitted them to speak with authority. The respondents were asked to state any particular opinions they had concerning the course. The following statements of opinions represent some individual viewpoints.

1. There is a need for two two-hour laboratory periods

---

14 Ibid., p. 74.
15 Ibid., p. 109.
rather than one, a self-written laboratory manual, and a closer liaison between laboratory and lecture.

2. Only the best instructors should teach the general biology course.

3. The course seems to be well organized and could be a much stronger course if more than one teacher were involved in the lecturing.

4. The course should be restructured around some significant theme or themes relating to living systems.

5. The molecular approach is considered essential today and students respond as well or better when the course is taught on a conceptual basis rather than from a "factual" approach.

6. The course should cover more biological principles (genetics, evolution, ecology) and less human biology.

7. The course needs updating and more integrating.

8. The course is given to enrich the students who come from impoverished scientific backgrounds.

9. The course is extensive; therefore, it should be required for non-science majors.

10. The instructors should have a greater awareness of a philosophy of general education.

11. For the next term, the first semester's work will be a Principles Course, and the second semester's course will be a Survey of the Plant and Animal Kingdoms.

12. One semester is too short a period for a biological survey course; at least one year is needed.

The opinions given were generally constructive. It was not suggested in any instance that such courses had little worth and should be abandoned. Certain needs for improvement were pointed out, such as updating content and approach and including and stressing broad underlying themes in the
courses. It is believed that science majors, as well as non-science majors, might benefit from such general courses. There was a concern also for the type of instructors teaching such courses, and it was the belief that each instructor should be grounded in the philosophy of general education.

Special problems associated with courses

The respondents were also asked if there were any special problems associated with the course. The following statements seem to represent the main areas of concern.

1. Basic biological terminology seems difficult and unfamiliar to students. There is also a lack of interest on the part of a majority of the students.

2. There are too many students, too few instructors, especially in laboratory sections.

3. Coordinating and scheduling of laboratory experiments to coincide with lectures create problems of securing and maintaining laboratory materials.

4. A large number of students in one class is difficult to handle and limits the types of tests which may be utilized. Most tests are of the multiple choice type. One instructor is responsible for teaching both biological and physical science classes.

5. Students in a given lecture section are placed in laboratory sections conducted by the same instructor, which is a desirable arrangement, but not always possible.

6. Each instructor is free to develop the course as he sees fit; therefore, considerable variations exist from section to section. There are five full-time instructors teaching sections of the general course.

7. There is a lack of general agreement on course content and common examinations.
8. The student's grasp of scientific terminology and basic scientific training is inadequate. There are insufficient laboratory materials and space.

9. A lack of the integration of course content obviates a meaningful course sequence.

10. The course has been recently introduced and cuts across program scheduling of the college. Classrooms, facilities and equipment are still not adequate.

11. A poor background in communication obviously is a major student deficiency.

12. There is a need for an understanding of basic chemistry prior to enrolling in biological science.

13. Students are grouped into sections on the basis of entrance examinations. This ability grouping creates problems in the conduct of the course.

14. An attempt is made to find a method for determining the subject matter content to include in the course and to develop meaningful laboratory experiences.

15. Implementing the first semester course with appropriate laboratory experiences has not been satisfactory.

16. There is a problem of getting teachers to prepare themselves for conducting the course as proposed.

17. Not enough time is devoted to field trips.

Coordinators and other instructors involved in the courses seemed very willing and eager to state what they considered as problems associated with their courses. Several of them pointed out that they found it difficult to communicate effectively with the students because of their limited backgrounds in science. Also, laboratory sections were often too large, and there was a lack of equipment and materials to handle large numbers of students. Although it is desirable to coordinate lecture topics with laboratory experiences,
this proved difficult to accomplish. Attempts were made to place the students with the same instructor in both lecture and laboratory sections. This arrangement when possible proved effective.

When several instructors were involved in the course, obtaining a consensus on the selection of content and on the need or desirability of common examinations seemed to be points of contention. Although broad guide lines were established for some courses, individual instructors were free to use various approaches in their individual classes. The large number of students enrolled in these courses seemed to restrict the types of tests given. Most tests were of the multiple-choice type; essay-type tests were infrequently given. Topics covered in the course were not properly integrated, especially when no underlying theme permeated the course. A basic knowledge of chemistry seemed essential if certain topics were to be adequately covered.

Ability grouping, based on entrance scores, proved effective in some cases and ineffective in others. An overall lack of interest in science seemed to be a detrimental factor related to the conduct of the courses.

As courses evolve, changes are frequently made to bring them in line with the originally established purposes or to update them based on current knowledge. A list of trends related to the evolution of biological science courses offered for general education was included in the questionnaire.
sent prospective respondents. Responses as to whether these
trends had already developed or whether further development
was contemplated appear in Table 18.

**TABLE 18**

**COURSE TRENDS AS INDICATED BY RESPONDENTS**

<table>
<thead>
<tr>
<th>Course Trends</th>
<th>Already Developed</th>
<th>Contemplated Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. More Individual Laboratory Work</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>2. A Trend Toward the &quot;Block and Gap&quot; Type Course—Fewer Topics, More Intensity</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>3. More Emphasis upon Understanding of Broad Principles and Concepts</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>4. Larger Enrollments Percentage-Wise in Science Courses for General Education</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>5. Marked Improvement in Available Audio-Visual Materials</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>6. More Use of Instructor or Group Demonstrations</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>7. More Student Participation in Selection of Course Content</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>8. Closer Integration of Physical and Biological Sciences</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>9. More Use of Audio-Visual Aids</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>10. Alteration of Traditional Courses in an Effort to Meet the Needs of Both the Transfer and the General Student</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>
TABLE 18 (Contd.)

<table>
<thead>
<tr>
<th>Course Trends</th>
<th>Already Developed</th>
<th>Contemplated Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. A Trend Toward the Broad Survey Type—More Topics, Less Intensity</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>12. More Emphasis upon Acquisition of Facts</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>13. Lower Proportion of Student Body Enrollment in Such Science Courses</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>14. More Segregation of Physical and Biological Sciences</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>15. Less Individual Laboratory Work</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>16. Less Student Participation in Selection of Course Content</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>17. Other</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

A cursory review of the above responses indicates that there is a trend toward more individual laboratory work; the block and gap is the most desirable type of course; there is more use of instructor or group demonstrations; there is more student participation in the selection of course content, and traditional courses are being altered to meet the needs of both general and transfer students. As for contemplated further trends, more emphasis will be placed upon broad concepts and principles; there will be closer integration of the physical and biological sciences; more use will be made of audio-visual aids, and there is a trend toward the broad
survey type of course. Additional comments concerning the above responses will be made in the Summary Chapter.

Course content

The selection of course content, when more than one instructor was involved in the conduct of the courses, seems to be a point of contention. Table 19 points out the basis upon which the subject matter for the courses was selected based on responses received.

<table>
<thead>
<tr>
<th>Basis</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook</td>
<td>45</td>
</tr>
<tr>
<td>Instructor's Opinion of Students' Needs</td>
<td>40</td>
</tr>
<tr>
<td>Special Study Conducted</td>
<td>15</td>
</tr>
</tbody>
</table>

The determination of the topics that should be included in a course in an area in which there is a wealth of information available and a time limitation placed on the course continues to be a problem for curriculum designers. It has been stated in the Introduction that the methodology involved in reaching stated objectives and determining content for a course constitutes two of the most pressing problems of general education.
Included in the questionnaire sent to participating institutions was a listing of topics which may be covered in general biology courses. The respondents were asked to check the degree of emphasis (major, moderate, slight) placed on these topics. The checks on all returns were tabulated, and the results appear in Tables 20 and 21.

**TABLE 20**

**TOPICS GIVEN MAJOR EMPHASIS IN COURSES IN GENERAL EDUCATION BIOLOGICAL SCIENCE IN ORDER OF FREQUENCY**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Genetics</td>
</tr>
<tr>
<td></td>
<td>*Photosynthesis and Carbon Compounds</td>
</tr>
<tr>
<td>2.</td>
<td>Mitosis and Meiosis</td>
</tr>
<tr>
<td>3.</td>
<td>Cells and Tissues</td>
</tr>
<tr>
<td></td>
<td>*Digestion</td>
</tr>
<tr>
<td></td>
<td>*Reproduction</td>
</tr>
<tr>
<td>4.</td>
<td>Evolution</td>
</tr>
<tr>
<td></td>
<td>*Ecology</td>
</tr>
<tr>
<td>5.</td>
<td>Respiration</td>
</tr>
<tr>
<td>6.</td>
<td>Circulation</td>
</tr>
<tr>
<td>7.</td>
<td>Science of Biology</td>
</tr>
<tr>
<td></td>
<td>*Plant and Animal Development</td>
</tr>
<tr>
<td></td>
<td>*The Vertebrates</td>
</tr>
<tr>
<td>8.</td>
<td>Principles of Chemistry</td>
</tr>
<tr>
<td>9.</td>
<td>Roots, Stems and Leaves</td>
</tr>
<tr>
<td>10.</td>
<td>Nervous Coordination</td>
</tr>
<tr>
<td></td>
<td>*The Senses</td>
</tr>
<tr>
<td></td>
<td>*The Seed Plants--Angiosperms</td>
</tr>
<tr>
<td></td>
<td>*Health and Diseases</td>
</tr>
<tr>
<td>11.</td>
<td>Flowers, Fruits and Seeds</td>
</tr>
<tr>
<td></td>
<td>*Chemical Coordination in Plants</td>
</tr>
<tr>
<td></td>
<td>*Microorganisms--Organization, Function</td>
</tr>
<tr>
<td></td>
<td>*Algae and Fungi</td>
</tr>
<tr>
<td></td>
<td>*Mosses and Liverworts</td>
</tr>
<tr>
<td></td>
<td>*Protozoa</td>
</tr>
<tr>
<td>12.</td>
<td>*Growth, Aging and Death Movement</td>
</tr>
<tr>
<td></td>
<td>*Seedless Vascular Plants</td>
</tr>
<tr>
<td></td>
<td>*The Seed Plants--Gymnosperms</td>
</tr>
<tr>
<td>13.</td>
<td>*Platworms</td>
</tr>
<tr>
<td>14.</td>
<td>*Covering and Support Arthropods</td>
</tr>
<tr>
<td></td>
<td>*Echinoderms</td>
</tr>
<tr>
<td>15.</td>
<td>*Taxonomy Coelenterates</td>
</tr>
<tr>
<td></td>
<td>*Rotifers and Roundworms</td>
</tr>
<tr>
<td></td>
<td>*Segmented Worms</td>
</tr>
<tr>
<td></td>
<td>*Mollusk</td>
</tr>
</tbody>
</table>

*Topics given equal emphasis.*
<table>
<thead>
<tr>
<th>Topics</th>
<th>Major</th>
<th>Moderate</th>
<th>Slight</th>
<th>Topics</th>
<th>Major</th>
<th>Moderate</th>
<th>Slight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Principles of Chemistry</td>
<td>32</td>
<td>54</td>
<td>14</td>
<td>13. Digestion</td>
<td>42</td>
<td>52</td>
<td>6</td>
</tr>
<tr>
<td>3. Cells and Tissues</td>
<td>54</td>
<td>43</td>
<td>4</td>
<td>14. Excretion</td>
<td>29</td>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td>4. Roots, Stems and Leaves</td>
<td>30</td>
<td>52</td>
<td>19</td>
<td>15. Movement</td>
<td>25</td>
<td>63</td>
<td>22</td>
</tr>
<tr>
<td>6. Respiration</td>
<td>46</td>
<td>46</td>
<td>7</td>
<td>17. Reproduction</td>
<td>52</td>
<td>31</td>
<td>17</td>
</tr>
<tr>
<td>8. Chemical Coordination in Plants</td>
<td>18</td>
<td>39</td>
<td>43</td>
<td>19. Mitosis and Meiosis</td>
<td>67</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>9. Nervous Coordination</td>
<td>22</td>
<td>52</td>
<td>26</td>
<td>20. Genetics</td>
<td>67</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Topics</td>
<td>Major %</td>
<td>Moderate %</td>
<td>Slight %</td>
<td>Topics</td>
<td>Major %</td>
<td>Moderate %</td>
<td>Slight %</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------</td>
<td>------------</td>
<td>----------</td>
<td>------------------------------</td>
<td>---------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>25. Mosses and Liverworts</td>
<td>19</td>
<td>31</td>
<td>50</td>
<td>36. Echinoderms</td>
<td>9</td>
<td>48</td>
<td>44</td>
</tr>
<tr>
<td>26. Seedless Vascular Plants</td>
<td>17</td>
<td>39</td>
<td>44</td>
<td>37. The Vertebrates</td>
<td>40</td>
<td>52</td>
<td>8</td>
</tr>
<tr>
<td>27. The Seed Plants—Gymnosperms</td>
<td>17</td>
<td>50</td>
<td>33</td>
<td>38. Evolution</td>
<td>48</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>29. Protozoa</td>
<td>20</td>
<td>56</td>
<td>24</td>
<td>40. Health and Diseases</td>
<td>25</td>
<td>45</td>
<td>29</td>
</tr>
<tr>
<td>30. Coelenterates</td>
<td>4</td>
<td>50</td>
<td>46</td>
<td>41. Others</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31. Flatworms</td>
<td>12</td>
<td>46</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. Rotifers and Roundworms</td>
<td>4</td>
<td>46</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. Segmented Worms</td>
<td>4</td>
<td>58</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34. Arthropods</td>
<td>8</td>
<td>54</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tables 20 and 21 indicate that greater emphasis is placed on conventional topics as opposed to topics concerned with a molecular approach. For example, the topic Principles of Chemistry is placed far below many conventional topics.

The many topics which may be considered in a biology course offered for general education may be placed in three broad areas: botany, human biology and zoology. Respondents were asked to approximate the percentage of their entire course content devoted to each of the above sciences. Table 22 shows the tabulated responses.

**TABLE 22**

| DISTRIBUTION OF APPROXIMATE PERCENTAGE OF ENTIRE COURSE CONTENT CONTRIBUTED BY EACH OF THE LISTED SCIENCES |
|---|---|---|---|---|---|---|---|---|---|---|
| Percentage | 0-9 | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-100 |
| **Botany** | 0 | 7 | 15 | 10 | 12 | 4 | 0 | 0 | 0 | 0 |
| **Human Biology** | 2 | 2 | 10 | 10 | 11 | 10 | 1 | 0 | 1 | 1 |
| **Zoology** | 1 | 6 | 6 | 18 | 9 | 6 | 1 | 1 | 0 | 0 |

The course content related to botany in all courses falls within the range of 10-59 per cent; Coverage of human biology content seems to be scattered somewhat evenly in the range between 20-59 per cent. The greatest concentration of courses reporting percentages of zoology included in the
course is found in the range between 10-59 per cent. It may be significant to note that the content included in three courses ranged from 60-100 per cent in human biology; in zoology, two courses were in the 60-79 per cent range.

The development of "scientific attitudes" appears to be one of the main objectives of general education science courses. This objective was found most frequently in the stated aims and objectives of general biology courses as listed in the college catalogs examined of those institutions included in the study.

Respondents were asked if cultural factors and/or social implications were emphasized in their attempts to develop "scientific attitudes." Interpreting the results obtained from the questionnaire for this question proved difficult because of the variety of responses and the apparent misinterpretations of the questions by some respondents.

Of the total responses, 8 per cent indicated that the question was not applicable to their courses. Cultural factors were emphasized by 44 per cent, and statements of explanation were listed also. Twenty-one per cent noted that cultural factors were not emphasized, whereas 27 per cent replied by stating "yes" with no explanations. For the emphasis on social implications of science, 58 per cent indicated that this area was emphasized along with brief explanations; 17 per cent indicated that the social implications of
science were not emphasized, whereas 17 per cent replied in the affirmative with no explanations.

The following responses were made by respondents regarding the above questions.

Emphasis on cultural factors

1. Cultural factors are emphasized only when they are pertinent to certain topics, such as reproduction and evolution.

2. Cultural factors are touched upon but not emphasized.

3. The works of biologists are used in discussions as a means of developing scientific attitudes; also, the students do special assignments and reports on the history of biology which serves a similar purpose.

4. In relating some of the basic biological principles, the instructor attempts to give attention to the social setting in which the discovery of the principle took place.

5. When we talk of genetics, evolution, disease, this easily leads to discussions of cultural factors, and these discussions are spontaneous, not a part of the actual lecture.

6. An explanation of the origin of the scientific method and attitudes among the Greeks, the object of it then and now, is often used to emphasize cultural factors.

7. Cultural factors are not taught as a separate topic. However, as situations arise in a regular class session, the implications of biology on human affairs and cultures are discussed in some cases. For example, while teaching the life cycle of the malarial parasite, Trichina, and hookworm diseases, it is found that the cultural living and eating habits of certain populations have some bearing on the intensity of these diseases. So, I shall say that in appropriate cases cultural factors are emphasized in my teaching.

8. The historical and modern accounts of discoveries (scientific principles) which bear on ancient and modern concepts of natural phenomena are cultural factors which are emphasized.
9. Consideration is given to those factors that surround the development of various scientific developments or ideas, for example, the nature of Greek civilization and its possible influence on the development of Greek sciences, or the atmosphere in which Darwin developed his theory of evolution.

From another point of view, the cultural backgrounds of students are considered in the planning of the content and emphasis of the program. For example, in the discussion of genetics, factors which are involved in intelligence or skin color are considered with these backgrounds in mind.

10. When cultural factors tend to be responsible for the spreading of disease organisms, especially parasites, emphasis is placed on this area.

11. Consideration is given to the hierarchy of organisms. The development of domesticated plants and animals is related to man's interest in art, literature, music. Both heredity and environment are treated as factors influencing the behavior of organisms. An appreciation for and the conservation of natural resources are stressed. Relationships between the environment and its inhabitants are considered.

12. Emphasis is placed upon the fact that current affluence in the United States is due to science and the achievement of scientists. The stereotype of the "mad scientist" is dealt with by emphasizing that there are more scientists now alive than in all the centuries past, that most of us know one or more scientists, and that scientists are just like other people in other occupations. It is also emphasized that science is neither religious nor non-religious, neither moral nor immoral, but amoral. Students are taught that a belief in a supreme being is not precluded by belief in the idea of organic evolution. This presents a special problem in West Virginia, which may be considered as being deep in the heart of the Bible Belt.

Ideas related to the problem of environmental pollution, which is particularly pertinent in this direct area, are also emphasized whenever possible.

Emphasis on social implications of science

1. Social health contributions propagate from scientific knowledge, and the extent of adjustment depends on proper biological functions.
2. We attempt to develop in the student a fundamental understanding and application of the methods of the sciences, to develop a spirit of reverence and religious responses, through an appreciation of the vastness and complexity of the universe, and to sensitize the students to the problems resulting from the potentialities of science for good and evil.

3. Social implications arise from time to time, especially in the section on molecular biology, ecology, evolution, and genetics.

4. Social implications are mentioned in "scientific method" and domain of science, for example, in genetics, "making of life" in test tube.

5. Social implications are emphasized with an insight into ecological understandings of man and his environment.

6. The individual should know objectivity when using scientific method; therefore, one's decision should be based on facts. Disease germs are spread from infected to non-infected persons. Science has altered man's life (nutrition, drug, etc.). One is a citizen first and a biologist secondarily.

7. When discussing animal and plant groups, we give much attention to the economic importance of the groups. Occasionally, reports are used to "tie in" the social implications of science.

8. Parts of large concepts in biology are devoted to the impact on society as a whole; the method of science affords an excellent opportunity for a consideration of social implications. Experimental control concerning drugs, food, and other items utilized by man helps to emphasize the social implications.

9. Since the faculty is 30 per cent Caucasian (twenty-five per cent of the biology faculty is Caucasian), frequent comparisons are made of students' reactions to Caucasians: their similarities, differences, duties, and responsibilities.

10. Differences and similarities of organisms are treated. Food supply is considered as it relates to poverty and deprivation. Deprivations and their causes are considered (a) inherited, (b) influenced or induced by the environment. Scientific literacy on the part of citizens who are not engaged in science is stressed. The impact of selected mating on new generations of organisms is stressed.
11. Social implications are emphasized when discussing the history and development of the biological sciences.

12. The social benefits and problems that grow out of the developments in sciences are considered. In this connection, individual and societal responsibilities are considered. For example, some of the developments in nuclear sciences are of benefit to mankind. Therefore, mankind has the moral responsibility to see to it that all developments in science should ultimately result in benefits to all mankind.

13. Teaching the evolution of scientific concepts as a function of technological advancements and by the accumulation of data over long periods of time is a means of pointing up the social implications of science.

14. The students are made aware of the necessity of "life" studies as being studies of themselves. Hence, the importance of learning about biology and its sundry implications is shown.

15. Emphasis is placed on pure and applied sciences and the role they play in social revolutions.

16. Biology is taught to current and future concerns of society.

17. Social implications are emphasized only when they are pertinent to certain topics, such as inter-relationships of animals to their environment, evolution and the reproductive process.

18. The fact that our lives are constantly involved in science is pointed out through various means.

19. For (a) and (b), emphasis on cultural factors and social implications, the point of view taken is that science is incapable of making pronouncements on values, morals, etc., whereas such are definitely within the realm of scientists.

20. The moral, ethical and legal questions arising from recent developments in science, such as birth control, abortion, suspended animation, and others, are considered. The question of authority with regard to creating life in a test tube, of controlling genes to make individuals to order, and of improving intelligence by administering RNA are also discussed. The idea that all races are basically the same, biologically and otherwise, is used as a method of discussing the lack of logic associated with bigotry.
The danger of increased war by perverted science and the promise of a golden future from reasoned science, in addition to the population explosion and food decline, are woven throughout the course.

21. Social implications of science are related to present-day living and especially international relationships.

The following statements taken from the literature seem to be pertinent to the foregoing statements concerning the degrees of emphasis placed on cultural factors and social implications as they relate to the development of "scientific attitudes" in biological science courses designed for general education purposes:

Few studies have been made of social factors affecting students' interests and progress in general education. But the little that is currently known about the influence of social-class background and the particular group situation in which the teaching-learning process occurs highlights this as a particularly fruitful area for research.18

No school or college is too small to study the relevance of its objectives and program in general education to the students it serves; none is too large or well established not to profit from this test of its mission as an educational institution.17

General education in science must also emphasize the social significance of science and technology for our times. Failure to understand how science has transformed the conditions under which men live is failure to understand the forces that have reshaped our civilization and now threatens to destroy it. At this of all times it should be clear that understanding the social implications of science is an imperative in general education.18


17 Ibid., p. 276.

Personal interviews

There are several techniques used for collecting data in studies of this type; the investigator used personal interviews to supplement other methods utilized in the study and to follow up certain unexpected results as well as to validate data obtained by other methods. Data collection methods may be categorized by the extent of their directness. There is a consensus that the interview affords the best means of obtaining data in "survey type" studies; however, in some cases, direct question may yield data that are invalid. The interview method is, nevertheless, flexible and adaptable to individual situations. It also permits the interviewer to probe into the context of responses to certain questions and find the reasons for these responses.

For this study, the investigator attempted to obtain data from colleges and universities located in nineteen states and the District of Columbia; the possibility of obtaining interviews with science staff members in each of the many institutions was neither geographically nor financially feasible. Interviews are costly and time consuming; however, the investigator was able to visit five colleges.

The interviews were not structured, but tended to be flexible and open; no schedule was used to ask questions sequentially arranged; however, the questioning followed the pattern set forth in the questionnaire sent previously. Much of the data collected was subjective and did not concern
itself with the informational aspects of the courses. Through these visitations, the investigator was able to inspect each of the five courses in its unique physical and social settings.

An attempt was made to interview as many staff members as possible associated with the courses. It was found that information obtained from the respondents coincided closely with data furnished previously; however, other staff members had extremely divergent viewpoints concerning various aspects of the courses. In many instances, there was a lack of agreement as to the desirable conduct of the courses. In the schools visited, laboratory equipment, audio-visual materials and library references were considered adequate. The investigator, having attended several classes in the various schools, found that a lack of interest on the part of many students was evident and that there was little communication between student and teacher in many instances.

Staff members interviewed were asked to state their opinions concerning the courses with emphasis on problem areas and suggestions for possible improvement. A summary of these concerns follows:

Nearly all of the students involved in these courses were non-science majors, coming into the course with various backgrounds in science. Some students had biology in secondary schools taught in a conventional manner, whereas others had exposure to one of the three versions resulting from the
B.S.C.S. content study program. A third group had no formal training in biology on the secondary level. Designing a course for such a heterogeneous group which would interest and challenge the students presented problems. One staff member commented that the students were so poorly prepared in science upon entering college that it was impossible to communicate effectively; therefore, much time was used on vocabulary drills.

Course content was one of the major concerns of many staff members. It was noted that a considerable number of students enrolled in the course had not had secondary school chemistry. This deficiency tended to limit the emphasis which could be placed on topics concerned with molecular biology. Keeping course content abreast with current knowledge in biology, therefore, presented additional problems. In coordinated courses involving several instructors with different academic backgrounds, the courses were highly structured with much emphasis being placed on the acquisition of factual material. Attempts were being made by several instructors to de-emphasize factual content and place increasing emphasis on principles and concepts based on broad underlying themes. It was suggested by one instructor that a study be made of the secondary school science backgrounds of the students and that the general education biological science course be initiated with materials familiar to the students.
A great deal of concern was evidenced in connection with laboratory experiences associated with the courses. It is believed by most staff members that the laboratory is important and much needed; however, various reasons were given for the absence of laboratory experiences. The large number of students involved, the available laboratory equipment, and the amount of consumable materials would tend to prevent effective laboratory experiences. Efforts were also being made to closely coordinate laboratory experiences with lecture topics whenever possible.

Many staff members were dissatisfied with their present methods of evaluating student progress when testing such large groups of students. They found that the time required for scoring the tests limited the types of tests given. The objective multiple choice type tests which may be machine scored were most frequently used. Common examinations were given at least twice each term when there were several sections of the course. It was generally agreed that common examinations are worthwhile; however, the structuring of these examinations create problems.

The administrators interviewed were concerned also with the qualifications of instructional personnel. They found it difficult to secure instructors with adequate training and with positive attitudes toward the course believing also that it has worth and serves a definite purpose. It was pointed out that in some cases when a single instructor was
responsible for the lecture, others who taught or coordinated laboratory sections showed little interest in the course. The investigator found it difficult to evaluate the intangible aspects of the courses and the many non-behavioral objectives listed. The personalities of the teachers, as well as the attitudes of the students apparently affected the overall conduct of the courses. All administrators or coordinators of the courses thought that the courses required considerable study and continuous reorganization.

**Examination of college catalogs**

The writer obtained college catalogs or bulletins from the schools under investigation as an additional source of data. These materials were examined critically for course descriptions, the number and kinds of courses offered, and aims and objectives of these courses, if listed. Information obtained from these sources afforded an excellent check on the replies to post card inquiries, as well as questionnaire responses. Only one discrepancy was discovered in the listing of courses according to titles and numbers. It was noted also that a few recent changes in courses offered did not appear in the catalogs, but were available. All data were corrected to coincide with the most recent information.

As indicated previously, a majority of these courses are included in the curricula of the biology departments of the colleges. Forty-six per cent of the course descriptions
could be considered as traditional descriptive statements of general biology courses, whereas 54 per cent had descriptive statements which were general education oriented. From these latter statements, one could readily infer that these courses were different from the general offering in biology and were designed for a specific purpose.

In all catalogs examined, the general aims and objectives of the institutions were listed. Additional aims and objectives were listed in some catalogs for their General Studies program. In three catalogs, specific course objectives were listed for the general education biology courses.

Of the many aims and objectives listed in the catalogs, syllabi and related materials, two of the most frequently stated ones are concerned with: transmission of the cultural heritage and the social implications of formal training. The questionnaire submitted to prospective respondents requested the extent of emphasis, if any, which was placed on cultural factors and social implications of science. The discrepancies between catalog statements and questionnaire responses (Table 23) are significant.

The major aim or objective of the course as listed in 90 per cent of the catalogs examined was the transmission of the cultural heritage; yet 50 per cent of the respondents indicated that this was not an objective of their course, or they did not choose to emphasize it, a discrepancy of 40 per cent. Ninety-one per cent of the catalogs examined listed
the social implications of formal training as a major aim or objective; however, 40 per cent of the respondents indicated that this was not an objective of their course, or they did not choose to emphasize it, a discrepancy of 51 per cent.

TABLE 23
EXAMINATION OF COLLEGE CATALOG AIMS AND OBJECTIVES

<table>
<thead>
<tr>
<th>Aims</th>
<th>Listed in College Catalog</th>
<th>Questionnaire Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Emphasis on Cultural Factors</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Emphasis on Social Implications</td>
<td>91%</td>
<td>9%</td>
</tr>
</tbody>
</table>

It should be understood that objectives and aims of departments as well as courses may differ; still, they should come within the broad aims and objectives of the institutions of which they are a part. It would seem, therefore, that a significant number of instructors are either not familiar with these two objectives or they do not choose to emphasize them as course objectives.

Student opinionnaire study

It may be assumed that in an investigation of this type the validity of the results may be enhanced by increasing the number of related sources from which data are obtained. There is a consensus that student needs and interests are of prime importance in the selection of content and in the conduct of
general education science courses. A request (Appendix H) was made of ten coordinators of general biology courses, in the institutions included in the study, to administer a "Student Opinionnaire" to students enrolled in their general biology courses. Five coordinators agreed to administer the opinionnaire to a representative sample of students enrolled in their classes, while five rejected the request due to time limitations placed on required course work and a belief that students were not in a position to pass judgment concerning the course.

The investigator however strongly believes that such information should be included in the study.

After checking several instruments for conducting the study, the investigator decided upon the following as being the most suitable for this purpose: "Student Opinionnaire for Appraising a Course and Its Information," Opinionnaire Form 2, 1951, Evaluation Service Center, Syracuse University (Appendix F). This instrument was prepared by the Psychological Research Center, a division of the Evaluation Service Center at Syracuse University. The opinionnaire consisted of eighteen questions with five possible choices of answers. The questions were not categorized; however, all items listed would fall in one of the following four categories: Instructional Procedure; Tests, Examinations, and Quizzes; Value of the Course; and Instructor-Student Relations.
It should be related, however, that the use of all such instruments has limitations. Factors, such as course objectives, methods of instruction, and instructors' statements, may affect the results.

The opinionnaire was administered to all students enrolled in the general education biology courses at Virginia State College. Of the 200 students responding to the questionnaire, more than 95 per cent were freshmen, and all were non-science majors. The opinionnaire was administered to students in six classes conducted by different instructors; all answer sheets were anonymous. The intent was not to pick a "most positive" class response, but to get a composite rating of all classes. These students were in the general education biology courses to satisfy the science requirements for various majors. It should not be surprising, therefore, to find students who resent or even dislike the course.

Representative samples of student opinions were obtained from five schools with a total of 451 students responding.

The total number of checks was determined for each of the five choices under the eighteen different statements on the opinionnaire. Percentages were computed for the total number of responses for each choice. A total percentage was also computed for the combined response for the five courses. It should be remembered that "a" designates the highest rating, "c," an average rating and "e," the lowest rating. A complete opinionnaire may be found in Appendix F.
Types of Courses in which Student Opinionnaires Were Administered

Course 1. A one-year block and gap course. Ninety-two students completed the opinionnaire near the end of the academic year. Responses from students in this course would seem to be significant since a large portion of the students enrolled were adults.

Course 2. A one-semester block and gap course. Fifty-six students completed the questionnaire near the end of the semester.

Course 3. A one-year survey course. Fifty-five students completed the questionnaire near the end of the academic year.

Course 4. A one-year survey course. Two hundred students completed the questionnaire near the end of the first semester.

Course 5. A one-semester survey course. Forty-eight students completed the questionnaire near the end of the semester.

Results from the Student Opinionnaire

Table 24 shows the percentage of responses to each of the eighteen statements included in the opinionnaire for each course and a total percentage for the responses obtained from the five courses. Each statement will be reported separately with the percentage of responses listed below it. The sequence of statements follows those as listed in the questionnaire.
TABLE 24

PERCENTAGE OF RESPONSES TO STUDENT OPINIONNAIRE STATEMENTS

Statement #1: Objectives of this Course were:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>51</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>68</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>92</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>40</td>
</tr>
</tbody>
</table>

Statement #2: Plans for the Course, as it progressed from week to week, were:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>51</td>
</tr>
<tr>
<td>2</td>
<td>43</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>73</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>35</td>
</tr>
</tbody>
</table>

Statement #3: Assignments were related to the purposes and development of the Course in a way which was:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>25</td>
</tr>
</tbody>
</table>
### TABLE 24 (Contd.)

Statement #4: Students were drawn into class activities in a way which:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39 28 25 5 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>25 54 19 0 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>18 49 27 6 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12 25 36 18 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>46 46 8 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Percentage</td>
<td>26 34 26 9 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statement #5: The principles or concepts developed in this class were:

<table>
<thead>
<tr>
<th>Course No.</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28 39 21 12 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>29 51 18 2 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>18 49 27 6 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>11 26 31 20 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>61 33 6 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Percentage</td>
<td>23 35 23 13 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statement #6: When tests or quizzes were given in this course, the students:

<table>
<thead>
<tr>
<th>Course No.</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28 25 19 10 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>11 41 28 9 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>11 42 36 11 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>18 17 28 14 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>40 50 10 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Percentage</td>
<td>21 27 25 10 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statement #7: The tests and examinations in this course:

<table>
<thead>
<tr>
<th>Course No.</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56 30 21 5 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>23 38 26 8 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>21 36 18 18 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>11 21 30 18 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>38 52 8 2 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Percentage</td>
<td>21 34 23 12 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Statement #8: The instructor used evidence about students' progress in such a way that:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>18</td>
</tr>
</tbody>
</table>

Statement #9: I believe that specific information obtained from this Course is, or will be:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>46</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>26</td>
</tr>
</tbody>
</table>

Statement #10: In this Course, I have become acquainted with:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>52</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>28</td>
</tr>
</tbody>
</table>

Statement #11: The experience of taking this Course has been of:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>54</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>23</td>
</tr>
</tbody>
</table>
TABLE 24 (Contd.)

Statement #12: Relative to helping students individually, in and out of class, the instructor seemed:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>64</td>
<td>26</td>
<td>7</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>46</td>
<td>28</td>
<td>20</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>80</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>28</td>
<td>19</td>
<td>30</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>71</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Percentage</td>
<td></td>
<td>49</td>
<td>22</td>
<td>18</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

Statement #13: The instructor's appreciation of the student's point of view was:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>50</td>
<td>38</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>21</td>
<td>52</td>
<td>11</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>36</td>
<td>62</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>28</td>
<td>24</td>
<td>22</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>58</td>
<td>42</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Percentage</td>
<td></td>
<td>36</td>
<td>37</td>
<td>13</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

Statement #14: The instructor's grasp of his subject and related fields was:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>71</td>
<td>26</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>80</td>
<td>16</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>81</td>
<td>18</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>50</td>
<td>24</td>
<td>24</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>50</td>
<td>37</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Percentage</td>
<td></td>
<td>62</td>
<td>24</td>
<td>13</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Statement #15: The instructor's ability and willingness to answer relevant questions in class was:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>65</td>
<td>26</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>55</td>
<td>29</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>82</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>19</td>
<td>25</td>
<td>39</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>90</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Percentage</td>
<td></td>
<td>48</td>
<td>23</td>
<td>21</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>
TABLE 24 (Contd.)

Statement #16: The instructor's regard for the students as individuals was:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>29</td>
</tr>
</tbody>
</table>

Statement #17: In dealing with students, the instructor:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>84</td>
</tr>
<tr>
<td>2</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>69</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>69</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>58</td>
</tr>
</tbody>
</table>

Statement #18: In my opinion, the instructor's personality was:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>54</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>58</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>61</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>46</td>
</tr>
</tbody>
</table>
Interpretation of results from
the student opinionnaire

The statements listed on the student opinionnaire were
categorized for the purpose of interpretation. The opinion-
naire elicited evaluative responses for four areas of concern.
These areas were instructional procedures; tests, examinations,
and quizzes; value of the course; and instructor-student re-
lations. The five-point scale for evaluating opinionnaire
items gave the following choices: a-superior, b-good, c-average,
d-below average, and e-poor. The instrument used for
appraisal procedures appeared to be well balanced and free of
bias.

Combining a and b responses as the upper limit of
responses, allowing c to represent the mid-point, and com-
bining d and e for the lower limits, the writer made the
following evaluation for the opinionnaire responses.

Instructional Procedures, Statements 2, 3, 4, and 5.

1. Sixty-two per cent felt instructional procedures were
effective; 24 per cent felt they were the same as
most instructional procedures, and 14 per cent felt
the instructional procedures were ineffective.

Tests, Examinations, and Quizzes, Statements 6, 7, and 8.

1. Fifty per cent felt tests, examinations, and quizzes
were effective; 25 per cent felt that they were about
the same as most tests for courses, and 25 per cent
felt that they were ineffective.

Value of the Course, Statements 1, 9, 10, and 11.

1. Fifty-four per cent felt the course had definite
value; 31 per cent felt the course was of no more
value than the average, and 15 per cent felt the
course had less value than other courses.
Instructor-Student Relations, Statements 12-18.

1. Seventy-three per cent felt instructor-student relations were effective; 18 per cent felt relations in this area were about the same as they would be in most courses, and 9 per cent felt they needed improving.

Considering combined responses of the courses, the investigator noted that the consensus of student respondent opinions would indicate effective characteristics for all four areas of the courses. One area, tests, examinations, and quizzes, where 25 per cent indicated ineffective characteristics, the largest percentage of responses in the lower limit of responses, a difference of 25 per cent, is significant.

Interpreting responses from individual courses, the investigator felt that some positive and negative aspects should be mentioned. A significant number of students believe that help is willingly given, that the student's point of view is appreciated, that the instructor's grasp of subject matter and related fields is extremely good, that the instructor deals fairly with all students, and that his personality is considered pleasing and attractive. On the negative side, in one course the students are not adequately apprised of course objectives; course plans are not organized, which would strongly stimulate thinking and problem solving, and neither principles nor concepts are well illustrated. For all five courses, unbalanced tests do not provide opportunity to demonstrate acquired knowledge and understanding, and the
instructors do not use evidence about students in such a way as to help clear up difficult points concerning subject matter content.

Generally speaking, the course instructors were given a high rating regarding other phases of the courses. The highest rating given was 62 per cent, attesting to the instructor's grasp of his subject matter and related fields. This consensus on the part of the students is interesting when one considers the areas of specialization of staff members conducting the lecture sections of these courses. Twenty-seven per cent had advanced academic preparation in botany, 18 per cent in human biology, 27 per cent in zoology, and 14 per cent in science education.

Staff members at several institutions were asked to express what they considered as being the general or overall attitudes and opinions of students toward the course in their section or sections. Their conceptions of the students' attitudes and opinions may or may not be valid because a minority of students with extremely positive or negative attitudes toward the course. This may tend to shade the instructors' views to the extent that they are really unaware of the attitudes and opinions of the majority of the students. However, what the instructors believe the students think of their course is significant. The responses obtained indicated that there was only slight disagreement between them and the results obtained from the student opinionnaire.
Thus, students and staff involved in general biology courses at the several institutions are generally in agreement as to their effectiveness. The information obtained from such studies enables teachers to improve their courses. It also gives an indication of the worth of the courses in question.

Since all institutions included in the study are predominantly Negro and are located geographically in the South with student bodies from similar socio-economic backgrounds, the writer assumes that if the same instrument were administered to the general biology students in the other institutions, the results would be essentially the same. The above results, therefore, should have some degree of external validity. The following quote from Kerlinger would tend to support the above conclusion.

Most research in education is done with relatively small nonrandom samples. If hypotheses are supported, they can later be tested with random samples of populations, and if again supported, the results can be generalized to populations of schools, children, and laymen. In other words, survey research can be used to test hypotheses already tested in more limited situations, with the result that external validity is increased.19

CHAPTER V

A CONCEPT OF GENERAL EDUCATION

BIOLOGICAL SCIENCE

The present widespread concern for general education in all areas involves a conception of man, society and knowledge. The data which have been obtained from various sources and have been reported in this study indicate without doubt that general education is a term with widely different meanings.

In order to develop a concept of general education of biological science, the investigator found it necessary to develop a philosophy of general education, to determine the criteria for general education, as well as specific criteria for general education science courses, to determine and evaluate the status of general education biological science courses in the selected colleges, to summarize these data, to draw conclusions to point out desirable trends, and to make certain recommendations.

The problem of determining the objectives of general education in biology involves a treatment of the nature of biological science, the nature of the learning process, and the nature of a democratic society.

143
Needs of the individual as a learner

Knowledge of our biological and physical worlds cannot be placed into separate compartments and be treated as distinct and separate entities. The learning process is a whole process, and it is essential that the instructor has as much information concerning his students as possible in order to conduct an effective course.

A report of the Committee on the Functions of Science in General Education, *Science in General Education*, noted that general education should meet the needs of the individuals in the basic aspects of living. The Committee's point of emphasis was the benefits individuals could obtain from a study of science. Four basic aspects of living were recognized: personal living, immediate personal-social relationships, social-civic relationships, and economic relationships.¹

Five major needs were listed for adolescents in the area of personal living: (1) The need for personal health, (2) The need for personal assurance, (3) The need for a satisfying world picture and a workable philosophy of life, (4) The need for a range of personal interests, and (5) The need for esthetic satisfactions.²

²Ibid., p. 64.
The needs of adolescents in the area of immediate personal-social relationship are as follows: (1) The need for increasingly mature relationships in home and family life, and with adults outside of the family, and (2) The need for successful and increasingly mature relationship with age mates of both sexes.3

The needs of adolescents in the area of social-civic relationships are (1) The need for responsible participation in socially significant activities, and (2) The need for social recognition.4

The needs of adolescents in the area of economic relationships are (1) The needs for emotional assurance of progress toward adult status, (2) The need for guidance for choosing an occupation and for vocational preparation, (3) The need for wise selection and use of goods and services, and (4) The need for effective action in solving basic economic problems.5

It must be realized that science, as a discipline, cannot possibly satisfy all of the listed foregoing needs of the individual; however, many significant contributions can be made by a study of science in the realization of many of them, leading to more effective participation in a democratic society.

3Ibid., p. 144.
4Ibid., p. 188.
5Ibid., p. 240.
As is true of other disciplines in general education, science seeks to prepare all students, regardless of their areas of specialization, for effective, satisfying, and wholesome living, both as individuals and as members of society. This type of training is designed to develop persons who are aware of their privileges and their responsibilities in a democratic society and who possess a positive attitude toward accepting them. We recognize the need on the part of every individual, moreover, for reasonable ability to think logically and to speak and write clearly and effectively. Biological science for general education should be geared to the development of these competencies in every student who enrolls in such courses. In structuring such a course, the course designer should keep several questions foremost in the minds. What are the facts, principles and concepts every educated person should know about biology? Are the materials the same as those required of the science major? What is an effective way of teaching biology as a general education course? Must students have at least an elementary background in chemistry in order to derive some meaning from molecular biology? What are the topics in biology which should be significant for the general student? How can breadth and depth be included in a course offered for students with various backgrounds? There should be a concern not only that as educated men and women, these students should possess the perspectives to see life steadily and to see it whole, but also
they should appreciate those finer interests which relieve and complement the preoccupations of the everyday world. As one participant in the Colloquium on Biology in a Liberal Education puts it, "An understanding of living matter, its origin, its properties, its qualities, its organization, its behavior, its continuity, its capacities and its limitations is all-pervasive in its influence upon society and the mind."^6

It is believed also that both through direct instruction and through incidental relationships and experiences, the student should be helped to develop a wholesome system of values and ethical principles which will influence his life and conduct. There is also a concern that the student understands the world in which he lives in order that he may adjust himself to that part of his biological and physical environment that is wholesome and may strive to improve that part which is not. There are areas of knowledge in which every person, regardless of his vocational plane and objective, should have at least a general competence. In a more general way, these competencies are concerned with the needs which are common to all persons. Though one student looks forward to becoming a scientist and another plans to enter the teaching profession, all are faced with the common necessity for conducting their personal lives and affairs and for managing

their several relationships with others in ways that are satisfying and effective. Upon the completion of the formal phase of their training, students will emerge into a world, except for their individual job responsibilities, which makes similar demands upon them all.

Men living in this complex age should have to some degree an understanding of men's lives both present and past and should be able to trace their moral and ethical values. Biological science, as a discipline, affects us in many ways: the understanding of its content, its implications, its leaders and their attitudes and motivations, and its past and current relationship to cultural growth. One of the goals of general education biological science should be to point out the similarities and differences of approach used by men of different ages and cultures to solve their many social and economic problems. The general education course in biology serves as a terminal course in science for many students. We should, therefore, put forth maximum effort to cover essential materials and let our teaching methods reflect biology as an investigative science.

In our western civilization, science and technology are so closely interwoven as to preclude any attempt at separate consideration. This observation should point up the strength of the forces which bind science and technology so intimately to the intellectual as well as the material accomplishments of our society. The resulting growth in our
scientific enterprises is reflected in the increasing numbers of persons being employed yearly in scientific or technological occupations. All citizens have a direct influence on the rate and direction of technological progress. We choose occupations; we purchase products, and we vote. It should be easily seen, therefore, that directly or indirectly all of us participate to some degree in the scientific enterprise.

General education biological science as other general education courses should prepare citizens capable of meeting their social obligations as well as maintaining a degree of personal security. The writer believes that all persons should have sufficient instruction in science to the extent that there is a general scientific literacy.

Some criteria for scientific literacy follow:

1. To recognize problem situations and employ certain procedures or skills in extricating themselves from those situations.

2. To make decisions in a manner which gives some assurance of contributing maximum social and personal security.

3. To communicate effectively with others regarding matters of common concern.

4. To use mechanical and other material products required for modern professional and technical competence and efficiency.

5. To use the products of science and technology in a manner conducive to a more satisfying and healthful life.
6. To interpret and make adequate judgments regarding reported events and advertisements having to do with discoveries of science and the products of technology.\(^7\)

These criteria cannot be met simply by learning about science. Each implies some kind of action or intellectual process with which there is associated a wide variety of skills.

**Social factors affecting general education**

Concerning the social factors affecting general education, Homer P. Rainey points out, "All social factors either directly or indirectly affect the problem of general education, since education is concerned with understanding the social patterns in which it operates."\(^8\) Academic, cultural and social backgrounds of students must be thoroughly considered in the selection of content and in the approaches used in courses. Thus, instructors must develop a means of creating interest in science for many of the students as well as develop a spirit of competitiveness among the students.

In a study made by Weaver on "Meeting the Needs of Negro Science Teachers in Alabama," he concluded:

Culture within which the Negro people operate is of such a nature as to force on the Negro people a

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\(^7\)Robert R. Buell (ed.), *Educational Comment* (Toledo: University of Toledo, Spring, 1964), p. 10.

contradictory and inconsistent approach to the basic problems of living in a democratic social order. This contradictory position and approach to everyday living is reflected in the confused and contradictory opinions, beliefs, attitudes, and approaches which Negro teachers make to the vital problems with which young people must cope. 

The writer is in agreement with Weaver's conclusions. He believes that the conditions expressed concerning the students and teachers in predominantly Negro institutions have not substantially changed. A substantial change must be effected in the overall social complex before the general educational programs of the predominantly Negro colleges can be genuinely appreciated and be effective in the lives of the students.

The purpose of general education should be understood in terms of performance and behavior, not in terms of mastering a particular body of knowledge which students obtain from their participation in such courses.

To teach for conceptual development, a teacher must analyze the concept and select experiences which will enable the student to build and clarify the concept. The real difference between general and special education lies in the orientation and purpose. Any course may be taught as a special or as a general education course, depending on the choice of content and the emphasis on method. The concept of

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general education refers less to the level of the course than to the approach used.

The determination of course organization and content is the real challenge presented by a course in biology which is to be offered for general education. Some patterns of course organization were suggested by some of the participants in the Colloquium on Biology in a Liberal Education. For some, all course content should adhere to a basic theme; for others, the method of presenting materials was more important. Briefly, some organizing principles were as follows:

1. The "inquiry" approach
2. The "scientific method" theme
3. The "evolution" approach
4. The "whole organism" theme
5. The "organismal-environment" complex
6. The "themeless" course
7. The "paperback" course.

Nearly all updated general education courses in biology include topics concerned with ecology, evolution, genetics, history of science, photosynthesis, anatomy and physiology, and metabolism. No specific curriculum is suggested here; however, the acquisition of scientific knowledge and a degree of training in judging validity of conclusions should be of prime concern. The intent here is not to argue against the acquisition of facts; rather, it is an argument for the methods of obtaining data.

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The question of whether or not scientific knowledge can be obtained by students at the level of their general education depends on the possibility of guiding them sufficiently in their study. This should be a matter for much concern since if it is not possible, then general education can provide information and no more. Many of the conclusions in biology require validation for a complete understanding. The possibility of giving the beginning student some training in the judgment of validity should be considered. The laboratory should afford some direct experience with data in order to appreciate how far removed the raw materials of biology are from the conclusions reached.

The unique character of biological science is the acquisition of scientific knowledge, not just the transmission of information. General education biological science courses must therefore find their strength in scientific content which may be validated by students. A general education course in biological science would not distinguish science majors from non-science majors. Its content should be of benefit to all students.

The history of science shows that there is a strong relation between the science of an age or culture and the broader aspects of cultural and intellectual life. The inclusion of history of science in introductory biology courses, however, may create numerous problems. This approach teaches about science but does not teach science itself. The
all important time element will not permit adequate coverage of current science materials, while at the same time pursuing the historical as well as the cultural side of its development. A limited amount of history, nevertheless, should be included in such courses.

Opinions and attitudes of instructors are important concerning such courses if they are to be conducted effectively. Inadequate physical facilities, equipment and other materials cannot be given as a primary cause for the ineffective conduct of general education biological science courses. Other factors, such as staffing, must be considered. It is desirable to staff this type of course with broadly trained personnel, many having had secondary school teaching experience. It is desirable also to maintain such general education biological science courses on the freshman or sophomore levels thus allowing students to have time to make firm commitments as to future subject matter majors.

Since the many instructors embrace various connotations of the nature and process of general education, it is suggested that each institution makes a firm choice of ends means after a thorough and thoughtful study of basic educational problems and issues. Problems of daily living related to the specific disciplines concerned should be the core of any general education course instead of the acquisition of a mass of factual material. This core of materials for general education biological science could be centered on human affairs.
Students should be taught to discover ideas in books, analyze the ideas, and interpret them. Instructors should be less concerned with teaching factual materials and place more stress on the nature and methods, the aims and limitations of science. Mason and Warrington conducted an experiment at Michigan State College in the natural science course in which current science articles were used as a supplement to the discussion technique in evaluating the articles. In their conclusions they noted that this technique was no more effective in developing the ability to think scientifically than their usual methods. They felt that possibly better results would have been obtained had the articles been more closely related to the subject matter of the course.\(^\text{11}\)

Gerald Holton's comment concerning the general education science course at Harvard seems significant. He states:

> I do not need to repeat here the details concerning the course I give from time to time at my university. I shall instead refer to three specific aspects of the course that may be generally applicable: rigor, the place of history of science, and the centrality of certain specifiable subject matter.\(^\text{12}\)

He further believes that general education courses are not ambitious enough in mathematics as well as science content. He insists that general education science courses should


consist of substantive scientific materials, going into depth with less encyclopedic coverage. He places the blame for ineffective courses on poor academic preparation of instructor, inadequate backgrounds of students in science, and a lack of time for course presentation.

The following suggestions, in the writer's opinion, may be of value in developing an effective biological science course for general education.

1. Develop a course with depth, few significant topics to be covered. Avoid superficial coverage of many topics.

2. Insist on adequate time to cover desirable aspects of course.

3. Avoid using too many subject matter specialists, especially if they lack interest in the course and have no desire to conduct it.

4. Concentrate on course organization, based on student needs, and stay abreast of national trends in order to keep courses updated, using those aspects appropriate to the needs of students in individual institutions.

5. Use laboratory and out-of-class experiences freely to supplement lecture materials.

It is essential that a broader education in the many disciplines is absolutely necessary if the youth and adults of America are to gain an appreciation and an understanding of the complex world in which they live. It should be expected that from such general education biological science courses student may develop an increased interest in science, a functional knowledge of science concepts and
principles, possible practical applications, a better understanding and an appreciation of the biological and physical phenomena which surround them, and employ critical thinking in attempting to find solutions to problems related to everyday living. It may be assumed that such a course will lead to good citizenship, emotional maturity, and scientific objectivity.

A general education course in biology as in other general education courses must not be based on custom or tradition, but on the needs, interests, and capacities of our students. It should be an ever-growing, ever-changing curriculum, responsive to the personal and social needs of the day. There is no question as to the need for improving the quality and the quantity of science education in our schools. Millions of dollars have been spent on content study programs as well as on the updating of instructional personnel in the field. It is easily seen that such expenditures are justified when our national security depends on a pool of trained scientific and technological manpower supported by scientifically literate citizenry.
CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a short summary of the study. The conclusions are based upon the data and recommendations which may be used by institutions in the process of organizing or reorganizing their general education biology courses.

General summary

It was stated at the outset that this investigation would be a status and appraisal study of biological science courses offered for general education in predominantly Negro colleges on a nationwide basis from which trends could be derived and a conceptual scheme developed. In carrying out this stated purpose, the investigator made a thorough search of the literature to determine the extent of research already done in this area and related areas. The review of the literature was presented in three categories: status studies, evaluative studies, and Negro studies. From this review of the literature, it was noted that very few studies of this nature concerned with the predominantly Negro colleges on a nationwide basis have been undertaken, especially within the last sixteen years. It was decided therefore that the study would be of value, and procedures were designed to expedite it.
The investigator compiled a list of all predominantly Negro colleges from The College Blue Book and the journal Plans for Progress. An original list of 129 colleges was formulated. In order to delimit the number to accredited colleges, this original list was compared with institutions listed in two publications: The Directory of Education, U.S. Office of Education, and Accredited Institutions of Higher Education, published by the Federation of Regional Accrediting Commissions of Higher Education. An eligible list of seventy-seven colleges remained which were used in the study.

Inquiry cards were sent to the Deans of colleges on the original list requesting data concerning their biology courses offered for general education, if such courses were offered, and the names of courses coordinators to be used for future correspondence.

A philosophy of general education was developed from which evaluative criteria were derived for comparing certain areas of the courses. This was accomplished by a thorough study of related literature regarding concepts and theories of general education by authorities in the field. From such a philosophy, the investigator was able to derive a list of criteria (objectives) by clarifying many general statements and reducing them to specific objectives. The investigator validated these criteria by comparing them with similar criteria listed in two nationally recognized publications on Science in General Education, edited by McGrath and Haun,
which seem to set certain standards for this area and A Design for General Education, published by The American Council on Education. Also used were the reports of various commissions and committees in the field of general education including the President's Report on Higher Education. From such comparisons, the investigator was able to attach more precise connotations in the formulation of specific statements.

In order to make a nationwide study of general education biological science courses in predominantly Negro colleges located in nineteen states and the District of Columbia, the investigator ruled out personal interviews as the main means of obtaining data due to time requirement and adequate finances. An extensive questionnaire was developed with the Major Committee's approval to be used as the primary data collecting device. Data supplied from this source were supplemented in a number of ways: course syllabi, textbooks, limited personal interviews, examination of college catalogs, opinions of respondents, and a student opinionnaire study.

Colleges were grouped and evaluated collectively to compensate for the different organizational patterns in the various institutions. Along with the established criteria used for evaluative purposes, an arbitrary four-point scale was devised to convert qualitative aspects of the courses to quantitative measures. This method proved most satisfactory. Comparisons were made of areas included under two broad headings: Administrative Organization and Instructional Procedures
and Policies. Questionnaires and letters of explanation were sent to course coordinators in the selected schools.

Initial responses were not deemed satisfactory for the purposes of the study; therefore follow-up letters were sent to prospective respondents resulting in an overall response of 62 per cent. This response was considered satisfactory.

Data received from the questionnaires and other sources were tabulated and evaluated based on established criteria. The results of these evaluations were presented in Chapter IV.

Conclusions

The data indicate that the number of colleges and students involved in the study represent a significant part of higher education in the United States, and the quality of the programs in these schools as well as their products should be of concern to all.

General education science courses are much more prevalent now than at any other period in the colleges studied.

Many course designations are found in descriptive materials such as biological science, general biology, natural science, science survey, foundations and orientation. Only two schools indicated that courses were currently being organized; however, several indicated that the data supplied the investigator did not represent a true picture of their courses since they are undergoing complete reorganization. Since this study has been underway, four of the colleges included in the
study, working as a unit, have received a 1.5 million dollar grant from the United States Office of Education. These Colleges are conducting a similar type study concerned with both biological and physical science courses offered for general education in their institutions.

Students enrolled in the courses fall in three general groupings: all science majors, all students, and elective for all students. There was some concern expressed by a small minority of the teachers that the regular introductory courses in biology were suitable for all students. Faculty opinions are divided in some instances as to the value or worth of general education courses. Most of them, however, favor such courses.

Concerning time spent on courses, the investigator noted that three courses were conducted for two quarters, seventeen for one semester, and twenty-eight for a period of one year. The number of courses with a one-year duration seems significant since more topics of importance could be covered. The typical course offers three credit hours each semester. It was pointed out in an earlier study that there was a trend away from the survey type of course toward the block and gap type organization. Data from this study reveal just the opposite. Of the forty-eight schools responding, thirty-six conducted survey type courses, seven block and gap, and five other patterns of organization. These forty-eight courses were distributed in colleges and universities with enrollments
ranging from fewer than 500 to more than 5,000 students.

Course syllabi were requested and received from 41 per cent of the respondents. These materials offered an excellent check on data obtained from other sources. Certain ideas, which may be of value to others, were taken from the syllabi and included in Chapter IV. The total enrollments in these courses for the academic year was approximately 12,365 students, or 9 per cent of the total student population. There were more females than males enrolled in the courses, approximately 60 per cent and 40 per cent respectively. Class sizes ranged from a low of 9 to 160 and above, in one case, for lecture groups. The mean for the smallest, average, and largest classes was 37, 49, and 94 students respectively. For discussion or quiz groups the mean for the smallest, average, and largest classes was 27, 36 and 45 students respectively. Laboratory sections had class means of 24, 25, and 30 students for the smallest, average, and largest classes respectively. Laboratory teams seemed well balanced with only four schools reporting teams consisting of more than five students. Regarding the time general education biological science courses have been offered in these schools, 74 per cent of them reported that their courses have been in existence more than five years, in 50 per cent of the schools more than ten years. It could be assumed then that the majority of these courses would be well organized providing they have undergone continuous study and updating based on current trends.
The most common methods of approach are in their order of frequency: subject matter survey, integrated science approach, selected units, use of current periodical materials, historical approach, and a study of selected problems. Eighteen responses indicated a combination of the above approaches. A majority of the instructors gave as a basis for adoption of the method used instructor preference based upon personal opinion and study, and instructor preference based upon personal experience and research. As for teaching loads of instructors involved in the courses, an average of two sections was indicated. The average number of clock hours devoted to lecture and laboratory were three and two respectively.

Regarding instructional procedures and policies, 72 per cent of the respondents use one recommended text along with other references; 25 per cent use a single text only, whereas 3 per cent make use of reference and supplementary materials only. There seems to be a consensus that laboratory experiences are essential to the effective conduct of general education biological science courses. Twenty-two per cent of the courses had no associated laboratory sections, whereas 67 per cent had laboratory work on a regular schedule. From personal observation and data received from other sources, space, equipment and other facilities seemed adequate for conducting effective courses. Only 15 per cent of the colleges gave a lack of funds, time, and facilities as reasons for not conducting courses which they considered effective.
Forty per cent of the schools made no use of field experiences; this indicated a weakness in this respect.

Twelve objectives listed in the questionnaire regarding general education science courses were checked in order of importance by respondents. Twenty-two additional course objectives were obtained from course syllabi and listed in Chapter IV. Specific objectives were not given for several courses.

Evaluative procedures were primarily objective. The most prevalent type of tests given was the multiple-choice type affording students little opportunity for self-expression, written or oral. Tests of this type make it difficult, if not impossible, to determine whether course objectives have been accomplished. The frequency of testing was satisfactory. The largest percentage of class time was devoted to lecturing with recitation and testing following in order.

One hundred and forty-seven instructors were associated with the forty-eight courses, with 63 per cent devoting full time to the course and 37 per cent devoting part time. Forty instructors held the doctorate degree, and based on rank (professors and associate professors) sixty-two were senior staff members. The majority of the instructors represented various areas of specialization. Botany and zoology were about equally represented with human biology and science education following in order. Areas other than those mentioned above were also represented. More than 50 per cent of
the instructors had been employed specifically to teach these courses. Only approximately 5 per cent of the total instructors have had professional experience in areas other than teaching.

Opinions of the respondents concerning the courses were requested by the investigator. Those opinions given were generally constructive and were concerned with areas of the courses needing improvement. Special problems, if any, associated with the courses were also requested. Areas of concern were inadequate backgrounds of students, selection of course content, adequacy of laboratory experiences, and staff qualifications. Although student opinions concerning the courses were not requested from respondents, a student opinionnaire study was conducted and was deemed highly desirable. Five schools administered an opinionnaire to some 451 students. Tabulated data indicate that the students considered the courses to be effective in all areas except the evaluative aspects (tests, examinations, and quizzes). A majority had high praise for their instructors, especially for their grasp of subject matter and their willingness to help the individual student. Only slight disagreement was noted between the results obtained from the student opinionnaire study and the responses of instructors regarding students' opinions of their courses.

A review of current literature in the field reveals the following trends which have taken place in general education
science in the past several years. (1) There is a definite need for two kinds of courses, one for science majors and one for non-science majors. (2) The general education science courses are going more into depth in the treatment of subject matter. (3) Survey type courses are now considered taboo. (4) There is a trend toward the block and gap or selected unit type of course. (5) The term "scientific method" is being replaced with more appropriate expressions, such as "the methods of science" or "tactics and strategy of science." (6) There is a trend away from demonstrating practical applications of science toward placing stress on the social implications for the group and the individual. (7) The survey approach is still in wide use along with an interdisciplinary approach. Historical and problem approaches are being used in a limited way to achieve specific ends. (8) There is an increased emphasis on laboratory experiences which are investigative in nature. (9) Single teachers are being used to conduct the entire course instead of groups of specialists. (10) There is a trend toward requiring general education science courses for all students, or developing courses which combine the two types.

Respondents indicating trends which, in their judgment, had already developed in the field and those which had promise for future development were about equally divided in their responses. Although a considerable number of instructors were
aware of current trends, there was a lack of evidence as to the inclusion of these practices in their individual courses.

There is one significant need from which many of the course deficiencies possibly are derived. There is a need for a thorough understanding of the philosophy of general education. There is a need also for an acquaintance with and an understanding of the overall aims and objectives of the institutions as well as specific aims and objectives of individual courses. The selection of course content and the overall conduct of the course are determined by stated objectives and aims which are sought. Apparently there is no ideal body of content for a general education biology course. The main criterion is that the content should be satisfactory in order to achieve the objectives of the course.

In the courses studied, zoology and botany received most of the attention of content stressed. The topics most frequently included in the courses were traditional in nature; few topics concerning molecular biology were evident.

The consensus is that science courses designed for general education should help meet the needs of the individual as a citizen of a democratic society and give to him a facility in the use of the methods of science in the solution of problems to which it is applicable.

The purpose of this study has been to determine and appraise the status of biological science courses offered for
general education in predominantly Negro colleges in the United States. Significant trends were used to develop a concept of biological science for general education which may be used as a guide line in the development or reorganization of biological science courses offered for general education.

This study was carried out on the basis of several assumptions and the following two hypotheses:

1. The findings of the study will reveal a general weakness in the biological science courses offered for general education in predominantly Negro colleges in regards to established criteria in the study.

2. Inadequate physical facilities are not the primary factors contributing to the general weakness of biological science courses offered for general education in predominantly Negro colleges.

The data gained from questionnaire responses, opinions of respondents, a student opinionnaire study, personal interviews, examination of course catalogs and syllabi, along with the evaluation of these materials based on established criteria, have convinced the investigator that the above stated hypotheses must be categorically accepted. It should be stated, however, in all fairness, that a very limited number of the courses investigated were very well organized and could be considered as being effective in all respects. In order to point up further the foregoing conclusions, the investigator decided to list the conclusions resulting from a similar study made by Goins.
1. One inference that evolves from the study is the general education programs of the several colleges suffer from the lack of a well-formulated, clearly-understood philosophy of general education in the colleges.

2. A second implication of the study is that the quality of the general education science courses in the colleges suffers because of inadequacies in equipment and supplies.

3. It seems fairly certain from the evidence gathered during the investigation that, although of considerable importance, inadequacies in equipment and supplies, and the lack of consistent educational philosophies do not fully explain the general low level of the colleges with respect to their adequately meeting student needs in the general education science courses. Some of the more subtle and important factors are to be found in the academic environment in which teachers and students perform and in the quality of instruction carried on.

4. From the frequency with which it was offered as an excuse for various shortcomings in the courses examined, one may easily infer that too little time is allocated in most colleges to the general education science courses.

5. Probably the most important conclusion of the study is that the Negro colleges are becoming increasingly aware of the shortcomings of their present general education courses
and are more sensitive to the requirements of an adequate general education program.¹

With the exceptions of statements 2 and 4 above, the conclusions resulting from Goins' study, which was concerned with a similar problem and the same population, seem reliable and conform closely with the conclusions resulting from the present study.

Recommendations

The foregoing presentation of data, summary and conclusions warrant the following recommendations:

1. Exchanges of experiences concerning general education science courses be made among the colleges included in the study and with other colleges.

2. Colleges attempt to design courses suitable for the needs of their own students through experimentation and study.

3. A student opinionnaire be developed and used on a wide scale to measure intensely the several phases of the general education science courses from the student's point of view.

4. More colleges prepare individual laboratory manuals to include experiences associated with lecture topics.

5. More colleges continuously revise their courses based on current trends and self-appraisal.

6. More colleges make greater use of community resources to supplement inadequate laboratory experiences, for example, establish nature trails on or near campuses.

7. More emphasis be placed on principles and concepts in the coverage of course content and less emphasis placed on factual materials.

8. All instructors, especially those involved in general education, re-evaluate their philosophies of education.

9. Various evaluative procedures and devices be used in the courses.

10. A variety of first-hand experiences be provided for students in the courses.

11. More attention be paid to the learner as an individual.

12. Cultural factors and social implications of science be stressed in the presentation of course content.

General education courses in science seem to be firmly established in the colleges under investigation. Potential college teachers may well be interested in this area as one of specialization. The challenge in general education science seems to be directed to the instructor to experiment, improvise, and conduct courses for the purposes for which they were designed. If effective instruction is carried out in this area, we can expect an increased degree of scientific literacy on the part of our future citizenry.
APPENDIXES
APPENDIX A

ACCREDITED COLLEGES INCLUDED IN THE STUDY

1. Alabama State College
   Montgomery, Alabama
2. Alabama A & M
   Normal, Alabama
3. Albany State College
   Albany, Georgia
4. Alcorn A & M
   Lorman, Mississippi
5. A, M & N Normal
   Pine Bluff, Arkansas
6. Barber-Scotia College
   Concord, North Carolina
7. Benedict College
   Columbia, South Carolina
8. Bennett College
   Greensboro, North Carolina
9. Bethune-Cookman
   Daytona Beach, Florida
10. Bishop College
    Dallas, Texas
11. Bluefield State
    Bluefield, West Virginia
12. Bowie State College
    Bowie, Maryland
13. Central State
    Wilberforce, Ohio
14. Cheyney State
    Cheyney, Pennsylvania
15. Claflin College
    Orangeburg, South Carolina
16. Clark College
    Atlanta, Georgia
17. Coppin College
    Baltimore, Maryland
18. Daniel Payne
    Birmingham, Alabama
19. Daytona Beach Junior
    Daytona Beach, Florida
20. Delaware State
    Dover, Delaware
21. Dillard University
    New Orleans, Louisiana
22. District of Columbia
    Teachers
    Washington, D.C.
23. Elizabeth City State
    Elizabeth City, North Carolina
24. Fayetteville State
    Fayetteville, North Carolina
25. Fish University
    Nashville, Tennessee
26. Florida A & M
    Tallahassee, Florida
27. Florida Memorial
    St. Augustine, Florida
28. Fort Valley State
  Fort Valley, Georgia
29. Grambling College
  Grambling, Louisiana
30. Hampton Institute
  Hampton, Virginia
31. Howard University
  Washington, D.C.
32. Huston-Tillotson
  Austin, Texas
33. Jackson State
  Jackson, Mississippi
34. Johnson C. Smith
  Charlotte, North Carolina
35. Kentucky State
  Frankfort, Kentucky
36. Knoxville College
  Knoxville, Tennessee
37. Lane College
  Jackson, Tennessee
38. Langston University
  Langston, Oklahoma
39. Le Moyne College
  Memphis, Tennessee
40. Lincoln University
  Jefferson City, Missouri
41. Lincoln University
  Oxford, Pennsylvania
42. Livingstone College
  Salisbury, North Carolina
43. Maryland State
  Princess Anne, Maryland
44. Morehouse College
  Atlanta, Georgia
45. Morgan State College
  Baltimore, Maryland
46. Morris Brown
  Atlanta, Georgia
47. Morristown N & I
  Morristown, Tennessee
48. North Carolina College
  Durham, North Carolina
49. North Carolina A & T College
  Greensboro, North Carolina
50. Oakwood College
  Huntsville, Alabama
51. Owen College
  Memphis, Tennessee
52. Paine College
  Augusta, Georgia
53. Philander-Smith
  Little Rock, Arkansas
54. Prairie View
  Prairie View, Texas
55. St. Augustine College
  Raleigh, North Carolina
56. St. Paul's College
  Lawrenceville, Virginia
57. St. Petersburg Junior College
  St. Petersburg, Florida
58. St. Phillip's Junior College
  San Antonio, Texas
59. Savannah State College
  Savannah, Georgia
60. Shaw University
  Raleigh, North Carolina
61. South Carolina State College  
    Orangeburg, South Carolina

62. Southern University  
    Baton Rouge, Louisiana

63. Spelman College  
    Atlanta, Georgia

64. Stillman College  
    Tuscaloosa, Alabama

65. Talledega College  
    Talledega, Alabama

66. Tennessee A & I University  
    Nashville, Tennessee

67. Texas Southern  
    Houston, Texas

68. Tougaloo College  
    Tougaloo, Mississippi

69. Tuskegee Institute  
    Tuskegee, Alabama

70. Virginia State College  
    Petersburg, Virginia

71. Virginia Union University  
    Richmond, Virginia

72. Voohees School & Junior College  
    Denmark, South Carolina

73. West Virginia State College  
    Institute, West Virginia

74. Wilberforce University  
    Wilberforce, Ohio

75. Wiley College  
    Marshall, Texas

76. Winston-Salem State College  
    Winston-Salem, North Carolina

77. Xavier University  
    New Orleans, Louisiana
APPENDIX B

INQUIRY CARD SENT TO PROSPECTIVE RESPONDENTS

Dear Sir:

I am conducting a study of college biological science courses designed for general education. I desire information concerning either integrated courses or single subject courses planned specifically for the general student rather than for the one who is to specialize in a particular field of science. Please fill in the attached card and mail it at your earliest convenience. Your cooperation will be appreciated.

HUNTER D. HAMLETT
Associate Professor of Biology
Virginia State College

The following courses in biological science for general education are offered at this school:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Department</th>
<th>Prof. in Charge</th>
</tr>
</thead>
</table>

If no course is offered, please answer Yes or No to the following statements:

____ We have had such a course but dropped it.
____ We plan to introduce such a course next year.
____ We desire such a course but have not introduced one because

______________________________

Respondent:
School:
APPENDIX C

A STUDY OF COLLEGE BIOLOGICAL SCIENCE COURSES
DESIGNED FOR GENERAL EDUCATION PURPOSES

Name of Institution ________________________________

Location _________________________________________

Respondent _______________________________________

Position __________________________________________

Date _____________________________________________

State Private Munic. Gen. Teachers Liberal Arts Junior College
__________________________________________________

Rated by: (Association)
__________________________________________________

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PART I
ENROLLMENT AND ADMINISTRATIVE ORGANIZATION

1. Current enrollment in your college (regular day students). _____________

2. List below the name, catalogue number, department or school, and professor in charge of biological science courses designed to meet the requirements of a program of general education in your institution.
   Title of Course __________________________
   Course No. _______________________________
   Dept. or School Offering _________________
   Professor in Charge ______________________

3. For what students, i.e., agriculture, engineering, pharmacy, law, medicine, education, liberal arts, etc., in each course a required subject? For what group or groups is each course elective?
   Required for (name groups) ____________
   Elective for (name groups) ______________

4. Biological science courses for general education offered during the year in your school are of the following types and duration. Indicate by check (/).
   Block and Survey Gap Other
   1 quarter _______ _______ _______ _______
   2 quarters _______ _______ _______ _______
   1 semester _______ _______ _______ _______
   1 year _______ _______ _______ _______

5. Has a syllabus, course outline, or other descriptive material been prepared? Yes _____ No ____
   a. The investigator desires the use of course syllabi and outlines for this study. These materials are being sent herewith.
      Yes _____ No _____

6. Please indicate any major differences between your present course and that specified in the descriptive material named in 5.

7. Total enrollment in course 1966-67 ________________

8. For the year 1966-67 the enrollment consists of
   ______ % men and ______ % women.

9. Class size (1966-67)
   Small- _Larg- _Aver-
est _age

   Number of students
   in a lecture group_______
   Number of students
   in a discussion or quiz group ______
   Number of students
   in a laboratory section ______

   Number of students in each laboratory team ______

   Please place a check mark in the blank before the appropriate statement in the following questions. Check more than one if needed.

10. The biological science course for general education has been offered:
    ______ a. less than 5 years
    ______ b. between 5-10 years
    ______ c. more than 10 years

11. The course is:
    ______ a. separated into units
    ______ b. taught as an integrated science course

12. The course is conducted by:
    ______ a. a single instructor
    ______ b. several instructors from specialized fields
    ______ c. a single instructor with guest lecturers.
13. Course credit:
   a. satisfy minimum science requirement for non-science majors
   b. is given as an elective for non-science majors
   c. is given as an elective for any student
   d. is required for non-science majors.

14. Teaching load of instructor conducting general education biological science courses:
   a. The instructor conducts sections of general education biological science.

PART II
INSTRUCTIONAL PROCEDURES AND POLICIES

Please check more than one answer if appropriate.

1. The selection of course content is based on:
   a. a single textbook
   b. student needs
   c. student needs as determined from student questionnaire

2. The course is taught from:
   a. a single textbook
   b. one text plus references
   c. no specific text but through reference texts and supplementary materials

3. What texts are used by students enrolled in the course?

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
</tr>
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<tbody>
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</table>

4. What principal supplementary readings are assigned to all students?

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
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</thead>
<tbody>
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</tbody>
</table>

5. The instructional approach is:
   a. block and gap--fewer topics, more intensity
   b. general survey--more topics, less intensity

6. Adoption of instruction approach was based on:
   a. instructor preference
   b. group consensus
   c. other

7. Laboratory work is performed:
   a. individually
   b. by groups or pairs
   c. as teacher or student demonstrations

8. Laboratory work is:
   a. not required
   b. is required
   c. provided as need arises

9. Class reports are based on:
   a. a problems approach
   b. a historical approach
   c. science oriented current events
   d. other
10. Audio-visual materials: triple check (✓) type used most frequently, double check (✓) type used next most frequently, and single check (✓) others used less frequently
   a. overhead projector
   b. micro-projector
   c. opaque projector
   d. sound motion pictures
   e. film strips
   f. slides
   g. television
   h. other

11. If audio-visual materials and other teaching devices are seldomly used, the main reason(s) are:
   a. lack of funds
   b. lack of time and facilities
   c. availability of materials
   d. other

12. Free teaching aids from industrial firms:
   a. are never used
   b. are used
   c. are considered of little value

13. Field experiences:
   a. are never used
   b. are used on an average of _______ times per term

14. Class projects, individual or group:
   a. are required
   b. are not required
   c. are optional

15. Course objectives suggested by the 46th Yearbook Committee of the N.S.S.E. Check those which you consider of importance.
   a. obtaining factual information
   b. understanding important scientific principles and concepts
   c. ability to make accurate observations
   d. ability to form workable hypotheses
   e. open-mindedness—willingness to consider new facts
   f. appreciation of basic cause and effect relationships
   g. appreciation of the contribution of scientists
   h. understanding the methods of science
   i. understanding the scientists as a person
   j. others

16. Instructional and evaluative procedures; short tests are:
   a. never used
   b. used _______ times per week
   c. used for both teaching and evaluative devices

17. Major tests are given _______ times per term.

18. Major tests are:
   a. returned to students
   b. not returned to students

19. Major tests are:
   a. mainly objective
   b. mainly subjective
   c. a combination of the above

20. Course grades are:
   a. based on a fixed formula
   b. based on a flexible formula
   c. based on instructor's judgment

21. Course grades:
   a. adhere to the normal curve
   b. are related to the curve for reference only

22. Approximate the percentage of class time devoted to the following instructional procedures:
   a. lecture
   b. discussion
   c. recitation
   d. testing
   e. other
### PART III

**INSTRUCTIONAL PERSONNEL, QUALIFICATIONS, OPINIONS**

1. How many instructors devote full time to the course? How many devote part time? What is the highest degree attained by each?

<table>
<thead>
<tr>
<th>Rank</th>
<th>Number in each Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assoc. Ass't.</td>
<td></td>
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<tr>
<td>Prof. Prof.</td>
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<tr>
<td>Prof. Inst. Ass't.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Degree Attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full time</td>
<td></td>
</tr>
<tr>
<td>Part time</td>
<td></td>
</tr>
<tr>
<td>Doctorate</td>
<td></td>
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<tr>
<td>Masters</td>
<td></td>
</tr>
<tr>
<td>Bachelors</td>
<td></td>
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</tbody>
</table>

2. How many instructors from each area of specialization are responsible for instructions in the course?

- Botany
- Human Biology
- Zoology
- Science Education

3. How many individuals have been employed specifically for the purpose of teaching this course?

4. What is the number of instructors with whom the individual student comes in contact during the course?

5. Are regular staff meetings held where more than one teacher is responsible for instruction in the course?

   Yes ________ No ________

6. Instructor's professional experience:
   a. number of years taught on college level
   b. number of years taught on elementary or secondary levels

7. Please use the space below to state any particular opinions you have concerning the course.

8. Special problems associated with the course are:

9. Double check (✓) those trends, which in your judgment, have already developed in general education biological science courses, and single check (✓) those which you believe will occur in the future.

   - a. more integration of physical and biological sciences
   - b. a trend toward the block and gap type of course
   - c. a trend toward the survey type of course
   - d. greater stress on factual materials
   - e. more emphasis on individual laboratory work
   - f. greater stress on principles and concepts
   - g. more emphasis on use of demonstrations
   - h. greater use of audio-visual materials
   - i. more emphasis on student-teacher planning
   - j. more emphasis on cultural factors and social implications of science
### PART IV  COURSE CONTENT

1. Would you please indicate the appropriate degree of emphasis placed in the following topics in your course.

<table>
<thead>
<tr>
<th>Topics</th>
<th>Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science of Biology</td>
<td></td>
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<tr>
<td>Principles of Chemistry</td>
<td></td>
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<tr>
<td>Cells and Tissues</td>
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<tr>
<td>Roots, Stems and Leaves</td>
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<tr>
<td>Flowers, Fruits and Seeds</td>
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<tr>
<td>Respiration</td>
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<tr>
<td>Photosynthesis and Carbon Compounds</td>
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<tr>
<td>Chemical Coordination in Plants</td>
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<tr>
<td>Nervous Coordination</td>
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<tr>
<td>The Senses</td>
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<tr>
<td>Circulation</td>
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<tr>
<td>Breathing</td>
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<td>Digestion</td>
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<td>Excretion</td>
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<td>Movement</td>
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<tr>
<td>Covering and Support</td>
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<tr>
<td>Reproduction</td>
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<tr>
<td>Microorganisms--Organization, Function</td>
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<tr>
<td>Mitosis and Meiosis</td>
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<td>Genetics</td>
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<tr>
<td>Plant and Animal Development</td>
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<tr>
<td>Growth, Aging and Death</td>
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<tr>
<td>Taxonomy</td>
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<tr>
<td>Algae and Fungi</td>
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<tr>
<td>Mosses and Liver-worts</td>
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<tr>
<td>Seedless Vascular Plants</td>
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<tr>
<td>The Seed Plants--Gymnosperms</td>
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<tr>
<td>The Seed Plants--Angiosperms</td>
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<tr>
<td>Protozoa</td>
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<tr>
<td>Coelenterates</td>
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<tr>
<td>Flatworms</td>
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<tr>
<td>Rotifers and Round-worms</td>
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<tr>
<td>Segmented Worms</td>
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<tr>
<td>Anthropods</td>
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<td>Mollusk</td>
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<td>Echinoderms</td>
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<tr>
<td>The Vertebrates</td>
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<tr>
<td>Evolution</td>
<td></td>
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<td>Ecology</td>
<td></td>
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<tr>
<td>Health and Diseases</td>
<td></td>
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<tr>
<td>Others</td>
<td></td>
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</tbody>
</table>

2. Please indicate the percentage of the entire course content contributed by each of the sciences listed below.

<table>
<thead>
<tr>
<th>Sciences</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td></td>
</tr>
<tr>
<td>Human Biology</td>
<td></td>
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<tr>
<td>Zoology</td>
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</tbody>
</table>
3. In the development of "scientific attitudes":


b. Are the social implications of science emphasized? Explain.
Dear

For the completion of requirements for the Ph.D. degree in science education at the Ohio State University, I am making a study of biological science courses offered for general education purposes in a selected group of colleges. This study will require the completion of the enclosed questionnaire by some key person who works in or is acquainted with biological science courses offered for general education.

A summary of the results of this study will be sent to respondents. I ask your cooperation by filling out the enclosed questionnaire at the earliest possible convenience.

Respectfully yours,

HUNTER D. HAMLETT
Associate Professor of Biology
Dear

The study which I am making of biological science courses offered for general education purposes is progressing satisfactorily. I am, however, attempting to obtain a maximum response to the questionnaire which was sent to key persons in the selected colleges during the month of November, 1966. I would appreciate receiving a response from you at your earliest convenience.

Respectfully yours,

HUNTER D. HAMLETT
Associate Professor of Biology
APPENDIX F

Opinionnaire
Form 2, 1951
Evaluation Service Center
Syracuse University

STUDENT OPINIONNAIRE

For Appraising a Course and its Information

Directions: Your instructor is interested in improving this course. You can help by giving your careful attention and your honest answers to the statements in this opinionnaire. For each statement, mark on the answer sheet the response which best expresses your opinion about the course and its instruction. Write the name of your instructor and the title and number of the course on the answer sheet. Do not write your own name.

1. Objectives of this course were:
   a) fully explained early in the course
   b) discussed in broad terms, but not fully explained
   c) mentioned by the instructor
   d) implied in a general way, but not specifically discussed
   e) not mentioned or discussed by the instructor

2. Plans for the course, as it progressed from week to week, were:
   a) very well organized
   b) evidently organized
   c) loosely organized
   d) vague and sketchy
   e) not evident to students

3. Assignments were related to the purposes and development of the course in a way which was:
   a) obvious, meaningful, constructive
   b) adequately clear, helpful
   c) fairly clear
   d) hazy, indefinite
   e) obscure, confusing

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4. Students were drawn into class activities in a way which:
   a) strongly stimulated thinking and problem solving
   b) moderately stimulated thinking and problem solving
   c) produced relatively little stimulation to thinking and problem solving
   d) tended to discourage thinking and problem solving
   e) discouraged thinking and problem solving

5. The principles or concepts developed in this class were:
   a) very well illustrated; explained in a way that students knew exactly what was meant.
   b) well illustrated; explained in a way that gave students a good grasp of the ideas
   c) fairly well illustrated; gave students a general idea of what was meant
   d) vaguely illustrated; left students in doubt
   e) badly illustrated; confusing; left students with mistaken ideas

6. When tests or quizzes were given in this course, the students:
   a) knew and understood in advance their major purpose and emphasis
   b) had a good idea what was coming
   c) had a general notion of what was expected
   d) did not know what to expect
   e) expected something quite different from what they actually got

7. The tests and examinations in this course:
   a) were very well balanced; provided excellent opportunity to demonstrate possession of broad knowledge and understanding
   b) were well balanced; sufficiently broad to cover the main objectives of the course
   c) provided a reasonable coverage of the main objectives
   d) tended to emphasize some parts of the course to the neglect of others
   e) stressed minor or irrelevant points; providing little or no opportunity for students to demonstrate a broad knowledge of the subject
8. The instructor used evidence about students' progress in such a way that:
   
a) most difficult points were cleared up  
b) many difficult points were cleared up  
c) some difficult points were cleared up  
d) none of the students' difficulties were cleared up  
e) students' difficulties tended to be increased

9. I believe that specific information obtained from this course is, or will be:
   
a) extremely useful  
b) quite useful  
c) of some use  
d) of very little use  
e) of no use at all

10. In this course, I have become acquainted with:
    
a) a great many new ideas and points of view  
b) a substantial number of new ideas and points of view  
c) some new ideas and points of view  
d) very few new ideas and points of view  
e) no new ideas and points of view

11. The experience of taking this course has been of:
    
a) great positive and personal value to me  
b) substantial positive and personal value to me  
c) some positive and personal value to me  
d) little positive and personal value to me  
e) no positive and personal value to me

12. Relative to helping students individually, in and out of class, the instructor seemed:
    
a) very willing  
b) quite willing  
c) neither pleased nor displeased to do so  
d) reluctant to do so  
e) opposed and unwilling

13. The instructor's appreciation of the students' point of view was:
    
a) very understanding, friendly sympathetic  
b) understanding and friendly  
c) generally sympathetic  
d) often neutral and unconcerned  
e) usually lacking and impatient
14. The instructor's grasp of his subject and related fields was:

a) extremely good, thorough and broad
b) good; extensive; wide
c) good in his subject, fair in related fields
d) fair in his subject; weak in related fields
e) poor, limited and restricted; inadequate

15. The instructor's ability and willingness to answer relevant questions in class was:

a) excellent; quick, to the point, and clear
b) good
c) fair
d) rather poor
e) very poor; grudging, vague, confusing

16. The instructor's regard for the students as individuals was:

a) genuine and sincere at all times
b) understanding, respectful
c) generally good
d) sometimes lacking in appreciation, tending to be aloof and unthinking
e) disrespectful, cold, sarcastic

17. In dealing with students, the instructor:

a) was completely fair at all times
b) was generally impartial and fair
c) was inconsistent
d) tended to be partial
e) showed definite favoritism and personal bias

18. In my opinion, the instructor's personality was:

a) outstandingly pleasing and attractive
b) definitely pleasing
c) generally pleasing
d) neutral; did not please or displease me
e) displeasing, unattractive
APPENDIX G

TEXTBOOKS USED IN COURSES


Supplementary Readings


Others

Current Readings in Newspapers and Magazines.

Industry Sponsored Materials.


*Life* Magazine.

*Science Digest*.

*Science Monthly*.

*Science Teacher*.

*Scientific American*.
APPENDIX H

Dear

Thank you for completing and returning the questionnaire which was sent to you concerning the study which I am making of college biological science courses designed for general education purposes.

In order to enhance the validity of the study, I am attempting to obtain a random sample of student opinions concerning these courses also. We have used a Student Opinionnaire for Appraising a Course and Its Information here at Virginia State College and have found the results quite rewarding.

I am requesting your cooperation in administering the same instrument to a representative sample of students enrolled in your general biology courses. We administered the instrument during our regular class periods utilizing approximately fifteen minutes. I would be pleased to send you the required number of opinionnaires upon request. The completed forms would be mailed to me C.O.D., and a listing of the results would be forwarded to you after tabulation of the data is completed.

Very truly yours,

Hunter D. Hamlett

HDH/1j

Enclosure
Adams, Clyde S. "The Importance of Laboratory Work in General Education at the College Level," Journal of Chemical Education (June, 1942), pp. 266-270.

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