A Report on the Status of Advanced Biology in Large Secondary Schools of the United States

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I. *Introduction*

In 1952 Martin reported, "The course in advanced biology . . . is a comparatively recent addition to the curriculum. It is offered more frequently in large high schools than in small high schools." (1)

In a recent article the author (2) presented the results of a survey on advanced biological science courses in large secondary schools. This survey of 1217 schools indicated that 171 of them offered advanced biology.

Advanced biology is defined as a one or two semester biology course requiring as a minimum prerequisite the completion of a course in General Biology. The survey also revealed that this course may have five different titles. These are Advanced Biology, Biology II, College Biology, Biology 3 and 4, and Biology III.

As a result of their prevalence a status study of these courses was undertaken. During the academic year 1959-1960 a questionnaire was sent to the chairman of the biology department in each of the schools offering advanced biology. One hundred thirty-five complete and usable questionnaires were returned. Therefore this article constitutes a summary statement on the status of advanced biology in 135 large secondary schools in the continental United States.

II. *Reasons for Offering Advanced Biology*

Speculation as to why the advanced biology course has been added in many large secondary schools prompted Fordyce (3) to list several possible reasons for its appearance. These included the nurturing of student interest in biology; enabling the student to gain either advanced standing and/or credit in biology upon entering college; providing for an additional course for the senior student who has completed three years of intensive course work; and attempting to extend the first year course into untouched areas. Kastrinos has reported offering a second year course "for the student interested in some phase of biology as a future." (4)

One hundred thirty-five teachers of advanced biology were asked to state the primary reason for offering their course. Eleven teachers reported their courses were designed for both the general education of terminal students and the specialized education of college preparatory students. The remaining 124 teachers stated the primary purpose of their advanced biology was college preparation or pre-professional education. Therefore over 91 per cent of advanced biology courses are designed for college-bound students.

Seventeen teachers reported that at least some of their students took the Advanced Placement Program Test in Biology (APPTB); six teachers specifically stated that their course was advanced placement biology. Ninety-five students in seventeen schools took the APPTB and over 4400 students in the remaining 118 schools did not take this test during the academic year 1958-1959. Fifty-nine students were reported to have received advanced standing and/or credit upon entering college; of these, forty-seven had also taken the APPTB. It becomes apparent that students accorded the advantages of the Advanced Placement Program are much more successful in obtaining college credit and course waiver. Perhaps more teachers of advanced biology should acquaint themselves with this program so that their better students could subsequently benefit.

III. *Textbooks and Reference Materials*

Textbooks have long played a leading role in our secondary schools. American teachers have traditionally relied on them to a much greater extent than have their European

TABLE 1

Primary Textbooks Used in Advanced Biology Courses

Textbook Used Title Author(s) Publisher	Textbook Level H = High School C = College	Frequency of Use		
		When One Textbook Is Used	When More Than One Text Used	Total Number Schools Using Text
1. LIFE Simpson, et al. Harcourt-Brace	C	13	2	15
2. GENERAL BIOLOGY Johnson, et al. Henry Holt	C	8	1	9
3. GENERAL BIOLOGY Mavor Macmillan	C	7	1	8
4. MODERN BIOLOGY Moon, et al. Henry Holt	H	7	1	8
5. HUMAN PHYSIOLOGY Morrison, et al. Henry Holt	C	6	2	8
6. THE SCIENCE OF BIOLOGY Weisz McGraw-Hill	C	6	1	7
7. PRINCIPLES OF BIOLOGY Whaley, et al. Harper	C	5	1	6
8. BIOLOGY Villee Saunders	C	5	1	6
9. PRINCIPLES OF MODERN BIOLOGY Marsland Henry Holt	C	4	1	5
10. BIOLOGY Brown Heath	C	4	1	5
11. ANIMALS WITHOUT BACKBONES Buchsbaum U. of Chicago	C	1	4	5
12. BIOLOGY MacDougall & Hegner McGraw-Hill	C	4	1	5
13. BIOTIC WORLD AND MAN Milne & Milne Prentice-Hall	C	4	0	4
14. BIOLOGY Winchester D. Van Nostrand	C	4	0	4

counterparts. As a result the textbook has become, "in the final analysis, the most influential factor in determining what is to be taught in any science." (5)

Leaders in science education have recommended that a textbook be used as the basis for a science program. Debatable as this point of view may be, Thurber and Collette state, "A textbook is fundamentally a course of study, designed to stand alone without implementation." (6)

In view of the fact that textbooks are primary tools of science teaching, a survey of the principal textbooks used in advanced biology courses was undertaken. Table 1 lists the fourteen most commonly used textbooks,

TABLE 2

Principal Reference Textbooks Used in Advanced Biology Courses

Textbook	Frequency of Use	Textbook	Frequency of Use
1. LIFE Simpson, et al. Harcourt-Brace	20	19. GENERAL ZOOLOGY Storer McGraw-Hill	5
2. THE SCIENCE OF BIOLOGY Weisz McGraw-Hill	19	20. THE LIVING BODY Best & Taylor Henry Holt	5
3. COLLEGE ZOOLOGY Hegner & Stiles Macmillan	17	21. GENERAL BIOLOGY Johnson, et al. Henry Holt	5
4. ANIMALS WITHOUT BACKBONES Buchsbaum U. of Chicago	15	22. PRINCIPLES OF GENETICS Sinnott, et al. McGraw-Hill	4
5. ELEMENTS OF ZOOLOGY Storer & Usinger McGraw-Hill	14	23. ANATOMY OF HUMAN BODY Gray Lea & Febiger	4
6. GENERAL BIOLOGY Mavor Macmillan	11	24. BACTERIOLOGY Bryan & Bryan Barnes and Noble	4
7. COLLEGE BOTANY Fuller & Tippo Henry Holt	10	25. HUMAN PHYSIOLOGY Morrison, et al. Henry Holt	4
8. BIOLOGY Brown Heath	9	26. MAN AND THE VERTEBRATES Romer U. of Chicago	3
9. BOTANY Robbins, et al. Wiley	8	27. MACHINERY OF THE BODY Carlson & Johnson U. of Chicago	3
10. BIOLOGY Winchester D. Van Nostrand	8	28. PRINCIPLES OF BIOLOGY Whaley, et al. Harper	3
11. BOTANY Wilson Dryden Press	7	29. SOURCEBOOK FOR BIO. SC. Morholt, et al. Harcourt-Brace	3
12. BIOTIC WORLD AND MAN Milne & Milne Prentice-Hall	7	30. THE HUMAN ORGANISM DeCoursey McGraw-Hill	2
13. MODERN BIOLOGY Moon, et al. Henry Holt	7	31. GENETICS Winchester Houghton-Mifflin	2
14. BIOLOGY Villee Saunders	6	32. PRINCIPLES OF ZOOLOGY Hickman Mosby	2
15. PRINCIPLES OF MODERN BIO. Marsland Henry Holt	6	33. GREAT EXPERIMENTS IN BIO. Gabriel & Fogel Prentice-Hall	2
16. TEXTBOOK OF PHYSIOLOGY Kimber, et al. Macmillan	5	34. GENERAL ZOOLOGY Miller & Haub Henry Holt	2
17. THE PLANT WORLD Fuller Henry Holt	5	35. TEXTBOOK OF PHYSIOLOGY Zoethout & Tuttle Mosby	2
18. MAN AND HIS BIO. WORLD Harrah, et al. Ginn	5	36. HOW LIFE BEGAN Adler Signet	2

their educational level, and their frequency of use. A total of thirty-seven different textbooks were reported as being the primary or co-primary advanced biology text by 112 secondary schools. Teachers in twenty-three schools reported that no specific textbook was used.

The fourteen texts listed in Table 1 are being used by 73.0 per cent of schools reporting the use of a textbook. As might be expected all but one are considered to be college level; with two exceptions all are general biology texts. Nine schools reported using a combination of two texts, three schools use three different books, and one school reported assigning four textbooks to the students.

No one textbook can possibly cover the materials of a course of study in precisely the manner or sequence proposed by all teachers. Therefore reference textbooks assume increased importance. Frankel (7) has said that separate supplementary reference books in advanced biology are most desirable and helpful.

A total of seventy-two different textbooks were reported being used as references. Table 2 lists thirty-six of the most common reference texts. These thirty-six constituted 85.5 per cent of the total reported.

Journals and magazines are extremely helpful in many academic courses. The latest developments from research may reach the reader of a periodical one to three years before they appear in a textbook. A single subject may be discussed in much greater depth in a journal than in a textbook. Illustrations are often more numerous in magazines than in books. Consequently magazines and journals can be very valuable supplements to advanced biology courses.

One hundred twenty-nine teachers reported their students made frequent use of regularly published periodicals. Table 3 lists the names of these publications and their frequency of use.

An investigation into the use of films and laboratory manuals was made. It was found that neither of these teaching aids are extensively used. Only twenty-six teachers, constituting less than 20 per cent of the sample, reported the use of a laboratory manual in advanced biology. Three-fourths of teachers replied that they used less than three hours of films during a semester.

IV. *Programming Advanced Biology*

Advanced biology is a recent addition to the science curriculum. Thirty-three schools reported offering the course for the first time during the 1959-1960 school year. The average length of time for which advanced biology has been offered is 5.3 years. However advanced biology has been included in the science curriculum of one school for thirty years.

TABLE 3
Journals and Magazines Used as Supplemental Reading Material

Name of Periodical	Frequency of Use
Scientific American	114
Science News Letter	91
National Geographic	68
Natural History	67
Nature	56
Science	51
American Biology Teacher	50
Science World	36
Scientific Monthly	23
American Scientist	12
Today's Health	9
Science Digest	7
The Science Teacher	4
Turtox News	4
Current Science and Aviation	2
Life Magazine	2
AMA Journal	2
Biological Abstracts	2
Journal of Biochemistry	1
Canadian Nature	1

One hundred twenty-two schools out of 135 offer advanced biology as a full year course. Twelve schools offer a one semester course. One school reported that their course was designed so that selected students could continue project work into a second year.

There were 116 schools that offer advanced biology every year. Three schools offered the course on alternate years and sixteen offered it only on demand. Fifty-six per cent of schools scheduled a single class of advanced biology per day and an additional 33.1 per cent schedule from two to four classes of the course per day.

The length of the mean class period was found to be 50.6 minutes. The mean laboratory period was 56.9 minutes; only sixteen schools reported a laboratory period double the length of the class period. Three schools

have no laboratory work and three replied that their course was entirely of laboratory nature. A further refinement of data indicated that the average advanced biology student spends 285 minutes per week in regularly scheduled classroom and laboratory periods. Of this total, 166.8 minutes are devoted to classroom activities and 118.2 minutes are spent carrying out laboratory work.

Fordyce (8) feels that the advanced biology class should be scheduled during the final periods of the day to allow a student to continue work uninterrupted into the informal after-school hours. However this practice is not widespread; in the 135 courses studied only twenty-two schools reported such scheduling.

A wide range of class sizes exists, one school reporting only three students in advanced biology to four schools reporting thirty-eight students per class. The mean class size was found to be 23.5 students. In regards to grade level of the students enrolled, 52.1 per cent were twelfth grade students, 38.9 per cent were in the eleventh grade, and 9.0 per cent were tenth grade students.

The degree to which chemistry had been made a prerequisite of advanced biology was also studied. It was found that forty-six secondary schools require either prior or concurrent registration in chemistry for entrance into advanced biology. Because chemistry has become such an integral part of modern biological knowledge, perhaps it would be well for advanced biology teachers to carefully consider adding this prerequisite to their course.

V. *Research Projects and Written Reports*

In the introductory chapters of nearly all secondary school science textbooks will be found a description of the scientific method. Five, six, or seven steps that a scientist uses in research are usually outlined. Apparently many authors consider this presentation sufficient introduction to research for many students. This is doubtful. As Silber points out, "How many high school students would be more interested in science careers if they could really do something creative and challenging?" (9) And Snyder says, "The real opportunity for enrichment comes with the preparation of a research project." (10)

Teachers of advanced biology were questioned on the use they made of research projects. To reduce the chance of misunderstanding, the term "research project" was defined as a problem of such nature that the student must be thoroughly acquainted with the literature on the problem *and* spend considerable time in the laboratory or field in an attempt to arrive at a solution.

Table 4 and Table 5 summarize the results of the inquiry on research projects. It is apparent that the number of teachers requiring individual projects is about equal to those making them optional. In regards to group research projects, Table 5 indicates that these are undertaken in 42.2 per cent of advanced biology courses. This is noteworthy when one considers how commonplace group effort has become in both basic and applied research today.

TABLE 4

The Extent to Which Research Projects Are Undertaken by Individual Students

Action Taken	Frequency	Per Cent
A. Research projects are required of all students	62	45.9
B. Research projects are optional	57	42.2
C. No research projects are undertaken	16	12.0

TABLE 5

The Extent to Which Research Projects Are Undertaken by Groups of Students

Action Taken	Frequency	Per Cent
A. Group research projects are undertaken	57	42.2
B. No group research projects are undertaken	78	57.7

VI. *The Advanced Biology Teacher*

The quality of an advanced biology course depends in no small part on the teacher. To be sure, the physical plant, the textbooks

used, and the laboratory equipment are important, but none surpass the teacher's role. Conant has stated "that on the quality of the teachers the quality of the education must ultimately depend." (11) An attempt was therefore made to ascertain some of the background of the advanced biology teacher.

One hundred eight teachers have earned either a master's or doctor's degree; the remaining possess a bachelor's degree. Seventy per cent of the graduate and 82 per cent of the undergarduate degrees were earned in conjunction with a biology subject matter major. Only three advanced biology teachers replied that they had neither a biology major while earning their degree nor had recently taken college work in biology.

When considering the rapid pace of research and its concomitant increase in biological knowledge, it is encouraging to learn that advanced biology teachers show great inclination to return periodically to school. Table 6 shows that some three-fourths of these teachers have taken biology course work in college within the past six years.

Advanced biology teachers desiring to take college work have received much help in the form of financed study grants. The 135 teachers reported a total of ninety-six grants; the National Science Foundation easily helped the greatest number of teachers, having supplied seventy-one of the grants that were reported.

TABLE 6

Number of Years Since the Teacher Has Taken a Biological Science Course in College

Years Since Such Courses Taken	Frequency	Per Cent of All Teachers
0 - 2	76	56.3
3 - 5	22	16.4
6 - 8	7	5.2
9 - 11	14	10.4
12 - 14	1	0.7
15 - 17	2	1.5
18 - 20	7	5.2
21 - 23	1	0.7
24 - 26	0	0.0
27 - 29	0	0.0
30 - 32	2	1.5
No Reply	3	2.2

Ninety-one per cent of advanced biology teachers have at least five years of teaching experience. The mean number of years experience was found to be 18.8 with a range from two to forty-four years.

Ninety-eight teachers representing 72.6 per cent of the 135 surveyed reported belonging to a science or science teaching organization. Nineteen such organizations were reported, the National Association of Biology Teachers and the National Science Teachers Association being the most popular.

The data would indicate that most advanced biology courses are taught by teachers who are experienced, well-prepared, professionally minded, and possessing much up-to-date information in the field of biology.

VII. *Course Content*

No status study of advanced biology would be complete without an investigation into the course content. Teachers are interested in what general and what specific subjects are included in the courses of study; what subjects are considered to have been adequately studied in prerequisite general biology; and, what emphasis is placed by the teacher on the subjects that are included in the course.

An investigation into course content is valuable for another reason. Although a course may carry the title of advanced biology and use a college level general biology textbook, in reality it may, for example, emphasize human physiology and anatomy and exclude other areas of biological importance. By obtaining information on the subjects comprehensively studied, it is possible to develop a better understanding of the course content.

Teachers were requested to respond to nine general content sections containing a total of sixty-nine specific subject items. A check list of the subject items was so prepared that the teacher could check one of four responses to each item. The four responses were:

A. The subject is presumed to have been adequately studied in the first biology course and, though possibly discussed, is not enlarged upon in advanced biology.
B. The subject is mentioned and/or defined

TABLE 7

Degree to Which Cellular Structures and Functions Are Studied in Advanced Biology

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Nature of cell membrane porosity	20	14.8	44	32.6	63	46.6	8	6.0
2. Nature of cell membrane permeability	23	17.0	32	23.7	77	56.9	3	2.2
3. Nature of diffusion, dialysis, osmosis	30	22.2	24	17.7	78	57.6	3	2.2
4. Nature of solutions in protoplasm	18	13.3	51	37.7	55	40.8	11	8.1
5. Nature of suspensions in protoplasm	19	14.0	51	37.7	53	39.2	12	9.0
6. Nature of emulsions in protoplasm	15	11.1	53	39.2	53	39.2	14	10.4
7. Nature of colloids in protoplasm	14	10.4	52	38.5	56	41.5	13	10.0
8. Nature of the mitochondria	8	6.0	56	41.5	52	38.5	19	14.0
9. Nature of plastids and vacuoles	14	10.4	52	38.5	61	45.2	8	6.0
Total	161	119.2	415	307.1	548	405.5	91	67.9
Mean	13.2		34.1		45.1		7.5	

TABLE 8

The Degree to Which Biochemistry of Nucleic Acids and Cell Metabolism Are Studied in Advanced Biology

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. The nature of ribonucleic acid	3	2.2	45	33.3	56	41.5	31	23.0
2. The nature of desoxyribonucleic acid	3	2.2	44	32.6	58	43.0	30	22.2
3. The nature of oxidative enzymes	4	3.0	54	40.0	53	39.2	24	17.7
4. The nature of the citric acid cycle	4	3.0	51	37.7	35	26.0	45	33.3
5. The nature of adenosine triphosphate	7	5.2	37	27.4	54	40.0	37	27.4
Total	21	15.6	231	171.0	256	189.7	167	123.6
Mean	3.1		34.2		37.9		24.7	

but no comprehensive study of it is made in advanced biology.

C. A comprehensive study of the subject is made in advanced biology.

D. The subject is not studied in advanced biology.

The per cent of response for each item was calculated. By totaling the per cent response for all items in each section and finding the arithmetic mean, it was possible to compute a mean per cent of emphasis accorded to each content section.

Basic to a study of biology is a knowledge of the cell. Winchester has said of the cell, "Here lies the key to an understanding of the complex problems of heredity, growth, reproduction, embryology, and physiology." (12) Table 7 shows that 45.1 per cent of advanced biology teachers undertake what they believe to be a comprehensive study of cell structure and function. In an additional 34.1 per cent of courses this content section on cells is merely mentioned and/or defined.

Table 8 shows the results of an inquiry on cell biochemistry. Although Weisz (13) has stated that teachers can no longer afford to be silent about DNA or molecular details of respiration, it is apparent that only slightly over one-third of advanced biology courses include a comprehensive study of this topic. In one-fourth of courses the subject is entirely omitted.

TABLE 9

The Degree to Which Types of Cell Division and Resultant Cellular Growth Are Studied

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Nature of the centrioles	12	9.0	55	40.8	58	43.0	10	7.4
2. Action of cellular chromatin	10	7.4	38	28.2	81	59.8	6	4.4
3. Nature of cellular mitosis	11	8.1	6	4.4	118	87.4	0	0.0
4. The nature of cellular meiosis	11	8.1	6	4.4	118	87.4	0	0.0
5. The process of fertilization	15	11.1	12	9.0	108	79.9	0	0.0
6. The process of zygotic cleavage	15	11.1	12	9.0	108	79.9	0	0.0
7. Germ layer development and derivatives	7	5.2	25	18.5	97	71.8	6	4.4
8. Development in the chick embryo	7	5.2	46	34.1	64	47.4	18	13.3
Total	88	65.2	200	148.4	752	556.6	40	29.5
Mean	8.1		18.5		69.6		3.7	

TABLE 10

The Degree to Which Structure, Function, and Classification of Lower Plants Are Studied

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Evolution of structure in algae	27	20.0	35	26.0	36	26.6	37	27.4
2. Evolution of reproduction in algae	29	21.5	37	27.4	37	27.4	32	23.7
3. Structure and function of the fungi	36	26.6	29	21.5	57	42.2	13	10.0
4. Study of the O, C, and N cycles	56	41.5	24	17.7	52	38.5	3	2.2
5. Study of the nature of viruses	23	17.0	45	33.3	57	42.2	10	7.4
6. Life cycle of moss or liverwort	55	40.8	18	13.3	46	34.1	16	12.0
7. Life cycle of the club moss or fern	55	40.8	19	14.0	46	34.1	15	11.1
Total	281	208.2	207	153.2	331	245.1	126	93.8
Mean	29.7		21.9		35.0		13.3	

The content section on fertilization and embryological growth, Table 9, is extensively studied in 70 per cent of courses, omitted in less than 4 per cent and is considered to have been adequately studied in general biology by 8.1 per cent of advanced biology teachers.

Subjects of a botanical nature are listed in Tables 10 and 11. It is apparent that 35 per cent of advanced biology courses include a comprehensive study of the structure, function, and classification of nonvascular plants. Thirty-six per cent of courses carry out a similar study on vascular plants, according to Table 11.

Tables 12 and 13 show the results of the investigation of fourteen different subjects related to invertebrate animal phyla. The number of teachers considering these subjects to be adequately treated in the first biology course are approximately equal to those who undertake an extensive study of them in advanced biology.

The subjects most universally accorded an extensive study in the 135 advanced biology courses surveyed were the major vertebrate systems. Table 14 lists nine systems found in vertebrates and the emphasis given to them. In eight out of ten courses the students undertake a comprehensive study

TABLE 11

The Degree to Which Structure, Function, and Classification of Higher Plants Are Studied

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Life cycle of a flowering plant	74	54.8	8	6.0	47	34.8	6	4.4
2. Nature of flowers and fruits	70	51.8	8	6.0	48	35.5	9	6.6
3. The structural nature of seeds	70	51.8	8	6.0	48	35.5	9	6.6
4. The anatomy of vascular plants	51	37.7	16	12.0	58	43.0	10	7.4
5. Forms of vegetative reproduction	19	14.0	62	45.9	47	34.8	7	5.2
6. The nature of photosynthesis	46	34.1	11	8.1	75	55.5	3	2.2
7. Economic importance of plants	28	20.8	70	51.8	25	18.5	12	9.0
8. Evolutionary significance of plants	37	27.4	37	27.4	48	35.5	13	10.0
Total	395	292.4	220	163.2	396	293.1	69	51.4
Mean	36.6		20.3		36.6		6.4	

TABLE 12

The Degree to Which Structural Development in Protozoa, Coelenterata, and Platyhelminthes Is Studied

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Cell structure diversity in Protozoa	43	31.8	13	10.0	76	56.3	3	2.2
2. Freeliving vs. parasitic Protozoa	39	29.0	29	21.5	56	41.5	11	8.1
3. Tissue organization in Coelenterata	57	42.2	24	17.7	49	36.3	5	3.7
4. Alternation of generation in Coelenterata	57	42.2	26	19.3	45	33.3	7	5.2
5. Regeneration in the Coelenterata	56	41.5	31	23.0	43	31.8	5	3.7
6. Mesoderm derivatives in Platyhelminthes	50	37.0	28	20.8	45	33.3	12	9.0
7. Bilateral symmetry in Platyhelminthes	53	39.2	26	19.3	50	37.0	6	4.4
8. Cephalization in the Platyhelminthes	46	34.1	30	22.2	35	26.0	24	17.7
9. Freeliving vs. parasitic Platyhelminthes	53	39.2	30	22.2	48	35.5	4	3.0
Total	454	336.2	237	176.0	447	331.0	77	57.0
Mean	37.3		19.5		36.8		6.3	

of these systems. In an additional 6.0 per cent of courses they are merely mentioned.

Table 15 gives a list of subject items that were included under the content section on heredity. It is evident that this topic also receives favorable treatment in advanced biology; 90.3 per cent of courses either accord heredity an extensive study or at least mention and/or define many terms related to the subject.

Table 16 lists additional subjects that are given an extensive study. This includes such diverse topics as space biology, anthropology, geology, and psychological problems.

"Biology" is defined as the science of life; i.e., the study of the origin, development, structure, function, distribution, and importance of all plants and animals. It is apparent in reviewing the mean per cent of emphasis in Tables 7 through 15 that some advanced biology courses are excluding several content areas of biology from extensive study. As a result, the author feels that some of the courses are misnamed. If secondary schools offer courses with the titles and prerequisites stated at the beginning of this article, such courses should give consideration to a comprehensive study of cells; of the structure,

TABLE 13

The Degree to Which Structural Development in Annelida and Arthropoda Are Studied

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Appearance of the coelom in Annelida	55	40.8	16	12.0	58	43.0	6	4.4
2. Segmentation in the Annelida	51	37.7	16	12.0	61	45.2	7	5.2
3. Serial homology in Arthropoda	49	36.6	26	19.3	50	37.0	10	7.4
4. Life cycles in the Arthropoda	61	45.2	23	17.0	45	33.3	6	4.4
5. Social organization in Arthropoda	64	47.4	30	22.2	32	23.7	9	6.6
Total	280	207.7	111	82.5	246	182.2	38	28.0
Mean	41.5		16.4		36.5		5.6	

TABLE 14

The Degree to Which Major Vertebrate Systems Are Studied in Advanced Biology

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. The vertebrate digestive system	16	12.0	6	4.4	111	82.2	2	1.5
2. The vertebrate respiratory system	17	12.6	6	4.4	110	81.4	2	1.5
3. The vertebrate circulatory system	16	12.0	6	4.4	111	82.2	2	1.5
4. The vertebrate excretory system	16	12.0	7	5.2	110	81.4	2	1.5
5. The vertebrate reproductive system	15	11.1	9	6.6	111	82.2	0	0.0
6. The vertebrate nervous system	15	11.1	10	7.4	110	81.4	0	0.0
7. The vertebrate endocrine system	15	11.1	10	7.4	110	81.4	0	0.0
8. The vertebrate skeletal system	16	12.0	7	5.2	110	81.4	2	1.5
9. The vertebrate muscular system	17	12.6	12	9.0	104	77.0	2	1.5
Total	143	106.5	73	54.0	987	730.6	12	9.0
Mean	11.8		6.0		81.2		0.9	

function, and classification of nonvascular and vascular plants, invertebrate phyla, and vertebrate systems; of genetics; of evolution; of ecology; and simplified explanations of recent and vital biochemical aspects of living systems. If not, then the course should carry a title indicative of the content.

VIII. *Concluding Statement*

Advanced biology courses are appearing more and more frequently in the science curricula of large secondary schools. They are being taught by well-prepared teachers using excellent textbooks. In most courses, the major areas of biology are included in the subject matter content. A wide range of opportunity for the student is offered via reference texts, resource periodicals, individual and group research projects, and laboratory experiences.

Suggestions for changing the present status were given for consideration. These included statements relative to the Advanced Placement Program, course prerequisites, scheduling of classes, course subject matter content, and course nomenclature.

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TABLE 15

The Degree to Which Genetics Is Studied in Advanced Biology

Subject-Matter Item	Type, Frequency, and Per Cent of Response							
	A	%	B	%	C	%	D	%
1. Mendel's historic genetic work	19	14.0	22	16.4	93	68.9	1	0.7
2. Nature of chromosomes and genes	8	6.0	10	7.4	117	86.6	0	0.0
3. The nature of alleles	8	6.0	22	16.4	98	72.6	7	5.2
4. The nature of linkage	6	4.4	22	16.4	99	73.3	8	6.0
5. The nature of crossing over	6	4.4	27	20.0	95	70.4	7	5.2
6. The nature of lethal genes	7	5.2	27	20.0	94	69.6	7	5.2
7. Nature of sex determination	12	9.0	19	14.0	102	75.5	2	1.5
8. The nature of mutations	8	6.0	19	14.0	106	78.5	2	1.5
9. Significance of genetics in evolution	7	5.2	26	19.3	100	74.0	2	1.5
Total	81	60.2	194	143.9	904	669.4	36	26.8
Mean	6.6		15.9		74.4		2.9	

TABLE 16

Additional Subject-Matter Items Receiving Comprehensive Study in Advanced Biology

Subject-Matter Item	Frequency	Per Cent
1. Theory on origin of life	65	48.1
2. Ecological problems	53	39.2
3. Study of Mollusca	45	33.3
4. Study of Nematoda	43	31.8
5. Study of Echinodermata	41	30.4
6. Living vs. nonliving matter	39	29.0
7. Disease prevention	33	24.4
8. Problems of conservation	24	17.7
9. Bacteriology	13	10.0
10. Radiation biology	13	10.0
11. Microbiology	9	6.6
12. Study of evolution	8	6.0
13. Review of biochemistry	8	6.0
14. Field biology	7	5.2
15. Psychological problems	5	3.7
16. History of biology	5	3.7
17. Paleontology	3	2.2
18. Geology	3	2.2
19. Space Biology	3	2.2
20. Anthropology	1	0.7

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New Bibliography

The *1960 Supplement to Selected Science Books for Secondary Schools* has been prepared by the Connecticut Science Teachers Association and is available from them at 35 cents a copy. It lists 165 titles, and these are in addition to the 525 included in the original bibliography of 1958. Copies may be obtained from Prof. R. Vincent Cash, Central Connecticut State College, New Britain, Connecticut.