

READINESS OF NINTH GRADERS
FOR THE STUDY OF
BIOLOGY

BY

ARNOLD W. UNTERSEHER

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CHAPTER I

INTRODUCTION

As a course, biology entered the secondary school curriculum about fifty years ago, and statistics today show that the majority of high school tenth graders in our country are enrolled in this course.

Most biology teachers have considered the tenth grade as the proper grade level for the teaching of their subject followed by a sequence of physics and chemistry in the eleventh and twelfth years.¹

Recently with publicity, suggestions have been made that biology be offered to the ninth graders.² During the past few years, there has been an increasing doubt of the need for general science in all the junior high grades: seventh, eighth, and ninth. The overlap of the topics studied at these three grade levels is extremely great. Further, many items dealt with in elementary science cover what formerly was studied in general science. Hence students often have three doses of the same subject matter. It would seem that ninth grade general science could well be dropped from the science curriculum.³

The continuing modernization of subject matter should have priority over all other considerations in improving education. The content of science courses has not adequately reflected the advance-

¹Sharkan, William W., "Ninth Grade Biology, Pros and Cons," School Science and Math 59:718-722, December, 1959.

²Ibid., 59:719.

³Mallinson, George G., "Biology - An Anomaly," American Biology Teacher 20:280-284, November, 1958.

ments which have been made in science itself during the past half century. Many efforts are currently underway to correct this situation.¹

Once the content of the various science courses has been reviewed and revised, there still remains the task of preparing textbooks and other learning aids. The learning process should call the human senses into play and use all the modern techniques of mass communication. Only those in contact with students can give sensible guidance as to what can usefully be absorbed by the student and how it best can be presented.

Of all the concrete actions that can be taken to improve education in the United States, the revision of the course content and the provision of high quality teaching aids are by all odds the most urgent and most attainable.

The writer has felt that the present course of biology taught in most schools at the tenth grade level might well be placed at the ninth grade level and designed to suit the needs of the overwhelming majority of students who elect it. As statistics show, very few high school students go into the field of biological science. By making biology available to all at the ninth grade level, those selected few who wished to enter the field of science would be given an added year of preparation before attending college.

Biology has been picked for science curriculum revision

¹Briber, Robert M., "Education For the Age of Science," Phi Delta Kappan 41:24, October, 1959.

over physics and chemistry because it is a non-mathematical high school science course which most students elect in high school, and because it requires less manipulative skill and dexterity than the physical sciences.

In an experiment conducted at the Arlington High School, Arlington, Illinois, it was found that biology was much more successful than a physical science.¹

Biology at the ninth grade level followed by a physical science fits all needs for the expanded science curriculum.²

Biology has served as an introduction to the science sequence because it is good for the science-shy student. It might also help a larger percentage of students because it would help those who later drop from high school.

Biology is admirably timed during the ninth grade because this is the onset of the pubescent spurt which makes the pupil more conscious of himself.

Ninth grade biology will strengthen and broaden the over-all four year science program and will further satisfy critics of American public education by raising standards.³ It will also allow the gifted students to gain one more year of science through school and enter college with advanced standing.

¹Lowry, Nelson L., "Experiences With a Physical Science Course at the Tenth Grade," Science Education 43:60-64, February, 1959.

²Ibid., Vol. 43, pp. 60-64.

³Ibid., Vol. 43, pp. 60-64.

Problem

For many years biology has been considered to be best placed in the tenth year of the formal education program followed by chemistry and physics in years eleven and twelve.

A great deal has been said about moving biology down into the ninth grade. It is the belief of the writer that this could be accomplished, giving an opportunity for the expansion of the science curriculum and still meet the needs of the pupil. It is the purpose of the writer to show that teaching ninth grade biology is feasible.

Procedures

Literature relative to the subject of teaching ninth grade biology was examined to secure the opinions of authorities in the field of biology in the high school curriculum.

To determine the evaluation of the content and placement of the biology program being offered in Montana, a questionnaire was administered to all the biology teachers in the state of Montana during the school year of 1959-60 to find out their opinions in regard to ninth graders' readiness for the study of biology.

Limitations

There were two limitations to this study. Since time did not permit an extensive survey of opinions of biology teachers, the questionnaire survey was restricted to Montana teachers. Time also re-

stricted the possibility of surveying the opinions of a large group who had experienced teaching biology to ninth grade students.

CHAPTER II

REVIEW OF CURRENT LITERATURE

In recent years much has been written and said about the expansion of the science curriculum in the high school. Since Sputnik I, the American public has become increasingly interested in education, especially the science preparation of our youth. Many have suggested that the biology course should be presented in the ninth grade. There are many who agree and as many who disagree.

It is becoming apparent, with the emphasis on science, that much of the material presented in the biology course has been introduced in the lower general science courses to strengthen the seventh and eighth grade science courses.

If biology were to replace general science in the ninth grade, it would make it possible to strengthen and broaden the overall four-year science program. This would also satisfy the demands of the critics of the American science program in schools and at the same time advance gifted students one year.

In order that all ninth graders may profit, this biology course should be functional, usable to all, and must be made available to all.

Earth science has become a part of many school curriculums, but the principles of earth science could easily be introduced in the elementary general science curriculum. It has been found that the teacher preparation is much better in the biology field than in that of the earth sciences.¹

¹"Ninth Grade Biology (a criticism)", The Science Teacher, p. 153, April, 1959.

It is the belief of the writer that biology in the ninth grade would serve a greater number of the youth. It would be presented to a larger number, therefore reaching many more who are dropping out of school.

Many disagree with the teaching of ninth grade biology because of the maturation factor. It is felt by many that the degree of maturation between the ninth and tenth grade is greater than any other period of development.

By demanding biology, the critics mention it would only add another glorified nature study to the curriculum.¹

The equipment needed would also create a problem. Many systems are on a 6-3-3 plan. This would mean adding biological science equipment to many junior high schools thus adding extra monetary burdens to many already underfinanced systems.

There seems to be an objection by many secondary science teachers who feel that the teaching of ninth grade biology would be a personal reflection upon themselves by sending them to teach junior high classes.

The questions which arise in the writer's mind are: What are the teachers trying to accomplish? Are all the goals in today's classes realistic? Are all the objectives or only a few evaluated?

In an experiment conducted by Goldstein,² a group of hand picked ninth graders who were going to take all the science courses in high

¹Ibid., p. 153.

²Goldstein, Philip, "Concerning Ninth Grade Biology," Science Teacher, December, 1958, pp. 454-457. (Chairman of biology, Abe Lincoln High School, Brooklyn, New York).

school, were permitted to take ninth grade biology. This would omit general science in the ninth grade and start them right off in biology. Following biology would be chemistry plus advanced biology in the tenth grade, physics in the eleventh, and would leave the twelfth year open for college physics, laboratory techniques or any other science electives.

Each of the ninth grade biology students in this Brooklyn experiment was bright, hand picked, and highly recommended by his previous teachers. Each applicant had a high IQ, a good reading score, a good arithmetic score, and a high standing on the Iowa tests. There was little question as to their basic ability. Parent agreement was received and an explanation of the difficulty of the course given to both applicants and parents. Quite by accident the teacher was the same teacher who was to teach a section of select tenth grade biology students. Both of these classes took the same Regents' Examination after completing the course. Table 1 shows the distribution of scores of the two classes on the Regents' Examination.¹

It seems immediately evident that the tenth grade group did far better on the examination than the ninth grade group. One look at the distribution curves of the two groups will show this clearly. Since the number of students in the two groups was not equal, the curves are plotted in terms of percentage of the group getting a given mark on the Regents' Examination as shown in Figure 1.

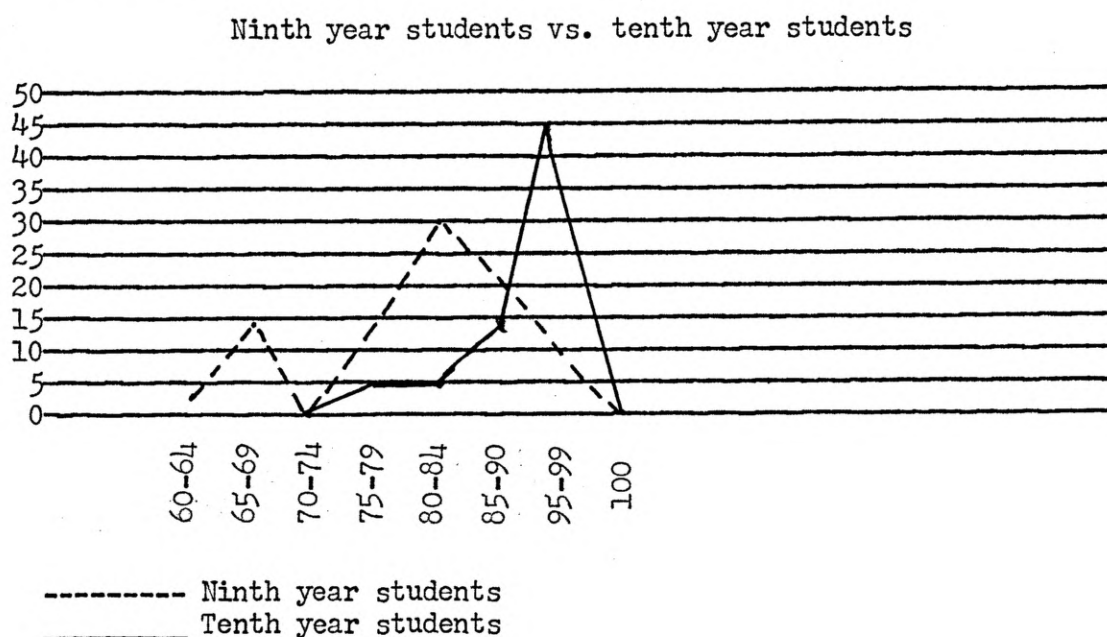
¹Goldstein, op. cit., pp. 454-457.

TABLE 1. DISTRIBUTION OF MARKS ON NEW YORK STATE REGENTS' EXAMINATION IN BIOLOGY IN JUNE, 1958.

Mark on Regents' Examination	Number Receiving This Mark			
	Ninth Year	% of Total	Tenth Year	% of Total
100	0		1	2.6%
95-99	6	18.8%	17	44.7%
90-94	6	18.8%	11	29.0%
85-89	9	28.1%	5	13.2%
80-84	2	6.3%	2	5.3%
75-79	4	12.5%	2	5.3%
70-74	0			
65-69	4	12.5%		
35-39	1	3.4%		
Total	32	100.1%	38	100.1%
Mark	84.7		93.0	

Comparing the means of the two groups, the ninth grade group had an average score of 84.7% while the tenth grade group averaged 93.0%. This shows an average difference of 8.3% in favor of the tenth-year group. By comparing the percentage of the ninth and tenth graders in the top half of the total group, the median score is shown to be 91.6%. In the ninth grade group only ten students out of 32 (31.2%) scored higher than the median score of the whole group. But in the tenth grade group 25 out of 38 (65.8%) of the students ranked above this median score. Thus more than twice as many tenth grade students

FIGURE 1. DISTRIBUTION OF SCORES ON NEW YORK STATE REGENTS' EXAMINATION IN BIOLOGY, JUNE, 1958.



ranked above the median of the ninth and tenth grade scores. All in all there seemed to be a significant advantage for the tenth grade biology student over the ninth grade student.

Another study was conducted during 1958-59 in the Denver Public Schools, Denver, Colorado. The purpose of the study was to compare the achievement of selected ninth grade students with the achievement of high school students in general biology, as measured by a test of general biology developed by Denver science teachers.¹

The test was developed by a committee of junior and senior high school science teachers. The questions tested the students' factual information and contained certain laboratory experiments from each of

¹Mathis, George and Blanc, Sam, "Biology Achievement in Grades Nine and Ten," Science Teacher 20:24, March, 1960.

the units included in general biology. The test was administered to all second semester biology pupils in the junior and senior high schools near the end of the school year. The senior high school pupils in the group were those who were enrolled in the standard biology course. The junior high school pupils were those who were completing the same course in grade nine. The total number of pupils taking the test by grade level and sex is given in Table 2.

TABLE 2. NUMBER OF PUPILS PARTICIPATING IN THE STUDY BY GRADE LEVEL AND SEX¹

Grade Level	Boys	Girls	Total
Grade 9	143	56	199
Grade 10	415	393	808
Grades 11 and 12	159	281	440
Total	717	730	1447

The ninth grade students were selected because of interest in science and in science related fields. Their ability was measured by a standardized IQ test, grades in academic subjects, and the recommendations of their science and counseling teachers.

The high ability of the ninth grade group can be seen by the distribution of scores on the Otis Test of Mental Abilities. Table 3 shows the range and interquartile scores.

¹Ibid., Vol. 20, p. 24.

TABLE 3. RANGE AND MEASURES OF CENTRAL TENDENCY FOR PUPILS TAKING BIOLOGY IN GRADE NINE AS MEASURED BY THE OTIS IQ TEST (199 pupils)¹

	Boys	Girls	Total Group
Q 3	127.0	121.0	124.0
Median	119.0	115.3	118.5
Q 1	112.4	112.0	112.3
Range	101-142	101-133	101-142

Since the test was given to practically all ninth graders and high school pupils taking biology, it was possible to compare scores of the two groups. By comparison, the ninth graders did substantially better than the high school pupils. Table 4 shows the measures of central tendency and gives the range of the two groups.

TABLE 4. A COMPARISON BETWEEN SELECTED NINTH GRADE PUPILS AND HIGH SCHOOL PUPILS ON TEST (perfect score equals 140)²

	Grade Nine	High School
Q 3	106.0	94.0
Median	97.5	82.5
Q 1	87.5	70.0
Range	59 - 128	25 - 125

¹Ibid., Vol. 20, p. 24.²Ibid., Vol. 21, p. 25.

In equalizing the ninth grade pupils with an equal number of tenth grade pupils for comparison scores made on the test, all 199 ninth graders and an equal number of tenth grade boys and girls were tested with the Otis IQ. The range and central tendency are given in Table 5. The two groups were so similar that for all practical purposes they may be said to have equal ability.

TABLE 5. RANGE AND MEASURES OF CENTRAL TENDENCY BETWEEN NINTH AND TENTH GRADE PUPILS MATCHED ON BASIS OF SEX AND SCORES ON THE OTIS TEST OF MENTAL ABILITIES (143 boys, 56 girls)¹

	Ninth Grade		Tenth Grade	
	Boys	Girls	Boys	Girls
Q 3	127.0	121.0	125.3	121.0
Median	119.0	115.3	119.6	115.3
Q 1	112.4	112.0	112.4	112.0
Range	101-142	101-133	101-138	101-133

From these results the conclusion may be drawn that selected ninth grade pupils can achieve as well as, and in some instances better, than tenth grade pupils of comparable ability in general biology.

Should ninth grade biology be presented? A number of reasons have been advanced as to why it should: (1) ninth grade general science is often repetitious of upper elementary or early junior high school science; (2) radio, television, and wide distribution of popular

¹Ibid., Vol. 21, p. 25.

science books and magazines have increased the general science knowledge of most youngsters; (3) many pupils are bored with ninth grade general science; and (4) these are not times to waste effort in the science education.¹

Most teachers who have favored ninth grade biology have done so because this allows the possibility of an advanced biology at the senior level.²

Biology and the Science Curriculum

In an age of curriculum review and revision, a number of people have been advocating the teaching of biology in the junior high school as part of general science and offering of advanced biology courses in grades ten, eleven, or twelve.

The trend to force subject matter down into the lower grades has appeared to be a common one in many areas. Biology is unique in that it is easily adaptable to the needs of pupils of varying abilities. Perhaps one of the difficulties has been the tendency to give anemic college courses in systematic biology as though all pupils are college bound. A careful look given to what is being taught, how it is being taught, and to whom it is being taught has been held to be more important than juggling the curriculum to the point where only selected pupils take high school biology.³

¹Herdgerd, Lloyd H., "More on Ninth Grade Biology", Science Teacher 27:20, March, 1960.

²Ibid., Vol. 27:20.

³Ibid., Vol. 27, p. 20.

Another question arises: Is it justified, within the framework of the philosophy of the American high school, to offer comparative anatomy or physiology? It seems that such courses are rightfully a part of the college curriculum.

Experimentations on Ninth Grade Biology

In the Baltimore public schools it was held that all pupils needed a good foundation in science whether these pupils are college bound or not, be they slow learners or not. To this end a science sequence has been developed whereby all pupils, when they complete grade ten, will have acquired one and a half years of biological science and one year of health.¹ This program was as follows:

Grade Seven

- One half year health
- One half year astronomy and geology

Grade Eight

- Air and water
- Matter
- Electricity
- Mechanics

Grade Nine

- One half year health
- One half year biology (six units)
 - Unit I Introduction
 - Unit II Living things of the world
 - Unit III Structure of organisms
 - Unit IV Simple forms of life
 - Unit V Man's dependency on plants and animals
 - Unit VI Relationship of living things to their environment

¹Palmer, Elra M., "Biology and the Science Curriculum", The American Biology Teacher 21:96, March, 1959.

Grade Ten

Biology (fourteen broad field units some of which are based on ecology problems)

First day suggestions

What does it mean to be alive

Chesapeake Bay

Insects and human welfare

How do complex animals maintain themselves

Reproduction

Heredity

The biological basis of emergency aid

Plant and animal behavior

Classification

Conservation

Consumer biology

Changing drama of life

How does biology help us to appreciate our everyday life¹

The Baltimore system would help broaden the science curriculum and give the fundamental concepts of biology in the ninth grade, therefore reaching more students. It would also reach those students of a non-college career type and the potential dropouts. The argument used for the one-half year of advanced course was that the advanced or superior science major could also be given the opportunity of taking at least one additional half year of mathematics.²

Raskin and Metzner³ reported that there is a ferment throughout the land of comparisons that have been made between American and Soviet secondary education. In many respects secondary science education is now regarded or considered as being inadequate to meet the needs of the nation.

¹Ibid., Vol. 21, p. 96.

²Ibid., Vol. 21, p. 96.

³Raskin, Abraham; Metzner, Jerome, "Trends in Science Education-1958", 44:24, February, 1960.

Books by Conant,¹ Rickover,² Bestor³ and Hechinger⁴ have made a number of recommendations for modifying and strengthening secondary education. The following were the trends:

1. Dissatisfaction with general science because of repetition and duplications
2. Firming up of elementary science and basing general science on this
3. Various provisions for nine year science especially for gifted students
 - a. earth science
 - b. biology
 - c. physical science emphasizing atomic and molecular structure of matter, basic chemical reactions and physical phenomena
4. Increased time for science instruction usually involving two periods of lab work per week.
5. Increased emphasis on lab work. Much attention being paid to open-ended experiments
6. Modernization of science courses to keep students informed concerning rapidly advancing frontiers of science
7. Offering of electives in science--many on the college level
8. Offering of college courses with promise of advanced standings
9. Planning on a national scale science courses of study

¹Conant, James Bryant, "Science and Common Sense", 1951, 446 pp.

²Rickover, Hyman G., "Education and Freedom", 1959, p. 17.

³Bestor, Arthur Eugene, "The Restoration of Learnings-A Program for Redeeming the Unfulfilled Promise of American Education", 1955, 354 pp.

⁴Hechinger, Fred M., "The Big Red Schoolhouse", 1959, 405 pp.

10. Experimentation with science curriculum involving
 - a. two year sequence - of integrated and related biology, chemistry and physics
 - b. ninth grade biology
 - c. twelfth grade biology
 - d. new physics course P.S.S.C.
 - e. acceleration in one or more science courses
 - f. enrichment
11. Summer science institutes for gifted students
12. National Defense Act funds in science equipment¹

At the present time few reports of experimentation of placing biology in the ninth grade have been published. Voss reported that there is little evidence found to give aid to the present problem of grade placement of biology.²

Some administrators have felt that biology could be moved down to the ninth grade because their students had obtained a good elementary background.

There has been at least one reason for holding biology in the tenth grade. Because of the lack of uniformity in the lower grades, a ninth grade general science course was needed. Students have entered high school with a diversity of grade school backgrounds. This may have been the reason for the trend to a strong ninth grade general science course.

¹Metzner, Jerome and Raskin, Abraham, "Trends in Science Education", Science Education 44:24, February, 1960.

²Voss, Burton E., "Biology, Fact and Future", The American Biology Teacher 22:79-82, February, 1960.

How Teachers Feel About a Ninth Grade Biology Course

The recent challenge of the scientific supremacy of the United States by Russia has resulted in an increased emphasis on science instructions at all levels as well as on the scientific production of the United States. The increased concern about science has resulted in many recommendations and some changes in approaches used in science courses, content of science courses, and science curricula in the public schools.

There are some schools where biology is taught for a half year at the eighth and ninth grade levels and this is all the exposure many girls and boys will receive. Many have suggested that biology should be upgraded. An interesting study was made by the Helena High School, Helena, Montana (an unpublished work) where the opinions of many teachers were gathered as to the presentation of ninth grade biology. Twenty-two of the larger school systems were surveyed. A copy of this survey appears in the appendix. Only seven schools (31%) offered some kind of biology program for their ninth graders. When asked at what grade level biology was best placed, 15 (68%) felt that the tenth grade was the best.

The 31% offering ninth grade biology did so only on an experimental basis and felt that not enough data had been collected to substantiate a ninth grade biology program. These schools which were surveyed were experimenting with only the superior, science-interested pupil.

It was the belief of the majority of the schools surveyed by the Helena study that the science sequence should be as follows: tenth

biology, eleventh physics, twelfth chemistry or eleventh chemistry and twelfth physics.

The pros and cons of teaching ninth grade biology are about equally divided. No one experiment or survey offered a nationwide plan for the teaching of ninth grade biology.

A proposed revision of biology is discussed on the following pages.

A Proposed Revision of Biology

To U. S. high school students, no science is more popular than biology.¹ One million two hundred thousand students take an introductory course in biology every year, but barely two percent come away with enough interest to take a second course. Many educators think high school biology is fossilized. Students have performed perfunctory experiments to prove points already memorized, poked away at frogs, and recited by rote an endless, largely meaningless list of Latin names, learning little of the processes by which life exists on earth and which have fascinated man since the beginning of time. Hurd stated as follows:

The mere skeleton of science is presented, and the facts are divorced from anything that might be called the processes of science, sterilized of their beauty and left dangling without a place in the scheme of things.²

¹Time, Life for the Fossil, 65:44-45, Education section of Time, July 4, 1960.

²Ibid., Vol. 56, p. 44.

During the last week in June, 1960, members of the American Institute of Biological Sciences opened a six week meeting at the University of Colorado in Boulder to put some life into the study of living things by revising the high school curriculum from amoeba to zygote. Subsidized by an initial \$738,000 grant from the National Science Foundation, the biologists had no illusions about producing high schools full of biology majors. They did hope to increase the percentage considerably, and at the very least give every youngster a good idea of what biology is all about. Grobman, director of the Colorado project stated the following:

We feel that the one biology course in high school is, in the majority of cases, the last chance to get across the concept of science as an on-going, self-correcting, intellectual activity. We want our students to be biologically literate when they leave school.¹

For a starter, the educators at Boulder would remove the dead weight of words from biology. They estimated that a first-year biology student must absorb more strange, unpronounceable new words than he does in any first-year foreign language course. They planned to organize the facts of biology around a few key ideas so that the student would get a better grasp of the whole.²

The Colorado group decided to work on three central ideas, divided into the "blue, yellow, and green courses".³ The blue, or physio-

¹Ibid., Vol. 56, p. 44.

²Ibid., Vol. 56, p. 45.

³Ibid., Vol. 56, p. 45.

logical approach to biology, would emphasize the underlying cellular activity in all living matter; the yellow, or morphological approach, would compare the structure of organic types; while the green, or ecological approach, would trace the evolution of forms and how they relate to one another. Specific species and experiments would fit into the overall pattern and would not dominate the course.¹

After the basic courses have been worked out and preliminary tests written, the biologists proposed to put their ideas to classroom test. Later in 1960, ten volunteer students were scheduled to try the courses and offer criticism. In the fall of 1960, new methods were to be tested in 105 selected high schools around the United States; the group would do more revising and expand the test to 500 in the 1961-62 school year. A.I.B.C. expected to have the material well enough in hand to put it into final textbook form by the summer of 1962.²

There is a varied degree of agreement and disagreement as to the advisability of teaching biology in the ninth grade according to the writer.

The review of literature indicates there is a definite concern about the placement of biology in the science curriculum. However, the teaching of ninth grade biology is in the experimental stage and has not been placed in the ninth grade science curriculum nationwide.

The attitudes of a number of Montana biology teachers in regard

¹Ibid., Vol. 56, p. 45.

²Ibid., Vol. 56, p. 45.

to the readiness of ninth graders for the study of biology are discussed in Chapter III.

CHAPTER III

THE QUESTIONNAIRE

In order to have proper evaluation of the opinions of the biology teachers, a random sampling of 130 biology teachers in Montana were surveyed (see questionnaire in Appendix, page 39).

One hundred returns were received--a return of approximately seventy-six percent.

Ninth Grade Biology Programs

Of the respondents, 17% did have a ninth grade biology program while 74% did not, and nine percent did not respond to the question of the teaching of ninth grade biology.

When asked if they favored a continuance of a ninth grade biology program, nine or 52% of those having such a program, answered yes, while eight or 47.1% did not recommend a continuance of a ninth grade biology program.

It was felt by the majority that ninth graders did not reach the degree of maturation necessary to grasp the following major concepts of biology: genetics, eugenics, reproduction, evaluating change. Their reactions are summarized in Table 6. It was felt that the maturation factor between the ninth and tenth grades was great enough to affect the teaching of biology.

TABLE 6. MONTANA BIOLOGY TEACHERS' OPINION ON NINTH GRADERS' DEGREE OF MATURATION NECESSARY AS TO THE UNDERSTANDING OF THE MAJOR CONCEPTS OF BIOLOGY.

Concepts	Yes	No
Genetics	9	20
Eugenics	7	22
Reproduction	13	16
Evolutionary Change	11	18

TABLE 7. MONTANA BIOLOGY TEACHERS' OPINIONS OF BIOLOGY CONCEPTS NECESSARY FOR THE NON-SCIENCE CAREER PUPIL.

Concepts	Yes	No	Question
Genetics	84	12	4
Eugenics	78	20	2
Reproduction	88	8	4
Evolutionary Change	65	31	4

Necessary Major Concepts of Biology

When asked if all the major concepts of biology (see list), were necessary for the "non-science career" pupil, a great majority felt that they were. The majority felt that all the major concepts of biology are necessary to all students whether they are going on with science or not.

Data in Table 7 reveals that the majority of respondents feel that the understanding of genetics, eugencis, reproduction and evolu-

tionary change is necessary for the "non-science career" student.

Biology in School Curriculum of Montana

The questionnaire did show that biology was the most frequently scheduled of the subjects in the science curriculum of most schools. The subjects now taught in the Montana curriculums are listed in Table 8.

TABLE 8. FREQUENCY OF SUBJECTS TAUGHT IN MONTANA SCIENCE CURRICULUMS.

Subject	Number of schools
General Science	82
Biology	96
Advanced Biology	6
Chemistry	90
Physics	87
Zoology	3
Botany	2
Earth Science	9
Physical Science	5
Advanced General Science	1
Advanced Physics	2

On none of the items of vocabulary, maturation, and chronological age, did the majority feel that ninth graders were ready for the study

of biology.

The comment received most frequently on this point was that tenth graders do have a definite advantage over ninth graders.

Opinions Regarding Biology as a Ninth Grade Elective

In response to the question as to whether they would favor biology as an elective in the ninth grade, 39% responded that they would while 57% did not favor such a practice, and nine percent questioned it.

When asked if they would consider offering a special course for those ninth graders who show science proficiency, 43% were in favor of such a course while eleven percent did not and forty-six percent questioned such a program.

Sixty-one percent felt that the degree of maturation occurring between grades nine and ten was necessary to master the major understandings in biology. The remainder (or 39%) felt that it was not necessary.

Fifty-five percent felt that the average ninth grader would have difficulty mastering the vocabulary necessary in biology.

Fifty-four percent of the responses felt that the differences chronologically between the ninth and tenth grade would affect the teaching of biology.

When asked which subjects they would like to have added to their present curriculum, the response was: advanced biology 39, zoology 18, botany 17, earth science 34, and a variety of selections by individual

teachers.

Comments given are:

"If biology is to be an elective in the ninth grade, then also insert earth science as an elective".

"If biology remains a tenth grade subject, then have average ninth graders take earth science and the average and below take general science".

"I feel that earth science should be offered to those who would take biology in the ninth grade. Then those who are capable should take chemistry and physics".

"I would like to omit general science from our curriculum as it is the same as given in the seventh and eighth grades".

"I find some ninth grade students not mature at the start of the biology course, but after a few weeks grasp the course very fast. I find no difference between our ninth and tenth grade biology students".

"I consider none of the concepts of biology necessary but certainly essential".

"I feel our science offerings are excellent in that they meet the needs of all students and I can think of no science course we could or should add which would be of any great value".

"Biology should be taught in the senior year after the pupil has had general science and chemistry".

"If the junior high program is adequate, ninth graders can handle biology".

"I think biology should be a required subject for ninth graders - not an elective. I have taught ninth grade biology in the past and have found it quite successful".

"Ninth grade biology is a very good idea. In most cases I have found there wasn't any difference between ninth and tenth grade pupils".

"Our schools are small, therefore an advanced biology cannot be offered. I think it necessary that the pupil must get as much as possible from what is offered - the tenth grade for biology".

"It has been my experience that one year of high school biology does a great deal".

Summary of Questionnaire Results

Only 17% of the 100 schools surveyed in Montana did have ninth grade biology in their curriculums of which nine or slightly over 50% favored a continuance of the teaching of ninth grade biology.

It was felt by the majority that not all ninth graders had reached the degree of maturation necessary to the following major concepts of biology: genetics; eugenics; reproduction; and evolutionary change.

Thirty-nine percent favored having ninth grade biology as an elective in the ninth grade curriculum but 57% did not. Forty-three percent favored a special biology course for those ninth graders who showed science proficiency while 11% did not favor a special course.

Maturation, vocabulary and chronological age did affect the teaching of biology according to the surveyed teachers and the majority felt that ninth graders would be handicapped in comprehension of the subject.

The 100 Montana biology teachers felt that the understanding of

all major concepts of biology (genetics, eugenics, reproduction and evolutionary change) were necessary for the non-science career pupil as well as the science career pupil.

Biology proved to be one of the most popular science courses offered according to the Montana biology teachers surveyed, with 86% having biology in their science curriculums. Closely following were chemistry (90%), physics (87%), and general science (82%). Others listed frequently were zoology, botany, earth science and advanced biology.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The following is a summary of the readiness of ninth graders for the study of biology. The science curriculum in the public high schools has been bitterly attacked and the teachers have been concerned about the offerings which are presently being given and the expansion of the curriculum to keep up with technology. It is the opinion of the writer that the placement of biology in the ninth grade would help to alleviate some of the criticism and advance science curriculums.

In the review of current literature, it was found that in the majority of school systems ninth grade biology was not being taught. However, a few schools were teaching ninth grade biology on an experimental basis.

A questionnaire was sent to 130 Montana biology teachers. Except for a few cases, ninth grade biology is not being taught in Montana and the majority of the teachers did not favor teaching it.

Seventeen percent of the surveyed biology teachers in Montana had ninth grade biology while 74% did not. Of the 17% having ninth grade biology, 50% favored a continuance of the course in the science curriculum.

The majority felt ninth graders had not reached the degree of maturation necessary to comprehend the following major concepts of biology: genetics, eugenics, reproduction, and evolutionary change.

Thirty-nine percent favored biology as a ninth grade elective

but 57% did not. Forty-three percent favored a special biology course for those ninth graders showing science proficiency while 11% did not favor such a course.

According to the surveyed biology teachers, maturation, vocabulary, and chronological age affected the teaching of biology because of these factors.

All 100 Montana biology teachers surveyed felt that the understanding of the major concepts of biology (genetics, eugencis, reproduction and evolutionary change) was necessary for all students whether they are science career pupils or not.

Biology proved to be one of the most popular science subjects taught according to the 100 schools surveyed. Eighty-six percent had biology in their science curriculums followed by chemistry (90%), physics (87%), and general science (82%). Zoology, botany, earth science and advanced biology were other subjects listed frequently in the curriculums of the surveyed schools.

Conclusions

Teaching biology in the ninth grade is a new practice and no definite conclusions can be drawn as to its advisability.

This study does not give the answer to the readiness of ninth graders for the study of biology. One study showed that biology could be taught to ninth graders if a simplification of vocabulary was made and consideration given to the maturation factor.

It has been found that there are many who defend the teaching

of biology in the ninth grade. Likewise, there are many who defend the placement of biology in the tenth grade because of the vocabulary and maturity factors.

The writer feels that this matter must be further studied and definite conclusions must be reached before the placement of biology can be justified.

Recommendations

It is felt that further studies should be made to justify the placement of biology in the science curriculum at the ninth grade level.

It is further recommended that the science curriculum should be closely studied to make sure that students get the best education possible.

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APPENDIX

APPENDIX A

QUESTIONNAIRE

on

40

"Readiness of Ninth Graders for the Study of Biology"

Name of Person Conducting
Questionnaire - A. W. Unterseher

School - Montana State
College, Bozeman, Montana

Purpose:

The writer wishes to suggest that the present course of biology taught in most schools at the tenth grade level may well be placed at the ninth grade level and designed to suit the needs of the overwhelming majority of students who elect it.

Directions:

Answer the statements below by placing a check by yes or no at the end of each question. A place has been left for comments.

- I. Do you now have ninth grade biology in your curriculum? If your answer is no please answer the questions under Section II. If yes please answer the questions below.

YES _____

NO _____

1. Do you favor a continuance of the teaching of biology in the ninth grade?

YES _____

NO _____

2. Have all ninth graders reached the degree of maturation necessary to the following major concepts in biology?

a. Genetics? YES _____

NO _____

b. Eugenics? YES _____

NO _____

c. Reproduction? YES _____

NO _____

d. Evolutionary change? YES _____

NO _____

COMMENTS:

(If more space is desired for comments, use reverse side.)

- II. Would you be in favor of biology as an elective in the ninth grade?

YES _____

NO _____

1. If your answer is no to offering biology to ninth graders, would you be in favor of offering a special course for those ninth graders who show science proficiency?

YES _____

NO _____

2. Is it your belief that the increase in maturation that occurs between the ninth and tenth grades is necessary to master major understandings in biology?
 YES _____ NO _____
3. Would the average ninth grader have difficulty mastering the vocabulary necessary in biology?
 YES _____ NO _____
4. Is the difference chronologically between the average ninth and tenth grader great enough to affect the teaching of biology?
 YES _____ NO _____

COMMENTS:

III. Are all concepts of biology necessary for the "non science career" pupil?

- | | | |
|-------------------------|-----------|----------|
| 1. Genetics? | YES _____ | NO _____ |
| 2. Eugenics? | YES _____ | NO _____ |
| 3. Reproduction? | YES _____ | NO _____ |
| 4. Evolutionary change? | YES _____ | NO _____ |

COMMENTS:

(If more space is desired for comments, use reverse side.)

IV. Which subjects do you now have in your present curriculum?

_____general science	_____zoology
_____biology	_____botany
_____adv. biology	_____earth science
_____chemistry	_____list others
_____physics	_____

V. What subject would you like to have added to your present curriculum and at what grade level?

Adv. biology _____

zoology _____

botany _____

earth science _____

others _____

COMMENTS:

APPENDIX B

Name of Town	Teach in 10th 9th	At what grade level best? Why?	Are you sacrificing biology due to student immaturity to accelerate other phases?	Opinion of Results	How many years teaching in 9th?
Mesa, Ariz.	yes no	10th at least-emphasis today on biochemistry, heredity, biophysics, evolution needs more mature student, 9th general science should provide background for chemistry and physics	No, because we are leaving biology at 10th grade level	This year taught 30 students in accelerated group These were "A" students--most not willing to do more than regular classes.	Do not teach it
Boulder, Colo.	yes no	Not earlier than 10th for real biology as distinguished from "Nature Study"--Concepts of energy transfer, evolution and metabolism hard enough to teach to 10th graders.	Yes--we could use a second year of biology	Our students do well in college biology	Do not teach it experimentally
Idaho Falls, Idaho	yes no	11th students more mature then--before they cannot get the most from biology	No--not to accelerate other phases of science program but because of immaturity	Doing a credit-able job with 10th graders--above average with college prep. biology and zoology	Do not teach it experimentally
Marquette Mich.	yes no	10th--students more mature and will remember more when they leave school	No	10th best	Do not teach it.
Ansonia Conn.	yes no	10th--students more physically and mentally mature	Do not have accelerated course	10th grade biology works well except for slow students	Do not teach experimentally

Name of Town	Does 9th grade biology strengthen or weaken total biology program?	Do you teach a second year to capable and interested?	What sequence and year should chemistry, biology, and physics be taught?	Do you have major in Biology?	Number of Years in Teaching?
Mesa, Ariz.	If it were to be taught it would weaken biology program	No--a few students have asked for it	10th biology 11th chemistry 12th physics	yes	22
Boulder, Colo.	Real biology cannot be taught at 9th grade level.	Would like to--problem is scheduling in already crowded science and physics, but curriculum. Have one semester anatomy course for good 11th and 12th grade students	Not qualified to speak on chemistry and physics, but would not like to see biology in 9th unless students took an advanced course later.	yes	10
Idaho Falls, Idaho	It would weaken	Not general biology, but teach zoology and a college prep. biology to capable students	Chemistry (Many Biology facts in Physics (chemistry that can be correlated to biology.)	no - minor	5
Marquette Mich.	It would weaken	No	Biology 10th Chemistry 11th Physics 12th	No	4
Ansonia, Conn.		No	Biology 10th Chemistry 11th Physics 12th	yes	27

Name of Town	Teach in 10th 9th	At what grade level best? Why?	Are you sacrificing biology due to student immaturity to accelerate other phases?	Opinion of Results	How many years teaching in 9th
Great Falls, Mont.	yes no	11th and 12th most desirable--certainly not below 10th	It would--acceleration not accomplished by putting biology in 9th and leaving 12th for advanced courses, but by track courses and advanced courses for 11th and 12th that run concurrently with regularly established courses in chemistry and physics.	Our 10th grade biology equals some advanced biology courses in other states.	We are not now and hope we never do.
Elmhurst, Ill.	yes no	10th--more mature 9th for gifted	If given to all 9th graders would have to be "watered down" to their level of understanding	Good results with 10 10th graders--fits well into 4 years of science	We are not experimenting
Austin, Minn.	yes no	10th--students more mature and better able to grasp material.	No	At present plan to keep biology in 10th and are working on a second year for 12th	Do not teach--although some teachers give some biol. in 9th--this is not too beneficial
Ypsilanti, Mich.	yes no	12th--students would have had chem. & phys. by then--custom keeps biology at 10th.	No--but much cannot be grasped--also much can be forgotten--we do not have accelerated program.		
Ames, Iowa	yes no	10th or above--students in 9th not mature enough to handle chem. involved it down.	Not yet--although some pressure in state to move		Do not teach

Name of Town	Does 9th grade biology strengthen or weaken total biology program?	Do you teach a second year to capable and interested?	What sequence and year should chemistry, biology, and physics be taught?	Do you have major in biology?	Number of years in Teaching?
Great Falls, Mont.	Weakens--read "Concerning 9th grade Biology" Goldstein(The Science Teacher, Dec., 1958) and "On 9th grade Biology-Berman, (American Biology Teacher) March, 1959.	Yes--advanced biology Doing a survey of 1217 secondary schools and 11% offer a second year biology or a 3rd semester of advanced biology.	When student takes all three: Biology 10th Chemistry 11th Physics 12th Chemistry and physics require a mathematical background.	yes	7
Elmhurst, Ill.	Too many people trying to make scientists of all gifted-other fields need gifted, too, as humanities and languages.	Have Honors Course in Biology for 10th grade gifted, but no second year.	Physical Science 9th (required) Biology 10th Chem. or Physics-11th and 12th(Physics tchrs like students to have 3 years math.)	yes	34
Austin, Minn.	If more courses is a strength, then it would strengthen it.	Not non-working on 2nd year for 12th, and Field Biology as a Summer Offering	Chemistry 10th Biology 11th Physics 12th Would prefer to teach biology after chem., but difficult to teach real chemistry to 9th or 10th.	yes	15
Ypsilanti, Mich.	Weakens	No		yes	13
Ames, Iowa		No	Chemistry - then biology preferred.	yes	21

Name of Town	Teach in 10th 9th	At what grade level best? Why?	Are you sacrificing biology due to student immaturity to accelerate other phases?	Opinion of Results	How many years teaching in 9th?
Decatur, Ala.	yes no	10th for general biology with 2nd year in 11th or 12th for college prep. Biology important background science for college.	No--most of our 10th graders are mature enough to grasp subject matter.	Our college students who had biology in 12th grade did best. It would not help program to give to 9th graders who are not ready for it.	Do not teach.
Monterey Calif.	yes (yes)	We are studying problem--not yet firm conclusions--offer to selected 9th grades answer depends in part upon science learning preceding biology	No	No comment	In our first year for selected students only.
Rochester Minn.	yes (yes)	Ordinary students can elect biology in 10th, 11th, 12th--we pick an advanced group of 7th and start on advanced science program 7th-genl. science, 8th-9th grade genl science 9th-freshman biology 10th-chemistry 11th-physics, 12th-adv. biol. chem., or physics	No, we can take care of advanced people as indicated. We don't make it too easy!	Tried to give Advanced Biol. to Soph. last year and concluded sophomores are too immature no matter what their I.Q.	In second year.
Mason City, Iowa.	yes one class	10th-although started this year with 30 accelerated 9th graders	Yes, am looking for poor biology groups in high school as a result	We will have to slow our high school biology down and cut out difficult material.	First year for 30 students

Name of Town	Does 9th grade biology strengthen or weaken total biology program?	Do you teach a second year to capable and interested?	What sequence and year should chemistry, biology, and physics be taught?	Do you have major in biology?	Number of years in teaching?
Decatur, Ala.	9th grade biology could weaken entire program	No, but students could benefit from such a course.	Genl. Biology-10th Chemistry and physics-11th and 12th	No - minor	19
Monterey Calif.	As far as we know now 9th grade biology for selected students is strengthening over all program.	Yes	Biology I - 10th Biology II and Chem.-11th, Physics-12th(for more math. preceding)	No	4
Rochester Minn.	Depends on your aims -for a high level course 9th grade too young! "Nature Study" another thing.	Yes	Answered in Column 4	Yes	26
Mason City, Iowa	If an advanced course also given, it could strengthen, otherwise weaken.	Not now	10th Biology 11th Physics 12th Chemistry	yes	30

Name of Town	Teach in 10th 9th	At what grade level best? Why?	Are you sacrificing biology due to student immaturity to accelerate other phases?	Opinion of Results	How many years teaching in 9th?
Gloucester, Mass.	yes for some	Student ability and grouping must be considered-have an experimental program for some 9th graders-most take it in 10th	No	Satisfied with set-up and results support opinion.	In second year.
Hamden, Conn.	yes for honor students	Honor students in 9th Most in 10th-college evidence not in yet.	Not so far	Could comment two years hence	In first year.
Lawrence Kans.	yes for some	10th except for some talented, superior students	No	Inconclusive as only started this year	In first year.
Waterville, Maine	yes no	10th through 12th 12th preferably	would be	Lack of lab. facilities and large classes makes results poor.	Not teaching it.
Blytheville, Ark.	yes no	10th and 11th-depends on how technical a course is given. Then more mature students required.	yes - or would be	We have no accelerated program	not teaching it.
Bloomington, Ind.	yes one class	Depends on how deeply ones goes into subject-better results at 10th grade level.	yes	9th grade class not doing too well-10th grade accelerated class did not do much better than others	2 years.

Name of Town	Does 9th grade biology strengthen or weaken total biology program?	Do you teach a second year to capable and interested?	What sequence and year should chemistry, biology, and physics be taught?	Do you have major in Biology?	Number of Years in Teaching?
Gloucester, Mass.	Strengthens	No.	10th biology (except for 9th grade experimental group) 11th chemistry 12th physics	yes	25
Hamden, Conn.	Cannot be completely objective--hence a qualified "strengthens"	yes	9th biology (honor students) 10th biology 10th adv. biol & zool. 11th human anatomy & physiology 11th, 12th chemistry and physics	yes	25
Lawrence Kans.	Strengthens	When present 10th grade reach 12th grade plan to have an advanced course	9th genl. science or biology for talented 10th physics or biol. 11th chemistry 12th adv. biology (phys. prerequisite to chem. and both essential to understanding of biology).	yes	2
Waterville, Maine	No comment	No	Depends on objective desired-Intro. in S. Sci.-allowing students 2 yrs of phys., biol, or chem. & 1 yr. of another science	yes	6
Bloomington, Ind.	Weakens it a little.	No	9th-gen.sci. (required) 10th-biology, 11th-chem., 12th-physics to allow math bkgrd.	yes	30

Name of Town	Teach in 10th 9th	At what grade level best? Why?	Are you sacrificing biology due to student immaturity to accelerate other phases?	Opinion of Results	How many years teaching in 9th?
Eureka, Calif.	yes no	Depends somewhat on science program in Jr. Hi. For us works well in 10th	Yes	(See Column on sequence) also need 2 new classes to round out program: Applied Life Science (less than "C" students Shop Science (C average in shop, taking adv. shop, math, shop physics, and shop chem.)	Not teaching it.
Englewood, Calif.	yes no	Depends on over-all curriculum-small, selected group could start in 9th if advanced class in 11th or 12th. If only one class, best to keep in high school.	Attempting to up-grade by giving terminal "Basic Science" for slower or disinterested students--accelerated program has merits, but must be carefully planned and administered.	Problem becomes one of guidance to limit to those teaching it. with ability.	Not teaching it.

Name of Town	Does 9th grade biology strengthen or weaken total biology program?	Do you teach a second year to capable and interested?	What sequence and year should chemistry, biology, and physics be taught?	Do you have major in biology?	Number of Years in Teaching?
Eureka, Calif.	Weakens	Start in fall of 1960	7th-Life Sci.(required) 8th-Phy.Sci.elements of chem. & Phys(required) 9th-Earth Sci-next yr. 10th-Reg.Biol. for "C" students-College Prep. Biol-"B" or better 11th-Reg.Chem-"C" or low in math. College Prep. Chem."B" or better. 12th-Adv.Biol.-"B" average-College Prep. Physics-"B" average, Reg.Physcs-"C" students.	yes	6
Englewood, Calif.		No, but working towards it--necessary changes in curriculum and guidance will take time	9th- genl. biol. 10th-chemistry 11th-physics 12th-advanced biology-chem. and physics would serve as background	yes	20