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A Study of Biology Teaching in the State of Washington – 1959 versus 1965

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CHAPTER I

THE PROBLEM, DEFINITIONS OF TERMS USED, LIMITATIONS OF THE STUDY, METHODS OF RESEARCH AND OVERVIEW

After the production of fission and fusion bombs and the launching of successful satelites, the American school system was caught up in a crossfire of criticism, evaluation and reorganization. The physical sciences became increasingly accented. However, the biological sciences also received marked attention.

As long ago as 1881, T.H. Huxley made a vigorous attempt to show the people the importance of biological science. He advanced the thought that:

> ...There can be no question as to the nature or the value of the connection between medicine and the biological sciences. There can be no doubt that the future of pathology and therapeutics, and therefore, that of practical medicine, depends upon the extent to which those who occupy themselves with these subjects are trained in the methods and impregnated with the fundamental truths of biology. (19:347)

In a publication by the National Society for the Study of Education it was stated that:

> All education in science at the elementary and secondary levels should be general. Even for students going to College, general courses in biological science and in physical science (according to the Harvard report) should make a greater contribution to the students general education and his preparation for a future study than a separate one-year course in physics and chemistry. (15:12)

In spite of the increased interest in the science fields and the importance of biology, there has been no recent evaluation of biology teaching in the State of Washington in terms of what changes have been wrought by the increased emphasis on science in recent years.

I. THE PROBLEM

In some locales in the United States, it had been conclusively determined that science education needed improvement. Hollmeyer stated, "In some schools, there is no time in the day's schedule for science; no space for science experiences or activities; no money appropriated for instructional equipment; and teachers have little or no training in this area." (18:127)

In light of this statement and because of the absence of information regarding biology teaching in the State of Washington, it seemed that the teaching of biology in public high schools of the state should be examined critically. The study could serve as a basis for improving science methods courses and assisting prospective biology teachers and provide information regarding possible trends in teaching biology.

It was the purpose of this study to (1) determine the scope and teaching methods used in biology courses in the State of Washington in 1965; (2) to determine the factors which influenced the scope and methods; (3) to compare the scope and methods with similar data collected in 1959; and (4) to determine if changes that occurred gave evidence of trends.

II. DEFINITIONS OF TERMS USED

The following terms were used in this study:

Group A included high schools which had an enrollment of 150 or less.

Group B included high schools which had an enrollment of 151 to 450.

Group C included high schools which had an enrollment of over 450.

Biology: That subject which was taught in the high schools and incorporated aspects of zoology and botany. Teachers who taught botany and zoology as separate courses were classified as biology teachers.

III. LIMITATIONS OF THE STUDY

The complete investigation of the teaching of biology in the State of Washington was beyond the scope of this study. Therefore, this study was limited in the following ways:

1. Only one questionnaire was sent to the biology department in each high school in the State of Washington.
2. The aspects of biology investigated pertained to:
   a. Planning courses
   b. Class size and composition
   c. Laboratories and laboratory work
   d. Evaluation of students
   e. Teaching techniques and methods
   f. Teacher preparation
   g. Equipment and materials
   h. Enrollment of school
3. The results of nearly identical questionnaires were compared and analyzed in terms of any trends that might appear evident.

IV. METHODS OF RESEARCH

270 questionnaires (Appendix) accompanied by self-addressed stamped envelopes were sent to the biology department of each public high school in the State of Washington in 1959. Two weeks later a follow-up letter was sent to all biology departments from which a response was not

received. In 1965 the process was repeated and 286 questionnaires were sent. The 1959 high school addresses were obtained from the Directory of All Public High Schools in the State of Washington. (12) The 1965 addresses were obtained from the Washington Educational Directory 1964-1965. (38)

167, or sixty-one and eight-tenths per cent of the 270 questionnaires sent in 1959, were returned. In 1965, sixty-one and two tenths per cent (175) of the 287 questionnaires were returned. The returned questionnaires were divided into three groups according to the enrollment of the schools. From group A schools (150 or less), fifty questionnaires were obtained in 1959 and thirty-nine in 1965. Fifty-four were received from teachers in group B schools (151 to 450) in 1959 and forty-seven in 1965. Teachers from group C schools (over 450) returned sixty-three questionnaires in 1959 and eighty-nine in 1965.

V. OVERVIEW

Some of the significant writings related to the teaching of science in general and to biology specifically are reviewed in Chapter II. In Chapter III the data received from teachers in groups A, B, and C schools are presented, compared and analyzed. Chapter IV is devoted to summary, conclusions and recommendations based upon the data.

CHAPTER II

REVIEW OF THE LITERATURE

In educational literature was found much of the material written in regard to science education. Selected references in science education that pertained to general education and to biology instruction were reviewed.

I. THE IMPORTANCE OF SCIENCE IN GENERAL EDUCATION

Science was at one time considered, to the layman at least, an intangible, etherial cosmos of mystery. Today, in order for us to live more effective lives in a democratic society of rapidly developing technology, we have learned to apply a great number of the scientific principles which effect our everyday living. "In the last three decades principles of science have gained wide acceptance as objectives of education." (37:241) Hoff explained this position in the following statement:

> The clothing we wear, the houses in which we live, the agricultural methods which produce our food and necessities, our automobiles, our telephones, our radios, the electrical appliances which are used in our home -- are all based upon scientific information. (7:17)

Renner, Bray and Powell realized:

> Our democratic way of life provides for the education of all the children of all the people. Secondary schools are no longer strictly college preparatory institutions. They serve those who will go to college, trade schools, and into military service and those for whom high school per se is terminal. This means that science instruction must serve general educational aims and purposes. (33:181)

To accentuate this point, they quoted the Cooperative Committee on the Teaching of Science and Mathematics of the American Association for the Advancement of Science:

> If scientists are to function effectively, they must work in a society where the individuals appreciate science, and obviously, capable scientists will develop in large numbers in a society where good instruction in science is a part of the general education. (33:182)

From the Commission on Secondary School Curriculum (8:64-138) came the report that the adolescent had five major needs which were satisfied in a well-developed science curriculum:

1. The need for personal health
2. The need for self-assurance
3. The need for a satisfying world picture and a workable philosophy of life
4. The need for a range of personal interests
5. The need for esthetic satisfactions

If it is important that these needs of adolescence be satisfied and the most effective means of satisfying them is through science, then all of the research which has been done in science education is certainly justified.

II. THE NECESSITY FOR GOOD SCIENCE TEACHING

Since science education is important to the American way of life, it becomes obvious, then, that good science teaching and good science teachers are needed. The view that people should be encouraged to become interested in science education was supported by Watson, Brandwein and Rosen who pointed out that "...The annual need for new science teachers exceeds 7,000 and will soon approach 10,000, while at present a maximum of 5,000 potential replacements graduate from college!" (40:10)

> The "quality" of our science teachers is crucial, for these teachers create the atmosphere and viewpoint within which the teaching influences the development of children. Books, equipment, buildings, curricual and administration are only aids to better instruction. Unless the teacher has the ability to utilize these aids effectively, he cannot arouse desired ideas and attitudes in pupils. We must be concerned then, with the quality, as well as the quantity, of those who become science teachers in the schools of the country. (40:48)

Lachlan Reed, Director of Industry-Education Relations for Minneapolis, Honeywell Regulator Company states, "Teachers really make or break education." He also noted that they have a tremendous sales job to do and in reference to that commented, "There are now seven Chinese and Russians for every American. We've got to make that one American better than seven Communists in knowledge and skill and in energetic interest in making the most of himself." (32:20)

Riddle brought to the fore the report of the President's Committee on Scientists and Engineers (December 1, 1957) which stated:

> There is ample evidence that the Soviet Union is bending every effort to achieve its goal of world domination by leading the way in the scientific revolution.... Today Russia has more scientists and engineers than the United States and is graduating more than twice as many each year.... The education program of the committee is largely directed to the secondary schools. Not only are the seeds of future career decisions planted during a student's high school days, or even earlier, but the courses he selects and the quality of instruction he receives frequently determine the possibility of his studying for a science or engineering degree in college. (35:151)

In 1964 Dr. Donald Stotler stated that Russia and China combined graduate thirteen scientists and engineers to every one graduated by the United States. He further stated that we are fighting a battle of

the sciences for our very survival.

It was interesting to note that according to Korol (23:300-03), the Soviet Union also possessed two of America's pet educational gripes. He stated that the Russians regretfully expressed that a great number of their educators did not have the necessary pedagogical education and that they were having a difficult time trying to solve the problem of excessive teacher load.

III. SCIENCE TEACHING METHODS AND TECHNIQUES

There were a number of authors who voiced definite ideas concerning science teaching methods. Heiss, Obourn and Hoffman (16:Ch. 7) organized science teaching techniques under five headings:

1. Techniques for developing knowledge
2. Techniques for developing scientific attitudes
3. Techniques for developing appreciations
4. Techniques for developing interests
5. Techniques for developing the skills of problem solving

Boeck (7:92-97), in a study of general science pupils, discovered that students retained information equally well under three methods of instruction. Only one of the methods utilized observation or experimentation. A number of authors recommend the use of experimental and demonstration methods. Bernard stated that, "In most research studies where one method has been found to have an advantage over another, it was usually the experimental method". (5:12) Zim, with documentary support, accentuated this by asserting that:

> ...the method of science is fundamentally the method of observation, and that the practice of science without firsthand observation is an impossibility. What we call

> "experimentation" is a valuable special technique to enhance the validity of observations. (45:13-14)

Murray expressed the opinion that the use of the scientific method in high school biology teaching "...is effective in the learning process because the students want to find the answers to their own questions. They are self-motivated. Also, an understanding of how all the knowledge of the scientific world was and is obtained becomes realized by the student. He begins to feel like an apprentice scientist." (30:62-63)

Hurd believed there was educational value in students knowing the ways in which scientists work:

> A number of teachers have expressed the opinion that more emphasis should be given to the development of scientific attitudes in students. These teachers tend to feel there is better "transfer" to real life problems in terms of attitudes than in terms of method.... ...a knowledge of the scientific method in areas of personal and social concern is an objective of major concern in science teaching at all grade levels. Second, there is some evidence that positive results can be obtained by teachers where student activities are planned specifically to achieve this objective. The major problem however, is to discover ways in which a greater degree of competency can be obtained in terms of getting students to appreciate and utilize critical methods in the solution of problems of a personal-social nature. (11:262)

Bleifeld (6:6-9) indicated some excellent examples of how the discoveries of great scientists could be used in a high school biology class to show how scientists approached and solved problems. He had his high school students "relive" the experiments of such great men as Alexander Fleming, Walter Reed, William Harvey and Charles Darwin. In a book distributed by the International Bureau of Education at Geneva (20:23-25), which pertains to natural science, were pointed out the following statements regarding the use of the scientific method:

> A brochure published by the Ministry of Education in England and Wales insists that, "The practice of scientific method, like that of virtue, is inculcated better by example than by precept".
>
> A booklet published by the Belgian Ministry of Education on the present reform of secondary education declares that, "the first law of natural science is active participation of pupils".
>
> In Alberta in Canada, for instance, where "the content and methods of teaching are chosen because of their significance for human living", the official viewpoint is that "laboratory experiments are useless unless performed with a purpose in view and definite outcomes in mind. The experiment must function in the life of the pupil. Such work should embody the spirit of problem solving as a teaching method. Evidence should be gathered and observations should be recorded faithfully. The laboratory should be a place where pupils can find answers to questions and not merely verify textbook descriptions."

In several of the above quotations the significance of the laboratory was indicated as being important to developing the scientific method. Washton (39:388) suggested that experimental syllabi be developed to implement proper scientific method teaching for science courses in general education.

With regard to laboratory work, Kahn (21:28-30) believed that proper homework assignments contributed effectively toward the laboratory as the "heart" of science education. He listed several reasons for making this statement:

1. They may give rise to student problems to be solved in the laboratory
2. Proper assignments may make laboratory problems more meaningful in terms of the students' life and experiences
3. Materials not ordinarily available, may be provided the school by the home
4. Proper assignments may give the student practice in laboratory procedures, where such practice time cannot

be found in the crowded school day
5. They may provide for greater individualization of laboratory instruction
6. Excellent assignments can teach effectively the scientific method and attitudes
7. Inspiration and ideas for individual and group projects may derive from well-devised home assignments.

Whitehead (44:14) stated that "the main ideas which are introduced into a student's education should be few and important, and thrown into as many combinations as possible." The view is supported by McKibben (26:187-96), and Dressel and Mayhey (27:Ch. 1).

Other suggestions pertaining to science teaching methods have been made. Richardson (34:Chs. 4, 5, and 6) and Heiss, Obourn and Hoffman (16:Chs. 5, 6, and 7) discussed the value of each of the following techniques of science teaching:

1. Demonstrations (with and without visual aids)
2. Class projects
3. Supervised study
4. Modifying work for slow and superior students
5. Field trips
6. Group discussions
7. Lectures
8. Individual reports
9. Use of resource persons
10. Reviews
11. Reference work
12. Problem solving using the scientific method
13. Relating science to other school work

IV. THE TRAINING OF BIOLOGY TEACHERS

Since the nation needed good science teachers, it was apparent that biology teachers should have strong academic backgrounds and student teaching experiences.

> The student who is preparing to become a teacher of biology obviously should have as many basic courses in biological sciences as he can fit into his college program. The better trained a teacher is in subject matter, the more enthusiastic and stimulating he is likely to be in his teaching. (31:75-75)

According to some recent studies, biology teachers were not, in many cases, adequately prepared. Blackwood and Brown (46:67) found that in the State of Iowa, the mean number of semester hours of biology completed by biology teachers was twenty-one and seven-tenths. Baker and Brooks (4:132) found that in Kansas only fifty-eight per cent of the biology teachers had taken college botany. Only sixty-six per cent had taken college zoology, and only forty-seven per cent had college credit in general biology. Shrader (32:154-55) found in his study of beginning teachers in Washington and Oregon that, "Most of the general science teachers and more than one-half of the teachers teaching biology, physics and chemistry had not earned sufficient quarter-credits in specified courses, according to the standards suggested by the National Society for the Study of Education, to be considered well-qualified to teach science." Koelsche (22:32-33) on the other hand, indicated that in the State of Ohio, biology teachers, as a whole, had relatively adequate academic backgrounds.

The International Bureau of Education (20:141) at Geneva found that natural science (biological science and closely related sciences), "at secondary level is generally taught by teachers who have taken a university course in science, accompanied, followed or preceded by a theoretical and practical professional course at the university or teacher training institution. In twenty of the fifty countries which

replied to the inquiry, natural science teachers were required to possess a degree in science or its equivalent, together with a teacher's diploma or certificate."

V. THE BSCS BIOLOGY PROGRAM

In 1960, a new experimental approach to biology was introduced to the high schools of the nation. It was called BSCS (Biological Science Curriculum Study). Although originally conceived for all levels of students, it has been interpreted by some as oriented toward one level more than another.

Weishar and Terry (43:345-46), N. Abraham (1:263-64) and Amaro (2:347) supported the use of the BSCS program for all levels of students. Lisonbee and Fleigler thought the BSCS program was suitable for the slower students. They stated that one goal:

> ...is to assure a high quality program in biology, and the evolvment of new concepts concerning the slow learner which will spread to other areas of the curriculum. Moreover, it will elevate the scientific competence of this nation through raising the scientific understanding of the slow learner. (25:336)

On the other hand, Weaver believes that "BSCS is too advanced for most students." (40:404) Also Crossland, one of Great Britain's educators, who completed a course of study on BSCS, stated, "...I do not feel it is perfected to the point where it might be adopted in England." (10:348-53)

(There is now a BSCS program being developed for students in the lower twenty per cent and its pilot version was placed in several schools during the school year 1964-65.)

Some writers thought the BSCS program was highly adaptable for gifted students and for advanced placement classes. Metzner believed that gifted students should be placed in a separate learning environment since "students who are gifted reveal a conceptual understanding that transcends that of their average classmates." (28:341-44)

CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

The data were not presented in the order the items occurred on the questionnaire. Instead, related questions were analyzed together. Some respondents failed to answer completely or correctly some portions of the questionnaire. Therefore, the number of teachers shown as responding to each item in the questionnaire may vary.

I. GRADE PLACEMENT OF BIOLOGY STUDENTS

Question two asked for the approximate percentage of biology students in each grade level. In Table I the average per cent of students in grade levels of each of the groups of schools is given.

In most instances biology was being taught as a sophomore subject. However, in 1959 and 1965, seven teachers and two teachers respectively, from group A schools, indicated that fifty per cent or more of their biology students were ninth graders. In addition, in 1959 and 1965, there were four teachers and two teachers, respectively, from group A schools who indicated that biology was primarily an eleventh grade subject. In both 1959 and 1965 there was one occasion where advanced biology was taught as a seminar subject in a group A school.

In 1959, all the group B teachers indicated that biology was a sophomore subject. However, in 1965, there were eight schools where biology was taught as a freshman subject and one school where ninety-seven per cent of the biology students were juniors.

Except for one school where all of the biology students were

TABLE I

PER CENT OF BIOLOGY STUDENTS ACCORDING TO GRADE LEVEL AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
GRADE	1959	1965	1959	1965	1959	1965
Ninth	9.9	6.1	.97	15.7	1.8	3.4
Tenth	76.0	79.4	88.0	74.8	84.0	75.6
Eleventh	9.9	8.6	8.9	7.5	9.8	15.1
Twelfth	4.2	2.6	2.2	2.4	4.4	6.1

*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 52 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 63 responses used in 1959 and 89 in 1965

freshmen, biology was taught in the 1959 group C schools as a sophomore subject. Most teachers in the 1965 C group noted that biology was a sophomore subject. However, in two schools biology was taught as a ninth grade subject, and in six schools biology was taught as an eleventh grade subject.

II. ABILITY GROUPING

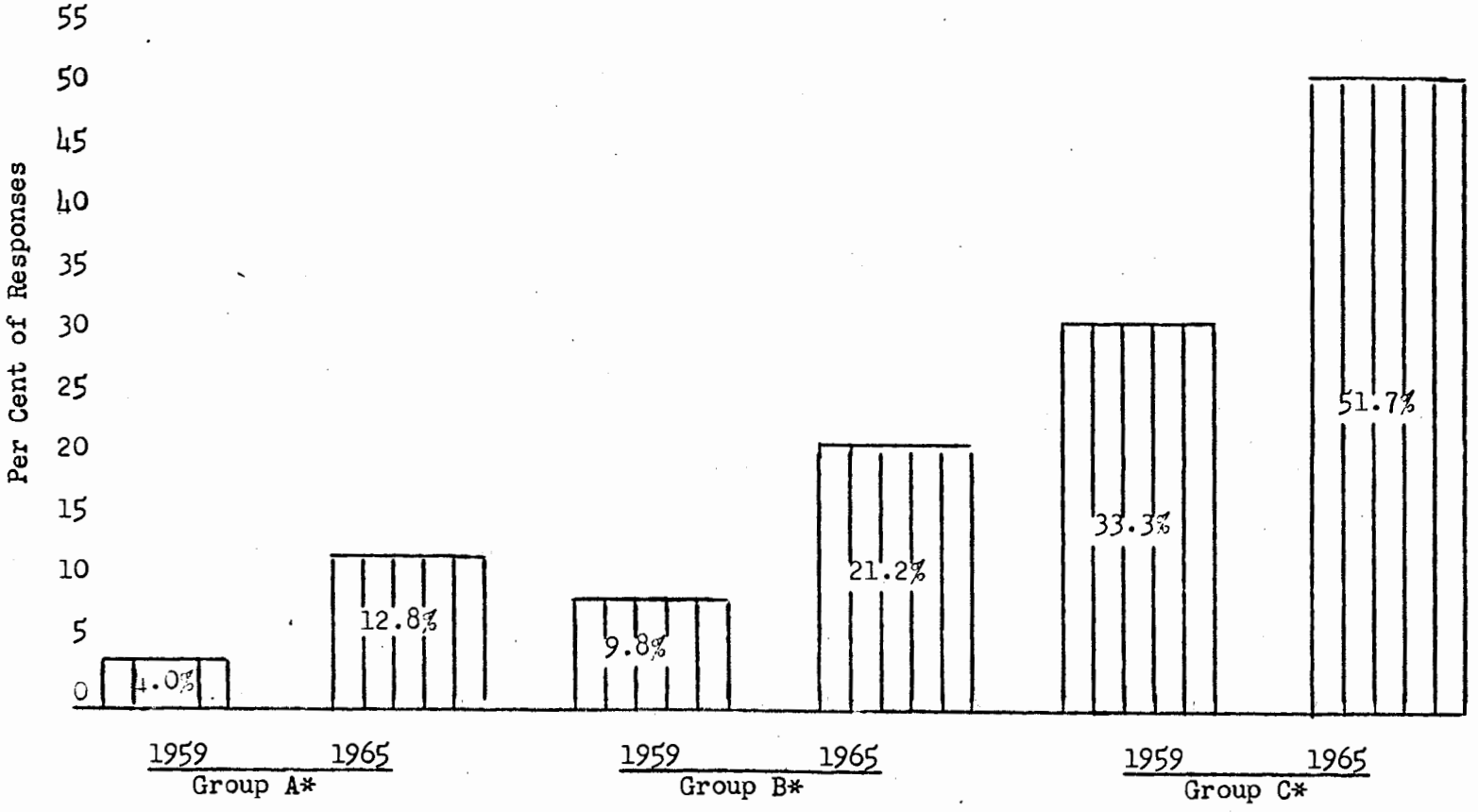
Information about ability grouping in biology classes was requested in question three. In the group A schools in 1959, there were only four per cent of the schools who had ability grouping. In 1965, twelve and eight-tenths per cent of these size schools had ability grouping. The group B schools showed nine and eight-tenths per cent ability grouping in 1959, while twenty-one and two-tenths per cent of the same group had ability grouping in 1965. Group C schools showed an increase in grouping from thirty-three and three-tenths per cent in 1959 to fifty-one and seven-tenths per cent in 1965. Figure I graphically shows these increases in ability grouping.

III. SCIENCE TRAINING OF BIOLOGY TEACHERS

Biology teacher education pertaining to areas of science was brought out in question seven. Data regarding the number of quarter hours of credit in certain sciences as earned by teachers in the different size schools are presented in Table II and Table III. The per cent of teachers who earned science credit is given. The average number of hours of botany, zoology, chemistry and biological science per teacher in

FIGURE I

PER CENT OF SCHOOLS, BY SIZE AND YEAR, THAT GROUPED STUDENTS ACCORDING TO ABILITY



*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959, 39 in 1965.
Group B = Schools with enrollments of 151 to 450, 51 responses used in 1959, 47 in 1965.
Group C = Schools with enrollments of 451 or more, 60 responses used in 1959, 89 in 1965.

TABLE II

AVERAGE NUMBER OF QUARTER HOURS EARNED IN CERTAIN SCIENCES
BY TEACHERS ACCORDING TO SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
COURSE	1959	1965	1959	1965	1959	1965
Botany	9.1	10.3	12.7	17.7	19.0	20.4
Zoology	12.9	18.1	20.2	27.6	22.8	31.6
Geology	3.5	3.1	3.5	3.3	4.4	4.3
Chemistry	17.5	18.1	23.2	16.1	15.7	19.2
Physics	9.6	6.6	7.1	5.2	6.3	5.3
Biological Science	9.6	10.6	14.2	12.9	13.5	20.9

*Group A = Schools with enrollments of 150 or less, 48 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 49 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 56 responses used in 1959 and 82 in 1965

TABLE III

PER CENT OF TEACHERS WHO EARNED CREDIT IN CERTAIN SCIENCES ACCORDING TO SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
COURSE	1959	1965	1959	1965	1959	1965
Botany	71.0	74.4	69.4	80.7	89.4	92.6
Zoology	83.4	79.5	81.6	89.2	94.6	93.8
Geology	37.6	41.1	38.8	48.9	41.1	46.4
Chemistry	81.2	79.5	85.7	80.7	80.3	87.8
Physics	58.5	48.7	38.8	53.2	59.0	51.2
Biological Science	71.0	61.5	69.5	57.4	64.3	76.8

*Group A = Schools with enrollments of 150 or less, 48 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 49 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 56 responses used in 1959 and 82 in 1965

group A schools increased between the years of 1959-1965. The average number of hours decreased in geology and physics. The per cent of group A teachers who had college credit in botany, zoology, chemistry and physics increased from 1959 to 1965, while the per cent having credit hours in biological science decreased. The group B teachers showed an increase from 1959 to 1965 in the average number of credits earned in botany and zoology only. However, the per cent of group B teachers having credit in botany, zoology, geology and physics increased. The number of hours of college credit in botany, zoology, chemistry and biological science per teacher in the C group schools increased from 1959 to 1965. The per cent of teachers having credit hours in botany, geology, chemistry and biological science also increased. Some teachers in various groups indicated that they had majors in agriculture, horticulture, animal science, fisheries and forestry.

IV. TEACHER LOAD

Information pertaining to teacher-load was requested in question eight. The average number of biology classes per teacher per day in group A remained the same for 1959 and 1965. The 1965 teachers of biology in groups B and C showed an increase in number of biology classes taught. The average number of students in biology classes in 1965 decreased slightly in all three groups. However, the average number of classes of all kinds taught per day by biology teachers was slightly higher in 1965 than in 1959 except for the C group which showed a slight decrease. In 1965 thirteen teachers in the C group indicated they

taught four classes of biology only per day, while in 1959 there were three teachers in this same group who had only four classes of biology per day to teach. However, in all groups, there were schools in both 1959-1965 in which teachers were required to teach six and in some cases as many as seven classes per day. Table IV provides information regarding class size and teaching loads.

V. LABORATORIES

In 1959, eleven of fifty teachers (twenty-two per cent) in the A group indicated that their classrooms were not designed for teaching science. Three of these schools were constructed since 1950. Forty-five per cent of the classrooms which were designed for teaching science had been constructed or renovated since 1950. The remaining thirty-two per cent of the science classrooms were either constructed or renovated between 1925 and 1949 (two in 1925 and two in 1926). Three teachers who did no laboratory work, had rooms that were not designed for teaching science. The 1965 responses from teachers in A group schools indicated there were eight of thirty-nine (twenty and five-tenths per cent) classrooms not designed for teaching science, one of these rooms having been constructed in 1964. Twelve laboratories, or thirty and eight-tenths per cent, of the total had been constructed or renovated since 1959, fourteen (thirty-five and nine-tenths per cent) from 1950 to 1959, three (seven and seven-tenths per cent) prior to 1949, and one in 1926. Nine teachers gave no date for last construction or renovation, eight of whom had no laboratories.

TABLE IV

AVERAGE NUMBERS OF ALL CLASSES, BIOLOGY CLASSES, AND BIOLOGY STUDENTS ACCORDING TO SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
	1959	1965	1959	1965	1959	1965
Average Number of Biology Classes per Teacher per Day	1.2	1.2	2.6	3.2	4.3	4.6
Average Number of Biology Students per Class	20.0	19.8	26.2	24.2	29.0	27.3
Average Number of Classes Taught per Day (all classes)	5.1	5.3	5.3	5.6	5.2	5.0

*Group A = Schools with enrollments of 150 or less, 46 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 49 responses used in 1959 and 45 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 88 in 1965

However, thirty-one and four-tenths per cent of the fifty-four teachers in the 1959 B group schools indicated they had classrooms not designed for teaching science. Only two teachers stated their pupils did no laboratory work. Twenty (thirty-seven per cent) laboratories had been constructed or renovated since 1950, and sixteen (twenty-nine and six-tenths per cent) were constructed or renovated from 1900 to 1948. In 1965, there were nine (nineteen and one-tenth per cent) of forty-seven teachers in group B who indicated their rooms were not designed for teaching science. Pupils of two teachers who had laboratory facilities did no laboratory work. Twenty-four (fifty-one per cent) of the school laboratories had been constructed or renovated since 1959, seven (fourteen and nine-tenths per cent) from 1950-1959, five (ten and six-tenths per cent) prior to 1949 and one in 1920. Nine teachers gave no date for the last date of construction, eight of whom had no laboratories. One school constructed in 1963 had no laboratory.

Of the sixty-three teachers from the C group schools in 1959, nine (fourteen and three-tenths per cent) indicated that their classrooms were not designed for teaching science. Pupils of four of these teachers did no laboratory work. Ten (fifteen and nine-tenths per cent) of the laboratories were constructed or last renovated prior to 1930, and one in 1900. Nine or fourteen and three-tenths per cent were constructed or renovated between 1930 and 1950, and thirty-five (fifty-five and five-tenths per cent) constructed or last renovated since 1950. Responses from the eighty-eight 1965 C group schools indicated that sixteen (eighteen and two-tenths per cent) of the classrooms were not designed

for teaching science. Three of these schools were constructed since 1959. Pupils of all teachers did laboratory work. Sixty school laboratories (sixty-three and two-tenths per cent) had been constructed or renovated since 1959, eighteen (twenty and four-tenths per cent) from 1950-1959, and seven (seven and nine-tenths per cent) prior to 1949. Three were constructed or last renovated in the 1920s and two in the 1930s. Summaries of data regarding laboratories are presented in Tables V and VI.

VI. EQUIPMENT AND MATERIALS

In question ten, teachers were asked what equipment and material they used in teaching their biology courses. There was a general decrease between 1959 and 1965 in the percentage of all teachers who used textbooks and charts. In Table VII are data regarding these various items.

The 1965 A group showed an increase over the 1959 A group in the per cent of teachers who used demonstration tables, dissecting microscopes, other microscopes, sinks, gas outlets, microprojectors, laboratory tables, demonstration specimens, demonstration apparatus, dissecting equipment and supplementary materials. According to the A group responses in 1965, there was also an increase in the average number of dissecting microscopes, other microscopes, and sinks available to teachers. However, there was a decrease in the average number of demonstration tables, gas outlets, microprojectors and laboratory tables. The percentage of teachers who had none of the specific items of equipment available to them showed a decrease from 1959 to 1965.

TABLE V

PER CENT OF RESPONSES OF TEACHERS REGARDING CLASSROOM DESIGN FOR TEACHING SCIENCE ACCORDING TO SIZE OF SCHOOL IN 1959

1959	Classrooms Not Designed For Teaching Science	Classrooms Designed For Teaching Science	Renovation or Construction Prior to 1950**	Renovation or Construction From 1950 to 1959**
Group A*	22.0	78.0	32.0	46.0
Group B*	31.5	68.5	29.6	37.0
Group C*	14.3	85.7	30.2	55.5

*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959
Group B = Schools with enrollments of 151 to 450, 54 responses used in 1959
Group C = Schools with enrollments of 451 or more, 63 responses used in 1959

**Not all teachers filled in the blank pertaining to date of last construction or renovation. Therefore, these columns will not total 100%.

TABLE VI

PER CENT OF RESPONSES OF TEACHERS REGARDING CLASSROOM DESIGN FOR TEACHING SCIENCE ACCORDING TO SIZE OF SCHOOL IN 1965

1965	Classrooms Not Designed For Teaching Science	Classrooms Designed For Teaching Science	Renovation or Construction Prior to 1950**	Renovation or Construction From 1950 to 1959**	Renovation or Construction From 1959 Thru 1964**
Group A*	20.5	79.5	10.2	35.9	30.8
Group B*	19.2	80.8	10.6	14.9	51.0
Group C*	18.2	81.8	8.0	9.1	68.1

*Group A = Schools with enrollments of 150 or less, 39 responses used in 1965
Group B = Schools with enrollments of 151 to 450, 47 responses used in 1965
Group C = Schools with enrollments of 451 or more, 88 responses used in 1965

**Not all teachers filled in the blank pertaining to date of last construction or renovation. Therefore, these columns will not total 100%.

TABLE VII

PER CENT OF TEACHERS WHO USED AND HAD AVAILABLE VARIOUS MATERIALS AND EQUIPMENT ACCORDING TO YEAR AND SIZE OF SCHOOL

GROUP A*

EQUIPMENT	Per Cent of Teachers Who Use		Extremes 1959 Number With None	Extremes 1959 High	Extremes 1965 Number With None	Extremes 1965 High	Average Number Available	
	1959	1965					1959	1965
Demonstration Table	62.5	78.7	14	5	7	3	1.3	1.2
Microscopes, Dissecting	34.9	63.6	28	14	12	18	4.7	5.1
Microscopes, Other	81.3	93.9	8	10	2	20	3.7	6.2
Sinks	79.0	93.9	9	10	2	9	3.4	3.7
Gas Outlets	81.3	82.8	8	26	4	16	9.5	6.8
Microprojector	48.7	84.8	22	2	5	2	1.5	1.1
Laboratory Tables	76.7	90.8	10	24	3	18	6.1	2.4
Textbooks	100.0	93.9						
Laboratory Manuals	69.8	63.6						
Charts	88.2	82.8						
Demonstration Specimens	76.7	82.8						
Demonstration Apparatus	62.8	81.7						
Dissecting Equipment	83.6	93.9						
Supplementary Materials	58.1	69.7						

*Group A = Schools with enrollments of 150 or less, 43 responses used in 1959 and 33 in 1965

TABLE VII (cont.)

GROUP B*

EQUIPMENT	Per Cent of Teachers Who Use		Extremes 1959 Number With None	Extremes 1959 High	Extremes 1965 Number With None	Extremes 1965 High	Average Number Available	
	1959	1965					1959	1965
Demonstration Table	81.7	68.2	8	8	13	4	1.7	1.5
Microscopes, Dissecting	31.8	80.4	30	12	8	18	5.8	4.8
Microscopes, Other	81.7	90.2	8	14	4	31	7.9	13.3
Sinks	84.0	95.0	7	9	2	25	3.3	9.8
Gas Outlets	72.7	90.2	12	28	4	32	7.9	11.3
Microprojector	59.0	87.7	18	2	5	12	1.2	1.7
Laboratory Tables	77.2	82.8	10	30	7	24	6.1	8.8
Textbooks	100.0	92.5						
Laboratory Manuals	40.9	68.3						
Charts	93.0	92.5						
Demonstration Specimens	95.3	92.5						
Demonstration Apparatus	61.3	70.7						
Dissecting Equipment	93.0	97.5						
Supplementary Materials	52.2	70.7						

*Group B = Schools with enrollments of 151 to 450, 44 responses used in 1959 and 41 in 1965

TABLE VII (cont.)

	GROUP C*							
	Per Cent of Teachers Who Use		Extremes 1959		Extremes 1965		Average Number Available	
EQUIPMENT	1959	1965	Number With None	High	Number With None	High	1959	1965
Demonstration Table	82.5	96.2	9	3	3	8	1.2	1.3
Microscopes, Dissecting	51.9	92.5	25	30	6	40	7.2	10.2
Microscopes, Other	98.0	100.0	1	36		50	13.0	19.0
Sinks	92.0	97.4	4	14	2	13	3.1	4.7
Gas Outlets	71.1	88.8	15	32	9	40	4.3	7.7
Microprojector	74.9	85.1	13	7	12	9	1.5	1.3
Laboratory Tables	74.9	92.5	13	18	6	35	11.5	11.4
Textbooks	100.0	98.7						
Laboratory Manuals	36.5	74.0						
Charts	100.0	95.0						
Demonstration Specimens	100.0	95.0						
Demonstration Apparatus	82.5	93.7						
Dissecting Equipment	94.0	98.7						
Supplementary Materials	74.9	83.9						

*Group C = Schools with enrollments of 451 or more, 52 responses used in 1959 and 84 in 1965

The data from the 1965 B group teachers showed that a larger per cent of them used dissecting microscopes, other microscopes, sinks, gas outlets, microprojectors, laboratory tables, laboratory manuals, demonstration apparatus, dissecting equipment and supplementary materials than those who responded in 1959. In terms of amounts of equipment available, the 1965 group showed an increase in numbers of other microscopes, sinks, gas outlets, microprojectors and laboratory tables. Generally, there was a decrease from 1959 to 1965 in the number of teachers who had none of the specific items of equipment available to them. However, the number of teachers increased who had no demonstration tables and microprojectors.

Responses from teachers in the 1965 C group indicated that the number of teachers who used demonstration tables, dissecting microscopes, other microscopes, sinks, gas outlets, microprojectors, laboratory tables, laboratory manuals, demonstration apparatus, dissecting equipment and supplementary materials increased. In addition, the average number of demonstration tables, dissecting microscopes, other microscopes, sinks and gas outlets available per teacher increased. The percentage of teachers who had none of the specific items of equipment available to them, showed a decrease.

VII. FACTORS AFFECTING COURSE PLANNING

Since the Biological Science Curriculum Study program (BSCS) introduced in 1960, no data pertaining to it was collected in 1959. The responses from teachers from group A schools indicated that in 1965

pupil interest and teacher constructed units were more valuable as factors for planning their biology courses for the year than in 1959. School curriculum guides received equal ratings for the two years. Coordination with other science courses, community resources available, guides from other sources, resource units, teacher-pupil planning, textbooks and workbooks, were all less valuable as factors which figured prominently in planning biology courses.

Teachers in the B group schools indicated that school curriculum guides were a more significant factor in the planning of biology courses in 1965 than in 1959. Other factors were all apparently less valuable. Coordination with other science courses was the single factor in the C group schools in 1965 which was more valuable in the planning of biology courses. The relative value of all other factors cited in Table VIII, except for BSCS factors seemed to have decreased. There was a markedly higher percentage of biology classes in group C schools affected by the BSCS program than in either group A or group B schools.

VIII. PUPIL LABORATORY EXPERIENCES

Question four A asked that teachers indicate which specimens were used consistently for dissection by individual pupils or small groups. They were asked also the time in hours spent on each specimen. The average numbers of hours spent on each type of dissection are given in Table IX.

Most of the teachers in group A schools indicated they required their pupils to dissect the crayfish and the frog and that the pupils spent more time on these two dissections in 1965 than in 1959. The

TABLE VIII

PER CENT OF TEACHERS INDICATING FACTORS PROMINENT IN PLANNING THEIR BIOLOGY COURSES FOR THE YEAR ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
	1959	1965	1959	1965	1959	1965
BSCS: Green	----**	12.8	----	17.0	----	29.2
BSCS: Yellow	----	7.7	----	25.5	----	62.9
BSCS: Blue	----	5.1	----	10.6	----	15.7
BSCS: Lab Blocks	----	7.7	----	17.0	----	21.4
Coordination	36.0	28.2	29.5	14.9	25.0	27.0
Commercial Resources	56.0	33.4	41.0	36.2	49.0	40.4
Guides, Other	20.0	17.9	18.5	12.7	14.5	9.0
Pupil Interest	64.0	75.8	61.0	40.4	51.0	35.9
Resource Units	34.0	12.8	28.0	10.6	22.0	16.8
School Curriculum Guide	10.0	10.0	3.7	14.9	17.5	11.2
Teacher Constructive Units	52.0	61.5	57.5	51.0	70.0	51.7
Teacher-Pupil Plan	18.0	15.4	18.5	10.6	11.1	7.9
Textbooks	96.0	74.4	98.0	61.6	86.0	64.0
Workbooks	54.0	33.4	35.0	27.6	27.0	21.4

*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 54 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 63 responses used in 1959 and 89 in 1965

**BSCS Program was not in existence until 1960

TABLE IX

SPECIMENS COMMONLY USED FOR DISSECTION BY INDIVIDUAL PUPILS OR SMALL GROUPS ACCORDING TO AVERAGE NUMBER OF HOURS, PER CENT OF TEACHERS REQUIRING DISSECTION, YEAR, AND SIZE OF SCHOOL

	GROUP A*				GROUP B*				GROUP C*			
	Average Hours Spent Dissecting		Per Cent of Teachers Requiring Dissection		Average Hours Spent Dissecting		Per Cent of Teachers Requiring Dissection		Average Hours Spent Dissecting		Per Cent of Teachers Requiring Dissecting	
	1959	1965	1959	1965	1959	1965	1959	1965	1959	1965	1959	1965
Clam	1.8	1.4	50.0	38.9	1.0	2.2	27.0	60.0	1.5	1.5	47.5	35.7
Crayfish	2.5	2.6	67.0	61.2	2.0	3.4	58.0	77.7	2.0	2.1	71.5	52.4
Dogfish	2.0	---	2.4	5.6	---	5.6	3.8	17.8	1.5	4.0	10.0	8.3
Earthworm	2.2	1.8	86.0	72.1	2.0	2.6	80.1	88.8	1.5	2.0	95.0	85.6
Frog	3.7	4.1	95.0	97.2	3.8	5.0	87.0	95.5	2.8	3.4	95.0	95.2
Grasshopper	2.2	2.0	83.0	61.2	1.8	3.1	52.0	71.1	2.0	1.8	71.0	57.1
Perch	2.5	2.2	55.0	52.8	1.5	2.5	48.0	57.8	2.3	2.0	46.0	40.5
Roundworm	1.0	1.0	4.8	8.3	---	2.6	5.8	20.2	1.0	1.2	19.5	36.9
Starfish	1.5	1.4	36.0	47.2	1.0	2.1	33.0	51.1	1.5	1.5	42.5	41.6

*Group A = Schools with enrollments of 150 or less, 42 responses used in 1959 and 36 in 1965
Group B = Schools with enrollments of 151 to 450, 52 responses used in 1959 and 45 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 88 in 1965

remaining most consistently dissected specimens were clams, earthworms, grasshoppers, perch, roundworms and stafish. These dissections required less time except for the roundworm which required an even one hour in both cases. Among other specimens that teachers indicated were used for dissection were hydra, other insects, sponges, foetal pigs, cats, heart, grantia, some plants, kidney, fowl, eggs, eyes, seashore specimens, cow internal organs, beaver, turtle, snails, reptiles, rats, squid, sea urchins, and one teacher even indicated that his students had been dissecting human bodies. The percentage of teachers who had students dissect the frog, the roundworm, and the starfish increased in 1965 over 1959.

Teachers from the B group schools indicated an increase in laboratory time spent in 1965 over 1959 for dissection of all the listed specimens. In addition, a higher percentage of teachers had their students dissect all of these animals.

Responses from teachers in group C schools indicated that more dissection time was required in 1965 than in 1959 for the crayfish, dogfish, earthworm, frog and roundworm. The starfish and the clam required the same amount of time, while the dissection of the grasshopper and the perch appeared to have required less. The roundworm was used for dissection by approximately twice the number of teachers on a percentage basis as in 1959.

Teachers were also asked to indicate in question four B if students made collections. Seventy-two per cent of the teachers who responded to the questionnaire from group A schools in 1959 indicated that their

students made collections, while in 1965 sixty-nine and three-tenths per cent of the students made collections. Seventy and four-tenths per cent of the respondents from the group B schools in 1959 indicated that they had their students make collections, and in 1965 they indicated that seventy-two and four-tenths per cent had their students make collections. In 1959, teachers from group C schools indicated that seventy-four and five-tenths per cent of their students made collections. Respondents from the same group in 1965 indicated that only fifty-two and three-tenths per cent required collections. Data pertaining to teachers who require collections are given in Table X.

Question four C requested that teachers requiring collections indicate what type collections their students make. Responses from the group A schools in 1965 indicated that there was an increase in the number of students who collected insects, leaves, microscopic plant forms and needles, while the percentage who collected algae remained exactly the same. The percentage of collections of other types decreased. Responses from teachers in group B schools indicated that the number of collections of algae, ferns, liverworts, and protozoa increased while the per cent collecting mosses remained the same. The per cent of students who made other more common types of collections decreased. Group C respondents indicated that more students collected algae in 1965 than in 1959, and less of all the other more commonly collected specimens which included cones, ferns, flowering plants, insects, leaves, liverworts, microscopic plant forms, mosses, needles and protozoa. Other specimens that teachers indicated fewer of their students collected included

TABLE X

PER CENT OF TEACHERS REQUIRING COLLECTIONS
ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
COLLECTIONS REQUIRED	1959	1965	1959	1965	1959	1965
Yes	72	69.3	70.4	72.4	74.5	52.3
No	28	30.7	29.6	27.6	25.5	47.7

*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 54 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 63 responses used in 1959 and 88 in 1965

vertebrates, marine life, twigs or branches, trees, roots, fossils, weeds, rocks and minerals, seeds, bark, skulls, bones, fungi, tropical fish, woods, skins, bird nests, feathers, shells, and mammals. Table XI shows data regarding the types of collections.

Teachers were asked in question four D if students identified the specimens in their collections. In 1959, the thirty-six teachers from the A group who had their students make collections indicated that the students did identify the specimens. In 1965, all but one of the twenty-seven respondents from the same group who had students make collections required identification of specimens. Of thirty teachers in the 1959 B group who had their students make collections, three did not require their students to identify the specimens. There were thirty-four responses from the 1965 B group. Only four teachers did not require students to identify specimens. Of forty-seven respondents from the 1959 group C schools, only two teachers did not require students to identify specimens. Two of the forty-six teachers in the 1965 C group who had students make collections did not require identification. In Table XII are data pertinent to identifying specimens.

Date regarding the average number of hours per week spent in laboratory work was derived from question four E and is presented in Table XIII. From the 1959 A group, fifty respondents averaged one and six-tenths hours per week in laboratory. Eighty-two per cent of the teachers had their students do laboratory work. The time in laboratory ranged from one-half hour to four hours per week. Of thirty-nine teachers from the A group in 1965, ninety-seven and four-tenths per cent

TABLE XI

PER CENT OF TYPE OF COLLECTIONS ACCORDING TO YEAR AND SIZE OF SCHOOL

TYPE	GROUP A*		GROUP B*		GROUP C*	
	1959	1965	1959	1965	1959	1965
Algae	22.2	22.2	21.1	35.2	27.6	32.6
Cones	36.1	14.8	31.6	26.4	34.0	19.5
Ferns	30.6	7.4	18.4	20.6	36.2	23.9
Flower Plants	69.5	63.0	76.4	64.7	78.7	54.3
Insects	77.8	88.8	84.2	67.6	85.0	76.0
Leaves	63.9	70.4	84.2	64.7	78.7	43.5
Liverworts	11.1	----	13.2	17.6	21.3	10.9
Miscellaneous Plant Forms	16.7	18.5	7.9	8.8	17.0	17.4
Mosses	30.6	11.1	26.4	26.4	44.7	21.7
Needles	11.1	14.8	15.8	5.9	25.6	6.5
Protozoa	22.2	18.5	15.8	36.0	40.5	34.8

*Group A = Schools with enrollments of 150 or less, 42 responses used in 1959 and 36 in 1965
Group B = Schools with enrollments of 151 to 450, 52 responses used in 1959 and 45 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 84 in 1965

TABLE XII

NUMBERS AND PERCENTAGE OF STUDENTS WHO IDENTIFIED THEIR OWN COLLECTIONS ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
RESPONSE	1959	1965	1959	1965	1959	1965
Yes	36	26	35	30	45	44
No	0	1	3	4	2	2
Percentage**	100.0	96.3	92.0	88.2	95.7	95.5

*Group A = Schools with enrollments of 150 or less, 36 responses used in 1959 and 27 in 1965
Group B = Schools with enrollments of 151 to 450, 38 responses used in 1959 and 34 in 1965
Group C = Schools with enrollments of 451 or more, 47 responses used in 1959 and 46 in 1965

**Based on number of teachers who have students making collections

TABLE XIII

PER CENT OF TEACHERS REQUIRING LABORATORY WORK AND THE LABORATORY TIME AND TIME RANGE ACCORDING TO YEAR AND SIZE OF SCHOOL

Group	Average Number Hours per Week Spent in Class		Range in Time Spent in Laboratory		Per Cent of Teachers Requiring Laboratory Work	
	1959	1965	1959	1965	1959	1965
A*	1.6	1.6	.5-4	.5-3.5	81.9	97.4
B*	1.1	1.8	.5-2.5	1-3	77.8	97.7
C*	1.6	2.2	.5-4	.5-5	87.3	100.0

*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 44 responses used in 1959 and 44 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 83 in 1965

of them had their students spend an average of one and six-tenths hours per week in laboratory. The range in time spent was one-half hour to three and one-half hours per week. Teachers from the B group in 1959 indicated that the average length of time spent in laboratory work per week was about one and two-tenths hours. Seventy-eight per cent of the forty-four respondents noted their students spent from one-half hour to two and one-half hours in the laboratory. About ninety-seven per cent of the forty-four respondents in the 1965 B group indicated that the average number of hours per week their students spent in laboratory was one and eight-tenths hours, with a range of one to three hours. Approximately eighty-seven per cent of fifty-nine teachers from the 1959 C group had students spend an average of one and six-tenths hours per week in the laboratory. The range in time was from one-half hour to four hours. All of the eighty-three teachers in the 1965 C group required laboratory work. The average time was in excess of two hours per week, with a range of one-half hour to five hours.

In Table XIV, answers for question four F are summarized with regard to the derivation of laboratory questions and problems. Teachers from all groups used a variety of sources for planning laboratory questions and problems. However, during both years all groups of teachers used self devised laboratory questions and problems more frequently than those from any other source. The data in Table VIII showed that in 1965 many teachers were using BSCS materials. It must be assumed that the BSCS text and laboratory manuals probably served as sources of laboratory questions and problems for these instructors.

TABLE XIV

PER CENT OF TEACHERS USING SOURCES OF LABORATORY QUESTIONS AND PROBLEMS ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
	1959	1965	1959	1965	1959	1965
From Text	71.5	44.8	53.8	54.3	33.9	44.3
From Workbook	61.7	60.5	44.2	63.0	39.0	64.7
Based on College Experience	35.8	26.4	44.2	47.8	44.1	34.1
Study Questions	45.3	50.0	21.2	32.6	30.5	27.3
Teacher Devised	83.4	81.5	80.7	76.0	91.5	81.7
Lab Blocks	----	2.6	----	8.7	----	13.6

*Group A = Schools with enrollments of 150 or less, 42 responses used in 1959 and 38 in 1965
Group B = Schools with enrollments of 151 to 450, 52 responses used in 1959 and 46 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 88 in 1965

Responses to question four F, four G and four A were compared. Within the A group schools, there were eight teachers in 1959 that did not require laboratory work of any kind and three offered only microscope work. Only three group A teachers in 1965 did not require dissections but all had microscope work done. In the 1959 B group, there were two teachers who designated no dissections by students and five who did not have students attempt microscope work. There were only two teachers in the 1965 B group who did not require dissections. All teachers had students do microscope work. Four teachers in the 1959 C group indicated they had students do no dissection or microscope work. The students of all the 1965 C group teachers did microscope work. Only five teachers did not have dissections done.

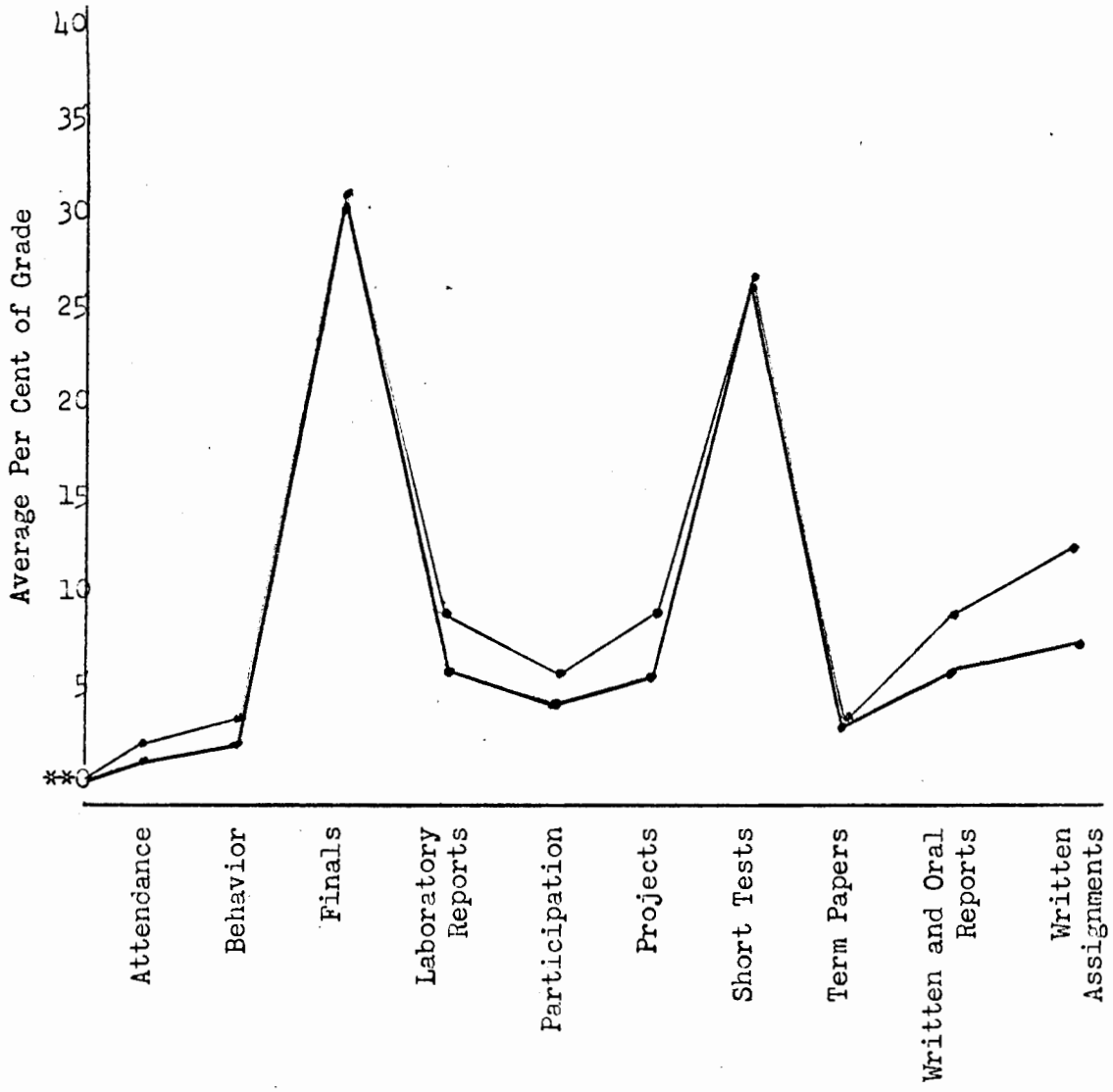
Questions four G asked teachers if students did microscope work as individuals or in small groups on protozoa, microscopic plant forms, plant tissue structure, animal tissue structure, meiosis, mitosis and other specimens. Only eight teachers in all groups in 1959 and 1965 indicated that their students examined bacteria. Table XV provides information regarding the per cent of students who do microscope work on various specimens.

IX. GRADING

Question six asked for an indication of factors considered in the composition of a student's grade and the percentage value assigned to each grade factor. The answers from all groups were quite similar. Figures two, three, and four show the emphasis upon different factors,

FIGURE II

THE PER CENT ASSIGNED TO VARIOUS FACTORS IN DETERMINING FINAL GRADES BY GROUP A* TEACHERS

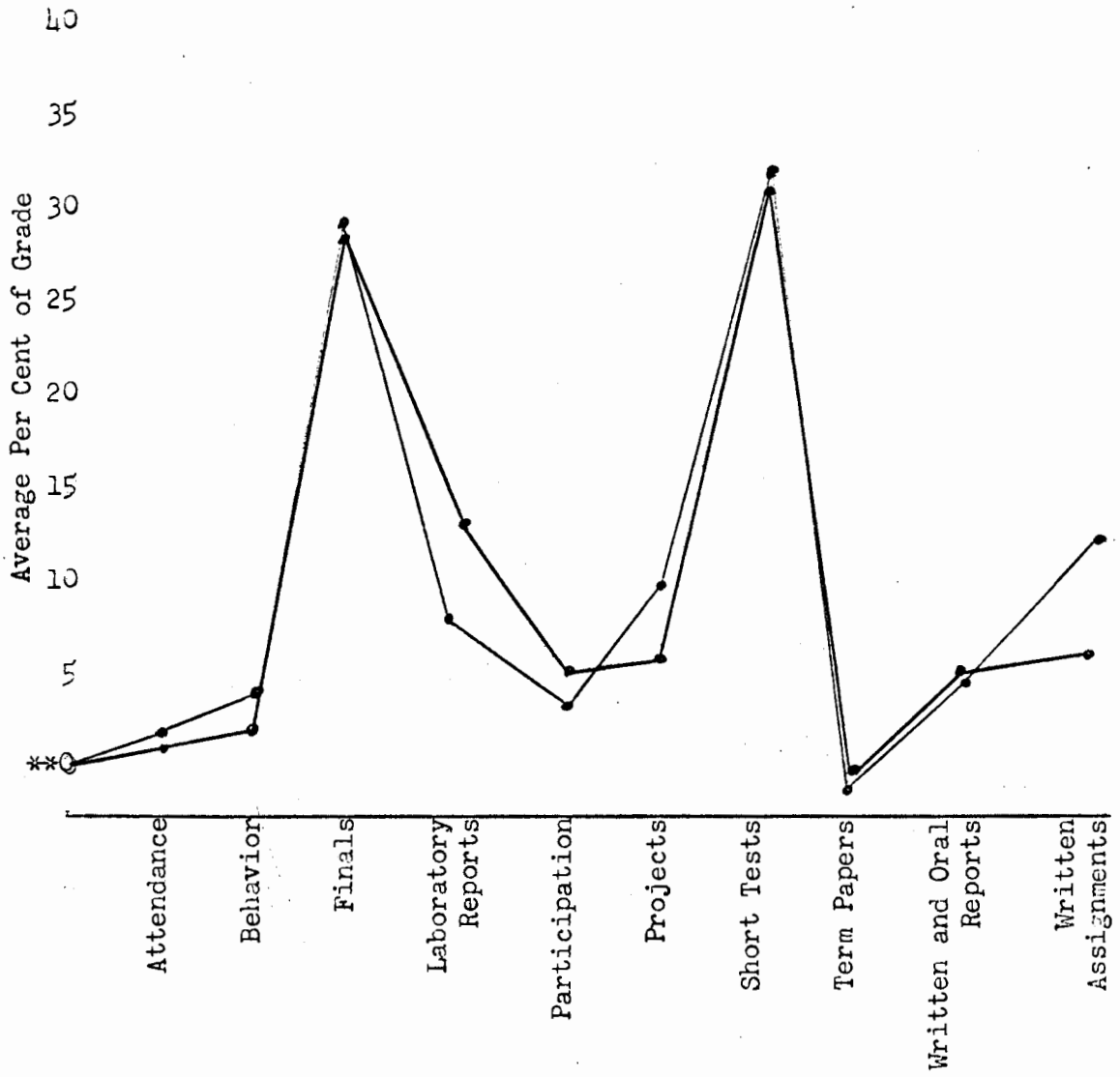


*Group A = Schools with enrollment of 150 or less, 50 responses used in 1959, 39 in 1965.

** = 1959 —— , 1965 —— .

FIGURE III(cont.)

THE PER CENT ASSIGNED TO VARIOUS FACTORS IN DETERMINING FINAL GRADES BY GROUP B* TEACHERS

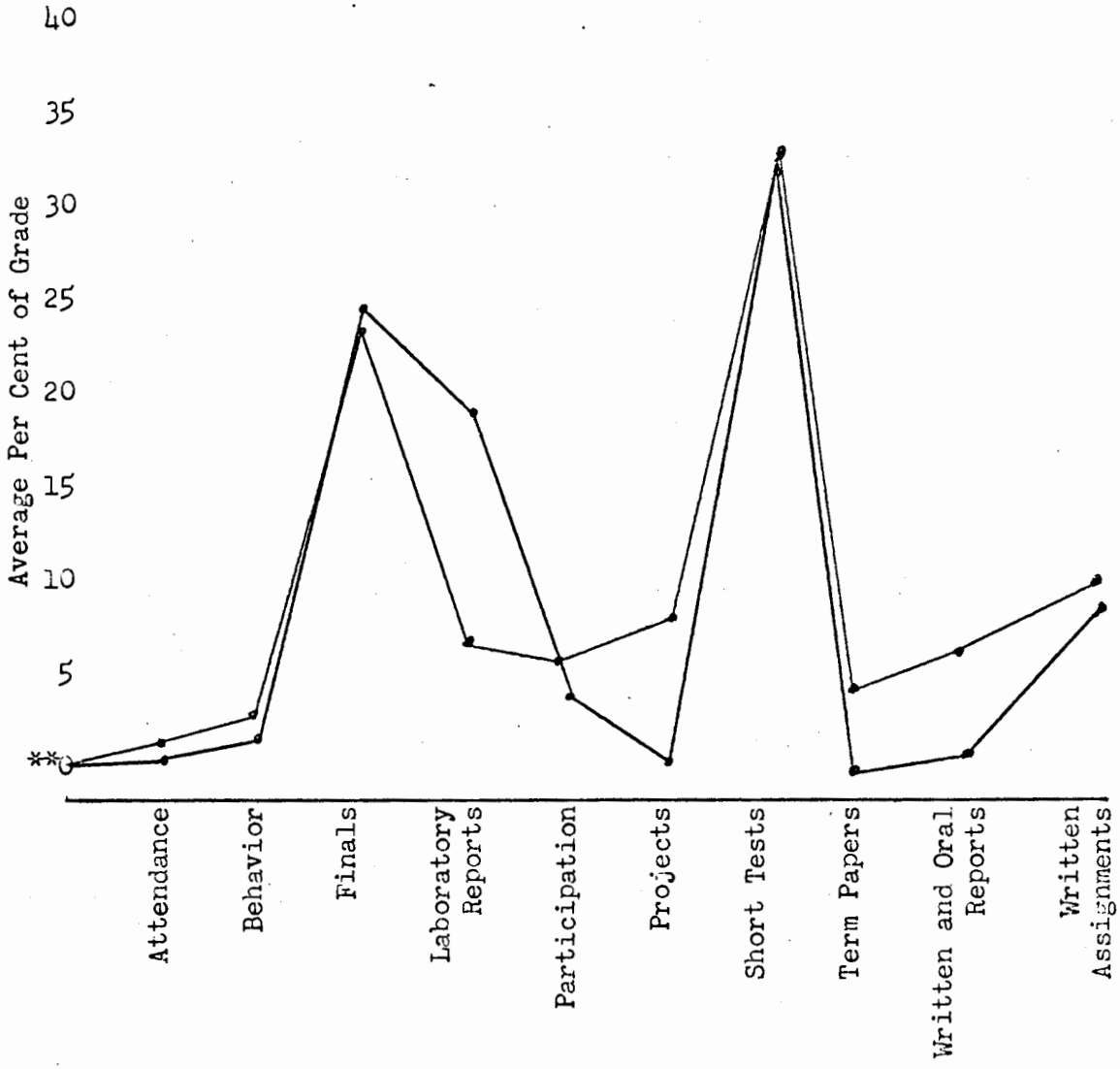


Group B = Schools with enrollments of 151 to 450, 54 responses used in 1959, 47 in 1965.

** = 1959 ——, 1965 — —.

FIGURE IV (cont.)

THE PER CENT ASSIGNED TO VARIOUS FACTORS IN DETERMINING FINAL GRADES BY GROUP C* TEACHERS



*Group C = Schools with enrollments of 451 or more, 63 responses used in 1959, 88 in 1965.

** = 1959 —— , 1965 — — .

TABLE XV

PER CENT OF STUDENTS DOING MICROSCOPIC WORK ON VARIOUS BIOLOGICAL SPECIMENS ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
STUDY TYPES	1959	1965	1959	1965	1959	1965
Animal Tissue	84.5	76.8	70.5	74.4	81.4	88.6
Meiosis	38.5	38.5	35.4	40.4	40.7	63.5
Microscopic Plant Forms	72.0	74.4	82.4	76.5	89.9	93.1
Mitosis	53.9	53.8	47.0	61.7	69.5	89.7
Plant Tissue	84.5	87.2	82.4	85.1	96.5	92.0
Protozoa	94.9	84.6	88.2	95.6	100.0	100.0

*Group A = Schools with enrollments of 150 or less, 39 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 49 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 88 in 1965

TABLE XVI

PER CENT OF TEACHERS USING VARIOUS FACTORS FOR DETERMINING FINAL GRADES ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
GRADE FACTORS	1959	1965	1959	1965	1959	1965
Attendance	13.6	2.6	21.2	12.5	21.4	8.8
Behavior	18.2	13.1	26.9	22.5	37.5	17.7
Final Examinations	95.3	94.6	98.0	97.5	94.5	89.8
Laboratory Reports	61.3	47.3	59.6	82.5	60.7	93.6
Participation	43.2	31.6	44.2	47.5	62.5	46.8
Projects	59.1	55.2	61.5	45.0	60.7	22.8
Short Tests	93.1	94.6	94.1	100.0	92.8	97.4
Term Papers	36.4	21.0	15.4	20.0	35.7	16.4
Written and Oral Assignments	61.3	47.3	50.0	72.5	64.3	45.5
Written Assignments	65.7	49.8	63.5	57.5	80.3	78.3

*Group A = Schools with enrollments of 150 or less, 44 responses used in 1959 and 38 in 1965
Group B = Schools with enrollments of 151 to 450, 52 responses used in 1959 and 40 in 1965
Group C = Schools with enrollments of 451 or more, 56 responses used in 1959 and 79 in 1965

and Table XVI shows the percentage of teachers from each group that used each of the grade factors.

Laboratory reports, final examinations, short tests, and written assignments were used by fifty per cent or more of the teachers in determining the grade. In 1965, attendance, term papers, and behavior were considered in the grade by less than twenty-five per cent of the teachers. More than fifty per cent of the grades for all teachers were based upon short tests and final examinations. There was a marked increase in the effect of laboratory reports on the final grade by group C teachers in 1965.

The results from question six also showed interesting extremes. One teacher in 1965 indicated that ninety per cent of the total grade was derived from short tests. Another teacher based one-half of the students total grade upon participation.

X. TEACHING TECHNIQUES

Question nine asked teachers to indicate which teaching techniques they used in teaching biology and to rate the techniques they used as being very valuable (one, two, three), valuable (four, five, six, seven) and of little value (eight, nine, ten). It was thought that ratings which differed by more than one point between 1959 and 1965 required discussion.

Variations in ratings by teachers in group A schools will be noted first. The 1959 group indicated that supervised study was a valuable teaching technique (five and one-tenth). The 1965 group, however, felt

TABLE XVII

THE AVERAGE RATING** OF VARIOUS TEACHING TECHNIQUES
ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
TECHNIQUES	1959	1965	1959	1965	1959	1965
Demonstrations	3.3	3.9	3.3	3.4	3.1	3.9
Relating Science and Non-Science Subjects	4.4	4.9	4.6	4.2	4.2	5.2
Audio-Visual Aids	3.7	3.8	3.4	2.8	3.2	3.3
Class Projects	4.3	4.3	4.1	4.6	3.9	5.1
Supervised Study	5.1	3.8	4.4	4.9	4.9	5.9
Modifying Work for Slow Learners	5.7	5.1	5.5	4.4	4.6	4.2
Modifying Work for Superior Students	3.1	4.9	3.6	3.7	2.8	3.6
Field Trips	5.1	5.5	5.1	4.2	4.4	5.3
Panels and Committees	7.8	5.8	5.3	6.4	4.7	6.0
Lecture	4.2	3.9	3.5	4.1	3.3	4.0
Class Discussion	3.0	3.5	2.7	3.3	2.7	3.0
Student Reports	5.0	4.5	4.9	5.3	4.7	5.4
Local Resource Persons	5.7	5.0	4.6	3.9	4.0	4.8
Reviews	3.8	5.1	3.6	4.5	4.6	4.6
Problem Solving Using the Scientific Method	3.2	3.6	3.8	3.0	3.2	3.2
Reference Work	4.1	4.2	4.5	4.5	4.1	4.7

*Group A = Schools with enrollments of 150 or less, 47 responses used in 1959 and 37 in 1965
Group B = Schools with enrollments of 151 to 450, 49 responses used in 1959 and 45 in 1965
Group C = Schools with enrollments of 451 or more, 59 responses used in 1959 and 84 in 1965

**Rating: 1-2-3 = very valuable; 4-5-6-7 = valuable; 8-9-10 = little value

that it was more valuable (three and eight-tenths). The 1965 respondents assigned a rating of valuable (four and nine-tenths) to the technique of modifying work for superior students, but respondents in 1959 felt that it was a very valuable technique (three and one-tenth). The use of panels and committees was assigned a rating of little value (seven and eight-tenths) in 1959, while in 1965 the technique was valuable (five and eight-tenths). The 1959 group also indicated that reviews were more valuable (three and eight-tenths) than their 1965 counterparts who thought it should be rated at five and one-tenth, although both ratings are within the valuable technique range.

The 1959 and 1965 B group teachers also showed differences in ratings. Modifying work for slow learners appeared to be more valuable (four and four-tenths) in 1965 than in 1959 (five and five-tenths). Panels and committees seemed to be slightly less valuable (six and four-tenths) to the respondents in 1965 than to teachers in 1959 who rated it as valuable (five and three-tenths).

Group C teachers for the two years studied gave some contrasting ratings. Class projects and panels and committees were also less valuable in 1965 than in 1959.

XI. INADEQUACIES

Question eleven requested that teachers state the most pressing inadequacies in order of importance and pertaining to their preparation and/or classroom facilities. Teachers identified forty-six inadequacies in the two years studied. There was little evidence that the responses

were indicative of order of importance on most questionnaires. Therefore, the inadequacies as they appear in Table XVIII are listed, approximately, in order of frequency.

More teachers in the 1965 A and C groups indicated that more equipment was needed than did the 1959 respondents. The 1965 B group noted that less equipment was needed in 1965. In addition, the need for microscopes on a percentage basis was less than half for all groups in 1965. From the 1965 A group an increase was noted in the per cent of rooms which were too small. There was a decrease in percentage of teachers in the 1965 B and C groups who thought rooms were too small. Educators from all three groups pointed out that more storage space and more preparation time were needed in 1965. The per cent of teachers from the 1965 B and C groups who commented upon poorly designed rooms was doubled since 1959. It is interesting to note that relatively few teachers thought they had an inadequate background for teaching biology. There was an increase between the 1959 and 1965 group C schools that lacked sinks. Responses in 1965 which indicated that classes were too large were at least double the 1959 figures for group A and B schools. Conversely, the per cent of teachers from the 1965 group C schools who said classes were too large was less than one-half that of the 1959 group. A noticeably smaller percentage of teachers from all 1965 groups complained of inadequate demonstration apparatus, demonstration specimens and visual aids than did the teachers in 1959.

As a possible indication of the changes in thinking regarding biology teaching, it should be pointed out that some of the inadequacies

TABLE XVIII

THE PER CENT OF TEACHERS WHO EXPRESSED VARIOUS INADEQUACIES ACCORDING TO YEAR AND SIZE OF SCHOOL

	GROUP A*		GROUP B*		GROUP C*	
INADEQUACY	1959	1965	1959	1965	1959	1965
Lack of Equipment	28.0	35.8	31.4	19.1	19.0	23.6
Lack of Microscopes	42.0	15.4	35.2	17.0	28.6	9.0
Room too Small	12.0	25.6	27.8	19.1	28.6	8.9
Storage Space	12.0	15.4	7.4	19.1	19.0	23.6
Preparation Time	10.0	12.8	14.8	14.9	11.1	16.8
Poorly Designed Room	18.0	2.6	7.4	17.0	4.8	10.1
Inadequate Background	12.0	17.9	14.8	4.3	7.9	5.6
Lack of Sinks	4.0	2.6	5.6	6.4	4.8	19.1
Class too Large	2.0	7.7	7.4	14.9	17.5	7.9
Lack of Demonstration Apparatus	8.0	2.6	12.9	6.4	11.1	1.1
Lack of Demonstration Specimens	16.0	10.2	9.2	----	7.9	----
Lack of Visual Aids	24.0	5.1	9.2	4.3	1.6	----
Preparation Space	----	7.7	----	8.5	6.4	12.3
Lack of Gas Outlets	6.0	----	----	6.4	7.9	8.9
Inadequate Laboratory Time	4.0	15.4	5.6	2.1	7.9	4.5
Lack of Laboratory Specimens	8.0	10.2	9.2	4.3	7.9	----
Lack of Reference Material	4.0	5.1	9.2	6.4	6.4	4.5
Lack of Laboratory Facilities	----	2.6	----	6.4	9.5	7.9
Lack of Laboratory Tables	12.0	2.6	5.6	2.1	6.4	1.1
Inadequate Text	4.0	----	14.8	6.4	----	2.2
Lack of Space for Living Materials	----	10.2	----	6.4	----	9.0
Lack of Microprojectors	12.0	----	11.1	----	1.6	----
Lack of Electrical Outlets	2.0	----	----	2.1	4.8	7.9
Teacher Load too Great	8.0	----	----	4.3	----	3.3
Poor Budget	----	2.6	----	2.1	1.6	8.9
No Greenhouse	----	2.6	----	4.3	4.8	5.6
Lack of Ability Grouping	2.0	2.6	3.7	4.3	4.8	2.2
Lack of Models	----	2.6	9.2	2.1	4.8	----
Lack of Project Work Area	----	----	----	6.4	----	7.9
Lack of Display Facilities	2.0	----	2.6	4.3	----	3.3
Lack of Laboratory	6.0	5.3	2.6	----	----	----
Lack of Film Showing Facilities	10.0	----	----	----	----	----
Lack of Aquarium	----	2.6	2.6	4.3	1.6	----
Lack of Bulletin Board Space	----	----	----	----	1.6	2.2
Lack of Hot Water	----	2.6	----	2.1	----	1.1
Lack of Laboratory Guides	----	5.3	----	----	1.6	----
Lack of Proper Lighting	----	----	----	2.1	3.2	----
Lack of Laboratory Assistant	----	----	----	----	----	3.3

TABLE XVIII (cont.)

INADEQUACY	GROUP A*		GROUP B*		GROUP C*	
	1959	1965	1959	1965	1959	1965
Inadequate Laboratory Manual	----	----	----	4.3	----	----
Lack of Students	2.0	----	----	----	----	----
Improper Heating	----	----	2.6	----	----	----
Inadequate Acoustics	----	----	----	----	1.6	----
Lack of Transportation for Field Trips	----	----	----	----	1.6	----
Inability to Reach Level of Students	----	----	----	----	1.6	----
Too Many Classroom Interruptions	----	----	----	2.1	----	----
Lack of Air Conditioning	----	----	----	----	----	1.1

*Group A = Schools with enrollments of 150 or less, 50 responses used in 1959 and 39 in 1965
Group B = Schools with enrollments of 151 to 450, 54 responses used in 1959 and 47 in 1965
Group C = Schools with enrollments of 451 or more, 63 responses used in 1959 and 89 in 1965

which were expressed by teachers in 1965 were not expressed in 1959. Three teachers indicated they had no hot water, fifteen complained of lack of space for living materials, ten stated that they were without a project work area, and three felt that they needed laboratory assistants.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In the following paragraphs, the data presented in Chapter III are summarized. Conclusions are based upon the most important information, and subsequently, recommendations are stated.

I. SUMMARY

The numbers of questionnaires returned from groups A, B and C in 1959 were fifty, fifty-four, and sixty-three respectively. These numbers were much more uniform than the numbers received in 1965 which for the same groups were thirty-nine, forty-seven, and eighty-nine respectively.

In both 1959 and 1965 the largest percentages of biology students were tenth graders. However, in 1965 there was a marked percentage increase in group B schools in which students took biology in the ninth grade.

All groups showed an increase in per cent of ability grouping in 1965. The schools with the largest enrollments showed the greater increases in the percentage of ability grouping.

Teachers from the 1959 and 1965 group B and C schools generally showed a considerably higher number of quarter hours of science completed than teachers from the 1959 and 1965 group A schools. This fact was particularly noticeable with regard to courses in botany and zoology. The average number of quarter hours in physics for teachers from all groups for both years was less than ten, but for chemistry the average was between fifteen and twenty hours.

Except for group A, the 1965 respondents indicated they taught more biology classes per day than did the respondents in 1959. There was a slight decrease in the average number of students per biology class in all three groups. The average number of all types of classes taught per day increased in both A and B groups and declined in group C in 1965. The number of group C teachers who had only four classes per day to teach increased from four in 1959 to thirteen in 1965.

About twenty of the group A teachers in both the 1959 and 1965 groups indicated that their labs were not designed for teaching science. The data for teachers in B group schools showed that between 1959 and 1965 the percentage of school laboratories not designed for teaching science decreased from about thirty-one per cent to nineteen per cent. Responses from group C teachers in 1959 pointed out that fourteen and three-tenths per cent of the laboratories were not designed for teaching science. The percentage increased to eighteen and two-tenths in 1965.

In all three groups the percentage of teachers using textbooks, other than BSCS, showed a decrease in 1965. The average amount of equipment available to teachers generally was greater.

The per cent of teachers who utilized the BSCS program was greater for the B schools than the A schools, and greater for the C schools than either the A or B schools.

Responses from teachers in the 1959 and 1965 A groups showed the amount of time spent dissecting most specimens did not vary greatly. The 1965 B group respondents indicated that they spent more time on dissection of the common specimens and in addition dissected more

different specimens than did the 1959 group B teachers. Most of the more common specimens were dissected by many students in the C group in 1965.

There was a slight decrease between 1959 and 1965 in the per cent of students who made collections in group A schools and the percentage was slightly higher in 1965 in the B group schools. Twenty-two per cent fewer teachers in the C group schools required students to make collections in 1965 than in 1959. Similar types of collections were made by students in all groups for the years 1959 and 1965. Almost all of the teachers in all three groups who required collections had the students identify the specimens.

The average number of hours per week spent in laboratory by students in group A schools was the same in 1959 as in 1965. The 1965 group B teachers specified there was an average increase of six-tenths hour per week spent in laboratory. Students from group C schools in 1965 are required to spend over two hours in laboratory as opposed to one and six-tenths hours per week in 1959. The per cent of teachers in all groups who require their students to spend time in laboratory increased between 1959 and 1965.

The methods used to derive laboratory questions and problems varied considerably. However, most teachers specified they used self-devised laboratory experiences.

A larger percentage of teachers in groups B and C schools indicated they required students to examine microscopic specimens in 1965 than in 1959, and particularly those slides dealing with meiosis and mitosis.

A smaller percentage of teachers in the 1965 group A required students to observe microscopically most of the more common specimens than in 1959.

Final examinations and short tests appeared to be the major factors used by teachers when computing a total grade. Respondents from all three groups indicated that these two factors accounted for at least fifty per cent of the grade in both 1959 and 1965. However, the group C respondents in 1965 indicated that nearly twenty per cent of the total grade was derived from laboratory reports as compared to less than seven per cent in 1959.

The average ratings by teachers of all groups with regard to the importance of various techniques varied by more than one point in nine instances. Those techniques which seemed to be of the greatest teaching value as indicated by a rating of less than four for all groups of teachers in 1965 were: demonstrations, audio visual aids, class discussions, and problem-solving using the scientific method. None of the techniques were rated within the little value range by any group of respondents during 1959 or 1965.

Those inadequacies which occurred most frequently (identified by teachers) pertained to equipment, microscopes, room size, storage space, and preparation time. In addition, there were some new complaints in 1965 that had to do with lack of hot water, space for living materials, project work areas and laboratory assistants.

II. CONCLUSIONS

As a result of the foregoing study, the following conclusions have been made.

1. Biology was taught in most schools as a tenth grade subject during both years studied.
2. There seemed to be a slight trend towards offering biology in the ninth grade.
3. There is a marked trend towards ability grouping in biology classes.
4. The biology teachers in 1965 were better prepared in botany and zoology than teachers in 1959.
5. Biology instructors teach more classes of biology per day in 1965 than they did in 1959, except for teachers in group A schools.
6. The number of biology students per class is decreasing in larger schools.
7. Few biology teachers can expect to teach only four classes a day, and most teachers can expect to teach five classes per day. There is a slight trend for biology teachers in large schools to teach only four classes per day.
8. There are a large number of students taking biology in classrooms not specifically designed for teaching science.
9. There is an increasing percentage of teachers who use demonstration tables, dissecting microscopes, other microscopes, sinks, gas outlets, microprojectors, and

laboratory tables.

10. Students in large high schools are more likely to be exposed to BSCS biology than those in small high schools.
11. Those factors which are most prominent in planning biology classes for the year are, with the exception of BSCS, textbooks, pupil interest, community resources available, workbooks, teacher constructed units, and coordination with other science courses.
12. The specimens most commonly used for dissection by teachers in all groups are the clam, crayfish, earthworm, frog, grasshopper, perch, and starfish.
13. Teachers using BSCS biology tend to minimize collections as compared to teachers using other textbooks.
14. Types of specimen collections seem to remain constant.
15. Almost all teachers who require collections expect students to identify their specimens.
16. The average number of hours per week spent in laboratory is increasing for students in larger schools.
17. The percentage of teachers requiring laboratory work is increasing.
18. Teachers use a variety of sources for obtaining laboratory questions and problems.
19. The most common slides used for microscope work are animal tissue, meiosis, microscopic plant forms, mitosis, plant tissue and protozoa.

20. The percentage of biology teachers who have students examine the processes of meiosis and mitosis microscopically has increased.
21. Almost all biology teachers use final examinations and short tests as the primary means of determining total grades.
22. An increasing number of teachers in large high schools are placing a greater emphasis upon laboratory reports in determining the final grade.
23. The most valuable techniques for teaching biology, apart from laboratory work, are demonstrations, the use of audio-visual aids, modifying work for superior students, class discussions and problem solving using the scientific method.
24. There are noticeable numbers of teachers dissatisfied with the amount of classroom equipment, numbers of microscopes, the size and design of the classroom, storage facilities, their preparation time and space.
25. Some of the inadequacies noted in item twenty-four may result from the influence of BSCS.
26. Many teachers require amounts of work for which the student is not given adequate credit.
27. A noticeable number of biology teachers in high schools in the State of Washington are inadequately prepared.

III. RECOMMENDATIONS

The following recommendations are based on the research procedures and the questionnaire.

1. In other investigations of this type, every effort should be made to insure that prospective respondents understand the terms used in the questionnaire and make certain that complete and easily understood directions for answering each question are given.
2. There should be increasing amount of money spent for needed items of equipment, specimens and materials.
3. The number of students in biology classes should be reduced to fewer then twenty-five.
4. Prospective biology teachers should be informed as to what factors are really important in determining final grades for students.
5. Every effort should be made to prevent biology students from being instructed by teachers who do not have adequate backgrounds in biology.
6. The class load for biology teachers should be four classes per day.
7. Prospective biology teachers should be better informed as to the value of various teaching techniques.
8. Further research regarding the teaching of biology in the State of Washington should be completed with particular emphasis upon the following aspects:
   a) the value of ability grouping
   b) teacher load as related to student learning
   c) the amount of time spent in laboratory as related to

understanding of biological principles

d) the value of the various types of laboratory work

e) the amount of equipment available as related to student learning.

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A P P E N D I X

Dear Biology Teacher:

Your assistance is desired and needed to determine what is being done in the high schools in the State of Washington with reference to Biology. Data, which only you and other selected teachers can provide, will help in evaluating the program for training Biology teachers at Central Washington College of Education.

A summary of the findings will be made available to all participants upon request. The study will be greatly aided if your completed, unsigned questionnaire is returned as soon as possible.

Thank you very much for your cooperation and assistance.

Sincerely yours,

Bert E. Thompson
Graduate Assistant
C.W.C.E.
Ellensburg, Washington

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1. Which factors figure prominently in planning your Biology course for the year? (mark applicable blanks (X)

___ Textbooks
___ Workbooks
___ Resource units
___ Teacher-constructed units (self)
___ School curriculum guide
___ Guides from other sources
___ Pupil interests
___ Community resources available
___ Teacher-pupil planning
___ Coordination with other science courses
___ Other_____

2. Please indicate the approximate <u>percentage</u> of your Biology students who are in each grade level.

___ 9th
___ 10th
___ 11th
___ 12th

3. Are students in your classes grouped in any of the following ways? (mark (X))
___ Students of all abilities in one section?
___ Students separated into sections according to ability?
___ Other_____

4. Laboratory work.

A. What specimens do you use consistently for dissection by individual pupils or small groups? (Indicate by marking, in the appropriate blanks, the time in hours spent on each.)

___ Dogfish
___ Crayfish
___ Frog
___ Starfish
___ Earthworm
___ Roundworm
___ Grasshopper
___ Perch
___ Clam
___ Other_____
___ Other_____

B. Do your students make collections?

___ Yes ___ No

C. For those students that do, what type collections are made? (mark (X))

___ Protozoa
___ Microscopic plant forms
___ Insect
___ Flowering plants
___ Leaves
___ Mosses
___ Liverworts
___ Ferns
___ Algae
___ Cones
___ Needles
___ Other_____
___ Other_____

D. Do students identify specimens in their own collections?

___ Yes ___ No

E. What is the average number of hours per week spent in laboratory work?
_____Hours

F. How are laboratory questions and problems derived? (mark applicable blanks (X))

___ From workbook
___ From text
___ Teacher-devised
___ Based on college experience
___ From student questions
___ Other_____

G. Do your students do microscope work as individuals or in small groups, on the following items? (Check if yes)

___ Protozoa
___ Microscopic plant forms
___ Plant tissue structure
___ Animal tissue structure
___ Meiosis
___ Mitosis
___ Other_____
___ Other_____

5. The classroom and the school.

___ What is the approximate enrollment of your school?
___ Is your laboratory designed explicitly for teaching science?
___ When was your laboratory constructed or last renovated? (year)

6. Grading

Approximately what per cent of the total grade is derived from each of the following items?

___ Final examinations
___ Short tests
___ Laboratory reports
___ Written and oral class reports
___ Written assignments
___ Projects
___ Term papers
___ Participation in class discussions
___ Attendance
___ Behavior
___ Other_____

7. How many hours did you take in each of the following science areas while attending college?

___ Botany
___ Zoology
___ Geology
___ Chemistry
___ Physics
___ Biological Science
___ Other science_____
___ Other science_____

Are these hours Quarter hours or Semester hours? (check one) Semester hours = 1½ Quarter hours

_____ Quarter hours ____ Semester hours

8. Teacher load

___ How many Biology classes do you teach each day?
___ What is the number of students in each of your Biology classes?
___ 1.
___ 2.
___ 3.
___ 4.
___ 5.
___ 6.
___ What is the total number of classes you teach each day? (Biology and non-biology)

9. Which of these teaching techniques do you use in teaching biology? (Check those techniques you use. Rate the techniques according to their usefulness to you by encircling the appropriate number.)

Used	Very valuable					valuable			little value		
___Demonstration.....	1	2	3	4	5	6	7	8	9	10
___Relating science and non-science subjects.....	1	2	3	4	5	6	7	8	9	10
___Audio-visual aids.....	1	2	3	4	5	6	7	8	9	10
___Class projects.....	1	2	3	4	5	6	7	8	9	10
___Supervised study.....	1	2	3	4	5	6	7	8	9	10
___Modifying work for slow learners.....	1	2	3	4	5	6	7	8	9	10
___Modifying work for superior students.....	1	2	3	4	5	6	7	8	9	10
___Field trips.....	1	2	3	4	5	6	7	8	9	10
___Panels and committees.....	1	2	3	4	5	6	7	8	9	10
___Lecture.....	1	2	3	4	5	6	7	8	9	10
___Class discussion.....	1	2	3	4	5	6	7	8	9	10
___Student reports.....	1	2	3	4	5	6	7	8	9	10
___Local resource persons.....	1	2	3	4	5	6	7	8	9	10
___Reviews.....	1	2	3	4	5	6	7	8	9	10
___Problem solving using the scientific method.....	1	2	3	4	5	6	7	8	9	10
___Reference work.....	1	2	3	4	5	6	7	8	9	10
___Other_____.....	1	2	3	4	5	6	7	8	9	10

10. What equipment do you use in teaching your Biology course?

Equipment	Used (check if used)	How many of each are available to you when needed?
Demonstration Table.....	___	_____
Microscopes, Dissecting.....	___	_____
Microscopes, Other.....	___	_____
Sinks.....	___	_____
Gas Outlets.....	___	_____
Microprojector.....	___	_____
Laboratory manuals (workbooks).....	___	_____
Charts.....	___	_____
Demonstration specimens.....	___	
Demonstrations apparatus.....	___	
Dissecting equipment.....	___	
Supplementary materials.....	___	

11. What do you consider to be the most pressing inadequacies in your classroom? (In order of importance and pertaining to your preparation or classroom facilities)

1.

2.

3.

P.O. Box 1059
Central Washington
College of Education
Ellensburg, Washington

Dear Biology Teacher:

The study on the teaching of biology in the State of Washington would be greatly aided if you would complete and return as soon as possible the questionnaire which was sent to you concerning this matter. (If this letter reaches you after you have returned the questionnaire, please disregard.)

Realizing that as a science teacher your time is very limited, you have probably temporarily set the questionnaire aside.

Since the data which you can provide is vital to the study, I sincerely hope you will soon be able to give this matter your attention.

Once again, I would like to express my gratitude for your cooperation and assistance.

Very truly yours,

Bert Thompson
Graduate Assistant
C.W.C.E.

Dear Biology Teacher:

Your assistance is desired and needed to determine what changes have been affected during recent years in the high schools in the State of Washington with reference to Biology. Data, which only you and other selected teachers can provide, will help in evaluating the program for training Biology teachers at Central Washington State College. A summary of the findings will be made available to all participants upon request. The study will be greatly aided if your completed, unsigned questionnaire is returned as soon as possible.

Thank you very much for your cooperation and assistance.

Sincerely yours,

Bert E. Thompson
Graduate Student
C.W.S.C.
Ellensburg, Washington

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1. Which factors figure prominently in planning your Biology course for the year? (mark applicable blanks (X)

___ B.S.C.S. Green Version
___ " Blue Version
___ " Lab Blocks
___ Other Textbooks
___ Other Workbooks
___ Resource Units
___ Teacher-constructed units (self)
___ School curriculum guide
___ Guides from other sources
___ Pupil interests
___ Community resources available
___ Teacher-pupil planning
___ Coordination with other science courses
___ Other_____

2. Please indicate the approximate percentage of your Biology students who are in each grade level.

___ 9th
___ 10th
___ 11th
___ 12th

3. Are students in your classes grouped in any of the following ways? (mark (X))

___ Students of all abilities in one section?
___ Students separated into sections according to ability?
___ Other_____

4. Laboratory work.

A. What specimens do you use consistently for dissection by individual pupils or small groups? (Indicate by marking, in the appropriate blanks, the time in hours spent on each.)

___ Dogfish
___ Crayfish
___ Frog
___ Starfish
___ Earthworm
___ Roundworm
___ Grasshopper
___ Perch
___ Clam
___ Other_____
___ Other_____

B. Do your students make collections?

___ Yes ___ No

C. For those students that do, what type collections are made? (mark (X))

___ Protozoa
___ Microscopic plant forms
___ Insect
___ Flowering plants
___ Leaves
___ Mosses
___ Liverworts
___ Ferns
___ Algae
___ Cones
___ Needles
___ Other_____
___ Other_____

D. Do students identify specimens in their own collections?

_____ Yes ____ No

E. What is the average number of hours per week spent in laboratory work?

_____ hours.

F. How are laboratory questions and problems derived? (mark applicable blanks (X)

___ From workbook
___ From text
___ Teacher-devised
___ Based on college experience
___ From student questions
___ Other_____

G. Do your students do microscope work as individuals or in small groups, on the following items? (Check if yes)

___ Protozoa
___ Microscopic plant forms
___ Plant tissue structure
___ Animal tissue structure
___ Meiosis
___ Mitosis
___ Other_____
___ Other_____

5. The classroom and the school.

___ What is the approximate enrollment of your school?
___ Is your laboratory designed explicitly for teaching science?
___ When was your laboratory constructed or last renovated? (year)

6. Grading

Approximately what per cent of the total grade is derived from each of the following items?

___ Final examinations
___ Short tests
___ Laboratory reports
___ Written and oral class reports
___ Written assignments
___ Projects
___ Term papers
___ Participation in class discussions
___ Attendance
___ Behavior
___ Other_____

7. How many credit hours did you take in each of the following science areas while attending college?

___ Botany
___ Zoology
___ Geology
___ Chemistry
___ Physics
___ Biological Science
___ Other science_____
___ Other science_____

Are these hours Quarter hours or Semester hours? (check one) Semester hours - 1½ Quarter hours

____Quarter hours ____Semester hours

8. Teacher load

___ How many Biology classes do you teach each day?
___ What is the number of students in each of your Biology classes?
___ 1.
___ 2.
___ 3.
___ 4.
___ 5.
___ 6.
___ What is the total number of classes you teach each day? (Biology and non-biology)

9. Which of these teaching techniques do you use in teaching biology? (Check those techniques you use. Rate the techniques according to their usefulness to you by encircling the appropriate number.)

Used	very valuable					valuable		little value		
___Demonstrations	1	2	3	4	5	6	7	8	9	10
___Relating science and non-science subjects	1	2	3	4	5	6	7	8	9	10
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___Reference work	1	2	3	4	5	6	7	8	9	10
___Other_____	1	2	3	4	5	6	7	8	9	10

10. What equipment and materials do you use in teaching your Biology course?

Equipment	Used (check if used)	How many of each are available to you when needed?
Demonstration Table	___	_____
Microscopes, Dissecting	___	_____
Microscopes, Other	___	_____
Sinks	___	_____
Gas outlets	___	_____
Microprojector	___	_____
Laboratory tables	___	_____
Charts	___	
Demonstration specimens	___	
Demonstrations apparatus	___	
Dissecting equipment	___	
Supplementary materials	___	

11. What do you consider to be the most pressing inadequacies in your classroom? (In order of importance and pertaining to your preparation and/or classroom facilities)

1.

2.

3.

2436 Pacific Way
Longview, Washington

Dear Biology Teacher:

The study on the teaching of biology in the State of Washington would be greatly aided if you would complete and return as soon as possible the questionnaire which was sent to you concerning this matter. (If this letter reaches you after you have returned the questionnaire, please disregard.)

Realizing that as a science teacher your time is very limited, you have probably temporarily set the questionnaire aside.

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