AN ATTITUDE SURVEY
OF JUNCTION CITY HIGH SCHOOL CHEMISTRY STUDENTS

by 149

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I. INTRODUCTION

Science and its related fields of activity have become one of the most powerful forces in our society. The science instructional program of our modern secondary school might be evaluated in light of the degree to which it accomplishes the following two general objectives:

1. General educational science for all students is needed so that a widespread understanding and appreciation of science can be accomplished.

2. Specialized science instruction in basic and applied science for all students is needed for those preparing for college, for a vocation, or for personal satisfaction.

For many years, however, science teachers, along with other educators, have made various attempts at dealing with the factors that might determine the attitudes of the science student. These included the maturity of the student, the future needs of the student, teacher-pupil relationships, grades awarded, and the use of various teaching methods. The majority of evidence presented about the attitudes of the science student, however, appears to be one largely based on opinions and limited observations; in only a few cases has experimental evidence been found to support these opinions.

II. THE PROBLEM AND DESIGN OF THE STUDY

The Problem

Statement of the problem. This Masters Report is a descriptive survey of attitudes, and factors determining the attitudes, of chemistry students toward their biology and chemistry courses at Junction City Senior High School, Junction City, Kansas.

Importance of the study. This study is of particular importance to the writer since the number of chemistry classes offered per year is determined by the total number of students enrolled in chemistry. After accepting the position of chemistry instructor in the Junction City Senior High School, the researcher became concerned upon finding that only three classes of chemistry were being offered during the 1965-1966 school year. The main reason for this concern was based on the fact that in the Larned Senior High School, in which the researcher had previously taught, three classes of chemistry were offered to about the same number of students. However, Larned Senior High School, which is a Class A school, had only about one third the enrollment of the Junction City Senior High School. The researcher was not satisfied with this small enrollment which affected his teaching load and, therefore, set out to alter the situation. Thus, the need for the chemistry-attitude survey on the part of the students seemed desirable.

Background of the study. Junction City Senior High School is a Class AA school with an average enrollment for the past five years of 973 students. All enrollment figures used in this study were taken on September 15 of each year. Since chemistry is offered only to seniors, it is the senior enrollment that is of particular importance to this study. The science curriculum in the senior high school includes the following courses: Life Science, Biology I, Biology II, physics, and chemistry.

Definitions of Terms Used

Attitude. The disposition of mind that indicates either a positive or negative response of an individual through a feeling or mood.

Interest. This emotion is the excitement of feeling that accompanies the special attention or concern given to a particular object or idea.

Descriptive survey. This is a normative or status survey which tells what is true at a particular time and describes the situation in a particular area as it is now.

Science. This discipline is defined as the organized body of knowledge pertaining to the physical universe, its various components, and its phenomena. It includes all of the attitudes related to, and all of the methods applied in, the search for new knowledge.

New science curriculum. This curriculum includes all of the experimental courses which are laboratory oriented and presently being used to teach science at the senior high school level of instruction. Examples of these courses include the following: Physical Science Study Committee, Biological Science Committee Study, and Chem Study.

General Chemistry course. This class is a course of study not oriented toward the college bound student. It is taught in such a manner that all levels of achievement can be obtained by individual students.

Chemistry. This course is an advanced study in science offered only to seniors in the Junction City Senior High School. It is traditional in nature, consisting of lecture and laboratory experiences which pertain to matter, its composition and structure, its changes in composition, and the related changes in energy that it will under go.

Biology I. This class is a required science course for sophomores which pertains to the study of all living things. It is an introductory course which is traditional in nature and consists of lecture and laboratory experiences pertinent to the study at hand.

Design of the Study

Research design. A research design was established to test for possible differences between the attitudes held by the students toward their biology and their chemistry courses. A second purpose was to determine the relationship between the students' attitudes toward these courses and certain scholastic criteria present in their high school program. These consisted of their chemistry grades, biology grades, Differential Aptitude Test scores, and grade point average.

The major research instrument used in this study was a student questionnaire. The design of the questionnaire was such that it enabled the researcher to do a comparative and correlational study on the data. The resultant *t*-test values and correlation coefficients thus determined, according to established levels of probability, the degree of relationship existing between the items studied.

Other instruments used in the study included a preliminary questionnaire, students' course grades, and certain standardized test scores.

Choice of instrument and sample population. A preliminary questionnaire was given to a random sample population in the Junction City Senior High School. The purpose of this questionnaire was to determine areas of investigation pertinent to the final questionnaire, which was to be the primary research instrument of this study. The sample population for the preliminary instrument included one hundred students during the 1965-1966 school year and one hundred students during the 1966-1967 school year. Each sample tested was taken from the following catagories: twenty students from Biology I, twenty students from Biology II, twenty students from physics, twenty students from chemistry, and twenty senior non-science students. Areas selected for their significant importance to the final questionnaire were as follows:

1. A comparison of students' attitudes about Biology I and chemistry could be utilized in the study.
2. The students' attitudes about grades seemed to be of significant importance to the study.
3. The items which could be compared for both Biology I and chemistry on the final questionnaire were as follows: laboratory experiences, teacher-pupil relationships, subject matter, and students' interests and achievements.

Two additional areas used on the final questionnaire, although not based on the preliminary study, involved lecture and teaching methods.

A final questionnaire, based primarily on the findings from the preliminary questionnaire, was then devised and used to test the hypotheses proposed for this study. The sample chosen for testing these hypotheses was the population of chemistry students in the Junction City Senior High School during the 1966-1967 school year. This population consisted of

65 students. Criteria which these students had in common were the following:

1. These students had taken Biology I.
2. These students were seniors.
3. These students had the same chemistry teacher.
4. These students were taking chemistry during the same school year.
5. These students' grades in chemistry were based on common criteria prescribed and utilized by the same instructor.

However, there were also some variables which the researcher was not able to control:

1. The differences in educational background of the students' parents.
2. Varying amounts of total study time due to the differing number of extracurricular activities in which the students were involved.
3. Varying amounts of study time actually devoted to the study of chemistry.
4. Differences in the students' aptitude toward science.
5. Variations in the biology background of the students, due to the influx of students from Fort Riley.

Hypotheses. The following hypotheses were made regarding the sample of chemistry students at Junction City Senior High School:

1. It is hypothesized that no significant differences exist between the attitudes that the chemistry students held toward their biology and chemistry courses, as measured by the given questionnaire.
2. It is hypothesized that no significant relationships exist between the students' grade point average, biology grades, chemistry grades, Differential Aptitude Test scores, and attitudes, that the

chemistry students held toward their biology and chemistry courses, as measured by the given questionnaire.

Assumptions. The nature of the questionnaire for testing the hypotheses was a consideration in its value for accepting or rejecting the hypotheses made. However, the value of the preliminary questionnaire in determining significant areas of inquiry added somewhat to the final instruments' validity. In addition, the number, types, and division of questions appeared to be reasonably representative and exhaustive.

Both the validity and reliability of the standardized Differential Aptitude Tests were assumed to be adequate. The validity and reliability of the biology, chemistry, and over-all grades was limited to the grading practices utilized by Junction City Senior High School. Such grades, nevertheless, are used to make judgments of a quantitative nature about educational achievements. This assumption does not imply, however, that there is any common or uniform standard for grading in all courses, fields, or even schools.

Statistical treatment of data. Measures of significant differences between attitudinal responses to the students' chemistry and biology courses were obtained by the use of *t*-tests. Homogeneity of variances in these was accounted for by the Computing Center in the determination of them. Product-moment correlations were used to determine the extent of relationship between chemistry grades, biology grades, Differential Aptitude Test scores, grade point averages, and attitudinal responses, as measured by the questionnaire. In all instances the .05 level of significance was adopted as the level indicating significant differences. The .01 level has been shown in those cases where this greater level of significance was found.

III. REVIEW OF THE LITERATURE

Much has been written in regard to trends of interest in science. Included here are several reviews of published articles found to be related and of particular importance to the study at hand. These particular articles were selected in order to answer the following questions. How great is interest in science today? What means can be used to stimulate interest in science? Why should the present science program be evaluated? How should the present science program be evaluated?

General Interest in Science

"General interest in science is greater than ever before,"[1] reported Dr. Jerome B. Wiesner, President Kennedy's top science advisor, as he spoke to the National Academy of Sciences. He stated that this increased interest includes a mood of the people for a "deep-seated concern about the character and purposes of the nation's scientific and technological undertakings."[2] Dr. Wiesner said that one of the greatest influences creating the interest in the study of science has developed from the field of research supported by the Federal Government.[3]

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[1] "Science Interest at Peak," Science News Letter, 84:274 November 2, 1963.

[2] Ibid.

[3] Ibid.

Dr. I. I. Rabi, famed physicist of Columbia University, New York, said during the same meeting that the rise in interest was also due to the realization that science "satisfies a basic desire or aspiration just to know, to find, or perhaps make order out of the otherwise chaotic jumble of immediate experience. Members of this community possess an inner conviction that the advance of science is important and worthy of their greatest effort."[1] Scientists are just individuals who never grew up, who never lost the nagging urge to ask how, why, and what.

In a sense, it seems that teachers should strive to develop this inquiring attitude in science students so that they will continue to ask how, why, and what, throughout their lives. But how can this inquiring attitude be developed? The following discussion explains several ways by which this can be accomplished.

Stimulating Interest in Science

The high school in Green River, Wyoming (population, 6,000), has achieved a national reputation for its teaching in the field of science.[2] It is also known for the interest its students have shown toward the study of science and for the achievements they have made through the study of the sciences. However, this situation did not just happen to occur; much planning and work on the part of many individuals brought this learning situation into being.

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[1] Ibid.

[2] John V. Bernard, "Science in the Small School: Green River, Wyoming," The Atlantic Monthly, 215:95-98, April, 1965.

About ten years ago, the school administrators decided that special emphasis should be given to the teaching of science and mathematics in order to keep abreast with the technology of the times. Of utmost importance to the revitalization of the science curriculum was the community's healthy interest in the school and its activities. This high community interest and spirit were responsible for an excellent school board. It has been said many times that good schools are synonymous with good school board members, and this is truly reflected in the progressive school policies of Green River.[1]

Increased interest in the study of science has been achieved through several means. One mean of stimulating interest is provided for by three chemical plants in the community which actively encourage young people to study in the area of science. They do this by awarding a scholarship to the outstanding senior at the Green River High School each year. These companies also donate their time to show students various processes and new developments in the area of chemical mining. This provides for the students a fertile climate for scientific interest to develop through a practical explanation of scientific processes and progress.

Another area that has been used to stimulate interest in science is that of curriculum change in the high school science courses. Conventional or traditional type courses were changed to the more modern laboratory experimental type programs. These included BSCS, PSSC, and CHEM Study programs. These courses involved the students in purposeful experimentation and

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[1]Ibid.

challenged them with advanced work to the limit of their ability. This same philosophy is also the basis of the junior high science program.

In essence, what has been achieved at Green River, and thus has stimulated interest in the field of science, is an outgrowth of an educational philosophy developed by the citizens and school personnel. Students in Green River are taught as groups that learning is an individual process which has to be stimulated through an enthusiasm to obtain knowledge. However, enthusiasm for knowledge and learning must first be transferred from the teacher to the student. The teacher is thus the final means by which interest in the sciences seems to have been increased in the Green River School System.

The importance of the work done in Green River can be appreciated much more when viewed in reference to the discussion which follows.

Survey of Teaching Methods

The National Defense Education Act was passed to promote better teaching of the sciences. However, a survey of high school teachers has revealed an amazing gap in science education. This gap is being blamed on the teachers and the schools themselves. It has been created by the fact that many science teachers are not keeping up with their professional training. This idea was substantiated by a study procured from the National Science Teachers Association in Washington D. C. which asked this question on the survey: "Do you feel you are professionally prepared in science for the latest developments in science discovery to adequately teach your classes?"[1]

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[1]John F. Etten, "What's Wrong With High School Science," Science Digest, (May, 1965), p. 64.

Twenty-seven percent of the respondents answered, "no" to this question. It would appear that high schools are lagging badly in acceptance and experimentation with the new trends of instruction. The following are three questions covering this area and the responses to them:

1. "Do you use educational TV in any portion of your science curriculum?"

   Yes - 19.9% No - 80.1%

2. "Do you use the 'team teaching' technique in any of your science courses?"

   Yes - 24.5% No - 76.5%

3. "Do you use teaching machines in your science program?"[1]

   Yes - 26.7% No - 74.3%

Another area of study involved the difficulty of separating mathematics from the sciences, and if this is true, it would seem that teachers from both disciplines must work together to create the new science curriculum. However, 55 percent of the science teachers replied, "no," when asked, "Are the science and mathematics departments ever brought together in planning interrelated courses?"[2]

If there is to be a correlation in the new science curriculum, there must be a true transitional process from the lower grades, to the junior high school, and finally into the more discipline-centered senior high school courses in science. Again, when senior high school teachers were

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[1] Ibid., p. 65.

[2] Ibid., p. 66.

asked the question, "Does your science program co-ordinate well with the elementary and junior high science curriculum?" Twenty-nine percent said, "no."[1]

The "modern science" courses are basically laboratory courses requiring extensive use of experimental equipment in the laboratory with a minimum of textbook information. Thus one would expect a trend for students to spend more time in the laboratory. But notice the responses to the following question, "What percentage of time do you spend on laboratory work with your students?"[2]

More than 80% - 1.3% responded yes

More than 70% - 2.6% responded yes

More than 60% - 5.9% responded yes

More than 50% -19.2% responded yes

Less than 50% -70.0% responded yes

Perhaps after reviewing the responses to these questions, science teachers should respond to the question, "What do you feel your science program needs most?" with the reply, "More planning for today's world."[3] In order for such plans to be made, however, it appears that an evaluation of the present science program must be formulated before desirable changes can be initiated.

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[1]Ibid.

[2]Ibid., p. 68.

[3]Ibid.

Evaluating the Science Program

The current need for an evaluation of the high school science program is a pressing responsibility facing the educational profession. This responsibility weighs heavily on many individuals: those who administer the programs; those who teach in the schools; those who design the programs; and of foremost consideration, those responsible for the preparation of science teachers.[1]

The impact of World War II on our social structure was felt in full force in our schools and most definitely affected the science and mathematics programs. General agreement was established on one proposition--there was room for improvement in the teaching of science and mathematics.[2] Thus, science educators made many proposals as to how the standards of science could be raised. Some of these were that: more sciences should be required, more specialists should be prepared, the abler student should take more advanced courses, the content of science should be reorganized, and the science program should develop critical thinking in the student.[3] However, in order to establish such proposals, an appraisal of the science program was necessary. This appraisal revealed a few of the characteristics of the current science program to be as follows:

1. The college preparatory function tends to dominate the science program in the high school with the respect to its objectives and design. With the

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[1]John S. Richardson, "Evaluating a High School Science Program," The North Central Association Quarterly, (Fall, 1966), p. 192.

[2]Ibid.

[3]Ibid., p. 193.

1. continued

increasing percentage of high school students attending college, this would seem to be good; however, the science courses in biology, chemistry, and physics, tend to be only copies of, or elementary editions of, college courses which are supposed to come later in the educational program.

2. The general education function, which is a major responsibility of the secondary school, shows signs of definite weakness. Science in the junior high school, for instance, continues to be only a sample of science course content which will be presented in the upper high school grades.

3. The laboratory portion of the secondary science program continues to falter. It continues to follow reading assignments and class discussions. A larger proportion of the laboratory work is illustration, verification of factual materials, or personal demonstrations previously verified by lecture experiences. In other words, the cart is before the horse: the laboratory should have the central role in providing the first hand information which will give meaning and purpose to the observer.

4. The field of education has attempted to take advantage of advancing knowledge about the nature of the learner and of the processes of learning. However, as yet, science education has not capitalized on such advances.[1] There is still the preoccupation with content, rather than the nature of the learner.

5. The science program in the school system should have the element of continuity, kindergarden through college. As yet, this situation has not become a reality. High school science programs seldom realize that the elementary student has been learning a great deal about science, both an interpretation of the universe and of the processes needed to study it.

6. Much effort and money have been invested in curriculum design in order to improve the science

[1] *Ibid.*, p. 194.

6. continued

> programs. Much work has been done in the area of course content improvement programs. Some of these programs are PSSC, CBA, BSCS, CHEMS, and ESCP. In these course content improvement studies, two of the qualities of primary interest are an inovation in the laboratory work based on the evidence collected and an updating of the textbook materials. However, the course content improvement efforts have still ignored the nature of the learner and the processes of learning. Little attention has been given to the adequate evaluation of the students' intellectual growth. The social function of science is hardly in evidence in the new materials being produced, and to an alarming extent the interests, attitudes, and problems of the learners are not even being considered.[1]

In considering the criteria for evaluating the facilities for the teaching of science, the major determinant would be the science curriculum in the school. The science curriculum provides for and reflects the students' experiences with natural phenomena and ideas related to nature. Thus, the criteria for evaluating the science facilities have a vital relationship to the following objectives set forth in the science program:

1. The science facilities should serve the science program by providing student experiences.
2. The essential role of student experience in learning should be utilized by the development of the course content improvement programs.
3. Laboratory work should be of a more liberal form and should become a central aspect of the learning experience.
4. Laboratory work should be of greater individual activity, enriched laboratory equipment, and extended supplies.

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[1] Ibid., pp. 194-195

5. The design of the laboratory space should reflect a maximum utility in respect to the science curriculum. It must be flexible and readily adaptable.

6. The classroom-laboratory design should be utilized because of its flexibility, ease of movement in varied instructional procedures, and economy of space and design.

Many different kinds of educational programs in science can be identified in the secondary school. Some of these programs show a spark of creativity and willingness to depart from the conventional procedures of the past. However, efforts to improve and extend science in our educational programs have through their diversity and magnitude created critical problems and issues. The only way these problems can be solved is to face them realistically through educational research. Thus, through educational research new knowledge and findings resulting from such research, can be disseminated and eventually put into practice.[1]

The researcher in doing this study is striving to add new knowledge and findings which will eventually initiate desirable changes in the science program at the Junction City Senior High School.

IV. METHODS OF RESEARCH

Since the purpose of this study was to review and describe the situation at the Junction City Senior High School, some means of collecting data had to be established.

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[1] *Ibid.*, pp. 201-202.

Methods of Collecting Data

The researcher decided on two methods of collecting the data. The first method was to make a study of records from the office files involving enrollment and grades for chemistry classes during the past five years. The second method was to prepare a questionnaire that could be used to gather data pertaining to the study.

Research and Data

The research utilized was comprised of three parts: (1) Study of chemistry enrollment, (2) Study of chemistry grades, and (3) Analysis of questionnaire results.

Study of chemistry enrollment. The first part of the research involved a study of the number of students enrolled in chemistry for the past five years. The results of the study is shown in Table I and the following conclusions were made from the data collected.

Low enrollment in 1963-1964 was due to the first offering of Biology II which pulled a number of seniors out of chemistry. The enrollment went back up in 1964-1965 because the transition needed for Biology II classes had taken place the previous year. The students wanting chemistry had taken Biology II as juniors and were now able to take chemistry their senior year. So the enrollment is shown to be almost back to normal at this time.

During the 1965-1966 school year a three percent decline is shown which was primarily due to low grades being given to students the previous year. This is substantiated by the data in Table II, page 21, which shows

TABLE I

PERCENTAGE OF STUDENTS, BASED ON SENIOR ENROLLMENT, TAKING CHEMISTRY IN JUNCTION CITY HIGH SCHOOL FROM 1962-1967

School year	Number of seniors enrolled	Number of chemistry students	Percentage of chemistry students
1962-1963	213	49	23.0
1963-1964	273	40	14.6
1964-1965	285	62	21.7
1965-1966	297	56	18.8
1966-1967	297	73	24.6
1962-1967 Average	273	56	20.6

that 61.6 percent of the students received C and D grades during the 1964-1965 school year. Interviews with the couselors who had enrolled students during the 1965-1966 school year also indicated that low grades had definitely affected the student attitude toward taking chemistry.

The six percent increase in the 1966-1967 school year was basically due to two reasons. A new chemistry teacher was employed during the 1965-1966 school year. This created a definite shift of course work from a strict college preparation type course to a general background chemistry course. There was also a definite change in grades as shown in Table II.

Study of chemistry grades. The second part of the research involved a study of grades made by the students enrolled in chemistry for the past five years. The results of the study are shown in Table II and the following conclusions were made from the data collected.

The number of students receiving A grades has steadily increased from 4.6 percent to 24.2 percent during the five year period.

The number of students receiving C and D grades was 61.6 percent during the 1964-1965 school year. This was an increase of five percent over the previous year. The number of students receiving B grades also declined by seven percent during this same grading period.

The number of students receiving A and B grades was 59.7 percent during the 1966-1967 school year as compared to only 37.0 percent during the 1964-1965 school year. This is an increase of 22.7 percent over a two year period.

Figure 1 shows the average grades of chemistry students enrolled for the past five years in reference to a normal grading scale. It shows

TABLE II

PERCENTAGE OF STUDENTS MAKING THE FOLLOWING FINAL GRADES
IN CHEMISTRY IN THE JUNCTION CITY HIGH SCHOOL
FROM 1962-1967

School year	A	B	C	D	F
1962-1963	4.6	37.2	44.0	14.0	0.0
1963-1964	5.4	35.2	35.2	21.6	2.6
1964-1965	8.8	28.2	30.8	30.8	1.4
1965-1966	16.0	40.0	40.0	4.0	0.0
1966-1967	24.2	35.5	22.6	16.1	1.6
1962-1967 Average	11.8	35.3	34.5	17.3	1.1

that 47.1 percent of the students received A and B grades over the five year period.

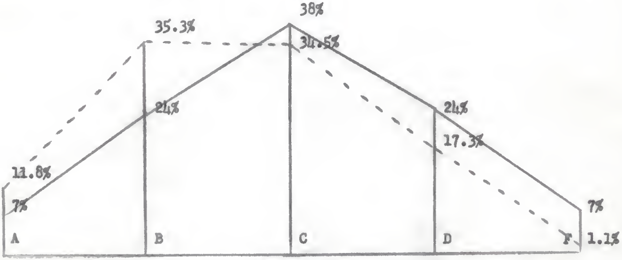

FIGURE 1

AVERAGE GRADES OF CHEMISTRY STUDENTS COMPARED
TO A NORMAL GRADING SCALE

Solid line indicates standard grading scale.

Dash line indicates average grades in chemistry during the last five years.

Analysis of questionnaire results. The third part of the research involved the preliminary questionnaire which has been previously mentioned. The questionnaire and the tabulated results of the study can be found in the appendix.

The final part of the research involved a statistical analysis of the responses to the final questionnaire.[1] For measures of significant differences, the following determinations were made:

[1]A copy of this questionnaire can be found in the appendix.

1. The differences between the students' attitudinal responses toward biology and chemistry for each of the 30 questions.

For measures of significant relationship, the responses were divided into six groups of related question areas, each consisting of five questions. Then the following determinations were made:

1. The relationship between the students' attitudinal responses toward questions pertaining to the laboratory and their biology grade, chemistry grade, Differential Aptitude Test score, and grade point average.

2. The relationship between the students' attitudinal responses toward questions pertaining to the lecture and their biology grade, chemistry grade, Differential Aptitude Test score, and grade point average.

3. The relationship between the students' attitudinal responses toward questions pertaining to teaching methods and their biology grade, chemistry grade, Differential Aptitude Test score, and grade point average.

4. The relationship between the students' attitudinal responses toward questions pertaining to pupil-teacher relationships and their biology grade, chemistry grade, Differential Aptitude Test score, and grade point average.

5. The relationship between the students' attitudinal responses toward questions pertaining to subject matter and their biology grade, chemistry grade, Differential Aptitude Test score, and grade point average.

6. The relationship between the students' attitudinal responses toward questions pertaining to interests and achievements and their biology grade, chemistry grade, Differential Aptitude Test score, and grade point average.

The frequency of the responses the students made in reference to the final questionnaire can be found in Table III. The mean values for the students' responses were found to be above average, with the exception of

TABLE III

FREQUENCY OF RESPONSES ON STUDENT QUESTIONNAIRE

Compared Questions	Response Frequencies 1	2	3	4	5	Mean	S.D.
1. Biology	0	6	19	30	10	3.68	.850
and							
1. Chemistry	0	2	15	42	6	3.80	.642
2. Biology	3	5	31	20	6	3.32	.920
and							
2. Chemistry	1	5	29	26	4	3.42	.788
3. Biology	0	5	19	29	12	3.74	.853
and							
3. Chemistry	1	3	20	35	6	3.65	.780
4. Biology	2	3	25	26	9	3.57	.901
and							
4. Chemistry	0	5	22	30	8	3.63	.802
5. Biology	0	9	31	19	6	3.34	.834
and							
5. Chemistry	0	6	23	27	9	3.60	.844
6. Biology	4	10	22	25	4	3.23	.996
and							
6. Chemistry	2	7	17	30	9	3.57	.968
7. Biology	3	9	24	25	4	3.28	.944
and							
7. Chemistry	1	9	25	23	7	3.40	.915
8. Biology	1	7	29	26	2	3.32	.773
and							
8. Chemistry	0	7	23	32	3	3.48	.752
9. Biology	1	15	30	15	4	3.09	.879
and							
9. Chemistry	1	13	27	21	3	3.18	.864
10. Biology	3	8	24	21	9	3.38	1.026
and							
10. Chemistry	3	8	20	23	11	3.48	1.062

TABLE III (continued)

Compared Questions	Response Frequencies 1	2	3	4	5	Mean	S.D.
11. Biology and	9	9	23	21	3	3.00	1.104
11. Chemistry	4	8	30	21	2	3.14	.899
12. Biology and	0	1	31	29	4	3.55	.638
12. Chemistry	0	3	22	35	5	3.65	.694
13. Biology and	3	11	31	16	4	3.11	.921
13. Chemistry	1	17	33	12	2	2.95*	.799
14. Biology and	6	20	26	9	4	2.77*	1.012
14. Chemistry	2	13	22	23	5	3.25	.969
15. Biology and	4	15	28	15	3	2.97*	.951
15. Chemistry	3	15	23	21	3	3.09	.964
16. Biology and	4	7	30	21	3	3.18	.917
16. Chemistry	1	11	24	21	8	3.37	.961
17. Biology and	4	10	28	19	4	3.14	.966
17. Chemistry	4	6	26	23	6	3.32	.986
18. Biology and	0	8	27	24	6	3.43	.829
18. Chemistry	0	2	22	29	12	3.78	.780
19. Biology and	7	9	28	14	7	3.08	1.108
19. Chemistry	9	9	25	14	8	3.05	1.192
20. Biology and	1	6	32	19	7	3.38	.860
20. Chemistry	1	9	23	26	6	3.42	.899

* Below average mean value, mean value=3.00

TABLE III (continued)

Compared Questions	Response Frequencies 1	2	3	4	5	Mean	S.D.
21. Biology	2	13	27	19	4	3.15	.922
and							
21. Chemistry	2	15	26	18	4	3.12	.937
22. Biology	1	6	20	30	8	3.58	.882
and							
22. Chemistry	0	7	17	35	6	3.62	.804
23. Biology	0	5	34	17	9	3.46	.831
and							
23. Chemistry	0	8	25	26	6	3.46	.831
24. Biology	3	16	29	11	6	3.02	.992
and							
24. Chemistry	13	20	17	8	7	2.63*	1.245
25. Biology	1	3	26	30	5	3.54	.772
and							
25. Chemistry	1	1	8	40	15	4.03	.749
26. Biology	9	14	13	22	7	3.06	1.248
and							
26. Chemistry	8	13	20	18	6	3.02	1.166
27. Biology	1	3	15	36	10	3.78	.820
and							
27. Chemistry	0	2	17	37	9	3.82	.705
28. Biology	14	16	23	8	4	2.57*	1.145
and							
28. Chemistry	11	11	27	12	4	2.80*	1.121
29. Biology	16	18	19	10	2	2.45*	1.118
and							
29. Chemistry	15	21	15	11	3	2.48*	1.161
30. Biology	7	6	28	11	13	3.26	1.203
and							
30. Chemistry	2	3	14	25	21	3.92	1.005

* Below average mean value, mean value=3.00

eight questions. Four of these eight questions, that had mean values which were below average, pertained to biology. The other four pertained to chemistry. The lowest mean value for any one question was 2.45, which had to do with the use of library facilities in the study of biology. The mean value for the same question in regards to chemistry was 2.48. The highest mean value was 4.03 on a question which related to the modern materials used in chemistry. However, on the same question in reference to biology the mean value was 3.54.

Table III, pages 24, 25, and 26, also indicates that the students responding to the questionnaire had basically a positive attitude about biology and chemistry. This was established by the fact that 86.6 percent of the questions have a mean value above 3.00.

A comparison of biology and chemistry attitude responses made by the students can be found in Table IV. The t-test values revealed that the attitudinal responses to the various questions differed significantly on only six questions posed by the questionnaire. The responses to three of these questions differed at the .05 level of significance and the remaining three at the .01 level of significance. These questions were as follows:

1. What value were your lecture experiences in determining your grades in the following classes?

2. To what extent were you encouraged to do individual research by the teacher in these courses?

3. To what extent did you find biology and chemistry teachers patient and understanding when compared to non-science teachers?

4. To what extent were you introduced to the study of these courses at the junior high level?

TABLE IV

COMPARISON OF BIOLOGY AND CHEMISTRY ATTITUDE RESPONSES
FOR THE ENTIRE SAMPLE POPULATION

Compared Questions	Mean	S.D.	Number	Difference	t
1. Biology	3.68	.850	65		
and				-.12	-.932
1. Chemistry	3.80	.642	65		
2. Biology	3.32	.920	65		
and				-.10	-.614
2. Chemistry	3.42	.788	65		
3. Biology	3.74	.853	65		
and				.09	.644
3. Chemistry	3.65	.780	65		
4. Biology	3.57	.901	65		
and				-.06	-.411
4. Chemistry	3.63	.802	65		
5. Biology	3.34	.834	65		
and				-.26	-1.777
5. Chemistry	3.60	.844	65		
6. Biology	3.23	.996	65		
and				-.34	-1.965*
6. Chemistry	3.57	.968	65		
7. Biology	3.28	.944	65		
and				-.12	-.755
7. Chemistry	3.40	.915	65		
8. Biology	3.32	.773	65		
and				-.16	-1.150
8. Chemistry	3.48	.752	65		
9. Biology	3.09	.879	65		
and				-.09	-.604
9. Chemistry	3.18	.864	65		
10. Biology	3.38	1.026	65		
and				-.10	-.504
10. Chemistry	3.48	1.062	65		

* .05 level of significance, t=1.960
** .01 level of significance, t=2.576

TABLE IV (continued)

Compared Questions	Mean	S.D.	Number	Difference	t
11. Biology	3.00	1.104	65		
and				-.14	-.784
11. Chemistry	3.14	.899	65		
12. Biology	3.55	.638	65		
and				-.10	-.789
12. Chemistry	3.65	.694	65		
13. Biology	3.11	.921	65		
and				.16	1.017
13. Chemistry	2.95	.799	65		
14. Biology	2.77	1.012	65		
and				-.48	-2.745**
14. Chemistry	3.25	.969	65		
15. Biology	2.97	.951	65		
and				-.12	-.733
15. Chemistry	3.09	.964	65		
16. Biology	3.18	.917	65		
and				-.19	-1.121
16. Chemistry	3.37	.961	65		
17. Biology	3.14	.966	65		
and				-.18	-1.078
17. Chemistry	3.32	.986	65		
18. Biology	3.43	.829	65		
and				-.35	-2.506*
18. Chemistry	3.78	.780	65		
19. Biology	3.08	1.108	65		
and				.03	.152
19. Chemistry	3.05	1.192	65		
20. Biology	3.38	.860	65		
and				-.04	-.199
20. Chemistry	3.42	.899	65		

* .05 level of significance, t=1.960
** .01 level of significance, t=2.576

TABLE IV (continued)

Compared Questions	Mean	S.D.	Number	Difference	t
21. Biology	3.15	.922	65	.04	.283
and					
21. Chemistry	3.12	.937	65		
22. Biology	3.58	.882	65	-.04	-.208
and					
22. Chemistry	3.62	.804	65		
23. Biology	3.46	.831	65	.00	.000
and					
23. Chemistry	3.46	.831	65		
24. Biology	3.02	.992	65	.39	1.948*
and					
24. Chemistry	2.63	1.245	65		
25. Biology	3.54	.772	65	-.49	-3.689**
and					
25. Chemistry	4.03	.749	65		
26. Biology	3.06	1.248	65	.04	.218
and					
26. Chemistry	3.02	1.166	65		
27. Biology	3.78	.820	65	-.04	-.230
and					
27. Chemistry	3.82	.705	65		
28. Biology	2.57	1.145	65	-.23	-1.161
and					
28. Chemistry	2.80	1.121	65		
29. Biology	2.45	1.118	65	-.03	-.154
and					
29. Chemistry	2.48	1.161	65		
30. Biology	3.26	1.203	65	-.66	-3.403**
and					
30. Chemistry	3.92	1.005	65		

* .05 level of significance, t=1.960
** .01 level of significance, t=2.576

5. To what extent were the materials presented in these courses up to date?

6. To what extent were these courses taken for college preparation?

For the most part, however, the results of Table IV, pages 28, 29, and 30, indicates that the students attitudes toward biology and chemistry on the given questionnaire do not differ. This was established by the fact that 80 percent of the students responses were related.

Intercorrelations between the students' grade point average, biology grades, chemistry grades, Differential Aptitude Test scores, and the responses to the 30 questions, as divided into six major question areas, can be found in Tables V through X.

High significant relationships were found to be present between the following criteria at the .01 level of significance: grade point average; biology grade; chemistry grade; and Differential Aptitude Test score. However, these criteria were not related significantly in most of the instances with the responses made to the questions in any of the six areas of attitudinal responses.

A high degree of relationship was shown, however, to exist between the responses the students made in reference to biology and chemistry on each question. For instance, Question Two in reference to biology was related to Question Two about chemistry at the .01 level of significance. In all, there were 21 questions related in this manner at the .01 level of significance, two questions at the .05 level of significance, and seven questions which did not show any significant relationship.

Significant relationships were also found to exist between responses to different questions with reference to only biology. For instance,

TABLE V: CORRELATIONS BETWEEN CRITERIA: GPA; GRADES; DAT; AND QUESTIONS PERTAINING TO LABORATORY
(N = 65)

	GPA	Biol	Chem	DAT	1)B	1)C	2)B	2)C	3)B	3)C	4)B	4)C	5)B	5)C
GPA		.766**	.854**	.513**	-.016	.073	.015	-.054	-.045	-.199	-.126	-.073	-.011	-.024
Biol			.638**	.473**	.157	.048	.021	-.030	.085	-.219	-.015	-.212	-.046	.072
Chem				.499**	.004	.063	-.003	.032	-.196	-.250*	-.194	-.068	-.016	.062
DAT					-.046	.100	-.132	-.116	-.094	-.021	-.058	-.226	.013	.030
1)B						-.006	.515**	.040	.636**	-.152	.509**	-.109	.267*	.166
1)C							.032	.138	-.183	.356**	-.016	.279*	.041	-.035
2)B								.350**	.448**	.118	.453**	.291*	.344**	.310*
2)C									-.068	.141	.058	.494**	.044	.019
3)B										.023	.543**	-.075	.324**	.178
3)C											.113	.388**	.019	.185
4)B												.187	.322*	.345**
4)C													.190	.240
5)B														.461**
5)C														

* .05 level of significance, r = .244
** .01 level of significance, r = .317

TABLE VI: CORRELATIONS BETWEEN CRITERIA: GPA; GRADES; DAT; AND QUESTIONS PERTAINING TO LECTURE
(N = 65)

	GPA	Biol	Chem	DAT	6)B	6)C	7)B	7)C	8)B	8)C	9)B	9)C	10)B	10)C
GPA		.766**	.854**	.513**	-.080	.170	-.298*	.036	-.238	-.045	-.156	.007	-.069	.121
Biol			.638**	.473**	.006	.085	-.098	-.046	-.098	-.239	-.158	-.079	-.096	-.026
Chem				.499**	-.148	.209	-.310*	.086	-.248*	.000	-.133	-.036	-.055	.055
DAT					-.123	.120	-.232	.022	-.203	-.171	-.086	.040	-.138	-.032
6)B						.461**	.629**	.308*	.653**	.289*	.332**	.040	.156	.145
6)C							.269*	.409**	.273*	.544**	.158	.022	.107	.097
7)B								.521**	.690**	.295*	.119	-.217	.259*	.038
7)C									.345**	.626**	.031	-.134	.033	.026
8)B										.322**	.162	-.184	.136	.076
8)C											.121	-.041	.062	.141
9)B												.491**	.428**	.387**
9)C													.148	.532**
10)B														.661**
10)C														

* .05 level of significance, r = .244

** .01 level of significance, r = .317

TABLE VII: CORRELATIONS BETWEEN CRITERIA: GPA; GRADES; DAT; AND QUESTIONS PERTAINING TO TEACHING METHODS
(N = 65)

	GPA	Biol	Chem	DAT	11)B	11)C	12)B	12)C	13)B	13)C	14)B	14)C	15)B	15)C
GPA		.766**	.854**	.513**	-.044	.182	.022	.116	.096	.138	-.153	.154	.053	.237
Biol			.638**	.473**	-.017	.097	.160	.029	.221	.123	-.006	.025	.243	.153
Chem				.499**	-.092	.192	.014	.158	.067	.164	-.098	.227	.112	.300*
DAT					-.130	.145	-.008	.087	.107	.132	-.004	.023	-.028	.181
11)B						.236	.155	-.082	.138	-.053	.182	-.088	.253*	-.103
11)C							.082	.005	.019	.205	.018	.319**	-.196	.039
12)B								.520**	.189	.143	.322**	.105	.234	.068
12)C									.183	.195	.327**	.271*	.125	.166
13)B										.580**	.295*	.057	.468**	.077
13)C											.199	.277*	.163	.391**
14)B												.186	.512**	.134
14)C													-.076	.143
15)B														.429**
15)C														

* .05 level of significance, r = .244
** .01 level of significance, r = .317

TABLE VIII: CORRELATIONS BETWEEN CRITERIA: GPA; GRADES; DAT; AND QUESTIONS PERTAINING TO TEACHER-PUPIL RELATIONSHIPS
(N = 65)

	GPA	Biol	Chem	DAT	16)B	16)C	17)B	17)C	18)B	18)C	19)B	19)C	20)B	20)C
GPA		.766**	.854**	.513**	-.298*	-.100	-.204	.062	-.252*	-.221	.060	.029	-.009	.079
Biol			.638**	.473**	-.303*	-.201	-.186	-.038	-.168	-.302*	.099	.078	.041	-.111
Chem				.499**	-.255*	-.079	-.212	.144	-.227	-.214	.021	-.049	-.016	.125
DAT					-.264*	-.164	-.079	-.014	-.275*	-.410**	.042	-.072	.047	.058
16)B						.436**	.253*	.019	.305*	.166	-.030	.135	.245*	.076
16)C							-.005	.301*	.052	.274*	.076	.162	.241	.326**
17)B								.264*	.295*	.102	.296*	.320**	.330**	.041
17)C									.133	.254*	.034	.187	.017	.392**
18)B										.411**	.065	.122	.268*	.154
18)C											-.017	.011	-.014	.152
19)B												.695**	.329**	.093
19)C													.302*	.040
20)B														.457**
20)C														

* .05 level of significance, r = .244
** .01 level of significance, r = .317

TABLE IX: CORRELATIONS BETWEEN CRITERIA: GPA; GRADES; DAT; AND QUESTIONS PERTAINING TO SUBJECT MATTER
(N = 65)

	GPA	Biol	Chem	DAT	21)B	21)C	22)B	22)C	23)B	23)C	24)B	24)C	25)B	25)C
GPA		.766**	.854**	.513**	.038	.057	-.225	.088	.011	.194	.185	.165	.217	.348**
Biol			.638**	.473**	.011	.075	.027	.004	.152	.106	.288*	.094	.282*	.227
Chem				.499**	-.044	.081	-.308*	.197	-.005	.169	.122	.166	.137	.284*
DAT					.068	-.045	-.185	.077	.097	.076	.053	-.087	-.083	.114
21)B						.468**	.272*	-.045	.355**	.049	.134	-.154	.167	-.030
21)C							.131	.491**	.216	.437**	-.019	.169	.264*	.218
22)B								.058	.671**	.095	-.064	-.313*	.357*	.020
22)C									.153	.621**	.008	.309*	.087	.176
23)B										.411**	-.085	-.286*	.167	.002
23)C											-.160	.228	.118	.153
24)B												.498**	.213	.294*
24)C													.080	.213
25)B														.565**
25)C														

* .05 level of significance, r = .244
** .01 level of significance, r = .317

TABLE X: CORRELATIONS BETWEEN CRITERIA: GPA; GRADES; DAT; AND QUESTIONS PERTAINING TO INTERESTS AND ACHIEVEMENTS
(N = 65)

	GPA	Biol	Chem	DAT	26)B	26)C	27)B	27)C	28)B	28)C	29)B	29)C	30)B	30)C
GPA		.766**	.854**	.513**	.028	.387**	-.082	.040	-.185	-.099	-.075	.040	.004	.346**
Biol			.638**	.473**	.104	.278*	-.148	-.039	-.145	-.143	-.040	.026	.067	.232
Chem				.499**	-.031	.477**	-.133	.085	-.203	-.210	-.008	.063	-.054	.309**
DAT					-.190	.219	-.183	-.262*	-.124	-.057	-.068	.007	-.188	-.040
26)B						.139	.471**	.155	-.156	.109	.472**	-.142	.390**	-.084
26)C							-.225	.251*	.087	-.165	-.113	-.080	-.053	.121
27)B								.309*	-.200	.054	.328**	.029	.360**	-.084
27)C									-.100	-.067	.066	-.134	.246*	.278*
28)B										.455**	-.275*	-.061	.342**	-.115
28)C											.085	.051	.150	.064
29)B												.380**	-.072	.190
29)C													.117	.216
30)B														.461**
30)C														

* .05 level of significance, r = .244
** .01 level of significance, r = .317

Question One in reference to biology and Question Two for biology were related at the .01 level of significance. A similar situation was also found to be the case for the chemistry questions. Where, however, 40 such significant relationships were found among attitudinal responses toward the biology courses, only 22 correlations were found among responses to chemistry.

Lastly, Tables V through X, pages 32 through 37, indicate that the students' biology and chemistry attitudinal responses, based on the questionnaire, were on the whole related. This was established by the fact that 76.6 percent of the students' responses in reference to biology and chemistry for each question were related.

V. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

On the basis of the statistical analysis of the 1967 Junction City Senior High School chemistry students' responses on the given questionnaire, the following conclusions were reached with respect to the null hypotheses tested:

1. The hypothesis, that no significant differences exist between the attitudes that the chemistry students held toward their biology and chemistry courses, as measured by the given questionnaire, was rejected.

2. The hypothesis, that no significant relationships exist between the students' grade point average, biology grade, chemistry grade, Differential Aptitude Test score, and attitudes that the chemistry students held toward their biology and chemistry courses, as measured by the given questionnaire, was rejected.

The first hypothesis was rejected on the basis of six questions that showed a significant difference to exist between the students' attitudinal responses to their biology and chemistry courses. The preferences which the students cited in each of these six instances were as follows:

1. They felt that their chemistry lecture experiences were more valuable in determining their grade than their biology lecture experiences.

2. They felt that they were encouraged to do more individual research in chemistry than in biology.

3. They felt that their chemistry teacher was more patient and understanding than their biology teacher, in comparison to non-science teachers.

4. They felt that they were introduced more to biology in junior high than chemistry.

5. They felt that the materials presented in chemistry were more up to date than in biology.

6. They felt that they were taking chemistry for college preparation more so than biology.

As may be seen, these preferences were shown to be favorable toward the study of chemistry in five of the instances. Thus a positive response by the students with regards to their course in chemistry was indicated. The one question that was not favorable toward chemistry had to do with the extent to which students were introduced to chemistry at the junior high level.

On the other hand, the implications of these responses for their biology courses seem to demonstrate a need for a closer look at the biology offering at Junction City Senior High School. An example of this need is illustrated by the response to the question pertaining to the recency of materials used in their biology and chemistry courses, respectively. It so happened that the textbook used in the students' biology course two years earlier had been five years outdated, whereas their chemistry textbook had been published in 1966, the year the course was actually taken.

The first hypothesis was accepted, however, for the remaining 24 questions. Of these 24 responses, 20 were of a positive nature in reference to the questions asked. The remaining four indicated a negative response on the part of the student. The areas showing a negative response were:

1. The degree to which the students made efficent use of their classroom time.

2. The extent to which the students devoted their time to study in these courses.

3. The extent that the students felt a lack of achievement in these courses.

4. The extent to which the students used the library facilities in these courses.

The responses in these four areas seem to indicate the need for additional effort on the part of the biology and chemistry teachers at Junction City Senior High School.

The second hypothesis was rejected on the basis that significant relationships were shown to exist between all of the scholastic criterion measures. Many significant relationships were also shown to exist among the students' attitudinal responses. In fact, 77 percent of the students' responses were shown to be significantly related. These same related responses were, for the most part, of a positive nature. Since the students' attitudes about biology and chemistry are basically positive and related, therefore, it would appear that student interest in the study of chemistry could be developed and encouraged during their biology course work.

Recommendations

The following recommendations were made by the researcher based on the findings of the study.

1. Since the students' biology and chemistry attitudes are related, biology teachers might consider stimulating interest in the study of chemistry.

2. Students should be introduced more to the study of chemistry in their biology courses.

3. Students should be introduced to the study of chemistry at the junior high level.

4. Students should be encouraged to do more individual research in biology.

5. The materials used in the study of science should be kept up to date.

6. The attitude, that chemistry is only for students preparing for college, should be changed.

7. Science students should be taught how to study efficently.

8. Science students should be encouraged to spend adaquate time for study of their course work.

9. Science teachers should try to have a means by which the students might evaluate, by means other than grades, their own achievements in their courses.

10. Science teachers should encourage regular usage of the library facilities through their course work.

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BIBLIOGRAPHY

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APPENDIX

PRELIMINARY QUESTIONNAIRE

1. My school classification is a

	1965-1966	1966-1967
a. Sophomore	17	19
b. Junior	34	30
c. Senior	49	51

2. What courses in science have you taken?

	1965-1966	1966-1967
a. None	0	0
b. Chemistry	25	29
c. Physics	28	33
d. Biology	100	88
e. Geology	3	2
f. Biology II	23	28
g. Life Science	2	3

3. Are you taking a science course at this time?

	1965-1966	1966-1967
a. Yes	80	80
b. No	20	20

4. If you are not taking a science course at this time, why aren't you?*

	1965-1966	1966-1967
a. Lack of interest	10	9
b. Hard subject matter	1	2
c. Feel no need	5	6
d. Pressure to make grades	0	1
e. No place on schedule	4	2

5. Why did you enroll in a science course?

	1965-1966	1966-1967
a. Required subject	33	23
b. Subject matter interesting	38	38
c. Background for other study	5	7
d. Pressure from parents	0	1
e. Preparation for college	21	31
f. Courses are challenging	3	0

*Only the senior non-science students answered this question.

6. What grade do you think you could make in chemistry?

	1965-1966	1966-1967
a. A	18	16
b. B	35	33
c. C	32	38
d. D	15	13

7. If you are taking chemistry or planning to take it, please explain why.*

	1965-1966	1966-1967
a. College preparation	31	25
b. Interesting subject	14	14

8. In the field of science what do you enjoy the most?

	1965-1966	1966-1967
a. Subject matter	21	22
b. Working problems	5	8
c. Lab work	70	69
d. Field trips	0	1
e. Nothing	4	0

9. Do you feel your attitude towards science is

	1965-1966	1966-1967
a. Good	60	56
b. Fair	35	38
c. Poor	5	6

10. Why is your attitude what it is?

	1965-1966	1966-1967
a. Past experience	73	61
b. Conversations with students	8	11
c. Pressure from students	0	1
d. Pressure from parents	0	2
e. Interest in science	12	20
f. Lack of interest	7	5

*All the students did not answer this question.

11. What course in science did you enjoy the most?

	1965-1966	1966-1967
a. Biology	58	58
b. Chemistry	15	13
c. Physics	7	4
d. Biology II	2	3
e. General Science	9	3
f. No answer	9	19

Why did you enjoy this science course?*

	1965-1966	1966-1967
Biology		
a. Study living things	8	9
b. Interesting subject	9	15
c. Lab work	3	5
Chemistry		
a. Interesting subject	4	4
b. Lab work	6	4
Physics		
a. Interesting subject	2	2
b. Like mathematics	0	2
Biology II		
a. Research type lab	2	3
General Science		
a. Varied subject matter	5	3
b. Interesting subject	2	0

12. In the field of science do you find the materials presented

	1965-1966	1966-1967
a. Hard to understand	35	32
b. Easy to understand	20	17
c. Same in other classes	45	51

*All the students did not answer this question.

13. Do you think students get low grades in chemistry?

	1965-1966	1966-1967
a. Yes	70	71
b. No	30	29

If yes, why do students get low grades?

a. Lack of study	29	31
b. Lack of interest	8	8
c. Poor teaching methods	1	2
d. Hard subject matter	32	30

14. Do you feel chemistry is harder than physics?

	1965-1966	1966-1967
a. Yes	27	24
b. No	66	73
c. About the same	7	3

15. Would you rather take chemistry or physics first?

	1965-1966	1966-1967
a. Chemistry	54	53
b. Physics	32	34
c. Neither one	5	1
d. Makes no difference	4	4
e. No answer	5	8

Please explain your answer.*

Chemistry

a. Background for physics	10	17
b. Physics is harder	9	10
c. More interesting	8	4

Physics

a. Background for chemistry	14	9
b. Chemistry is harder	2	3
c. More interesting	3	2

*All the students did not answer this question.

16. Do you feel the science students have more pressure placed on them to understand subject matter than in other classes?

	1965-1966	1966-1967
a. Yes	47	51
b. No	53	49

If yes, please explain.*

a. Subject matter is hard to understand	17	12
b. Old materials support new ideas	6	12
c. Must be able to apply lecture to lab	3	5

17. Do you feel the attitudes displayed by the teacher toward his subject has influenced you to take an advanced course in science?

	1965-1966	1966-1967
a. Yes	53	63
b. No	38	37
c. No answer	9	0

18. Has pure hear say from other students about a particular subject kept you from taking this subject in science?

	1965-1966	1966-1967
a. Yes	25	13
b. No	71	87
c. No answer	4	0

19. As a student, do you find science teachers are (more or less) tolerant and understanding as far as the learning processes are concerned.

	1965-1966	1966-1967
a. More	58	58
b. Less	32	27
c. No difference	10	15

*All the students did not answer this question.

20. As a student of science what would you suggest in order to improve the interest of students toward the study of chemistry?*

	1965-1966	1966-1967
a. Let students know what chemistry is about	6	10
b. Make lab apply to real situations	3	7
c. Use more demonstrations in class	5	3
d. Use lab to teach the subject matter	6	3
e. Cover materials slower	5	5
f. Make the course easier	4	4
g. Teach students how to study	4	2
h. Use an up to date textbook	4	0
i. Show students a need for it	3	3

*All the students did not answer this question.

QUESTIONNAIRE

Name ____________________

Please answer all of the following questions in a manner which will indicate your attitude about the idea expressed in each question. Read each question and think carefully before answering. Indicate your answer with a check mark in the proper space provided on the questionnaire.

QUESTIONS PERTAINING TO LABORATORY

1. How much did you enjoy the laboratory work in these courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

2. What value were your laboratory experiences in determining your grades in the following classes?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

3. How interesting were the laboratory experiments in the following courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

4. How meaningful were the laboratory experiments in the following courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

5. To what extent were the laboratory facilities adaquate in carrying on experiments in these courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

QUESTIONS PERTAINING TO LECTURE

6. What value were your lecture experiences in determining your grades in the following classes?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

7. How interesting were the lectures in the following courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

8. How meaningful were the lectures in the following courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

9. To what extent were audio-visual aids used in these courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

10. What value would you place on audio-visual aids in these classes?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

QUESTIONS PERTAINING TO TEACHING METHODS

11. To what extent did the teaching methods used in these courses stimulate your interest in studying advanced courses in science?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

12. To what extent were materials presented in an organized manner in the following courses?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

13. To what degree did you make efficent use of your classroom time?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

14. To what extent were you encouraged to do individual research by the teacher in these courses?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

15. To what extent was your study time devoted to these courses?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

QUESTIONS PERTAINING TO TEACHER-PUPIL RELATIONSHIPS

16. In these courses how much help was available to you in understanding the more difficult subject matter in relationship to non-science classes?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

17. To what extent did the attitudes displayed by your teachers influence you in a positive manner to take advanced courses in science?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

18. To what extent did you find biology and chemistry teachers patient and understanding when compared to non-science teachers?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

19. To what extent was your interest in these courses controlled by the teachers own interests.

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

20. To what extent were you able to express your ideas in the following classes?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

QUESTIONS PERTAINING TO SUBJECT MATTER

21. To what extent can the subject matter presented in these courses be applied to everyday experiences?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

22. To what extent was the subject matter interesting in these courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

23. To what extent was the subject matter meaningful in these courses?

	1 None	2 Below Average	3 Average	4 Above Average	5 Extreme
Biology					
Chemistry					

24. To what extent were you introduced to the study of these courses at the junior high level?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

25. To what extent were the materials presented in these courses up to date?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

QUESTIONS PERTAINING TO INTERESTS AND ACHIEVEMENTS

26. To what extent are you interested in continuing your study of biology and chemistry?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

27. What importance would you place on the study of biology and chemistry for high school students?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

28. To what extent did you feel a lack of achievement in these courses?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

29. To what extent did you use the library facilities in preparation for these classes.

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

30. To what extent were these courses taken for college preparation?

	1	2	3	4	5
Biology					
	None	Below Average	Average	Above Average	Extreme
Chemistry					

AN ATTITUDE SURVEY
OF JUNCTION CITY HIGH SCHOOL CHEMISTRY STUDENTS

by

MICHAEL WILLIAM WATTERS

B. S., Southwestern College, 1961

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1967

Science and its related fields of activity have become one of the most powerful forces in our society. For this reason, the science instructional program of our modern secondary school should be under constant evaluation. Perhaps it can be evaluated in light of the degree to which it accomplishes the following general objectives:

1. General educational science for all students is needed so that a widespread understanding and appreciation of science can be accomplished.

2. Specialized science instruction in basic and applied science for all students is needed for those preparing for college, for a vocation, or for personal satisfaction.

The high school instructional program should also be planned in view of the students' interests and abilities. However, for many years, science teachers along with other educators have only guessed at the factors that determine the attitudes of the science student.

This study was initiated to do research relative to the attitudes that chemistry students have toward science in the Junction City Senior High School at Junction City, Kansas. A research design was established to test for possible differences between the attitudes held by the students toward their biology and their chemistry courses. A second purpose was to determine the relationship between the students' attitudes toward these courses and certain scholastic criteria present in their high school program. These consisted of their chemistry grades, biology grades, Differential Aptitude Test scores, and grade point average.

The major research instrument used in this study was a student questionnaire. The number of chemistry students involved in the study was 65. The design of the questionnaire was such that it enabled the researcher to do both a comparative and a correlational study of the data. _T_-tests and product-moment correlations were utilized as a means of subjecting the obtained attitudinal and scholastic data to statistical analysis.

Other instruments used in the study included a preliminary questionnaire and the students' permanent record file which supplied such pertinent information as grades and standardized test scores.

On the basis of the rejection of the two null hypotheses tested, certain conclusions were reached with respect to the 1967 Junction City Senior High School chemistry students.

The first hypothesis was rejected on the basis of six questions that showed a significant difference to exist between the students' attitudinal responses. The students' attitudinal responses, shown on the questions which differed significantly, were found to be positive and favorable toward the study of chemistry. The implication of these responses seem to demonstrate a need for a closer look at the biology offering at the Junction City Senior High School.

The second hypothesis was rejected on the basis that significant relationships were shown to exist between the criterion measures. Significant relationships were found to exist between all of the scholastic criteria. There were also many significant relationships found to exist between the students' attitudinal responses. These same attitudinal responses were shown to be of a positive nature. Since the students' attitudes about biology and chemistry are basically positive and related, it would appear that the student interest in the study of chemistry could be developed and encouraged during their biology course work.