Spring 1962

A Study of the Opinions of High School and College Students of Western Kansas Regarding Science Teachers and Science Courses

Henry A. Levin
Fort Hays Kansas State College

A STUDY OF THE OPINIONS OF HIGH SCHOOL AND COLLEGE STUDENTS OF WESTERN KANSAS REGARDING SCIENCE TEACHERS AND SCIENCE COURSES

being

A Thesis Presented to the Graduate Faculty
of Fort Hays Kansas State College in
Partial Fulfillment of the Requirements for
the Degree of Master of Science

by

Henry A. Levin, B. S.
Fort Hays Kansas State College

Date May 8, 1962 Approved Ward J. Simms
Major Professor

Approved Ralph A. Coder
Chairman, Graduate Council

THESIS ABSTRACT

I. Purpose of Study

The purpose of this study was to evaluate, on the basis of student opinion:

1. The outstanding characteristics of the effective science teacher.
2. Student preference as to instructional procedures.
3. The attitudes of students toward science courses.
4. The areas of science that students consider especially interesting and important.

II. Procedure

This study was undertaken with the assumption that student opinions and reactions are valid to use as criteria in judging the suitability of science courses and the characteristics of the effective science teacher.

After surveying the related studies, four questionnaires were prepared and submitted to 2098 junior high, high school and college students.

III. Conclusions

The data secured through the techniques used in this investigation seems to indicate that:

1. The outstanding characteristics of the effective science teacher are the ability to explain clearly and expert knowledge of subject matter.
2. Demonstrations, laboratory and field trips received the highest ratings as instructional procedures.

3. The data concerning the responses of students regarding science courses shows a wide difference of opinion. However, a very high percentage of the students believed that the study of science is valuable, interesting and important for all students.

4. The four groups of respondents were in general most interested in two areas; first, that area concerning information about themselves and their personal welfare--topics such as reproduction, heredity, the human body and the nature and control of disease. The other area of particular interest deals with those things of current importance in everyday life. Such an area includes the nature and control of matter and energy and the basic principles of physics and chemistry.

ACKNOWLEDGEMENTS

Acknowledgement is given the kind assistance, encouragement, and constructive criticism of Dr. Ward L. Sims, under whose guidance this study has been completed.

To Dr. David E. Proctor, the author is indebted for his advice, and constructive suggestions in the treatment of statistical data. Also to Drs. B. W. Broach, H. C. Reynolds and G. W. Tomanek, the writer extends his thanks for their timely suggestions and interest in this study.

The author owes gratitude to the students, instructors, and superintendents of the following educational institutions, from which the data was secured,

Fort Hays Kansas State College	Hays, Kansas
Garden City Junior College	Garden City, Kansas
Hutchinson Junior College	Hutchinson, Kansas
Dodge City Junior College	Dodge City, Kansas
Hays High School	Hays, Kansas
Garden City High School	Garden City, Kansas
Kensington Public Schools	Kensington, Kansas
Almena Public Schools	Almena, Kansas
Norton Public Schools	Norton, Kansas
Lenora Public Schools	Lenora, Kansas
St. John Public Schools	St. John, Kansas
Russell Public Schools	Russell, Kansas

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Statement of the Problem

The purpose of this study was to evaluate on the basis of student opinion:

1. The outstanding characteristics of the effective science teacher.
2. Student preference as to instructional procedures.
3. The attitudes of students toward science courses.
4. The areas of science that students consider especially interesting and important.

Technique and Procedure

The validity of using the questionnaire as a measuring device for compiling a study of students opinions was established by Ahrens (1951). It was decided that this was the only practical technique to use in making this a significant study.

After surveying the related studies, two questionnaires were prepared and submitted to 87 biological and physical science students at Fort Hays Kansas State College during the 1961 summer session.

Evaluation of the opinions of these eighty-seven students established the reliability of the questionnaire. It was decided that several age groups should be surveyed. A form letter was sent to eighteen junior high, senior high and college science instructors. Twelve of these returned the letter indicating that they would agree to administer the questionnaire.

Questionnaires were administered not only to junior high, and high school but college students as well.

Since, the same questionnaire could not be used for all groups, four similar and comparable questionnaires were prepared, one to fit each situation. A copy of each questionnaire that was used is to be found in the appendix.

The questionnaires were given to 2098 students, 1037 boys and 1061 girls. Eight hundred and fifty-nine of the college questionnaires were usable for a subtotal of 423 boys and 436 girls. Two hundred and seventeen of the boys were enrolled in college biology. Two hundred and six were enrolled in physical science. Two hundred and thirty-two of the girls were enrolled in college biology and 204 in physical science. Four hundred and seven senior high school biology students replied, 205 boys and 202 girls. Eight hundred and thirty-two junior high school replies were evaluated, 207 seventh grade boys and 214 seventh grade girls. The data for the eighth grade consisted of the replies of 202 boys and 209 girls.

All of the questionnaires were administered during the month of October, 1961, so that time would not be considered a variable factor.

The responses are tabulated in detail in the following chapters. Ratings of the first two questions were grouped to make the data easier to manipulate. If the statement was rated as first, second, or third choice, the item was believed to have prime importance. The rating of fourth through seventh choice was to have medium importance.

If rated eighth through tenth choice, it was believed that the item had little significance.

In order to avoid the hesitancy many individuals have in making categorical "yes" and "no" answers or in making judgments to include or exclude absolutely everyone, options were given for marking a statement "true", "generally true", "seldom true" or "false".

It will be noted that some ideas are put in positive statements and others in negative statements. This was done in an effort to prevent the respondent from developing a pattern of marking every item in the same place because of any prejudicial opinion or mindset.

Related questions were not always placed together to minimize the tendency for an answer to one question to influence that answer on the next. This arrangement also required more careful attention on the part of the respondent.

The percentages that appear in the data were calculated by dividing the number of responses to each statement by the number of students who replied. This number was then rounded off to the closest whole number.

There are certain limitations in the data. Some students were probably influenced by comments of their colleagues. Some may have hesitated to register their real opinion. In a few cases, students made criticisms that were completely untrue. However, it is felt that the data is reasonably valid.

SURVEY OF RELATED STUDIES

Recently there has been much discussion in newspapers and magazines concerning a decline in science education, particularily in the percentage of high school students taking science. A logical question arises as to why this decline has occurred. Few, if any, individuals engaged in education would challenge the statement that a study of science is important in the general education of every student.

Being primarily concerned with the opinions of the students, it was decided that the literature dealing with student attitudes should be surveyed. Several articles were located dealing with student evaluation of science teachers and science courses. Because of these observations, it is deemed advisable to point out some of the most significant of their findings.

Bullington (1950) approached the problem of evaluating, on the basis of stusent opinion, the instructional procedures preferred in general education science courses. The study was undertaken with the assumption that student opinions were valid to use in criteria in judging the suitability of teaching procedures. He found that the students preferred the following procedures in the order given, (1) demonstrations with lectures, (2) the laboratory, (3) a comprehensive coverage of science, (4) opportunity for student discussion, (5) the relationship of course to everyday life, (6) the use of audio visual aids.

He also found they disliked the following; (1) lectures, (2) too much material covered in too short a time, (3) laboratory work,

(4) supplementary reading assignments.

It was the recognition of the "free career choice", that motivated a study of the attitudes of young people toward science and science related careers by Allen (1959). While the attitudes were considered positive and constructive, the opinions may well indicate deterrents to scientific career choice. Eighty-one per cent of the high school seniors that responded considered that (1) scientists are usually shy, unsociable, lonely individuals, (2) training for a career in science is not worth the time and effort, (3) scientific work is boring and monotonous.

Wilson (1954) made as attempt to determine the opinions related to certain aspects of science and its place in society. The data indicated that twenty-five per cent of the 570 high school respondents thought scientists were more intelligent than those in other lines of work. Twenty-four per cent of the same students did not seem to distinguish between pure science with its aim of advancing knowledge, and the application of the knowledge to the production of useful devices.

A study concerning the opinions of college students regarding science courses was conducted by Frazer (1955). Students enrolled in seven sections of physical science, and eight sections of biological science responded to the questionnaire.

The most significant findings revealed in the total study follow:

1. More than one half of the sections reported that individual laboratory work should be introduced into the course.

2. They also indicated the use of more field trips and panel discussions.

3. Slightly more than one-half of the sections expressed a desire for a greater amount of student participation in the classes.

Crouch and Leathers (1951) administered a student reaction survey. The outcomes of this study indicate that student opinions are of value in assessing a program of college biology. By grouping the 342 students several interesting observations were evident; (1) Students preferred instructors well versed in subject matter, (2) Organization of subject matter is important; (3) Tests were not given frequently enough.

Winier (1954), conducted a student evaluation of teaching procedures. The purpose of this study was to determine whether students preferred the lecture-discussion method or the group method. They found that fifty-four per cent of the students preferred the group method, whereas only forty-six per cent favored lecture-discussion.

While working with twelve high schools, Winier (1957), undertook a study of the attitudes of science students toward science courses. Student opinionnaires were administered to 785 high school students. He found that; (1) Eighteen per cent of the general science students and twenty-five per cent of the biology students were taking science courses because they were interesting, (2) Experiments rated first place as a reason why students liked science, (3) The topic of most interest in biology was the human body, with

diseases being second, (4) Astronomy and electricity were rated as the most interesting topics in physical science.

Haun (1959), surveyed student reactions to high school science. The sample included biology students in two of the larger high schools in Des Moines, Iowa. Two hundred and fifty-four students responded to the questionnaire. On the basis of the responses obtained, these students seem to be thoroughly convinced that science is important, valuable, and interesting for all students whether they are following science vocationally or not. Nearly ninety per cent of them agreed that science is interesting and that science has value for non-technical vocations. About eighty per cent agreed that all students should take biology and physical science.

CHAPTER II

OPINIONS OF JUNIOR HIGH SCHOOL STUDENTS

Four grade schools and two junior high schools were selected to supply the data for this chapter. They were as follows:

	NUMBER RESPONDING TO QUESTIONNAIRE			
	SEVENTH GRADE		EIGHTH GRADE	
	Boys	Girls	Boys	Girls
St. John Grade School St. John, Kansas	34	31	34	37
Lenora Grade School Lenora, Kansas	6	10	9	10
Norton Junior High School Norton, Kansas	44	43	43	46
Almena Grade School Almena, Kansas	29	26	26	24
Kensington Grade School Kensington, Kansas	25	23	28	31
Russell Junior High School Russell, Kansas	69	81	62	61
SUB-TOTAL	207	214	202	209
TOTAL SEVENTH GRADE				421
TOTAL EIGHTH GRADE				411
TOTAL SEVENTH AND EIGHTH GRADE				832

To simplify the discussion of the results, the items covered in the questionnaire have been divided into several categories.

SEVENTH GRADE STUDENTS RATING OF CHARACTERISTICS OF THE SCIENCE TEACHER

The students were asked in the first question to list in the order of their preference the characteristics of a good science teacher, starting with number one as the most important characteristic and proceeding to ten with items of lesser importance. After examining the results, items one, two and three were grouped as being of great importance. Items four, five, six and seven were grouped as having medium importance. The last three items were believed to have little significance as a positive factor, and were grouped as having little importance.

The data of the seventh grade science student's evaluation of the effective science teacher is presented in Table 1, page 10. The item of most importance, as rated by sixty-eight per cent of the girls, was expert knowledge of subject matter. Fifty-six per cent of the boys rated this item in second place.

The item rated most important by fifty-eight per cent of the boys, was the ability to explain clearly; one half of the girls rated this item as second most important.

The highest rating for the item of medium importance was given by the girls to systematic organization of subject matter.

The ability to encourage thought and systematic organization of subject matter tied for medium importance with fifty-eight per cent of the boys.

TABLE I

CHARACTERISTICS OF THE EFFECTIVE SCIENCE TEACHER

AS RATED BY 421 SEVENTH GRADE SCIENCE STUDENTS*

		Great Importance Percent Rating	Medium Importance Percent Rating	Little Importance Percent Rating
Expert Knowledge of subject matter	Boys	56	28	16
	Girls	68	22	10
Ability to explain clearly	Boys	58	38	4
	Girls	50	36	14
Fairness in making and grading tests	Boys	42	44	14
	Girls	38	32	20
Good speaking ability	Boys	38	48	14
	Girls	36	40	24
Ability to encourage thought	Boys	30	58	12
	Girls	30	44	26
Enthusiastic attitude toward subject	Boys	30	32	38
	Girls	26	44	30
Tolerance toward student disagreement	Boys	18	32	50
	Girls	12	40	48
Pleasing personality	Boys	10	26	64
	Girls	20	34	46
Systematic organization of subject	Boys	16	58	26
	Girls	10	62	28
Sympathetic attitude toward students	Boys	10	36	54
	Girls	10	36	54

*NOTE: This table should be read as follows: Fifty-six per cent of the boys rated expert knowledge of subject matter as being an item of great importance.

Sixty-four per cent of the boys thought pleasing personality was an item of little importance. Fifty-four per cent of the girls thought sympathetic attitude toward students had little significance. A more complete analysis of the data is revealed in Table I page 10.

PREFERENCE AS TO TEACHING PROCEDURE

The seventh grade students rated laboratory as their favorite teaching procedure. Seventy-two per cent of the boys and sixty-eight per cent of the girls preferred this method. Table II page 12 bears this out.

The boys, with sixty-eight per cent, and the girls, with sixty-four per cent, rated field trips as second choice.

Demonstrations rated third place with sixty-two per cent of the girls and sixty per cent of the boys.

Fourth choice for the boys with seventy-two per cent was special oral reports. Special assignments was rated fourth with sixty per cent of the girls.

Fifty-six per cent of the girls gave oral discussion their fifth response. Panel discussion received the same rating with fifty-eight per cent of the boys.

Oral discussion ranked sixth with fifty-four per cent of the boys. Panel discussion was sixth choice with fifty-four per cent of the girls.

Forty-eight per cent of the girls rated both workbooks and special oral reports in seventh place. The boys gave their seventh response to special assignments.

TABLE II

PREFERENCE OF TEACHING PROCEDURE AS RATED BY

421 SEVENTH GRADE SCIENCE STUDENTS*

		Choice 1-3 Percent Rating	Choice 4-7 Percent Rating	Choice 8-10 Percent Rating
Laboratory	Boys	72	12	16
	Girls	68	24	8
Field trips	Boys	68	30	2
	Girls	64	24	12
Demonstrations	Boys	60	26	14
	Girls	62	18	20
Oral discussion	Boys	30	54	16
	Girls	22	56	22
Panel discussion	Boys	18	58	24
	Girls	18	54	28
Lecture	Boys	16	32	52
	Girls	18	28	54
Special oral reports	Boys	12	72	16
	Girls	12	48	40
Special assignments	Boys	8	42	40
	Girls	16	60	24
Recitation	Boys	8	40	52
	Girls	14	40	54
Workbooks	Boys	8	34	58
	Girls	6	48	46

* NOTE: This table should be read as follows: Seventy-two per cent of the boys rated laboratory as first, second, or third choice. Twelve per cent rated the item as fourth through seventh choice and sixteen per cent rated the statement as eighth through tenth choice.

Preference for eighth choice was illustrated by the boys for workbooks with fifty-eight per cent. The same rating was given to lecture by the girls with fifty-four per cent.

Forty-six per cent of the girls voted for recitation and workbooks as their ninth choice. A fifty-two per cent priority was given to lecture and recitation by the boys. Fifty-four per cent of the girls rated lecture as tenth choice. The boys ranked special assignments in tenth place with a fifty-four per cent majority.

ATTITUDES TOWARD SCIENCE COURSES

The evaluation of science courses by the seventh grade illustrated a wide diversion of opinions. Fourteen per cent of the boys and two per cent of the girls believe that science courses are hard. Twenty per cent of the boys and thirty-six per cent of the girls thought they were generally hard. Rating science courses seldom hard was thirty-eight per cent of the boys and fifty-two per cent of the girls. Twenty-four per cent of the boys thought that science courses were always hard, whereas, only ten per cent of the girls had the same opinion.

The belief that science was not interesting was illustrated by two per cent of the boys and zero per cent of the girls. The percentage that thought science was generally not interesting was six per cent of the boys and ten per cent of the girls. A more complete analysis of the data is revealed in Table III page 14.

Twenty per cent of the girls and eighteen per cent of the boys thought it is seldom true that science is not interesting.

TABLE III

OPINIONS OF 421 SEVENTH GRADE SCIENCE

STUDENTS REGARDING SCIENCE COURSES*

		Percent True	Percent Generally True	Percent Seldom True	Percent False
Science courses are hard	Boys	14	20	38	24
	Girls	2	36	52	10
Science is not interesting	Boys	2	6	18	74
	Girls	0	10	20	70
Science has no value for nontechnical students	Boys	14	18	10	58
	Girls	8	16	26	50
Students want easy courses	Boys	18	26	32	24
	Girls	32	24	22	22
Students are afraid of science	Boys	2	8	26	64
	Girls	4	8	30	58
Science courses require too much work	Boys	2	6	28	64
	Girls	8	8	42	42
Science courses are too extensive and complicated	Boys	10	10	24	56
	Girls	6	12	46	36

* NOTE: This table should be read as follows: Fourteen per cent of the boys thought science courses to be hard, twenty per cent thought they were generally hard, thirty-eight per cent thought they were seldom hard, and twenty-four per cent thought they were not hard.

The largest percentage, seventy-four per cent of the boys and seventy per cent of the girls thought that science was interesting.

The opinion that science has no value for nontechnical students received fourteen per cent of the boys' vote and eight per cent of the girls' vote. Eighteen per cent of the boys and sixteen per cent of the girls believe that generally science has no value for nontechnical students. Ten per cent of the boys and twenty per cent of the girls believed that science seldom has any value for nontechnical students. Fifty-eight per cent of the boys and one-half of the girls thought science has a value for nontechnical students.

Seventh grade boys believe that eighteen per cent of the students want easy courses. Thirty-two per cent of the girls agreed with this. The boys believing that students generally want easy courses totaled twenty-six per cent. Twenty-four per cent of the girls gave the same response. The attitude that students seldom prefer easy courses was demonstrated by thirty-two per cent of the boys, a similar vote was given by twenty-two per cent of the girls. Twenty-four per cent of the boys and twenty-two per cent of the girls related that students do not want such courses.

Only two per cent of the boys and four per cent of the girls believed that students are afraid of science. Eight per cent of the boys and the girls both agree that students are generally afraid of science. The data indicates that thirty per cent of the girls and twenty-six per cent of the boys assumed that students seldom are afraid of science. Sixty-four per cent of the boys and fifty-

eight per cent of the girls related that students are not afraid of science.

Voting that science courses require too much work were two per cent of the boys and eight per cent of the girls. Students' presuming that science courses generally require too much work totaled six per cent of the boys and eight per cent of the girls. Science courses seldom require too much work received a favorable response from forty-two per cent of the girls and twenty-eight per cent of the boys. The largest percentage of the boys, sixty-four per cent, thought that science courses do not require too much work, however, only forty-two per cent of the girls believed this.

The point of view held by ten per cent of the boys and six per cent of the girls was that science courses are to extensive and complicated. Twelve per cent of the girls and ten per cent of the boys related that science courses generally are too complicated and extensive. By their response twenty-four per cent of the boys and forty-six per cent of the girls presumed that science courses are seldom too extensive and complicated. Correlated with the same idea fifty-six per cent of the boys and thirty-six per cent of the girls affirmed that they did not believe that science courses are too extensive or complicated.

A large percentage of the seventh grade science students believed that general science should be a required course. This was affirmed by seventy-four per cent of the boys and eighty-two per cent of the girls.

The responses summarized in Table Iv page 18 illustrate that one-half of the boys, and thirty-four per cent of the girls related that general science should be a required course, because it will be needed in later life. The data also conveyed that twelve per cent of the boys and fourteen per cent of the girls thought that science better explains nature. Eight per cent of the girls and twelve per cent of the boys thought that science should be required because it was interesting.

Preparation for a vocation received the response of six per cent of the girls as the reason why science should be required; whereas, eight per cent of the girls used the reason that science helps to make a better world.

Twenty-six per cent of the boys and eighteen per cent of the girls related that general science should not be a required course. The specific reason that everyone may not want to take a general science course was projected by ten per cent of the boys.

Six per cent of the girls related that everyone can't be scientists. Only four per cent of the girls and two per cent of the boys felt that science was not interesting and that it was too difficult.

A more complete summary of the responses of seventh grade students regarding why general science should not be a required course is available in Table V page 19.

TABLE IV

REASONS WHY SEVENTH GRADE SCIENCE STUDENTS BELIEVE GENERAL SCIENCE SHOULD BE REQUIRED

	PERCENT BOYS		PERCENT GIRLS
Needed in later life	50	Help in later life	34
Better explains nature	12	Better explains nature	14
Very interesting	12	No comment	12
		Help make better world	8
		Very interesting	8
		Preparation for vocation	6

TABLE V

REASONS WHY SEVENTH GRADE SCIENCE STUDENTS DO NOT BELIEVE GENERAL SCIENCE SHOULD BE REQUIRED

	PERCENT BOYS		PERCENT GIRLS
May not want to take course	10	Everyone can't be scientists	6
No comment	6	Not interesting	4
May not need	4	Might not need	4
Too many subjects	4	May not want to take Course	4
Too hard	2		

SIGNIFICANT TOPICS

The range of response shown in Table VI page 21 indicated a wide variation in science interests among seventh grade students. For example, eighty-six per cent of the boys thought that animals should be included in a general science course; only sixty-four per cent of the girls agreed. Electricity rated in second place with eighty-six per cent of the boys. Fifty-one per cent of the girls gave electricity a seventh place rating.

The human body was considered an interesting topic by both boys and girls; it was rated by fifty-six per cent of the girls, and forty-four per cent of the boys.

It seems feasible to say on the basis of the data that their major interests lie in two general areas; first, that area dealing with nature and control of matter and energy and the basic principles of physics. And second, the area centering around themselves and their personal welfare, (such topics as: the human body, heredity and the nature and control of disease).

Table VI reaffirms that students interests vary considerably. All of the responses from the questionnaire concerning significant topics were tabulated. However, only the twenty topics of greatest interest were included in the data for this chapter.

TOPICS SEVENTH GRADE SCIENCE STUDENTS BELIEVE SHOULD BE INCLUDED IN A GENERAL SCIENCE COURSE IN HIGH SCHOOL*

	PERCENT BOYS		PERCENT GIRLS
Animals	86	Weather	86
Electricity	82	Chemistry	80
Minerals	72	Space	79
Chemistry	72	Animals	64
Plants	60	Human body	56
Human body	44	Heredity	55
Atmosphere	44	Electricity	51
Weather	43	Plants	43
Biology	40	Atomic energy	37
Astronomy	36	Heat	35
Nature	35	Energy	31
Soil	34	Sound	31
Color	31	Light	28
Space	28	Geology	27
Airplanes	24	Environment	23
Engines	23	Machines	21
Health	20	Minerals	21
Boats	19	Air	19
Fish	16	Cells	17
Cells	16	Biology	15

* Only items rated from 1 - 20 are included in this table.

EIGHTH GRADE STUDENTS RATING OF CHARACTERISTICS OF THE EFFECTIVE SCIENCE TEACHER

In tabulating the responses of the eighth grade science students there seems to be a great deal of similarity. Both the boys and girls prefer teachers who exhibit the ability to explain clearly, and who have expert knowledge of their subject matter.

A more complete analysis of the data concerning the characteristics of the effective science teacher as rated by eighth grade science students is available in Table VII page 23.

The ability to explain clearly was most frequently mentioned as an item of great importance for the eighth grade students, with seventy-four per cent of the boys and fifty-eight per cent of the girls agreeing. Expert knowledge of subject matter was rated second most important with fifty-three per cent of the boys and fifty-six per cent of the girls. For third choice, pleasing personality received forty-four per cent of the eighth grade girls' responses, and thirty-six per cent of the eighth grade boys' votes.

Both the eighth grade boys and girls rated systematic organization and sympathetic attitude toward students as having little importance.

Preference of Teaching Procedure

Demonstrations rated as the favorite teaching procedure, by frequency of response, with eighty-five per cent of the eighth grade boys. First place for the girls was laboratory with sixty-six per cent. The laboratory was second place with sixty-four per cent of the boys. Demonstrations held second place with the same percentage of the girls.

TABLE VII

CHARACTERISTICS OF THE EFFECTIVE SCIENCE TEACHER

AS RATED BY 411 EIGHTH GRADE SCIENCE STUDENTS*

		Great Importance Percent Rating	Medium Importance Percent Rating	Little Importance Percent Rating
Ability to explain clearly	Boys	74	22	4
	Girls	58	36	6
Expert knowledge of subject matter	Boys	53	32	15
	Girls	56	36	8
Pleasing personality	Boys	36	30	34
	Girls	44	32	24
Enthusiastic attitude toward subject	Boys	32	50	18
	Girls	30	36	34
Fairness in making and grading tests	Boys	28	58	14
	Girls	22	62	16
Good speaking ability	Boys	24	44	32
	Girls	44	44	12
Ability to encourage thought	Boys	24	56	20
	Girls	14	60	26
Tolerance toward student dissagreement	Boys	14	36	50
	Girls	14	44	42
Systematic organization of subject	Boys	12	50	38
	Girls	14	38	48
Sympathetic attitude toward	Boys	20	22	58
	Girls	4	12	84

* NOTE: This table should be read as follows: Seventy-four per cent of the boys rated ability to explain clearly as being an item of great importance.

Field trips were third choice for the boys and girls, with a rating of fifty-six per cent of the boys and one half of the girls.

As a method of teaching, workbooks were rated as last choice by frequency of response. This procedure received a two per cent rating by the eighth grade boys and a six per cent vote by the eighth grade girls.

On the basis of the data in Table VIII page 25 it would be safe to say that the eighth grade students prefer demonstrations, laboratory, and field trips as their favorite teaching procedures.

Opinions Regarding Science Courses

Eight per cent of the eighth grade boys thought science courses to be hard while twelve per cent of the eighth grade girls had the same opinion. In the second and third catagories there was a tie; forty-four per cent of the boys believed that science courses were generally hard. A like number thought science courses were seldom hard. Sixty per cent of the girls believed that science courses are generally hard while only twenty per cent thought they were seldom hard. Four per cent of the boys and eight per cent of the girls related that science courses were not hard. A more complete tabulation of the eighth grade students' responses regarding science courses is to be found in Table IX page 26.

A very small percentage, two per cent of the boys and six per cent of the girls voted that science is not interesting. Only six per cent of the girls and ten per cent of the boys believed that science courses were generally not interesting. The greatest percentage,

TABLE VIII

PREFERENCE OF TEACHING PROCEDURE AS RATED BY

411 EIGHTH GRADE SCIENCE STUDENTS*

		Choice 1-3 Percent Rating	Choice 4-7 Percent Rating	Choice 8-10 Percent Rating
Demonstrations	Boys	84	16	0
	Girls	64	16	20
Laboratory	Boys	64	22	14
	Girls	66	28	6
Field Trips	Boys	56	26	18
	Girls	50	34	16
Oral Discussion	Boys	34	52	14
	Girls	40	48	12
Panel Discussion	Boys	14	68	18
	Girls	32	40	28
Recitation	Boys	12	52	36
	Girls	16	42	42
Special Assignments	Boys	18	44	38
	Girls	6	48	46
Special Oral Reports	Boys	10	46	44
	Girls	10	50	40
Lecture	Boys	6	42	52
	Girls	10	40	50
Workbooks	Boys	2	32	66
	Girls	6	44	50

* NOTE: This table should be read as follows: Eighty-four per cent of the boys rated Demonstrations as first, second, or third choice. Sixteen per cent rated the item as fourth through seventh choice and zero per cent rated the statement as eighth through tenth choice.

TABLE IX

OPINIONS OF 411 EIGHTH GRADE SCIENCE

STUDENTS REGARDING SCIENCE COURSES*

		Percent True	Percent Generally True	Percent Seldom True	Percent False
Science courses are hard	Boys	8	44	44	4
	Girls	12	60	20	8
Science is not interesting	Boys	2	10	34	54
	Girls	6	6	44	44
Science has no value for nontechnical students	Boys	10	10	18	62
	Girls	8	8	16	68
Students want easy courses	Boys	22	48	20	10
	Girls	18	50	18	14
Students are afraid of science	Boys	2	4	52	42
	Girls	0	12	52	36
Science courses require too much work	Boys	4	10	44	42
	Girls	6	22	36	36
Science courses are too extensive and complicated	Boys	4	10	46	40
	Girls	0	12	56	32

* NOTE: This table should be read as follows: Eight per cent of the boys thought science courses to be hard, forty-four per cent thought they were generally hard, forty-four per cent thought they were seldom hard and four per cent did not think they were hard.

fifty-four per cent of the boys and fifty-five per cent of the girls related that science courses were interesting.

The belief that science has no value for nontechnical students received eight per cent of the girls' responses and ten per cent of the boys' votes. The largest percentage, sixty-eight per cent of the girls and sixty-two per cent of the boys believed that science has value for nontechnical students.

Seventy per cent of the boys related that students want easy courses or that they generally want easy courses. This corresponds to sixty-eight per cent of the girls who have the same belief. Only ten per cent of the boys and fourteen per cent of the girls believed that students do not want easy courses.

As for students being afraid of science, only two per cent of the boys and zero per cent of the girls related such. Four per cent of the boys and six per cent of the girls believed that science courses require too much work. Approximately even percentages of the boys and girls presumed that science courses seldom require too much work or that they did not require too much work.

Ninety-four per cent of the eighth grade boys and eighty-eight per cent of the eighth grade girls related that general science should be a required course. Forty-eight per cent of the girls and thirty-six per cent of the boys related the fact that general science would be needed in later life as sufficient evidence for making it a required course. A complete list of the reasons why general science should be a required course is available in Table X page 28.

TABLE X

REASONS WHY EIGHTH GRADE SCIENCE STUDENTS BELIEVE

GENERAL SCIENCE SHOULD BE A REQUIRED COURSE

	PERCENT BOYS		PERCENT GIRLS
Needed in later life	36	Help in later life	48
Better explains nature	24	Better explains nature	26
College preparation	20	Basic Knowledge	10
Needed for background	14	Helps in other classes	4

The belief that science better explains nature was held by twenty-four per cent of the eighth grade boys and twenty-six per cent of the eighth grade girls. A more complete list of the reasons why general science should not be a required course is available in Table XI page 30.

Ten per cent of the eighth grade girls related that general science should be a required course because it is basic knowledge; while four per cent believed that it helped in other classes.

Only six per cent of the eighth grade boys presumed that general science should not be a required course. Four per cent thought they were taking too many subjects; while two per cent related that general science was too hard.

The belief that general science should not be a required course received twelve per cent of the eighth grade girls' votes. Six per cent related that the course may not be needed. Two per cent of the eighth grade girls believed that science was not interesting.

SIGNIFICANT TOPICS

A wide range of replies were tabulated regarding the topics eighth grade science students believe should be included in a general science course in high school. As first choice, seventy-two per cent of the girls responded to space as one topic. First choice for the boys was atomic behavior securing sixty-two per cent of their responses. Space, the second choice for the boys, received fifty-eight per cent of their replies. The human body was second choice for the girls and third choice for the boys.

TABLE XI

REASONS WHY EIGHTH GRADE SCIENCE STUDENTS DO NOT BELIEVE GENERAL SCIENCE SHOULD BE A REQUIRED COURSE

	PERCENT BOYS		PERCENT GIRLS
Too many subjects	4	May not need	6
Too hard	2	May not want to take course	4
		Not interesting	2

Third choice for fifty-six per cent of the girls was electricity; this topic was seventh choice with forty-six per cent of the boys. Weather was in fourth place with fifty-six per cent of the boys; while it was ninth choice for the girls.

A more complete tabulation of the topics eighth grade science students believe should be included in a general science course is to be found in Table XII page 32.

TABLE XII

TOPICS EIGHTH GRADE SCIENCE STUDENTS BELIEVE SHOULD BE INCLUDED IN A GENERAL SCIENCE COURSE IN HIGH SCHOOL*

	PERCENT BOYS		PERCENT GIRLS
Atomic behavior	62	Space	72
Space	60	Human body	68
Human body	58	Electricity	56
Weather	56	Chemistry	52
Machines	52	Atomic power	46
Animals	48	Geology	46
Electricity	46	Conservation	44
Plants	42	Plants	44
Nature	42	Weather	42
Evolution	40	Diseases	42
Medicine	39	Animals	38
Chemistry	36	Heredity	34
Astronomy	32	Light	34
Matter	30	Sound	32
Conservation	26	Health	30
Weights and measures	36	Nature	30
Pressure	25	Machines	28
Light	24	Air	26
Heat	23	Medicine	24
Sound	22	Radiation	24

* Only items rated 1 - 20 are included in this table.

CHAPTER III

OPINIONS OF SENIOR HIGH SCHOOL STUDENTS

Six high schools were selected to supply the data for this chapter. They were as follows:

SCHOOL	NUMBER RESPONDING TO QUESTIONNAIRE BOYS	GIRLS
Hays High School Hays, Kansas	76	84
Garden City High School Garden City, Kansas	62	43
Kensington High School Kensington, Kansas	10	14
Almena High School Almena, Kansas	12	11
Norton High School Norton, Kansas	30	38
Lenora High School Lenora, Kansas	15	12
SUB-TOTAL	205	202
TOTAL BOYS AND GIRLS		407

To simplify the discussion of the results, the items covered in the questionnaire have been divided into several catagories.

CHARACTERISTICS OF THE SCIENCE TEACHER

A list of ten characteristics of the effective science teacher were provided in the questionnaire. The high school biology students were asked to rank in order from one through ten the characteristics they considered most important. The items were then grouped in the tabulation. Items rated first through third choice were believed to have great importance. Items receiving fourth through seventh choice

received medium importance, while items rated eight through ten were believed to have little significance.

The ability to explain clearly was most frequently mentioned as an item of great importance by both the boys and girls. Eighty-two per cent of the girls and sixty-six per cent of the boys considered this factor to have prime importance.

The data of the high school biology students' evaluation of the effective science teacher is presented in Table XIII page 35.

Expert knowledge of subject matter was rated as an item of great importance by sixty per cent of the boys and fifty-eight per cent of the girls; this factor therefore received a second place rating.

Good speaking ability received third place as an item checked most frequently by the boys and girls. Thirty-five per cent of the boys and thirty-four per cent of the girls considered this characteristic as third most important.

The fourth most commonly checked item regarding the characteristics of the effective science teacher was enthusiastic attitude toward subject. Placing the above item as fourth choice was thirty-four per cent of the boys and thirty per cent of the girls.

Sympathetic attitude toward students received a last place rating by both the boys and girls. Only seven per cent of the boys and nine per cent of the girls believed this item to have great importance.

TABLE XIII

CHARACTERISTICS OF THE EFFECTIVE SCIENCE TEACHER

AS RATED BY 407 HIGH SCHOOL BIOLOGY STUDENTS*

		Great Importance Percent Rating	Medium Importance Percent Rating	Little Importance Percent Rating
Ability to explain clearly	Boys	66	29	5
	Girls	82	18	0
Expert Knowledge of Subject matter	Boys	60	31	9
	Girls	58	26	16
Good Speaking ability	Boys	35	46	19
	Girls	34	49	17
Enthusiastic attitude toward	Boys	34	42	24
	Girls	30	49	21
Fairness in making and grading tests	Boys	27	48	25
	Girls	24	56	20
Pleasing Personality	Boys	28	24	48
	Girls	15	39	49
Ability to encourage thought	Boys	23	46	31
	Girls	22	56	22
Tolerance toward student disagreement	Boys	12	37	51
	Girls	9	39	52
Systematic organization of subject matter	Boys	8	62	30
	Girls	18	48	34
Sympathetic attitude toward students	Boys	7	34	59
	Girls	9	20	71

* NOTE: This table should be read as follows: Sixty-six per cent of the boys rated ability to explain clearly as being an item of great importance.

PREFERENCE AS TO TEACHING PROCEDURE

A list of ten teaching procedures were provided in the questionnaire. The high school biology students were asked to rank in order from one through ten their favorite teaching procedures.

Demonstrations were rated most frequently as the teaching procedure preferred by both the boys and girls. Eighty-five per cent of the boys and sixty-one per cent of the girls preferred this method. A more complete analysis of the data is revealed in Table XIV page 37.

Field trips were the second most preferred method for teaching high school biology with both the boys and girls. By frequency of response sixty-seven per cent of the boys and fifty-seven per cent of the girls related this method as second choice.

The laboratory was the third most frequently mentioned procedure by both the boys and girls. Sixty-six per cent of the boys and fifty-three per cent of the girls voted for this method.

Oral discussion received fourth choice by frequency of response. Forty per cent of the boys and girls preferred this procedure.

Recitation was fifth choice for the boys, while lecture held the same rating for the girls. The percentages varied from nine per cent of the boys for recitation to twenty per cent of the girls for lecture.

Workbooks received the last place rating for the boys, while the girls voted for special reports as their last choice.

TABLE XIV

PREFERENCE OF TEACHING PROCEDURE AS RATED BY

407 HIGH SCHOOL BIOLOGY STUDENTS

		Choice 1-3 Percent Rating	Choice 4-7 Percent Rating	Choice 8-10 Percent Rating
Demonstrations	Boys	85	12	3
	Girls	61	30	13
Field Trips	Boys	67	24	9
	Girls	57	19	20
Laboratory	Boys	66	31	3
	Girls	53	43	4
Oral Discussion	Boys	40	37	23
	Girls	40	45	15
Recitation	Boys	9	53	38
	Girls	16	59	25
Lecture	Boys	8	56	36
	Girls	21	42	37
Special Reports	Boys	8	36	56
	Girls	5	28	67
Panel	Boys	7	67	26
	Girls	22	58	20
Special Assignments	Boys	6	32	62
	Girls	15	40	45
Workbooks	Boys	4	52	44
	Girls	7	38	55

* NOTE: This table should be read as follows: Eighty-five per cent of the boys rated Demonstrations as first, second, or third choice. Twelve per cent rated the item as fourth through seventh choice and three per cent rated the statement as eight through tenth choice.

ATTITUDES TOWARD SCIENCE COURSES

Seven statements regarding science courses were included in the questionnaire. The high school biology students were asked to indicate their opinion by checking the statements true, generally true, seldom true, or false.

The evaluation of science courses by the high school biology students illustrated a wide diversity of opinions. Sixteen per cent of the boys and fifty-one per cent of the girls thought they were generally hard. Rating science courses seldom hard was ten per cent of the boys and twelve per cent of the girls. Only two per cent of the boys thought that science courses were not hard, whereas sixteen per cent of the girls had the same opinion. A more complete analysis of the data is revealed in Table XV page 39.

The belief that science was not interesting was illustrated by zero per cent of the boys and two per cent of the girls. The percentage that thought science was generally not interesting was two per cent of the boys and nine per cent of the girls.

Eighteen per cent of the boys and twenty-three per cent of the girls thought it is seldom true that science is not interesting. The largest percentage, eighty per cent of the boys and sixty-six per cent of the girls related that science was interesting.

The opinion that science has no value for nontechnical students received two per cent of the girls' vote and zero per cent of the boys' vote. Three per cent of the girls and zero per cent of the boys related that generally science has no value for non-

TABLE XV

OPINIONS OF 407 HIGH SCHOOL BIOLOGY STUDENTS

REGARDING SCIENCE COURSES*

		Percent True	Percent Generally True	Percent Seldom True	Percent False
Science courses are hard	Boys	16	72	10	2
	Girls	21	51	12	16
Science is not interesting	Boys	0	2	18	80
	Girls	2	9	23	66
Science has no value for nontechnical students	Boys	0	0	10	90
	Girls	2	3	17	78
Students want easy courses	Boys	16	56	20	8
	Girls	10	46	33	11
Students are afraid of science	Boys	6	40	40	12
	Girls	20	36	34	10
Science courses require too much work	Boys	0	11	61	28
	Girls	3	20	51	16
Science courses are too extensive and complicated	Boys	4	22	46	28
	Girls	8	18	46	18

* NOTE: This table should be read as follows: Sixteen per cent of the boys thought science courses to be hard, seventy-two per cent thought they were generally hard, ten per cent thought they were seldom hard and two per cent did not think they were hard.

technical students. The largest percentage, ninety per cent of the boys and seventy-eight per cent of the girls thought that science has a value for nontechnical students.

Sixteen per cent of the boys and ten per cent of the girls agreed that students want easy courses. The largest majority, fifty-six per cent of the boys and forty-six per cent of the girls thought that students generally want easy courses.

Only eight per cent of the boys and twenty per cent of the girls believed that students are afraid of science. Forty per cent of the boys and thirty-six per cent of the girls agree that students generally are afraid of science. The data indicates that sixty-one per cent of the boys and fifty-one per cent of the girls assumed that students seldom are afraid of science. Twenty-eight per cent of the boys and sixteen per cent of the girls related that students are not afraid of science.

Voting that science courses require too much work were zero per cent of the boys and three per cent of the girls. Students' presuming that science courses generally require too much work totaled eleven per cent of the boys and twenty per cent of the girls. Science courses seldom require too much work received a favorable response from sixty-one per cent of the boys and fifty-one per cent of the girls.

The point of view held by four per cent of the boys and six per cent of the girls was that science courses are too extensive and complicated. Eighteen per cent of the girls and twenty-two per

cent of the boys related that science courses generally are too complicated and extensive. By their response forty-six per cent of the boys and girls presumed that science courses are seldom too extensive and complicated. Correlated with the same idea fifty-six per cent of the boys and thirty-six per cent of the girls affirmed that they did not believe that science courses are too extensive or complicated.

A large percentage of the high school biology students believed that biology should be a required course. This was affirmed by seventy-nine per cent of the boys and eighty-three per cent of the girls.

The responses summarized in Table XVI illustrate that eighteen per cent of the boys and twenty-nine per cent of the girls related that biology should be a required course, because it will be needed in later life. The data also conveyed that twenty-three per cent of the boys and nineteen per cent of the girls thought that science better explains nature.

Six per cent of the girls and five per cent of the boys thought science should be required because it was interesting.

Twenty-one per cent of the boys and seventeen per cent of the girls related that biology should not be a required course. The specific reason that biology would only be needed in the scientific field was projected by sixteen per cent of the boys.

Nine per cent of the girls related that everyone may not need to take a course in biology. Only three per cent of the girls and

TABLE XVI

REASONS WHY HIGH SCHOOL BIOLOGY STUDENTS BELIEVE

BIOLOGY SHOULD BE A REQUIRED COURSE

	PERCENT BOYS		PERCENT GIRLS
Better explains nature	23	Needed in later life	29
Improves general knowledge	19	Better explains nature	10
Needed in later life	18	Helps in other courses	15
College preparation	14	College preparation	12
Very interesting	5	Very interesting	6
		Help in vocation	2

two per cent of the boys felt that biology was too hard to be a required course. A more complete analysis of the data is available in Table XVII page 44.

SIGNIFICANT TOPICS

The range of response shown in Table XVIII page 45 indicated a wide variation of interests among high school biology students. For example, seventy-six per cent of the boys thought that space biology should be included in a high school biology course. Reproduction was first place as a topic to be included in a high school biology course for the girls; it received second place by the boys.

The human body was second choice as a topic for the girls while it was third choice for the boys. Third choice for the girls was animals; while, they were seventh choice for the boys. Plants were fourth choice for the girls and sixth choice for the boys.

Table XVIII reaffirms that students' interests vary considerably. All of the responses from the questionnaires concerning significant topics were tabulated. However, only the twenty topics of greatest interest were included in the data for this chapter.

TABLE XVII

REASONS WHY HIGH SCHOOL BIOLOGY STUDENTS DO NOT BELIEVE BIOLOGY SHOULD BE A REQUIRED COURSE

	PERCENT BOYS		PERCENT GIRLS
Only needed in the field	16	May not need	9
Should have choice	3	Not interesting	5
Too hard	2	Too hard	3

TABLE XVIII

TOPICS HIGH SCHOOL BIOLOGY STUDENTS BELIEVE SHOULD BE INCLUDED IN A BIOLOGY COURSE IN HIGH SCHOOL*

	PERCENT BOYS		PERCENT GIRLS
Space biology	76	Reproduction	83
Reproduction	71	Human body	81
Human body	61	Animals	78
Field biology	58	Plants	72
Diseases	45	Human behavior	63
Plants	43	Heredity	54
Animals	41	Diseases	52
Human behavior	41	Cells	49
History of life	40	Health	41
Heredity	39	Conservation	36
Life processes	38	Radiation	27
Bacteria	28	Foods	26
Body systems	28	Bacteria	24
Conservation	27	Hormones	21
Ecology	24	Biochemistry	19
Cells	23	Life processes	18
Insects	21	Field biology	17
Geology	20	Formation of the earth	15
Evolution	19	Classification	15
Palentology	19	Soil	14

* Only items rated 1 - 20 are included in this table.

CHAPTER IV

OPINIONS OF COLLEGE STUDENTS

Four colleges were selected to supply the data for this chapter. They are as follows:

NUMBER RESPONDING TO QUESTIONNAIRE

	Biology Students		Physical Science Students	
COLLEGE	BOYS	GIRLS	BOYS	GIRLS
Fort Hays Kansas State College Hays, Kansas	97	144	98	103
Hutchinson Junior College Hutchinson, Kansas	37	32	42	36
Garden City Junior College Garden City, Kansas	42	33	29	37
Dodge City College Dodge City, Kansas	41	23	37	28
SUB-TOTAL	217	232	206	204
TOTAL BIOLOGY STUDENTS				449
TOTAL PHYSICAL SCIENCE STUDENTS				410
TOTAL COLLEGE STUDENTS				859

COLLEGE BIOLOGY STUDENTS RATING OF CHARACTERISTICS OF THE SCIENCE TEACHER

In the first question, the college biology students were asked to list in the order of their preference the ten characteristics of the effective science teacher, starting with number one as most important characteristic and proceding to ten with items of lesser importance. The items were then grouped according to importance.

The data of the college biology students illustrates that both the boys and girls believed that the ability to explain clearly was the outstanding characteristic of the effective science teacher.

By their responses, eighty-two per cent of the girls and sixty-two per cent of the boys preferred this procedure.

A preference was shown for expert knowledge of subject matter as the second most important characteristic. Fifty-six per cent of the boys and fifty-one per cent of the girls voted for this method.

By frequency of response, good speaking ability rated third most important for the boys. Systematic organization of subject matter was considered third most important by the girls.

The fourth most commonly checked item for both the boys and girls was enthusiastic attitude toward subject. Thirty-six per cent of the boys and thirty-five per cent of the girls preferred this procedure.

Sympathetic attitude toward students received a ninth place rating by both the boys and girls. The item considered to have the least significance was tolerance toward student disagreement.

A more complete tabulation of the data concerning the biological students evaluation of the effective science teacher is revealed in Table XIX page 48.

The college biology students were asked to rate their high school science teachers as above average, average, or below average. Thirty-nine per cent of the boys rated their high school science teachers as above average, forty-three per cent rated them as average, and eighteen per cent rated them as below average. Forty-two per cent of the girls rated them above average, fifty-three per cent as average, and five per cent below average.

TABLE XIX

CHARACTERISTICS OF THE EFFECTIVE SCIENCE TEACHER

AS RATED BY 449 COLLEGE BIOLOGY STUDENTS*

		Great Importance Percent Rating	Medium Importance Percent Rating	Little Importance Percent Rating
Ability to explain clearly	Boys	62	36	2
	Girls	82	18	0
Expert knowledge of subject matter	Boys	56	34	10
	Girls	51	38	11
Good speaking ability	Boys	46	48	6
	Girls	33	48	19
Enthusiastic attitude toward subject	Boys	36	52	12
	Girls	35	58	7
Systematic organization of subject matter	Boys	36	50	14
	Girls	36	51	13
Ability to encourage thought	Boys	22	64	14
	Girls	34	48	18
Pleasing personality	Boys	36	30	44
	Girls	9	36	55
Fairness in making and grading tests	Boys	8	42	50
	Girls	13	48	39
Sympathetic attitude toward students	Boys	4	12	84
	Girls	5	24	71
Tolerance toward student disagreement	Boys	4	32	64
	Girls	2	31	67

*NOTE: This table should be read as follows: Sixty-two per cent of the boys rated ability to explain clearly as being an item of great importance.

PREFERENCE AS TO TEACHING PROCEDURE

The section dealing with the preference of teaching procedure was identical for all the questionnaires. The college biology students were asked to rate the ten procedures, starting with their favorite as number one.

Demonstrations were rated most frequently as the teaching procedure preferred by both the boys and girls. Eighty per cent of the boys and sixty-eight per cent of the girls responded to this method. A more complete analysis of the data is revealed in Table XX page 50.

By frequency of response, field trips rated as second choice for the boys. Second choice for the girls was oral discussion. Preference for third choice was illustrated by the boys for laboratory with forty-eight per cent. The same rating was given to lecture by the girls with fifty-five per cent concurring.

Preference for fourth choice was illustrated by the boys for lecture with thirty-eight per cent. Recitation was fourth choice for the girls.

Thirty per cent of the boys voted for oral discussion as their fifth choice. Fifth choice for the girls was panel discussion.

Workbooks were rated as the last choice of teaching procedures by both the boys and the girls. Only six per cent of the boys and three per cent of the girls responded to this procedure.

TABLE XX

PREFERENCE OF TEACHING PROCEDURE AS RATED BY

449 COLLEGE BIOLOGY STUDENTS*

		Choice 1-3 Percent Rating	Choice 4-7 Percent Rating	Choice 8-10 Percent Rating
Demonstrations	Boys	80	20	0
	Girls	68	28	4
Field Trips	Boys	52	44	4
	Girls	35	49	16
Laboratory	Boys	48	42	10
	Girls	35	43	22
Lecture	Boys	38	38	24
	Girls	55	32	13
Oral discussion	Boys	30	52	18
	Girls	57	36	7
Recitation	Boys	12	50	38
	Girls	18	44	38
Panel discussion	Boys	18	52	30
	Girls	11	44	45
Special Assignments	Boys	8	38	54
	Girls	10	46	44
Special Reports	Boys	8	28	64
	Girls	8	32	60
Workbooks	Boys	6	36	58
	Girls	3	46	51

* NOTE: This table should be read as follows: Eighty per cent of the boys rated Demonstrations as first, second, or third choice. Twenty per cent rated the item as fourth through seventh choice and zero per cent rated the statement as eight through tenth choice.

ATTITUDES TOWARD SCIENCE COURSES

The evaluation of science courses by the college biology students illustrated a wide difference of opinion. Sixteen per cent of the boys and twenty-one per cent of the girls believed that science courses were hard. Sixty-three per cent of the boys and fifty-three per cent of the girls related that they were generally hard. Rating science courses seldom hard were sixteen per cent of the boys and nineteen per cent of the girls. Only five per cent of the boys and seventeen per cent of the girls presumed that science courses were not hard. A more complete analysis of the data is revealed in Table XXI page 52.

The belief that science was not interesting was illustrated by five per cent of the boys and four per cent of the girls. The percentage that thought science was generally not interesting was six per cent of the boys and twelve per cent of the girls. Twenty per cent of the boys and twenty-three per cent of the girls thought it was seldom true that science was not interesting. The largest percentage, sixty-nine per cent of the boys and sixty-one per cent of the girls thought that science was interesting.

The opinion that science has no value for nontechnical students received three per cent of the boys' vote and two per cent of the girls believed that generally science has no value for nontechnical students. Thirteen per cent of the boys and nineteen per cent of the girls believed that science seldom has any value for nontechnical students. The largest percentage, seventy-eight per cent of the boys and sixty-nine per cent of the girls related

TABLE XXI

OPINIONS OF 449 COLLEGE BIOLOGY STUDENTS

REGARDING SCIENCE COURSES*

		Percent True	Percent Generally True	Percent Seldom True	Percent False
Science courses are hard	Boys	16	63	16	5
	Girls	21	53	19	17
Science is not interesting	Boys	5	6	20	69
	Girls	4	12	23	61
Science has no value for nontechnical students	Boys	3	6	13	78
	Girls	2	10	19	69
Students want easy courses	Boys	24	27	30	19
	Girls	24	30	32	14
Students are afraid of science	Boys	8	22	47	23
	Girls	10	23	48	19
Science courses require too much work	Boys	10	15	39	36
	Girls	7	17	47	29
Science courses are too extensive and complicated	Boys	7	23	33	37
	Girls	10	17	47	26

* NOTE: This table should be read as follows: Sixteen per cent of the boys thought science courses to be hard; sixty-three per cent thought they were generally hard: sixteen per cent thought they were seldom hard and five per cent did not think they were hard.

that science has a value for nontechnical students.

The statement that students want easy courses was regarded as true by twenty-four per cent of both the boys and girls. The boys believing that students generally want easy courses totaled twenty-seven per cent. Thirty per cent of the girls gave the same response. The attitude that students seldom prefer easy courses was demonstrated by thirty per cent of the boys; a similar vote was given by thirty-two per cent of the girls. Nineteen per cent of the boys and fourteen per cent of the girls related that students do not want easy courses.

Only seven per cent of the girls and ten per cent of the boys believed that students are afraid of science. Fifteen per cent of the boys and seventeen per cent of the girls agree that students are generally afraid of science. The data indicates that forty-seven per cent of the boys and forty-eight per cent of the girls assumed that students seldom are afraid of science. Twenty-three per cent of the boys and nineteen per cent of the girls related that students are not afraid of science.

Responding that science courses require too much work were ten per cent of the boys and seven per cent of the girls. Students' presuming that science courses generally require too much work totaled fifteen per cent of the boys and seventeen per cent of the girls. Science courses seldom require too much work received a favorable response from thirty-nine per cent of the boys and forty-seven per cent of the girls. Only twenty-

nine per cent of the girls and thirty-six per cent of the boys related that science courses do not require too much work.

The point of view held by ten per cent of the girls and seven per cent of the boys was that science courses were too extensive and complicated. Twenty-three per cent of the boys and seventeen per cent of the girls related that science courses generally are too complicated and extensive. By their response, thirty-three per cent of the boys and forty-seven per cent of the girls presumed that science courses are seldom too extensive and complicated. Correlated with the same idea, thirty-seven per cent of the boys and twenty-six per cent of the girls affirmed that they did not believe that science courses were too extensive or complicated.

Ninety-five per cent of the girls and eighty-eight per cent of the boys believed that biology should be a required course. Forty-eight per cent of the boys and twenty-two per cent of the girls thought the fact that biology would be needed in later life sufficient reason for making it a required course.

The belief that biology better explains nature was held by twenty-four per cent of the boys and thirty per cent of the girls. A more complete listing of the reasons why college biology should be a required course is available in Table XXII page 55.

Only five per cent of the girls and twelve per cent of the boys presumed that biology should not be a required course. Four per cent of the boys and three per cent of the girls related that biology was not interesting that this was sufficient reason for not

TABLE XXII

REASONS WHY COLLEGE BIOLOGY STUDENTS BELIEVE

BIOLOGY SHOULD BE A REQUIRED COURSE

	PERCENT BOYS		PERCENT GIRLS
Needed in everyday life	48	Better explains nature	30
Better explains nature	24	Needed in everyday life	22
Broadens background	16	Improves general knowledge	21
		Better explains environment	12
		Helps vocabulary	10

TABLE XXIII

REASONS WHY COLLEGE BIOLOGY STUDENTS DO NOT BELIEVE

BIOLOGY SHOULD BE A REQUIRED COURSE

	PERCENT BOYS		PERCENT GIRLS
Should take course in major	8	Not interesting	3
Not interesting	4	Too hard	1
		Should take courses in major	1

making it a required course.

The belief that students should take courses closer related to their major was held by eight per cent of the boys and one per cent of the girls.

A more complete tabulation of the reasons why biology should not be a required course is available in Table XXIII page 56.

SIGNIFICANT TOPICS

A wide range of replies were tabulated regarding the topics college biology students believe should be included in a high school biology course.

By frequency of response, reproduction rated as first choice as a topic to be included in a high school biology course. Eighty-six per cent of the girls and eighty-two per cent of the boys responded to this topic.

Second choice, by frequency of response, was given to the life processes by the girls and to the human body by the boys. Animals rated third choice for the boys, while the human body had the same rating for the girls.

Fourth choice with eighty-one per cent of the girls was animals. Fourth choice for the boys was given to cells. Plants was fifth choice for both the boys and the girls.

A more complete listing of the topics college biology students believe should be included in a high school biology course is available in Table XXIV page 58.

TABLE XXIV

TOPICS COLLEGE BIOLOGY STUDENTS BELIEVE SHOULD BE INCLUDED IN A HIGH SCHOOL BIOLOGY COURSE*

	PERCENT BOYS		PERCENT GIRLS
Reproduction	82	Reproduction	86
Human body	72	Life processes	84
Animals	62	Human body	82
Cells	58	Animals	81
Plants	54	Plants	80
Diseases	48	Diseases	57
Life processes	44	Heredity	46
Heredity	40	Evolution	42
Conservation	28	Anatomy	38
Radiation	26	Conservation	32
Definition of terms	26	Physiology	30
Atomic Structure	25	Classification	29
Mutations	24	Body systems	26
Classification	23	Cytoloty	24
Ecology	22	Insects	20
Evolution	22	Health	19
Phyotosynthesis	21	Nature	18
Physiology	19	Mutations	17
Anatomy	18	Life cycles	16
Biochemistry	15	History of course	14

* Only items rated 1 - 20 are included in this table

COLLEGE PHYSICAL SCIENCE STUDENTS RATING OF CHARACTERISTICS OF THE SCIENCE TEACHER

The characteristic receiving the highest percentage of responses was the ability to explain clearly. Eighty per cent of the college physical science boys and eighty-eight per cent of the college physical science girls rated this item as having great importance.

Expert knowledge of subject matter rated second choice by frequency of response. Fifty-six per cent of the girls and forty-six per cent of them preferred this characteristic.

Third choice for the boys was good speaking ability; forty-four per cent of the boys voted for this item. Third choice for the girls was systematic organization of subject matter, forty-two per cent rated this item as having great importance.

Last choice for the girls was tolerance toward student disagreement, only two per cent of the girls related that this characteristic had great importance. Sympathetic attitude toward students, and tolerance toward student disagreement, both received similar last place ratings by the boys.

A more complete tabulation of the data concerning the characteristics of the effective science teacher as rated by college physical science students is available in Table XXV page 60.

The college physical science students were also asked to rate their high school science teachers as above average, average, or below average. Forty-two per cent of the girls and forty per cent of the boys rated their high school science teachers above average.

TABLE XXV

CHARACTERISTICS OF THE EFFECTIVE SCIENCE TEACHER AS RATED BY 410 COLLEGE PHYSICAL SCIENCE STUDENTS*

		Great Importance Percent Rating	Great Importance Percent Rating	Great Importance Percent Rating
Ability to explain clearly	Boys	80	20	0
	Girls	88	12	0
Expert knowledge of subject matter	Boys	46	32	22
	Girls	56	32	12
Good speaking ability	Boys	44	46	10
	Girls	28	64	8
Enthusiastic attitude toward subject	Boys	42	38	20
	Girls	26	48	26
Systematic organization of subject matter	Boys	20	62	18
	Girls	42	36	22
Ability to encourage thought	Boys	32	48	20
	Girls	26	60	14
Pleasing personality	Boys	24	34	42
	Girls	14	42	44
Fairness in making and grading tests	Boys	8	66	26
	Girls	12	48	40
Sympathetic attitude toward students	Boys	2	18	80
	Girls	6	20	74
Tolerance toward student disagreement	Boys	2	36	62
	Girls	2	38	60

* NOTE: This table should be read as follows: Eighty per cent of the boys rated ability to explain clearly as being an item of great importance.

Forty-six per cent of the boys and thirty-eight per cent of the girls rated them as average. Only fourteen per cent of the boys and twenty per cent of the girls thought their high school science teachers to be below average.

PERFERENCE AS TO TEACHING PROCEDURE

Demonstrations were rated most frequently as the teaching procedure preferred by both the college physical science boys and girls. Eighty-two per cent of the boys and eighty-four per cent of the girls responded to the above procedure.

By frequency of response, lecture rated as second place. Fifty-six per cent of the girls and fifty-two per cent of the boys voted for this method.

Laboratory rated as third choice for the boys while oral discussion had the same rating for the girls.

Fourth choice for the boys was field trips. The same percentage of the girls responded to both field trips and laboratory for their fourth choice.

Workbooks received an eighth place rating by the girls and a ninth place rating by the boys. Panel discussion rated in last place for the girls while the boys voted for special assignments as their final choice.

A more complete listing of the data concerning the teaching procedures preferred by college physical science students is available in Table XXVI page 62.

TABLE XXVI

PREFERENCE OF TEACHING PROCEDURE AS RATED BY

410 COLLEGE PHYSICAL SCIENCE STUDENTS*

		Choice 1-3 Percent Rating	Choice 4-7 Percent Rating	Choice 8-10 Percent Rating
Demonstrations	Boys	82	14	4
	Girls	84	14	2
Lecture	Boys	52	42	6
	Girls	56	28	16
Laboratory	Boys	50	38	12
	Girls	32	44	24
Oral discussion	Boys	34	52	14
	Girls	48	42	10
Field trips	Boys	48	44	8
	Girls	32	50	18
Recitation	Boys	10	50	40
	Girls	16	58	26
Special assignments	Boys	4	44	52
	Girls	14	36	50
Panel discussion	Boys	10	48	42
	Girls	4	34	62
Workbooks	Boys	8	46	46
	Girls	8	48	44
Special reports	Boys	2	22	76
	Girls	6	46	48

* NOTE: This table should be read as follows: Eighty-two per cent of the boys rated Demonstrations as first, second, or third choice. Fourteen per cent rated the item as fourth through seventh choice and four per cent rated the factor as eighth through ten choice.

ATTITUDES TOWARD SCIENCE COURSES

The evaluation of science courses by the college physical science students illustrated a wide difference of opinion. Eighteen per cent of the boys and thirty per cent of the girls believed that science courses are hard. Sixty-four per cent of the boys and forty-two per cent of the girls related they were generally hard. Rating science courses seldom hard were twelve per cent of the boys and girls. Only six per cent of the boys and sixteen per cent of the girls related that science courses were not hard. A more complete analysis of the data is revealed in Table XXVII page 64.

The belief that science was not interesting was illustrated by zero per cent of the boys and two per cent of the girls. The percentage that thought science was generally not interesting was only two per cent of both the boys and girls. Twenty-six per cent of the boys and sixteen per cent of the girls thought it is seldom true that science is not interesting. The largest percentage, seventy-two per cent of the boys and eighty per cent of the girls thought that science was interesting.

The opinion that science has no value for nontechnical students received zero per cent of the girls' vote and two per cent of the boys' responses. Six per cent of the girls and zero per cent of the boys believed that generally science has no value for nontechnical students. Ten per cent of the girls and eight per cent of the boys related that science seldom has any value for nontechnical students. The largest percentage, ninety per cent of the boys and eighty-four

TABLE XXVII

OPINIONS OF 410 COLLEGE PHYSICAL SCIENCE

STUDENTS REGARDING SCIENCE COURSES*

		Percent True	Percent Generally True	Percent Seldom True	Percent False
Science courses are hard	Boys	18	64	12	6
	Girls	30	42	12	16
Science is not interesting	Boys	0	2	26	72
	Girls	2	2	16	80
Science has no value for nontechnical students	Boys	2	0	8	90
	Girls	0	6	10	84
Students want easy courses	Boys	32	34	24	10
	Girls	36	40	6	18
Students are afraid of science	Boys	8	48	26	18
	Girls	50	30	10	10
Science courses require too much work	Boys	2	14	56	28
	Girls	0	28	36	36
Science courses are too	Boys	6	10	48	36
	Girls	10	24	32	34

* NOTE: This table should be read as follows: Eighteen per cent of the boys thought science courses to be hard, sixty-four per cent thought they were generally hard, twelve per cent thought they were seldom hard and six per cent did not think they were hard.

per cent of the girls thought science has a value for nontechnical students.

About one-third of the students, thirty-two per cent of the boys and thirty-six per cent of the girls related that students want easy courses. The boys believing that students generally want easy courses totaled thirty-four per cent. Forty per cent of the girls gave the same response. The attitude that students seldom prefer easy courses was demonstrated by twenty-four per cent of the boys, six per cent of the girls agreed with this. Ten per cent of the boys and eighteen per cent of the girls related that students do not want easy courses.

One half of the girls and eight per cent of the boys believed that students are afraid of science. Forty-eight per cent of the boys and thirty per cent of the girls agree that students are generally afraid of science. The data indicates that twenty-six per cent of the boys and ten per cent of the girls assumed that students seldom are afraid of science. Eighteen per cent of the boys and ten per cent of the girls related that students are not afraid of science.

Voting that science courses require too much work were two per cent of the boys and zero per cent of the girls. Students' presuming that science courses generally require too much work totaled fourteen per cent of the boys and twenty-eight per cent of the girls. Science courses seldom require too much work received a favorable response from fifty-six per cent of the boys and thirty-six per cent of the girls. Twenty-eight per cent of the boys and thirty-six per cent of the girls related that science courses do not require too much work.

The point of view held by six per cent of the boys and ten per cent of the girls was that science courses are to extensive and complicated. Ten per cent of the boys and twenty-four per cent of the girls agree that science courses generally are too complicated and extensive. By their response, forty-eight per cent of the boys and thirty-two per cent of the girls presumed that science courses are seldom too extensive and complicated. Correlated with the same idea thirty-six per cent of the boys and thirty-four per cent of the girls affirmed that they did not believe that science courses were to extensive or complicated.

A large percentage of the college physical science students believed that physical science should be a required course in college. This was affirmed by ninety-two per cent of the boys and eighty-eight per cent of the girls.

The responses summarized in Table XXVIII illustrate that twenty-four per cent of the girls, and eighteen per cent of the boys believed that physical science should be a required course because it will be used in later life. The data also conveyed that forty-six per cent of the boys believed that it helps to fill in their background of knowledge. Twenty per cent of the girls and sixteen per cent of the boys thought it better explains the environment.

Only eight per cent of the boys and twelve per cent of the girls related that physical science should not be a required course in college. The specific reason that everyone may not need to take a course in physical science was projected by six per cent of the

TABLE XXVIII

REASONS WHY COLLEGE PHYSICAL SCIENCE STUDENTS BELIEVE PHYSICAL SCIENCE SHOULD BE A REQUIRED COURSE IN COLLEGE

	PERCENT BOYS		PERCENT GIRLS
Fill in background	46	Improves general knowledge	28
Use in later life	18	Useful in everyday life	24
Better explains environment	16	Better explains environment	20
Explains everyday happenings	8	Increases interest	10
Very interesting	4	Improves vocabulary	6

TABLE XXIX

REASONS WHY COLLEGE PHYSICAL SCIENCE STUDENTS DO NOT BELIEVE PHYSICAL SCIENCE SHOULD BE A REQUIRED COURSE IN COLLEGE

	PERCENT BOYS		PERCENT GIRLS
Not interesting	4	May not need	6
Use time in major	4	Should have choice of subjects	4
		Use time in major	2

girls. Four per cent of the boys and two per cent of the girls related they could better spend the time in their major field.

SIGNIFICANT TOPICS

The range of response shown in Table XXX page 70 indicated a wide variation in science interests among college physical science students.

As a topic, college physical science students believe should be included in a general science course in high school, chemistry rated as first place for the boys, while geology was first choice for the girls. Chemistry was second choice for the girls, while electricity was second choice for the boys.

Physics was third choice for the boys, while it was seventh choice for the girls. Weights and measures was third choice for the girls, while this topic was fifteenth choice for the boys.

Weather was considered an interesting topic by both the boys and girls; it was rated by sixty-two per cent of the boys, and sixty per cent of the girls.

Astronomy was fifth choice for the girls while it was eighth choice for the boys. Table XXX reaffirms that students interests vary considerably. All of the responses from the questionnaire concerning significant topics were tabulated. However, only the twenty topics of greatest interest were included in the data for this chapter.

TABLE XXX

TOPICS COLLEGE PHYSICAL SCIENCE STUDENTS BELIEVE SHOULD BE INCLUDED IN A HIGH SCHOOL GENERAL SCIENCE COURSE*

	PERCENT BOYS		PERCENT GIRLS
Chemistry	74	Geology	82
Electricity	68	Chemistry	78
Physics	66	Weights-measures	68
Weather	62	Weather	60
Atoms	56	Astronomy	54
Radiation	54	Electricity	52
Gravity	46	Physics	48
Astronomy	44	Atmosphere	36
Space	38	Formation of earth	36
Geology	32	Conservation	34
Machines	31	Simple machines	31
Energy	30	Atomic structure	31
Universe	26	Space	30
Sound	24	Energy	29
Weights-measures	23	Radioactivity	28
Matter	22	Heat	25
Heat	18	Molecular laws	24
Compounds	16	Sound	22
Atomic research	15	Electronics	20
Atmosphere	14	Light	19

* Only items rated 1 - 20 are included in this table.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to evaluate, on the basis of student opinion:

1. The outstanding characteristics of the effective science teacher.
2. Student preferences as to teaching procedures.
3. The attitudes of students toward science courses.
4. The areas of science that students consider especially interesting and important.

The study was undertaken with the assumption that student opinions and reactions are valid to use as criteria in judging the suitability of science courses and the characteristics of the effective science teacher.

Questionnaires were prepared and submitted to 2098 junior high, high school and college students. Because of certain differences, the same questionnaire could not be used for all four groups. Instead, four similar and comparable questionnaires were prepared, one to fit each situation.

The outcomes of this study indicate that student opinions are of value in assessing science courses and science teachers. It should be recognized, however, that the finding of this study concern a limited number of schools within a local area. There seems to be little justification for attempting to draw conclusions with regard to the total science picture in the state of Kansas. However, the data collected from this close look and "first hand" contact with the

schools does seem to provide a kind of index to the attitudes of the students over the state.

To simplify the discussion of the results, the items covered in the questionnaire have been divided into several categories. Each item will be considered separately.

Characteristics of the Science Teacher

A list of ten characteristics of the effective science teacher was provided in the questionnaire. The students were asked to rank in order from one through ten the characteristics they considered most important. The items were then grouped in the tabulation. Items rated first through third choice were believed to have great importance. Items receiving fourth through seventh choice received medium importance, while items rated eight through ten were believed to have little significance.

The ability to explain clearly was most frequently mentioned as an item of great importance by all of the groups except the eighth grade science students. The item most frequently mentioned by the eighth grade students as having great importance was expert knowledge of subject matter. The ability to explain clearly was second most important., All of the groups, except the eighth grade, rated expert knowledge of subject matter as their second choice.

Good speaking ability received third place as an item checked most frequently by all of the groups except the seventh and eighth grade. The eighth grade science students responded to pleasing personality as their third choice, while the seventh grade chose

fairness in making and grading tests.

The fourth most commonly checked item regarding the characteristics of the effective science teacher by all of the groups, except the seventh grade students, was enthusiastic attitude toward subject; the seventh grade chose good speaking ability.

Diversity is noted in the fifth choice regarding the characteristics of the science teacher. The seventh grade chose the ability to encourage thought, the eighth grade and high school biology students responded to fairness in making and grading tests, while the college biology students and college physical science students chose systematic organization of subject matter.

The college biology students and college physical science students were asked to rate their high school science teachers as above average, average, or below average. Forty per cent of the college physical science students thought their high school science teachers to be better than average teachers, forty-eight per cent thought they were average teachers, and twelve per cent thought they were below average teachers. Forty-one per cent of the college biology students thought their high school science teachers to be better than average teachers, forty-two per cent thought they were average teachers, and seventeen per cent thought they were below average teachers.

Preference as to Teaching Procedure

A list of ten teaching procedures were provided in the questionnaire. The students were asked to rank in order from one through

ten their favorite teaching procedures.

Demonstrations were rated most frequently as the teaching procedure preferred by all of the groups except the seventh grade science students. The laboratory was most frequently mentioned by the seventh grade students as their favorite teaching procedure.

Field trips was the second most preferred method as rated by all of the groups except the eighth grade students and college physical science students. The laboratory was second choice for the eighth grade students while lecture was preferred by the college physical science students.

The laboratory was the third most frequently mentioned procedure by the high school biology students, college biology students, and college physical science students. Demonstrations were third choice for the seventh grade students while the eighth grade held field trips as their third choice.

Oral discussion was the fourth most frequently mentioned procedure by all of the groups except the college biology students, lecture was their fourth choice.

Panel discussion received fifth choice by frequency of response with the seventh and eighth grade science students. Recitation was fifth choice for the high school biology students, while oral discussion was preferred by the college biology students.

All of the students except the college physical science students rated workbooks as their tenth choice; they rated them as ninth choice.

Attitudes Regarding Science Courses

Seven statements regarding science courses were included in the questionnaire. The students were asked to indicate their opinion by checking the statements true, generally true, seldom true, or false.

The data concerning the responses of students regarding science courses shows a wide diversion of opinions. However, a very high percentage of the students believe that the study of science is valuable, interesting and important for all students.

Seventy per cent of the students that responded agreed that science courses are hard; although in this connection, it cannot be overlooked that thirty per cent agreed that students want easy courses. Ninety per cent of the students believed that science is interesting. The belief that science has no value for nontechnical students was held by only a small fraction of the responses.

Only ten per cent of the students related that science courses require too much work while thirteen per cent believe that science courses are too extensive and complicated.

When asked if they thought the science course they were enrolled in should be required, eighty per cent or more responded in the affirmative.

The most frequently mentioned reason why the science course that they were enrolled in should be required, was that science will be needed in later life. The next most frequently mentioned reason was that science better explains nature.

As a topic to be included in a high school general science

course space was first choice with the eighth grade girls; while it was third choice for the seventh grade girls. The human body was rated as second place by the eighth grade girls and fifth choice for the seventh grade girls.

The eighth grade boys rated the human body as third choice while it was sixth choice for the seventh grade boys.

The topics college physical science students and seventh and eighth grade science students believe should be included in a general science course in high school compare rather favorably. Chemistry was first place for college physical science boys, second place for college physical science girls, and seventh grade girls, fourth place for seventh grade boys, and eighth grade girls, and twelfth choice for eighth grade boys.

As a topic to be included in high school biology reproduction was first choice for the high school girls and second choice for the high school boys. Both the college biology boys and girls rated reproduction as first choice as a topic to be included in college biology.

The human body was rated as the second topic by high school girls and college boys. It was third choice for the college girls.

It seems feasible to say on the basis of the study that all four groups of respondents are in general most interested in two areas. First, that area concerning information about themselves and their personal welfare--topics such as reproduction, heredity, the human body and the nature and control of disease. The other area of

particular interest deals with those things of current importance in everyday life. Such an area includes the nature and control of matter and energy and the basic principles of physics and chemistry, new advancements in space and a multitude of other things related to chemical and radiant energy and their relation to life in todays' unsettled world. Noticeably of less interest, as indicated in this study are the topics fossils, biophysics, embryology, insects, nutrition and foods.

This study has substantiated the feasibility of establishing descriptive models of persons engaged in secondary school science teaching.

There is no royal road to learning, but there are techniques of imparting information and of effecting growth of pupils which are more efficient than other methods. It behooves those who are in the field of education to employ the methods which have been found to be most effective in the light of our scientific studies in teaching procedure.

There is no one best method, but the teacher should utilize the best portion of each of the methods, and adapt these procedures to the problem at hand and to the personality of the teacher.

In view of the indications from this study, it would be interesting to study further why students say that science courses are too hard and demanding. Is science necessarily hard? If so, can youth be challenged to the difficult; or if they are not necessarily hard, how have we made them hard and how do we avoid making them

unnecessarily difficult?

It is recommended that additional research be instituted utilizing similar instruments but applying them to varying populations.

It seems that further investigation in the areas of significant topics, perhaps by more refined methods, would be profitable. The result of such studies should definitely influence the content of science courses, particularly those which are a part of a general education program.

APPENDIX

SEVENTH AND EIGHTH GRADE QUESTIONNAIRE

Age_____ Sex_____

I am in Seventh grade_____, Eighth grade_____, Ninth grade_____, Sophomore_____. The subject I like best is_____. The Science Courses I have taken or am taking are General Science_____, Others (write in)_____

List in the order of your preference the characteristics of a good science teacher. Starting with number one as the more important and proceeding to ten with items of lesser importance.

_____ Good speaking ability
_____ Ability to explain clearly
_____ Ability to encourage thought
_____ Systematic organization of subject matter
_____ Sympathetic attitude toward students
_____ Expert knowledge of subject
_____ Enthusiastic attitude toward subject
_____ Fairness in making and grading tests
_____ Tolerance toward student disagreement
_____ Pleasing personality

List in the order of your preference the classroom procedure you prefer. Start with your favorite as number one and proceed to ten with items you like.

_____ Field trips
_____ Demonstrations
_____ Lecture
_____ Recitation
_____ Oral discussion (teacher directed)
_____ Special Assignments
_____ Panel discussion by students
_____ Special oral reports
_____ Workbooks
_____ Laboratory

Make a checkmark in the spaces provided on the right of the page that gives your opinion of the statements below.

	True	Generally true	Seldom True	False
Science courses are hard	_____	_____	_____	_____
Science is not interesting	_____	_____	_____	_____
Science has no value for non-technical vocations	_____	_____	_____	_____
Students want easy courses	_____	_____	_____	_____
Students are afraid of science	_____	_____	_____	_____
Science courses require too much work	_____	_____	_____	_____
Science courses are too extensive and complicated	_____	_____	_____	_____

Do you believe everyone should take a general science course?

(Yes or No) _____

If your answer to the above question was yes briefly explain why.

_____

_____

_____

_____

If your answer to the above was no briefly explain why.

_____

_____

_____

_____

What areas or topics <u>should</u> be included in a high school course in general science?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

HIGH SCHOOL BIOLOGY QUESTIONNAIRE

Age _____ Sex _____

I am a Senior _____, Junior _____, Sophomore _____, Freshman _____, The subject I like best is _____. The Science Courses I have taken or am taking in High School are: General Science _____, Biology _____, Physics _____, Chemistry _____, Others (Write in) _____

List in the order of your preference the characteristics of a good science teacher. Starting with Number one as the more important and proceeding to ten with items of lesser importance.

_____ Good speaking ability
_____ Ability to explain clearly
_____ Ability to encourage thought
_____ Systematic organization of subject matter
_____ Sympathetic attitude toward students
_____ Expert knowledge of subject
_____ Enthusiastic attitude toward subject
_____ Fairness in making and grading tests
_____ Tolerance toward student disagreement
_____ Pleasing personality

List in the order of your preference the teaching procedure you prefer. Starting with your favorite as number one and proceeding to ten with items you like less.

_____ Field trips
_____ Demonstrations
_____ Lecture
_____ Recitation
_____ Oral discussion (teacher directed)
_____ Special assignments
_____ Panel discussion by students
_____ Special oral reports
_____ Workbooks
_____ Laboratory

Make a checkmark in the spaces provided on the right of the page that gives your opinion of the statements below.

	True	Generally true	Seldom True	False
Science courses are hard	___	___	___	___
Science is not interesting	___	___	___	___
Science has no value for non-technical vocations	___	___	___	___
Students want easy courses	___	___	___	___
Students are afraid of science	___	___	___	___
Science courses require too much work	___	___	___	___
Science courses are too extensive and complicated	___	___	___	___

Do you believe everyone should take a course in biology? (Yes or No) _____

If your answer to the above question was yes briefly explain why.

_____
_____
_____
_____

If your answer to the above was no briefly explain why.

_____
_____
_____
_____

What areas or topics should be included in a high school course in Biology?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

COLLEGE BIOLOGY QUESTIONNAIRE

Age _____ Sex _____

I am a Senior _____, Junior _____, Sophomore _____, Freshman _____, in College. My major or best liked subject is _____.
The Science Courses I have taken (or am taking), in High School:
General Science _____, Biology _____, Physics _____, Chemistry _____,
Others (write in) _____.
in College: Physical Science _____, Biology _____, Others (write in)_____.
The approximate number of students in my high school graduating class was ___.

List in the order of your preference the characteristics of an effective science teacher. Starting with number one as the more important and proceeding to ten with items of lesser importance.

_____ Good speaking ability
_____ Ability to explain clearly
_____ Ability to encourage thought
_____ Systematic organization of subject matter
_____ Sympathetic attitude toward students
_____ Expert knowledge of subject
_____ Enthusiastic attitude toward subject
_____ Fairness in making and grading tests
_____ Tolerance toward students disagreement
_____ Pleasing personality

According to your "ideal" teacher please rate your high school science teacher as average, above average, or below average. _____

List in the order of your preference the teaching procedure you prefer, starting with your favorite as number one.

_____ Field trips
_____ Demonstrations
_____ Lecture
_____ Recitation
_____ Oral discussion (teacher directed)
_____ Special assignments
_____ Panel discussion by students
_____ Special oral reports
_____ Workbooks
_____ Laboratory

Check, in the spaces provided on the right, your opinion of the statements below.

	True	Generally true	Seldom true	False
Science courses are hard	_____	_____	_____	_____
Science is not interesting	_____	_____	_____	_____
Science has no value for non-technical vocations	_____	_____	_____	_____
Students want easy courses	_____	_____	_____	_____
Students are afraid of science	_____	_____	_____	_____
Science courses require too much work	_____	_____	_____	_____
Science courses are too extensive and complicated	_____	_____	_____	_____

Do you believe everyone should take a biological science course? (Yes or No) _____

If your answer to the above question was yes briefly explain why.

_____

_____

_____

_____

If your answer to the above was no briefly explain why.

_____

_____

_____

_____

What areas or topics should be included in a high school course in Biology?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

COLLEGE PHYSICAL SCIENCE QUESTIONNAIRE

Age _____ Sex _____

I am a Senior _____, Junior _____, Sophomore _____, Freshman _____, in College. My major or best liked subject is _____.
The Science Courses I have taken (or am taking), in High School:
General Science _____, Biology _____, Physics _____, Chemistry _____,
Others (write in) _____.
in College: Physical Science _____, Biology _____, Others (write in) _____.
The approximate number of students in my high school graduating class was ___.

List in the order of your preference the characteristics of an effective science teacher. Starting with number one as the more important and proceeding to ten with items of lesser importance.

_____ Good speaking ability
_____ Ability to explain clearly
_____ Ability to encourage thought
_____ Systematic organization of subject matter
_____ Sympathetic attitude toward students
_____ Expert knowledge of subject
_____ Enthusiastic attitude toward subject
_____ Fairness in making and grading tests
_____ Tolerance toward students disagreement
_____ Pleasing personality

According to your "ideal" teacher please rate your high school science teacher as average, above average, or below average. _____

List in the order of your preference the teaching procedure you prefer, starting with your favorite as number one.

_____ Field trips
_____ Demonstrations
_____ Lecture
_____ Recitation
_____ Oral discussion (teacher directed)
_____ Special assignments
_____ Panel discussion by students
_____ Special oral reports
_____ Workbooks
_____ Laboratory

Check, in the spaces provided on the right, your opinion of the statements below.

	True	Generally True	Seldom True	False
Science courses are hard	_____	_____	_____	_____
Science is not interesting	_____	_____	_____	_____
Science has no value for non-technical vocations	_____	_____	_____	_____
Students want easy courses	_____	_____	_____	_____
Students are afraid of science	_____	_____	_____	_____
Science courses require too much work	_____	_____	_____	_____
Science courses are too extensive and complicated	_____	_____	_____	_____

Do you believe everyone should take a physical science course in college? (Yes or No) _____

If your answer to the above question was yes briefly explain why.

_____
_____
_____
_____

If your answer to the above was no briefly explain why.

_____
_____
_____
_____

What areas or topics <u>should</u> be included in a high school or junior high school General Science course? <u>Do not</u> include topics that are biological

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

LITERATURE CITED

Ahrens, Edward H. 1950. The validity of the questionnaire. Science Education. 34:41-42.

Allen, Hugh. 1959. Study of attitudes. Science Teacher. 26:469-470.

Black, E.E. and H.F. Glidden. 1953. A study of student opinion concerning survey courses in natural science. Science Education. 37:187-192.

Bullington, Robert A. 1950. A study of student opinion of college general education science courses. Science Education. 34:73-78.

Crouch, H.B., and C.M. Leathers. 1951. The validity of student opinions in evaluating a program of college biology. Science Education. 35:73-76.

Frazer, Thomas P. 1955. A study of the opinion of students on college general education science. Science Education. 39:213-219.

Haun, R.R. 1959. Students reactions to high school science. Science Education. 43:45-50.

Wilson, Leland L. 1954. A study of opinions related to the nature of science and its purpose in society. Science Education. 38:159-164.

Winier, Leonard. 1954. Student evaluation of teaching procedures in biology. Science Teacher. 21:123-125.

Winier, Leonard. 1957. A study of the science programs in twelve Iowa High Schools. Science Education. 41:181-190.