A STUDY OF THE RELATIONSHIPS BETWEEN ACHIEVEMENT IN HIGH SCHOOL BIOLOGY AND APTITUDE, INTELLIGENCE, INTEREST, ACHIEVEMENT, AND SEX

by 45

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INTRODUCTION TO THE PROBLEM

An important consideration in the development of new curriculum programs is the relations between student characteristics and achievement by the student in these programs. The newer curricular approaches to the teaching of high school biology may reflect new relations between student characteristics and achievement in biology.[1] The extent of these relations is not fully known and may vary.

I. THE PROBLEM

Statement of the problem. The purpose of this study was to investigate the relationships between the achievement of students in a selected high school biology program, Biological Sciences Curriculum Study Green Version, and various measures of interest, aptitude, intelligence, achievement, and sex. More specifically the primary consideration of this study was to test the following hypothesis:

H: There is no significant relation between achievement in biology as measured by final grade and the following criteria:

1. Sex
2. Interest in science as measured by the Kuder

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[1] Ralph W. Cain, "An Analysis of Relationships Between Achievement in High School Biology and Mathematical Aptitude and Achievement," Science Education, 51:255, April, 1967.

Preference Record--Vocational.

3. Scientific achievement in junior high school.
4. Scholastic achievement in junior high school.
5. Intelligence as measured by the Otis Quick-Scoring Mental Ability Test, Form AMI.
6. Verbal reasoning aptitude as measured by the Differential Aptitude Test of Verbal Reasoning.
7. Mathematical aptitude as measured by the Differential Aptitude Test of Numerical Ability.
8. General scholastic aptitude as measured by the combined scores of the Differential Aptitude Test of Verbal Reasoning and the Differential Aptitude Test of Numerical Ability.
9. Aptitude in biological science as measured by the Processes of Science Test, before a course in biology.
10. Aptitude in biological science as measured by the Processes of Science Test, after a course in biology.

Need for the study. The Biological Sciences Curriculum Study (BSCS) was established by the American Institute of Biological Sciences, a professional society representing 85,000 biologists, in 1959 as a means of contributing to the improvement of secondary school biological education. The

primary approach throughout the work of BSCS has been to emphasize investigation and inquiry as means of acquiring significant knowledge in science. The materials produced by BSCS comprise a number of different approaches to the study of high school biology, regardless of the students' aptitudes or career goals.[2]

From the beginning BSCS emphasized the following objectives:

1. An understanding of the diversity of life and of the interrelations of all organisms.
2. An understanding of the nature of scientific inquiry.
3. An understanding of the limitations of science and of the scientific method.
4. An understanding of the biological basis of problems in medicine, public health, agriculture, and conservation.
5. An appreciation of the beauty, drama, and tragedy of the living world.
6. An understanding of the history of biological concepts.
7. An understanding of what biologists currently

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[2]Joseph J. Schwab, Biology Teachers' Handbook: BSCS (New York: John Wiley and Sons, Inc., 1963), p. 8.

know regarding the basic biological problems of evolution, development, and inheritance.

8. An understanding of man's own place in the scheme of nature.[3]

In order to evaluate their objectives, BSCS emphasized testing programs which examined the higher mental abilities of students, such as comprehension, analysis, synthesis, application of facts, and the understanding of the methods of science rather than the mere memorization of facts.[4] Various abilities and aptitudes of the student could very well affect his success in achieving the BSCS objectives.

If achievement in biology could be affected by such student characteristics as sex, interest, intelligence, aptitude, and previous achievement, one might ask what relationship exists between these student characteristics and achievement in biology. This is a crucial question when viewed in the light of Burton E. Voss's prediction that for America, "In five years about 75% of our students will take some kind of BSCS biology."[5]

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[3]Biological Sciences Curriculum Study, High School Biology: BSCS Green Version, Teachers' Guide (Chicago: Rand McNally and Company, 1964), p. 5.

[4]Burton E. Voss, "The Impact of BSCS Biology," School Science and Mathematics, 67:145, February, 1967.

[5]Ibid., p. 148.

Assumptions and limitations. This report has certain limitations: (1) The total sample was taught by two teachers during the second semester. Though the students were ultimately under the direction of their regular teacher, the writer served as a student teacher with the students of this study. This could have caused some variations in student achievement, although the students' grades during the second semester were similar to the first semester. (2) Administration times of aptitude, intelligence, and interest measures were not uniform. For most students, these measures were administered during the last year of junior high school (ninth grade); however, for some students the time of administration of the measures varied from the first year in junior high school (seventh grade) to the sophomore year in high school (tenth grade).

It is assumed that the teacher assigned final grade is a valid criterion for achievement in biology.

II. DEFINITIONS OF TERMS USED

BSCS Green Version biology. All three versions of BSCS biology are based on the assumption that for the majority of students this will be their only formal exposure to biology as a science.[6] With this in mind the Green Version

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[6]Schwab, op. cit., p. 8.

was designed to approach the objectives of BSCS with this frame of reference.

REVIEW OF THE LITERATURE

Previous to the development of newer curriculum programs, data on relations between achievement in secondary school science and student characteristics was incomplete and not applicable to many of the varied science programs offered in the schools. The development of BSCS materials created a standardized curriculum against which one could evaluate achievement and other factors of success in biology.[7] Beginning with the 1960-62 and 1962-63 Evaluation Programs of BSCS, increasing quantities of data became available for the study of achievement in biology.

I. INTEREST

Kuder measure of interest. The relation between interest and achievement in science is neither clearly known or understood. Frank Bernhardt, in comparing scientific interest with achievement in junior high school science, found a positive correlation between interest and science grades; however, the correlation was significant for males

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[7]Cain, op. cit., p. 255.

only.[8] Using the Kuder Preference Record--Vocational, Louis Barrilleaux found a high, positive, and significant relation between relative intensity of science interest and the probability of success in high school science.[9] He recommended that the scientific interest measure be employed as a ". . . differentiating factor in the identification of the more capable students."[10] Vincent Calia also found the Kuder measure of interest to be related to scientific achievement in junior college. He found significant relations between interest and scholastic success, and was able to use the extent of interests to predict achievement.[11] The findings of Gerald Hanna, however, seem to indicate that the Kuder measure of interest may not be a reliable predictor of achievement in science. His investigation showed that the scientific scale of the Kuder correlated significantly, but

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[8]Frank L. Bernhardt, "Factors Predicting Seventh Grade Students' Interest for and Achievement in Science," (unpublished Doctoral Dissertation, in Dissertation Abstracts, 27:322, 1966.)

[9]Louis E. Barrilleaux, "High School Science Achievement as Related to Interest and I. Q.," Educational and Psychological Measurement, 21(4):935, 1961.

[10]Ibid., p. 935-36.

[11]Vincent F. Calia, "The Use of Discriminant Analysis in the Prediction of Scholastic Performance," Personnel and Guidance Journal, 39:189, November, 1960.

negatively, with achievement in high school geometry.[12]

II. INTELLIGENCE

Otis measure of intelligence. William Coleman and Edward Cureton in studying the relation between intelligence, as measured by the Otis Quick Scoring Mental Ability Test, and achievement, as measured by Stanford Achievement Tests, discovered a high correlation between achievement and intelligence.[13] In fact, achievement and intelligence may be essentially the same measures. Coleman and Cureton concluded that ". . . the school achievement test may well permit better inferences about differences in native capacity than can be made on the basis of the group intelligence test (insofar as there are any differences at all)."[14]

III. APTITUDE

DAT measures of aptitude. Studies seem to show a high degree of correlation between Differential Aptitude Test (DAT)

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[12]Gerald S. Hanna, "An Attempt to Validate an Emperically-Derived Interest Scale and Standard Kuder Scales for Predicting Success in High School Geometry," Educational and Psychological Measurement, 26:446, Summer, 1966.

[13]William Coleman and Edward E. Cureton, "Intelligence and Achievement: The 'Jange Fallacy' Again," Educational and Psychological Measurement, 14:348, 1954.

[14]Ibid., p. 350.

measures of Verbal Reasoning (VR), Numerical Ability (NA), and achievement in biology. The measures of verbal reasoning and numerical ability were among the best predictors of achievement in high school science courses.[15] In fact, the evidence is strong that there are many courses ". . . which actually require the kinds of abilities which the DAT measures.[16]

In a study comparing achievement in BSCS biology with DAT measures of aptitude, George Hollenbeck discovered high relations between these criteria. The scholastic aptitude scale, as measured by the combined Verbal Reasoning and Numerical Ability (VR + NA) measures, was the best predictor of achievement. The Verbal Reasoning test alone was the next best predictor followed by the Numerical Ability test.[17] Hollenbeck's study supports the data of Hulda Grobman who found the DAT VR + NA to be the best predictor of achievement in BSCS biology, followed by the DAT VR and the DAT NA.[18]

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[15]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, "The Differential Aptitude Tests: An Overview," Personnel and Guidance Journal, 35:85, October, 1956.

[16]Ibid.

[17]George P. Hollenbeck, "Predicting High School Biology Achievement with the Differential Aptitude Tests and the Davis Reading Test," Educational and Psychological Measurement, 27:440-41, 1967.

[18]Hulda Grobman, "Identifying the 'Slow Learner' in BSCS High School Biology," Journal of Research in Science Teaching, 3:7, 1965.

Grobman's study, however, was only concerned with average and below-average students. Ralph Cain, in a study comparing achievement in BSCS biology and DAT measures of aptitude, found significant relationships between DAT NA scores and achievement.[19] His recommendations included suggesting that ". . . special remedial classes for students of low mathematical aptitude might be made prerequisite to enrollment in a biology course of the BSCS type."[20]

Though many studies indicate a high relation when verbal and mathematical aptitudes are correlated with achievement in science during high school, these studies may not reflect a valid relationship when achievement is measured in terms of success in college. Gladys Kleinman's study; which correlated aptitudes of Physical Science Study Committee Physics (PSSC) students' aptitudes with academic achievement in first year college physics, indicated the ". . . existence and importance in academic achievement of factors other than mathematical and verbal aptitudes."[21]

POST measures of aptitude. The Processes of Science Test (POST) was designed to measure the processes of science

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[19]Cain, op. cit., p. 258.

[20]Ibid., p. 259.

[21]Gladys S. Kleinman, "Aptitude and Achievement: Differences at the Top," Science, 150:554, October 29, 1965.

and is content-free in that it is not tied to the factual knowledge of biology that would be unique to any one biology course. Correlations between POST scores and achievement in BSCS biology, as reported in the POST Manual, compare favorably with correlations between DAT scores and achievement in biology.[22] Hulda Grobman, in studying average and below average students, found correlations between POST scores and achievement BSCS biology that supported the data in the POST Manual.[23]

EXPERIMENTAL PROCEDURES

The purpose of this study was to determine the relationship between achievement in biology with various measures of interest, intelligence, aptitude, achievement, and sex, and to ascertain whether differences between these measures are significant.

I. DESIGN OF THE STUDY

Students used in the study. Sophomore students were used in this study. A majority of the students had had at least two years of junior high school science; moreover, a

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[22]Biological Sciences Curriculum Study, "Manual for the Processes of Science Test," New York: The Psychological Corporation, p. 8, 1965.

[23]Grobman, op. cit., p. 8.

minority had taken advanced science during their ninth grade of junior high. An analysis of previous or concurrent education in mathematics was not made. No distinction was made between students concerning the extent of previous science or mathematics courses taken.

School used in the experiment. For the purpose of carrying out the proposed study, the cooperation of the Topeka Public Schools, located at Topeka, Kansas was secured. At the time of the study there were 117 students in BSCS biology divided into five classes at Topeka West High School. The students were grouped into three classes of regular biology and two classes of accelerated biology as shown in Table I.

TABLE I

CLASS ASSIGNMENTS OF BSCS BIOLOGY STUDENTS

Class period	1	2	3	4	5	6	Total
Regular biology	24	23	0	30	0	0	77
Accelerated biology	0	0	0	0	21	19	40
Totals	24	23	0	30	21	19	117

Students in the accelerated biology classes covered the same material as the regular biology classes, but in greater depth. In this study, no distinctions were made between students in the regular classes of biology and the accelerated classes of biology. The material presented to the students

was taken from the textbook and accompanying laboratory manual, High School Biology: BSCS Green Version, compiled by the American Institute of Biological Sciences Biological Sciences Curriculum Study and published by Rand McNally & Company.

Data collected. The following data were collected for all students:

1. Sex of the students.
2. Measure of interest in science--score on the Scientific Interest Scale of the Kuder Preference Record--Vocational.
3. Measure of achievement in biology--teacher-assigned final grade, collected from school and teacher records.
4. Measure of achievement in junior high school science--mean teacher--assigned cumulative grade average in science and mathematics, collected from school records.
5. Measure of scholastic achievement in junior high school--mean teacher-assigned cumulative grade average, collected from school records.
6. Measure of intelligence--score on the Otis Quick-Scoring Mental Ability Test, Form AM.
7. Measure of verbal reasoning ability--score on the Differential Aptitude Test of Verbal Reasoning.

8. Meaure of mathematical aptitude--score on the Differential Aptitude Test of Numerical Ability.
9. Measure of general scholastic aptitude--combined scores of the Differential Aptitude Test of Verbal Reasoning and the Differential Aptitude Test of Numerical Ability.
10. Measure of aptitude in biological science before a course in biology--score on the Processes of Science Test, Form A.
11. Measure of aptitude in biological science after a course in biology--score on the Processes of Science Test, Form A.

Sex was coded by assigning boys the number 1.0 and assigning girls the number 2.0.

The measure of achievement in biology was computed by finding the mean grade average of the first and second semester final grades. The mean grade average was computed on the basis of a twelve point scale, with a grade of A in biology being the equivalent of twelve points, a grade of A- being worth eleven points, a grade of B+ being worth 10 points, and a grade of B being worth nine points. Grades of C, D, and F were assigned equivalent values of 6, 3, and 0 points respectively with a point being added for a plus grade and a point being subtracted for a minus grade.

The measures of achievement in junior high school

science and scholastic achievement in junior high school were computed on a four point scale with a grade of A being equivalent to four points, and grades B, C, D, and F being assigned equivalent values of 3, 2, 1, and 0 respectively; no distinction was made between plus and minus grades in the measures of junior high school achievement.

The Processes of Science Test, Form A was administered during the first week of the fall semester and during the last week of the spring semester.

Method of data analysis. For purposes of comparison and analysis the various measures of student characteristics and ability were arranged into four groups in which all measures were correlated. The measures were correlated for (1) the sample as a whole and then reordered according to (2) low, (3) average, and (4) high interest in scientific activities as measured by their score on the Kuder Preference Record--Vocational.

Since relationships between pairs of variables were the focus of interest in this study, some form of correlation analysis was suggested. Investigation of the data collected showed that all assumptions underlying the use of Pearson product-moment coefficients of correlation were satisfied. Values for significant differences in the four groups analyzed

were obtained from a statistical table.[24] The literature indicated that a .01 level of significance is ordinarily considered a high level of control and that a .10 is so low a level of control that it is seldom used in educational research. As a compromise between these two levels a .05 level of significance was used.[25] The Pearson product-moment coefficients of correlation were computed on a Control Data Corporation 1604 digital computer.

ANALYSIS OF THE RESULTS

The test of the hypothesis--that there is no significant relation between achievement in biology and various measures of interest, aptitude, intelligence, achievement, and sex--lies, as far as this study is concerned, in the comparisons of eleven criteria of student characteristics.

The measures of aptitude, intelligence, and scientific interest were objective. In the cases of achievement in biology, achievement in junior high school science, and junior high school scholastic achievement however, the scores recorded relied to a certain extent on the subjective

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[24] E. F. Lindquist, Statistical Analysis in Educational Research (New York: Houghton Mifflin Company, 1940). Table 13, p. 212.

[25] Charles Peccolo, The Effect of Thermal Environment on Learning: A Pilot Study, Iowa Center for Research in School Administration, (Iowa City, Iowa: University of Iowa), p. 13.

evaluation of the teachers assigning the grades.

I. ACHIEVEMENT

Achievement in biology. Table II shows that the mean score on achievement in biology for the total sample was 6.2607 or roughly a grade of C. When the students were grouped according to interest in science, small differences existed in scores of achievement in biology. Those included in the low scientific interest group had a mean score of 4.9375. The mean score for students with an average interest in science was 5.6207, while the mean score for students with a high interest in science was 7.6163. The variation between the achievement of the low interest group and the high interest group was 2.7 or approximately a variation from a grade of C- for the low interest group to a grade of B- for the high interest group.

TABLE II

MEANS AND STANDARD DEVIATIONS OF INTEREST GROUPINGS FOR ACHIEVEMENT IN BIOLOGY

Scientific Interest Group	Total Sample	Low Interest	Average Interest	High Interest
Mean	6.2607	4.9375	5.6207	7.6163
Standard deviation	3.1837	3.0049	3.0641	2.9858

II. INTEREST AND SEX

Sex correlations. There were no significant relations between the sex of the students and achievement in biology. The coefficient of correlation between sex and achievement in biology for the total sample was .1229 as shown in Table III. Scores of students with a low interest in science gave a correlation of .3494. The correlation for students with an average interest in biology was .2210, while a negative correlation of -.1331 existed for students with a high interest in science. Girls excelled boys in achievement in all groups except the high scientific interest group, though not significantly.

Kuder Preference Record--Vocational correlations. Considerable variation between correlations existed when scores on the Kuder Preference Record--Vocational were compared with achievement in biology. Among the four groupings the only significant correlation was a correlation of .2369 for the total sample as shown in Table III. The highest correlation among the four groupings was a negative correlation of -.4344 for scores of students with a low interest in science, though this correlation was not significant. Scores of students with an average interest in science gave a correlation of -.0890, which was the lowest correlation of the four groupings. Scores of students with a high interest in

TABLE III

CORRELATIONS OF SEX, INTEREST, ACHIEVEMENT, AND INTELLIGENCE WITH ACHIEVEMENT IN BIOLOGY

Scientific Interest Grouping	Total Sample	Low Interest	Average Interest	High Interest
Criteria				
Sex	.1229	.3494	.2210	-.1331
Kuder	.2369*	-.4344	-.0890	.1293
Science Achievement	.8493*	.9149*	.8795*	.7308*
Scholastic Achievement	.8344*	.9249*	.8857*	.6839*
Otis	.7117*	.7109*	.7487*	.5983*

*.05 level of significance.

science gave a correlation of .1293.

III. PREVIOUS ACHIEVEMENT

Science achievement in junior high school correlations. Significant correlations in all groupings were found when the students' grade point average in junior high school science was compared with achievement in biology. Table III shows a correlation of .8493 between junior high school science grade and achievement in biology for the total sample. Scores of students with a low interest in science gave a correlation of .9149. A correlation of .8795 existed for

scores of students with an average interest in science, while scores of students with a high interest in science gave a correlation of .7308. One can note that the students' scores in the high interest in science grouping gave the lowest correlation between grade in science and achievement in biology.

Scholastic achievement in junior high school correlations. The correlations between scholastic achievement in junior high school and achievement in biology, along with correlations between science achievement in junior high school and achievement in biology, gave the highest correlations of all criteria in relation to achievement in biology. Significant correlations between scholastic achievement and achievement in biology were found for all groupings. The total sample, as shown in Table III gave a correlation of .8345. Scores of the low interest in science grouping had a correlation of .9249. This was the highest correlation of all criteria compared with achievement in biology. A correlation of .8857 existed for scores of students with an average interest in science, while scores of students with a high interest in science gave a correlation of .6839.

IV. INTELLIGENCE

Otis Quick-Scoring Mental Ability Test correlations. Significant correlations were found between Otis Quick-Scoring Mental Ability Test scores and achievement in biology. Table III shows a significant correlation of .7117 for the total sample. The low scientific interest grouping had a correlation of .7109, while the average scientific interest group had a correlation of .7487. Both the low and average scientific interest groupings showed significant correlations. While the correlations of the total sample, low, and average scientific interest groupings were similar with only small differences, the high scientific interest grouping gave a correlation of .5983. This correlation was somewhat lower than the other correlations, though the high scientific interest group's correlation was also significant. Thus, all four groupings gave significant correlations.

V. APTITUDE

DAT Verbal Reasoning correlations. Scores on the Differential Aptitude Test of Verbal Reasoning gave a significant correlation of .7082 when compared with scores of achievement in biology by the total sample, as shown in Table IV. When the students were grouped according to interest in science, scores of those students with a low interest

in science gave a correlation of .4647, which was not significant. The groupings of average and high interest in science gave significant correlations. The group with an average interest in science gave a correlation of .7500, while the group with a high interest in science exhibited a correlation of .6553.

TABLE IV

CORRELATIONS OF APTITUDES WITH ACHIEVEMENT IN BIOLOGY

Scientific Interest Grouping	Total Sample	Low Interest	Average Interest	High Interest
Criteria				
DAT VR	.7082*	.4647	.7500*	.6553*
DAT NA	.7307*	.7893*	.7654*	.6482*
DAT VR + NA	.7686*	.6822*	.8288*	.6695*
POST I	.7716*	.6448*	.8080*	.6922*
POST II	.7516*	.6740*	.7823*	.6706*

*.05 level of significance.

DAT Numerical Abilities correlations. All groupings with respect to scientific interest showed significant correlations when scores on the Differential Aptitude Test of Numerical Abilities was compared with achievement in biology. The total sample gave a correlation of .7307 as shown in Table IV. Scores of students with a low interest in science

gave a correlation of .7893, while scores of students with an average interest in science gave a correlation of .7654. The lowest correlation of this criterion in the four groupings was a correlation of .6482 for students with a high interest in science.

DAT Verbal Reasoning plus Numerical Ability correlations. Measures of scholastic aptitude, as determined by the combined score of the Differential Aptitude Test of Verbal Reasoning and the Differential Aptitude Test of Numerical Ability, correlated significantly with achievement in biology in all four groupings. The total sample gave a correlation of .7686 as shown in Table IV. Small differences were found when the students were grouped according to scientific interest. Scores of students with a low interest in science gave a correlation of .6822. The highest correlation among the four groupings was a correlation of .8288 for students with an average interest in science, while students' scores with a high interest in science gave a correlation of .6695, the lowest correlation of the four groupings.

POST I correlations. Differences among groupings according to interest occurred when scores on the first administration (before a course in biology) of the Processes of Science Test were compared to achievement in biology, though all correlations were significant. The total sample gave a

correlation of .7716 as shown in Table IV. The lowest correlation among the four groupings was a correlation of .6448 for students with a low interest in science. The average scientific interest grouping gave a correlation of .8080, while the high scientific interest grouping gave a correlation of .6922.

POST II correlations. When scores on the second administration (after a course in biology) of the Processes of Science Test were compared to achievement in biology, significant correlations were found for all four groupings. The total sample gave a correlation of .7516 as shown in Table IV. Scores of students with a low interest in science gave a correlation of .6740. The highest correlation of the four groupings was given by the scores of students with an average interest in science, while scores of students with a high interest in science gave a correlation of .6706.

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the relationship between achievement in biology and various measures of interest, intelligence, aptitude, achievement, and sex.

I. PROCEDURE

Four groupings of students were used for comparison and analysis of the relation between various student characteristics and achievement in biology: (1) total sample; (2) students with a low scientific interest; (3) students with an average scientific interest; and (4) students with a high scientific interest. Correlations between various criteria and achievement in biology were computed within these four groupings.

II. SUMMARY OF RESULTS

Total sample. When students were grouped in the total sample, the measures of interest, intelligence, aptitude, and achievement gave significant correlations when compared with the students' grades in biology. However, there was no significant correlation between sex and biology grades.

Low interest. Biology grades of students grouped according to low scientific interest gave significant correlations when compared with measures of intelligence, achievement and aptitude.

Measures of interest, sex, and verbal reasoning ability gave no significant correlations when compared with biology grades.

Average interest. Biology grades of students grouped according to an average interest in science showed significant correlations between all measures of aptitude, achievement, and intelligence. Measures of sex and interest in science gave no significant correlations when compared with grades in biology.

High interest. Biology grades of students grouped according to a high interest in science gave significant correlations between all measures of aptitude, achievement, and intelligence. Measures of sex and interest in science gave no significant correlations when compared with grades in biology.

III. IMPLICATIONS

Rejection of the null hypothesis reveals that there is a significant relation between grades in biology and certain measures of achievement, aptitude, and intelligence; however, this study showed no significant relations between biology grades and measures of scientific interest and sex. The knowledge of these relations implies that these measures may have value in selecting students for accelerated and low ability biology classes. Further study may show which measures would be the most accurate predictors of success in high school biology.

Some suggestions for further study include:

1. The use of partial correlation techniques in analyzing the data to minimize the interrelationships among the variables.

2. Investigating the relation between socio-economic background and students' scores on the various measures of aptitude, intelligence, achievement, and interest.

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APPENDIX

TABLE V

THE CRITERION MEASURES

Item	Symbol	Measure and Brief Description
1	Sex	Boys assigned 1.0, girls assigned 2.0
2	Kuder	Scientific Interest Scale on Kuder Vocational Preference Inventory
3	Biograde	Achievement in Biology
4	GPA Sci	Achievement in Junior High School Science (Mean Grade Point Average)
5	GPA Ovl	Scholastic Achievement in Junior High School (Overall Grade Point Average)
6	Otis IQ	Intelligence
7	DAT VR	Verbal Reasoning Aptitude
8	DAT NA	Mathematical Aptitude
9	DAT VR + NA	General Scholastic Aptitude
10	POST I	Biological Science Aptitude (Before a biology course)
11	POST II	Biological Science Aptitude (After a biology course)

TABLE VI

GENERAL DATA FOR CRITERION MEASURES OF THE TOTAL SAMPLE (N = 117)

Criteria		Mean	Maximum	Minimum	Standard Deviation
1	Sex	1.4530	2.0000	1.0000	0.4999
2	Kuder	39.2393	69.0000	8.0000	13.6335
3	Biograde	6.2607	12.0000	0.0	3.1837
4	GPA Sci	2.6658	4.0000	0.8000	0.8909
5	GPA Ovl	2.7444	4.0000	0.8000	0.8484
6	Otis IQ	110.8376	134.0000	80.0000	12.0702
7	DAT VR	28.0085	45.0000	8.0000	9.8685
8	DAT NA	22.7607	38.0000	7.0000	7.5995
9	DAT VR+NA	50.5897	80.0000	16.0000	15.8936
10	POST I	23.2479	38.0000	7.0000	7.3166
11	POST II	28.7179	39.0000	8.0000	7.2598

TABLE VII

CORRELATIONS BETWEEN CRITERIA: TOTAL SAMPLE
(N = 117)

		Sex 1	Kuder 2	Bio-grade 3	GPA Sci 4	GPA Ovl 5	Otis IQ 6	DAT VR 7	DAT NA 8	DAT VR+NA 9	POST I 10	POST II 11
Sex	1											
Kuder	2	-.3790*										
Biograde	3	.1229	.2369*									
GPA Sci	4	.2674*	.1554	.8494*								
GPA Ovl	5	.2916*	.0984	.8345*	.9493*							
Otis IQ	6	.1337	.1349	.7117*	.6997*	.7279*						
DAT VR	7	.1303	.1659	.7082*	.6722*	.7092*	.7657*					
DAT NA	8	.0991	.1172	.7307*	.7745*	.7870*	.7515*	.6928*				
DAT VR+NA	9	.1386	.1434	.7686*	.7707*	.7998*	.8176*	.9372*	.8855*			
POST I	10	.1152	.2028*	.7716*	.7118*	.7242*	.7145*	.7211*	.7085*	.7698*		
POST II	11	.1067	.1503	.7516*	.7589*	.7646*	.7138*	.7221*	.6488*	.7472*	.7781*	

*.05 level of significance.

TABLE VIII

GENERAL DATA FOR CRITERION MEASURES OF LOW SCIENTIFIC INTEREST

Criteria		Mean	Maximum	Minimum	Standard Deviation
1	Sex	1.3750	2.0000	1.0000	0.5000
2	Kuder	20.3125	30.0000	8.0000	8.1053
3	Biograde	4.9375	9.5000	0.0	3.0049
4	GPA Sci	2.3187	3.7000	1.0000	0.9586
5	GPA Ovl	2.5875	3.6000	1.1000	0.8632
6	Otis IQ	108.0625	125.0000	84.0000	10.8789
7	DAT VR	25.6875	40.0000	10.0000	8.2439
8	DAT NA	22.4375	35.0000	12.0000	6.4495
9	DAT VR+NA	48.1250	75.0000	27.0000	13.0786
10	POST I	20.4375	30.0000	11.0000	5.7616
11	POST II	27.0000	36.0000	18.0000	5.6451

TABLE IX

CORRELATIONS BETWEEN CRITERIA: LOW INTEREST
(N = 16)

		Sex 1	Kuder 2	Bio-grade 3	GPA Sci 4	GPA Ovl 5	Otis IQ 6	DAT VR 7	DAT NA 8	DAT VR+NA 9	POST I 10	POST II 11
Sex	1											
Kuder	2	-.8698*										
Biograde	3	.3494	-.4344									
GPA Sci	4	.4573	-.4813	.9146*								
GPA Ovl	5	.3514	-.3805	.9249*	.9236*							
Otis IQ	6	.0812	-.1227	.7109*	.6846*	.6447*						
DAT VR	7	.1759	-.2179	.4674	.5137*	.4519	.7124*					
DAT NA	8	.4006	-.4020	.7893*	.8666*	.8680*	.7132*	.5783*				
DAT VR+NA	9	.3084	-.3356	.6822*	.7512*	.7129*	.8008*	.9155*	.8576*			
POST I	10	.5178*	-.5799*	.6448*	.6587*	.5896*	.5984*	.4943	.6117*	.6132*		
POST II	11	.3071	-.4342	.6740*	.7281*	.7360*	.7828*	.6876*	.7544*	.8055*	.7912*	

*.05 level of significance.

TABLE X

GENERAL DATA FOR CRITERION MEASURES OF AVERAGE SCIENTIFIC INTEREST

Criteria		Mean	Maximum	Minimum	Standard Deviation
1	Sex	1.4483	2.0000	1.0000	0.5017
2	Kuder	34.5690	49.0000	21.0000	7.8832
3	Biograde	5.6207	11.5000	0.0	3.0641
4	GPA Sci	2.5034	4.0000	0.8000	0.9478
5	GPA Ovl	2.5724	4.0000	0.8000	0.9328
6	Otis IQ	108.8276	131.0000	80.0000	12.4099
7	DAT VR	26.1552	44.0000	8.0000	10.2406
8	DAT NA	21.3966	37.0000	7.0000	7.8672
9	DAT VR+NA	47.5517	80.0000	16.0000	16.5319
10	POST I	22.0345	38.0000	7.0000	7.6868
11	POST II	27.1552	39.0000	8.0000	8.1020

TABLE XI

CORRELATIONS BETWEEN CRITERIA: AVERAGE INTEREST
(N = 94)

		Sex 1	Kuder 2	Bio-grade 3	GPA Sci 4	GPA Ovl 5	Otis IQ 6	DAT VR 7	DAT NA 8	DAT VR+NA 9	POST I 10	POST II 11
Sex	1											
Kuder	2	-.8198*										
Biograde	3	.2210	-.0890									
GPA Sci	4	.3030*	-.1762	.8795*								
GPA Ovl	5	.3568*	-.2126	.8857*	.9695*							
Otis IQ	6	.2155	-.1702	.7487*	.7491*	.7646*						
DAT VR	7	.1365	-.0748	.7500*	.7347*	.7739*	.7349*					
DAT NA	8	.1320	-.0382	.7654*	.8372*	.8124*	.7321*	.6612*				
DAT VR+NA	9	.1474	-.0645	.8288*	.8536*	.8654*	.8036*	.9341*	.8855*			
POST I	10	.1506	-.1098	.8080*	.7246*	.7447*	.7387*	.7372*	.7094*	.7942*		
POST II	11	.1811	-.1956	.7823*	.7665*	.7801*	.7565*	.7425*	.6370*	.7631*	.7721*	

*.05 level of significance.

TABLE XII

GENERAL DATA FOR CRITERION MEASURES IN HIGH SCIENTIFIC INTEREST

Criteria		Mean	Maximum	Minimum	Standard Deviation
1	Sex	1.4884	2.0000	1.0000	0.5058
2	Kuder	52.5814	69.0000	39.0000	7.5316
3	Biograde	7.6163	12.0000	2.5000	2.9858
4	GPA Sci	3.0140	4.0000	1.1000	0.6621
5	GPA Ovl	3.0349	4.0000	1.5000	0.6358
6	Otis IQ	114.5814	134.0000	82.0000	11.3247
7	DAT VR	31.3721	45.0000	10.0000	9.1652
8	DAT NA	24.7209	38.0000	9.0000	7.3560
9	DAT VR+NA	55.6047	77.0000	19.0000	14.9955
10	POST I	31.4651	39.0000	11.0000	5.7336

TABLE XIII

CORRELATIONS BETWEEN CRITERIA: HIGH INTEREST
(N = 43)

		Sex 1	Kuder 2	Bio-grade 3	GPA Sci 4	GPA Ovl 5	Otis IQ 6	DAT VR 7	DAT NA 8	DAT VR+NA 9	POST I 10	POST II 11
Sex	1											
Kuder	2	-.6701*										
Biograde	3	-.1331	.1293									
GPA Sci	4	.0929	.0060	.7308*								
GPA Ovl	5	.1383	.0011	.6839*	.9089*							
Otis IQ	6	.0033	.0431	.5983*	.5495*	.6466*						
DAT VR	7	.0780	.0058	.6553*	.5394*	.6245*	.7886*					
DAT NA	8	-.0585	.1147	.6482*	.6261*	.7016*	.7668*	.7372*				
DAT VR+NA	9	.0512	.0358	.6695*	.5872*	.6753*	.8157*	.9378*	.8809*			
POST I	10	-.1039	.1981	.6922*	.6307*	.6844*	.6519*	.6929*	.7110*	.7314*		
POST II	11	-.1377	.1193	.6706*	.6863*	.6675*	.5495*	.6255*	.5993*	.6499*	.7334	

*.05 level of significance.

A STUDY OF THE RELATIONSHIPS BETWEEN ACHIEVEMENT IN HIGH SCHOOL BIOLOGY AND APTITUDE, INTELLIGENCE, INTEREST, ACHIEVEMENT, AND SEX

by

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The purpose of this study was to determine the relationship between achievement in biology and various measures of interest, intelligence, aptitude, and sex. The measures were: (1) final grade in biology; (2) Kuder Preference Record--Vocational; (3) science achievement in junior high school; (4) scholastic achievement in junior high school; (5) Differential Aptitude Test (DAT)--Verbal Reasoning; (6) DAT--Numerical Ability; (7) DAT--Verbal Reasoning plus Numerical Ability; (8) Process of Science Test (POST); (9) Otis Quick-Scoring Mental Ability Test and (10) sex.

An experiment was conducted in Topeka West High School at Topeka, Kansas, using sophomore students who were enrolled in BSCS biology. The various measures of student characteristics and ability were arranged into four groups in which all measures were correlated using Pearson product-moment coefficients of correlation. The measures were correlated for (1) the sample as a whole and then reordered according to (2) low, (3) average, and (4) high interest in scientific activities as measured by their score on the Kuder Preference Record--Vocational.

It was found in the total sample, the measures of interest, intelligence, aptitude, and achievement gave significant correlations when compared with the students' grades in biology, with no significant correlation between sex and biology grades. When the students were grouped according to

low scientific interest, significant correlations between aptitude, achievement, intelligence, and achievement in biology were found; however, no significant correlations were found between sex, interest, verbal reasoning ability, and achievement in biology. Significant correlations between all measures of aptitude, achievement, intelligence, and achievement in biology were found when students were grouped according to an average interest in science; however, measures of sex and interest in science gave no significant correlations when compared with grades in biology. Biology grades of students grouped according to a high interest in science gave significant correlations between all measures of aptitude, achievement, and intelligence. Measures of sex and interest in science gave no significant correlations when compared with grades in biology.

From the findings of this study it was concluded that the original hypothesis--that there is no significant relation between achievement in biology and measures of interest, aptitude, intelligence, achievement, and sex--was rejected for the total sample and groupings according to low, average, and high scientific interest. It was found that a relation does exist for all groupings between achievement in biology and measures of aptitude, intelligence, and achievement. However the same hypothesis was accepted for sex in all groupings and for interest in all groupings except for the total sample.