The Effect of Daily Vocabulary Quizzes on Motivating Pupils to Study High School Biology

John Bernard Purcell

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THE EFFECT OF DAILY VOCABULARY QUIZZES
ON MOTIVATING PUPILS TO STUDY
HIGH SCHOOL BIOLOGY

by

John Bernard Purcell

A Dissertation Submitted to the Faculty of the Graduate School
of Loyola University in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Education

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LIFE


From February, 1950 until April, 1951, the author worked as an employment clerk at the Continental Can Company, Chicago, Illinois. He was in the United States Army from April, 1951 until March, 1953. After being in the Army, the author returned to work at the Continental Can Company as a timekeeper until December, 1953. He worked as a salesman for Mall Tool Company, Chicago, Illinois from December, 1953 until January, 1956.

He attended St. Ambrose College, Davenport, Iowa from February, 1956 to May, 1959 and graduated with the degree of Bachelor of Arts. He began teaching biology at Gage Park High School, Chicago, Illinois, September, 1959 where he is still employed. He was graduated from Chicago Teachers College, Chicago, Illinois, April, 1965, with the degree of Master of Education. He began his doctoral studies at Loyola University in June, 1967.

The author was married in April 1960, and he and his wife adopted a son in August 1965.
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CHAPTER I

INTRODUCTION

This dissertation is an outgrowth of a study on mastery learning conducted in the Chicago public schools by Dr. Benjamin S. Bloom of the University of Chicago, during the 1968-1969 school year. The author was one of ten biology teachers engaged in the study.

In Bloom's study on mastery learning the students were requested to record their weekly study time. The author felt that study time could be compared with achievement in classes where the amount of testing was varied. In this study classes having daily quizzes, weekly quizzes and a unit test were compared on the amount of their reported study time and their achievement.

Statement of the Problem

The purpose of this dissertation is to determine the effect of daily vocabulary quizzes on the study time of high school biology students and the students' achievement on the unit test.

Importance of the Problem

One of the problems in teaching today is motivating the student to learn.
Motivation is a complex subject, and there are many factors, both inside and outside the school, which affect the student's motivation. In the secondary school, the student is in the adolescent period. This is a period of great change for the student and one in which he attempts to create a new identity for himself. This is a period when the student is especially open to new experiences which will help or hinder him in determining who he is and what he might become.¹

Schools and peer groups are increasingly in conflict, and the student may learn very different things in these two subsystems of society. Especially during adolescence we find these two subsystems diverging.² It is under this circumstance that the teacher must use techniques that will help motivate a student to learn.

The school has its emphasis on learning tasks, deferred gratifications, and adult-controlled social activity. It thus has a difficult time in competing with a peer society which offers exciting and meaningful activity with immediate and powerful rewards quite independent of adult controls. If the student does not regard secondary education as appropriate and sees no relevance in it for his occupational future, he may mark time until he is permitted to drop out of school.³


³Bloom, Compensatory Education for Cultural Deprivation, pp. 34-5.
Students differ in the rate at which they can learn, but not in the level to which they can achieve or their basic capacity to learn, when given appropriate learning conditions. Evaluation should be used to promote learning. It can also help a student develop a sense of accomplishment and a positive self-view. It is likely that testing may become a very effective tool in helping the schools relate education and teaching to the individual.

**Description of the Study**

Three sophomore regular level biology classes were used in this study. The students were randomly assigned to classes by a computer. The classes were taught at Gage Park High School, Chicago, Illinois. The investigator taught all three classes. The same textbook was used in all three classes. The same references, equipment, materials, and specimens were available to all three classes. The order of presentation of topics and vocabulary words were the same for all three classes.

**Definition of Terms**

1. learning - the acquisition of knowledge and skills

2. regular level biology class - a biology class composed of students

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1 Bloom, "Innocence in Education," p. 5.

2 Ibid., pp. 13-4.


with stanines of four, five, and six on the California Test of Mental Maturity

3. section A - the class receiving daily quizzes, weekly quizzes and a unit test

4. section B - the class receiving weekly quizzes and a unit test

5. section C - the class receiving only a unit test

6. study - the setting of the mind or thoughts upon a subject to be learned or investigated\(^1\)

7. student study time - any time that a student spends outside of class working on a particular subject

8. vocabulary card - a file card with a vocabulary word on the front and its definition on the back\(^2\)

9. vocabulary words - three biology words or phrases from the unit to be learned each day

10. vocabulary quiz - a matching quiz composed of ten definitions to be matched to fifteen vocabulary words.\(^3\)

**Null Hypotheses**

This study was designed to investigate the following null hypotheses:

H\(_1\): There is no significant difference in the mean (unit)\(^4\) pre-test

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\(^2\)See Appendix I.

\(^3\)See Appendix II.

\(^4\)Hereafter pre-test refers to the unit pre-test.
scores among sections A, B and C. ¹

H₂: There is no significant difference in the mean (unit)² post-test scores among sections A, B and C.

H₃: There is no significant difference in the mean study time among sections A, B and C.

H₄: There is no correlation between the mean study time and the mean post-test scores among sections A, B and C.

In conformance with educational literature, a predetermined significance level of .05 was chosen for these hypotheses. ³

Basic Assumptions

The following basic assumptions were made relative to the hypotheses and to the design of this study: (1) the content and methods used in the three groups were the same, except for the number of quizzes given; (2) all groups were composed of representative samples of tenth grade biology students at Gage Park High School; (3) a difference in the mean post-test scores among the three groups may be considered due to the amount of study time, the use of vocabulary cards, and the number of quizzes taken; and (4) a difference in the mean study time among the three groups may be

¹ Hereafter reference to sections A, B and C refers to the students in these sections.

² Hereafter post-test refers to the unit post-test.

considered due to the number of quizzes taken because this was the major variation in the classes. The first, third, and fourth assumptions were made because the instructor, materials, books, equipment, and class levels were all the same. The second assumption was based on the fact that all class members were randomly assigned by computer.

Questions Concerning the Issues Involved

This dissertation is concerned with the effect daily vocabulary quizzes have on motivating pupils to study. If frequent vocabulary quizzes are given, will there be an increase in achievement? If frequent vocabulary quizzes are given, will they motivate the student to study more? Will the student study and learn without the use of quizzes? Does the use of study aids help the student achieve? Will the student use an easily obtainable study aid?

Method Employed

Each class was given three vocabulary words to learn each day, thus making a total of fifteen words per week. It was suggested to the students that they make vocabulary cards to be used for study purposes. 1 Each week section A was given daily vocabulary quizzes covering the fifteen words that had been given during the previous week. 2 Section B was given a weekly quiz covering vocabulary words, class lectures, and laboratory work. 3

1 See Appendix I.
2 See Appendix II.
3 See Appendix III.
Section C was given only a unit test. ¹ A pre-test was given each section to determine the students' initial levels of knowledge. ² A post-test was given to determine the students' final achievement. ³ All classes filled out daily study sheets during a week, which were collected at the beginning of the following week. ⁴

At the end of the study the three sections were compared on their: (1) mean study time; (2) mean pre-test scores; and (3) mean post-test scores (see Experimental Design of the Study).

**EXPERIMENTAL DESIGN OF THE STUDY**

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¹See Appendix IV.

²Ibid.

³Ibid.

⁴See Appendix V.
Instruments and Technical Data

The vocabulary quizzes consisted of matching ten definitions with fifteen possible words. ¹ To facilitate correcting the quizzes, answer sheets were designed to be used in conjunction with them. ² To correct the answer sheets the instructor made a stencil. ³

As part of Bloom's mastery learning project, student study time record sheets were collected, indicating the amount of time spent studying biology each week. These sheets requested the student to indicate if he studied less than one hour, one to two hours, two to four hours, four to six hours, six to eight hours, and more than eight hours per week.

The author felt that it would be difficult for each student to recall his study time for the entire week, and that the categories were too indefinite. The category of less than one hour did not indicate the number of students who had studied very little or not at all. The author devised another study time record sheet that could be filled out daily. ⁴ This new sheet had categories of zero minutes, five minutes, ten minutes, twenty minutes, thirty minutes, forty-five minutes, and one hour. These categories could be checked in multiples to give any total possible in minutes and hours in five

¹See Appendix II.
²See Appendix VI.
³See Appendix VII.
⁴See Appendix V.
minute intervals. Using a daily study time record sheet gave a more accurate estimate of total daily study time than a weekly record sheet.

At the end of the study, a study time survey form was filled out by the students to be used as a comparison with the daily study time record sheets to determine the types of study most frequently engaged in by the students.¹ A student evaluation sheet was filled out at the end of the study to determine the students' reaction to the study of vocabulary words and quizzes.²

**Statistical Analysis**

The one-way analysis-of-variance (F-test) was used for four comparisons: (1) the means of the pre-test scores to determine if there was an initial significant difference in achievement among the three sections; (2) the means of the post-test scores to determine if there was a significant difference in achievement among the three sections at the end of the study; (3) the means of the daily reported study time to determine if there was a significant difference among the three sections in the amount of time they studied; and (4) the means of the reported study time for the study time survey to determine if there was a significant difference among the three sections in the amount of time they reported studying at the end of the study.³

A Pearson product-moment coefficient of correlation was computed for

¹See Appendix VIII.
²See Appendix IX.
³Infra, p. 40.
the mean study time and the mean post-test scores to determine if there was a relationship between the amount of reported study time on the daily study time record sheets and the post-test scores of the three groups. ¹ The Fisher t ratio for testing the significance of a coefficient of correlation was used to determine if the relationship between the reported study time and the post-test scores of the three groups was significant. ²

Fisher's t for testing a difference between uncorrelated means was used for three comparisons: (1) the means of the pre and post-test scores to determine if there was a significant difference in achievement for each of the three sections; (2) the means of the reported study time for the daily study time record and the study time survey to determine if there was a significant difference in the amount of study time reported during the study and the amount of study time reported at the end of the study; and (3) the means of the post-test scores to determine which of all possible pairs of post-test means differed significantly among the three sections. ³

¹Infra, p. 41.
²Infra, p. 41.
³Infra, p. 40.
CHAPTER II

SELECTED REVIEW OF THE LITERATURE

History of the Problem

Many experiments, with differing results, have been conducted on the frequency of testing. In one experiment in high school social studies, a group was tested daily, another three times a week, and a third every six weeks. No significant difference in achievement among the three groups was evident at the .05 level. In another experiment in high school biology, one group was tested daily, a second was given unit tests, and a third was tested without notice at irregular intervals. The group taking the daily tests had the lowest scores on the final exam. In an experiment in high school physics, one group was tested daily, and another group was given unit tests. No significant difference in achievement between the two groups was evident at the .05 level.¹

Pikunas and Mazzota studied the effects of weekly testing in the teaching of chemistry. Four classes were divided into two groups consisting of two classes each. Each group covered one of two sets of six chapters.

For two phases of the study each group acted as control and experimental. The unit test scores of the experimental groups were significantly higher than the control groups.  

Curo studied the effects of daily testing in high school American history classes. The experimental group was tested daily, and the control group was given only a unit test. The study was conducted for a six week period. No significant difference in achievement between the two groups was evident at the .05 level.

Various surveys have been conducted on the amount of time students spend doing homework or studying. However, most of these are concerned with homework in general and not with any specific techniques to motivate study in a particular subject. One of the most widely used instruments is the Survey of Study Habits and Attitudes by Brown and Holtzman. This is a personality inventory that covers study behavior and attitudes. There are both high school and college forms. It is designed to distinguish students with good marks from those who do poorly. It is useful in counseling and how to study courses.

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Leidy and Starry conducted two surveys on the amount of time spent on homework. The purpose was to determine the average time students spend working on school assignments after school hours. Their results showed that students studying more than two hours increased in number from seven percent in 1948 to twenty percent in 1967.¹

Leibert concluded from his research of high school pupils taking a reading course that: (1) only a small percentage of pupils polled actually studied; (2) the majority of pupils spent most of their textbook time completing homework assignments; and (3) most of the pupils cram­med for tests.²

Bloom found that there is a zero or slightly negative correlation between final grades and the amount of time spent on homework. Thus, the amount of time spent on homework does not seem to affect achievement.³

Haslam and Brown taught the "Brown-Holtzman Effective Study Course: High School Level" to high school sophomores to determine the effectiveness and acceptability of study-skills instruction. Their conclusion was that study-skills instruction given to the sample of high school sophomores increased the knowledge about effective study procedures and improved the


Related Studies on Vocabulary

Pless conducted a study to determine the effectiveness of a special teaching procedure accenting structural analysis of vocabulary terms on the learning and retention of definitions of selected biology terms by 200 tenth grade biology students. The experimental group used vocabulary instruction booklets especially designed to accent structural elements of vocabulary terms in conjunction with the class program. The experimental subjects obtained significantly higher mean test score gains in the learning of definitions of biology terms included in the special teaching procedure. 2

Lazow conducted a study to develop a vocabulary test with a conceptual basis in science and to determine its validity and reliability when applied to a selected sample of 590 science pupils at the end of the ninth grade. The four major areas of science, namely earth science, biology, physics and chemistry, were represented. The Pearson product moment correlations of the final test were with the following: Read General Science Test, .740; Teacher Grades, .615; and the Terman-McNemar Test of Mental Ability,

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A Chi square analysis revealed that eighty-eight percent of the test items can be used to help an instructor discriminate between the upper and lower twenty-seven percent of the testees at the .01 or .05 level of significance. According to Lazow, this indicates that the test can be used in the ninth grade as a power test to determine science achievement.¹

Roberts conducted an investigation to explore the relationships between the ability and criterion measures at different stages of practice in vocabulary learning. Two forms of vocabulary learning materials were developed. One form taught word meanings through the use of synonyms (SYN method) and the other method taught word meanings through the use of dictionary definitions (DEF method). Six tenth grade English classes were used. In the SYN group, correlations between the ability tests, criterion achievement and time scores showed significant decreasing trends over stages of practice. In the DEF group, no significant trends were found between ability and achievement. The SYN group showed significantly better performance when changed to the DEF material than did the DEF group on the first three days of practice. No similar trend was found in the DEF group when

it was changed to the SYN materials.¹

Skinner studied the effect of subliminal and supraliminal words presented via video-taped motion pictures on vocabulary development of ninth grade students. The analysis of the data resulted in the subliminal and supraliminal groups achieving significantly greater post-treatment scores than the group that had no words projected via video-taped motion pictures.²

Bishop constructed vocabulary tests for use with first and second year high school students. He stated that the vocabulary of boys is larger than that of girls because of the wider variety of experiences permitted to boys. He also claimed that children are not capable of absorbing more than ten new words per week. His conclusions were only tentative since no statistical tests were carried out.³

Brown conducted a study to determine which of two teaching methods was more effective in teaching seventh-grade pupils complex vocabulary.


The two methods used were the gaming technique and the discussion method. The hypothesis that students in the experimental group would make a statistically significant gain on the vocabulary post-test over the control group was not supported.¹

Knoll explored preservice teacher strategies in teaching the vocabulary of elementary school science. The purposes of this study were to: (1) to identify and describe strategies associated with vocabulary teaching in elementary school science; and (2) to formulate hypotheses relevant to an integrated language arts approach to the teaching of vocabulary which would be useful in preservice and inservice education.²

Wilkerson conducted a study to determine the relationship between depth of vocabulary knowledge, where multiple meanings of words are known, and general vocabulary knowledge as measured by a standardized diagnostic reading test. A standardized vocabulary test proved to be a good predictor of a subject's in-depth vocabulary knowledge.³


Layton conducted a study to determine if a technical science vocabulary is necessary for successful achievement in science content materials. He also investigated if vocabulary is independent of social residence, intelligence and reading achievement. The Science Vocabulary Reading Test showed no significant difference in the technical science vocabulary of the suburban or rural subjects.  

Geiger investigated teaching vocabulary to seventh and eighth grade students using a programmed text that emphasized content clues, a programmed text augmented by listening assistance and a programmed text augmented by a work analysis supplement. The study indicated that vocabulary can be developed using a programmed text that emphasizes context clues. Listening assistance is an effective means of reinforcement instruction in developing vocabulary and comprehension. A work-analysis supplement does not contribute to the effectiveness of a programmed text in vocabulary development that emphasizes context clues.

Lieberman studied the effect of direct instruction of vocabulary concepts on reading achievement. There was no significant difference in read-


ing achievement between the conventional instruction group and the experi-
mental group. The experimental group achieved significantly higher gains
in concept attainment than the control group did. 1

Hayes conducted a study to determine whether doing college shorthand
homework by writing from print would improve dictation skill more than
homework consisting only of copying textbook shorthand plates. The ex-
periment concluded that practice on printed materials including more in-
frequently used words than occur in the textbook improves shorthand dicta-
tion and transcription skills more than does copying textbook material. 2

Crouse performed two free-recall learning experiments with college
students. The experiments consisted of two phases, the items being pre-
sented for study during the input or storage phase, and recall being tested
during the output or retrieval phase. Category names of the nouns to be
learned were presented along with them and served as storage cues (e.g.,
weapons--bomb, cannon: crimes--treason, theft). During the output phase
the same category names were presented as retrieval cues. In Experiment
I the presence or absence of retrieval cues was varied factorially with the
presence or absence of storage cues. Results showed, retrieval cues fa-

1 Janet Elaine Lieberman, "The Effect of Direct Instruction in Vocabu-
lary Concepts on Reading Achievement" (unpublished Ph. D. dissertation,
New York University, 1965), abstract in, Dissertation Abstracts Interna-
tional, Vol. XXVII, 1966, p. 960A.

2 Myrtle Ione Hayes, "Shorthand Homework Practice Under Attention-
Focusing and Vocabulary-Expanding Conditions" (unpublished Ph. D. dis-
sertation, University of Northern Colorado, 1971), abstract in, Dissertation
ciliated recall when storage cues were present, but not when they were absent. Experiment II showed that the facilitating effects of retrieval cues depended on the paring of storage cues and the words to be recalled.¹

**Related Studies on Homework and Study**

A number of studies concern compulsory homework at the elementary, high school and college levels. Some studies cited here use questionnaires of study policies or study habits. Many of the college level studies were conducted in conjunction with study skills courses.

Goutevenier investigated the effect of a flexible modular schedule (FMS) on achievement, study habits and attitudes of 140 average tenth grade students. Study habits and attitudes were measured with the Brown-Holtzman Survey of Study Habits and Attitudes (SSHA). Achievement was measured with the Iowa Tests of Educational Development (ITED). Both of these instruments were administered as pre-tests and post-tests. There was no significant difference between the experimental and the control groups on any of the scales of the SSHA, including the total score for the survey. Differences statistically favored the experimental group on four of the eleven scales of the ITED: Background in Natural Sciences (0.05 level); Correctness and Appropriateness of Expression (0.01 level); Ability to Interpret Literary Materials (0.01 level); and the Use of Sources of Information

Taylor compared the effects of achievement and attitude using two different approaches to handling homework in Algebra I and Geometry I. One approach was to make homework compulsory with the work evaluated by the teacher. The other was a non-compulsory approach to homework where the student’s work was not evaluated. Two classes of Algebra I and two of Geometry I participated in the eighteen week study. Pre-tests were given all four groups in mathematics achievement and general attitude toward mathematics. Means were tested by use of the related and unrelated t-test. The Pearson product-moment correlation coefficient was used. Hypotheses were tested at the five percent confidence level, and no mean differences tested were significant.

Lash investigated the relative merits of three modes of assistance used by students while doing their homework in geometry. The investigation was conducted during the 1969-1970 school year in twenty-four schools. These schools were assigned to three experimental and one control group. The treatment in the experimental group consisted of providing each stu-


dent with a booklet which contained hints, answers, or complete solutions to all homework exercises. There were significant differences among the groups on the pre-test and post-test analysis. The mean of the Solutions group was significantly lower than each of the means of the hints, answers and control groups. The Solutions group mean was also significantly lower than that of the Hints or Answers group.¹

Olson determined the effects of pair-study on achievement and attitude of students in plane geometry. Five classes of 134 students composed the experimental group, and five classes of 142 students composed the control group. Students in experimental classes worked in pairs during periods of supervised study throughout the semester. Students in control classes worked individually during periods of supervised study throughout the semester. Student achievement in experimental classes was not significantly different from student achievement in control classes. Students in experimental classes did not exhibit a more positive attitude toward mathematics than their counterparts in control classes.²

Singh investigated the effect of individualized homework upon the academic achievement of elementary school children. It was concluded that


individualized homework does result in significant academic achievement. ¹

Grant conducted an experimental study of the effects of compulsory arithmetic homework assignments upon the achievement of fifth-grade pupils. There was no significant difference in achievement between the homework and the non-homework groups. ²

Doane studied the effects of homework on arithmetic skills in fourth grade students. The students who were assigned homework achieved higher scores than those who did not have homework assignments. ³

Bradley conducted a study of individualized and blanket-type homework assignments in elementary school mathematics. There was a significant gain in achievement by those students receiving individualized homework assignments. ⁴


Micklich studied the effect of directed and non-directed homework assignments on the achievement of college mathematics students. Students taught under the two methods did not differ significantly in their achievement. ¹

Hayes studied the effects of personalized homework assignments and usual textbook assignments upon attitude, achievement, and study habits in a college mathematics course. The results favored the personalized homework group but were not significant. The experimental students liked the presentation of homework and the control students did not. The students' perceptions of study habits were quite similar.²

Hanses investigated the effects of required homework on achievement in college mathematics. There was no significant difference between the achievement of the homework groups over the no-homework groups.³

Mason studied the effect of compulsory homework on the achievement


of college algebra students. There was no significant difference in achievement between the homework and the non-homework groups.¹

Fillman investigated the effects of teaching study skills and reading, writing, and listening skills as a specific course of study for ninth grade students. The experimental group gained significantly more than the control group in study skills. The study concluded that the teaching of study skills as a specific course of study is beneficial for ninth grade students.²

Gualderon investigated the validity of the Test of Study Habits and Skills in predicting the academic achievement of disadvantaged twelfth-grade students. The data collected revealed that the Test of Study Habits and Skills was a valid predictor of academic achievement of disadvantaged high school seniors. The data also indicated that formal instruction in appropriate study behavior could not be established as making any significant difference with regard to academic achievement.³


Redd conducted a study to determine whether parents and students regarded the study assignments of the secondary schools in Washington State as an interference with formal education. The Pearson product-moment correlation between the grade received and the amount of time spent doing homework for a given subject was generally low. Significantly more students than parents desired that all study assignments be completed during school hours.¹

Bowman investigated the incidence and nature of study policies and practices in Washington State secondary schools. Four groups of high school principals and teachers were sent questionnaires dealing with study policies and practices. Only eighteen percent of the secondary schools developed study policies. Actual study assignments generally agreed with principals' and teachers' opinions of desirable assignments. Pupils' access to conferences with school personnel and the use of library facilities was rather limited. All principals and most teachers thought it desirable to limit home study assignments to permit time for informal education.²

Kernan conducted an experiment using student study-teams in junior high school. Although seventy-six percent of the students and all the


teachers reported that the study-team approach was profitable, academic
growth tended to indicate that progress in the study-team classes was not
significantly better than might have been anticipated if study-teams had not
been used.\textsuperscript{1}

Holtzman and Brown evaluated Form H of their Survey of Study Habits
and Attitudes (SSHA). They determined that the low correlation between
SSHA and scholastic aptitude indicated that the SSHA measures important
traits related to school achievement that are untouched by the standard
scholastic aptitude tests.\textsuperscript{2}

Draayer and McLure compared student study habits and attitudes on
traditional and modular scheduling of high school students. The results in-
dicated that there is a strong connection between improvement in student
study habits and attitudes and the school's schedule. This study supports
the shift into modular scheduling in terms of the positive impact on student
study habits and attitudes.\textsuperscript{3}

Anthony investigated the effects of a study skills course and a self-un-


\textsuperscript{3} Donald R. Draayer, and John W. McLure, "A Comparison of Student Study Habits and Attitudes on Traditional and Modular Scheduling," The North Central Association Quarterly, XXXXVI (Winter 1972), 359.
derstanding program on low achieving college students. The results indicated that both the study skills course and the self-understanding program had a significant effect on the academic improvement of both groups, while the control groups did not show a significant effect on academic improvement. 1

Powell investigated the use of video-taped instructional television and simulated activities in providing a study skills course for university students. The most significant difference noted from data analysis was a much more favorable attitude toward instruction on the part of the video-tape treatment group. This led to a conclusion that the video-tape approach to study skills instruction at the college level can provide colleges with a favorable alternative to traditional lecture approaches to study skills courses. 2

Federico examined the efficacy of a study skills program while considering the effects of volunteering versus nonvolunteering for the program. The most important finding of this study was that volunteer status was not a


significant factor related to the effectiveness of the study skills program.\(^1\)

Wilson compared the academic achievement of college students who took a course in effective study with students who did not take the course. There was no significant difference in academic achievement among students who took an effective study course and those students who did not take the course.\(^2\)

Keetz evaluated the effect of a required reading and study skills course on the performance of selected college freshmen enrolled in scientific curricula. He evaluated their performance in certain reading and study abilities and their academic achievement. The experimental students were required to take a reading and study skills course. The control subjects were not permitted to enroll in the course. Analysis of the data revealed no significant differences between the two treatment groups.\(^3\)

Paplia studied how to help a group of low-achieving, high-potential


male freshmen succeed in a compensatory program. The experimental group was subjected to a specialized reading and study skills program. The experimental group had a lower rate of college retention than the comparison group and the male freshmen as a whole.¹

Foxe investigated the effects of a brief study skills program on the achievement of college freshmen in chemistry and on their total first semester achievement. This was a six-session experimental program. Both experimental and control groups were limited to those students who indicated interest in participating in the program. The short-term traditional reading and study skills program had no significant effect on students' chemistry grades or grade-point averages.²

Warga conducted a study to determine if there was any time during the first semester when college students felt a maximum, congruent-in-time need for help in English, mathematics and chemistry. The significant correlations demonstrate that the variables—grade predictions, stated attitudes toward help and scores on the SSHA—support one another, but at a low level, as expressions of students' attitudes toward help. The results of


this study indicate that a study skills course should be voluntary. It should be general in nature at the start, but as the term progresses, the topics should deal with specific methods to solve problems as they arise in particular courses and students should be grouped accordingly.  

CHAPTER III

PROCEDURE

The Subjects

Three regular level biology classes including seventy-three students were used in the study. The level of the students was determined on the basis of their stanines as obtained on the California Short-Form Test of Mental Maturity. Those students with stanines of four, five, and six were randomly assigned to regular level classes by computer. One class was given daily quizzes, a second class was given weekly quizzes, and a third class was given a unit test. The instructor randomly chose one class of twenty-four students as the daily quiz class, one class of twenty-two students as the weekly quiz class, and a third class of twenty-seven students as the unit test class.

Length and Subject Matter of the Study

The study covered a unit on reproduction which lasted five weeks. The unit began with one-celled organisms and continued through flowering plants and mammals. It also included material on mitosis and meiosis.
Class Introduction

All classes were informed that they would be required to learn three new biology words or phrases each day. The classes were given the option of placing these words on vocabulary cards for twenty-five extra credit points at the end of the marking period.\(^1\) The daily quiz class was informed that there would be a daily vocabulary quiz, except on announced quiz or unit test days. The weekly quiz group was informed there would be one quiz given each week on a specified day, with a unit test to be announced in advance. The unit test group was informed that there would be only an announced unit test.

Pre and Post-Tests

All classes were given a pre-test consisting of fifty objective questions to determine how much the students already knew about the subject.\(^2\) It also aided the instructor in planning the unit. The same test was used as the unit or post-test. The instructor would thus have an estimate of any increase in learning that had taken place.

Vocabulary Words

At the beginning of each class, the students were given three biology words or phrases to look up in their texts or reference books on their

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1See Appendix I.
2See Appendix IV.
desks. The students wrote on file cards or in their notebooks, and the definitions were discussed. During the regular class periods, lectures, discussions, filmstrip showings, etc., these words again appeared and were discussed for a second time. While the student did his outside reading assignments, these words appeared for a third time, and while working on class assignments the words were encountered for a fourth time. These words appeared once more on the quizzes for the daily quiz class. Thus the student was exposed to the same words under a variety of situations. When classes did not meet because of holidays, pep-rallies, etc., the students were given the words they missed the next class meeting to make a total of fifteen words per week.

Vocabulary Quizzes

The daily vocabulary quizzes were of the matching type, composed of ten definitions and fifteen vocabulary words. ¹ Alternate forms were used each day to reduce the chances of students trying to memorize the answers. ²

Problems in Marking Quizzes

One of the major problems with giving many quizzes is the great time involved in correcting them. In many cases instructors have students correct their own, their neighbors', or another classes' papers. Grading ir-

¹See Appendix II.
²Ibid.
regularities can accidentally or intentionally occur by these methods. Another disadvantage is the time involved in correcting the papers in class. While having students correct papers reduces the load placed upon the instructor, it takes away from class time. To hand back, discuss, and recollect a short, ten item quiz takes at least four minutes. Having the students correct the papers could take twice as long. Because of these problems, the author corrected the papers out of class.

**Quiz Answer Sheet**

In order to facilitate the correcting of quiz papers, the author devised a quiz answer sheet composed of ten lines having fifteen letters each. The answer sheet was designed to be used with the vocabulary quizzes. The student selected the word that was defined by the definition and blotted out the letter on the answer sheet that corresponded to the word on the quiz paper. The students were instructed to use pencils for marking the answer sheets so they could change the selection if they made a mistake.

**Quiz Answer Sheet Correction Stencil**

A correction stencil is a piece of cardboard with holes which enables an instructor to correct answer sheets rapidly. By using answer sheets and a correction stencil, a set of ten item quizzes can be corrected in about ten minutes. This makes it possible for the instructor to correct all his

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1See Appendix VI.
2See Appendix VII.
own quizzes and eliminate the confusion that may result from having the class correct the papers.

Once the answer sheets had been graded, they were passed back to the class and discussed. The students were first told to check their papers for the correct numerical grade. They did this by counting the number of red ink marks, multiplying by ten and subtracting from 100. If there were any mistakes in grading, they were corrected at this time. The quiz items were then discussed and any other corrections made.

After the quiz was discussed, the students recorded their grades on their grade sheets. The answer sheets were re-collected so the grades could be recorded and the paper filed for future reference.

**Grade Sheets**

Each student was given a grade sheet at the beginning of the semester to record his grades and finally to grade himself. The numerical grade range, corresponding to a letter grade, was established at the beginning of the course. Therefore, the student knew that the grade he received was not based on a capricious decision of the instructor. The student recorded the quiz grades in the left hand column and the test grades in the center column. These were totaled and averaged at the end of the marking period. The quiz and test averages were then placed in the right hand column along with the other numerical grades and averaged. For the second, third and fourth

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1 See Appendix X.
marking periods, the grade was averaged with the preceding marking period(s) grade(s) to give a cumulative numerical grade average. The student then recorded his letter grade as determined by his numerical average. The instructor also figured each student's grades and compared them with the student's grade sheet to make sure no mistakes were made.

**Weekly Quizzes**

Weekly quizzes were given to both the daily quiz class and the weekly quiz class. The weekly quizzes differed from the daily quizzes in that they were composed of twenty questions, made up of matching, true-false, and other objective items. The weekly quizzes were designed to test not only vocabulary, but also reading, lecture, class discussion, and laboratory work.

**Using Diagrams in Quizzes**

For diagram quizzes, the structures to be labeled are listed on one sheet. The students then mark the numerals from the diagram on their answer sheets.

**Vocabulary Cards**

Vocabulary cards are 3"x5" file cards. Any size cards or paper

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1 See Appendix III.
2 See Appendix XI.
3 See Appendix I.
could be used, but the 3"x5" file cards are convenient to use and easy to obtain. The vocabulary word is placed on one side of the card, and the definition is placed on the other side. The student can then take the cards and look at each word. If he knows what the word means, he can place the card in a pile of known words. If he does not know the word, he can study the definition until it is learned. When the words are learned, their cards are placed in the stack of known word cards and can be reviewed periodically. In using the cards the pupil is studying by taking a self-administered quiz. Also, a student can study at any convenient time and place and for any amount of time.

As an incentive for using the cards in this study, the students were given twenty-five extra credit points for making and submitting cards to the instructor. Some students made out the cards the night before they were to be turned in and never studied them. This gave them the extra credit points, but not the use of the cards as a study aid.

**Daily Study Time Record Sheet**

At the beginning of each week the students were given the Daily Study Time Record Sheet. At the same time the sheet from the previous week was collected. Each day the student would list the amount of time spent studying. At the end of the week these amounts were totaled and the record sheet turned in. The sheet was so designed that any amount of study time

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1See Appendix V.
in five minute intervals could be indicated. It was composed of seven sections, one for each day of the week beginning with Monday and ending with Sunday. Across these sections were eight columns, seven indicating specific five minute intervals running from zero minutes to one hour and the eighth a total column. By checking various columns one or more times, the student could indicate the amount of time in five minute intervals spent studying and then total the time in the last column. By having a zero column, the student could check this if he did not study at all that day.

The purposes of the Daily Study Time Record Sheet were: (1) to make the student aware of study time; (2) to make the student keep a record of his study time; (3) to motivate the student to study; and (4) to give the instructor an idea of the total study time of each student in the class.

**Study Time Survey Form**

The Study Time Survey Form was passed out to each student at the end of the study.\(^1\) The students were instructed to place their names, date, and class section on top of the paper. The purposes of the Study Time Survey Form were: (1) to determine how long the student thought he studied each week as compared to the study time on the Daily Study Time Record Sheet; (2) to determine what percentage of time was spent studying alone or with others; and (3) to determine what percentage of time was spent on various other types of studying.

\(^1\)See Appendix VIII.
Student Evaluation Sheet

At the end of the unit each student filled out an evaluation sheet. The students were told not to place their names on the paper. The purposes of the Student Evaluation Sheet were to determine student attitudes on: (1) testing; (2) vocabulary words; and (3) vocabulary cards.

Statistical Formulas

The one-way analysis-of-variance (F-test) was used for four comparisons: (1) the mean pre-test scores; (2) the mean post-test scores; (3) the daily reported study time means; and (4) the means of the reported study time for the study time survey.  

\[ F = \frac{S_{ag}^2}{S_{w}^2} \]

Fisher's t for testing a difference between uncorrelated means was used for three comparisons: (1) the mean pre and post-test scores; (2) the means of the reported daily study time and the study time survey; and (3) all the possible pairs of post-test means of the three sections.

\[ t = \frac{M_1 - M_2}{\sqrt{\left( \frac{\sum x_1^2 + \sum x_2^2}{N_1 + N_2 - 2} \right) \left( \frac{N_1 + N_2}{N_1, N_2} \right)}} \]

1 See Appendix IX.


3 Guilford, op. cit., p. 183.
The Pearson product-moment coefficient of correlation was used to compare the mean reported study time and the mean post-test scores.¹

\[ r_{xy} = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{(N\sum x^2 - (\sum x)^2)(N\sum y^2 - (\sum y)^2)}} \]

Fisher's t ratio was used for testing the significance of the coefficient correlations.²

\[ t = \frac{r \sqrt{N - 2}}{\sqrt{1 - r^2}} \]


²Guilford, op. cit., p. 163.
CHAPTER IV

FINDINGS OF THE STUDY

Hypotheses to be Tested

In this study section A received daily vocabulary quizzes, section B received weekly quizzes, and section C was given only a unit test. The following null hypotheses were tested in this study:

H₁: There is no significant difference in the mean pre-test scores among sections A, B and C.

H₂: There is no significant difference in the mean post-test scores among sections A, B and C.

H₃: There is no significant difference in the mean study time among sections A, B and C.

H₄: There is no correlation between the mean study time and the mean post-test scores among sections A, B and C.

The Pre-test

The study was begun by giving a fifty item, short answer, pre-test.¹

The purposes of the pre-test were: (1) to allow the instructor to see how

¹See Appendix IV.
much the students knew about the subject; (2) to enable the instructor to plan the unit for each classes’ maximum improvement; (3) to let the students see how much they knew about the subject; and (4) to use the pre-test, which was the same as the post-test, as a comparison with the post-test at the end of the unit to determine the amount of learning that had taken place.

On the pre-test section A had a maximum raw score of 33 items correct, a minimum raw score of 13 items correct, a range of 20, a standard deviation of 4.75, and a mean of 21.04 items correct. Section B had a maximum raw score of 30 items correct, a minimum raw score of 11 items correct, a range of 19, a standard deviation of 5.25, and a mean of 20.41 items correct. Section C had a maximum raw score of 29 items correct, a minimum raw score of 12 items correct, a range of 17, a standard deviation of 4.25, and a mean of 18.63 items correct (see Table 1).

**TABLE 1**

**PRE-TEST RAW SCORES FOR SECTIONS A, B AND C**

<table>
<thead>
<tr>
<th></th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section A</td>
<td>33</td>
<td>13</td>
<td>20</td>
<td>21.04</td>
<td>4.75</td>
</tr>
<tr>
<td>Section B</td>
<td>30</td>
<td>11</td>
<td>19</td>
<td>20.41</td>
<td>5.25</td>
</tr>
<tr>
<td>Section C</td>
<td>29</td>
<td>12</td>
<td>17</td>
<td>18.63</td>
<td>4.25</td>
</tr>
</tbody>
</table>

For the pre-test section A had the highest maximum raw score, the highest minimum raw score, and the highest mean raw score. Section B
had the middle maximum raw score, the lowest minimum raw score, and the middle mean raw score on the pre-test. Section C had the lowest maximum raw score, the lowest mean raw score, and the middle minimum raw score on the pre-test (see Table 1). On the pre-test the number of students having fifty percent or more of the items correct was four in section A, six in section B, and two in section C (see Figures 1, 2, and 3).

The F ratio for an analysis of variance of the pre-test for the three sections was 1.81. To be significant at the .05 level, an F ratio of 3.13 is needed when the degrees of freedom are 2 and 70. Therefore, the null hypothesis, of no significant difference in the mean pre-test scores among the three groups at the .05 level, was accepted (see Table 2). Since there was no significant difference in the mean pre-test scores among the three groups, the use of the analysis of variance technique was justified in the other statistical analyses.

**TABLE 2**

**ANALYSIS OF VARIANCE OF PRE-TEST SCORES FOR SECTIONS A, B AND C**

<table>
<thead>
<tr>
<th>Components</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Variance</th>
<th>F</th>
<th>Tabled F .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Sets</td>
<td>80.30</td>
<td>2</td>
<td>40.15</td>
<td>1.81</td>
<td>3.13</td>
</tr>
<tr>
<td>Within Sets</td>
<td>1,554.58</td>
<td>70</td>
<td>22.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,634.88</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 1.--Pre-Test Raw Scores for Students in Section A
Fig. 2.--Pre-Test Raw Scores for Students in Section B
Fig. 3. --Pre-Test Raw Scores for Students in Section C
Daily Study Time Record

Section A received daily vocabulary quizzes, had a reported study time of 12 to 205 minutes per week, a range of 193, a standard deviation of 52.25, and a mean of 85.96 minutes per week. Section B received weekly quizzes, had a reported study time of 9 to 212 minutes per week, a range of 203, a standard deviation of 46.90, and a mean of 82.09 minutes per week. Section C received no quizzes, had a reported study time of 15 to 229 minutes per week, a range of 214, a standard deviation of 57.95, and a mean of 85.93 minutes per week (see Table 3).

Section A reported that students studied by themselves 99.82 percent of the time, they studied with classmates .14 percent of the time, and with an adult .04 percent of the time. Section B students reported studying 99.68 percent of the time by themselves, they studied with classmates .27 percent of the time, and by other methods .05 percent of the time. Section C students reported studying 97.85 percent of the time by themselves, 1.77 percent of the time with classmates, with an adult .34 percent of the time, and .04 percent of the time by other methods (see Table 3).

Section A reported the highest mean and the lowest maximum study time per week. Section B reported the lowest mean and the lowest minimum study time per week. Section C reported the highest maximum and the highest minimum study time per week. The mean study time per day was 12.24 minutes for section A, 11.82 minutes for section B, and 12.25 minutes for section C (see Table 3). The percentage of students studying 10
<table>
<thead>
<tr>
<th></th>
<th>Section A</th>
<th>Section B</th>
<th>Section C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Minutes of weekly study time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>205.00</td>
<td>212.00</td>
<td>229.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>12.00</td>
<td>9.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Mean</td>
<td>85.96</td>
<td>82.09</td>
<td>85.93</td>
</tr>
<tr>
<td>Range</td>
<td>193.00</td>
<td>203.00</td>
<td>214.00</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>52.25</td>
<td>46.90</td>
<td>57.95</td>
</tr>
<tr>
<td>2.</td>
<td>Percentage of weekly study time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. by yourself</td>
<td>99.82</td>
<td>99.68</td>
<td>97.85</td>
</tr>
<tr>
<td>b. with classmates</td>
<td>.14</td>
<td>.27</td>
<td>1.77</td>
</tr>
<tr>
<td>c. with an adult</td>
<td>.04</td>
<td>.00</td>
<td>.34</td>
</tr>
<tr>
<td>d. by other methods</td>
<td>.00</td>
<td>.05</td>
<td>.04</td>
</tr>
<tr>
<td>3.</td>
<td>Minutes of daily study time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>29.30</td>
<td>30.30</td>
<td>32.70</td>
</tr>
<tr>
<td>Minimum</td>
<td>1.72</td>
<td>1.28</td>
<td>2.14</td>
</tr>
<tr>
<td>Mean</td>
<td>12.24</td>
<td>11.82</td>
<td>12.25</td>
</tr>
</tbody>
</table>

minutes or less per day was 54.2 percent for section A, 50.0 percent for section B, and 51.9 percent for section C (see Table 4).

The highest reported study time mean for all three sections was 229 minutes per week, or approximately 32.70 minutes per day, and the lowest was 9 minutes per week. Only 4 students in all three sections reported study times of three hours or more per week. No one reported a study time of four hours or more per week (see Figures 4, 5, and 6).

An analysis of variance performed for the reported daily study time
Fig. 4. --Mean Reported Study Time for Students in Section A
Fig. 5. -- Mean Reported Study Time for Students in Section B
Fig. 6. --Mean Reported Study Time for Students in Section C
TABLE 4
PERCENTAGE OF STUDENTS AND TIME STUDIED EACH DAY FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th></th>
<th>10 minutes or less</th>
<th>11 to 20 minutes</th>
<th>21 to 30 minutes</th>
<th>More than 31 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section A</td>
<td>54.2</td>
<td>25.0</td>
<td>20.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Section B</td>
<td>50.0</td>
<td>45.3</td>
<td>0.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Section C</td>
<td>51.9</td>
<td>29.6</td>
<td>14.8</td>
<td>3.7</td>
</tr>
</tbody>
</table>

gave an F ratio of .04. To be significant at the .05 level, an F ratio of 3.13 is needed when the degrees of freedom are 2 and 70. Thus, there was no significant difference among the means of the reported daily study time for the three sections. Therefore, the null hypothesis, of no significant difference in the mean study time among the three groups at the .05 level, was accepted (see Table 5).

TABLE 5
ANALYSIS OF VARIANCE OF DAILY REPORTED STUDY TIME FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th>Components</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Variance</th>
<th>F</th>
<th>Tabled F .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Sets</td>
<td>227.86</td>
<td>2</td>
<td>113.93</td>
<td>.04</td>
<td>3.13</td>
</tr>
<tr>
<td>Within Sets</td>
<td>204,682.63</td>
<td>70</td>
<td>2,924.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>204,910.49</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Post-test

The study ended with the administration of a fifty item, short answer, post-test. The purposes of the post-test for the three groups were: (1) to allow the instructor to use the post-test as a comparison with the pre-test to determine the amount of improvement that had taken place; (2) to let the students see how well they had done on the unit; (3) to provide the students with incentive for units to follow; (4) to provide one of the criteria for assigning grades; (5) to enable the instructor to improve future teaching and learning situations; and (6) to infer which testing method in this study is better.

On the fifty item post-test, section A had a maximum raw score of 40 items correct, a minimum raw score of 20 items correct, a range of 20, a standard deviation of 5.30, and a mean of 26.87 items correct. Section B had a maximum raw score of 45 items correct, a minimum raw score of 10 items correct, a range of 35, a standard deviation of 9.70, and a mean of 26.41 items correct. Section C had a maximum raw score of 35 items correct, a minimum raw score of 10 items correct, a range of 25, a standard deviation of 6.78, and a mean of 21.18 items correct (see Table 6).

Section A had the highest minimum and mean raw scores of correct items on the post-test. Section B had the highest maximum raw score of correct items on the post-test. Section C had the lowest maximum and

\[\text{See Appendix IV.}\]
TABLE 6
POST-TEST RAW SCORES FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th></th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section A</td>
<td>40</td>
<td>20</td>
<td>20</td>
<td>26.87</td>
<td>5.30</td>
</tr>
<tr>
<td>Section B</td>
<td>45</td>
<td>10</td>
<td>35</td>
<td>26.41</td>
<td>9.70</td>
</tr>
<tr>
<td>Section C</td>
<td>35</td>
<td>10</td>
<td>25</td>
<td>21.18</td>
<td>6.78</td>
</tr>
</tbody>
</table>

lowest mean raw scores of correct items on the post-test (see Table 6). On the post-test the number of students having fifty percent of the items or more correct was fourteen in section A, thirteen in section B, and two in section C (see Figures 7, 8, and 9).

The F ratio for an analysis of variance of the post-test for the three sections was 4.83. To be significant at the .05 level, an F ratio of 3.13 is needed when the degrees of freedom are 2 and 70. Therefore, the null hypothesis, of no significant difference in the mean post-test scores among the three groups at the .05 level, was rejected (see Table 7).

Comparison of the Pre-test and Post-test Scores and Study Time

Section A, the daily quiz section, had the highest pre-test mean of 21.04, the highest post-test mean of 26.87, made the second largest point gain from the pre-test to the post-test of 5.83 points, and reported the highest mean amount of study time of 85.96 minutes per week. The t ratio
Fig. 7.--Post-Test Raw Scores for Students in Section A
Fig. 8.--Post-Test Raw Scores for Students in Section B
Fig. 9. --Post-Test Raw Scores for Students in Section C
TABLE 7
ANALYSIS OF VARIANCE OF POST-TEST SCORES
FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th>Components</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Variance</th>
<th>F</th>
<th>Tabled F .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Sets</td>
<td>511.02</td>
<td>2</td>
<td>255.51</td>
<td>4.83</td>
<td>3.13</td>
</tr>
<tr>
<td>Within Sets</td>
<td>3,700.02</td>
<td>70</td>
<td>52.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4,211.04</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

for the difference between the pre and post-test means was 3.49. To be significant at the .05 level, a t ratio of 2.01 is needed when the degrees of freedom are 46. Therefore, the t ratio was significant at the .05 level.

Section B, the weekly quiz section, had the second highest pre-test mean of 20.41, the second highest post-test mean of 26.41, the largest gain from the pre-test to the post-test of 6.00 points, and reported the lowest mean amount of study time of 82.09 minutes per week. The t ratio for the difference between pre and post-test means was 2.52. To be significant at the .05 level, a t ratio of 2.02 is needed when the degrees of freedom are 42. Therefore, the t ratio was significant at the .05 level.

Section C, the section having only a unit test, had the lowest pre-test mean of 18.63, the lowest post-test mean of 21.18, made the smallest gain from the pre-test to the post-test of 2.55 points, and reported the second highest mean amount of study time of 85.93 minutes per week. The t ratio for the difference between the pre and post-test means was 1.62. To be
significant at the .05 level, a t ratio of 2.00 is needed when the degrees of freedom are 52. Therefore, the t ratio was not significant at the .05 level (see Table 8).

TABLE 8

STUDY TIME, PRE & POST-TEST MEANS
FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th>Section</th>
<th>Study Mean</th>
<th>Pre-test Mean</th>
<th>Post-test Mean</th>
<th>df</th>
<th>t</th>
<th>Tabled t</th>
<th>Mean Gain Pre to Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>85.96</td>
<td>21.04</td>
<td>26.87</td>
<td>46</td>
<td>3.49*</td>
<td>2.01</td>
<td>5.83</td>
</tr>
<tr>
<td>B</td>
<td>82.09</td>
<td>20.41</td>
<td>26.41</td>
<td>42</td>
<td>2.52*</td>
<td>2.02</td>
<td>6.00</td>
</tr>
<tr>
<td>C</td>
<td>85.93</td>
<td>18.63</td>
<td>21.18</td>
<td>52</td>
<td>1.62</td>
<td>2.00</td>
<td>2.55</td>
</tr>
</tbody>
</table>

* significant at the .05 level

Coefficient of Correlation for the Reported Study Time and the Post-test Scores

A product-moment correlation coefficient was computed for all three sections for their reported study time and their post-test raw scores. Section A had a coefficient of .381 which was not significant at the .05 level. Section B had the highest coefficient of .677 which was significant at the .05 level. Section C had the lowest coefficient of .361 which was not significant at the .05 level. Therefore, the null hypothesis that there is no correlation between the study time and the post-test scores for the three groups is rejected (see Table 9).
TABLE 9

COEFFICIENT OF CORRELATION FOR THE REPORTED STUDY TIME AND THE POST-TEST SCORES FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th></th>
<th>Section A</th>
<th>Section B</th>
<th>Section C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of Correlation</td>
<td>.381</td>
<td>.677*</td>
<td>.361</td>
</tr>
</tbody>
</table>

* significant at the .05 level

Study Time Survey

The Study Time Survey was administered at the end of the study. 1 The reported study time per week for section A on the Study Time Survey was 180 minutes maximum, 0 minutes minimum, with a mean of 76.66 minutes. On the Daily Study Time Record sheet, section A reported a 205 minute maximum, a 12 minute minimum, giving a mean of 85.96 minutes per week. The mean difference between the Daily Study Time Record sheet and the Study Time Survey was 9.30 minutes per week. The t ratio for the difference between the Daily Study Time Record and the Study Time Survey was .60. To be significant at the .05 level, a t ratio of 2.01 is needed when the degrees of freedom are 46. Therefore, the t ratio was not significant at the .05 level.

The reported study time per week for section B on the Study Time Survey was 180 minutes maximum, 0 minutes minimum, with a mean of 73.41

1See Appendix VIII.
minutes. On The Daily Study Time Record sheet, section B reported a 212 minute maximum, a 9 minute minimum, giving a mean of 82.09 minutes per week. The mean difference between the Daily Study Time Record sheet and the Study Time Survey was 8.68 minutes per week. The t ratio for the difference between the Daily Study Time Record and the Study Time Survey was .67. To be significant at the .05 level, a t ratio of 2.02 is needed when the degrees of freedom are 42. Therefore, the t ratio was not significant at the .05 level.

The reported study time per week for section C on the Study Time Survey was 240 minutes maximum, 0 minutes minimum, with a mean of 74.26 minutes. On the Daily Study Time Record sheet, section C reported a 229 minute maximum, a 15 minute minimum, giving a mean of 85.93 minutes per week. The mean difference between the Daily Study Time Record sheet and the Study Time Survey was 11.67 minutes per week. The t ratio for the difference between the Daily Study Time Record and the Study Time Survey was .79. To be significant at the .05 level, a t ratio of 2.00 is needed when the degrees of freedom are 52. Therefore, the t ratio was not significant at the .05 level (see Tables 3, 10, and 11).

Section A reported that students studied by themselves 90 percent of the time, they studied with classmates 8 percent of the time, and by other methods 2 percent of their study time. Section B students reported studying 95 percent of the time by themselves, 3 percent of the time with classmates, and 2 percent of their time with an adult. Section C students re-
TABLE 10

\textit{t} TEST OF WEEKLY STUDY TIME MEANS FOR THE STUDY TIME SURVEY AND THE DAILY STUDY TIME RECORD FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th>Section</th>
<th>Daily Record Mean</th>
<th>Survey Mean</th>
<th>df</th>
<th>t</th>
<th>Tabled t</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>85.96</td>
<td>76.66</td>
<td>46</td>
<td>.60</td>
<td>2.01</td>
<td>9.30</td>
</tr>
<tr>
<td>B</td>
<td>82.09</td>
<td>73.41</td>
<td>42</td>
<td>.67</td>
<td>2.02</td>
<td>8.68</td>
</tr>
<tr>
<td>C</td>
<td>85.93</td>
<td>74.26</td>
<td>52</td>
<td>.79</td>
<td>2.00</td>
<td>11.67</td>
</tr>
</tbody>
</table>

Reported studying 85 percent of the time by themselves, 13 percent of the time with classmates, and 2 percent of the time with an adult (see Table 11).

Section A reported that 22 percent of the students' study time was spent reading the textbook, 4 percent re-reading the textbook, 29 percent studying vocabulary cards, 40 percent doing exercises, 3 percent reading other books, and 2 percent using workbooks. Section B reported that 23 percent of the students' study time was spent reading the textbook, 8 percent re-reading the textbook, 30 percent studying vocabulary cards, 24 percent doing exercises, 13 percent reading other books, 2 percent in other types of studying. Section C reported that 37 percent of the students' study time was spent reading the textbook, 16 percent re-reading the textbook, 14 percent studying vocabulary cards, 30 percent doing exercises, 2 percent reading other books, and 1 percent of the time was spent studying with tutors (see Table 11).
### TABLE 11

**STUDY TIME SURVEY SUMMARY**
**FOR SECTIONS A, B AND C**

<table>
<thead>
<tr>
<th></th>
<th>Section A</th>
<th>Section B</th>
<th>Section C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Minutes of weekly study time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>180</td>
<td>180</td>
<td>240</td>
</tr>
<tr>
<td>Minimum</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>76.66</td>
<td>73.41</td>
<td>74.26</td>
</tr>
<tr>
<td><strong>2. Percentage of weekly study time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. by yourself</td>
<td>90</td>
<td>95</td>
<td>85</td>
</tr>
<tr>
<td>b. with classmates</td>
<td>8</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>c. with an adult</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>d. by other methods</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>3. Percentage of weekly study time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. read textbook</td>
<td>22</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td>b. re-read textbook</td>
<td>4</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>c. study vocabulary cards</td>
<td>29</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>d. do exercises</td>
<td>40</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>e. read other books</td>
<td>3</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>f. use workbooks</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>g. tutors</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>h. other</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

An analysis of variance performed for the Study Time Survey gave an F ratio of 0.02. To be significant at the .05 level, an F ratio of 3.13 is needed when the degrees of freedom are 2 and 70. Thus, there was no significant difference among the means of the Study Time Survey for the three sections (see Table 12).
TABLE 12

ANALYSIS OF VARIANCE OF WEEKLY STUDY TIME FOR THE STUDY TIME SURVEY FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th>Components</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Variance</th>
<th>F</th>
<th>Tabled F .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Sets</td>
<td>135.08</td>
<td>2</td>
<td>67.54</td>
<td>.02</td>
<td>3.13</td>
</tr>
<tr>
<td>Within Sets</td>
<td>203,786.84</td>
<td>70</td>
<td>2,911.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>203,921.92</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary of Study Time, Pre & Post-Tests for Sections A, B and C

The F ratio for an analysis of variance of the pre-test for the three sections was 1.74 which was not significant at the .05 level. Therefore, the null hypothesis, of no significant difference in the mean pre-test scores among the three groups, was accepted. An analysis of variance performed for the reported daily study time gave an F ratio of .04 which was not significant at the .05 level. Therefore, the null hypothesis, of no significant difference in the mean study time among the three groups, was accepted.

The F ratio for an analysis of variance of the post-test for the three sections was 4.51 which was significant at the .05 level. Therefore, the null hypothesis, of no significant difference in the mean post-test scores among the three groups, was rejected (see Table 13).

To decide which pairs of post-test means differed significantly all pos-
TABLE 13
SUMMARY OF STUDY TIME, PRE & POST-TESTS
FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th></th>
<th>Section A</th>
<th>Section B</th>
<th>Section C</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Time Mean</td>
<td>85.96</td>
<td>82.09</td>
<td>85.93</td>
<td>.04</td>
</tr>
<tr>
<td>Pre-test Mean</td>
<td>21.04</td>
<td>20.41</td>
<td>18.63</td>
<td>1.74</td>
</tr>
<tr>
<td>Post-test Mean</td>
<td>26.87</td>
<td>26.41</td>
<td>21.18</td>
<td>4.51*</td>
</tr>
</tbody>
</table>

* significant at the .05 level

sible pairs among the three sections were tested individually with a t test.\(^2\)
The t ratio for sections A and B was .19 which was not significant at the .05 level. The t ratio for sections A and C was 3.23 which was significant at the .05 level. The t ratio for sections B and C was 2.17 which was significant at the .05 level (see Table 14).

Vocabulary Cards

It was suggested that vocabulary cards be used as a study aid. As an incentive to make and use vocabulary cards, the students of all sections were given twenty-five extra credit points at the end of the marking period.

---

1 The results are typical of a pilot study that was conducted earlier in the year although those results were not statistically checked.

TABLE 14

*t TEST OF POST-TEST MEANS FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th>Section</th>
<th>Post-test Means</th>
<th>df</th>
<th>t</th>
<th>Tabled t .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>26.87</td>
<td>44</td>
<td>.19</td>
<td>2.01</td>
</tr>
<tr>
<td>B</td>
<td>26.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>44 .19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>26.87</td>
<td>49</td>
<td>3.23*</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>- 21.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>21.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>47 2.17*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* significant at the .05 level

for turning in the cards. It was further suggested that the students make these vocabulary cards at the beginning of the class period when the words were assigned. Thus, the making of the vocabulary cards became an easy, optional assignment for which time was provided in class. The percentage of students handing in cards for extra credit in section A was 70.8, in section B 59.1 and section C 49.1 (see Table 15).

TABLE 15

VOCABULARY CARDS TURNED IN FOR EXTRA CREDIT FOR SECTIONS A, B AND C

<table>
<thead>
<tr>
<th></th>
<th>Section A</th>
<th>Section B</th>
<th>Section C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Students</td>
<td>70.8</td>
<td>59.1</td>
<td>49.1</td>
</tr>
<tr>
<td>Turning in Cards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Students</td>
<td>29.2</td>
<td>40.9</td>
<td>51.9</td>
</tr>
<tr>
<td>Not Turning in Cards</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In section A two students had lower grades on the post-test than on the pre-test. One of these students handed in vocabulary cards and the other did not (see Table 16). In section B, three students had lower grades on the post-test than on the pre-test. One of these students handed in vocabulary cards and two did not (see Table 17). In section C, eight students had lower grades on the post-test than on the pre-test. Three of these students handed in vocabulary cards and five did not (see Table 18).

For section A, the students receiving the five highest scores on the post-test handed in vocabulary cards (see Table 16). In section B, the students receiving the four highest scores on the post-test handed in vocabulary cards (see Table 17). In section C, the students receiving the two highest scores on the post-test handed in vocabulary cards (see Table 18).

**Student Evaluation**

A student evaluation consisting of twenty items was given at the end of the study. Sections A and B answered all twenty items. Section C was instructed not to answer items one through eight and fifteen (see Table 19). The evaluation mainly concerned quizzes, vocabulary words and vocabulary cards. Questions one through eight referred to quizzes and ten through sixteen to the vocabulary words. Some of the questions on the quizzes were repeated with a slight change for the vocabulary words. Questions seventeen through nineteen referred to the vocabulary cards. Other ques-

---

1 See Appendix IX.
### TABLE 16

**TABULATION OF STANINES, STUDY TIME, TEST SCORES AND VOCABULARY CARDS FOR SECTION A**

<table>
<thead>
<tr>
<th>Student</th>
<th>Stanine</th>
<th>Mean Study Time Min. Per Week</th>
<th>Pre-test Scores</th>
<th>Post-test Scores</th>
<th>Mean Study Time Survey Min. Per Week</th>
<th>Vocabulary Cards Extra Credit</th>
<th>Scores on Post-test Below Pre-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>5</td>
<td>25</td>
<td>29</td>
<td>24</td>
<td>20</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>4</td>
<td>18</td>
<td>17</td>
<td>21</td>
<td>15</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>5</td>
<td>137</td>
<td>16</td>
<td>26</td>
<td>90</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>5</td>
<td>70</td>
<td>21</td>
<td>31</td>
<td>60</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>6</td>
<td>58</td>
<td>22</td>
<td>20</td>
<td>75</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>4</td>
<td>205</td>
<td>23</td>
<td>35</td>
<td>180</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>6</td>
<td>12</td>
<td>28</td>
<td>29</td>
<td>35</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>NA</td>
<td>54</td>
<td>18</td>
<td>25</td>
<td>35</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>6</td>
<td>34</td>
<td>21</td>
<td>24</td>
<td>20</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>6</td>
<td>35</td>
<td>21</td>
<td>30</td>
<td>30</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>6</td>
<td>151</td>
<td>33</td>
<td>39</td>
<td>180</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>4</td>
<td>131</td>
<td>22</td>
<td>24</td>
<td>90</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>6</td>
<td>142</td>
<td>24</td>
<td>40</td>
<td>90</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>6</td>
<td>51</td>
<td>17</td>
<td>22</td>
<td>90</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>6</td>
<td>99</td>
<td>24</td>
<td>28</td>
<td>120</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>4</td>
<td>85</td>
<td>21</td>
<td>27</td>
<td>180</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>6</td>
<td>164</td>
<td>20</td>
<td>23</td>
<td>50</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>4</td>
<td>90</td>
<td>19</td>
<td>25</td>
<td>60</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>NA</td>
<td>157</td>
<td>13</td>
<td>22</td>
<td>150</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>5</td>
<td>59</td>
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o criterion not met
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TABLE 18

TABULATION OF STANINES, STUDY TIME, TEST SCORES, AND VOCABULARY CARDS FOR SECTION C

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x  criterion met

o  criterion not met
Results of Responses

**Question one**  The giving of quizzes is a ____ method of teaching. The purpose of this question was to determine how the students felt about taking daily vocabulary quizzes as a learning technique. The percentage of students checking "good" was 79.0 in section A and 57.9 in section B. None of the students in section A and 5.3 percent of the students in section B thought the quizzes were a "poor" method. From this it would seem that the students favored daily quizzes over weekly quizzes and did not resent having a daily quiz.

**Question two**  Did the use of quizzes help you understand biology? This question was used to determine how the students felt taking quizzes related to their understanding of biology. In section A, 68.4 percent of the students checked "greatly." In section B, 52.7 percent of the students felt the relationship was "slight." This could have been because section B received only weekly quizzes.

**Question three**  Did the use of quizzes increase your knowledge of biology more than other methods of studying used in this course? This question was used to determine how students felt about quizzes as compared to other studying methods used in the course. In section A, 47.3 percent of the students checked "greatly," but 73.7 percent of the students in section
B checked "slightly," indicating that they did not feel quizzes were vastly superior to other methods.

Question four Could the time devoted to study and taking of quizzes have been better spent on some other learning activity? The percentage of students that felt the use of quizzes was a profitable learning activity was 84.2 in section A and 68.4 in section B.

Question five Did the taking of quizzes help you prepare for the unit test? The purpose of this question was to determine if the students saw any relationship between studying for the quizzes and the unit test. In section A, 68.4 percent of the students checked "greatly." However, 57.9 percent of the students in section B checked "slightly," and 10.5 percent of the students in section B checked "not at all."

Question six Did the taking of quizzes cause you to do ____ studying of assignments? This question was used to determine whether the students felt compelled to study their assignments due to the taking of quizzes. The percentage of students studying more was 21.0 in section A and 26.3 in section B. The percentage of students studying the same amount was 63.2 in section A and 52.7 in section B.

Question seven Did the thought of having a quiz cause you to study? This question was used to determine if the student felt motivated to study because he knew he was going to have a quiz. The percentage of students
checking "slightly" was 52.7 in section A and 57.9 in section B.

Question eight Was the grading of quizzes _____? This question gave the students the opportunity to express their feelings about the grading system. In section A, 89.5 percent of the students thought the grading was "about right," but 10.5 percent of the students thought it was "too strict." Everyone in section B thought the grading was "about right."

Question nine Did the thought of having a unit test cause you to study? This question relates to question seven and was used to determine if a unit test had a greater motivational effect on study than quizzes. For section A, there was a shift toward more studying for the unit test as compared with the quizzes, but 57.9 percent of the students still checked "slightly." In section B, there was a reverse from question seven with 52.7 percent of the students checking "greatly." It was assumed that the students in section C, included in this question, would have been highly motivated to study for their one and only test, but 47.4 percent of the students checked "slightly," and 5.2 percent of the students checked "not at all."

Question ten Was the learning of vocabulary words a _____ study method? In determining how students felt about the learning of vocabulary words, the percentage of students checking "good" was 73.7 in section A, 68.4 in section B, and 63.2 in section C. In both sections B and C, 10.5 percent of the students checked "poor."
**Question eleven**  Did the vocabulary words help you understand biology?

This question was used to determine if the students saw a relationship between vocabulary words and understanding biology. In both sections A and B, 63.2 percent of the students checked "greatly," and 47.4 percent of the students checked "greatly" in section C. In both sections B and C, 5.2 percent of the students checked "not at all."

**Question twelve**  Was the learning of vocabulary words helpful in studying biology? The intent of this question was to determine if the students thought the vocabulary words were helpful. The percentage of students checking "greatly" was 73.7 in section A, 63.2 in section B, and 57.9 in section C.

**Question thirteen**  Did the use of vocabulary words increase your knowledge of biology more than other methods of studying used in the course? The purpose of this question was to determine if the students thought the presentation of vocabulary words as the best method of studying used in the course. The percentage of students checking "greatly" was 47.4 in section A, 57.2 in section B, and 31.6 in section C.

**Question fourteen**  Could the time devoted to the learning of vocabulary words have been better spent in some other learning activity? This question was used to determine if the students felt there were better learning activities than studying vocabulary words. The percentage of students fa-
voring vocabulary words as a learning activity was 89.5 in section A, 79.0 in section B, and 68.4 in section C. This may have been due to the stress placed on vocabulary words.

**Question fifteen** Did the learning of vocabulary words help you study for quizzes? This question was used to determine if the students saw a relationship between the learning of vocabulary words and studying for the quizzes. In section A, 73.7 percent of the students checked "greatly." In section B, 52.7 percent of the students checked "greatly," and 5.3 percent of the students checked "not at all."

**Question sixteen** Did the learning of vocabulary words help you study for the unit test? This question relates to question fifteen and was used to determine if the students saw a greater relationship between the learning of vocabulary words and the studying for the unit test or the quizzes. The percentage of students who saw only a "slight" relationship between the learning of vocabulary words and the studying for the unit test was 63.2 in section A, 57.9 in section B, and 73.7 in section C.

**Question seventeen** Did you try to use vocabulary cards as a study aid in other subjects? The assumption was made that if the students thought that the vocabulary cards were a good study aid, they would use them in other classes. The percentage of students not using the cards was 63.2 in section A, 47.5 in section B, and 63.1 in section C. It would seem that this study method did not transfer to other subjects.
Question eighteen  Was the use of vocabulary cards a ___ study aid?
The purpose of this question was to determine how the students felt about using vocabulary cards. The percentage of students checking "good" was 79.0 in both sections A and B and 63.2 in section C. This shows that a majority in all sections considered the use of vocabulary cards a good study aid for the learning of vocabulary words.

Question nineteen  Did you use vocabulary cards? This question was used to determine if the students actually used the vocabulary cards. The percentage of students checking "greatly" was 63.2 in section A, 52.7 in section B, and 31.6 in section C. Although students may consider the use of vocabulary cards a good study aid, they may not necessarily use them in this class or any other class.

Question twenty  If you have any further comments on this unit, please write them on the back of this questionnaire. This item gave the students the opportunity to comment on the teaching methods. The percentage of students answering this item was 68.5 in section A, 47.4 in section B, and 73.6 in section C. The comments covered a wide range of topics concerning the subject and class activities. Some students repeated comments from the previous questions or elaborated upon them. Some stated that the subject was easier than they thought it would be. Others thought there was too much work and some of it boring. Still others thought the course was too strict. One student stated he did not know why he took biology, because
he did not like science very much. Another was more explicit in writing, "I hate science." Still others wrote, "The cards are a good idea, if you study, that is," and "You can't study biology every night when you have homework in other subjects." There were other favorable comments concerning the learning of vocabulary words, the use of vocabulary cards, and classroom organization.
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STUDENT EVALUATION SUMMARY  
FOR SECTIONS A, B AND C

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CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effect daily vocabulary quizzes have on study time of high school biology students and the students' achievement on a unit test. Three regular level biology classes, at Gage Park High School, Chicago, Illinois, were used in this study. The information for the study was obtained from: (1) a review of the literature on studying and homework, and the use of vocabulary in teaching; (2) an analysis of the achievement results of three classes, one using daily ten point vocabulary quizzes, another weekly twenty point quizzes, and a third a fifty point unit test; and (3) an examination of the use of students' vocabulary cards, daily study time records, study time surveys, and unit evaluations.

A pre-test was given to all three sections at the beginning of the study to determine how much the students knew about the reproduction unit of biology. The study ended with the administration of a post-test (same as pre-test to determine the amount of learning that had taken place. The students were given three vocabulary words each day, and it was suggested
that they make vocabulary cards as a study aid. Daily study sheets were used by the students to keep a record of their study time. Students figured their own grades. Students recorded the percentage of time spent in different types of study situations. A course evaluation sheet was used to gain an insight into ways to improve the teaching methods and to understand how the students viewed the course.

The Experiment

The findings of the study are summarized as follows: (1) the null hypothesis of no significant difference in the mean pre-test scores among the three groups was accepted, indicating there was no initial difference among the groups; (2) the null hypothesis of no significant difference in the mean post-test scores among the three groups was rejected. In examining the means of the post-test scores of the three groups, it was found that a higher mean results as the amount of testing increases; (3) the null hypothesis of no significant difference in the mean study time among the three groups was accepted as indication that the amount of testing had no influence over the amount of time spent studying; and (4) the null hypothesis of no correlation between mean study time and mean post-test scores among the three groups was rejected. Section B had a correlation coefficient of .667 as compared to section A with a correlation coefficient of .381 and section C with a correlation coefficient of .361. The correlation coefficient of section A was slightly higher than that of section C but neither relationships were significant at
The correlation coefficient of section B was considerably higher than either sections A or C and was significant at the .05 level.

**Vocabulary Cards** The students should have handed in seventy-five vocabulary cards in five weeks. The percentage of students not handing in vocabulary cards was: (1) 29.2 percent in section A; (2) 40.9 percent in section B; and (3) 51.9 percent in section C (see Table 15). The students in section C may not have handed in vocabulary cards for extra credit points due to over confidence of good performance on the unit test. Also, they had no prior testing experience on the material covered in the unit and would not see the relationship of studying the vocabulary words to the testing program. In addition, it would seem that some students will not take advantage of extra credit work even if it is relatively easy to do.

**Daily Study Time Record** The students were informed at the beginning of the year that they were expected to keep up with the reading assignments, spend at least thirty minutes each day studying biology, and complete all unfinished class exercises for homework. They used the Daily Study Time Record sheets to record the amount of time they spent studying alone, with classmates, with adults and on other study methods.

Considering that the students had four major subjects to study each day, the requirement to study biology thirty minutes a day should not be considered unreasonable. If the student did study the required thirty minutes a day, the total for the week would be three and one-half hours of study.
time. The highest reported study time of about thirty-three minutes per
day was only slightly above this requirement, while the mean reported
study time was about twelve minutes (see Table 3).

The mean study time for the Daily Study Time Record and the Study
Time Survey for the three groups were compared using t tests. The t
ratios were not significant (see Table 10). This may indicate that the use
of Daily Study Time Record sheets was not necessary, and that the Study
Time Survey may have been sufficient.

**Study Time Survey** The students reported a lower weekly study time on the
Study Time Survey than they did on the Daily Study Time Record (see Ta­
bles 3 and 11). The reasons for this may have been that: (1) the students
estimated their mean weekly study for the whole unit and did not have a day
by day record; (2) they rounded their estimates off in hour and half hour
intervals; and (3) some students listed their study time as "0" when they
had previously reported some study time.

On the Daily Study Time Record the students indicated that they stud­
ied over ninety-seven percent of the time by themselves. On the Study
Time Survey the students indicated that they studied eighty-five to ninety­
five percent of the time by themselves. The Daily Study Time Record may
be more accurate than the Study Time Survey as the amount of study time
was recorded each day (see Tables 3 and 11).

The Study Time Survey indicated that the major type of studying done
by students consisted of reading the textbook, followed by studying vocabu-
Iary words and doing written assignments. Very little study time was devoted to re-reading the textbook, reading other books, using workbooks, or studying with tutors (see Table 11). Thus, if a student was going to study, he would probably read the textbook by himself.

**Student Evaluation** The Student Evaluation revealed that the majority of students were not averse to daily vocabulary quizzes, and they saw value in repeating quizzes over similar material. However, the majority of students could not be motivated to study for these quizzes. Likewise, the majority of students felt that the learning of vocabulary words was a good study method but did not seem willing to do the studying. Also, most students thought that the use of vocabulary cards was a good study aid, but again only a small percentage of the students actually used them. A number of students made the vocabulary cards the night before they were to be collected to receive extra credit points.

**Conclusion**

The results of this study indicated that the administering of a daily quiz in biology had a slight but not significant advantage over a weekly quiz in improving student achievement on the post-test. There were indications that giving either daily or weekly quizzes may be a better method of testing than giving only one test at the end of a unit.

The major problem with the administration and discussion of a daily quiz was that the time involved at least twelve minutes or about one-third
of the daily class time. Although the taking of a daily quiz may force stu-
dents to study, it would seem that about two-thirds of all the students in
this experiment studied very little or not at all. Thus, considering the
amount of time involved in giving daily quizzes, discussing them, and re-
cording their grades, the results produced might not warrant such time
priorities.

**Recommendations for Further Research**

Different study techniques could be substituted for the use of vocabu-
lary cards. It might be determined if the techniques would transfer to
learning situations other than biology. The number of words studied each
day could be varied to determine if there is an optimal amount.

The timing of introducing words could also be varied. In this study the
words were given at the beginning of each class period. The students im-
mediately looked up their definition, and the meaning of each word was dis-
cussed. It might be better to assign the words as they appear in the class
lesson or as a list to study as desired.

A study like this should not be conducted at the beginning of the school
year, because students are entering class or being transferred to other
classes for about a four week period. The study should also not be held
during the last few weeks of the school year, because students may be
leaving school or starting early vacations.
SELECTED BIBLIOGRAPHY
A. BOOKS


B. PERIODICALS


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Front of Card

Definition

Back of Card
QUIZ-BIOLOGY VOCABULARY

Mark the correct LETTER on the answer sheet.

1. reproduction by only one parent  
2. a reproductive cell whose nucleus fuses with that of another, thus starting a new organism  
3. a method of asexual reproduction in which a swelling on the parent's body grows into an organism that is like the parent  
4. sperm-making organ  
5. an animal that has both ovaries and testes  
6. the theory that non-living matter could produce living organisms  
7. a small male cell usually able to swim  
8. reproduction that starts with the union of two sex cells  
9. the uniting of an egg and sperm  
10. the growth of an unfertilized plant or animal egg into an embryo

a. asexual reproduction  
b. budding  
c. conjugation  
d. egg  
e. embryo  
f. fertilization  
g. fission  
h. gamete  
i. hermaphrodite  
j. ovary  
k. parthenogenesis  
l. sexual reproduction  
m. sperm  
n. spontaneous generation  
o. testis
QUIZ-BIOLOGY VOCABULARY

Mark the correct LETTER on the answer sheet.

1. the uniting of an egg and sperm
2. reproduction that starts with the union of two sex cells
3. reproduction by only one parent
4. egg-making organ
5. the growth on an unfertilized plant or animal egg into an embryo
6. a method of asexual reproduction in which a swelling on the parent's body grows into an organism that is like the parent
7. sperm-making organ
8. reproduction involving the splitting of a cell into two parts
9. the uniting of two cells, often of similar size and appearance
10. a female sex cell (ovum)

a. asexual reproduction  
b. budding  
c. conjugation  
d. egg  
e. embryo  
f. fertilization  
g. fission  
h. gamete  
i. hermaphrodite  
j. ovary  
k. parthenogenesis  
l. sexual reproduction  
m. sperm  
n. spontaneous generation  
o. testis
QUIZ-BIOLOGY VOCABULARY

Mark the correct LETTER on the answer sheet.

1. a young organism in its earliest stages of growth
2. reproduction involving the splitting of a cell into two parts
3. a method of asexual reproduction in which a swelling on the parent's body grows into an organism that is like the parent
4. a reproductive cell whose nucleus fuses with that of another, thus starting a new organism
5. a female sex cell (ovum)
6. sperm-making organ
7. the theory that non-living matter could produce living organisms
8. egg-making organ
9. a small male cell usually able to swim
10. the uniting of two cells, often of similar size and appearance

a. asexual reproduction  i. hermaphrodite
b. budding  j. ovary
c. conjugation  k. parthenogenesis
d. egg  l. sexual reproduction
e. embryo  m. sperm
f. fertilization  n. spontaneous generation
g. fission  o. testis
h. gamete
QUIZ-BIOLOGY VOCABULARY

Mark the correct LETTER on the answer sheet.

1. reproduction involving the splitting of a cell into two parts
2. the uniting of two cells, often of similar size and appearance
3. a young organism in its earliest stages of growth
4. a female sex cell (ovum)
5. the growth of an unfertilized plant or animal egg into an embryo
6. the uniting of an egg and sperm
7. reproduction that starts with the union of two sex cells
8. a small male cell usually able to swim
9. the theory that non-living matter could produce living organisms
10. an animal that has both ovaries and testes

a. asexual reproduction  i. hermaphrodite  
b. budding  j. ovary  
c. embryo  k. parthenogenesis  
d. egg  l. sexual reproduction  
e. conjugation  m. sperm  
f. fertilization  n. spontaneous generation  
g. fission  o. testis  
h. gamete
APPENDIX III

TWENTY ITEM QUIZZES
QUIZ-TWO TYPES OF REPRODUCTION

Place the correct word or words next to the number.

1. an egg whose nucleus has fused with that of a sperm
2. an egg-making organ
3. reproduction by only one parent
4. a reproductive cell whose nucleus fuses with that of another, thus starting a new organism
5. a large female cell, usually stationary
6. a method of asexual reproduction in which a swelling on the parent's body grows into an organism that is like the parent
7. sperm-making organ
8. an animal that has both ovaries and testes
9. the theory that non-living matter could produce living organisms
10. a small male cell usually able to swim
11. reproduction that starts with the union of two sex cells
12. the uniting of two cells, often of similar size and appearance
13. the person who finally disproved the theory of spontaneous generation
14. the fused mass in spirogyra, when the cells of two filaments unite
15. the uniting of an egg and a sperm

For the following, mark (a) if the method is asexual and (b) if the method is sexual.

16. fusion of two gametes
17. conjugation of paramecium before dividing
18. dividing of ameba into two equal parts
19. budding of hydra
20. grafting of an apple tree
QUIZ-REPRODUCTION IN HIGHER PLANTS

Mark the correct LETTER on the answer sheet.

1. After fertilization, an ovule in a bean flower becomes the (a) embryo. (b) pod. (c) fruit. (d) seed.
2. A germinating pollen grain develops (a) an ovary. (b) a pollen tube. (c) a seed. (d) an embryo.
3. Anthers are related to stamens as ovaries are related to (a) pistils. (b) filaments. (c) stigmas. (d) styles.
4. A pistillate flower must be (a) self-pollinated. (b) perfect. (c) cross-pollinated. (d) complete.
5. Pollination in flowers is completed as soon as (a) an embryo is formed. (b) pollen reaches the pistil. (c) the petals fall off. (d) a pollen tube is formed.
6. The roots of a pea plant develop from the (a) hilum. (b) cotyledon. (c) hypocotyl. (d) plumule.
7. After fertilization occurs in an apple blossom, the (a) ovule becomes the embryo. (b) pollen tube becomes the micropyle. (c) ovary becomes the fruit. (d) egg becomes the seed.
8. Seed plants are to pollen as vertebrates are to (a) genes. (b) hormones. (c) sperms. (d) blood.
9. A cell that unites with another cell to form a new organism is a (a) zygote. (b) gamete. (c) neuron. (d) seed.
10. A part of a flower that is not a female structure is the (a) stigma. (b) microple. (c) petal. (d) anther.
11. An imperfect flower lacks either (a) pistils or petals. (b) petals or stamens. (c) pistils, petals, or sepals. (d) pistils or stamens.
12. The bulk of a corn grain is filled with (a) endosperm. (b) testa. (c) cotyledons. (d) embryo.
13. The ovule of an apple blossom is the structure in which (a) an apple develops. (b) pollination takes place. (c) fertilization occurs. (d) six ova are formed.
14. An essential part of a flower is the (a) stamen. (b) petal. (c) sepal. (d) peduncle.
15. The bulk of a bean seed is filled with (a) endosperm. (b) testa. (c) cotyledons. (d) embryo.
16. An oval scar marking the point of attachment of a bean is the (a) hilum. (b) testa. (c) micropyle. (d) hypocotyl.
17. A large quantity of food is stored in a seed or corn in the (a) cotyledon. (b) endosperm. (c) plumule. (d) hypocotyl.
18. An example of a monocotyledon is (a) a bean. (b) corn. (c) a pea. (d) a peanut.
19. The opening in the ovule wall through which the pollen tube enters is the (a) cotyledon. (b) endosperm. (c) micropyle. (d) style.
20. A structure in a flower which matures into a seed after fertilization is (a) ovary. (b) ovule. (c) hypocotyl. (d) plumule.
QUIZ-REPRODUCTION IN HIGHER ANIMALS

Place the correct word or words next to the number.

1. the vertebrate class that produces the largest number
   of eggs
2. a mammal that has the longest gestation period
3. the common name of the placenta
4. sperms of a fish
5. fish eggs
6. ovum
7. the structure through which a mammal embryo is nourished
   before birth
8. pertaining to a mammal that is carrying unborn young
9. the cord that connects the mammal embryo with the placenta
10. the organ within which the human and other mammal embryos
    develop

Place a (true) or (false) next to the number.

11. Every cell in the human body contains a different number of chromo-
    somes.
12. The human sperm contains twenty-three chromosomes.
13. Each human ovary produces an ovum every twenty-eight days.
14. The mammal embryo uses its stomach before birth.
15. The eggs of the earthworm are fertilized in the oviducts.
17. The mammal embryo does not use its lungs before birth.
18. The eggs of fish are fertilized in the uterus.
19. The oviduct is the duct through which sperms leave the testis.
20. The eggs of snakes are fertilized as they leave the body.
QUIZ-GROWTH OF ANIMAL EMBRYOS

Mark the correct LETTER on the answer sheet.

1. The endoderm layer of an embryo gives rise to the (a) digestive tract.  
   (b) nerve tissue.  (c) bone tissue.  (d) muscles.
2. During mitotic cell division, the (a) chromosomes split in half.  
   (b) chromosomes duplicate themselves.  (c) cell membrane breaks.  
   (d) cell membrane disappears.
3. If a skin cell contains sixteen chromosomes, after mitosis each new cell 
   contains (a) four chromosomes.  (b) eight chromosomes.  (c) sixteen 
   chromosomes.  (d) thirty-two chromosomes.
4. In the development of a chicken embryo, fertilization is soon followed by 
   (a) meiosis.  (b) reduction division.  (c) cell division.  (d) maturation.
5. If an egg cell of an organism has twelve chromosomes, a (a) fat cell has 
   three.  (b) sperm cell has six.  (c) nerve cell has twelve.  (d) bone cell 
   has twenty-four.
6. Spermatozoa in man (a) undergo gestation.  (b) are produced in the 
   sperm duct.  (c) contain twenty-three chromosomes.  (d) have two genes 
   for each trait.
7. The technical name for the nuclear changes that lead to reduction divi-
   sion is (a) mitosis.  (b) meiosis.  (c) hermaphroditism.  (d) meta-
   morphosis.
8. In most mammals, fertilization occurs in the (a) uterus.  (b) ovary.  
   (c) testes.  (d) oviduct.
9. The ectoderm layer of an embryo gives rise to the (a) digestive tract.  
   (b) nerve tissue.  (c) bone tissue.  (d) muscles.
10. Maturation of one egg mother cell results in (a) a cell with haploid 
    number.  (b) a cell with diploid chromosome number.  (c) forty-eight 
    centromeres.  (d) four egg cells.
11. The inner lining of the digestive system of a developing embryo arises 
    from the (a) ectoderm.  (b) endoderm.  (c) endosperm.  (d) mesoderm.
12. Each sperm mother cell produces (a) one sperm by mitotic cell division.  
    (b) one sperm by reduction division.  (c) four sperms by parthenogenesis.
13. Fertilization normally restores the (a) plasma genes.  (b) haploid chro-
    mosome number.  (c) diploid chromosome number.  (d) linkage groups.
14. If the muscle cell of an animal normally has twenty-four chromosomes, 
    (a) a skin cell has six.  (b) an egg cell has twelve.  (c) a sperm cell has 
    twenty-four.  (d) a nerve cell has forty-eight.
15. The stage in mitosis in which two new nuclei and two new cells are form-
    ed is (a) anaphase.  (b) metaphase.  (c) prophase.  (d) telophase.
16. The first process to occur is (a) meiosis.  (b) gestation.  (c) cell 
    differentiation.  (d) fertilization.
17. The mesoderm layer of an embryo gives rise to the (a) digestive tract.  
    (b) nervous system.  (c) muscles.  (d) respiratory tract.
18. The stage in mitosis in which the chromosomes move away from the equator is (a) anaphase. (b) metaphase. (c) prophase. (d) telophase.

19. A structure in the chicken embryo that serves as a respiratory organ is (a) amnion. (b) yolk. (c) allantois. (d) chalaza.

20. The stage in mitosis in which the spireme breaks up to form chromosomes is the (a) anaphase. (b) interphase. (c) prophase. (d) metaphase.
TEST-REPRODUCTION

Mark the correct LETTER on the answer sheet.

1. The egg cells of a mammal are produced in the (a) oviducts. (b) ovaries. (c) sperm ducts. (d) testes.
2. After fertilization, an ovule in a bean flower becomes the (a) embryo. (b) pod. (c) fruit. (d) seed.
3. A germinating pollen grain develops (a) an ovary. (b) a pollen tube. (c) a seed. (d) an embryo.
4. In the development of a chicken embryo, fertilization is soon followed by (a) meiosis. (b) reduction division. (c) mitosis. (d) maturation.
5. If an egg cell of an organism has twelve chromosomes, the (a) fat cell has three. (b) sperm cell has six. (c) nerve cell has twelve. (d) bone cell has twenty-four.
6. An apricot branch grafted onto a peach stock will bear (a) a combined apricot-peach. (b) apricots only. (c) peaches only. (d) some apricots and some peaches.
7. Spermatozoa in man (a) undergo gestation. (b) are produced in the sperm duct. (c) contain twenty-three chromosomes. (d) have two genes for each trait.
8. Anthers are related to stamens as ovaries are related to (a) pistils. (b) filaments. (c) stigmas. (d) styles.
9. The technical name for the nuclear changes that lead to reduction division is (a) mitosis. (b) meiosis. (c) hermaphroditism. (d) metamorphosis.
10. In most mammals, fertilization occurs in the (a) uterus. (b) ovary. (c) testes. (d) oviduct.
11. The ectoderm layer of a developing embryo gives rise to (a) bone. (b) nerve tissue. (c) stomach lining. (d) muscles.
12. A pistillate flower must be (a) self-pollinated. (b) perfect. (c) cross-pollinated. (d) complete.
13. Carbon dioxide and other wastes diffuse from the capillaries of a mammalian embryo into the mother's capillaries in the (a) placenta. (b) umbilical cord. (c) ovary. (d) ureters.
14. If a woman is Rh-negative, her second embryo may be injured or die if the (a) father is Rh-positive. (b) first child is Rh-negative. (c) embryo is Rh-negative. (d) father is Rh-negative.
15. The sperm cells of a cat are produced in the (a) oviducts. (b) ovaries. (c) uterus. (d) testes.
16. Pollination in flowers is completed as soon as (a) the pollen reaches the pistil. (b) the petals fall off. (c) a pollen tube is formed. (d) an embryo is formed.
17. The roots of a pea plant develop from the (a) hilum. (b) cotyledon. (c) hypocotyl. (d) plumule.
18. The inner lining of the digestive system of a developing embryo arises from the (a) ectoderm. (b) endoderm. (c) endosperm. (d) mesoderm.

19. The first process to occur is (a) meiosis. (b) gestation. (c) cell differentiation. (d) fertilization.

20. Fertilization normally restores the (a) haploid chromosome number. (b) diploid chromosome number. (c) plasma genes. (d) linkage groups.

21. After fertilization occurs in an apple blossom, the (a) ovule becomes the embryo. (b) pollen tube becomes the micropyle. (c) ovary becomes the fruit. (d) egg becomes the seed.

22. Seed plants are to pollen as vertebrates are to (a) genes. (b) hormones. (c) sperms. (d) blood.

23. If the muscle cell of an animal normally has twenty-four chromosomes, (a) a skin cell has six. (b) an egg cell has twelve. (c) a sperm cell has twenty-four. (d) a nerve cell has forty-eight.

24. In mammals the placenta (a) surrounds the umbilical cord. (b) attaches the embryo to the uterus. (c) carries food into the embryo. (d) contains only the mother's capillaries.

25. A cell that unites with another cell to form a new organism is a (a) zygote. (b) gamete. (c) neuron. (d) seed.

26. When a zygote undergoes cell division, the process is known as (a) fertilization. (b) maturation. (c) conjugation. (d) cleavage.

27. An organism that is able to reproduce by only one method is a (an) (a) hydra. (b) paramecium. (c) ameba. (d) spirogyra.

28. The stage in mitosis in which the chromosomes move away from the equator is the (a) anaphase. (b) metaphase. (c) prophase. (d) telophase.

29. In the embryonic development of a mammal, the mesoderm forms the (a) nervous system. (b) muscles. (c) digestive tract. (d) respiratory tract.

30. A part of a flower that is not a female structure is the (a) stigma. (b) micropyle. (c) pistil. (d) anther.

31. During the process of mitosis, the stage in which the spireme breaks up to form chromosomes is the (a) anaphase. (b) interphase. (c) prophase. (d) metaphase.

32. An imperfect flower lacks (a) pistils or petals. (b) petals or stamens. (c) pistils, petals, or sepals. (d) pistils or stamens.

33. In the growth of the embryo, the stage in which the cells form a globular mass is the (a) morula. (b) gastrula. (c) zygote. (d) blastula.

34. A structure in the chicken embryo that serves as a respiratory organ is the (a) amnion. (b) yolk. (c) allantois. (d) chalaza.

35. A term that applies only to mammals is (a) gestation. (b) incubation. (c) germination. (d) fertilization.
For the following, mark (a) if the method is asexual and (b) if the method is sexual.

36. self-pollination of plants
37. fusion of two gametes
38. budding of hydra
39. cross-pollination of plants
40. grafting of an apple tree

Mark the correct LETTER on the answer sheet.

41. reproduction by only one parent
42. sperms of fish
43. fish eggs
44. ovum
45. organ which produces pollen
46. egg making organ
47. mature ovule
48. top of a pistil
50. inner layer of gastrula

a. asexual
b. ectoderm
c. egg
d. endoderm
e. fruit
f. hypocotyle
g. mesoderm
h. milt
i. ovary
j. oviduct
k. plumule
l. roe
m. seed
n. sexual
o. sperm
p. stamen
q. stigma
APPENDIX V

DAILY STUDY TIME RECORD SHEET
DAILY STUDY TIME

a - by yourself  b - with classmates  c - with an adult  d - other (explain)

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APPENDIX VII

QUIZ CORRECTION STENCIL
APPENDIX VIII

STUDY TIME SURVEY
STUDY TIME SURVEY

1. List the average amount of time you spend studying biology each week. ________

2. Write the percentage of time you spend studying biology each week
   a. by yourself. ________
   b. with classmates. ________
   c. with an adult. ________
   d. by other methods. Specify. ________

3. Write the percentage of time you spend studying biology each week using these methods.
   a. read textbook ________
   b. reread textbook ________
   c. study vocabulary cards ________
   d. do exercises ________
   e. read other books ________
   f. use workbooks ________
   g. with tutors ________
   h. other (specify) ________
APPENDIX IX

STUDENT EVALUATION
STUDENT EVALUATION

Do not place your name on this paper. Check the one answer for each item that is most applicable to you.

1. The giving of quizzes is a  a. good b. fair c. poor method of teaching.
2. Did the use of quizzes help you understand biology?
   a. greatly b. slightly c. not at all
3. Did the use of quizzes increase your knowledge of biology more than other methods of studying used in this course?
   a. greatly b. slightly c. not at all
4. Could the time devoted to study and taking of quizzes have been better spent on some other learning activity?
   a. yes b. possibly c. no
5. Did the taking of quizzes help you prepare for the unit test?
   a. greatly b. slightly c. not at all
6. Did the taking of quizzes cause you to do a. more b. the same amount c. less studying of assignments?
7. Did the thought of having a quiz cause you to study?
   a. greatly b. slightly c. not at all
8. Was the grading of quizzes a. too strict? b. about right? c. too easy?
9. Did the thought of having a unit test cause you to study?
   a. greatly b. slightly c. not at all
10. Was the learning of vocabulary words a. good b. fair c. poor study method?
11. Did the vocabulary words help you understand biology?
    a. greatly b. slightly c. not at all
12. Was the use of vocabulary words helpful in studying biology?
    a. greatly b. slightly c. not at all
13. Did the use of vocabulary words increase your knowledge of biology more than other methods of studying used in the course?
    a. greatly b. slightly c. not at all
14. Could the time devoted to the learning of vocabulary words have been better spent in some other learning activity?
    a. yes b. possibly c. no
15. Did the learning of vocabulary words help you study for the quizzes?
    a. greatly b. slightly c. not at all
16. Did the learning of vocabulary words help you study for the unit test?
    a. greatly b. slightly c. not at all
17. Did you try to use the vocabulary cards as a study aid in other subjects?
    a. greatly b. slightly c. not at all
18. Was the use of vocabulary cards a. good b. fair c. poor study aid?
19. Did you use the vocabulary cards?  a. greatly  b. slightly  
c. not at all

20. If you have any further comments on this unit, please write them on the back of this questionnaire.
APPENDIX X

GRADE SHEETS
GRADE SHEET

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Letter Grade

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# GRADE SHEET

## Third Marking Period

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Total Average

Numerical Grade

Letter Grade
APPENDIX XI

TWENTY ITEM DIAGRAM QUIZ
BEAN SEED

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20
QUIZ - FLOWER, BEAN SEED, AND CORN GRAIN

Using the diagrams mark the correct NUMBER of the structures listed below on the answer sheet that follows.

1. stamen
2. hylum
3. silk scar
4. bean cotyledons
5. corn plumule
6. ovules
7. embryo
8. corn cotyledon
9. style
10. bean hypocotyl
11. pistil
12. corn hypocotyl
13. anther
14. bean plumule
15. stigma
16. endosperm
17. micropyle
18. sepal
19. ovary
20. filament
APPROVAL SHEET

The dissertation submitted by John B. Purcell has been read and approved by members of the Department of Curriculum and Instruction.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

Signature of Advisor

Date