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THE USE OF COMMUNITY RESOURCES AS A METHOD IN THE TEACHING OF BIOLOGY AT THE EAST TEXAS BAPTIST COLLEGE

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To Dr. Harvey Daniel Bruce, President of the East Texas Baptist College, and to the East Texas Baptist College, this dissertation is dedicated.

TABLE OF CONTENTS

LIST OF TABLES

THE USE OF COMMUNITY RESOURCES AS A METHOD IN THE TEACHING OF BIOLOGY AT THE EAST TEXAS BAPTIST COLLEGE

CHAPTER I

INTRODUCTION, THE PROBLEM AND THE METHOD OF INVESTIGATION

Introduction

The East Texas Baptist College along with many other colleges requires two semesters or eight semester hours of science for graduation. Many students elect biology but do so with no liking for the subject. These students are taking a required course and are not always happy with this requirement. How may an appreciation for biology be fostered in them? In addition to fostering an appreciation for a beginning course in biology the need for scientists and science teachers must be mentioned. Industry is in need of people who are trained in the sciences, and educators are in need of science and mathematics teachers.[1] Why are there not enough science students?

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[1]Fletcher G. Watson, "A Crisis in Science Teaching," Scientific American, CXC (February, 1954), p. 27.

College teachers and possibly high school teachers are well aware of the fact that students lose interest in science, as is shown by Herbert A. Smith, who says:

> One of the fundamental questions that we must face is why students lose interest in science. We are all acquainted with the fact that in pre-school and lower primary grades children have a great many interests which might properly be termed scientific. They ask endless questions derived from their observations of their environment. These questions involve plants and animals, the stars and the sky; they involve the processes of reproduction and life and death itself. Why is it then that we see a gradual diminution of these interests as a child progresses through school? Very frequently by the time the child gets to the junior high school years he seems to have no interests in science at all. Is this due to the development of competing interests? Is it due to poor teaching? Is it due to maturation or to the development of an anti-scientific set of values during adolescence?[1]

The blame is often put on the secondary schools because they lack adequately trained science teachers. The blame cannot stop with the secondary schools and their teachers. Some of the blame must be placed on the scientists as was brought out by the American Association for the Advancement of Science, Cooperative Committee on the Teaching of Science and Mathematics, which reported:

> Although many scientists criticize the high school, and many college teachers of science deplore the preparation their students bring from high school, scientists have not, on the whole, accepted responsibility for the training of high-school teachers. This responsibility has been left largely to departments of education. College departments of science have not seen to it that

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[1]Herbert A. Smith, panel statement presented for symposium on "Needed Research in Science Education," Science Education, XL (December, 1956), p. 365.

> prospective teachers had a good background in subject matter; they have not provided--as have education departments--summer-school courses for teachers; they have not encouraged their students to become science teachers; they have not made science teachers feel themselves to be part of the total scientific community. The many individual exceptions to these generalizations are encouraging, but still leave it true that scientists themselves must accept part of the responsibility for the shortage of science teachers and the inadequate preparation of many who are teaching science courses.[1]

Research is necessary to strengthen the college science program as Herman Branson points out when he says:

> The subject of this talk rests upon two major premises which should not remain inarticulate. The first is that research in science education should be a vibrant, fruitful activity on the college level affecting profoundly our course methods, procedures, and philosophy. The second is that there is need to strengthen the college science program. One can argue these positions interminably. The anticipated doubling of our college enrollment within the next 20 years and the existing serious shortage of scientists and engineers may be taken as sufficient justification for us to examine at least in a cursory manner some research aimed at the college science courses as effective agents for realizing the aims and objectives of our colleges in science instruction and in meeting the needs of the specialized and general student.[2]

This investigation is concerned with methods of instruction and the evaluation of these methods. The need of evaluation is brought out in a report on "Studies in Testing and Evaluation of Science Teaching," in which is stated:

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[1]AAAS, Cooperative Committee on the Teaching of Science and Mathematics, "Improving Science Teaching," Science, CXXII (July 22, 1955), p. 146.

[2]Herman Branson, "What Research in Science Education Is Needed to Strengthen the College Science Program?" Science Education, XL (December, 1956), p. 374.

> A relatively unexploited area of research in science education at the college level is the general field of testing and evaluation. While there are a few "landmark studies" which have dealt with areas of content mastery; attitudes, appreciations, insights, formation of principles and concepts, and the likes have not yet been adequately dealt with.
>
> Trends in testing and evaluation of science education programs continue, with a few notable exceptions to be terms of subject matter mastery and retention of the facts of science. Achievement in any educational enterprise can be appraised only in terms of the goals sought. Although a considerable number of studies reported a wide range of goals, including attitudes, appreciations, insights, and the like, most of the current studies were concerned with externally patterned or stereotyped behavior which is no longer considered a valid index of desired outcomes. A few studies have been concerned with creative expression, and the exercise of intelligence or application of scientific principles, methods, habits, and the like in molding a changing environment in the service of society. A very few studies have been concerned with the individual's behavioral changes as he makes the necessary adjustments to the environment.[1]

What methods are useful in the study of biology? A definition of biology might prove helpful in choosing methods for study. Biology is defined as the science of life. Since biology is defined in this manner, living organisms including man are brought to mind. When living things are thought of, the out-of-doors immediately comes to mind. In order to teach biology the teacher should include the out-of-doors. H. E. Jaques advocates this when he says, "It is difficult to teach skating or dancing by correspondence. Nature study, likewise, needs to be taken to its source if the best results

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[1]Edward K. Weaver, et al., "Review of Recent Research in the Teaching of Science at the College Level III," Science Education, XL (December, 1956), pp. 350-351.

are to be had."[1]

What methods would be useful in the study of living organisms including man and the out-of-doors? The answer would seem to be the use of community resources which would involve in this study the environment of the East Texas Baptist College. Since Caddo Lake would be included in the environment, it became the basis on which the problem was formulated.

Caddo Lake, according to legend, was formed by an earthquake, as described by Robert Kemp:

> The first white men ever to see Caddo Lake were a group of exploring Spaniards who stumbled upon it during their wandering in 1536. At that time Caddo was a swampy chain of small lakes and winding bayous. Then in 1811, according to Indian legend, a chief of the Caddo tribe was warned of impending disaster by the Great Spirit. Heeding the vision, he led his people to higher ground, whereupon the earth trembled, the ground sank, and floods poured over the land where the tribe once lived. Less romantic historians say that this was the great New Madrid earthquake which shook all the Southern states, giving birth to Reelfoot Lake in Tennessee as well as enlarging Caddo Lake in Texas-Louisiana.[2]

Caddo Lake is a lake that is loved by sportsmen. Fish, ducks, pearls (at one time), alligators, turtles, alligator gars, and deer (closed season) are found in abundance. At one time steamboats traveled from New Orleans through Caddo Lake and Cypress Bayou to Jefferson, a large port town.

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[1]H. E. Jaques, "Field Trip Values and Types," The American Biology Teacher, VIII (February, 1946), p. 104.

[2]Robert Kemp, "Let's Explore Caddo Lake," Louisiana Conservationist, IV (January, 1952), p. 17.

According to Kemp, Caddo Lake is an interesting place to teach biology:

> Caddo, lying half in Texas and half in Louisiana, is the largest natural lake in the South. It has an estimated area of 35,000 to 45,000 acres, but so much is made up of swamps and water-filled cypress breaks that the lake has an average depth of something less than ten feet. Caddo is roughly thirty-five miles long and three miles wide.
>
> Honeycombed with impenetrable cypress picturesquely draped with Spanish moss, Caddo becomes a series of mysterious bayous, channels, and hidden lakes in its upper reaches. The lower or eastern half, referred to as Big Lake, is a broad expanse of open water, dotted here and there with an occasional cypress tree and covered with ancient hollow stumps.[1]

The main disadvantage in using Caddo Lake for teaching purposes is that it is approximately twenty miles from the campus. In addition, it is swampy during bad weather. This difficulty was overcome by broadening the scope of the investigation to include any community resources which would be useful in the teaching of biology.

Community resources are used by many in the teaching of biology. Heiss, Obourn, and Hoffman recommend the use of community resources:

> The modern science teacher uses the resources of the community for purposes of enrichment and supplementation, wherever such correlation can practically be made. The extent to which community resources should be used will depend upon their potential usefulness in achieving the major goals of science instruction.[2]

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[1] Ibid.

[2] Elwood D. Heiss, Ellsworth S. Obourn, and Charles W. Hoffman, Modern Science Teaching (New York: The Macmillan Co., 1950), p. 291.

Community resources include projects, student planning, field trips, camps, resource speakers, and the like. Mogens B. Lange writes that in Denmark teachers arrange excursions or museum visits either during the lesson hour or for entire school days.[1] Community resources make it possible for the students to get firsthand experience with the things being studied and to participate more in the planning of their work.

The problem of the investigation becomes one of the use of community resources as a method in teaching biology and of evaluating this method in terms of objective subject-matter and attitude tests and other records.

The Problem

Statement of Problem

Since there has been a trend toward the use of community resources in the teaching of biology, this study deals with the evaluative use of community resources in teaching a beginning course in college biology. The problem is:

1. Can the biological curriculum be integrated with community resources?

2. If so, to what extent, with what effect, and under what conditions?

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[1]Mogens B. Lange, "The Teaching of Biology in Danish Schools," The American Biology Teacher, XVII (April, 1955), pp. 137-138.

Delimitation of the Problem

The investigation was limited to the year 1953-1954 and to instruction offered by the writer at the East Texas Baptist College. A one-year study was considered necessary because identical conditions could not be duplicated for additional years. One year of experimental work was considered to be enough to facilitate use of comparisons.

Definition of Terms

For the purpose of this study the term community resources will be used to mean materials from Caddo Lake and other similar places of interest, printed materials other than the text, resource speakers, field trips, and group planning.

The term lecture will be used to mean discussions by the teacher, questions by the students, and assignments in the textbook.

The term unit will be used to mean subject-matter units which are used in a beginning course in college biology.

The term variable methods will be used to refer to methods of presenting the subject-matter units. For a given unit Section I utilized the regular lecture and laboratory plan of study. For the same unit Section II utilized community resources with some discussion and laboratory work.

Section I refers to the group of students taking biology Monday, Wednesday, and Friday from 8:00 to 10:00 A. M.

Section II refers to the group of students taking biology Tuesday and Thursday from 1:30 to 4:30 P. M.

The following types of evaluation were used: objective subject-matter tests, attitude tests, and records of interests as shown by outside readings, collections, and comments on the course.

Type of Research

The research was of the experimental type. Two different methods of instruction were used followed by objective subject-matter and attitude tests which were treated statistically. Records were kept of outside readings, collections, and comments on the course.

Procedure of the Study

Two sections of students in a beginning course of college biology were used for the experiment, which was started in September, 1953. The plan was explained to the students, and individual record sheets were filled out by the students (see Appendix A). Information concerning age, number of years in school, majors and minors, occupations of parents, marital status, nationality, science courses in high school, total hours in college, and hours enrolled was requested on the record sheets. The California Test of Mental Maturity[1] was given to obtain the I. Q. of each student.

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[1]E. T. Sullivan, W. W. Clark, and E. W. Tiegs, California Test of Mental Maturity (Los Angeles: California Test Bureau, 1951).

CHAPTER II

METHODS USED IN TEACHING

Units of Teaching

The units used in the teaching of biology for the experiment were chosen to satisfy the course description in the catalogue of the East Texas Baptist College, which was:

> 141 An introductory course designed for students beginning work in biology. The aim of the course is to give the liberal arts student a broad cultural background in the general field of biology, and also to give a good foundation to the premedical student and those majoring in biology. Fundamental biological principles of natural phenomena are stressed. The various representative animal phyla will be studied and application of the basic biological principles as they relate to man will be made whenever possible.
>
> 142 A continuation of Biology 141. This course will consist of a study of the plant kingdom with emphasis placed upon the basic biological principles as they apply to the various phyla of the plant kingdom. Emphasis will also be given to the more elementary phases of ecology, zoogeography, and paleontology as a supplementary phase of the two courses.[1]

The units and the numbers given to them are listed on the following page:

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[1] East Texas Baptist College Bulletin, XXXII (Marshall, Texas: East Texas Baptist College, 1953), p. 56.

Number	Title
1	A better understanding of the meaning, value, and scope of biology.
2	Where and how invertebrates live.
3	Some of the parasites man encounters and how they may be controlled.
4	Some segmented animals, their habitats and value to man.
5	Functions carried on by animals and the importance of these functions in the lives of the animals.
6	A better understanding of the meaning, value, and scope of botany. Function of roots and stems, their structure and uses.
7	How to know algae and fungi, their characteristics and habitats.
8	How to understand the structure, functions, and kinds of leaves.
9	How seed plants reproduce.
10	How to know the plant kingdom, its classification and characteristics.

Methods of Instruction

Two different methods of instruction were used. One was the utilization of community resources supplemented by pupil discussions and readings under the guidance of the instructor. The other was the utilization of the lecture supplemented by questions from the pupils and assigned readings by the instructor.

Two sections, Section I and Section II, were used for the experiment. The two different methods of instruction described in the preceding paragraph were used with both

sections, but the methods of instruction were alternated. Section I utilized the lecture method for Unit 1, the lecture method for Unit 2, the community resource method for Unit 3, the lecture method for Unit 4, the community resource method for Unit 5, the community resource method for Unit 6, the lecture method for Unit 7, the community resource method for Unit 8, the lecture method for Unit 9, and the community resource method for Unit 10. Section II utilized the lecture method for Unit 1, the community resource method for Unit 2, the lecture method for Unit 3, the community resource method for Unit 4, the lecture method for Unit 5, the lecture method for Unit 6, the community resource method for Unit 7, the lecture method for Unit 8, the community resource method for Unit 9, and the lecture method for Unit 10.

Section I and Section II utilized the lecture method for Unit 1 with laboratory assignments. From the introductory material which was presented by use of the lecture method, the students were expected to gain a background of biology which would enable them to utilize either the lecture method or community resource method in learning biology. The first semester (fall) was devoted to zoology.

Section I utilized the lecture method for Unit 2 with assignments in their textbook. Section II utilized the community resource method. The class visited Mill Pond off Big Cypress Bayou in Caddo State Park and Johnson's Ranch which is a resort where fishermen keep their boats because

it is located on the main channel. The class observed the natural habitat of the animals and collected water containing much animal and plant life. These samples were taken back to the laboratory where several periods were spent in studying the animals collected.

Section II utilized the lecture method for Unit 3. Section I utilized the community resource method. The students were divided into three groups. Group I composed of ten students wrote for literature on parasites to determine types, effects, control, treatment, and occurrence.

Group II composed of sixteen students met together and made plans to visit the veterinarians in Marshall, Texas, and one in Texarkana to obtain information concerning parasites. The group was advised to find out what animals had parasites and what were the kinds, treatment, and prevention.

Group III composed of ten students were to visit meat packing plants and a grocery store which does its own slaughtering to find out what parasites were present in the meat, the effects of the parasites on the use of the meat, prevention, and information on meat inspection. Several members of this group did not receive any cooperation at the grocery store. These students went to see one of the veterinarians being interviewed by another group.

Information and samples were collected by the students. To exchange information obtained by the different

groups, reports were given in class from which a summary was prepared by the teacher. This material was mimeographed and given to each student in Section I. (See Appendix B.)

Section I utilized the lecture method for Unit 4 with laboratory assignments. Section II utilized the community resource method and was scheduled to go to Caddo Lake to collect arthropods. Due to bad weather the class spent the afternoon collecting arthropods on the campus. The arthropods were classified into classes and orders and placed on demonstration by the students. Laboratory assignments were made to this group also.

Section II utilized the lecture method for Unit 5 and studied the frog in the laboratory. Section I utilized the community resource method and studied the frog in the laboratory. The part of Unit 5 which was emphasized was the digestive system. Section I was divided into groups to find out information on vitamins and food. Group I planned a balanced meal for a day and gave a report on this. Group II reported on foods from the grocery store which had vitamins included on the labels. Group III reported on vitamins which could be purchased at the drug store. Group IV reported on vitamin deficiencies. Group V reported on the sources of vitamins and included a poster showing the sources.

Miss Fonta Brittenum, one of the home service counselors for Southwestern Gas and Electric Company, spent a class period with Section I. A copy of her notes will be

found in Appendix A. One student, having become interested in coffee during the visit of the home economist, requested and received permission to write a report on coffee.

The second semester of the biology course was devoted to botany. Since the school does not offer many beginning courses the second semester (spring), some work had to be duplicated because students are allowed to take Biology 142 without Biology 141. The meaning of biology and the use of the microscope were repeated. New students spent a laboratory period on the use of the microscope.

Section II utilized the lecture method for Unit 6 with laboratory assignments. Section I utilized the community resource method with class discussions and laboratory assignments. The class went out on the campus and to Yates Lumber Mill.

Logically the leaf would have been studied next, but due to a late spring the leaves had not appeared. The next unit, then, was on algae and fungi. Section I utilized the lecture method with laboratory assignments for Unit 7. Section II utilized the community resource method with class discussion and laboratory assignments. Section II went to Mill Pond and Johnson's Ranch again. They observed the algae which were macroscopic and brought back samples of water containing algae which were both macroscopic and microscopic. (See Appendix A for classification.)

Section II utilized the lecture method with laboratory

assignments for Unit 8. Section I utilized the community resource method with laboratory assignments. The group went out on the campus and to Caddo State Park.

Section I utilized the lecture method with laboratory assignments for Unit 9. Section II utilized the community resource method with laboratory assignments. This group went to the City Park and the Lions Park, grocery and drug stores, and the Cotton Oil Mill. A diagram was used to summarize reproduction by flowers for both groups. (See Appendix A.)

Section II utilized the lecture method with laboratory assignments for Unit 10. Section I utilized the community resource method and went out on the campus. (See Appendix for classification.)

CHAPTER III

METHODS OF EVALUATION

The results were evaluated (1) by subject-matter and attitude tests (see Appendix B) and (2) by records of interests as shown by outside readings, collections, questions, and comments on the course.

Objective subject-matter tests for each unit were made by the instructor. Attitude tests for each unit were made by the instructor under the supervision of Dr. Ellsworth Collings and Dr. Henry D. Rinsland. Both sections were given the same subject-matter tests.

Subject-matter and attitude tests were given at the end of each subject-matter unit during the regular class period. For Unit I two subject-matter tests, Tests 1 and 2, were given. For Unit 2 Subject-matter Test 3 and Attitude Test 1 were given; for Unit 3 Subject-matter Test 4 and Attitude Test 2 were given; for Unit 4 Subject-matter Test 5 and Attitude Test 3 were given; for Unit 5 Subject-matter Test 6 and Attitude Test 4 were given; and Subject-matter Test 7 was given as a final for the fall semester. For Unit 6 Subject-matter Test 8 and Attitude Test 5 were given; for

Unit 7 Subject-matter Test 9 and Attitude Test 6 were given; for Unit 8 Subject-matter Test 10 and Attitude Test 7 were given; for Unit 9 Subject-matter Test 11 and Attitude Test 8 were given; and for Unit 10 Subject-matter Test 12 and Attitude Test 9 were given.

The attitude tests were not signed by the students. Each test was numbered, and the students signed their names on a separate sheet of paper by the number corresponding to their test number. These sheets of paper were not checked until the end of the school year.

The subject-matter and attitude tests were scored, and the scores treated statistically. Distributions of the scores were made from which the mean and the standard deviations were determined. The differences between the means were determined as was the standard error of the difference between the two means. From this information the "t" test could be applied. In addition the chi-squares of the attitude tests were determined. The statistical treatment of the subject-matter and attitude tests will be found in Chapter IV.

Records were kept of questions concerning tests, collections, reports, outside readings, attendance at review sessions, and comments in the school yearbook, The Martian.

The subject-matter tests were returned to the students who were told to check for mistakes in scoring and to write out questions concerning the scores and requests for

explanations. The tests and the questions were then returned to the teacher.

During the semester records were kept of articles read by the students and mentioned in class concerning biology. At the close of the second semester the students were asked to list any articles or books which they had read concerning biology and any themes which they had written concerning biology for their other classes. Nineteen articles were read by students in Section I, and twelve articles were read by students in Section II. Three term papers related to biology were written by students in Section I, and two term papers were written by students in Section II. Two books on biology were read by one student in Section II, and portions from three books were read by one student in Section II. One student in Section I reported that he had discussed biology with a doctor. One student in Section I brought a clipping from the newspaper concerning research on fish. One student in Section II brought a sprouting grapefruit seed to class, and another student in Section II reported on a biological movie. One student in Section II sent back a specimen for identification after leaving school. One student in Section II collected a tarantula and some earthworms, and one student in Section I collected a very large beetle. Other animals and plants were collected in connection with the units of study.

Before three of the tests were given in the fall, students were encouraged to spend some time in the laboratory in review. During session one sixteen students from Section I and seventeen students from Section II attended. During session two sixteen students from Section I and thirteen from Section II attended. During session three twenty-one from Section I and nineteen from Section II attended.

During the last test The Martian was placed where the students could write in it if they so desired. These statements were most difficult to put into categories, but most of them were statements concerning the course or the teacher. Since these statements do not constitute any form of valid measurement of attitudes, the attitude tests were constructed for this purpose. Some of the statements which were considered typical are listed below. They are:

> The field trips interspersed with classroom instruction is a good teaching method. The humor has added to the enjoyment of the best. I wish you success in the attainment of your doctorate. JHC
>
> Thank you so much for making a class I was dreading to take one of the most interesting and enjoyable courses on my schedule. Thanks for your fairness to all and your understanding nature. AA
>
> Thank goodness it's over at last. ALB
>
> It has been fun knowing you. I can't say it has been so much to take biology but I have enjoyed you as a teacher. JC
>
> I have had a lot of fun in your class. If I had studied more, I would have made better grades. DS
>
> I still enjoyed some of the stuff even if you did throw me out of class one day. GR

I came into biology hating it. Now it isn't so bad --thanks to you. I shall never forget your help. May God richly bless you. EW

I am a veteran in this course so you can believe me when I say, the teacher makes the course, and I have thoroughly enjoyed it this year. Best of everything to a wonderful person. HE

I have enjoyed parts of Biology 142, but others I can't say much for. Suppose I'll see you next fall. Best wishes in the future. JH

From these quotations it is possible to see the reactions of some of the students to a biology course.

CHAPTER IV

RESULTS OF INVESTIGATION

For each unit of work an objective type test on subject matter was given (see Appendix B for copies of tests). For each subject-matter test given the mean[1] was determined for Section I and Section II. The standard deviation[2] was determined for each section as well as the standard error[3] of each mean. From the standard error of each mean the standard error of the difference between the two means[4] was determined. The difference between the two means was then divided by the standard error of the difference between the

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[1]Henry E. Garrett, Statistics in Psychology and Education (3rd ed. rev.; New York: Longmans, Green and Co., 1947), p. 33. $M = \frac{\Sigma fx}{N}$.

[2]Ibid., p. 59. $\sigma = \sqrt{\frac{\Sigma fd^2}{N}}$

[3]Ibid., p. 189. $\sigma_{mean} = \frac{\sigma}{\sqrt{N - 1}}$.

[4]Ibid., p. 198. $\sigma_{Difference} = \sqrt{\sigma^2_{M_1} + \sigma^2_{M_2}}$.

two means to obtain "t."[1] The Table of "t"[2] was used to ascertain any significant difference between the two methods of instruction. Table 1 shows the results of these calculations.

Both Section I and Section II utilized the lecture method for Unit 1 to gain a background of biology which would enable them to utilize either the lecture method or the community resource method in learning biology. Two tests, 1 and 2, were given on Unit 1. Test 1 was given because too much time would have elapsed without a test, and Test 2 was given because the East Texas Baptist College requires some type of nine-weeks examination. It is of interest to note that there was no significant difference in the results of the two tests at or beyond the .05 level of confidence. Test 7, a test to satisfy the requirement for a final, shows no significant difference in the results of the test at or beyond the .05 level of confidence (see Appendix C for data).

For Unit 6, Test 8, the mean for Section I (community resource method) was 28; the mean for Section II (lecture method) was 36; and the "t" was 3.27. This would indicate a significant difference at or beyond the .05 level of confidence.

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[1] Ibid., p. 213. $t = \frac{D}{\sigma_{Diff.}}$.

[2] Ibid., pp. 190-191, Table 29.

TABLE 1

MEANS AND "t" SIGNIFICANCE FOR SUBJECT-MATTER TESTS FOR EACH UNIT AND SUB-UNIT FOR FALL AND SPRING

Unit	Test	Section I		Section II		Mean Diff.	S. E. Diff.	t
		No.	Mean	No.	Mean			
Fall								
1	1	36	46	37	46	0		
	2	36	28	36	29	1	3.27	0.31
2	3	35	29	36	25cr[a]	4	2.83	1.41
3	4	35	27cr	36	30	3	1.67	1.80
4	5	33	46	36	45cr	1	2.99	0.33
5	6	34	58cr	36	58	0		
	7	32	29	35	32	3	2.61	1.11
Spring								
6	8	34	28cr	35	36	8	2.44	3.27[b]
7	9	33	20	35	20cr	0		
8	10	33	36cr	34	39	3	4.32	0.69
9	11	33	28	33	40cr	12	3.40	3.53[b]
10	12	33	29cr	33	32	3	2.00	1.50

[a]cr refers to section using community resource method.

[b]Significant beyond the 0.05 level of confidence.

For Unit 9, Test 11, the mean for Section I (lecture method) was 28; the mean for Section II (community resource method) was 40; and the "t" was 3.53. This also indicates a significant difference at or beyond the .05 level of confidence. The results of the other tests show no significant differences between the two sections.

For each unit of work an objective type test on attitude was given. Most of the attitude tests were divided into two parts. One part was labeled "like" because the responses would be expected to be similar for both groups. The other part was labeled "unlike" because it was possible for the responses not to be similar. The two parts were treated statistically like the subject matter tests, and a table of "t" was used to ascertain any significant difference between the two sections which would indicate a difference in the preference of the students for one of the two methods of instruction. Table 2 shows the results of the calculations for the part of the tests which was called "like" and Table 3 shows the results of the calculations for the part of the tests which was called "unlike." (See Appendix C for data.)

For Unit 2, Test 1 (like), the mean for Section I (lecture method) was 1.5, and the mean for Section II (community resource method) was 1.5. For the same unit (unlike) the mean for Section I was 0.1; the mean for Section II was 1.1; and the "t" was 3.13. This would indicate a significant difference at or beyond the .05 level of confidence.

TABLE 2

MEANS AND "t" SIGNIFICANCE FOR ATTITUDE TESTS FOR EACH UNIT FOR FALL AND SPRING (LIKE)

Unit	Test	Section I		Section II		Mean Diff.	S. E. Diff.	t
		No.	Mean	No.	Mean			
Fall								
2	1	22	1.5	25	1.5cr[a]	0		
3	2	22	1.6cr	25	1.4	0.2	0.20	1.00
4	3	22	1.6	25	1.2cr	0.4	0.37	1.08
5	4	22	2.1cr	25	1.8	0.3	0.34	0.88
Spring								
6	5	33	1.8cr	34	4.0	2.2	0.74	2.97[b]
7	6	33	-0.9	33	-0.3cr	0.6	0.67	0.90
8	7	33	1.4cr	33	1.5	0.1	0.26	0.36
9	8	33	1.2	33	1.3cr	0.1	0.33	0.30

[a]cr refers to section using community resource method.

[b]Significant beyond the 0.05 level of confidence.

TABLE 3

MEANS AND "t" SIGNIFICANCE FOR ATTITUDE TESTS FOR EACH UNIT FOR FALL AND SPRING (UNLIKE)

Unit	Test	Section I		Section II		Mean Diff.	S. E. Diff.	t
		No.	Mean	No.	Mean			
Fall								
2	1	22	0.1	24	1.1cr[a]	1.0	0.30	3.13[b]
3	2	22	1.9cr	25	1.2	0.7	0.40	1.75
4	3	22	0.8	25	1.5cr	0.7	0.40	1.75
5	4	22	1.5cr	25	1.3	0.2	0.28	0.71
Spring								
6	5	33	1.3cr	34	0.9	0.4	0.37	1.08
7	6	33	-0.2	33	0.3cr	-0.5	0.44	1.14
8	7	33	0.7cr	33	0.9	0.2	0.21	0.95
9	8	33	2.8	33	3.8	1.0	0.59	1.69
10	9	33	0.8	33	0.8	0		

[a]cr refers to section using community resource method.

[b]Significant beyond the 0.05 level of confidence.

For Unit 6, Test 5 (like), the mean for Section I (community resource method) was 1.8; the mean for Section II (lecture method) was 4.0; and the "t" was 2.97. This would indicate a significant difference at or beyond the .05 level of confidence. For the same unit (unlike) the mean for Section I was 1.3; the mean for Section II was 0.9; and the "t" was 1.08. This would indicate no significant difference. The results of the other attitude tests show no significant differences between the two sections.

The chi-square test was used on the attitude tests to see if there were any significant differences in the two sections. The parts of the attitude tests were scored according to three categories, like, indifferent, and dislike. (See Appendix B for data.) With the exception of several tests the majority of the test scores for the "dislike" category was extremely small as was the theoretical frequency. Since "the commonest weakness in the application of the chi-square test to contingency tables is the use of extremely small theoretical frequencies,"[1] the categories, "indifferent" and "dislike," were considered together as is shown in Tables 4 and 5. The chi-square was calculated for a 2 x 2 contingency table by using a formula corrected for

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[1]Don Lewis and C. J. Burke, "The Use and Misuse of the Chi-Square Test," Psychological Bulletin, XLVI (November, 1949), p. 460.

continuity.[1] The results are found in Table 4 and Table 5.

To test the null hypothesis of no difference in the responses of the two sections with respect to their attitude toward biology, the chi-square test was used. The hypothesis may be interpreted as stated by Snyder:

> As a matter of convention biologists and statisticians refer to any statistical constant such as chi-square as a "significant" value when it exceeds the value corresponding to a probability of .05. A value exceeding the .01 value is labeled "highly significant." This means that there is significant, or highly significant evidence against the hypothesis under test.[2]

In the case of Unit 2, Test 1 (unlike) the chi-square was 9.6208 which indicates that there were differences in the two sections as shown by the attitude test. In the case of Unit 6, Test 5 (like), the chi-square was 23.3807 which would indicate that there were differences in the two sections as shown by the attitude test. In the case of Unit 6, Test 5 (unlike), the chi-square was 8.7822 which would also indicate that there were differences in the two sections. In the case of Unit 7, Test 6 (unlike) the chi-square was 8.3867 which would indicate that there were differences in the two sections as shown by the attitude test. The chi-

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[1]Allen L. Edwards, Experimental Design in Psychological Research (New York: Rinehart and Company, Inc., 1950), pp. 85-86.

$$Chi^2 = \frac{N\left(bc - ad - \frac{N}{2}\right)^2}{(a + b)(c + d)(a + c)(b + d)}.$$

[2]Laurence H. Snyder, The Principles of Heredity (4th ed. rev.; Boston: D. C. Heath and Company, 1951), p. 75.

TABLE 4

SCORES AND CHI-SQUARE FOR ATTITUDE TESTS FOR EACH UNIT FOR FALL AND SPRING (LIKE)

Unit	Test	Section	Like	Indifferent and Dislike	Marginal Total	Chi Square
Fall						
2	1	I	32	12	44	
		II	40	10	50	
			72	22	94	0.3444
3	2	I	37	7	44	
		II	35	15	50	
			72	22	94	1.8656
4	3	I	37	29	66	
		II	38	37	75	
			75	66	141	0.2222
5	4	I	47	19	66	
		II	52	23	75	
			99	42	141	0.0035
Spring						
6	5	I	99	165	264	
		II	143	129	272	
			242	294	536	23.3807[a]
7	6	I	35	163	198	
		II	33	165	198	
			68	328	396	0.0178
8	7	I	49	50	99	
		II	52	47	99	
			101	97	198	0.0808
9	8	I	46	53	99	
		II	44	55	99	
			90	108	198	0.0204

[a]Significant at or beyond the .05 level of confidence.

TABLE 5

SCORES AND CHI-SQUARE FOR ATTITUDE TESTS
FOR EACH UNIT FOR FALL AND SPRING
(UNLIKE)

Unit	Test	Section	Like	Indifferent and Dislike	Marginal Total	Chi Square
Fall						
2	1	I	13	31	44	
		II	32	18	50	
			45	49	94	9.6208[a]
3	2	I	48	18	66	
		II	36	39	75	
			84	57	141	2.4239
4	3	I	30	36	66	
		II	43	32	75	
			73	68	141	1.5367
5	4	I	32	34	66	
		II	35	40	75	
			67	74	141	
Spring						
6	5	I	62	70	132	
		II	39	97	136	
			101	167	268	8.7822[a]
7	6	I	14	118	132	
		II	33	99	132	
			47	217	264	8.3867[a]
8	7	I	29	37	66	
		II	33	33	66	
			62	70	132	2.7373
9	8	I	110	121	231	
		II	129	102	231	
			239	223	462	2.8086
10	9	I	38	94	132	
		II	37	95	132	
			75	189	264	0

[a]Significant at or beyond the .05 level of confidence.

squares of the other tests did not indicate any significant differences in the two sections.

CHAPTER V

SUMMARY, THEORETICAL CONSIDERATIONS AND CONCLUSIONS

Summary

Scientists and educators are in need of more science students for research and for teaching at all levels. Students apparently lose interest in science which they had manifested as children. How may students be attracted and kept interested? The answer to the question would seem to be in the method of teaching. Not enough research on methods evaluated by valid tests has been done.

Since biology is the study of life, the method best suited for the study of biology would seem to involve living organisms and the out-of-doors. In the experiment this method was called the community resource method. The problem of this study, then, was:

1. Can the biological curriculum be integrated with community resources?

2. If so, to what extent, with what effect and under what conditions?

The investigation was limited to the year 1953-1954 and to instruction offered by the writer at East Texas

Baptist College, and the research was of the experimental type. Two different methods of instruction, the lecture method and the community resource method, were alternated between two sections, Section I meeting 8:00 - 10:00 A. M. on Monday, Wednesday, and Friday and Section II meeting 1:30 - 4:30 P. M. on Tuesday and Thursday.

The course was divided into units which were chosen to satisfy the course description in the catalogue of the East Texas Baptist College. Ten units were included in the study followed by twelve subject-matter tests and ten attitude tests which were made by the instructor. These tests which were objective-type tests were treated statistically. Records were kept of outside readings, collections, and comments on the course.

Only two of the subject-matter tests revealed any significant differences when subjected to the "t" test as was shown by Table 1 in Chapter IV. One was Test 8 for Unit 6 which was the unit entitled "A better understanding of the meaning, value, and scope of botany. Function of roots and stems, their structure and uses." For Test 8 the mean for Section I (community resource method) was 28; the mean for Section II (lecture method was 36; and the "t" was 3.27 which is significant at or beyond the .05 level of confidence. The other test was Test 11 for Unit 9 which was the unit entitled "How seed plants reproduce." For Test 11 the mean

for Section I (lecture method) was 28; the mean for Section II (community resource method) was 40; and the "t" was 3.53 which is significant at or beyond the .05 level of confidence.

Only two of the attitude tests revealed any significant differences when subjected to the "t" test as was shown by Table 2 and Table 3 in Chapter IV. One was Test 1 (unlike, see Table 3) for Unit 2 which was the unit entitled "Where and how invertebrates live." For Test 1 (unlike) the mean for Section I (lecture method) was 0.1; the mean for Section II (community resource method) was 1.1; and the "t" was 3.13 which is significant at or beyond the .05 level of confidence. The difference is not significant on the like portion of the test. The other test was Test 5 (like, see Table 2) for Unit 6. For Test 5 (like) the mean for Section I (community resource method) was 1.8; the mean for Section II (lecture method) was 4.0; and the "t" was 2.97 which is significant at or beyond the .05 level of confidence. The difference is not significant for the unlike portion of the test.

Four of the attitude tests revealed significant differences when subjected to the chi-square test. One was Test 1 (unlike, see Table 5) for Unit 2. For Test 1 (unlike) the chi-square was 9.6208 which is significant at or beyond the .05 level of confidence. The difference is not significant for the like portion of the test. Another one was Test 5 (like, see Table 4) for Unit 6. For Test 5 (like) the chi-square was 23.3807 which is highly significant at or

beyond the .05 level of confidence. For Test 5 (unlike, see Table 5) the chi-square was 8.7822 which is significant at or beyond the .05 level of confidence. The last one was Test 6 (unlike, see Table 5) for Unit 7 which was the unit entitled "How to know algae and fungi, their characteristics and habitat." For Test 6 (unlike) the chi-square was 8.3867 which is significant at or beyond the .05 level of confidence. The difference is not significant for the like portion of the test.

For Unit 6 the mean was higher for Section II on the subject-matter test, Test 8, and the method of instruction was the lecture method. For the same unit the mean was higher for Section II on the attitude test, Test 5 (like). For the same unit the chi-squares for the attitude test, Test 5 (like and unlike) indicated differences in the two sections. It would be possible then to consider that the lecture method for Unit 6 might be preferable to the community resource method since the "t" indicates that a significant difference exists and the mean was higher for the lecture method.

For Unit 9 the mean was higher for Section II on the subject-matter test, Test 11, and the method of instruction was the community resource method. No significant differences were revealed by the "t" tests or the chi-squares for the attitude tests for Unit 9. Here the community resource method would seem to be the better method of instruction.

For Unit 2 the mean was higher for Section II on the attitude test, Test 1 (unlike), and the method of instruction was the community resource method. The chi-square for this test indicated that significant differences existed between Section I and Section II. It would be possible then to consider that the community resource method might be preferable to the lecture method as indicated by the attitude tests.

Theoretical Considerations

In discussing theoretical considerations, it should be recalled from Chapter I that the term lecture was to be used to mean discussions by the teacher, questions by the students, and assignments in the textbook. Likewise the term community resources was to be used to mean materials from Caddo Lake and other similar places of interest, printed materials other than the text, resource speakers, field trips, and group planning. For the sake of brevity these terms as they were applied to methods were referred to as the lecture method and the community resource method. It would be impossible in either case to state that the method was purely one method.

In the teaching of biology many methods are useful because there are so many supplemental materials which may be used to enrich the course. No one method should be used to the exclusion of others. A teacher should use the method or methods which best suit a given unit and the class in-

volved. One method might work better with one group than it would with another.

In this study, then why did the two subject-matter tests show significant differences between the two sections? Why did the attitude tests show significant differences between the two sections? Was it a difference in the two methods of instruction? Was it a difference in the two sections? Was it a difference in the time of meeting of the two sections? Was it a combination of the method and the sections?

There are a number of people who think that different methods should be used in the teaching of biology and that one method should not be preferred above all others. From this experiment it would appear that the community resource method might be preferred for some units and that the lecture method might be preferred for others.

Samuel L. Meyer advocates the use of a combination of methods or biology teaching in "Three-D." He refers to the "three-D's" as discourse, discussion, and discovery. By discourse he means mainly the lecture method, and by discussion he means the "group-conference system" so named by S. M. Dietz. The discussion method has been included in the community resource method of this experiment. The discovery method as described by Meyer is the community resource method of this experiment. He says:

> In this the third-D of the group, we include a variety of experiences with emphasis on the material itself.

> Through his own efforts, the student discovers information and sources of information. This discovery may be facilitated by observations under the microscope, a dissection, a field trip, a movie, a lantern slide, a chart, a map, a model, an experiment, a demonstration, a reference in a book, an original research paper. W. Hugh Stickler refers to the conflict between the relative merits of the 'demonstration' versus the 'laboratory.' It is his opinion that much of the so-called 'controversy' lies in the definition of terms. In that he is certainly correct. It is impossible to teach biology by talking about it. The experience to be remembered by the student is that which results from contact with the material itself. One of the advantages enjoyed by the biology teacher is that his subject matter is alive. For that reason, whenever possible, we strongly recommend use of living material in the classroom or in the field.[1]

By way of summary he says:

> Discourse, discussion, and discovery! These are the resources available for the effective teaching of biology. No one needs to be used to the exclusion of the others. No one is better than the other. Whatever the method, or combination of methods, in any analysis of effective teaching, we come ultimately to the teacher himself. It is his enthusiasm for his subject, his interest in young people, his grasp of the pertinent information in his field and its significance--it is all these which form that vital, yet intangible, pathway for exchange of ideas and inspiration between student and teacher. Just as the master painter blends his colors to produce a picture of great beauty so he who aspires to be a master teacher of biology must work out the proper balance of those resources which will transmit to youthful minds the fascinating story of the science of living things.[2]

Certainly one can say from observation that the students seemed to enjoy the community resource method of instruction even though the attitude tests did not necessarily

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[1]Samuel L. Meyer, "Teaching Biology by a Combination of Methods or Biology Teaching in 'Three-D,'" The American Biology Teacher, XVI (November, 1954), pp. 174-175.

[2]Ibid., p. 176.

reveal this. For Unit 2 the students in Section II (community resource method) had a higher mean on the attitude test (unlike) than did those of Section I (lecture method). The students from all appearances enjoyed the outing to Caddo Lake. For Unit 3 entitled "Some of the parasites man encounters and how they may be controlled," no significant differences were revealed. However, Section I (community resource method) entered into the work with a great deal of energy and apparent enjoyment. One group on failing to find out what they wanted to know at one place went on to another place. Was the failure of the subject-matter and attitude tests to reveal any significant differences due to the tests, to the apparent disinterest of some students in any phase of biology, or perhaps to the time of day of the class meetings?

Sarah Clark wrote concerning the use of projects in biology. Projects would certainly be a part of the community resource method in its fullest meaning. She found a successful way to teach biology to high school students. However, she offers no statistical evidence to support her opinion. She says:

> Skits, dioramas, collections, models, charts, unusual experiments, and an endless variety of projects attract youngsters. One idea often leads to another. Those of you who have never attempted project work with a group of lively youngsters have a delightful experience in store for you. One of the greatest thrills I have had as a teacher is to see these projects materialize and go to successful completion. When a pupil, who has been indifferent in class, does an outstanding piece of work, I feel that he is really interested, and I try

> to find some means of holding that interest. Enthusiasm is contagious and an enthusiastic teacher will stir up enthusiasm among her students.[1]

John P. Harrold advocates using the community as a laboratory in the teaching of biology. He says:

> Using your community as a laboratory is excellent public relations for your school. You are acquainting the community with what is going on within your department. You will be surprised at the cooperation you will receive from your fellow citizens. The pupils receive a broader view and a better understanding of their local environment. Why not plan now to make the best use of what your community has to offer?[2]

Along these same lines George Hunter writes that "in the opinion of the writer the sooner that young people are introduced to field trips the sooner the course becomes vital to students."[3]

One of the reasons for making biology interesting is to attract and keep students in the field of biology. Statistical evidence for all ideas and statements would be nice but is impossible. Paul Brandwein offered the following suggestions and observations:

> Reorganizing biology teaching to meet the needs and interests of youth involves first, a willingness to meet youth halfway in planning content. It involves, second a reorientation of content. The courses are not organized around Spirogyra, Hydra, Planaria, the earthworm

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[1]Sarah Clark, "The Use of Projects in Biology," The American Biology Teacher, XVI (December, 1954), p. 213.

[2]John P. Harrold, "Using the Community as a Laboratory," The American Biology Teacher, XIV (October, 1952), p. 150.

[3]George Hunter, "Biological Field Trips as an Integral Part of Science Education," The American Biology Teacher, IV (October, 1941), p. 5.

> and the pea but around man. And it is time biology teachers placed their emphasis on human biology. The course content at once becomes significant, teaching becomes meaningful, the goals are clear and justification for teaching biology is found in every day's work. Experimental data fall into a proper framework.
>
> The content of a course organized around problems of living generally centers around these areas: nutrition, human physiology, behavior, disease, and life span, heredity, evolution and anthropology, and biologic production.
>
> Classes taught by this method have consistently shown high results in the New York State Board of Regents and in college entrance examinations. They read more, do more, take more science than do students of equal intelligence (measured by I. Q., reading score and background) taught by the same teacher under conditions where cooperative planning is eliminated, where the state syllabus is adhered to strictly, where subject matter is a primary goal and not the interests and needs of students. And what is most surprising is that students who participate in such learning know such details as conjugation in spirogyra and bread mould, budding in hydra and other minutiae which have little or no bearing on their own problems of life and living. It seems that they are strongly motivated to read the entire textbook.[1]

An interesting finding on the use of discussion versus absence of class discussion was brought out in a review of recent research in the teaching of science in college. Edward K. Weaver was chairman of the group. In studies related to teaching techniques the following was written:

> Mason and Angell selected 93 students, enrolled in five laboratory sections in the first of a three term course in biological science, and utilized a teaching variable of a 20-minute discussion period carried on during certain laboratory sections. The instructor assumed the responsibility of directing the discussion period, and an attempt was made to establish rapport with the students and maintain situations in which they would

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[1]Paul F. Brandwein, "Reorganizing Biology to Meet the Needs and Interests of Youth," The Science Teacher, XII (December, 1946), pp. 60-61, 86.

feel free to express themselves. Students in the laboratory periods in which the discussion activity was carried on did slightly better than did students in the control group in which the discussion activity was not a part of the instructional program. Students participating in the discussion activity, as indicated by their responses to an unsigned questionnaire felt that the discussion period not only provided experiences which were helpful with respect to such objectives as acquisition of facts and ability to solve problems, but also opportunities for growth in some of the more general aims of education.[1]

In a similar type of report with Thomas P. Fraser as chairman, the following was written:

> Winer and Paul ascertained the reactions of students to a biological science course taught by (a) the group method, and (b) a lecture-discussion method. Two general education biology classes taught by one instructor were taught by both the group method and the lecture-discussion method for half term each. The groups were equated by ACE Psychological Tests, Kuder preference scales, and the registrar's records. Responses were elicited from the students as to which method of instruction they preferred and their reasons for this preference. A forty-item check list was used to secure reasons. Major findings indicated that: (1) of the 51 respondents, 27 favored the group method, 24 the lecture method; (2) a general reaction of part of the group seemed to favor a compromise situation in which the main values of the two teaching procedures could be put to use; (c) students felt that the group method held more interest for them; (4) students felt that with the lecture-discussion method it was easier to prepare for tests, take notes, and learn factual material than in the group method; and (5) instructors found that the class rapport seemed much better under the group method than under the lecture-discussion method.[2]

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[1]Edward K. Weaver, et al., "Review of Recent Research in the Teaching of Science at the College Level III," Science Education, XL (December, 1956), p. 353.

[2]Thomas P. Fraser, et al., "Review of Recent Research in the Teaching of Science at the College Level III," Science Education, XXXIX (December, 1955), p. 359.

Wayne A. Stafford reported that there were no significant differences when he used two groups in high school biology to check the use of the textbook versus supplemental material. He used the rotational technique as described by Good, Barr, and Scates as follows:

> The rotation method involves the reversal of the groups at intervals, in terms of the procedures followed. This method is frequently used when parallel groups are not available or there is doubt concerning the equivalence of the groups, due to such factors as initiative, industry, or study habits which are very difficult if not impossible to control. The groups may be reversed as often as desired by the investigator.[1]

From using these two methods of teaching and from testing with subsequent use of the "t" test for significance, his conclusions were:

1. Great amounts of supplemental material of value for use in high-school biology were found to be available.
2. At the expense of a great deal of time and energy this supplemental material can be organized into a form that might be used to replace a textbook in so far as subject matter is concerned.
3. There was evidence that every student grew in biology achievement during both semesters under both systems.
4. The first semester Group A (Textbook) grew more in achievement than Group B (Supplemental). The difference in growth amounted to an average of 1.70 points per pupil.
5. The second semester Group A (Supplemental) grew more in achievement than Group B (Textbook). The differences in growth amounted to an average of 1.30 points per pupil.
6. The differences in growth in achievement in biology of group A over Group B were not significant either

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[1]Wayne A. Stafford, "The Textbook versus Supplemental Material in Teaching Biology," School Science and Mathematics, LII (December, 1952), p. 740.

semester (see Table IV).

7. The differences in achievement in biology during both semesters was apparently influenced more by the personnel in Group A than by the type of reference materials used.
8. The evidence from this study, although limited in scope substantiates the statement in the 46th Yearbook of the National Society for the Study of Education with respect to the use of the textbook.[1]

While the experiment carried out by Wayne A. Stafford was not duplicated in the experiment which is the subject of this dissertation, and while all of his conclusions do not necessarily appertain to the experiment, attention should be called to his conclusion numbered six in which he stated that "the differences in growth in achievement in biology of Group A over Group B were not significant either semester."[2] This conclusion seems to be substantiated by the experiment which is the subject of this dissertation.

No one method should be used in teaching biology. Each teacher must decide for himself the best method for a given time, class, or unit. R. W. Gerard says that "there is no one best way to teach; each must operate according to his own metier to be most effective."[3] Richard L. Weaver says:

> Experience has demonstrated the necessity for the use of many methods and techniques in the teaching of biology. The teacher should be familiar with many

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[1] Ibid., pp. 741-742. [2] Ibid., p. 742.

[3] R. W. Gerard, "Higher General Education in Biology," The American Institute of Biological Sciences Bulletin, VI (April, 1956), p. 21.

> methods in order to select wisely the proper methods to fit best the situation. Better use of texts, references, and audio-visual materials, more adequate appraisal and wider use of community resources, particularly out-door laboratories, study areas, school camping, school forests, gardens, and the like.[1]

Most of this discussion has been concerned with methods, but this is not all. More than likely some differences existed between the sections which cannot be shown. The hours of the meetings of the two sections should be mentioned. Section I met on Monday, Wednesday, and Friday at 8:00 for two hours. Section II met Tuesday and Thursday at 1:30 for three hours. Perhaps the students and the teacher were more wide awake in the afternoon, and as a result of this, the differences which did show up seemed to have been in favor of the afternoon section.

Conclusions

In the teaching of biology many methods are useful, and no one method should be used to the exclusion of others. Different attitudes are developed by students of biology as these methods are used. Since people are different, the attitudes which they develop are important because there are many fields in biology which they may choose to enter. Some of these fields would attract the student who was interested in research, and others would attract students who wanted to work in the out-of-doors.

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[1]Richard L. Weaver, "Improvement of Biology Teaching," School Science and Mathematics, LVI (April, 1956), p. 262.

The lecture method which includes the textbook is still a very necessary part of a biology course. Some units of biology particularly those which include a great deal of factual information considered necessary for students of biology including nomenclature and classification seem to be taught better by the lecture method. The lecture method for these factual units seems to be preferred, at least from this study, by the students. Certainly at the college level one would expect the lecture method to be used extensively in the future as it has been in the past.

Some units of biology may be made more meaningful by the use of community resources. The students even though it cannot be shown statistically seem to enjoy this method. A different type of testing than was used in this experiment may be necessary to show this enjoyment.

For some reason which cannot be explained completely Section II meeting from 1:30 - 4:30 P. M. on Tuesday and Thursday seemed to be motivated to excel on the material tested. Section II seemed to have a better attitude toward biology than did Section I which met from 8:00 - 10:00 A. M. on Monday, Wednesday, and Friday.

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APPENDIX A

INDIVIDUAL RECORD SHEET

INFORMATION FOR BIOLOGY 141

Last First Middle M D Year

Name: _____ Age: _____

School Address: _____ Marital status:

_____ M S D

Home Address: _____

	Years	Science Courses Taken
High School:		
College:		

Parents' Occupations: _____ Mother

_____ Father

Major: _____ Minor: _____

Total hours completed: _____ Hours enrolled _____

Employed: _____ Where: _____ Hours/week: _____

REMARKS, ABSENCES, ETC.

INDIVIDUAL REPORT SHEET USED DURING EXPERIMENT

Last First Middle

Name:

Scores

	Lecture	Lab	Final Exam
Quizzes 1	_____	1 _____	_____
2	_____	2 _____	
3	_____	3 _____	
4	_____	4 _____	
5	_____	5 _____	
Total	_____	_____	
Exams 1	_____	1 _____	Project _____
2	_____	2 _____	Dissections _____
3	_____		_____
4	_____		_____
5	_____		
Total	_____	_____	

California Mental Maturity Test Scores _____

Tests of Evaluation _____ _____

_____ _____

_____ _____

_____ _____

Absences _____ _____

Final Score _____ _____

Final Grade _____ _____

Mimeographed Summary of Parasitic Worms

For Section I

(Unit 3)

1. Information on worms as reported by the Texas State Health Department.
   - A. Phylum Platyhelminthes, Class Cestoda.
     1. Description: Dwarf, pork, beef tapeworms.
     2. Infection: Eating of meat which is not sufficiently cooked.
     3. Size: May attain length of 75 ft.-beef tapeworm. May have 3000 segments - each filled with eggs.
     4. Affect digestive organs: cause loss of weight, lack of energy, and general fatigue.
     5. Life cycle (pork tapeworm):
        - a. Adult tapeworm in intestines produce eggs.
        - b. Eggs are deposited on ground in body waste.
        - c. Eggs swallowed by hogs.
        - d. Egg hatches to larva in stomach of hog.
        - e. Bores through intestinal wall to blood stream.
        - f. Carried to muscle by blood stream.
        - g. Changes in muscle to a larval form called cysticercus.
        - h. Eaten by man in improperly cooked food.
        - i. Cysticercus hatches to adult in stomach and attaches to intestine wall. Eggs are produced and life cycle begins again.

   - B. Phylum Nemathelminthes.
     1. Pinworms - <u>Enterobius</u>.
        - a. Description: White, approximately one fourth to one half inch long and about the same diameter as the average needle.
        - b. Infection: Ingestion of ova on soiled hands, in contaminated food and drink or from other objects placed in the mouth. Children from 2 to 15 years are most susceptible to pinworms.
        - c. Life cycle:
          - (1) Eggs are taken in with contaminated food or soiled hands.
          - (2) Eggs hatch out in the intestine and grow to mature worms.

(3) Adult worm produces more eggs and deposits them on perianal region.
(4) Worm attaches itself to intestinal wall.

2. Ascaris
   a. Description: Large, white, and reach length of 6 - 15 inches. Female may produce as many as 200,000 eggs.
   b. May cause loss of weight, nausea, elevated temperature, and even pneumonia; may stop up alimentary canal.
   c. Life cycle:
      (1) Egg deposited on soil.
      (2) Egg enters human alimentary canal in food and drink.
      (3) Egg hatched out in alimentary canal.
      (4) Larva bores through intestinal wall.
      (5) Larva enters blood stream.
      (6) Larva is pumped to lungs via heart.
      (7) Larva bores through lungs and goes to throat.
      (8) Larva swallowed in food and drink and makes way to intestine where it matures and produces more eggs.

II. Information on worms from veterinarians.
   A. Veterinarians visited: Sanders, Black, and Wilmore - Marshall; Winchester and Duncan - Texarkana.
   B. Summary of questions asked veterinarians.
      1. The overall symptoms of parasitism in animals are rapid; loss of weight, loss of energy, occasional bloating, occasional loss of the use of muscles, and loss of appetite.
      2. Symptoms of parasitism are prevalent during the fall and early winter months mostly because of curtailment in pasture produce which thus causes a general run-down condition or lowered resistance in the animals. The humid climate of this area is very conducive, coupled with dampness, to parasitism. Both malnutrition and climatic influences play major roles.
      3. There has been an overall increase in parasitism during the past year as revealed in statistical reports. The most extensive increase has been noticed in the hookworm which has increased 14%. However, there are naturally

increases in some parasites in the area where they are most predominant. Even with better preventive measures parasitism is increasing.

4. Parasites are divided roughly into two groups, internal and external. External parasites include mosquitoes, ticks, lice, flies, etc. Internal parasites affect such areas as the alimentary tract, the liver, and the circulatory system.
5. Internal parasites detected more readily in fecal analysis - ova.
6. Parasites thrive in unsanitary conditions. In cattle, sheep, and goats, the stomach worm is prevalent. A destructive parasite which is becoming more prevalent is the filaria, or heart worm, which infects the blood stream. Blood-sucking worms cause the presence of foreign bodies in the blood stream. The cure or treatment for the heart worm is often fatal.

III. Information on worms from meat-packing plants.
   A. Plants: Marshall Food Locker Plant, Caddo Packing Plant, and the inspector, Dr. Wilmore.
   B. Worms:
      1. Ascaris.
      2. Macracanthorhynchus hirudinacens Thorn-head.
         a. Found in hogs.
         b. Hogs eat acorns which contain the larva.
         c. The worm goes to the stomach; then attaches itself to the walls of the intestine by means of "thorns" or "hooks."
         d. No treatment.
      3. Grubs or wolves.
         a. Found under skin; commonly found on back or throat.
         b. May enter skin by fly laying eggs on the hair of a cow; the cow licks up the egg and swallows it. Worm burrows to the back.
         c. May enter skin by the fly stinging the heel. The worm then burrows up the leg under the skin to the back where it forms a cyst.
         d. Treatment: Rub table salt on sore spot.

Miss Fonta Brittenum's Notes on

Nutrition and Vitamins

for Section I

(Unit 5)

Nutrition is the science of food and its relation to health. Nutrition deals with food; with the ingredients of food known as nutrients, such as vitamins, minerals, carbohydrates; and with the way in which the body makes use of these ingredients.

Vitamins are a group of substances present in foods in very minute quantities. These are essential to promote growth and good health. A lack of these substances gives rise to various corresponding diseases. When these substances were first discovered their exact chemical nature was unknown, and so they are recognized by letters of the alphabet. Some have been broken down into subdivisions, e.g., the B vitamin has been broken down into several different ones and now it goes by the B complex vitamins.

Vitamin A is a fat soluble substance and is essential for growth, maintenance of good health, normal eye functioning, healthy skin and mucous membrane linings of body. It also helps resist infection to the body.

1. Deficiency of this vitamin is denoted by retarded growth, night blindness, rough dry skin, low resistance to disease, and severe inflammation of the eye.

2. Good sources of this vitamin are liver, butter, spinach, carrots, cod liver oil, tomatoes, and peas.

Vitamin B has to be broken down into its component parts, which are B_1 or Thiamine, B_2 or Riboflavin, and Niacin.

Vitamin B_1 or Thiamine.

1. This vitamin is essential for carbohydrate metabolism, normal digestion and elimination, growth, normal functioning of nerves, and normal appetite.
2. A lack of this vitamin is known by retarded growth, nervousness, insomnia, lack of appetite, constipation, general fatigue, and beriberi.
3. Good sources of this water soluble vitamin are pork, ham, heart, kidneys, veal, cereals, dried beans, egg yolk, peanuts, milk, yeast, and nuts.

Vitamin B_2 or Riboflavin is a water soluble vitamin.

1. This vitamin is needed for growth and for healthy skin and eyes.
2. A deficiency of this vitamin in the body is characterized by blood-shot eyes or very sensitive eyes, retarded growth, sores in the angles of the mouth, and sores in the folds of the nose.
3. Good sources of this vitamin are wheat germ, yeast, liver, milk, eggs, whole cheese, and

leafy vegetables.

Niacin is needed for growth, proper functioning of the digestive tract, and healthy skin.

1. A lack of niacin will result in pellagra, loss of appetite and weight, rough, red skin, and digestive and neural disturbances.
2. This can be found in liver, meat (lean), poultry, fish, peanuts, dried fruits, yeast, and green leafy vegetables.

Vitamin C is necessary to form and maintain the cementing substance between body cells.

1. The deficiency symptoms are a tendency to bruise easily; spongy gums; loose teeth; a degeneration of muscle fibers, ligaments, and tendons; bone changes, rickets; anemia, and scurvy.
2. Foods that contain vitamin C are all citrus fruits, lemons, oranges, and grapefruits; liver; tomatoes; berries; broccoli; cantaloupe; raw salad greens; and green peppers.
3. Vitamin C can only be stored in small amounts so that we need a daily supply of this vitamin. It is not very stable and is easily destroyed by cooking. Much of it is lost in preserving foods.

Vitamin D is our "sunshine vitamin" as it is produced in the skin by the sun.

1. This is essential to build and maintain sound

bones and teeth, to regulate calcium and phosphorus metabolism, and growth.

2. A deficiency of this vitamin results in malformed or soft bones, rickets, poor development of teeth, stunted growth, and insufficiency of calcium and phosphorus in the body.
3. This vitamin is obtained from Vitamin D evaporated milk, Vitamin D milk, fish liver oils, sunshine, and eggs.

Vitamin E is necessary for reproduction in animals, but its significance in human nutrition is unknown.

Vitamin K helps with blood clotting ability. This is obtained from spinach, kale, liver, and soy beans.

This concludes our better known vitamins.

Proteins are needed to build and repair tissues. Foods that are high in protein are lean meat, fish, dairy products, poultry, dried beans, and dried peas.

Carbohydrates provide energy for body activities and heat. These are broken into two classes, starches and sugars. Important sources of these are breads, cereals, fruits, crackers, flour, macaroni, cookies, cakes, candies, etc.

Fats help to maintain body heat and to supply, in concentrated form, energy for body activities. Sources of these are butter, cheese, chocolate, cream, lard, margarine, meat fats, nuts, salad dressing, salad oils, shortening, and vegetable oils.

Minerals help to build and maintain the body and regulate its functions.

Calcium is essential for the development of strong bones and teeth, for normal blood clotting, and in regulating activity of muscles and nerves.

1. Deficiency symptoms are slow clotting of blood, stunted growth, defective structure of teeth and bones, called rickets in young children.
2. Best sources of calcium are milk and milk products, soy beans, and green leafy vegetables.

Phosphorus is essential in all body tissues and cells, and for proper development of bones and teeth.

1. A deficiency of phosphorus can be detected by stunted growth, defective structure of teeth and bones.
2. Good sources of phosphorus are meat, milk, poultry, fish, eggs, dried beans, dried peas, nuts, and whole grain cereals.

Iron is essential for building and maintaining blood.

1. Deficiency shows up in nutritional anemia.
2. Good sources are liver, heart, kidney, egg yolk, lean meat, turkey, green leafy vegetables, dried beans, and dried fruits.

To save figuring out exactly the amount of each essential nutrient needed each day, we can use a general rule. This "basic seven" chart is excellent. If foods from each

group are eaten daily, probably the food requirements will be met.

In our first group, green and leafy vegetables, the main contributions are vitamin A, calcium, and iron. We need one or more servings of this group. These foods can be eaten raw, cooked, or frozen.

To save the nutrients these steps can be followed.

1. Do not let stand in water because water soluble vitamins are lost.
2. Cook quickly in small amounts of water in a light pan.
3. Cook only until tender.
4. Keep juice in which these have been cooked for soups or sauces.

In our second group, citrus fruits, tomatoes, and raw cabbage, the main contributions are vitamins C, A, and the B group. We need one or more servings a day.

To conserve the food nutrients these steps can be followed.

1. Store these foods in refrigerator. Do not keep for long periods of time.
2. Serve fruit juices unstrained because the pulp contains vitamins.
3. Serve fruits whole as much as possible. Vitamin is lost rapidly when foods are crushed or dropped in preparation.

In our third group, potatoes and other vegetables and fruits, the main contributions are thiamine, vitamins A and C, calcium, and phosphorus. We need two or more servings of these a day.

To save the nutrients these steps can be followed.

1. Eat raw as much as possible.
2. Wash foods thoroughly but quickly. Do not let stand in water.
3. Cook quickly in small amounts of water only until tender. Cook in skins as much as possible.
4. Again save liquid in which foods were cooked.

In our fourth group, milk, cheese, and ice cream, the chief contributions are calcium, phosphorus, riboflavin, and protein. The whole milk can be evaporated, soured, or sweetened. Skim milk and buttermilk are also valuable. Daily requirement for children is one quart and for adults, two or more cups per day.

To care for these foods properly these steps can be followed.

1. Should be stored in refrigerator.
2. Evaporated or condensed milk will keep on kitchen shelf until opened.

In our fifth group, meat, poultry, fish, eggs, dried beans, peas, and nuts, the chief contributions are protein, vitamin B group, iron, and phosphorus. The daily requirement is one serving daily.

For economical and efficient use these steps can be followed.

1. Amount of bone will help determine amount to allow per serving. One pound of boneless meat will serve three people.
2. Use these foods with cream soups and casseroles to cut down cost. Also use less tender cuts of meat, for they have the same nutritive values.
3. Meats may be frozen successfully. Do not overcook. Broiling is preferred to frying for saving nutrients and is not so fattening.

In our sixth group, breads, flour, and cereals (these may be whole grained, enriched and restored), the chief contributions are thiamine, niacin, iron, calories, and roughage. No special care is necessary for these.

In our group seven, butter and margarine, some is needed daily. These foods should be stored in covered containers in refrigerators.

THE PLANT KINGDOM

(Unit 7 and Unit 10)

Subkingdom Thallophyta

Phylum Cyanophyta (Blue-green-Algae)

Class Cyanophyceae

Order Chroococcales
Gloeocapsa, *Merismopedia*, *Synechocystis*

Order Nostocales
Nostoc, *Oscillatoria*, *Scytonema*, *Gleotrichia*

Phylum Chlorophyta (Green Algae)

Class Chlorophyceae

Order Volvacales
Chlamydomonas, *Pandorina*, *Volvox*

Order Ulotrichales
Ulothrix, *Protococcus*

Order Oedogoniales
Oedogonium

Order Conjugales
Spirogyra, *Zygnema*, *Closterium*, *Cosmarium*

Order Chlorococcales
Hydrodictyon, *Scenedesmus*

Order Siphonales
Vaucheria

Class Charophyceae

Order Charales
Chara

Phylum Phaeophyta (Brown Algae)

Class Isogeneratae

Order Ectocarpales
Ectocarpus

Class Heterogeneratae

Order Laminariales
Laminaria, *Nereocystis*

Class Cyclosporeae

Order Fucales
Fucus, *Sargassum*

Phylum Rhodophyta (Red Algae)

Class Rhodophyceae
Batrachospermum, *Corallina*, *Polysiphonia*, *Pterosiphonia*

Phylum Schizomycetophyta (Bacteria)

Phylum Myxomycetophyta (Slime Fungi)

Stemonitis, *Fuligo*, *Plasmodiophora*, *Comaricha*, *Enerthema*

Phylum Eumycetophyta (True Fungi)

Class Phycomycetes

Order Saprolegniales
Saprolegnia

Order Peronosporales
Albugo, *Phytophthora*, *Plasmopara*, *Peronospora*

Order Mucorales
Rhizopus

Class Ascomycetes

Order Endomycetales
Saccharomyces, *Eremascus*

Order Eurotiales
Aspergillus, *Penicillium*

Order Erysiphales
Uncinula

Order Pezizales
Plectania, *Peziza*

Order Heliotiales
Sclerotinia

Order Taphrinales (Exoascales)
Taphrina (*Exoascus*)

Order Spaeriales
Neurospora

Class Basidiomycetes

Subclass Eubasidiomycetes

Order Agaricales
Agaricus, *Hydnum*, *Polyporus*, *Psalliota*, *Amanita*, *Coprinus*

Order Lycoperdales
Geaster

Subclass Protobasidiomycetes

Order Uredinales
Cronartium, *Puccinia*

Subclass Hemibasidiomycetes

Order Ustilaginales
Ustilago

Phylum Bryophyta

Class Hepaticae (Liverworts)

Order Marchantiales
Riccia, *Ricciocarpus*, *Marchantia*

Order Jungermanniales

Suborder Anacrogynae
Pellia

Suborder Acrogynae
Porella

Class Anthocerotae

Order Anthocerotales
Anthoceros

Class Musci (Mosses)

Order Sphagnales
Sphagnum

Order Funariales
Funaria

Order Eubryales
Mnium

Order Polytrichinales
Polytrichum

Phylum Psilopsida
Psilotum

Phylum Lycopsida

Order Selaginellales
Selaginella

Phylum Sphenopsida

Order Equisetales
Equisetum

Phylum Pteropsida (True Ferns)

Class Filicineae

Order Filicales
Polypodium, *Pteris*, *Marsilia*, *Azolla*, *Salvinia*, *Dryopteris*

Class Gymnospermae

Order Coniferales
Pinus

Class Angiospermae

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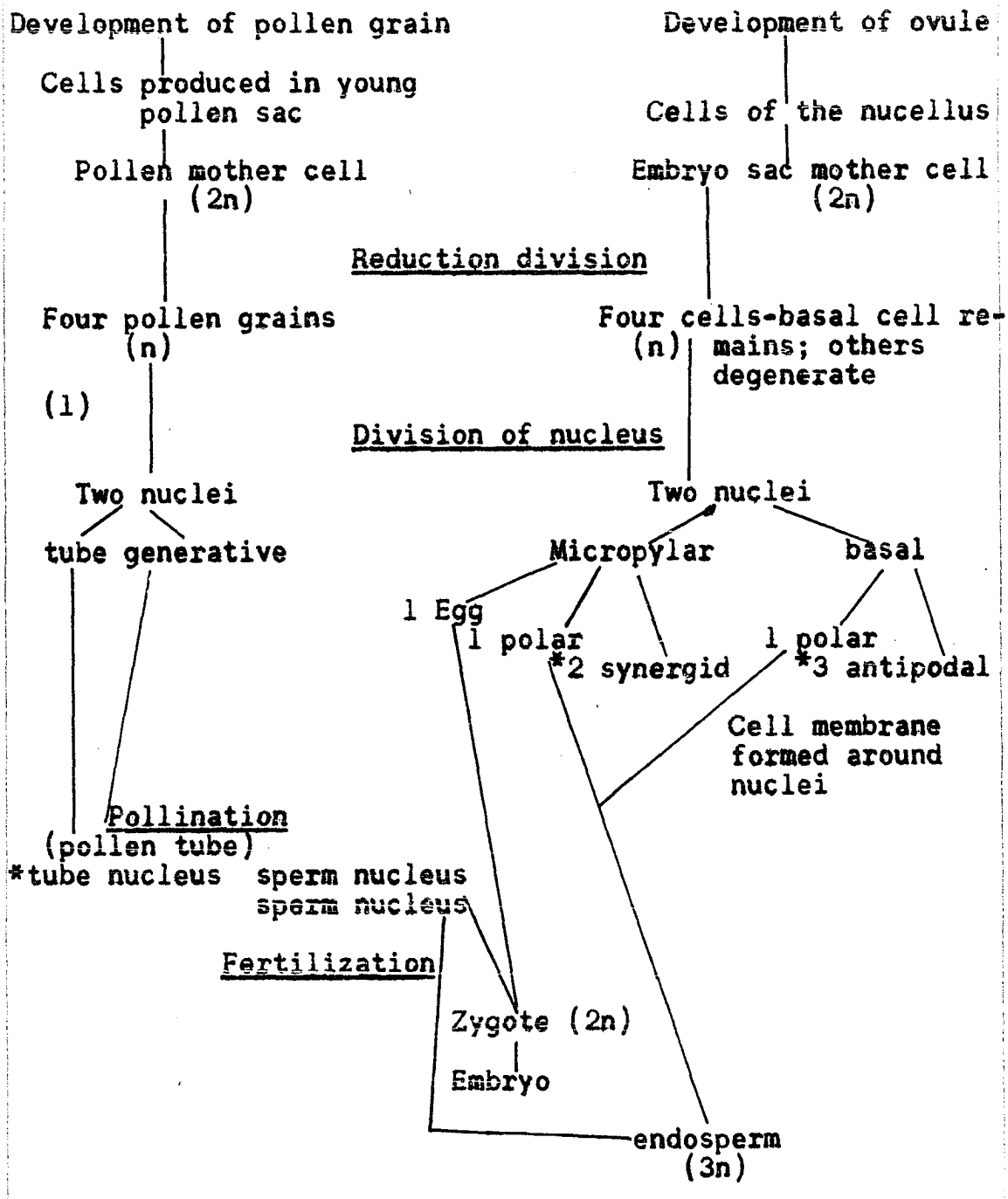
REPRODUCTION IN FLOWERS
(Unit 9)



*Undergo disorganization

APPENDIX B

TABLE 6

ORIGINAL DATA OF EACH SECTION FOR FALL AND SPRING CLASSES

Original Cases	I.Q.	Units and Subtests (Section I: Fall, 1953)						
		1		2	3	4	5	
		1	2	3	4	5	6	7
1	109	35	9	21	29	42	49	35
2	96	34	20	16	27	32	50	
3	98	43	17	25	27	32	66	28
4	107	35	32	44	20	44	55	20
5	108	48	34	36	35	46	60	37
6	101	43	27	33	21	44	55	20
7	102	46	44	39	34	60	56	39
8	97	39	8	27	25	42	48	23
9	88	39	13	17	28	51	54	36
10	100	37	19	23	29		44	13
11	98	35	12	3	19	33	48	25
12	100	51	43	39	35	34	58	35
13	103	47	41	38	30	55	70	46
14	112	46	45	39	41	62	61	
15	117	54	30	31	30	40	59	23
16	102	40	19	12	27			
17	116	61	45	44	34	69	74	37
18	93	48	18	15	21	43	42	19
19	116	48	27	29	21	42	59	18
20	104	47	19	23	26	43	61	34
21	92	38	17	17	18	42	45	21
22	95	65	50	43	24	66	66	51
23	103	40	19					
24	108	41	15	12	28	23	52	16
25	104	48	25	22	22	43	61	28
26	110	56	39	37	29	58	62	27
27	100	41	15	27	25	58	69	25
28	114	60	40	48	33	55	71	39
29	103	41	32	38	30	55	63	38
30	91	36	24	35	13	28	42	16
31	110	44	9	24	24	49	66	22
32	94	42	25	20	18	39	56	32
33	108	58	49	40	28	66	73	40
34	106	48	33	23	31	40	62	21
35	100	45	31	26	27	30	54	24
36	104	61	45	42	32	67	68	46
	M =	46	28	29	27	46	58	29

TABLE 6--Continued

Original Cases	I.Q.	Units and Subtests (Section I: Spring, 1954)				
		6	7	8	9	10
		8	9	10	11	12
1	109	27	13	38	42	36
2	104	49	64	75	68	46
3	98	26	23	30	23	34
4	107	22	16	16	22	32
5	102	37	31	48	42	45
6	105	35	20	56	41	29
7	95	19	9	29	21	17
8	100	22	5	27	27	25
9	88	30	8	31	33	25
10	100	17	7	20	26	27
11	113	39	13	39	27	33
12	111	34	19	32	26	29
13	98	16	11	15	25	21
14	124	18	48	44	34	28
15	103	40	28	61	51	37
16	106	21	26	54	18	32
17	117	38	17	29	17	30
18	103	25	19	15	14	24
19	111	34	26	33	24	23
20	113	36	34	42	30	27
21	104	19	20	28	22	26
22	116	31	27	39	42	39
23	110	35	25	67	45	34
24	108	19	7	16	11	13
25	104	23	16	33	19	24
26	100	29	4	6	20	28
27	88	24	17	26	17	27
28	110	21				
29	94	19	18	45	24	18
30	94	22	11	15	12	26
31	99	32	6	33	16	30
32	108	24	36	52	41	45
33	106	35	19	40	24	26
34	100	20	13	42	23	23
	M =	28	20	36	28	29

TABLE 6--Continued

Original Cases	I.Q.	Units and Subtests (Section II: Fall, 1953)						
		1		2	3	4	5	
		1	2	3	4	5	6	7
1	104	63	59	48	42	72	79	60
2	107	37	14	22	25	24	55	18
3	106	45						
4	116	44	26	17	33	56	60	25
5	108	63	31	29	36	59	70	43
6	95	27	17	8	21	26	40	26
7	116	70	51	45	37	54	82	50
8	106	66	55	50	40	70	77	41
9	87	45	31	12	33	48	48	30
10	87	37	23	34	16	42	51	12
11	103	47	34	22	39	44	58	30
12	115	47	29	36	37	48	62	35
13	100	38	51	37	42	64	68	48
14	106	47	13	23	28	44	53	31
15	89	52	33	15	32	35	45	27
16	109	50	35	40	33	54	69	36
17	103	37	26	25	29	41	63	28
18	105	57	42	37	34	51	63	36
19	103	38	10	18	24	31	52	27
20	96	45	13	13	30	44	61	43
21	101	36	27	13	20	50	60	39
22	108	48	26	27	35	46	58	41
23	93	49	8	7	17	23	58	24
24	116	60	42	28	35	39	59	37
25	100	59	43	39	39	51	64	35
26	105	30	9	9	19	41	46	22
27	91	44	11	11	11	29	39	13
28	99	30	12	27	25	26	44	13
29	88	31	18	20	32	33	51	21
30	101	37	20	9	24	41	56	21
31	120	54	57	48	37	60	74	48
32	115	49	40	21	40	67	75	48
33	106	35	19	16	24	38	50	
34	112	45	24	17	31	44	55	36
35	94	37	11	12	28	41	48	22
36	103	53	45	38	28	54	58	24
37	100	51	42	22	35	43	51	42
	M =	46	29	25	30	45	58	32

TABLE 6--Continued

Original Cases	I.Q.	Units and Subtests (Section II: Spring, 1954)				
		6	7	8	9	10
		8	9	10	11	12
1	119	36	37	71	60	43
2	108	52	22	58	50	36
3	106	55	44	62	72	42
4	114	34	11	25	30	23
5	87	25	14	37	23	21
6	103	29	10			
7	115	35	26	20	34	37
8	100	41	29	51	72	36
9	89	39	19	33	47	33
10	110	39	18	31	31	21
11	92	24	9	25	14	22
12	103	17	21	18	29	18
13	96	29	17	36	37	25
14	101	40	22	15	24	32
15	93	21	8	29	27	22
16	93	37	13	53	31	44
17	100	48	23	46	49	39
18	114	51	26	62	33	45
19	99	25	14	11	17	24
20	103	23	30	52	48	31
21	106	44	17	57	50	20
22	101	29	13	16	50	31
23	120	55	52	75	60	44
24	115	43	17	60	49	29
25		13	7	14		
26	101	15	13	20	28	15
27	121	39	10	64	49	29
28	103	43	21	61	54	41
29	112	44	7	32	26	43
30	118	30	14	26	19	29
31	103	45	27	43	30	31
32	100	35	19	36	48	38
33	116	24	17	32	37	29
34	104	57	37	74	58	40
35	113	40	8	25	47	28
	M =	36	20	39	40	32

TABLE 7

ORIGINAL DATA OF EACH SECTION FOR FALL AND SPRING CLASSES

Original Cases	Attitude Tests (Section I: Fall, 1953)							
	1		2		3		4	
	Like	Un-like	Like	Un-like	Like	Un-like	Like	Un-like
1	2	-1	2	1	1	1	3	2
3[a]	2	-1	2	2	1	-1	2	2
7	2	2	2	3	3	3	1	2
9	2	2	2	3	3	3	3	1
10	2	0	0	-1	2	2	2	2
11	1	0	1	3	2	2	3	2
13	2	2	2	3	2	3	3	3
15	2	-1	2	2	0	0	2	0
20	1	0	2	1	2	0	1	0
21	1	-1	2	1	2	0	2	2
24	1	0	2	1	2	0	3	2
25	2	1	1	3	2	0	1	2
26	0	1	2	2	1	-1	1	0
27	2	-1	1	1	3	2	1	1
28	1	0	1	3	2	1	2	1
29	2	0	2	3	1	2	3	2
31	1	-2	1	-1	0	-1	3	1
32	1	0	2	3	3	0	3	1
33	0	1	2	2	0	-1	2	1
34	2	1	1	2	1	1	3	0
35	1	0	2	3	1	2	3	2
36	2	0	2	2	1	0	0	3
M =	1.5	0.1	1.6	1.9	1.6	0.8	2.1	1.5

[a]Scores omitted for cases who left the course (throughout Table 7).

[b]Since this unit was a short one, only the unlike portion of the test was given (throughout Table 7).

TABLE 7--Continued

Original Cases	Attitude Tests (Section I: Spring, 1954)								
	5		6		7		8		9[b]
	Like	Unlike	Like	Unlike	Like	Unlike	Like	Unlike	Unlike
1	3	2	1	1	1	0	2	2	2
2	2	2	2	0	2	1	0	-1	-1
3	4	3	0	1	1	2	1	6	2
4	-2	2	1	-1	0	0	3	3	1
5	8	4	0	0	3	2	2	7	0
6	2	0	-6	-2	2	0	1	5	1
7	5	0	3	1	2	1	3	6	0
8	1	1	-1	1	1	0	1	0	2
9	8	4	0	0	0	0	0	0	0
10	-4	-2	1	1	2	1	0	3	1
11	0	3	-5	-2	2	1	3	6	3
12	0	1	2	2	2	0	-2	0	-1
13	1	2	1	2	2	2	1	6	0
14	-1	0	0	1	2	0	1	4	0
15	7	3	0	0	3	2	3	7	3
16	3	2	0	1	2	1	1	3	0
17	-6	-2	0	-1	1	1	2	3	1
18	-7	-3	-6	-4	-1	-2	-1	-7	-4
19	-3	1	-1	-1	1	1	2	3	1
20	2	2	1	0	2	1	1	4	0
21	0	0	0	0	0	-1	3	5	0
22	6	1	0	-1	1	1	2	1	2
23	-2	1	-2	-3	0	1	2	2	0
24	1	1	0	0	0	1	0	2	0
25	3	1	-4	-4	0	-1	0	4	1
26	3	1	1	0	2	0	0	1	0
27	8	3	6	1	3	2	2	6	1
29[a]	5	1	0	0	1	1	2	2	0
30	2	2	0	0	2	2	0	3	0
31	3	2	3	1	2	0	-1	-1	3
32	5	2	2	-1	2	1	2	2	4
33	1	2	0	0	2	0	2	2	0
34	0	1	-1	0	0	1	3	5	3
M =	1.8	1.3	-0.9	-0.2	1.4	0.7	1.2	2.8	0.8

TABLE 7--Continued

Original Cases	Attitude Tests (Section II: Fall, 1953)							
	1		2		3		4	
	Like	Un-like	Like	Un-like	Like	Un-like	Like	Un-like
1	2	0	2	1	2	1	-2	0
2	2	2	2	-3	-1	-1	3	3
5[a]	2	2	2	3	3	3	3	1
6	1	1	2	0	2	2	0	-1
8	0	0	0	0	0	0	0	0
9	2	0	2	3	3	3	3	3
11	2	2	2	3	1	2	1	2
12	1	2	1	0	-1	0	2	2
13	1	2	1	2	2	2	3	1
14	2	2	1	2	2	3	2	1
15	2	2	1	3	0	1	3	1
17	-2	-2	-1	2	3	-1	3	3
19	2	2	2	1	2	3	3	2
20	1	2	2	0	2	3	3	1
21	2	2	1	1	0	0	1	1
23	2	0	1	-1	-2	0	2	1
25	2	1	1	2	-2	0	1	1
29	2	1	2	3	3	3	1	1
30	1	1	1	1	1	2	1	1
31	2	1	1	2	2	2	2	1
32	2	1	2	1	2	2	3	3
34	1	0	0	0	0	0	2	1
35	2	1	2	0	2	1	3	1
36	2	2	2	3	3	3	0	3
37	2	1	2	1	2	3	3	0
M =	1.5	1.1	1.4	1.2	1.2	1.5	1.8	1.3

TABLE 7--Continued

Original Cases	Attitude Tests (Section II: Spring, 1954)								
	5		6		7		8		9[b]
	Like	Unlike	Like	Unlike	Like	Unlike	Like	Unlike	Unlike
1	8	4	6	1	3	1	3	5	2
2	5	-2	-6	-2	3	0	3	7	4
3	1	1	0	0	0	1	0	0	0
4	2	0	0	2	3	1	0	1	-4
5	7	2	0	0	0	0	3	7	0
7[a]	3	0	0	2	1	1	2	3	0
8	2	2	0	0	-1	1	0	0	2
9	7	2	5	1	2	1	2	4	3
10	5	1	0	2	1	1	0	3	1
11	5	0	-6	-4	2	0	1	3	-3
12	4	1	1	0	2	1	1	6	2
13	2	0	0	0	1	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	2	-2	-2	0	1	2	0	4	2
16	5	1	-6	-4	2	1	3	3	0
17	2	1	1	2	3	1	1	6	0
18	5	0	3	2	1	1	1	3	0
19	6	-1	-2	0	0	1	-1	-2	0
20	4	0	0	0	1	0	1	5	0
21	4	0	1	2	3	2	3	6	3
22	3	0	-3	-1	1	0	3	7	3
23	4	0	0	0	3	1	0	3	0
24	4	1	0	0	1	2	2	6	0
25	5	1							
26	8	4	0	2	2	2	3	6	4
27	6	3	3	3	3	2	1	4	1
28	6	3	3	3	3	1	3	6	3
29	1	0	-6	-4	1	0	0	0	0
30	4	1	1	0	2	1	1	6	1
31	6	4	6	4	1	2	3	7	4
32	1	0	0	0	1	0	0	0	0
33	2	1	-2	0	2	0	2	1	-1
34	4	0	-1	2	2	2	0	6	3
35	3	1	-6	-3	0	1	2	5	-1
M =	4.0	0.9	-0.3	0.3	1.5	0.9	1.3	3.8	0.8

TABLE 8

ORIGINAL DATA OF EACH SECTION FOR FALL AND SPRING CLASSES

Cases	Four Attitude Tests - Like[a] (Section I: Fall, 1953)											
	1			2			3			4		
	L	I	D	L	I	D	L	I	D	L	I	D[b]
1	2			2			1	2		3		
3	2			2			1	2		2	1	
7[c]	2			2			3			1	2	
9	2			2			3			3		
10	2			1		1	2	1		2	1	
11	1	1		1	1		2	1		3		
13	2			2			2	1		3		
15	2			2			1	1	1	2	1	
20	1	1		2			2	1		1	2	
21	1	1		2			2	1		2	1	
24	1	1		2			2	1		3		
25	2			1	1		2	1		1	2	
26		2		2			1	2		1	2	
27	2			1	1		3			1	2	
28	1	1		1	1		2	1		2	1	
29	2			2			1	2		3		
31	1	1		1	1		1	1	1	3		
32	1	1		2			3			3		
33		2		2				3		2	1	
34	2			1	1		1	2		3		
35	1	1		2			1	2		3		
36	2			2			1	2			3	
Total	32	12	0	37	6	1	37	27	2	47	19	0

[a]Like refers to the part of tests in which the responses would be expected to be similar for both groups (throughout Table 8).

[b]L refers to Like; I refers to Indifferent; and D refers to Dislike. These are the possible responses on the tests (throughout Table 8).

[c]Scores omitted for cases who left the course (throughout Table 8).

TABLE 8--Continued

Cases	Four Attitude Tests - Like[a] (Section I: Spring, 1954)											
	5			6			7			8		
	L	I	D	L	I	D	L	I	D	L	I	D[b]
1	5	1	2	3	2	1	1	1	1	2	1	
2	2	6		2	4		2	1			3	
3	5	2	1	1	4	1	1	2		1	2	
4	1	4	3	2	3	1	1	1	1	3		
5	8				6		3			2	1	
6	4	2	2		1	5	2	1		1	2	
7	5	3		3	3		2	1		3		
8	1	7			5	1	1	2		1	2	
9	8				6			3			3	
10	1	2	5	1	5		2	1			3	
11	2	4	2		1	5	2	1		3		
12	1	6	1	3	2	1	2	1			1	2
13	2	5	1	2	3	1	2	1		1	2	
14	2	3	3	3		3	2	1		1	2	
15	7	1			6		3			3		
16	3	5			6		2	1		1	2	
17	1		7		6		1	2		2	1	
18		1	7			6	1		2	1		2
19		5	3		5	1	1	2		2	1	
20	2	6		1	5		2	1		1	2	
21		8			6			3		3		
22	6	2		1	4	1	1	2		2	1	
23	1	4	3		4	2	1	1	1	2	1	
24	1	7			6			3			3	
25	3	5			2	4		3			3	
26	3	5		1	5		2	1			3	
27	8			6			3			2	1	
29[c]	5	3			6		1	2		2	1	
30	3	5		3	2	1	2	1			2	1
31	2	6			6		2	1			3	
32	5	3		2	4		2	1		2	1	
33	1	7			6		2	1		2	1	
34	1	6	1	1	3	2		3		3		
Total	99	124	41	35	127	36	49	45	5	46	48	5

TABLE 8--Continued

Cases	Four Attitude Tests - Like[a] (Section II: Fall, 1953)											
	1			2			3			4		
	L	I	D	L	I	D	L	I	D	L	I	D[b]
1	2			2			2	1			1	2
2	2			2			1		2	3		
5[c]	2			2			3			2		
6	1	1		2			2	1		1	1	1
8		2			2			3			3	
9	2			2			3			3		
11	2			2			1	2		1	2	
12	1	1		1	1			2	1	2	1	
13	1	1		1	1		2	1		3		
14	2			1	1		2	1		2	1	
15	2			1	1			3		3		
17			2		1	1	3			3		
19	2			2			2	1		3		
20	1	1		2			2	1		3		
21	2			1	1			3		1	2	
23	2			1	1			1	2	2	1	
25	2			1	1			1	2	1	2	
29	2			2			3			2		1
30	1	1		1	1		1	2		2		1
31	2			1	1		2	1		2	1	
32	2			2			2	1		3		
34	1	1			2			3		3		
35	2			2			2	1		3		
36	2			2			3				3	
37	2			2			2	1		3		
Total	40	8	2	35	14	1	38	30	7	52	18	5

TABLE 8--Continued

Cases	Four Attitude Tests - Like[a] (Section II: Spring, 1954)											
	5			6			7			8		
	L	I	D	L	I	D	L	I	D	L	I	D[b]
1	8			6			3			3		
2	5	3				6	3			3		
3	1	7			6			3			3	
4	2	6			6		3				3	
5	7	1			6			3		3		
7[c]	3	5			6		1	2		2	1	
8	4	4	1	1	4	1		2	1		3	
9	7	1		5	1		2	1		2	1	
10	5	3			6		1	2			3	
11	5	3				6	2	1		1	2	
12	4	4		1	5		2	1		1	2	
13	2	6			6		1	2			3	
14		8			6			3			3	
15	3	4	1		4	2	1	2			3	
16	5	3				6	2	1		3		
17	2	6		1	5		3			1	2	
18	5	3		3	3		1	2		1	2	
19	6	2		1	2	3	1	1	1		2	1
20	4	4			6		1	2		1	2	
21	4	4		1	5		3			3		
22	3	5			3	3	1	2		3		
23	4	4			6		3				3	
24	4	4			6		1	2		2	1	
25	5	3										
26	8				6		2	1		3		
27	6	2		3	3		3			1	2	
28	6	2		3	3		3			3		
29	1	7				6	1	2			3	
30	4	4		1	5		2	1		1	2	
31	6	2		6			1	2		3		
32	2	5	1		6			3			3	
33	4	2	2	1	2	3	2	1		2	1	
34	4	4			5	1	2	1			3	
35	5	1	2			6	1	1	1	2	1	
Total	143	122	7	33	122	43	52	44	3	44	54	1

TABLE 9

ORIGINAL DATA OF EACH SECTION FOR FALL AND SPRING CLASSES

Cases	Four Attitude Tests - Unlike[a] (Section I: Fall, 1953)											
	1			2			3			4		
	L	I	D	L	I	D	L	I	D	L	I	D[b]
1		1	1	2		1	2		1	2	1	
3[c]		1	1	2	1			2	1	2	1	
7	2			3			3			2	1	
9	2			3			3			1	2	
10		2		1		2	2	1		2	1	
11		2		3			2	1		2	1	
13	2			3			3			3		
15		1	1	2	1		1	1	1		3	
20		2		1	2			3			3	
21		1	1	1	2		1	1	1	2	1	
24		2		2		1	1	1	1	2	1	
25	1	1		3			1	1	1	2	1	
26	1	1		2	1			2	1		3	
27		1	1	1	2		2	1		1	2	
28	1		1	3			2		1	1	2	
29		2		3			2	1		2	1	
31			2	1		2	1		2	1	2	
32	1		1	3			1	1	1	1	2	
33	1	1		2	1			2	1	1	2	
34	1	1		2	1		1	2			3	
35	1		1	3			2	1		2	1	
36		2		2	1			3		3		
Total	13	21	10	48	12	6	30	24	12	32	34	0

[a]Unlike refers to the part of tests in which the responses would be expected not to be similar (throughout Table 9).

[b]L refers to Like; I refers to Indifferent; and D refers to Dislike (throughout Table 9). These are the possible responses on the tests.

[c]Scores omitted for cases who left the course (throughout Table 9).

TABLE 9--Continued

Cases	Five Attitude Tests - Unlike[a] (Section I: Spring, 1954)														
	5			6			7			8			9		
	L	I	D	L	I	D	L	I	D	L	I	D	L	I	D[b]
1	3		1		4		1	1		3	3	1	2	2	
2	2	2			4		1	1		1	4	2		3	1
3	3	1		1	3		2			6	1		2	2	
4	3		1	1	1	2	1		1	3	4		2	1	1
5	4				4		2			6	1			4	
6	1	2	1		1	3	1		1	5	2		2	1	1
7		4		1	3		1	1		6	1			4	
8	1	3		1	3			2			7		2	2	
9	4				4			2			7			4	
10	1		3	1	3		1	1		4	2	1	1	3	
11	3	1			2	2	1	1		6	1		3	1	
12	1	3		2	2			2		1	5	1		3	1
13	2	2		2	2		2			6	1			4	
14	1	2	1	1	3		1		1	4	3		2		2
15	3	1			4		2			7			3	1	
16	2	2		1	3		1	1		3	4			4	
17	1		3		3	1	1	1		4	2	1	2	1	1
18		1	3			4			2			7			4
19	2	1	1		3	1	1	1		3	4		1	3	
20	2	2			4			2		3	4			4	
21		4			4			1	1	5	2			4	
22	2	1	1		3	1	1	1		3	2	2	3		1
23	2	1	1		1	3	1	1		3	3	1	1	2	1
24	1	3			4		1	1		2	5			4	
25	2	1	1			4		1	1	4	3		1	3	
26	2	1	1		4			2		1	6			4	
27	3	1		1	3		2			6	1		1	3	
29[c]	1	3			4		1	1		2	5			4	
30	3		1	1	3			2		1	4	2	3	1	
31	2	2			4		2			3	4			4	
32	2	2			3	1	1	1		2	5		4		
33	2	2			4			2		2	5			4	
34	1	3		1	2	1	1	1		5	2		3	1	
Total	62	51	19	14	95	23	29	30	7	110	103	18	38	81	13

TABLE 9--Continued

Cases	Four Attitude Tests - Unlike[a] (Section II: Fall, 1953)											
	1			2			3			4		
	L	I	D	L	I	D	L	I	D	L	I	D[b]
1		2		1	2		1	2			3	
2	2					3	1		2	3		
5[c]	2			3			3			2		1
6	1	1			3		2	1			2	1
8		2			3			3			3	
9	1		1	3			3			3		
11	2			3			2	1		2	1	
12	2				3			3		2	1	
13	2			2	1		2	1		1	2	
14	2			2	1		3			1	2	
15	2			3			1	2		1	2	
17			2	2	1		1		2	3		
19	2			1	2		3			2	1	
20	2				3		3			1	2	
21	2			1	2			3		1	2	
23		2		1		2	1	1	1	1	2	
25	1	1		2	1			3		1	2	
29	2			3			3			1	2	
30	1	1		1	2		2	1		1	2	
31	1	1		2	1		2	1		1	2	
32	1	1		1	2		2	1		3		
34		2			3			3			3	
35	1	1			3		2	1		1	2	
36	2			3			3			3		
37	1	1		2		1	3			1	1	1
Total	32	15	3	36	33	6	43	27	5	35	37	3

TABLE 9--Continued

Cases	Five Attitude Tests - Unlike[a] (Section II: Spring, 1954)														
	5			6			7			8			9		
	L	I	D	L	I	D	L	I	D	L	I	D	L	I	D[b]
1	4			1	3		1	1		5	2		2	2	
2	1		3	1		3	1		1	7			4		
3		4			4		1	1			7			4	
4		4		2	2		1	1		2	4	1			4
5	2	2			4			2		7				4	
7[c]		4		2	2		1	1		3	4			4	
8	2	2			4		1	1			7		2	2	
9	2	2		1	3		1	1		4	3		3	1	
10	1	3		2	2		1	1		3	4		1	3	
11		4				4		2		3	4			1	3
12	1	3			4		1	1		6	1		2	2	
13		4			4			2			7			4	
14		4			4			2			7			4	
15		2	2	2		2	2			4	3		2	2	
16	1	3				4	1	1		3	4			4	
17	1	3		2	2		1	1		6	1			4	
18	1	2	1	2	2		1	1		3	4			4	
19	1	1	2	1	2	1	1	1		3	3	1	1	2	1
20		4			4			2		5	2			4	
21		4		2	2		2			6	1		3	1	
22		4			3	1		2		7				4	
23		4			4		1	1		3	4			4	
24	1	3			4		2			6	1			4	
25	1	3													
26	4			2	2		2			6	1		4		
27	3	1		3	1		2			4	3		1	3	
28	3	1		3	1		1	1		6	1		3	1	
29		4				4		2			7			4	
30	2	1	1		4		1	1		6	1		1	3	
31	4			4			2			7			4		
32		4			4		1	1			7			4	
33	2	1	1	1	2	1	1		1	3	2	2	1	1	2
34		4		2	2		2			6	1		3	1	
35	2	1	1		1	3	1	1		5	2			3	1
Total	39	86	11	33	76	23	33	31	2	129	98	4	37	84	11

APPENDIX C

SUBJECT-MATTER TESTS

The subject-matter tests were made by the teacher in charge of the course. The responses were scored by giving one point for each correct response. Test 2, Test 7, Test 9, and Test 12 were given as laboratory practicals even though much of the material ordinarily would have been given in a lecture test because mimeographing was not possible for these tests. For some of these tests the answers have been given to make the test more understandable to the reader.

Test 10 had one question which was given as a laboratory practical. The answers have been given for this question.

Unit 1 - Test 1

I. Directions: Below are given two columns. For each name of the animal studied which is in column 1, there is a phylum to which it belongs in column 2. Find this phylum and place its number in the parentheses in front of the animal in the first column.

	1	2
0.	(5) Actinocephala	1. Coelenterata
1.	(___) Amoeba	2. Ctenophora
2.	(___) Grantia	3. Platyhelminthes
3.	(___) planaria	4. Porifera
4.	(___) tapeworm	5. Protozoa
5.	(___) Euglena	
6.	(___) Paramecium	
7.	(___) Hydra	
8.	(___) Plasmodium	
9.	(___) Gonionemus	
10.	(___) Obelia	

II. Directions: In each of the sentences below one or more words are needed in the numbered blank spaces to make the sentences complete and true. Place the word or words in the correspondingly numbered blanks to the right. Spelling or capitalization will not count unless the word is obviously wrong.

The Amoeba belongs to the class (1) and moves by means of (2). 1. _____ 2. _____

Hydra, one of the simplest of the many celled animals, belongs to the class (3) and possesses nettling organs called (4) which aid in the capture of food. 3. _____ 4. _____

The Paramecium which belongs to the class (5) moves by means of (6). 5. _____ 6. _____

(7) are often referred to as organic catalysts. 7. _____

(8) consists of a building up process called anabolism and a tearing down process called katabolism. 8. _____ 9. _____

(9) is the taking in of oxygen and giving off of carbon dioxide. 10. _____ 11. _____

The enzyme which is in saliva and aids in the digestion of starch is called (10). 12. _____ 13. _____

The study of the structure of organisms is called (11). 14. _____ 15. _____

The fundamental units of structure and function in organisms are the (12).

A compound which tends to prevent shifts in the hydrogen-ion concentration of solutions is called (13).

A compound which gives up hydrogen ions when it is dissolved is called (14).

Benedict's solution is a test for (15).

III. Directions: Complete the following statements by placing the number of the word or group of words in the parentheses to the left. Only one answer is correct.

(_4_) 0. Fats are broken down in digestion into soluble substances one of which is called (1) amino acids (2) starch (3) diastase (4) glycerol (5) glucose.

(___) 1. Proteins differ from carbohydrates and fats in that they always contain (1) carbon (2) iron (3) nitrogen (4) chlorine (5) hydrogen.

(___) 2. Reproduction is an increase in the number of units. In living organisms the unit is the (1) molecule (2) atom (3) tissue (4) cell (5) element.

(___) 3. The directional response to gravity is called (1) geotropism (2) chemotropism (3) thigmotropism (4) thermotropism.

(___) 4. The simplest of the organic substances found in protoplasm is (1) starch (2) sugar (3) fats (4) proteins (5) cellulose.

(___) 5. Protoplasm contains (1) organic compounds (2) dissolved inorganic salts (3) dissolved gases (4) negative ions (5) none of these (6) all of these.

(___) 6. Taxonomy is (1) the study of stuffing animals (2) the study of inheritance in living organisms (3) the branch of biology that treats of the systematic classification of an organism (4) none of these.

(___) 7. Living organisms are characterized by (1) responsiveness to stimuli (2) ability to reproduce their kind (3) adaptation to their environment (4) none of these (5) all of these.

(___) 8. When two or more elements are united they form a (1) compound (2) proton (3) electron (4) element (5) atom.

(___) 9. The study of inheritance is called (1) cytology (2) pathology (3) biology (4) heredity (5) taxonomy.

(___) 10. The study of life is called (1) geology (2) heredity (3) cytology (4) biology (5) English

IV. Directions: Complete the following statements by placing the number of the word or group of words in the parentheses to the left. Only one answer is correct.

(___) 1. The kinds of atoms found in living substance (protoplasm): (1) are found also in non-living matter; (2) are peculiar to protoplasm (i.e., are found only in living substance).

(___) 2. Metabolism: (1) refers specifically to oxidation of food in the cells; (2) includes all chemical reactions in the cells.

(___) 3. The study of how living organisms function is called: (1) anatomy; (2) physiology.

(___) 4. When you shift to higher magnification: (1) the intensity of the light is increased and a larger area of the object is brought into the field of vision; (2) it is necessary to use the fine adjustment only and to exercise more care when you move the slide.

(___) 5. When changing from one microscope slide to another: (1) you should first get the new slide in focus with the low power objective, even if you intend to observe it under high power; (2) it will save time and be just as easy to get the new slide in focus with the high power objective first, if that is what you intend to use eventually.

(___) 6. In the cell you have observed in class, the most darkly-stained granular substance (chromatin) was usually present in: (1) the cytoplasm; (2) the nucleus.

(___) 7. Our knowledge of the functional significance of the nucleus in a cell is largely based upon: (1) inference from experiments in which the behaviour of nucleated and non-nucleated fragments of cells was compared; (2) direct observation of the activity of the nucleus in living cells.

(___) 8. Tissues are: (1) the units of structure and function in living things; (2) groups of similar cells having a common function.

(___) 9. A pH of 3 designates: (1) a stronger acidity; (2) a weaker acidity; than a pH of 6.

(___) 10. Those substances which cannot be decomposed by chemical methods are: (1) chemical compounds; (2) elements.

(___) 11. The ultimate unit which manifests all of the properties of a chemical compound is: (1) a molecule; (2) an atom.

(___) 12. All proteins: (1) contain carbon, hydrogen, oxygen, nitrogen, and sulfur; (2) contain carbon, hydrogen, oxygen, and nitrogen, but not necessarily sulfur.

(___) 13. If normal saliva is added to a neutral starch solution and the resulting mixture permitted to stand for 20 minutes, a test made with Benedict's at the end of that period: (1) should not; (2) should; be positive for sugar.

(___) 14. When Benedict's solution is heated with glucose: (1) no change in color occurs; (2) a brick-red precipitate results.

(___) 15. Benedict's solution, on heating with a mixture of starch solution and boiled saliva (which has stood for 10 - 20 minutes: (1) yields a brick-red precipitate; (2) shows no color change.

(___) 16. The ratio of hydrogen atoms to oxygen atoms is nearly always that of 2 to 1 in: (1) fats; (2) carbohydrates.

(___) 17. A compound having the formula $NH_2 - \overset{CH_3}{\underset{COOH}{C}} - H$ is: (1) a fatty acid; (2) an amino acid.

(___) 18. (1) The peripheral cytoplasm of an amoeba is clear, the inner cytoplasm granular; (2) the peripheral cytoplasm is granular, the inner cytoplasm clear.

(___) 19. Protoplasm is composed of: (1) a mixture of chemical compounds; (2) a single extremely complex chemical compound, the composition of which is the same in all animal cells.

(___) 20. Reproduction in amoebas is accomplished by: (1) division of the cell into two equal parts; (2) fusion of two cells which subsequently divide to form two amoebas.

(___) 21. In amoebas digestion of food occurs in: (1) the food vacuoles; (2) the outer hyaline portion of the cytoplasm.

(___) 22. An amoeba is cut in two in such a manner that one portion contains the intact nucleus. (1) The non-nucleated fragment is able to carry on all of the activities of a normal amoeba; (2) the non-nucleate portion may be able to move and take in food, but cannot digest new food or reproduce.

(___) 23. Locomotion in the paramecium is accomplished by cilia which beat: (1) obliquely backward; (2) directly backward.

(___) 24. Ingested materials which Paramecium is incapable of digesting: (1) pass out through the pellicle at any point; (2) are discharged to the exterior at a definite place.

(___) 25. A species of amoeba found in salt water is placed in pond water. The contractile vacuole would probably fill and discharge its contents: (1) more rapidly; (2) more slowly; than when the animal was in the original salt water.

(___) 26. Paramecium reproduces by: (1) simple fission; (2) formation of spores.

(___) 27. The existence of an intracellular coordinating mechanism in Paramecium is suggested especially: (1) by the direction and timing of the strokes of individual cilia in relation to one another; (2) by synchronism in the pulsations of the contractile vacuole.

(___) 28. Cellular respiration is: (1) synonymous with metabolism; (2) one aspect of metabolism.

(___) 29. Irritability is: (1) characteristic of all protoplasm; (2) exhibited by nervous tissue only.

(___) 30. Man has known of the cellular nature of living things for the past: (1) 100 years, approximately; (2) 500 years, approximately.

(___) 31. The main parts of a cell are: (1) the nucleus and centrioles; (2) nucleus and cytoplasm.

(___) 32. Conjugation means: (1) the temporary fusion of two unicellular animals during which nuclear material is exchanged; (2) the permanent fusion of two unicellular animals to produce a new individual.

(___) 33. Intracellular digestion, gastrovascular cavity, nervous system, hermaphroditism, mesoglea and tentacles can be all found in: (1) Hydra; (2) planaria.

(___) 34. Planaria is: (1) a free-living flatworm; (2) a parasitic flatworm.

(___) 35. The digestive tract of planaria: (1) has a single opening, the mouth; (2) has both mouth and anus.

(___) 36. The auricles of planaria have: (1) an auditory; (2) a tactile; function.

(___) 37. Nematocysts are found: (1) only in Hydra and other fresh-water Coelenterates; (2) in all members of the phylum Coelenterata.

(___) 38. Planaria is: (1) radially symmetrical; (2) bilaterally symmetrical.

(___) 39. Hydra reproduces: (1) exclusively by budding; (2) either sexually or asexually.

(___) 40. Hydra: (1) possesses conspicuously pigmented "eye-spots" at the tips of its tentacles; (2) has no readily identifiable light-receptor structures.

Unit 1 - Test 2 (Nine-weeks Test)
(Laboratory Practical)

		Key
1.	Name animal.	1. tapeworm
2.	Give phylum.	2. Platyhelminthes
3.	Give class.	3. Cestoda
4.	Name structure which is often called "the head."	4. scolex
5.	Name structures or segments following the head.	5. proglottids
6.	Name animal.	6. Obelia
7.	Give phylum.	7. Coelenterata
8.	Give class.	8. Hydrozoa
9.	Name structure at end of pointer.	9. gonangium
10.	_____ are produced from structure #9.	10. medusae
11.	Name animal at end of pointer.	11. Amoeba
12.	Give phylum.	12. Protozoa
13.	Give class.	13. Sarcodina
14.	Name animal.	14. planaria
15.	Give phylum.	15. Platyhelminthes
16.	Give class.	16. Turbellaria
17.	Name structure.	17. eyespot
18.	Name structure.	18. auricle
19.	Name structure.	19. intestine
20.	Name animal	20. Volvox
21.	Name phylum	21. Protozoa
22.	Name class	22. Mastigophora

23. Name organ of locomotion.	23. pseudopodium
24. Name structure.	24. contractile vacuole
25. Name animal.	25. Paramecium
26. Name phylum.	26. Protozoa
27. Name class.	27. Infusoria
28. Name structure.	28. macronucleus
29. Name organ of locomotion.	29. cilia
30. What type section is this?	30. cross-section
31. Name structure surrounding pointer.	31. central cavity
32. What opens into structure #31?	32. radial canal
33. What type of section is this?	33. cross-section
34. Name cavity	34. gastrovascular
35. Name outside layer of cells.	35. epidermis
36. Name inside layer of cells.	36. gastrodermis
37. Name animal.	37. Hydra
38. Give phylum.	38. Coelenterata
39. Give class.	39. Hydrozoa
40. Name finger-like projections.	40. tentacles
41. #40 contain _____ which help in obtaining food.	41. nematocysts
42. The mouth is in the _____.	42. hypostome
43. Name animal (scientific).	43. Grantia, Scypha
44. Give phylum.	44. Porifera
45. Give class.	45. Calcarea

46.	This animal is covered with a network of needle-like, interlacing _____.	46. spicules
47.	Name animal.	47. Euglena
48.	Give phylum.	48. Protozoa
49.	Give class.	49. Mastigophora
50.	Name animal.	50. Gonionemus
51.	Give phylum.	51. Coelenterata
52.	Give class.	52. Hydrozoa
53.	The "hairy-like or finger-like" processes are called _____ (in vicinity of pin).	53. tentacles
54.	The convex surface is called the _____.	54. exumbrella
55.	The concave surface is called the _____.	55. subumbrella
56.	In the center of #55 hangs the handle-like _____ which contains the	56. manubrium
57.	_____.	57. mouth
58.	Name animal (scientific).	58. Metridium
59.	Give phylum.	59. Coelenterata
60.	Give class.	60. Anthozoa
61.	Name animal.	61. Fasciola
62.	Give phylum.	62. Platyhelminthes
63.	Give class.	63. Trematoda
64.	Name animal.	64. rotifer
65.	Give phylum.	65. Rotifera
66.	Name animal (scientific).	66. Asterias

67. Give phylum.	67. Echinodermata
68. Give class.	68. Asteroidea
69. Name structure.	69. madreporite
70. Name structure.	70. hepatic caeca
71. Name structure.	71. tube feet
72. Name animal.	72. clam
73. Give phylum.	73. Mollusca
74. Give class.	74. Pelecypoda
75. The name of this class means _____ which describes the organ of locomotion.	75. hatchet foot

Unit 2 - Test 3

I. For each of the animals listed below give the phylum to which each belongs. Place the answer in the blank to the right of each animal.

0.	Aurelia	Coelenterata
1.	Amoeba	
2.	Endamoeba histolytica	
3.	Trypanosoma gambiense	
4.	Grantia	
5.	Hydra	
6.	Gonionemus	
7.	Pectinatella	
8.	Euglena	
9.	Paramecium	
10.	Obelia	
11.	planaria	
12.	Volvox	
13.	mussel	
14.	snail	
15.	rotifers	
16.	Ceratium	
17.	Order Chrysomonadina	
18.	Vorticella	
19.	Cyclops	
20.	Daphnia	

II. Directions: Below are given two columns. For each animal in column one, there is a class in column two to which it belongs. Find this class and place its number in the parentheses in front of the animal in the first column.

	1	2
0.	(12) Plasmodium vivax	
1.	(___) Daphnia	1. Phylum Bryozoa
2.	(___) Cyclops	2. Calcarea
3.	(___) Vorticella	3. Cestoda
4.	(___) Chrysomonadina	4. Ciliata
5.	(___) Ceratium	5. Crustacea
6.	(___) rotifers	6. Gastropoda
7.	(___) snail	7. Hydrozoa
8.	(___) mussel	8. Insecta
9.	(___) Volvox	9. Mastigophora
10.	(___) planaria	10. Pelecypoda
11.	(___) Obelia	11. Phylum Rotifera
12.	(___) Paramecium	12. Sarcodina
13.	(___) Euglena	13. Sporozoa
14.	(___) Pectinatella	14. Trematoda
15.	(___) Gonionemus	15. Turbellaria
16.	(___) Hydra	
17.	(___) Grantia	
18.	(___) Trypanosoma gambiense	
19.	(___) Endamoeba histolytica	
20.	(___) Amoeba	

III. Directions: Place a plus (+) in the column to the right of the animals listed below which best describes the habitat of each.

Animal	Sea water only		Fresh water		
	Free	Attached	Free	Attached	Parasitic
Plasmodium vivax					
Amoeba					
Endamoeba histolytica					
Trypanosoma gambiense					
Grantia					
Hydra					
Gonionemus					
Pectinatella					
Euglena					
Paramecium					
Obelia					
planaria					
Volvox					
mussel					
snail					
rotifers					
Ceratium					
Chrysomonadina					
Vorticella					
Cyclops					
Daphnia					

Unit 3 - Test 4

I. For each animal listed below place the phylum and class under the proper column to the right.

	Animal	Phylum	Class
1.	tapeworm	_____	_____
2.	pinworm	_____	_____
3.	Ascaris	_____	_____
4.	hookworm	_____	_____
5.	Fasciola	_____	_____
6.	grubs	_____	_____

II. For each animal listed below place a number in the parentheses to the left to indicate the steps (in their proper sequence) in the life cycle.

A. Necator Americanus

1. (___) Eggs discharged in feces.
2. (___) Larvae attach themselves to intestine.
3. (___) Larvae become adult.
4. (1) Larvae burrow through skin between toes.
5. (___) Larvae coughed up into trachea.
6. (___) Larvae enter blood stream.
7. (___) Larvae enter heart.
8. (___) Larvae enter pulmonary artery.
9. (___) Larvae hatch on ground.
10. (___) Larvae remains in lungs.
11. (___) Larvae swallowed with food.

B. Tapeworm

1. (___) Bladder worms encyst in muscles.
2. (___) Cyst swallowed by man.
3. (_1_) Eggs develop in proglottids.
4. (___) Embryos bore way out of intestinal tract.
5. (___) Proglottids discharged with feces.
6. (___) Proglottids or embryos swallowed by pig.

C. Pinworm

1. (___) Adult worm produces eggs which are deposited on perianal region.
2. (_1_) Eggs are taken in with food or soiled hands.
3. (___) Eggs hatch out in intestines.
4. (___) Mature worms develop.
5. (___) Worm attaches itself to intestinal wall.

D. Ascaris

1. (___) Egg deposited on soil.
2. (_1_) Egg enters human alimentary canal in food and drink.
3. (___) Egg hatched out in alimentary canal.
4. (___) Larva bores through intestinal wall.
5. (___) Larva bores through lungs and goes to throat.
6. (___) Larva enters blood stream.
7. (___) Larva is pumped to lungs via heart.
8. (___) Larva swallowed in food and drink and makes way to intestines where it produces more eggs.

III. Directions: Complete the following statements by placing the number of the word or group of words in the parentheses to the left. Only one answer is correct.

1. (___) The overall symptoms of parasitism in animals are: (1) loss of weight, loss of energy; (2) gain of weight; (3) gain of energy; (4) good health.

2. (___) Symptoms of parasitism are prevalent during the: (1) fall and early winter; (2) summer; (3) spring; (4) spring and summer.

3. (___) (1) dry climate and good food; (2) malnutrition and climatic influences; (3) humid climate, malnutrition, and climatic influences: are conducive to parasitism.

4. (___) Mosquitoes, ticks, lice, fleas, etc. are: (1) internal parasites; (2) external parasites; (3) neither.

5. (___) Ascaris, the tapeworm, etc. are: (1) internal parasites; (2) external parasites; (3) neither.

6. (___) Parasites thrive in: (1) sanitary conditions; (2) unsanitary conditions; (3) neither.

7. (___) A parasite is: (1) merely tolerated by the host; (2) lives in or on another at the expense of the host; (3) both.

Unit 4 - Test 5

I. Directions: Below are given two columns. For each name of the insect in column one, there is an order in column two to which it belongs. Find this order and place its number in the parentheses in front of the insect in the first column.

	1		2
0.	(8)	bees	1. Anoplura
1.	(___)	termites	2. Aptera
2.	(___)	fleas	3. Coleoptera
3.	(___)	mosquitoes	4. Corrodentia
4.	(___)	moths	5. Diptera
5.	(___)	grasshopper	6. Ephemerida
6.	(___)	weevils	7. Hemiptera
7.	(___)	beetles	8. Hymenoptera
8.	(___)	earwigs	9. Isoptera
9.	(___)	ants	10. Lepidoptera
10.	(___)	lice	11. Mallophaga
11.	(___)	bugs	12. Mecoptera
12.	(___)	crickets	13. Neuroptera
			14. Odonata
			15. Orthoptera
			16. Plecoptera
			17. Siphonaptera
			18. Thysanoptera
			19. Tricoptera

II. Directions: Below are given two columns. For each structure in column one, there is a function in column two to which it belongs. Find this function and place its number in the parentheses in front of the structure in the first column.

	1		2
0.	(1)	stomach	
1.	(___)	clitellum	1. digestion
2.	(___)	setae	2. excretion 3. Locomotion
3.	(___)	typhlosole	4. reproduction 5. respiration
4.	(___)	crop	6. skeleton 7. sensory
5.	(___)	gizzard	
6.	(___)	nephridia	
7.	(___)	nephrostome	
8.	(___)	seminal receptacles	
9.	(___)	seminal vesicles	
10.	(___)	carapace	
11.	(___)	swimmerets	
12.	(___)	spiracles	
13.	(___)	malpighian tubules	
14.	(___)	antenna	
15.	(___)	ommatidia	
16.	(___)	olfactory organs	

III. Directions: For each structure listed below give the phylum to which it belongs. In addition give the class to which it belongs. Place these names in the blanks to the right of the structure.

		Phylum	Class
0.	contractile vacuole	Protozoa	Sacodina
1.	clitellum		
2.	setae		
3.	typhlosole		
4.	nephridia		
5.	cephalothorax		
6.	swimmerets		
7.	uropod		
8.	chloragogue cells		
9.	telson		
10.	rostrum		

IV. Directions: Complete the following statements by placing the number of the word or group of words in the parentheses to the left. Only one answer is correct.

(___) 1. The dorsal surface of the earthworm is: (1) darker; (2) lighter; than the ventral surface.

(___) 2. Setae are found: (1) on the ventral and ventrolateral surfaces only; (2) on ventral, ventrolateral and dorsal surfaces.

(___) 3. Earthworms are: (1) diploblastic; (2) triploblastic.

(___) 4. The term metamere: (1) means the same as somite; (2) is applicable to an individual segment of an Annelid body only, while somite is applicable only to arthropods.

(___) 5. A coelom is found: (1) in all annelids; (2) in some annelids, such as the earthworm, but not in others.

(___) 6. In the body wall of the earthworm: (1) both longitudinal and circular muscles are found; (2) there are longitudinal muscles only.

(___) 7. The intimate physical apposition which occurs between two earthworms in connection with their reproductive activities is known as: (1) copulation; (2) fecundation

(___) 8. Fertilization in the earthworm occurs: (1) during copulation; (2) after the separation of the copulating worms.

(___) 9. Respiratory exchange in the earthworms is effected: (1) by gill-like structures known as nephridia; (2) through the general body surface.

(___) 10. The circulatory mechanism in the earthworm consists: (1) of a closed system of continuous vessels; (2) of a number of major vessels whose branches empty into spaces in the tissues called blood sinuses.

(___) 11. The circulatory system in the earthworm contains: (1) colorless blood; (2) red blood.

(___) 12. The major function of hemoglobin in the blood of the earthworm is probably: (1) to regulate the osmotic pressure; (2) to increase its oxygen-carrying capacity.

(___) 13. The absorptive surface of the earthworm's intestine is greater than that of a simple tube by virtue of the fact that the intestine: (1) is very much coiled; (2) has an infolded dorsal wall.

(___) 14. The longitudinal nerve cord of the earthworm is: (1) dorsal; (2) ventral; to the alimentary tract.

(___) 15. Thousand-legs (millipedes) belong to the phylum: (1) Annelida; (2) Arthropoda.

(___) 16. Thousand-legs are found in: (1) dark and damp places; (2) plenty of sunlight.

(___) 17. Thousand-legs and centipedes belong to the class: (1) Insecta; (2) Myriapoda.

(___) 18. Leeches belong to the Phylum: (1) Annelida (2) Arthropoda.

(___) 19. The habitat of adult Arthropods: (1) is in all cases terrestrial; (2) may be fresh water, salt water, or land.

(___) 20. Spiders and daddy long legs belong to the class: (1) Arachnida; (2) Onychophora.

(___) 21. Respiratory exchange in the crayfish is typically effected through: (1) thoracic gills; (2) gills attached to the abdominal appendages.

(___) 22. Respiratory exchange in most Arachnida is effected: (1) through book lungs; trachea, or both; (2) by book gills.

(___) 23. The basic body divisions of the Arthropoda are: (1) head, thorax, and abdomen; (2) cephalothorax, abdomen and tail.

(___) 24. A ganglion is (1) a local thickening of the fibers in a nerve cord; (2) a group of nerve cell-bodies.

(___) 25. The jaw-like mouth-parts of the crayfish are: (1) mandibles; (2) maxillae.

(___) 26. (1) Drone bees (males); (2) Worker bees (females); have no fathers.

(___) 27. The wings of an insect are found: (1) on the thorax; (2) on the abdomen.

(___) 28. Earthworms: (1) are responsive to the variety of stimuli including light, although they have no eyes; (2) have well developed eyes, but are sensitive to few, if any, kinds of stimuli other than light and sound.

(___) 29. Earthworms are: (1) an agricultural pest because they eat the roots of crop plants and interfere with their growth; (2) an agricultural boon because they loosen and enrich the soil and facilitate its aeration and drainage.

(___) 30. Arthropods are the only animals studied in which we found: (1) metamorism; (2) compound eyes.

Unit 5 - Test 6

I. Directions: Complete the following statement by placing the number of the word or group of words in the parentheses to the left. Only one answer is correct.

(___) 1. Egg white is largely composed of: (1) protein (2) starch.

(___) 2. A fat-digesting enzyme is secreted: (1) by the pancreas; (2) by the liver.

(___) 3. The end products of fat digestion are: (1) lipids; (2) glycerol and fatty acids.

(___) 4. Glucose is a digestion product of: (1) glycerol; (2) starch.

(___) 5. Salivary enzymes act on: (1) fats; (2) carbohydrates.

(___) 6. Pepsin facilitates the digestion of: (1) fats; (2) proteins.

(___) 7. Gastric enzymes work best: (1) in an acid medium; (2) in an alkaline medium.

(___) 8. Veins receiving blood from the head are: (1) the subclavians; (2) the jugulars.

(___) 9. Blood from all of the abdominal organs: (1) does (2) does not; have to go into the inferior vena cava before returning to the heart.

(___) 10. A dye injected into the right subclavian artery: (1) could; (2) could not; reappear in the left subclavian artery without passing through the pulmonary circulation.

(___) 11. A dye injected into the right subclavian artery: (1) could; (2) could not; reappear in the right subclavian vein without passing through the pulmonary circulation.

(___) 12. Muscular contractions throughout the body tend to: (1) assist; (2) impede; the return of venous blood to the heart.

(___) 13. (1) Veins are generally provided with valves, arteries not; (2) both veins and arteries have valves at frequent intervals.

(___) 14. Fibrinogen is a protein which is: (1) important for nutrition; (2) essential for blood coagulation.

(___) 15. Red cells are: (1) more numerous; (2) less numerous; than white cells in the blood.

(___) 16. (1) Red blood cells; (2) white blood cells: constitute a major factor in defense against invading bacteria.

(___) 17. The platelets play a part: (1) in the transport of nutrients in the blood; (2) in the clotting of blood.

(___) 18. Virilism (masculinization) of females is likely to result from: (1) overactivity; (2) underactivity; of the adrenal cortex.

(___) 19. Measurements of oxygen consumption at rest are used to test the function of the: (1) pituitary gland; (2) thyroid gland.

(___) 20. A major factor in the control of calcium metabolism is a hormone of the (1) pituitary gland; (2) parathyroid.

(___) 21. Iodized salt is widely used as a preventive of: (1) hyperpituitarism; (2) hypothyroidism.

(___) 22. Insulin reaches the liver via: (1) the blood stream; (2) the bile ducts.

(___) 23. Secretin stimulates the pancreas to liberate: (1) digestive enzymes; (2) insulin.

(___) 24. Muscles are attached to bone by: (1) tendons; (2) ligaments.

(___) 25. Smooth muscle is: (1) generally; (2) rarely; under conscious control.

(___) 26. The knee is: (1) a ball-and-socket joint; (2) a hinge joint.

(___) 27. The human male has: (1) one rib fewer than; (2) the same number of ribs as; the human female.

(___) 28. A lung is covered with a thin layer which is called the (1) peritoneum; (2) pleura.

(___) 29. Hemoglobin combines more readily with: (1) carbon monoxide; (2) oxygen.

(___) 30. It is possible to hold one's breath until: (1) death results from oxygen starvation; (2) loss of consciousness occurs.

(___) 31. Breathing is under the control of the respiratory center which is located in the (1) medulla oblongata; (2) cerebellum.

(___) 32. The larynx: (1) contains the vocal cords; (2) is posterior to the trachea.

(___) 33. The trachea divides to form the (1) bronchi; (2) alveoli.

(___) 34. A balanced meal would be a meal with: (1) several carbohydrates and nothing else; (2) carbohydrates, proteins, and fats in the proper proportion.

(___) 35. Foods enriched with vitamins: (1) can; (2) cannot be purchased at grocery stores.

(___) 36. To save the nutrients in food, the food should be cooked: (1) quickly in small amounts of water; (2) slowly in large amounts of water.

(___) 37. To save the nutrients in food: (1) the food should be allowed to stand in water; (2) the food should not be allowed to stand in water.

(___) 38. Coffee is a: (1) stimulant; (2) depressant.

(___) 39. The consumption of coffee: (1) has; (2) does not have; food value.

(___) 40. An inadequate intake of the antirachitic vitamin: (1) can; (2) cannot; be compensated for by increasing the intake of calcium above normal levels.

(___) 41. Rickets may occur: (1) When there is an insufficient calcium or phosphate intake, even if there is abundant antirachitic vitamin in the diet; (2) only when there is a deficiency of the antirachitic vitamin.

(___) 42. Ultraviolet irradiation of many fats and oils can increase their content of: (1) the antirachitic vitamin; (2) the antiscorbutic vitamin.

(___) 43. A deficiency in vitamin E: (1) causes sterility in rats, and perhaps in man; (2) is a frequent cause of human sterility, but has no effect on rats.

(___) 44. A retinal pigment of the eye, visual purple, is a derivative of: (1) vitamin A; (2) vitamin B.

(___) 45. Bones are often attached to one another by: (1) ligaments; (2) tendons.

(___) 46. Pyridoxine, pantothenic acid, and biotin are: (1) required in the diet of man but not of several other animals; (2) are necessary in the diet of several other animals, but apparently not of man.

(___) 47. An inadequate intake of yellow and green vegetables is likely to cause: (1) anemia; (2) defective night vision.

(___) 48. People who drink large quantities of orange juice are pretty certain not to develop: (1) scurvy; (2) rickets.

(___) 49. Pellagra is prevented by a diet adequate in: (1) niacin (2) vitamin E.

(___) 50. Inhabitants of the tropics are likely to require in their diet: (1) more vitamin D; (2) less vitamin D; than the people who live in arctic regions.

(___) 51. A deficiency of vitamin D may produce: (1) rickets; (2) hemorrhagic disease of the newborn.

(___) 52. A vitamin found in yeast is: (1) vitamin B complex; (2) vitamin K.

(___) 53. A vitamin found in citrus fruits is: (1) vitamin C; (2) vitamin E.

(___) 54. A vitamin found in yellow and green vegetables is: (1) vitamin A; (2) vitamin D.

(___) 55. Niacin (nicotinic acid), riboflavin, and thiamin are all: (1) fractions of vitamin B complex; (2) fat soluble vitamins.

(___) 56. The vitamins required by man and by other animals are: (1) the same in all cases; (2) sometimes different.

(___) 57. For the normal growth of an animal: (1) both vitamins and a specific assortment of amino acids are necessary; (2) the proper vitamins, plus any amino acids in sufficient quantity to exceed the minimal energy requirements of the body will suffice.

(___) 58. Vitamins are important for human nutrition because: (1) their oxidation yields disproportionately large amounts of energy in comparison with other foods; (2) they are necessary for certain essential chemical reactions in the body.

II. Directions: In each of the sentences below, one or more words are needed in the numbered blank spaces to make the sentences complete and true. Place the word or words in the correspondingly numbered blanks to the right. Spelling or capitalization will not count unless the word is obviously wrong.

The study of life is called (0).	0.	_____
In the vertebrates the skeleton makes its first appearance in the embryo as the (1).	1.	_____
	2.	_____
Skeletons may be internal, (2) as in man, fish, or frogs; or external, (3) as in the crayfish, beetle, or snail.	3.	_____
The general term, (4) is given to certain antagonistic or corrective substances which form when foreign proteins are introduced into the blood stream of animals.	4.	_____
The white blood cells are called (5).	5.	_____
Blood, as seen in vertebrates, is a complex material made up of a fluid portion, the (6) and cellular constituents, the (7).	6.	_____
	7.	_____
The red cells are called (8).	8.	_____

The gaseous interchange which results from the metabolism of protoplasm is termed (9). 9. _____

The process of breaking down food chemically through the action of certain secretions is called (10). 10. _____

A (n) (11) is a tubular vessel conveying blood from the heart. 11. _____

A (n) (12) is a tubular vessel conveying blood to the heart. 12. _____

A (13) is a secretion absorbed directly into the blood which influences various organs or growth processes. 13. _____

A (14) is one of a class of substances existing in minute quantities in natural foods, which are necessary to normal nutrition and growth, absence from the diet produces so-called deficiency diseases. 14. _____

(15) are often referred to as organic catalysts. 15. _____

III. Directions: Below are given two columns. For each name of an organ or structure in column one, there is a function given in column two. Find this function and place its number in the parentheses in front of the name in column one.

	1	2
0. (___)	nephridia	1. endocrine
1. (___)	vertebral column	2. excretory 3. circulatory 4. digestive
2. (___)	gill	5. respiratory
3. (___)	parathyroids	
4. (___)	lung	
5. (___)	trachea	

6. (___) thyroid
7. (___) humerus
8. (___) gizzard
9. (___) valve
10. (___) ulna
11. (___) ovary
12. (___) liver
13. (___) bronchi
14. (___) stomach
15. (___) adrenal glands

Test 7 (Final Fall Test)
(Laboratory Practical)

		Key
1.	To what phylum does this animal belong?	1. Arthropoda
2.	To what class does this animal belong?	2. Crustacea
3.	Name region surrounded by tag #3.	3. cephalothorax
4.	Name covering over region #3.	4. carapace
5.	Name structure	5. telson
6.	Name structure	6. uropods
7.	Name structure (tag #7).	7. cheliped
8.	Name structure (tag #8).	8. antenna
9.	The human fallopian tubes (oviducts) lead directly into the _____.	9. uterus
10.	Spermatozoa are produced in the _____.	10. testes
11.	Fertilization normally takes place in the _____.	11. fallopian tubes
12.	The most anterior region of the brain is the _____.	12. cerebrum
13.	The most posterior region is the _____.	13. medulla oblongata
14.	A ganglion is _____.	14. group of nerve cells
15.	Motor nerve fibers are: (1) afferent; (2) efferent.	15. (2)
16.	Afferent fibers are those which carry impulses: (1) to the central nervous system; (2) away from the central nervous system.	16. (1)

17.	A functional unit composed of a neuron from a sensory receptor and a motor neuron leading to an effector is called: (1) synapse; (2) a reflex arc.	17.	(2)
18.	Regeneration: (1) occurs to some degree in all plants and animals; (2) does not occur in vertebrates.	18.	(1)
19.	A placenta is found in: (1) mammals only; (2) mammals and birds.	19.	(1)
20.	Nervous connections between mother and fetus (in mammals): (1) run through the umbilical cord; (2) do not exist.	20.	(2)
21.	A zygote is: (1) a germ cell produced by an organism of either sex; (2) the product of union between egg and sperm.	21.	(2)
22.	A cross of two homozygotes will yield progeny which are: (1) all homozygotes; (2) about 3/4 homozygous, ¼ heterozygous.	22.	(1)
23.	If a man should by chance produce only Y-bearing sperm, his progeny would be: (1) all males; (2) mostly males.	23.	(1)
24.	Hemophilia is dependent on a sex-linked recessive gene. A hemophilic male mated to a homozygous normal woman should produce: (1) sons all hemophilic, daughters all phenotypically normal; (2) sons and daughters all phenotypically normal.	24.	(1)
25.	In four o'clocks, homozygous RR is red-flowered, and homozygous rr is white-flowered; the heterzygote (Rr) is pink-flowered, i.e., intermediate	25.	(2)

	in color. If two pink-flowered (Rr) are crossed with each other, among a large number of progeny we should expect to find: (1) red- and pink-flowered plants only; (2) red, pink and white-flowered plants.	
26.	Fraternal twins are: (1) always of the same sex; (2) about half the time of the same sex.	26. (2)
27.	Fraternal (dizygotic) twins develop: (1) from a single zygote which splits into two parts; (2) from the fertilization of two simultaneously discharged ova by separate sperm.	27. (2)
28.	If a man and his wife are both of blood group A, their children may be: (1) group A, but not group O; (2) either group A or group O.	28. (2)
29.	If a man belongs to blood group A and his wife to group B, their children may be (1) A or B, but not AB or O; (2) A, B, AB, or O.	29. (2)
30.	If a man belongs to group AB and his wife to group O, their children may be: (1) A or B, but not AB or O; (2) A, B, or AB.	30. (1)
31.	If a man and his wife both belong to group AB, their children may be: (1) A or B, but not AB; (2) A, B, or AB.	31. (2)
32.	To what phylum does this animal belong?	32. Annelida
33.	To what class does this animal belong?	33. Chaetopoda
34.	Name structure.	34. crop

35.	Name structure.	35. intestine
36.	Name structure.	36. gizzard
37.	Name structure.	37. seminal vesicle
38.	Name structure.	38. nerve cord
39.	Name structure.	39. clitellum
40.	To what phylum does this animal belong?	40. Chordata
41.	To what class does this animal belong?	41. Amphibia
42.	Name dark structure.	42. tympanic membrane
43.	Name muscle.	43. triceps femoris
44.	Name blood vessel (artery or vein).	44. coeliac artery
45.	This blood vessel, #44, sends a branch to the stomach called the _____ (artery or vein).	45. gastric artery
46.	This blood vessel, #44, sends a branch to the liver called the _____ (artery or vein).	46. hepatic artery
47.	This blood vessel, #44, sends a branch to the pancreas called the _____ (artery or vein).	47. pancreatic artery
48.	Name blood vessel.	48. dorsal artery
49.	Name blood vessel.	49. external iliac artery
50.	Name organ.	50. lung
51.	Name blood vessel.	51. conus arteriosus
52.	Name structure.	52. stomach
53.	Name structure.	53. liver

54.	Name structure.	54.	ventricle
55.	Name structure.	55.	small intestine
56.	Name structure.	56.	oviduct
57.	Name structure.	57.	kidney
58.	Name structure.	58.	spleen
59.	Name blood vessel.	59.	systemic arch
60.	Name blood vessel.	60.	ventral abdominal vein
61.	Name blood vessel	61.	pelvic vein
62.	Name blood vessel	62.	renal portal vein
63.	Name muscle.	63.	external oblique
64.	Name muscle.	64.	gracilis major
65.	Name muscle.	65.	rectus abdominis
66.	Name muscle.	66.	gastrocnemius

Unit 6 - Test 8

I. Directions: Complete the following statements by placing the number of the word or group of words in the parentheses to the left. Only one answer is correct.

(_3_) 0. Reproduction is an increase in the number of units. In living organisms the unit is the
(1) molecule (3) cell
(2) atom (4) tissue

(___) 1. The structures in the cell which contain starch granules are the
(1) chloroplasts (3) leucoplasts
(2) chromoplasts (4) nucleus

(___) 2. A dicot stem differs from a monocot stem
(1) in the presence of cambium in the vascular bundles
(2) in the presence of phloem and xylem in the vascular bundles
(3) in the presence of pith
(4) in the presence of epidermis.

(___) 3. The chromosomes pairs when lined up at the center of the cell (equator) are said to be in one of the following stages listed below, the
(1) prophase (3) anaphase
(2) metaphase (4) telophase

(___) 4. Vascular bundles are scattered more or less irregularly throughout
(1) woody dicot stems (3) monocot stems
(2) herbaceous dicot stems (4) woody dicot roots

(___) 5. The most significant fact about mitosis is that each daughter cells has
(1) a nucleus
(2) protoplasm
(3) exactly the same amount of protoplasm as the mother cell
(4) exactly the same number and kinds of chromosomes as the mother cell.

(___) 6. The directional response to gravity is called
(1) geotropism (3) thigmotropism
(2) chemotropism (4) thermotropism

(___) 7. Vascular cambium produces
(1) primary xylem and phloem (3) cork
(2) secondary xylem and phloem (4) pith

(___) 8. The bending of oat leaves toward light is a demonstration of
(1) geotropism (3) photosynthesis
(2) chemotropism (4) phototropism

(___) 9. The growth of plant roots toward water is an example of
(1) hydrotropism (3) chemotropism
(2) thermotropism (4) phototropism

(___) 10. The process in which the chromosome number is reduced is called
(1) mitosis (3) cytokinesis
(2) amitosis (4) meiosis

(___) 11. Sieve tubes are found in
(1) xylem (3) cambium
(2) phloem (4) endodermis

(___) 12. Small structures on the stem which serve as openings for the passage of gases to and from the stem are called
(1) leaf scars (3) stomata
(2) lenticels (4) terminal buds

(___) 13. Chlorophyll is contained in the part of the cell known as
(1) inclusions (3) plastids
(2) vacuoles (4) chromatin

(___) 14. A centrally located tissue of the stem which serves primarily for the storage of food is the
(1) xylem (3) pith
(2) phloem (4) cortex

(___) 15. The Irish potato is an example of a modified
(1) root (3) seed
(2) stem (4) embryo

II. In each of the sentences below, one or more words are needed in the numbered blank spaces to make the sentences complete and true. Place the word or words in the correspondingly numbered blanks to the right. Spelling will not count off unless the word is obviously wrong.

1. The Swedish scientist who is called the "Father of Modern Taxonomy is named (1). 1. _____

2. The growing point of the stem is composed of the following regions: (2) (3) (4) (5).

3. The primary functions of the leaf are (6) (7) (8).

4. The primary functions of the stem are (9) and (10).

5. The secondary functions of the stem are (11) (12) and (13).

6. The primary functions of the root are (14) and (15) and a secondary function is (16).

7. The study of tissues is called (17).

8. The science dealing with the cell is called (18).

2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

III. Directions: Below are given two columns. For each definition or example in column one, there is a type of modified stem in column two. Find the type of modified stem and place its number in the parentheses in front of the word or words in column one.

	1	2
(___)	1. a short, solid, vertical enlarged underground stem in which food is stored.	1. bulbs 2. corm 3. rhizomes 4. runner 5. tubers
(___)	2. a short, flattened, or disc-shaped underground stem, with many fleshy scale leaves filled with stored food.	

(___) 3. a much enlarged, short fleshy underground stem.

(___) 4. a stem that grows horizontally along the ground surface.

(___) 5. an elongated underground, horizontal stem.

(___) 6. Irish potato.

(___) 7. strawberry plant.

(___) 8. iris.

(___) 9. onion.

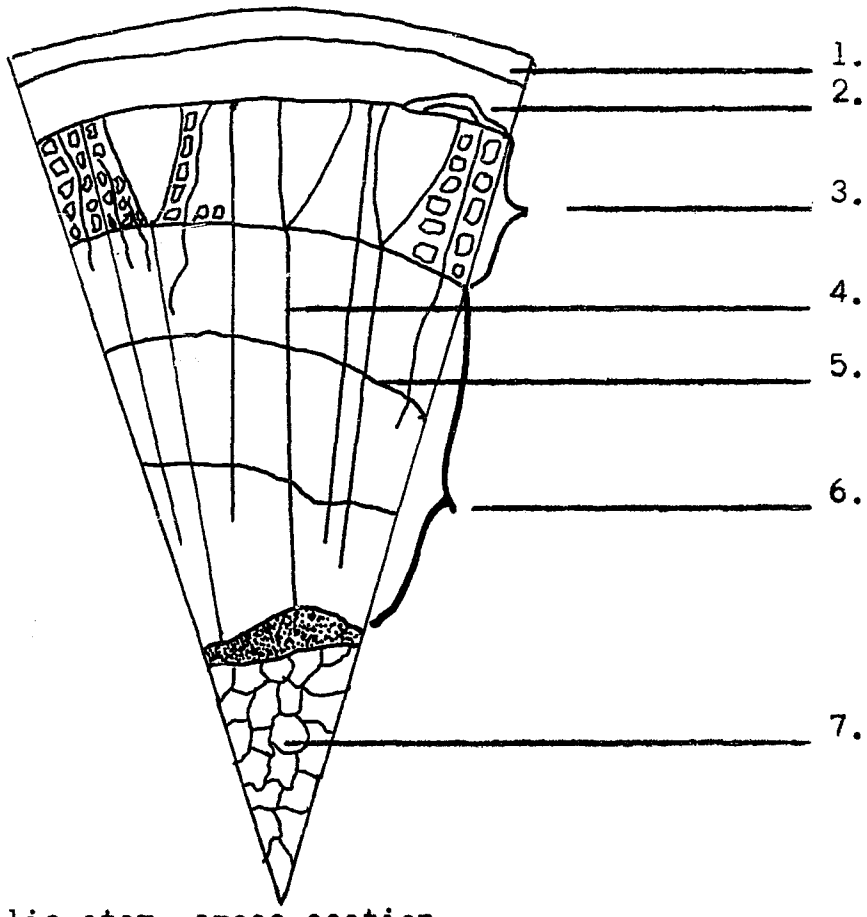
(___) 10. gladiolus.

IV. Directions: Below are given two columns. For each statement in column one, there is a word or group of words which the statements in column one define. Find this word or group of words and place the number to the left of the statement in column one.

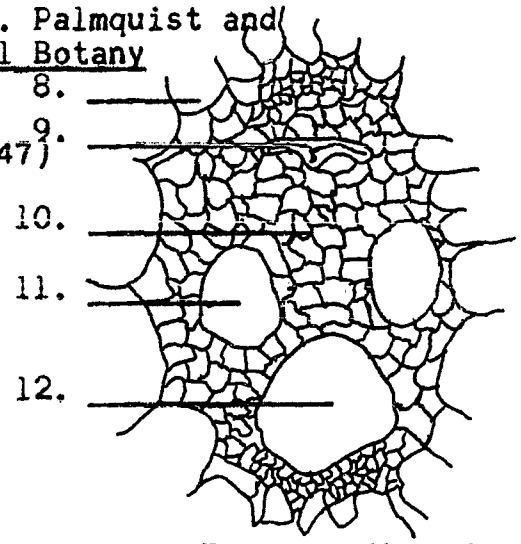
1	2
(___) 1. $6CO_2 + 6H_2O = C_6H_{12}O_6 + O_2$	(See following page)
(___) 2. $C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O$	
(___) 3. A plant which lives more than two years.	
(___) 4. A slightly enlarged portion of the stem where leaves and buds arise.	
(___) 5. Produces the epidermal system.	
(___) 6. Formulated the cell theory.	
(___) 7. The first mechanical tissue to be developed.	
(___) 8. Aid in determining the age of a tree.	

1		2
(___)	9. The scattering of the molecules or ions of one component of a solution among those of the other components, resulting in a uniform distribution of the particles of all components throughout the solution.	1. adventitious buds 2. annuals 3. annual rings 4. axillary buds 5. biennials 6. carbohydrates 7. collenchyma 8. diffusion 9. equation - photosynthesis 10. equation - respiration 11. ground meristem 12. internodes 13. nodes 14. osmosis 15. parenchyma 16. perennials 17. phloem 18. procambium 19. proteins 20. protoderm 21. Schleiden and Schwann 22. sclerenchyma 23. terminal buds 24. transpiration 25. xylem
(___)	10. escape of water in the form of water vapor.	
(___)	11. buds which arise anywhere on the plant, except in the axils of leaves.	
(___)	12. complex carbon compounds, containing, in addition to carbon, hydrogen, and oxygen, the elements nitrogen and sulfur.	
(___)	13. produces primary vascular system.	
(___)	14. a plant which completes its life cycle within two years.	
(___)	15. The tissue which conducts water and inorganic substances.	

V. Identify structures:



Tilia stem, cross-section
(Redrawn from Edward M. Palmquist and Loren C. Petry, General Botany Laboratory Book (Philadelphia: W. B. Saunders Co., 1947) p. 64a.



Zea mays Vascular Bundle

Unit 7 - Test 9
(Laboratory Practical)

I. Place the numbers of the pigments which are characteristic of the different classes of algae in the blanks of the answer sheet.

0. Black algae 1,2,3,4,5,6

1. Class Chlorophyceae _____

2. Class Cyanophyceae _____

3. Class Rhodophyceae _____

4. Class Phaeophyceae _____

1. chlorophyll a
2. chlorophyll b
3. carotin
4. phycocyanin
5. fucoxanthin
6. phycoerythrin
7. xanthophyll

II. Place the numbers of the algae which have the structures and methods of reproduction listed below in the blanks on the answer sheet.

5. forms which are without sexual reproduction or zoospore formation _____

6. Forms which produce heterogametes and zoospores _____

7. Forms which produce isogametes but no zoospores _____

8. Forms which produce isogametes and zoospores _____

1. desmids
2. Oedogonium
3. Protococcus
4. Scenedesmus
5. Spirogyra
6. Ulothrix

III. Questions 9 - 36 are to be matched with the words on separate sheets. Select the word which best defines the statement or question, and place this word in the blanks on the answer sheet.

9. rod-shaped bacteria

10. short filaments which break off from longer filaments

11. gametes which are alike in size and structure

12. Thallophytes which are capable of making their own food are said to be _____

13. the fusion of similar gametes to form a zygote

14. the name given to the zygote which is formed by the fusion of similar gametes

15. the male gametangium

16. spherical-shaped bacteria

17. dissimilar gametes

18. the fusion of dissimilar gametes

19. the zygote which is formed by the the fusion of dissimilar gametes

20. spiral-shaped bacteria

21. Thallophytes which secure their food directly or indirectly from other organisms are said to be _____

22. the female gametangium

23. an association of two different kinds of living organisms involving benefit to both

24. motile asexual spores

25. asexual reproduction involving merely the division of a single-celled individual into two new single-celled individuals of equal size.

26. protoplast which fuses with another protoplast to form the zygote in the process of sexual reproduction

27. enlarged colorless cell which may occur in the filaments of certain blue-green algae

1. antheridium
2. autoecious
3. autophytic
4. bacilli
5. cocci
6. coenocytes
7. conceptacles
8. conjugation
9. dichotomy
10. fertilization
11. fission
12. gametes
13. heterocyst
14. heteroecious
15. heterogametes
16. heterophytic
17. hormogonia
18. isogametes
19. lateral
20. oogonium
21. oospore
22. paraphysis
23. scalariform
24. sporangium
25. spirillum
26. symbiosis
27. tetraspore
28. zoospore
29. zygospore

28. refers to fungi which cannot carry through their complete life cycle unless two different hosts species are present

29. a plant or filament whose protoplasm is continuous and multinucleate without any division by walls into separate protoplasts

30. conjugation which takes place between cells of two different filaments

31. spores which are in groups of fours and are found in the red algae

32. a method of branching by forking

33. refers to fungi which require but a single host in order to complete their life cycle

34. conjugation which takes place between cells of the same filament

35. reproductive structures of the brown algae (be specific)

36. slender multicellular hair; sterile branches or hyphae associated with asci in the fruiting body of certain fungi

IV. Put answers in blanks on answer sheet.

	Key
37. Identify this organism.	37. Spirogyra
38. Give the phylum.	38. Chlorophyta
39. Give the class.	39. Chlorophyceae
40. This filament represents the _____ (N, 2N) stage.	40. N
41. Identify structure at end of pointer.	41. zygote
42. This structure represents the _____ (N, 2N) stage.	42. 2N

	Key
43. What name is given to the tube that joins two cells in the process of reproduction?	43. conjugation tube
44. What name is given to the conspicuous globular structures in the chloroplast?	44. pyrenoids
45. Identify this organism.	45. lichen
46. The mutual benefit association between an alga and a fungus is spoken of as _____	46. symbiosis
47. The "2N" refers to the haploid or diploid number of chromosomes.	47. diploid
48. The "N" refers to the haploid or diploid number of chromosomes.	48. haploid
49. Name organism.	49. Nostoc
50. Give the phylum of this organism.	50. Cyanophyta
51. The large colorless spherical or barrel-shaped cells are called _____.	51. heterocyst
52. Reproduction in this form is usually _____ (sexual or asexual).	52. asexual
53. Identify the filament.	53. Oedogonium
54. Name structure at end of pointer.	54. antheridia
55. What are the large, round bodies called?	55. zygote
56. Give the phylum.	56. Chlorophyta
57. The vegetative cells have the _____ (N, 2N) number of chromosomes.	57. N
58. Identify organism.	58. Fucus
59. The large, round structures are contained in a _____ (male, female) gametangium.	59. female

60. The gametes have the _____ (N, 2N) number of chromosomes.	60. N
61. Name organism.	61. Rhizopus
62. Give class of the organism.	62. Phycomycetes
63. Name organism.	63. lichen
64. Name organism.	64. Puccinia graminis
65. Give the name of the spores.	65. urediniospore
66. These spores are contained in a structure called the _____.	66. uredinia
67. Give the class of this organism.	67. Basidiomycetes
68. Give the name of the spores.	68. teliospore
69. These spores are contained in a structure called the _____.	69. telia
70. This slide shows a _____ (male, female) gametangium.	70. male
71. Identify this organism.	71. Puccinia graminis
72. Give the name of the spores.	72. aeciospore
73. These spores are contained in structures called _____.	73. aecia
74. Name organism.	74. bacteria
75. Name organism.	75. Ulothrix

Unit 8 - Test 10

I. Discuss photosynthesis with reference to raw products (2 points), energy factor (2 points), by products (1 point), and the end products (2 points).

II. Directions: In each of the sentences below, one or more words are needed in the numbered blank spaces to make the sentences complete and true. Place the word or words in the correspondingly numbered blanks to the right. Spelling will not count unless the word is obviously wrong.

1. The two main functions of the leaf are (1) and (2).
2. The two principal types of arrangement of veins in leaves are (3) and (4).
3. The two types of leaves (form of the leaf blade) are (5) and (6).
4. When the leaf blade is made up of a number of separate leaf-like parts, these leaf-like parts are called (7).
5. Some leaves have blades which are made up of a number of lobes separated by deep clefts or (8). If these clefts are directed toward the midrib, the leaf is said to be (9) lobed. If these clefts are directed toward the base of the blade the leaf is said to be (10) lobed.
6. The by-product of photosynthesis is (11).
7. Special functions sometimes are performed by leaves. Three of these functions are: (12), (13), and (14).
8. Three of the factors affecting transpiration are: (15), (16), and (17).

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

9. The product of photosynthesis may be transformed chemically into substances which serve various purposes in the life of the plant. These substances are: (18), (19), (20), and (21).

10. The four conditions which influence the rate of photosynthesis are: (22), (23), (24), and (25).

19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____

III. Directions: Below are given two columns. For each statement in column one, there is a word in column two which defines this statement. Find this word and place its number in the parentheses in front of the statement in the first column.

1	2
0. (1) whip like filaments of protoplasm	1. cilia 2. cutin 3. epidermal hairs 4. epidermis 5. guard cells 6. lamina 7. lemma 8. mesoderm 9. mesophyll 10. palisade 11. palmately veined 12. pedicel 13. peduncle 14. petiole 15. pinnately veined 16. sessile 17. spongy 18. stipules 19. stoma 20. vascular bundles
1. (___) expanded leaf blade	
2. (___) leaf-like structures from either side of the leaf base	
3. (___) covers the whole leaf surface and protects it from mechanical injury and drying out	
4. (___) parenchyma cells which are green and able to carry on photosynthesis	
5. (___) the stalk of the leaf	
6. (___) leaves which have no stalk	
7. (___) opening through which the exchange of gases occurs	
8. (___) structures which control the opening through which the exchange of gases occurs	
9. (___) first layer of cells just below upper epidermis	

10. (___) first layer of cells just above lower epidermis

11. (___) the conducting elements of the leaf

12. (___) leaves that have a single primary vein or midrib from which smaller veins branch off

13. (___) leaves that have several principal veins spreading out from the upper end of the stalk.

IV. Directions: Follow the instructions given on the cards in the laboratory.

	Key
1. Give common name.	1. Bois d'Arc
2. Give genus.	2. Maclura
3. Give species.	3. pomifera
4. Give common name.	4. blackjack oak
5. Give genus.	5. Quercus
6. Give species.	6. marilandica
7. Give common name.	7. elm
8. Give genus.	8. Ulmus
9. Give species.	9. americana
10. Give common name.	10. dogwood
11. Give genus.	11. Cornus
12. Give common name.	12. water oak
13. Give genus.	13. Quercus
14. Give species.	14. nigra
15. Give common name.	15. pine
16. Give genus.	16. Pinus
17. Give scientific name of leaf.	17. Syringa vulgaris

18. Name layer of cells at the end of the pointer.	18. palisade
19. Give common name.	19. catalpa
20. Give genus.	20. Catalpa
21. Give common name.	21. buckeye
22. Give genus.	22. Aesculus
23. Give species.	23. octandra
24. Give scientific name.	24. Zea mays
25. Name large and long cells at end of pointer.	25. bulliform
26. Name opening at end of pointer.	26. stoma
27. This opening (#26) is controlled by _____ cells.	27. guard
28. Give common name.	28. maple
29. Give genus.	29. Acer
30. Give species.	30. rubrum
31. Give common name.	31. magnolia
32. Give genus.	32. Magnolia
33. Give species.	33. grandiflora
34. Name common name, the tree found growing in the water at Caddo.	34. cypress
35. Give common name.	35. post oak
36. Give genus.	36. Quercus
37. Give species.	37. stellata
38. Give common name.	38. cedar
39. Give genus.	39. Juniperus

Unit 9 - Test 11

I. Directions: Below are given two columns. For each fruit or flower in column one, there is a word in column two which describes it. Find this word and place its number in the parentheses in front of the flower or fruit in column one.

	1		2
0.	(15)	squash	1. achene
1.	(___)	carrot flower	2. capsule
2.	(___)	oat flower	3. caryopsis
3.	(___)	wheat flower	4. catkin
4.	(___)	hyacinth flower	5. compound spike
5.	(___)	willow flower	6. compound umbel
6.	(___)	sunflower	7. corymb
7.	(___)	onion flower	8. drupe
8.	(___)	cherry flower	9. follicle
9.	(___)	iris (fruit)	10. head
10.	(___)	ash (fruit)	11. hesperidium
11.	(___)	milkweed (fruit)	12. legume
12.	(___)	crucifers (fruit)	13. nut
13.	(___)	lemon (fruit)	14. panicle
14.	(___)	pea (fruit)	15. pepo
15.	(___)	pear (fruit)	16. pome
			17. raceme
			18. samara
			19. schizocarp
			20. silique
			21. spike
			22. umbel

II. Directions: In each of the sentences below, one or more words are needed in the numbered blank spaces to make the sentences complete and true. Place the word or words in the correspondingly numbered blanks to the right. Spelling will not count unless the word is obviously wrong.

1. The petal and sepals taken together are called the (1).
2. The stalk or stem of a flower which is born singly is called the (2).
3. In many plants the flowers are borne on clusters called (3).
4. All fruits may be classified on the basis of the number of ovaries involved in their formation into the following 3 groups: (4), (5), and (6).
5. Every seed consists of at least two parts, the (7) and the (8); frequently a third part, the (9) is present.
6. (10), (11), and (12) are the three external conditions which are essential for the germination of seeds.
7. Four of the principal processes going on in the seed during germination are (13), (14), (15), and (16).
8. Three of the chief factors which determine the vitality of seeds are (17), (18), and (19).
9. From the time when the young emerges from the seed to the time when it becomes entirely dependent upon food manufactured by itself, it is called (20).

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

III. Directions: In each of the sentences below, one or more words are needed in the numbered blank spaces to make the sentences complete and true. Place the word or words in the correspondingly numbered blanks to the right. Spelling will not count unless the word is obviously wrong.

1. The transfer of pollen from the anther to the stigma is called (1).
2. The four pollen grains, each of which has (2) chromosome(s) are produced by the division of the pollen mother cell which has (3) chromosome(s).
3. The nucleus of each of the pollen grains divides into two nuclei, the (4) and the (5).
4. The fusion of the sperm and egg nuclei is called (6) and the nucleus, plus cytoplasm, is called the (7).
5. The fusion of the polar nuclei and the sperm nucleus results in the formation of the (8) nucleus.
6. If pollen is transferred from anther to the stigma of the same flower (9)-pollination is the name of the process. If pollen transferred from an anther to the stigma of another flower, (10)-pollination is the name of the process.
7. The seed coats are developed from the (11).
8. The three nuclei at the basal end of the embryo sac are called the (12) nuclei.

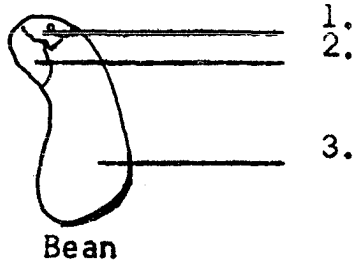
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

IV. Directions: Below are given two columns. For each statement in column one, there is a word in column two which defines this statement. Find this word and place its number in the parentheses in front of the statement in the first column.

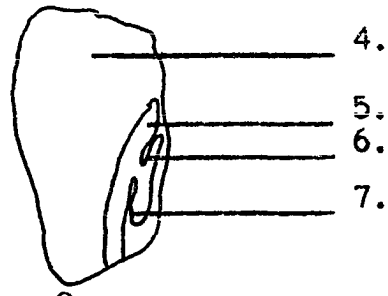
1	2
1. (___) One carpel; splitting along two sutures.	1. achene
2. (___) one-seeded; pericarp firmly united all around to testa or seed coat.	2. capsule
3. (___) a hard, one-seeded fruit, generally produced from a compound ovary.	3. caryopsis
4. (___) a type of berry with a leathery rind.	4. drupe
5. (___) carpel one splitting along two sutures.	5. follicle
6. (___) derived from a single carpel and one seeded; exocary thin forming the skin; mesocarp fleshy; endocarp stony.	6. hesperiduim
7. (___) a type of berry with a leathery rind.	7. legume
8. (___) carpels two; separating at maturity leaving a partition wall persistent.	8. nut
9. (___) "key fruit"	9. pepo
10. (___) one seeded; seed attached to ovary wall at one point only.	10. pome
	11. samara
	12. schizocarp
	13. silique

V. Name five seeds which are used by man and give the use of each. Two of the five must be used for something other than food.

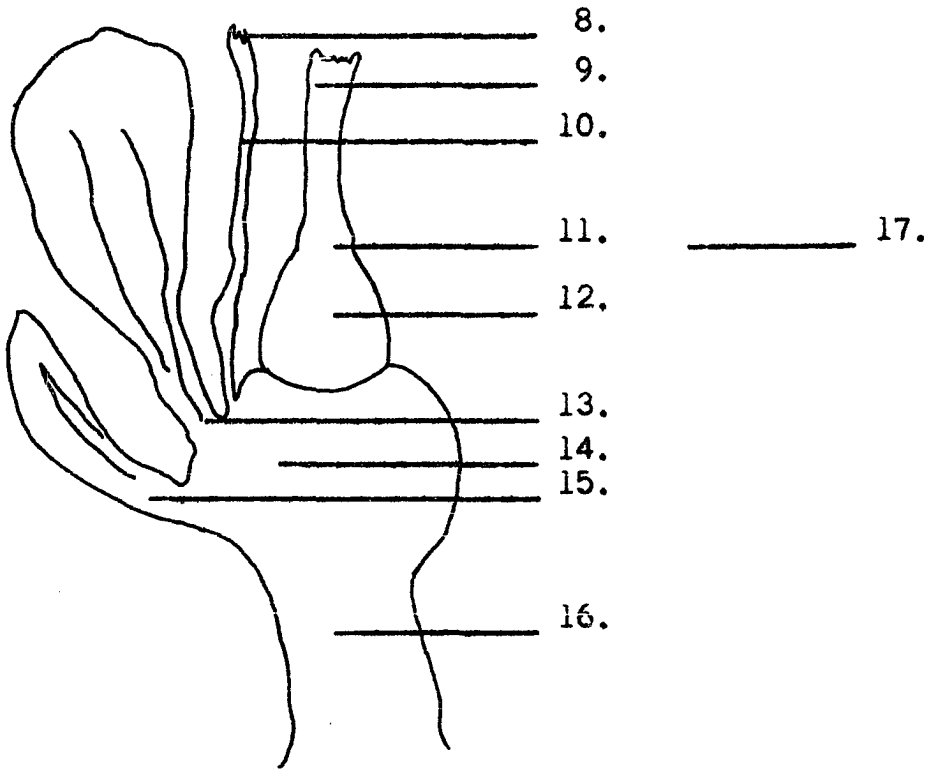
VI. Identify structures:



Bean



Corn



Flower*

*Redrawn from Richard M. Holman, and Wilfred W. Robbins, A Textbook of General Botany for Colleges and Universities (4th ed. revised; New York: John Wiley & Sons, Inc., 1951), p. 231.

Unit 10 - Test 12

I. Directions: Below are given two columns. For each word or words in column one there is a phylum to which it belongs in column two. Find this phylum and place its number on the answer sheet to the right of the number which corresponds to the number in column one.

1	2
1. red algae	1. Bryophyta
2. blue-green algae	2. Chlorophyta
3. brown algae	3. Cyanophyta
4. green algae	4. Eumycophyta
5. slime fungi	5. Lycopsida
6. bacteria	6. Myxomycophyta
7. true ferns	7. Phaeophyta
8. mosses	8. Pteropsida
9. true fungi	9. Rhodophyta
10. monocots	10. Schizomycophyta
11. liverworts	
12. horsetails	
13. Class Musci	
14. Class Angiospermae	
15. Class Filicineae	
16. Class Hepaticae	
17. Class Gymnospermae	
18. Pinus	
19. Selaginella	
20. cypress tree	
21. cedar tree	

II. Directions: Below are some statements which describe plants or animals. Place an "a" for animal and a "p" for plant to the right of the number which corresponds to the number of the statement on the answer sheet.

22. The great majority of these organisms are not able to move from place to place. Many of the simple ones are, however, capable of such movement (locomotion).

23. The cells of these organisms are generally without surrounding walls.

24. These organisms are unable to make their own foods.

25. In most of these organisms growth and development proceed in an unlimited fashion. New organs and tissues continue to be produced through the life of the organisms.

26. In most of these organisms each of the cells, or minute masses of living substances of which the bodies of all organisms are made up, is surrounded by a relatively rigid wall.

27. In most of these organisms organs are fairly well formed in the embryo and growth and development consist chiefly in their enlargement and maturing.

III. Directions: Below are listed the primary functions of stem, root, and leaf. Place an "s" for stem, an "r" for root, and an "l" for leaf to the right of the number on the answer sheet which corresponds to the function (primary).

29. anchorage

30. support of foliage leaves and floral leaves

31. conduction of water and mineral substances from the soil.

32. absorption of water and certain mineral salts

33. manufacture of carbohydrates (photosynthesis)

34. conduction of plant foods

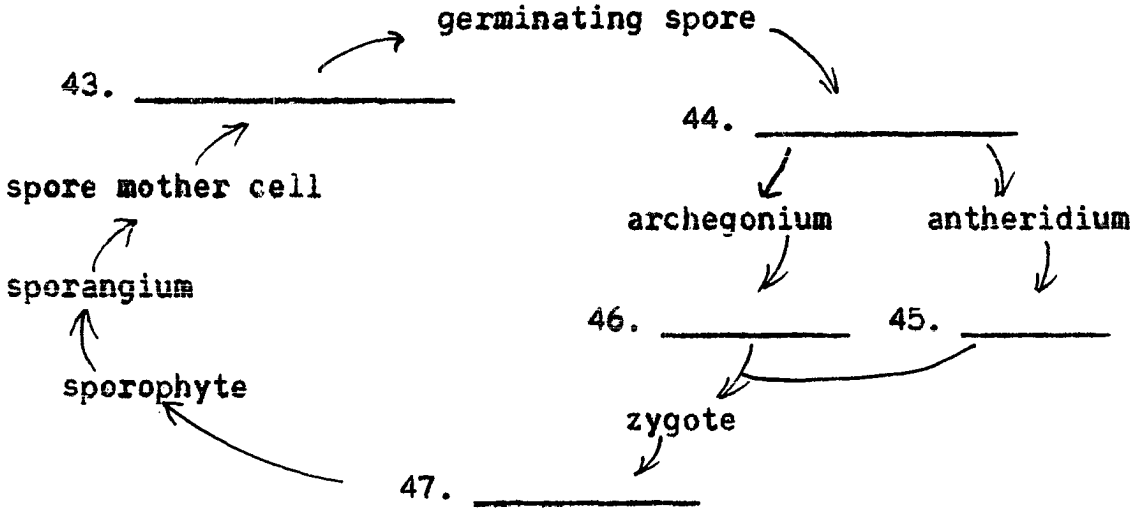
35. transpiration

36. synthesis of nitrogenous foods

IV. Directions: Below are two columns. In column one are words or groups of words which pertain to photosynthesis. In column two are words which describe the role of these words in column one. Find this word and place its number on the answer sheet to the right of the number which corresponds to the number in column one.

1	2
37. carbon dioxide	1. by-product
38. glucose	2. end product
39. oxygen	3. energy source
40. water	4. raw material
41. chlorophyll	
42. light	

V. Directions: Below is a description of the life cycle of a fern. Fill in the blanks in this life cycle by placing the word or words which are necessary to describe the life cycle on the answer sheet to the right of the number which corresponds to the blank.



Attitude Tests

The attitude tests were made by the teacher in charge of the course. The responses were scored by giving a plus one for response number one, a zero for response number two, and a minus one for response number three. Each test was given two scores. One was for the like portion of the test, and the other was for the unlike portion. An asterisk marks the unlike portion of the tests.

Unit 2 - Test 1
(Section I)

Purpose: To measure objectively the interests of students in the study of the habitats of aquatic invertebrates in a beginning course in college biology.

Examination: A number of statements concerning your feeling relative to the study of the habitats of aquatic invertebrates have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of aquatic invertebrates.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(___) 3. I hate my teacher.

(___) I.
1. I like field trips.
2. I neither like nor dislike field trips.
3. I do not like field trips.

(___) *II.
1. I like the study of the natural habitat of aquatic invertebrates.
2. I neither like nor dislike the study of the natural habitat of aquatic invertebrates.
3. I did not like the study of the natural habitat of aquatic invertebrates.

(___) III.
1. I like being furnished aquatic invertebrates for study.
2. I neither liked nor disliked being furnished aquatic invertebrates for study.
3. I did not like being furnished aquatic invertebrates for study.

(___) *IV
1. I liked the study of the natural habitat of aquatic invertebrates from the textbook.
2. I neither liked nor disliked the study of the natural habitat of aquatic invertebrates from the textbook.

3. I did not like the study of the natural habitat of aquatic invertebrates from the textbook.

Unit 2 - Test 1
(Section II)

Purpose: To measure objectively the interests of students in the study of the habitats of aquatic invertebrates in a beginning course in college biology.

Examination: A number of statements concerning your feeling relative to the study of the habitats of aquatic invertebrates have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of aquatic invertebrates.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

( ) I.
1. I like field trips.
2. I neither like nor dislike field trips.
3. I do not like field trips.

( ) *II.
1. I like the study of the natural habitat of aquatic invertebrates.
2. I neither like nor dislike the study of the natural habitat of aquatic invertebrates.
3. I did not like the study of the natural habitat of aquatic invertebrates.

( ) III.
1. I liked being furnished aquatic invertebrates from their natural habitat for study.
2. I neither liked nor disliked obtaining aquatic invertebrates from their natural habitat for study.
3. I did not like obtaining aquatic invertebrates from their natural habitat for study.

(___) *IV. 1. I like studying the natural habitat of aquatic invertebrates by observing them in their natural habitats.
2. I neither liked nor disliked studying the natural habitat of aquatic invertebrates by observing them in their natural habitats.
3. I did not like studying the natural habitats of aquatic invertebrates by observing them in their natural habitats.

Unit 3 - Test 2
(Section I)

Purpose: To measure objectively the interests of students in the study of parasitic worms in a beginning course in college biology.

Examination: A number of statements concerning your feeling relative to the study of parasitic worms have been printed below. Each statement is expressed three different ways to indicate three different ways you might feel about the study of parasitic worms.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) *I.
1. I liked the study of parasitic worms.
2. I neither liked nor disliked the study of parasitic worms.
3. I did not like the study of parasitic worms.

(___) II.
1. I thought that the study of the life cycles of the parasitic worms was interesting.
2. I thought that the study of the life cycles of parasitic worms was neither interesting nor uninteresting.
3. I thought that the study of the life cycles of parasitic worms was not interesting.

(___) III.
1. I like working in groups.
2. I neither like nor dislike working in groups.
3. I do not like working in groups.

(___) *IV. 1. I like the use of community resources in the study of parasitic worms.
2. I neither liked nor disliked the use of community resources in the study of parasitic worms.
3. I did not like the use of community resources in the study of parasitic worms.

(___) *V. 1. I liked obtaining parasitic worms for study.
2. I neither liked nor disliked obtaining parasitic worms for study.
3. I did not like obtaining parasitic worms for study.

Unit 3 - Test 2
(Section II)

Purpose: To measure objectively the interests of students in the study of parasitic worms in a beginning course in college biology.

Examination: A number of statements concerning your feeling relative to the study of parasitic worms have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of parasitic worms.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) *I.
1. I liked the study of parasitic worms.
2. I neither liked nor disliked the study of parasitic worms.
3. I did not like the study of parasitic worms.

(___) II.
1. I thought that the study of the life cycles of the parasitic worms was interesting.
2. I thought that the study of the life cycles of parasitic worms was neither interesting nor uninteresting.
3. I thought that the study of the life cycles of parasitic worms was not interesting.

(___) III.
1. I like working in groups.
2. I neither like nor dislike working in groups.
3. I do not like working in groups.

(___) *IV. 1. I liked the use of the textbook for the study of parasitic worms.
2. I neither liked nor disliked the use of the textbook for the study of parasitic worms.
3. I did not like the use of the textbook for the study of parasitic worms.

(___) *V. 1. I like being furnished parasitic worms for study.
2. I neither liked nor disliked being furnished parasitic worms for study.
3. I did not like being furnished parasitic worms for study.

Unit 4 - Test 3
(Section I)

Purpose: To measure objectively the interests of students in the study of the Phylum Arthropoda in the beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the Phylum Arthropoda have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of the Phylum Arthropoda.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like biology.
2. I neither like nor dislike biology.
(1) 3. I do not like biology.

(___) I.
1. I liked the study of the Phylum Arthropoda.
2. I neither liked nor disliked the study of the Phylum Arthropoda.
3. I did not like the study of the Phylum Arthropoda.

(___) *II.
1. I liked using the textbook in the study of arthropods (insects, centipedes, spiders, etc.).
2. I neither liked nor disliked using the textbook in the study of arthropods.
3. I did not like using the textbook in the study of the arthropods.

(___) III.
1. I liked the study of the crayfish.
2. I neither liked nor disliked the study of the crayfish.
3. I did not like the study of the crayfish.

(___) *IV. 1. I would have liked to have collected live arthropods for study.
2. I would have neither liked nor disliked to have collected live arthropods for study.
3. I would not have liked to have collected live arthropods for study.

(___) V. 1. The study of the crayfish helped in the understanding of the place of the different animals in the animal kingdom.
2. The study of the crayfish neither helped nor hindered me in the understanding of the place of the different animals in the animal kingdom.
3. The study of the crayfish did not help me in the understanding of the place of the different animals in the animal kingdom.

(___) *VI. 1. The study of the insects, spiders, centipedes, etc., helped me in the understanding of the place of the different animals in the animal kingdom.
2. The study of the insects, spiders, centipedes, etc., neither helped nor hindered me in the understanding of the place of the different animals in the animal kingdom.
3. The study of the insects, spiders, centipedes, etc., did not help me in the understanding of the place of the different animals in the animal kingdom.

Unit 4 - Test 3
(Section II)

Purpose: To measure objectively the interests of students in the study of the Phylum Arthropoda in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the Phylum Arthropoda have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of the Phylum Arthropoda.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like biology very much.
2. I neither like nor dislike biology.
(1) 3. I do not like biology.

(___) I.
1. I liked the study of the Phylum Arthropoda.
2. I neither liked nor disliked the study of the Phylum Arthropoda.
3. I did not like the study of the Phylum Arthropoda.

(___) *II.
1. I liked studying the live arthropods (insects, spiders, centipedes, etc.) which I collected.
2. I neither liked nor disliked studying the live arthropods which I collected.
3. I did not like studying the live arthropods which I collected.

(___) III.
1. I liked the study of the crayfish.
2. I neither liked nor disliked the study of the crayfish.
3. I did not like the study of the crayfish.

(___) *IV. 1. I liked collecting the live arthropods for study.
2. I neither liked nor disliked collecting the live arthropods for study.
3. I did not like collecting the live arthropods for study.

(___) V. 1. The study of the crayfish helped me in the understanding of the place of the different animals in the animal kingdom.
2. The study of the crayfish neither helped nor hindered me in the understanding of the place of the different animals in the animal kingdom.
3. The study of the crayfish did not help me in the understanding of the place of the different animals in the animal kingdom.

(___) *VI. 1. The study of the insects, spiders, centipedes, etc., helped me in the understanding of the place of the different animals in the animal kingdom.
2. The study of the insects, spiders, centipedes, etc., neither helped me nor hindered me in the understanding of the place of the different animals in the animal kingdom.
3. The study of the insects, spiders, centipedes, etc., did not help me in the understanding of the place of the different animals in the animal kingdom.

Unit 5 - Test 4
(Section I)

Purpose: To measure objectively the interests of students in the study of the digestive system (emphasis on vitamins) in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of vitamins have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of vitamins.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(_1_) 3. I dislike my teacher.

(___) *I.
1. I liked the study of vitamins.
2. I neither liked nor disliked the study of vitamins.
3. I disliked the study of vitamins.

(___) II.
1. The study of vitamins in a course in biology is important.
2. The study of vitamins in a course in biology is neither important nor unimportant.
3. The study of vitamins in a course in biology is not important.

(___) III.
1. The study of vitamins is an important part of the study of the digestive system.
2. The study of vitamins is neither an important nor unimportant part of the study of the digestive system.
3. The study of vitamins is not an important part of the study of the digestive system.

(___) *IV. 1. The help of the home economist in the study of vitamins was beneficial.
2. The help of the home economist in the study of vitamins was neither beneficial nor not beneficial.
3. The help of the home economist in the study of vitamins was not beneficial.

(___) V. 1. The study of vitamins was beneficial.
2. The study of vitamins was neither beneficial nor not beneficial.
3. The study of vitamins was not beneficial.

(___) *VI. 1. I liked the class reports on vitamins.
2. I neither liked nor disliked the class reports on vitamins.
3. I did not like the class reports on vitamins.

Unit 5 - Test 4
(Section II)

Purpose: To measure objectively the interests of students in the study of the digestive system (emphasis on vitamins) in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of vitamins have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of vitamins.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I dislike my teacher.

(___) *I.
1. I liked the study of vitamins.
2. I neither liked nor disliked the study of vitamins.
3. I disliked the study of vitamins.

(___) II.
1. The study of vitamins in a course in biology is important.
2. The study of vitamins in a course in biology is neither important nor unimportant.
3. The study of vitamins in a course in biology is not important.

(___) III. 1. The study of vitamins is an important part of the study of the digestive system.
2. The study of vitamins is neither an important nor unimportant part of the study of the digestive system.
3. The study of vitamins is not an important part of the study of the digestive system.

(___) IV. 1. The presentation of vitamins by the teacher with the help of the textbook was adequate.
2. The presentation of vitamins by the teacher with the help of the textbook was neither adequate nor inadequate.
3. The presentation of vitamins by the teacher with the help of the textbook was not adequate.

(___) V. 1. The study of vitamins was beneficial.
2. The study of vitamins was neither beneficial nor not beneficial.
3. The study of vitamins was not beneficial.

(___) *VI. 1. The study of vitamins by use of community resources (outside speakers, class reports, interviews, etc.) would have been very beneficial.
2. The study of vitamins by use of community resources would have been neither beneficial nor not beneficial.
3. The study of vitamins by use of community resources would not have been beneficial.

Unit 6 - Test 5
(Section I)

Purpose: To measure objectively the interests of students in the study of cells, tissues, stems and roots in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of cell, tissues, stems and roots have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of cells, tissues, stems and roots.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: O.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) I.
1. I like biology.
2. I neither like nor dislike biology.
3. I dislike biology.

(___) II.
1. I like to use the microscope.
2. I neither like nor dislike to use the microscope.
3. I dislike to use the microscope.

(___) III.
1. I like field trips.
2. I neither like nor dislike field trips.
3. I dislike field trips.

(___) IV.
1. I liked the study of cells and tissues.
2. I neither liked nor disliked the study of cells and tissues.
3. I disliked the study of cells and tissues.

(___) V.
1. I liked the study of the physiology of the cell (photosynthesis, diffusion, transpiration, etc.)
2. I neither liked nor disliked the study of the physiology of the cell (photosynthesis, diffusion, transpiration, etc.).
3. I disliked the study of the physiology of the cell (photosynthesis, diffusion, transpiration, etc.).

(___) *VI.
1. I liked the study of the external anatomy of the stem (lenticels, leaf scars, etc.) from the trees on the campus.
2. I neither liked nor disliked the study of the external anatomy of the stem (lenticels, leaf scars, etc.) from the trees on the campus.
3. I disliked the study of the external anatomy of the stem (lenticels, leaf scars, etc.) from the trees on the campus.

(___) VII.
1. I liked the study of the functions of stems.
2. I neither liked nor disliked the study of the functions of stems.
3. I disliked the study of the function of stems.

(___) VIII.
1. I liked the study of the structure of the roots.
2. I neither liked nor disliked the study of the structure of the roots.
3. I disliked the study of the structure of the roots.

(___) IX.
1. I liked the study of the functions of the roots.
2. I neither liked nor disliked the study of the functions of the roots.
3. I disliked the study of the functions of the roots.

(___) *X.
1. I liked the study of the anatomy of the woody dicot stem (xylem, phloem, annular rings, etc.) from the trees (stumps and longitudinal sections) on the campus.
2. I neither liked nor disliked the study of the anatomy of the woody dicot stem (xylem, phloem, annular rings, etc.) from the trees (stumps and longitudinal sections) on the campus.

3. I disliked the study of the anatomy of the woody dicot stem (xylem, phloem, annular rings, etc.) from the trees (stumps and longitudinal sections) on the campus.

(___) *XI. 1. I liked the trip to the sawmill to study the different sections of wood.
2. I neither liked nor disliked the trip to the sawmill to study the different sections of wood.
3. I disliked the trip to the sawmill to study the different sections of wood.

(___) *XII. 1. I liked the study of stem modifications (tubers, corms, rhizomes, etc.).
2. I neither liked nor disliked the study of stem modifications (tubers, corms, rhizomes, etc.).
3. I disliked the study of stem modifications (tubers, corms, rhizomes, etc.)

Unit 6 - Test 5
(Section II)

Purpose: To measure objectively the interests of students in the study of cells, tissues, stems, and roots in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of cells, tissues, stems, and roots have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of cells, tissues, stems, and roots.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) I.
1. I like biology.
2. I neither like nor dislike biology.
3. I dislike biology.

(___) II.
1. I like to use the microscope.
2. I neither like nor dislike to use the microscope.
3. I dislike to use the microscope.

(___) III.
1. I like field trips.
2. I neither like nor dislike field trips.
3. I dislike field trips.

(___) IV.
1. I liked the study of cells and tissues.
2. I neither liked nor disliked the study of cells and tissues.
3. I disliked the study of cells and tissues.

(___) V. 1. I liked the study of the physiology of the cell (photosynthesis, diffusion, transpiration, etc.).
2. I neither liked nor disliked the study of the physiology of the cell (photosynthesis, diffusion, transpiration, etc.).
3. I disliked the study of the physiology of the cell (photosynthesis, diffusion, transpiration, etc.).

(___) *VI. 1. I liked the study of the external anatomy of the stem (lenticels, leaf scars, etc.).
2. I neither liked nor disliked the study of the external anatomy of the stem (lenticels, leaf scars, etc.).
3. I disliked the study of the external anatomy of the stem (lenticels, leaf scars, etc.).

(___) VII. 1. I liked the study of the function of stems.
2. I neither liked nor disliked the study of the functions of stems.
3. I disliked the study of the functions of stems.

(___) VIII. 1. I liked the study of the structure of the roots.
2. I neither liked nor disliked the study of the structure of the roots.
3. I disliked the study of the structure of the roots.

(___) IX. 1. I liked the study of the functions of the roots.
2. I neither liked nor disliked the study of the functions of the roots.
3. I disliked the study of the functions of the roots.

(___) *X. 1. I liked the study of the internal anatomy of the woody dicot stem (xylem, phloem, annular rings, etc.) from the prepared slides.
2. I neither liked nor disliked the study of the internal anatomy of the woody dicot stem (xylem, phloem, annular rings, etc.) from the prepared slides.
3. I disliked the study of the internal anatomy of the woody dicot stem (xylem, phloem, annular rings, etc.) from the prepared slides.

(___) *XI.
1. I liked the study of the different sections of wood (tangential, cross, and radial).
2. I neither liked nor disliked the study of the different sections of wood (tangential, cross, and radial).
3. I disliked the study of the different sections of wood (tangential, cross, and radial).

(___) *XII.
1. I liked the study of stem modifications (tubers, corms, rhizomes, etc.).
2. I neither liked nor disliked the study of stem modifications (tubers, corms, rhizomes, etc.).
3. I disliked the study of the stem modifications (tubers, corms, rhizomes, etc.).

Unit 7 - Test 6
(Section I)

Purpose: To measure objectively the interests of students in the study of the algae and fungi in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the algae and fungi have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of the algae and fungi.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) *I.
1. I like the study of the algae.
2. I neither liked nor disliked the study of the algae.
3. I disliked the study of the algae.

(___) II.
1. I liked the study of the fungi.
2. I neither liked nor disliked the study of the fungi.
3. I disliked the study of the fungi.

(___) III.
1. I liked the study of the life cycles of the algae.
2. I neither liked nor disliked the study of the life cycles of the algae.
3. I disliked the study of the life cycles of the algae.

(___) IV.
1. I liked the study of the life cycles of the fungi.

2. I neither liked nor disliked the study of the life cycles of the fungi.
3. I disliked the study of the life cycles of the fungi.

(___) *V.
1. I liked the study of the lichens.
2. I neither liked nor disliked the study of the lichens.
3. I disliked the study of lichens.

(___) VI.
1. I liked the study of the pigments found in the algae.
2. I neither liked nor disliked the study of the pigments found in the algae.
3. I disliked the study of the pigments found in the algae.

(___) VII.
1. I liked the study of the classification of the algae and fungi.
2. I neither liked nor disliked the classification of the algae and fungi.
3. I disliked the study of the classification of the algae and fungi.

(___) *VIII.
1. I liked the study of the distribution of the algae from the textbook.
2. I neither liked nor disliked the study of the distribution of the algae from the textbook.
3. I disliked the study of the distribution of the algae from the textbook.

(___) *IX.
1. I liked the study of the lichens from the textbook.
2. I neither liked nor disliked the study of the lichens from the textbook.
3. I disliked the study of the lichens from the textbook.

(___) X.
1. I liked the study of the slides of the algae.
2. I neither liked nor disliked the study of the slides of the algae.
3. I disliked the study of the slides of the algae.

Unit 7 - Test 6
(Section II)

Purpose: To measure objectively the interests of students in the study of the algae and fungi in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the algae and fungi have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of the algae and fungi.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) *I.
1. I liked the study of the algae.
2. I neither liked nor disliked the study of the algae.
3. I disliked the study of the algae.

(___) II.
1. I liked the study of the fungi.
2. I neither liked nor disliked the study of the fungi.
3. I disliked the study of the fungi.

(___) III.
1. I liked the study of the life cycles of the algae.
2. I neither liked nor disliked the study of the life cycles of the algae.
3. I disliked the study of the life cycles of the algae.

(___) IV.
1. I liked the study of the life cycles of the fungi.

2. I neither liked nor disliked the study of the life cycles of the fungi.
3. I disliked the study of the life cycles of the fungi.

(___) *V.
1. I liked the study of the lichens.
2. I neither liked nor disliked the study of the lichens.
3. I disliked the study of the lichens.

(___) VI.
1. I liked the study of the pigments found in the algae.
2. I neither liked nor disliked the study of the pigments found in the algae.
3. I disliked the study of the pigments found in the algae.

(___) VII.
1. I liked the study of the classification of the algae and fungi.
2. I neither liked nor disliked the classification of the algae and fungi.
3. I disliked the study of the classification of the algae and fungi.

(___) *VIII.
1. I liked the study of the algae at Caddo.
2. I neither liked nor disliked the study of the algae at Caddo.
3. I disliked the study of the algae at Caddo.

(___) *IX.
1. I liked the study of the lichens on the campus.
2. I neither liked nor disliked the study of the lichens on the campus.
3. I disliked the study of the lichens on the campus.

(___) X.
1. I liked the study of live algae.
2. I neither liked nor disliked the study of live algae.
3. I disliked the study of live algae.

Unit 8 - Test 7
(Section I and Section II)

Purpose: To measure objectively the interests of students in the study of the leaf and its functions in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the leaf and its functions have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of the leaf and its functions.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(_1_) 3. I hate my teacher.

(___) *I.
1. I liked the study of the external morphology of the leaf.
2. I neither liked nor disliked the study of the external morphology of the leaf.
3. I disliked the study of the external morphology of the leaf.

(___) II.
1. I liked the study of the anatomy of the leaf.
2. I neither liked nor disliked the study of the anatomy of the leaf.
3. I disliked the study of the anatomy of the leaf.

(___) III.
1. I liked the study of photosynthesis.
2. I neither liked nor disliked the study of photosynthesis.
3. I disliked the study of photosynthesis.

(___) IV. 1. I liked the study of transpiration.
2. I neither liked nor disliked the study of transpiration.
3. I disliked the study of transpiration.

(___) *V. 1. I liked the identification of trees by their leaves.
2. I neither liked nor disliked the identification of trees by their leaves.
3. I disliked the identification of trees by their leaves.

Unit 9 - Test 8
(Section I and Section II)

Purpose: To measure objectively the interests of students in the study of flowers, fruits, seeds, and seedlings in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the flowers, fruits, seeds, and seedlings have been printed below. Each statement is expressed in three different ways you might feel about the study of the flowers, fruits, seeds, and seedlings.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: 0.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I hate my teacher.

(___) *I.
1. I liked the study of the flower.
2. I neither liked nor disliked the study of the flower.
3. I disliked the study of the flower.

(___) *II.
1. I liked the study of the parts of the flower.
2. I neither liked nor disliked the study of the parts of the flower.
3. I disliked the study of the parts of the flower.

(___) *III.
1. I liked the study of the types of flowers.
2. I neither liked nor disliked the study of the types of flowers.
3. I disliked the study of the types of flowers.

(___) *IV. 1. I liked the study of the principal kinds of inflorescences.
2. I neither liked nor disliked the study of the principal kinds of inflorescences.
3. I disliked the study of the principal kinds of inflorescences.

(___) V. 1. I liked the study of the reproduction by flowers.
2. I neither liked nor disliked the study of the reproduction by flowers.
3. I disliked the study of the reproduction by flowers.

(___) *VI. 1. I liked the study of the kinds of fruits.
2. I neither liked nor disliked the study of the kinds of fruits.
3. I disliked the study of the kinds of fruits.

(___) *VII. 1. I liked the study of the seed.
2. I neither liked nor disliked the study of the seed.
3. I disliked the study of the seed.

(___) *VIII. 1. I liked the study of the uses of various seeds.
2. I neither liked nor disliked the study of the uses of various seeds.
3. I disliked the study of the uses of various seeds.

(___) IX. 1. I liked the study of seed germination.
2. I neither liked nor disliked the study of seed germination.
3. I disliked the study of seed germination.

(___) X. 1. I liked the study of seedlings.
2. I neither liked nor disliked the study of seedlings.
3. I disliked the study of seedlings.

Unit 10 - Test 9
(Section I and Section II)

Purpose: To measure objectively the interests of students in the study of the miscellaneous phyla in a beginning course in biology.

Examination: A number of statements concerning your feeling relative to the study of the miscellaneous phyla have been printed below. Each statement is expressed in three different ways to indicate three different ways you might feel about the study of the miscellaneous phyla.

Directions: Read each sentence through carefully and decide which one of the three statements best expresses the way you feel. Please do not try to choose the answer which you think will please the teacher. When you have come to a decision, write the number of the sentence in the parentheses which have been provided for this purpose in the left-hand margin of the page.

Sample: O.
1. I like my teacher.
2. I neither like nor dislike my teacher.
(1) 3. I dislike my teacher.

(___) *I.
1. I liked the study of mosses.
2. I neither liked nor disliked the study of mosses.
3. I disliked the study of mosses.

(___) *II.
1. I liked the study of the resurrection plant (Selaginella).
2. I neither liked nor disliked the study of the resurrection plant (Selaginella).
3. I disliked the study of the resurrection plant (Selaginella).

(___) *III.
1. I liked the study of ferns.
2. I neither liked nor disliked the study of ferns.
3. I disliked the study of ferns.

(___) *IV.
1. I liked the study of pines.
2. I neither liked nor disliked the study of pines.
3. I disliked the study of pines.