A STUDY OF LABORATORY METHODS USED IN TEACHING FRESHMAN BIOLOGY

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by

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CHAPTER I

INTRODUCTION

Biology means many things to many people. When the writer's son was two years old, he said, "my daddy teaches 'bilology'. That is about bugs, people's bones, and dirty worms". Such limited intrepretations are not false; strictly speaking, they are merely incomplete, reflecting a piecemeal appreciation of the magnitude of biology. Biology is all of these and more. It is the study of all aspects of the living world.

In teaching biology, one must try to meet the needs of all three types of students usually found in general biology classes: those who plan to major in biology, botany, or zoology; those who are preparing for further study in medicine or agriculture; and those for whom this is a terminal course as a part of their general education program.

Biology is usually taught as a laboratory course which in itself presents many problems, such as required drawings, presentation of laboratory and lecture materials. Many students have difficulty in finding and interpreting microscopic materials which are to be studied in the laboratory. The dissection of preserved materials presents problems as how to best dissect the materials so that the student will learn more from having done the dissection, and at the same time develop his power of observation. Should the student be allowed to dissect in their own manner or should the students be

given directions for dissections?

The writer of this paper has chosen the following problems in making this study: (1) Laboratory drawings, (2) Lecture-Laboratory arrangement, and (3) Use of field trips in the teaching of freshman biology.

I. THE PROBLEM AREA

Statement of the problem. The most accepted method of teaching biology is the drawing method where the student is given living or preserved specimens and from these makes certain observations which he represents on paper in the form of drawings.

The time element involved in making drawings puts a definite limit on the scope of material that can be covered. In order to cover more material in the allotted time, one is forced to seek some quicker and at the same time equally satisfactory means of aiding the student in acquiring the necessary facts on which to base his broader concepts of biology. This situation brings one the following questions: (1) Must the student make drawings in order to learn? (2) Will he retain his knowledge as readily if he does not represent on paper what he sees with his eyes? (3) Can ready-made drawings be used as a tool for acquiring knowledge just as the other laboratory equipment is used? (4) In using ready-made drawings will the student's power of observation be developed as much as the other types of laboratory procedure used in teaching biology?

Lecture-Laboratory Method. The arrangement of laboratory and lecture periods have also presented problems as to whether the lecture should precede or follow the laboratory period. At this point one might ask some questions concerning the learning process of the student and the arrangement of the lecture-laboratory period. Is the student able to better understand material studied in the laboratory if that material has been discussed in class? Would the student be able to learn and remember more if the material were discussed in the class period before being studied in the laboratory? Would the student learn more if the laboratory and lecture were as one period. Which of these methods would tend to develop the scientific method best?

The problems presented above are a few of the problems an instructor would encounter in teaching a course in freshman biology. In attempting to solve the problems above the instructor would be faced with the problem of evaluation. Evaluation must be based upon the student's achievement in terms of the objectives of the laboratory work.

II. OBJECTIVES OF LABORATORY WORK

The objectives of laboratory work may be stated: (1) Acquittance with and use of the scientific method, (2) Development of keen powers of observation, (3) Development of concepts (physiological and morphological) of living things, (4) The development of specific

laboratory techniques and skills used in studying microscopic and macroscopic structures.

III. THE FIELD TRIP DEFINED

The field trip is any school exercise designed to provide complete sensory experiences with things and phenomenon which cannot be brought into the classroom. It involves the taking of students to places where subject matter may be studied firsthand.

The term "field trip" is a type of a school journey as spoken of in a broader meaning. However, this paper will be concerned primarily with the term as it applies to the teaching of biology. The field trip as a teaching technique is excellent in that it gives students firsthand experiences with things studied in the laboratory, and also those things that cannot be brought into the laboratory for study. For the student to think of plants and animals in relation to their natural environment is an important part of training in biology. When field trips are at all possible they should be arranged because they result in the production of attitudes not otherwise possible. Students know that laboratory or demonstration materials come out of cans or bottles, but too frequently they are unable to trace the materials farther. The recognition of organisms in the out-of-doors is a long step toward the appreciation of nature and of life itself. The elements of ecology may be made quite simple and quite interesting to beginning students of biology.

For a successful field trip the conductor must know at least a few of the fundamentals of plant and animal distribution. He should be aware of the fact that such environmental factors as water supply, light, temperature, oxygen supply, hydrogen-ion concentration, and fertility of the soil determines the types of plant communities to be found and consequently the types of animal forms likely to be encountered. He should know that certain forms are found only about ponds, swamps, or bogs. Many species found in a beech-maple forest are not found in oak-hickory associations, swamp forest, or in grasslands, etc.

The careful observer will have noted gradual changes of one type of community into another as environmental conditions change. Any farmer can tell something of the changes brought about by drainage. The landscape of our agricultural regions has been vastly changed by such procedures. An area once covered with frog ponds and cattail swamps may become dry grasslands or grain fields. The wild flower enthusiast can readily relate instances of favorite forests being lumbered, resulting soon in the disappearance of the usual spring, summer, and autumn flowers. He may also have noted that after a certain forest type was removed it was often succeded by a different kind of forest if the area was not further disturbed. Conversations with the older inhabitants of a community often will reveal many interesting facts concerning vegetation changes.

Many teachers are confronted with the problem of being

surrounded by agricultural lands on which most of the original vegetation has been destroyed. Too often they regard the situation as hopeless as far as field work is concerned. However, if the region is carefully studied, pastured grasslands, wooded lots, ponds, and streams are likely to be found. Quite a variety of species can be listed from these. The shrewd teacher will be able to substitute many local forms for the standard ones of biology texts. There are always waste areas along roads and railways which offer possibilities to the biologist. Abandoned fields or vacant city lots will yield numerous possibilities especially in the study of plant succession. A comparison of the vegetation of a series of similarly located waste areas will bring out the extremely interesting phenomenon of one plant and animal population succeeding another as the environmental conditions change. A study of weeds, insects, rodents, birds, fur-bearing animals, game animals, cultivated and native trees, shrubs, and plant and animal diseases of an agricultural region will arouse interest. And, after all, knowledge concerning these are of fundamental and immediate value to the student living in these particular surroundings. When a teacher once realizes that an available jungle of native vegetation is not necessarily a prequisite to successful field trips, he may become aware of the numerous possibilities of his particular community.

IV. OBJECTIVES OF FIELD TRIP

Some general objectives have been given for a field trip in the preceding discussion. The following will include objectives more specific for this particular study.

The field trip seems to be enjoyed by all the students taking part in such an outdoor class. Perhaps just a change in routine is part of the reason for enjoying it as they do. It could be said that any type of trip would be beneficial to the students, but certainly a well planned trip could and would mean more to the students.

The trip should first have some worthwhile objectives, it should also be to a place which would best show and illustrate the subjects and problems studied in the classroom as much as possible. A trip to just any place in the field or woods will not be suitable for a well rounded trip.

The objectives of the field trip under study here are explained below. The student should be able to make observations which would illustrate the idea of the object or objects under observation. The student in making his observations should realize or become aware of the living things around him, both plant and animal. In making these observations and becoming aware of surrounding life, the student should study and learn the different types of habitats for animal and plant life in that particular area. In doing this the student will become familiar with and be able to identify some of the more common plants and animals studied. The

student would enjoy his study of biology if he were able to identify some of the plants and animals with which he comes in contact in everday life. Through a study of life around hin, the student should begin to realize and understand some of the ecological factors involved in the habitats and habits of the organisms living in that area. Some of these ecological factors which may be studied may well be; the moisture content of the area, position in relation to north and south. The amount of sunlight available is important for plants, and animals to some extent. The population, food supply, and requirements would also be included as ecological factors for life in a given area.

Conservation is something that most people are interested in to some degree. The conservation of land use, erosion, etc., should be studied in any biological field trip, as well as conservation of animal and plant life. The conservation of water is very important to wild life and cultivated life as well. In the student's study of conservation, he should be come familiar with the conservation of our forests, which would include reforesting, water run-off, thinning and organized cutting of timber.

The above objectives of the field trip under study, could be altered to meed requirements of other types of biological field trips. It would also be good to have some type of evaluation of the trip. This evaluation could be in discussion form, or a formal evaluation in the written form. By listening to comments made by the students and observing their reactions will help the instructor evaluate the field trip.

V. BACKGROUND OF THIS SPECIFIC STUDY

The value of laboratory drawings has been debated for many years. It is the opinion of some instructors that the students should make detailed drawings and label the parts indicated in these drawings. This method has certain advantages in that the student will spend more concentrated time on a particular subject or specimen, and it also tends to develop accurate laboratory habits. However, this method is very time comsuming and much less material can be covered in the time allotted for laboratory. It is the opinion of some students that they can learn more by making detail drawings.

Should the students be required to make drawings at all, or should they prepare rough sketches of the specimen in their own manner? In some schools the students are not required to make drawings to be graded by the instructor. If a student can sketch a drawing of a speciman, it may mean more to him than a detailed drawing. However, some students will not work as hard or observe as closely to learn if they are not required to make drawings for the instructor to grade.

It is the practice of some instructors and schools to use prepared drawings to which the student merely labels the parts which are shown. The advantages of this method are that more material can be covered in a given period of time, and that the student will know the type of material that he is expected to learn.

VI. LIMIT OF THIS STUDY

The extent of this study is somewhat limited due to the grouping of students, the number of students used, and the problem of evaluation of the materials covered in this study.

VII. PURPOSE OF THIS STUDY

It is the purpose of the writer to make a study of these problems and to present the results which may help to develop a better method of teaching biology. It is also the purpose of the writer to attempt to determine the best arrangement of the lecture and laboratory periods, through the study of the different arrangements of these periods. A third purpose is to learn the best usage of the laboratory drawings. The fourth purpose in making this study is to learn the best use of the field trip in teaching biology.

The writer hopes to gain from this study experience and information which will improve the quality of teaching general biology.

CHAPTER II

REVIEW OF RELATED LITERATURE

Some of the research on related problems will be reviewed as a background or an introduction for the problems to be studied in connection with this paper.

Tobler conducted a study in this area in order to determine the effectiveness of laboratory procedure in teaching freshman biology.[1]

Forms A and B of the Ruch-Crossman Tests were given two groups of students being studied by Tobler. Group A attained a median score of 16 points on Form A of the test. Group B attained a median score of 19 points on this same test. Results of Form B were that Group A attained a median score of 46 points, a rise of 30 points. Group B scored 61 points on Form B of the test. These results show that Group A had a gain of 30 points on the tests, while Group B had a gain of 42 points on the same tests. On the Iowa Every-Pupil Biology Test, Group A scored a median of 49 points and Group B scored a median of 54 points.

These results indicate that Group B, which was assigned the prepared drawings to be labeled, made a difference of 12

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[1] I. V. Tobler, "Teaching Values of the Prepared Biology Drawings Versus the Original Laboratory Drawings," School Science and Mathematics, (May, 1945), 45: 479-82

points over Group A which was assigned the task of making its own drawings. According to this study the method using prepared drawings would be superior to the method of making drawings.

Another study made in this same area of biology drawings was one made by Taylor.[2] In this study the author made an effort to ascertain whether students who made drawings of laboratory specimens acquire more knowledge than those who make their own observations and are presented with accurate, ready-made drawings to which they merely attach labels.

The students were divided into two groups. One group was assigned the task of making their own drawings. The second group of students labeled ready-made drawings.

The results of this study were made in the form of a comparison between the achievement of all students who made their own drawings and all who did not make drawings. In 87 cases of those students who did not make drawings, the average was 80.6; and in 91 cases of those students who made drawings, the average achievement was 75.4. This shows a difference of achievement between the two groups of 5.2 points. Here, as in the preceding study, the method of using ready-made drawings seems to be a better method of teaching biology.

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[2]Lourene Taylor, "The Ready-Made Drawings with Relation to the Student Achievement," School and Society, (September, 1930) 32:371-74

I. LIMIT OF RELATED LITERATURE

The available research on problems similar to this study is very limited; therefore, the literature reviewed here was brief. The writer has failed to find specific research on the lecture and laboratory arrangement in the teaching of biology.

CHAPTER III

PROCEDURE

I. LECTURE-LABORATORY ARRANGEMENT

The problem of the lecture-laboratory arrangement was studied for three quarters of school work at Appalachian State Teachers College.

The students used in this study were members of the freshman class taking general biology. The students in the sections under study met the classed and the laboratories the same number of times per week. The classes met for one hour, two days per week; and the laboratories met for two hours, one day per week for three quarters of school work.

In each of the following methods of studying these problems the students studied the same materials, and all sections were kept as close together as possible with no section being more than one period ahead of another section at any time during the school year. All of the students were given the same set of directions, and the procedure for each section was the same as far as possible, except for the differences which are mentioned in the discussion of each problem which follows.

A different method was used each quarter in studying the problems of laboratory drawings and the arrangement of the lecture

and laboratory periods. The same groups of students were used in each quarter of study, for each problem.

During the fall quarter of the 1957-58 school term a group of about 30 students were used in this study. During this quarter the students were given lecture immediately followed by laboratory on the same material taken up in the lecture period. This method will be referred to as the Lecture-Laboratory Method.

In the winter quarter the procedure was reversed and the laboratory preceded the lecture. In the laboratory the students were concerned with the materials which were to be discussed in the lacture which immediately followed the laboratory. This method will be referred to as the Laboratory-Lecture Method.

During the spring quarter the lecture and laboratory were combined into one period. Explanations were made and questions were answered. Brief directions were also given, as necessary, throughout the period for dissection and study. This method will be referred to as the Combined Lecture-Laboratory Method.

Another group of students were used in studying this problem. This group could be called the "Control Group". The teaching method used with this group was the same throughout the year. The lecture and laboratory arrangement varied slightly, but was about the average method used in teaching biology. This group also made their own drawings.

A questionnaire or checklist was given the students in order to obtain their opinion as to which method of teaching biology they preferred.[1]

II. THE PROBLEM OF LABORATORY DRAWINGS

Drawings have been a problem in the teaching of biology for many years. This problem was studied for three quarters of school work, during the school term 1957-58, at Appalachian State Teachers College.

In this study a group of 27 students were used. During the fall quarter these students were required to make detailed and labelled drawings from the observations made in the laboratory of the specimens given them for study. During the winter quarter the students were not required to make drawings to be graded by the instructor. The students were allowed to make sketches from their observations of the materials they were studying if they wished to do so. During the spring quarter the students were given prepared drawings of the materials to be studied and observed in the laboratory.[2] The students were required to label the parts indicated on the drawings and to return them to the instructor to be corrected for mistakes in their labelling. Later the drawings were returned

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[1]See Appendix A page 54.

[2]See Appendix B pages 47-53.

to the students for study in preparation for the final test on the materials which had been studied for the entire quarter.

A test was given the students at the end of each quarter for comparison of the progress made by the students. A checklist was also given the students at the end of the school year asking them for their opinion as to which method they liked best and under which method they felt that they learned more biology.[3]

III. PROBLEM OF THE FIELD TRIP

The procedure for the field trip made in connection with this study was as follows: The trip was planned, and the writer visited the area to which the trip would later be made in order to better plan and understand the area to be covered by the students on the actual trip. The most important stations or points of interest were found and noted by a plaque or card. These plaques gave short comments about the object being studied. The instructor made additional comments when necessary. The trip also allowed for points of interest noticed by the students or the instructor to be discussed as the trip proceded. Some student was appointed to gather the plaques (Fig. 1 page 18) when the group had passed to the next point of interest to be discussed. The students enjoyed collecting things to take back to their room.

An evaluation of the trip was made in the form of a short

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[3]See Appendix A page 55.

summary by each student and also by answering some general questions about the specimens observed. A checklist was also used to obtain the opinion of the students of the field trip, as to the likes and dislikes of the method, and to what extent they learned new facts from having made the trip.[4]

Fig. 1, A Picture of a Plaque Used on the Field Trip.

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[4]See Appendix A page 56.

CHAPTER IV

I. RESULTS OF THE STUDY MADE ON THE LECTURE-LABORATORY ARRANGEMENT

In order to obtain results of the study concerning lecture-laboratory arrangement, a checklist was given each student. This section of students may be referred to as Section "C." These students had lecture before laboratory during the fall quarter. In the winter quarter they had laboratory before lecture. During the spring quarter these students had lecture and laboratory combined into one period.

A checklist was given each student on which he was asked to check the answers he felt were correct in his own individual case. The results for Section "C" were: Three students checked that they liked the laboratory before lecture, twelve checked that they liked the lecture before laboratory, and twelve checked they liked the lecture and laboratory combined into one period.

These students were also asked to check the method in which they felt they learned more biology. Five students checked laboratory before lecture, and eight checked laboratory and lecture combined, while twelve checked lecture before laboratory. Two of the students did not answer this question.

The question was asked: When studying the same topic in laboratory or in the field, in which method did you learn more

TABLE I

RESULTS OF STUDY OF SECTION "C"

Method Liked Best:

Lecture Before Laboratory	12
Laboratory Before Lecture	3
Lecture and Laboratory Combined	12

Method Learned More in:

Lecture Before Laboratory	12
Laboratory Before Lecture	5
Lecture and Laboratory Combined	8
Liked use of Field Trip	26

Learned More About Same Topic in:

Laboratory	7
Field Trip	16

View Points and Concepts Best Learned in:

Lecture Before Laboratory	10
Laboratory Before Lecture	5
Lecture and Laboratory Combined	7
Field Trip	4

about the same topic? Seven students checked the laboratory, and sixteen checked the field trip, and four did not answer this question.

In order to get some idea as to the progress that the students had made in understanding the scientific method, they were asked if they better understood the method after a year of study. Twenty-five checked that they better understood the scientific method after their study of biology.

These students were also asked which method better helped them to get view points and concepts about biology in general. Ten students checked lecture before laboratory, five checked laboratory before lecture, and seven checked lecture and laboratory combined, four checked the field trip.

Here again the above answers may have been influenced by the likes and dislikes for a certain topic studied during a particular quarter. They were asked to give the topic they liked best. Seven students gave the frog, four gave frog and man compared, three gave the earthworm, and two each the one cell animals and man, while one each gave the grasshopper, animals in general, and frog and earthworm, heredity, cell division, and the crayfish and frog.

On the same checklist the students were asked to give the topic they believed they learned most about in biology. Eight students gave the frog, five gave frog and man compared, three gave worms in general, and one each gave the following: animals in general,

TABLE II

TOPICS MOST LIKED IN BIOLOGY

SECTION "C"

Grasshopper	1
Earthworm	3
Animals	1
Frog	7
Frog and Man	4
One Cell Animals	2
Man	2
Frog and Earthworm	1
Heredity	1
Cell Division	1
Crayfish and Frog	1

man, grasshopper, crayfish, one cell animals, heredity and classification. (See TABLES II and III).

The preceding data was obtained from the study using Section "C." A copy of the checklist may be found in the appendix.

TABLE III

TOPICS LEARNED MOST ABOUT IN BIOLOGY

SECTION "C"

Frog	8
Worms	3
Animals	1
Frog and Man	5
Man	1
Grasshopper	1
Crayfish	1
One Cell Animals	1
Heredity	1
Classification	1

II. RESULTS OF A STUDY MADE ON THE PROBLEMS OF LABORATORY DRAWINGS

A checklist was given each student at the end of the spring quarter. This group of students are referred to as Section "B". On this checklist eight students checked that they preferred to make detail drawings that were to be labelled. No student checked that he liked the method used during the winter quarter in which no drawings were required. Twenty-four checked that they preferred the method used during the spring term in which they were given prepared drawings to be labelled.

On this same checklist, Section "B" students were asked to check the method under which they felt they learned more biology. Nine students checked that they learned more biology by making and labelling their own drawings. Twenty-one students indicated that they learned more by using the method in which they labelled prepared drawings. Here again no student indicated that he learned more during the winter when no drawings were required.

The average final grade for the class for each quarter was: Fall quarter 76.7, Winter quarter 86.4, Spring quarter 79.0. These grades seem to indicate that the students learned more biology during the winter quarter in which no drawings were required. However, the spring quarter grades were better than the grades of the fall quarter. The differences in these grades could be due to several things, such as: More adjusted in the winter quarter than during

TABLE IV

RESULTS OF STUDY OF SECTION "B"

Method Most Liked:

Making Drawings and Labelling	10
No Drawings Made	0
Use of Prepared Drawings	24

Method Learned More in:

Making Drawings and Labelling	9
No Drawings Made	0
Use of Prepared Drawings	21

Learned More About Same Topic in:

Laboratory	8
Field Trip	24

Scientific Method Best Understood in:

Making and Labelling Drawings	13
No Drawings Made	3
Use of Prepared Drawings	12

View Points and Concepts Best Learned in:

Making and Labelling Drawings	8
No Drawings Made	2
Use of Prepared Drawings	3
Field Trip	5
Combination of Methods	14

the fall quarter, lack of interest during the spring quarter, dislike for a particular subject during one quarter, etc.

The question was asked if they learned more about a topic when studied in one method than another method. Twenty-four students checked that they lerned more about the same topic when studied on a field trip than in the laboratory. Eight students checked that they learned more about the same topic in laboratory than on a field trip.

The writer wished to obtain an idea as to which method helped these students to better understand the scientific method. They were asked to check the method they felt helped them to better understand this method. Thirteen students checked that by making drawings they better understood the scientific method. Three students indicated that no drawings being required helped them to better understand this method. Twelve students indicated that by the use of prepared drawings they better understood the scientific method. Three students indicated that by using a combination of all three methods they were able to better understand the scientific method. One student did not check either of the methods.

In order to obtain some idea as to which method best helped students to get view points and concepts of biology they were asked to check the method they felt helped them most. Eight students checked that by making drawings helped them, two indicated that the use of no drawings was better for them, three students checked that

the use of prepared drawings helped them to obtain wiew points and concepts. Five checked the use of the field trip was a better method for them, while fourteen checked that a combination of the above methods was better for them in obtaining view points and concepts of biology.

The results given above, for Section "B", may have been influenced by the likes and dislikes of the students as to the subject being studied during a particular quarter. The students were asked to give the topic or subject they liked best. Eleven students gave that they liked the study of the human body, seven indicated that they liked the study of frog and man compared, whild five indicated that they liked the study of heredity. Other less popular topics were given by one to three students. (For these topics see TABLE V)

The students were also asked to indicate the topic or subject that they felt they learned more about. Five gave the frog and man compared, five gave the study of heredity, four gave the round and flat worms, four gave the human body, three gave that they learned more about classification of organisms. Here again other less popular topics were given by one or two students. (For these topics see TABLE VI)

TABLE V

TOPICS MOST LIKED IN BIOLOGY

SECTION "B"

Human Body	11
Reproduction	1
One Cell Animals	3
Classification	1
Earthworm	3
Frog and Man	7
Pine Trees	1
Round Worms	1
Heredity	5
Grasshopper	1

TABLE VI

TOPICS LEARNED MOST ABOUT IN BIOLOGY

SECTION "B"

Frog and Man	5
Heredity	5
Worms	4
Human Body	4
Classification	3
Animals	2
Frog	2
One Cell Animals	1
Plants	1
Arthropods	1
Grasshopper	1

III. RESULTS OF STUDY MADE ON THE FIELD TRIP AS A TEACHING METHOD

A checklist on the field trip was given to 214 students of the biology department. These students were asked to check the answers according to their beliefs and feelings.

These students were asked the question: Five years from now will you remember the laboratory period taken in the field better than, less than, or equally as well as the other laboratory periods you had in this biology course? Five students checked that they would remember the field trip less than the other laboratory periods. One hundred-fifty-one students checked that they would remember the field trip better than the other laboratory periods. Fifty-six students checked that they would remember the field trip equally as well as the other laboratory periods they had had in the course.

The next question asked on this checklist was: Do you better understand the differences in good land use and poor land use after this trip? To this question 198 students answered "yes". Only 7 students answered "no" to this question. There were 10 students who did not answer this question.

The third question on the checklist was: Did you better understand the meaning of the conservation of water after this trip? To this question 159 students answered "yes", while 49 students answered "no" to the question.

The next question asked was: Does the expression "farming the forest" mean more to you now? To this question 190 students answered "yes", and 17 answered "no" to the question.

To the question: Were you aware of the variety of plant life before this trip? This question was answered as "yes" by 125 students and "no" by 84 students.

The question was asked concerning the effect of the trip on planning of their future vocation or avocation. Fifty-six students answered that the trip did have a value in the planning of a vocation or an avocation, while 153 answered that the trip did not have any value for them in planning their future vocation or avocation.

The students were asked if they better understood the meaning of plant succession and plants involved after the trip. To this question 179 students answered "yes", and 29 answered "no" to the question.

The next question asked the students was: Does the term "wildlife habitats" mean more to you after the trip? To this question 182 students answered "yes", and 30 students answered "no" to the question.

The students were asked if they thought that the use of the field trip as a method of teaching biology had a place in future education. To this question 213 students answered "yes", and only one student answered "no" to this question.

The next question was concerned with the fact that the public

is becoming more "outdoor education" minded. The students were asked if they thought that this would bring about a better understanding of plant and animal life of the out-of-doors. Only one student answered "no", while 212 students answered "yes" to this question. One student did not answer this question.

The students were asked if they better understood the statement: Nature will do an excellent job, with just a little help from man. Only five students answered "no" to this question, while 207 answered "yes" to the question.

The students were also asked if they saw any relationship between the use of the land and the low standard of living in North Carolina. Thirty students answered "no", while 167 answered "yes" to this question.

The last question on the checklist was: In this area did you see any need for better pest control (blights, fungus, insects and undersirable seed plants) at our national borders? To this question 152 students answered "yes", and 49 of the students answered "no" to the question.

For a condensed view of the results of this study see, FIELD TRIP CHECKLIST RESULTS, page 34.

FIELD TRIP CHECKLIST RESULTS

1. Five years from now will you remember this laboratory period: Less than 5 , Better than 151 , Equally as well as 56 the other laboratories you had in this biology course?

2. Did you better understand the differences in good land use and poor land use? Yes 198 , No 7

3. Did you better understand the meaning of the conservation of water after this trip? Yes 159, No 41

4. Does the expression "farming the forest" mean more to you now? Yes 190 , No 17

5. Were you aware of the variety of plant life, befor this trip? Yes 125 , No 84

6. Did the trip have any value for you in planning your future vocation or avocation? Yes 56 , No 153

7. Do you better understand plant succession and the types of plants involved? Yes 179 , No 29

8. Does the term "wildlife habitats" mean more to you? Yes 182 No 30

9. Do you feel that this type of teaching biology has a place in future education? Yes 213 , No 1

10. The public is becoming more "outdoor education" minded. Do you feel that this will bring about a better understanding of plant and animal life of the out-of-doors? Yes 212 , No 1

11. Do you better understand the statement: Nature will do an excellent job, with just a little help from man? Yes 207 No 5

12. Did you see any relationship between the land use and the low standard of living in North Carolina? Yes 167 , No 30

13. In this area did you see any need for better pest control (blights, fungus, insects and undersirable seed plants) at our national borders? Yes 152 , No 49

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

The methods used in making this study were varied. The problem of lecture and laboratoy arrangement was studied by using three different methods. During the fall quarter the students of Section "C" had lacture before laboratory. Forty-four pre cent of the students checked that they liked this method best. During the winter quarter the same students had laboratory before lecture. Forty-four pre cent of the students checked that they liked this method best. Then in the spring quarter the students had the lecture and laboratory combined into one period. Twelve pre cent of the students checked that they liked this method better than either of the other two methods used.

The average grade for Section "C" during the fall quarter was 69.0. For the laboratory portion of the course these students had an average grade of 70.2 and for the lecture portion of the course these students had an average grade of 69.2.

When the students were asked to check the method which they felt they learned more biology, five checked laboratory before lecture. Eight checked laboratory and lecture combined, while 12 checked lecture before laboratory.

During the winter quarter the average grade for the class

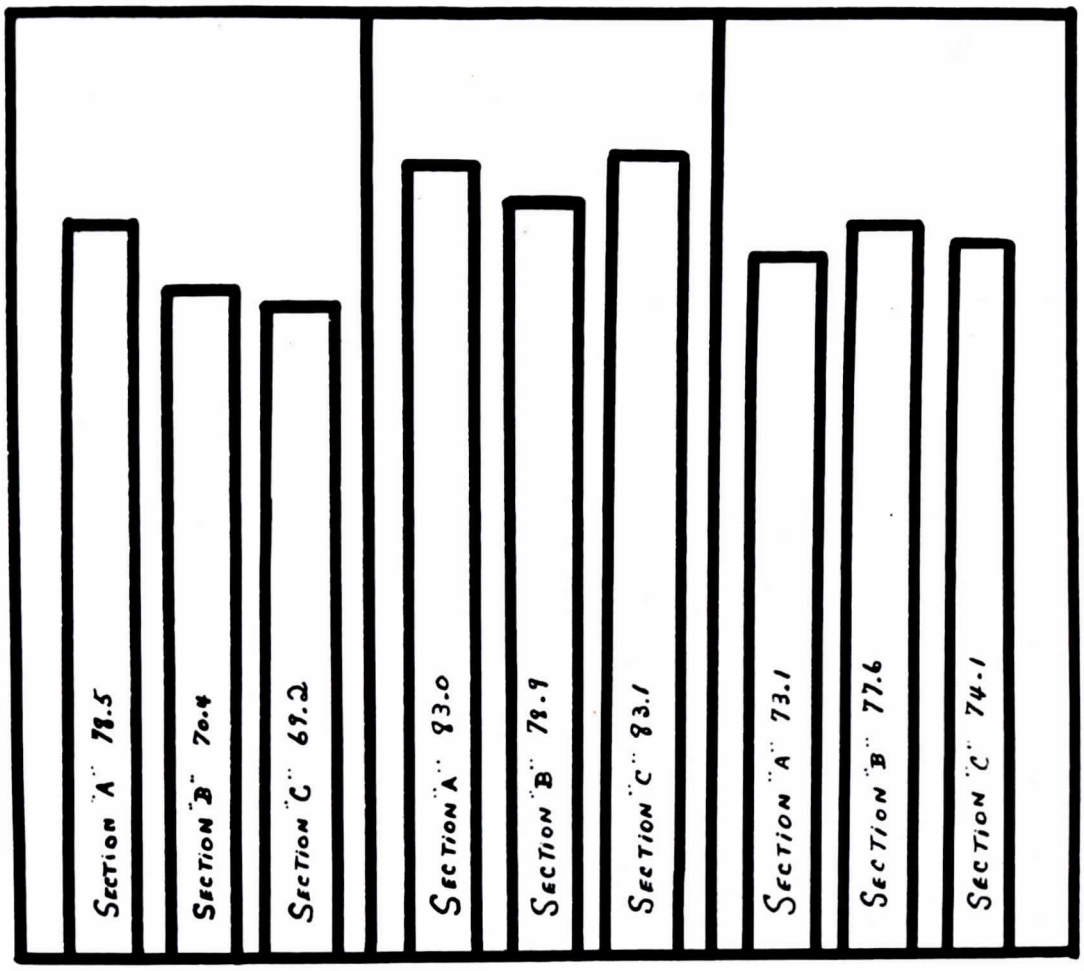
was 81.1. In this quarter Section "C" had laboratory before lecture. In the laboratory portion of the course for this quarter these students had an average grade of 79.2, and for the lecture portion of the course an average grade of 83.1.

The average grade for the combined lecture and laboratory periods during the spring quarter was 75.7. Laboratory portion of the course was 77.3 and lecture portion was 74.1. As can be seen from the preceding data the two methods liked best by the students show by average grades the students did best during the winter quarter with an average of 79.1. The second equally liked method showed an average grade of 69.7 against the least liked method of the spring quarter with an average grade of 75.7 for the quarter.

Section "A" are the students which were being used as a "control" for the study. This group was taught by the same method throughout the year. The average grade for this group for the fall quarter was 69.0, the laboratory portion average was 68.8, and the lecture portion of the course average was 78.5. Section "A" had a better average on the lecture than Section "C" for the fall quarter. During the winter quarter Section "A" had a final average grade of 79.0, with a final lecture grade of 83.0, and a final laboratory grade of 83.0. There was a difference of .9 points in the grade of Section "A" compared with Section "C" for the winter quarter. In the spring quarter Section "A" had a final average of 75.0 and

COMPARISON OF LECTURE GRADES

BY SECTIONS



FALL QUARTER WINTER QUARTER SPRING QUARTER

Section "C" 75.9. This made a difference of .9 points in favor of Section "C". The final laboratory grade for Section "A" was 75.8 compared with 77.3 for Section "C", a difference of 2.5 points. The final lecture grade for Section "A" was 73.1 and Section "C" 74.1 a difference of 1 point. (For a comparison of these grades see figure 2.)

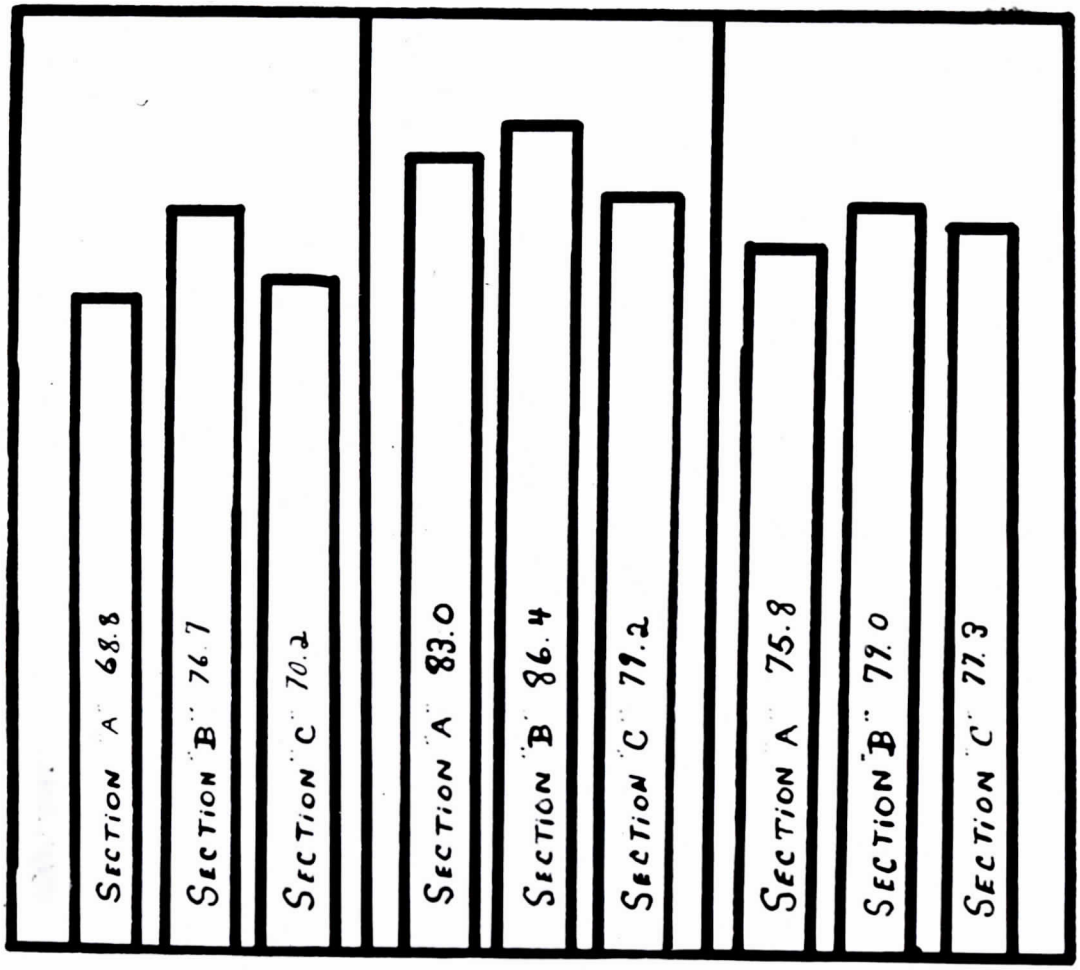
The final average for the year for Section "A" was 74.3 compared with the final for the year of Section "C" which was 74.9, a difference of .6 points.

The results of Section "B" have been compared with Section "A", the control section. Section "B" was concerned with the problem of making or not making laboratory drawings. Section "A" made drawings throughout the year. The results for Section "B" during the fall quarter in which the group made their own drawings was 76.4, compared with 69.0 for Section "A" the control section. The final laboratory grade for Section "B" in the fall quarter was 76.7, compared with 68.8 for Section "A". The final lecture grade for Section "B" was 70.4, compared with 78.5 for Section "A". Here Section "B" scored 8.1 points less than Section "A" for the fall quarter.

During the winter quarter Section "B" made no drawings. Their final grade for this quarter was 83.8, compared with Section "A" which had a final for the quarter of 79.0, a difference of 4.8 points. The final laboratory grade of Section "B" during the

COMPARISON OF LABORATORY GRADES

BY SECTIONS



FALL QUARTER WINTER QUARTER SPRING QUARTER

winter quarter was 86.4, compared with 83.0 for Section "A", a difference of 3.4 points in favor of Section "B". The final lecture grade for Section "B" during the winter quarter was 78.9, compared with 83.0 for Section "A", a difference of 4.1 points in favor of Section "A". For the whole quarter of work the average grade for Section "B" was 83.8, compared with 79.0 for Section "A", a difference of 4.8 points for the quarter. (For a comparison of these grades see figure 3)

During the spring quarter Section "B" labelled prepared drawings and was not required to make drawings. The average grade for Section "B" for the spring quarter was 82.7, compared with 75.0 for Section "A". The final laboratory grade for Section "B" for the spring quarter was 79.0, compared with 75.8 for Section "A", a difference of 3.2 points. The final lecture grade for Section "B" for the spring quarter was 77.6, compared with 73.1 for Section "A", a difference of 4.5 points for the quarter.

The final grade for the year for Section "B" was 80.9, compared with 74.3 for Section "A", a difference of 6 points. (For a comparison of these grades see figure 4)

A comparison will now be made between the final grades for the three sections of students involved in this study. These grades will be the final averages for the complete year's work. Section "A" had an average of 74.3, Section "B" 80.9, and Section "C" an average of 74.9 for the year.

COMPARISON OF FINAL GRADES

BY SECTIONS

FALL QUARTER WINTER QUARTER SPRING QUARTER

II. CONCLUSIONS

The conclusions of this study are drawn from the combined results of the sections concerned in each study. The method of instruction which was liked best by most students was the method in which the material to be studied in the laboratory was discussed in detail in a class period before the material was to be studied in the laboratory. This method has been referred to in this study as the Lecture-Laboratory Method. However, the better grades were not made under the use of the above method but were made during the winter quarter under the use of the Laboratory-Lecture Method, the reverse of the Lecture-Laboratory Method.

The students checked that they felt they learned more biology under the Lecture-Laboratory Method, but as can be seen from the preceding SUMMARY the better grades were made during the use of the Laboratory-Lecture Method.

The next most liked method of instruction was the combining of the lecture and laboratory into one period. This method was used in the spring quarter. The grades of Section "C", the group involved in the use of this method, made better grades under this method than the same section did during the fall quarter and the use of the Lecture-Laboratory Method. However, the grades of Section "C" for the spring quarter were not as good as for the Laboratory-Lecture Method during the winter quarter. This method, lecture and laboratory combined was listed as second highest according to the checklist, in the opinions of the students as to the method in which

they believed they learned more biology. According to their final grades this was not true in their case.

The results of the next method under study was concerned with laboratory drawings. Seventy-five per cent of the students of Section "B" liked the use of prepared drawings. Sixty-five pre cent of the students indicated on the checklist that they felt that they learned more biology under this method. The final grade of this group for the quarter was 82.7, as compared to 83.8 for the quarter in which no drawings were made, and 76.4 for the quarter in which drawings were made. These grades then show that the students learned more during the winter quarter when they were not required to make drawings, but the grades also show that the students learned more by the use of prepared drawings than by making the time comsuming drawings as was done in the fall quarter.

The writer will attempt to give a brief summary as to what might be a suitable method of teaching biology, according to the opinions of the writer and based on the results from this study.

Perhaps the best arrangement for teaching freshman biology would be by the use of a lecture period in which a subject was discussed and then the students were allowed to study the same material in detail in what might be called a laboratory period. The use of prepared drawings to be labelled by the students would be better than having the students make their own drawings. Also the use of the field trip when and if possible in connection with materials being studied would be very helpful for the students.

From this study the writer has formed the opinion that the students get more from having studied plant and animal life in its natural environment, if possible. As can be seen from the field trip checklist results the students became aware of much that could not be taught as easily in a classroom and a laboratory, as it could out-of-doors. From the use of the field trip the students could learn more practical biology. By using this procedure in teaching freshman biology more material could be covered in less time. It would seem that where problems of schedule, transportation, location, etc. are not too great, the field trip has a definite place in teaching of biology.

Evidence indicates that there probably is no one best method of teaching biology for all students.

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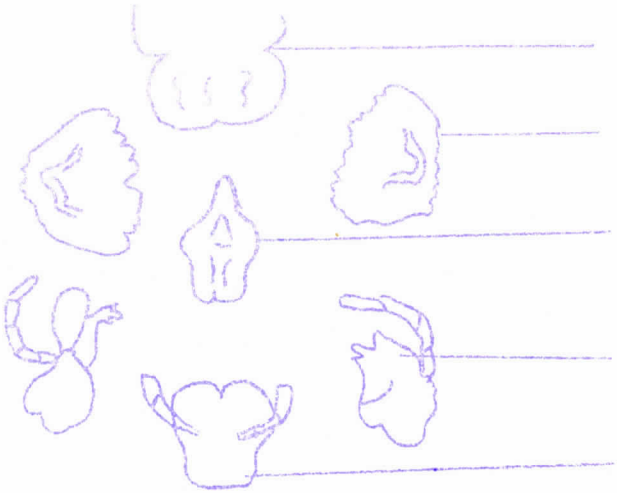
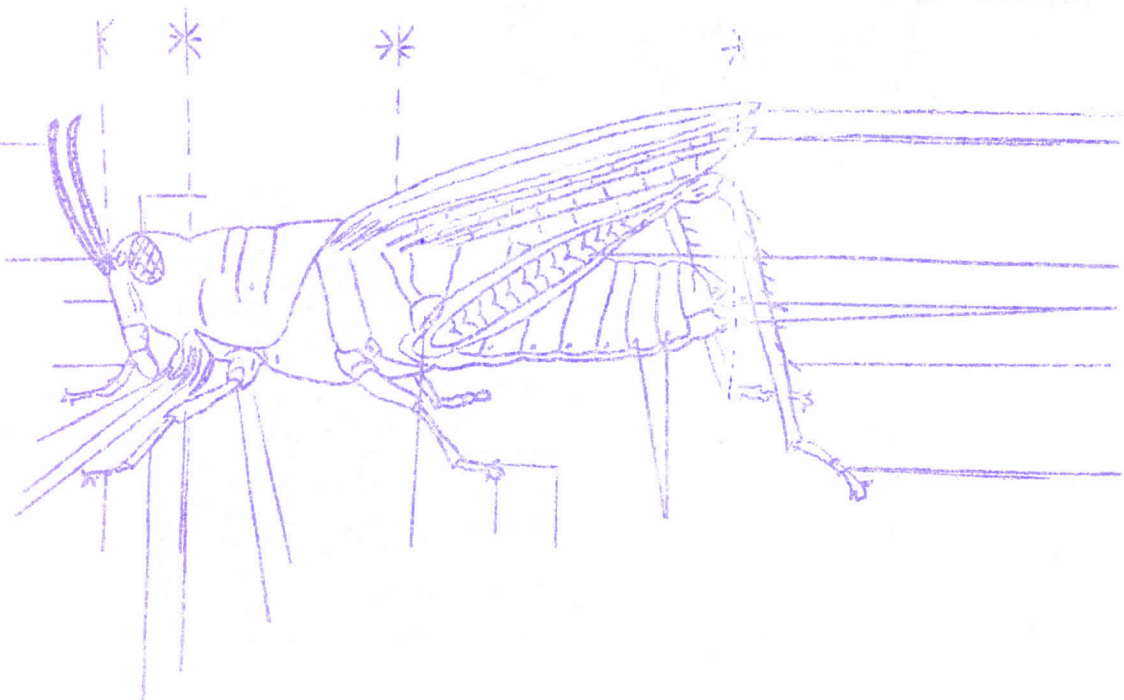
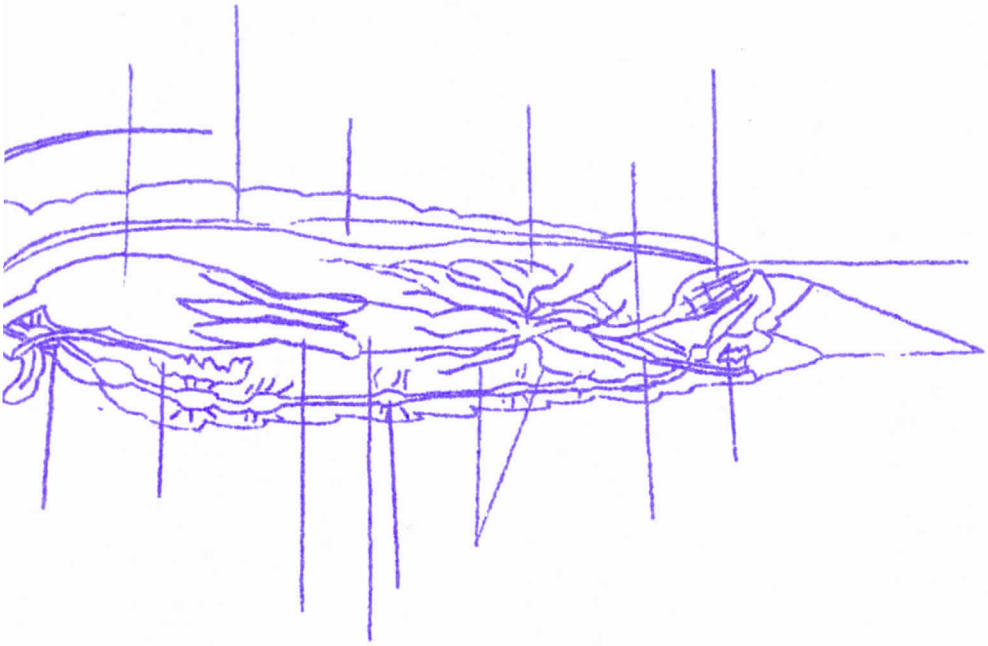
APPENDIX

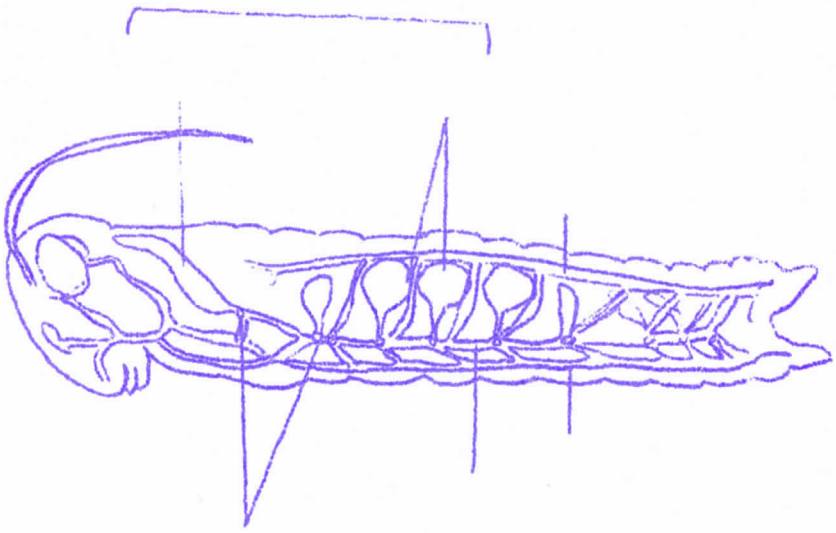




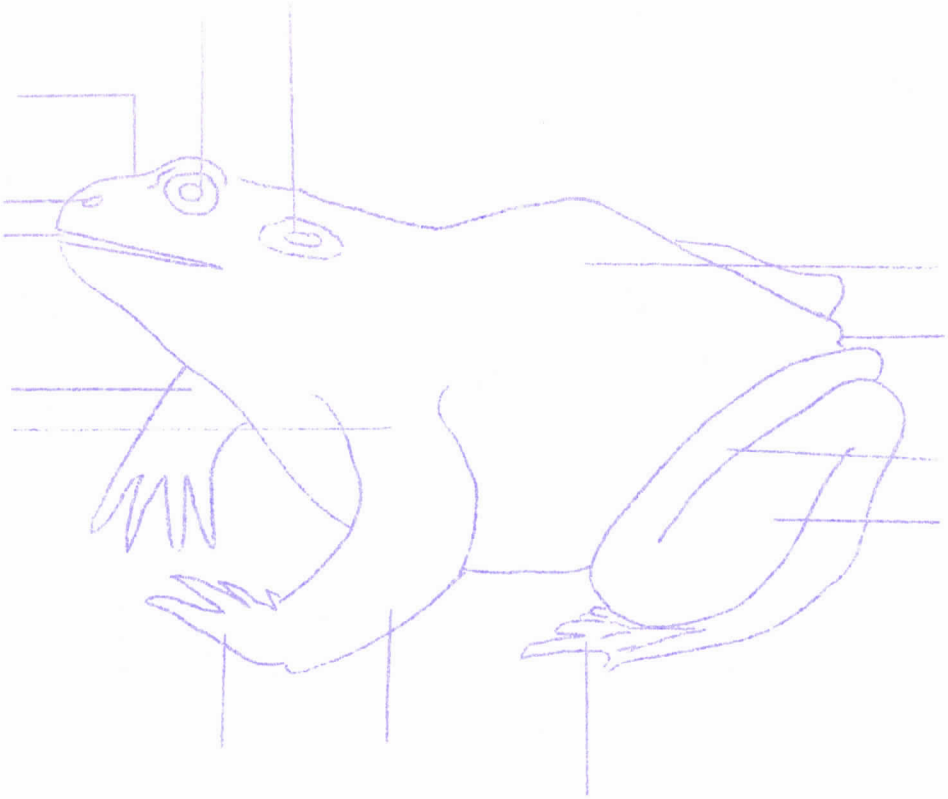
GRASSHOPPER



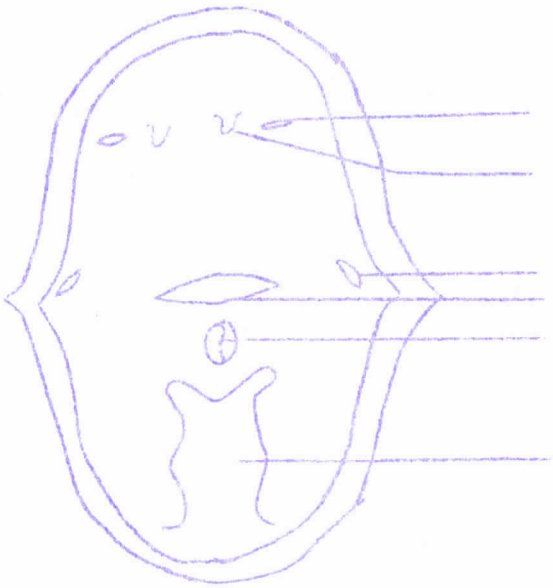
INTERNAL ANATOMY OF THE GRASSHOPPER



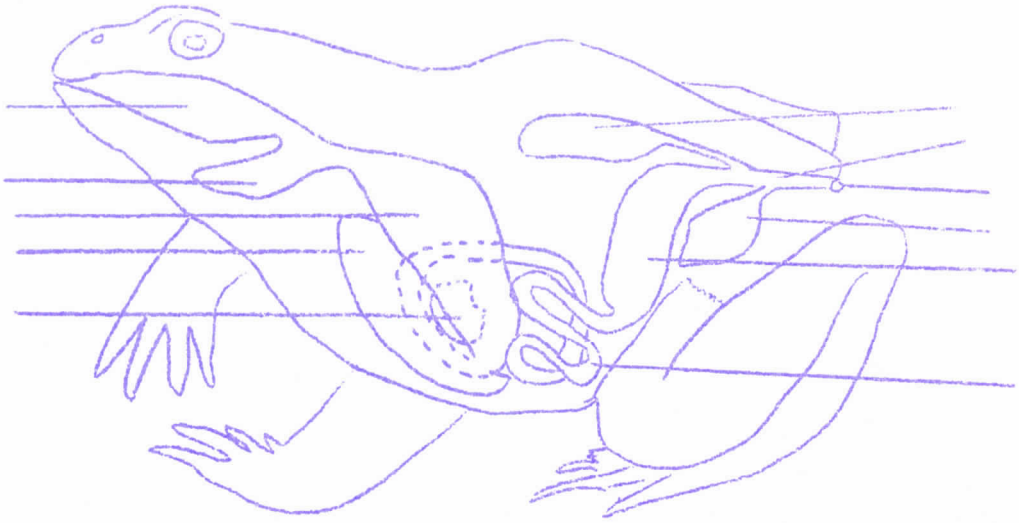
RESPIRATORY SYSTEM OF THE GRASSHOPPER



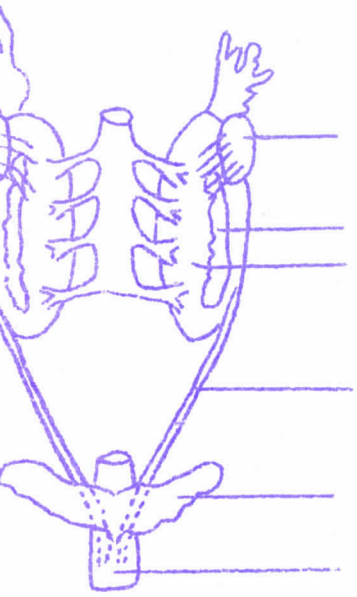
External Anatomy of the Frog



Oral Cavity of the Frog



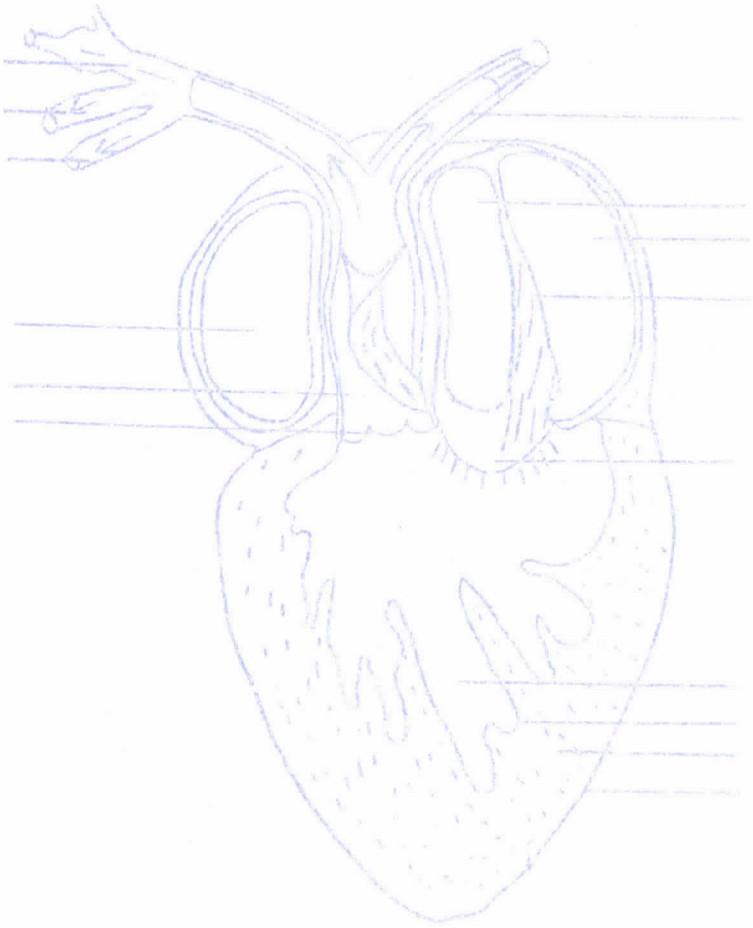
Digestive System of the Frog



urogenital system

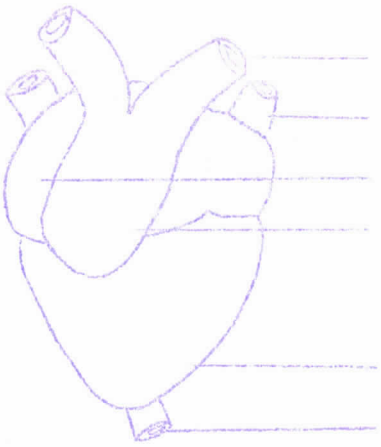
Female urogenital system

LABEL ALL PARTS INDICATED



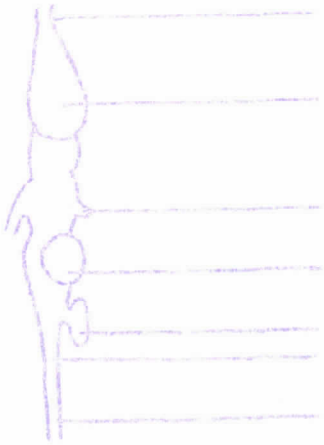
A DISSECTION OF THE HEART OF THE FROG FROM THE VENTRAL SIDE

HEART OF THE BULLFROG

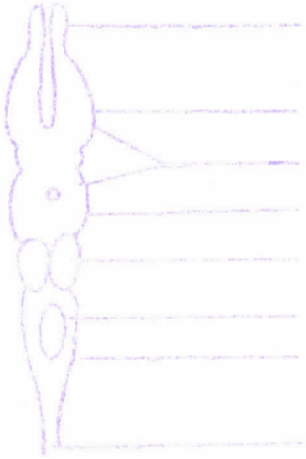


DORSAL VIEW

EXTERNAL VENTRAL VIEW



LATERAL VIEW



DORSAL VIEW

VENTRAL VIEW

CHECKLIST FOR SECTION "C"

1. During the fall quarter you had biology lecture which was followed by the laboratory on the same material discussed in the lecture period.

2. During the winter quarter you had laboratory on the same materials which were discussed in the lecture period which immediately followed the laboratory period.

3. During the spring quarter the lecture and laboratory were combined into one period. In other words the materials were discussed as they were studied in the laboratory.

Please check the method you liked best as far as the arrangement was concerned: _____lecture before lab; _____laboratory before lecture; _____laboratory and lecture combined.

Please check the method in which you feel that you learned more biology: _____lecture before laboratory; _____laboratory before lecture; _____laboratory and lecture combined.

4. The field trip was used to some degree during the later part of the spring quarter. On these trips studies and observation of plant and animal life were made. Do you like the field trip better than indoor laboratory exercises? Yes_____ No_____

5. Do you feel you learned more, about the same topic on the field trip or in the laboratory? Field trip_____ Laboratory_____

6. After studying biology for three quarters do you feel that you better understand the scientific method of study? (This method was used when possible in the laboratory exercises) Yes_____ No_____

7. What topic studied in biology did you most enjoy?

8. What topic do you feel that you learned more about in your study of biology?

9. Which method do you feel helped you to better understand the concepts and view points of biology? Laboratory before lecture _____; Lecture before laboratory_____; Laboratory and lecture combined_____; Field trip_____

CHECKLIST FOR SECTION "B"

1. During the fall quarter you were required to make detailed drawings, which were to be labelled, of the specimens studied.

2. During the winter quarter you were not required to make any drawings of the specimens studied, but were allowed to do so if you wished.

3. During the spring quarter you were given prepared drawings which you were to label the parts indicated.

Please check the method you liked best: Drawings_____; No drawings _____; Prepared drawings_____

Please check the method under which you think you learned more biology: Drawings_____; No drawings_____; Prepared drawings_____.

4. Do you like the use of field trips in studying biology? Yes____ No_____

5. When the same materials or topics were studied in the laboratory and in the field: Which do you think helped you to learn more about the topic, _____laboratory, or _____field trip?

6. Do you feel that the field trip should be used, when possible, in the study of biology? Yes_____ No_____

7. What topics do you like best in you study of biology?

8. Which topic did you learn more about in your study of biology?

9. Which method do you feel helped you to better understand the scientific method of study? Drawings_____, No drawings_____, Prepared drawings_____,

10. Which method do you feel helped you to better understand the concepts and view points of biology? Drawings_____, No drawings_____, Prepared drawings_____, Field trip_____, A combination of all methods_____.

FIELD TRIP CHECKLIST

1. What one thing do you remember most as a result of this trip?

2. Five years from now will you remember this lab period: Less than_____, Better than_____, Equally as well as_____ the other labs you had in this biology course?

3. Did you better understand the differences in good land use and poor land use? Yes_____ No_____

4. Did you better understand the meaning of the conservation of water after this trip? Yes_____ No_____

5. Does the expression "farming the forest" mean more to you now? Yes_____ No_____

6. What evidence did you see of soil erosion being checked?

7. Were you aware of the variety of plant life, before this trip? Yes_____ No_____

8. Did the trip have any value for you in planning your future vocation or avocation? Yes_____ No_____

9. Do you better understand plant succession and the types of plants involved? Yes_____ No_____

10. Does the term "wildlife habitats" mean more to you? Yes_____ No_____

11. Do you feel that this type of teaching biology has a place in future education? Yes_____ No_____

12. The public is becoming more "outdoor education"minded. Do you feel that this will bring about a better understanding of plant and animal life of the out-of-doors? Yes_____ No_____

13. Do you better understand the statement: Nature will do an excellent job, with just a little help from man? Yes_____ No_____

14. Did you see any relationship between this land use and the low standard of living in North Carolina? Yes_____ No_____

15. In this area did you see any need for better pest control (blights, fungus, insects and undersirable seed plants) at our national borders? Yes_____ No_____