



# **FOR GENERAL INVERTEBRATE ZOOLOGY**

TYLER A. WOOLLEY

# **A Laboratory Manual for GENERAL INVERTEBRATE ZOOLOGY**

by

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by

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Revised Edition 1956

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Lab. Section \_\_\_\_\_ Seat No. \_\_\_\_\_



**BURGESS PUBLISHING CO.**

**Minneapolis 15 - Minnesota**

## PREFACE

Many times a manual is the outgrowth of a particular system of teaching, or the result of a particular course in a specific institution. The systems and approaches to teaching vary with schools and with individuals, and it is doubtful if the "best" method has yet been devised.

There are several types of zoology laboratory manuals. Some are general; others are specific. Many are profusely illustrated; some contain merely descriptions or instructions to be followed. Some exhibit detailed drawings of the work to be done by the student. A few are arranged to include outline drawings or a general format without details.

In some manuals the material to be studied is drawn in detail and reproduced on a page adjacent to the drawing plate. In such instances there are always those students who take advantage of the arrangement and attempt to do the work without observing the specimens. One need only compare the student drawing with the printed illustration to see the duplication involved. Furthermore, the student's inadequate knowledge of the specimen is usually demonstrated in any type of practical examination. One cannot supervise students constantly, nor is such an attitude conducive to adequate laboratory work. In effect, however, profuse illustration in a laboratory manual negates much of the work which any instructor attempts to accomplish in his classes.

Some students are distressed when confronted with the simple mechanics of arranging a drawing plate. In addition to the general format, the relative proportion of the drawings is a problem. If this general difficulty can be overcome and an adequate description of the work to be accomplished can be provided, the instructor is relieved of much of the initial difficulties in the laboratory.

This manual is an attempt to accomplish several of these things. First, it is an attempt to provide a general format for the drawings which are submitted by the students. The students must make the drawings in a particular place, which determines the size, and to some extent, the proportion of the drawing. In some instances the outline of an animal is provided. The student must add the detail as he observes the specimen. He must also use a regular format for the heading, numbering of plates and labelling of the drawings.

Some manuals follow the "type plan" of animal presentation. The approach of the present manual is modified to include other representatives of phyla in a more extensive sampling of the animals. Because of this second feature it is hoped that the student will retain a better understanding of the relationships within and between major groups.

Elaborate drawings are eliminated as a third approach. The detailed instruction within each exercise is assumed to be sufficient for the student to find the described parts in the specimen.

Lastly, the various sections and exercises of the manual have sets of questions concerning the material discussed in both lecture and laboratory. An attempt has been made to arrange the questions in such a way that they will indicate the extent of the information which should be learned by the student.

The arrangement of classification in this manual has been adapted from Brown, SELECTED INVERTEBRATE TYPES, Chandler, INTRODUCTION TO PARASITOLOGY, Hyman, THE INVERTEBRATES, and Storer, GENERAL ZOOLOGY. Other references included Buchsbaum, ANIMALS WITHOUT BACKBONES and Parker and Haswell, A TEXTBOOK OF ZOOLOGY.

The key to the animals which is used in this manual is a modification of one used in the department for several years. Changes have been made over this period to clarify the couplets and to facilitate student use of the key. As it is arranged the key is by no means inclusive of all invertebrates, but is designed to identify general demonstration animals used in the key exercise.

## ACKNOWLEDGEMENTS

The writer here expresses his thanks to several colleagues for aid in the preparation of this manual. He is grateful to Dr. O. Wilford Olsen, Head of the Department of Zoology, Colorado A and M College, for his encouragement of the work. Thanks are also extended to Dr. John R. Olive, of the same department, for his help in editing the manuscript, and to Dr. J. Frank Cassel, Department of Zoology, North Dakota Agricultural College for his criticisms of the initial phases of the work.

November 1952

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## INTRODUCTION

Zoology is an extensive study. There are so many phases of the science that students and investigators are becoming more and more specialized in its pursuit. There is such an extensive amount of material that each worker seems required to limit his activities to a particular phase of the subject. Indeed, many workers find it almost impossible to complete an intensive study of one small phase, one or two species, or a single section within the picture of the whole. The fields of genetics, entomology, histology and endocrinology are but a few examples of these specialized pursuits, and yet each offers the challenge of a lifetime of investigation within it.

In the study of general zoology one usually investigates two main groups of animals, viz., the Invertebrates and the Vertebrates. This manual is an attempt to aid the student of the former group. Through its use it is hoped that the student may be able to gain an elementary background in certain principles of zoology, that he will become acquainted with certain major examples of "animals without backbones", that he will be conversant with the structure and general classification of these representative forms, and, finally, that he will gain a deeper appreciation of the animal life about him.

In such a study of general zoology a student would have difficulty visualizing anatomical features of animals by merely looking at pictures or by reading verbal descriptions. A printed picture or a photograph exhibits a certain amount of detail, but the study of an actual specimen demonstrates anatomy with a clarity not available in the printed page. Laboratory work is instituted to serve this need.

Word characterizations and illustrations of the text help the student a great deal, but the laboratory work provides several additional aids. First, the laboratory exercises help the student correlate lectures and text materials with the actual specimens. Secondly, the student gains experience and self-confidence in accomplishing the dissections and drawings as well as other work performed in the laboratory. Thirdly, the laboratory will afford an opportunity for the student to observe for himself some of the facts of nature upon which conclusions in the zoological science are based.

Insofar as possible lectures will precede the laboratory exercises in order that the student may have some idea of the subject before beginning the laboratory work. If the student will conscientiously review the lecture and read the text and lab manual pertaining to each specific exercise before coming to lab, he will greatly facilitate his conduct in the laboratory and better his understanding of the subject.

Laboratory Specimens: For the most part the animals used in the laboratory will consist of specimens injected with different preserving fluids. These animals will be kept in individual student jars which will be labelled and kept in a particular place in the laboratory. Each student jar will contain the animals necessary for most of the laboratory exercises. Since some specimens will be used for more than one exercise, the student is cautioned to follow the manual and to dissect carefully. Mutilated specimens will not be replaced.

These laboratory animals are preserved in solutions of alcohol and formaldehyde. The student should rinse his specimen with water before placing it in the dissecting pan for study. Some of the preservative, however, may remain on

the specimen. Since students will handle these animals, they should take precautions to not rub their eyes or touch their lips or noses with their fingers, which may have these chemicals on them. Alcohol and formalin are both extremely irritating to mucous membrane and contact of the preservatives with such areas should be avoided. These solutions may also irritate the skin, so all students should wash their hands thoroughly before leaving the laboratory.

Some of the specimens used in the laboratory are mounted on glass slides. A few temporary mounts will be made by the students and other temporary glycerine mounts will have been prepared beforehand. Permanent slide mounts are usually stained and fixed on the slide in a resinous medium to facilitate observation under the microscope. These preparations are difficult to make and are variously priced, depending upon the type of mount. Some of them are very expensive. Students are expected to use care in handling these slides and are held financially responsible for breakage or loss of permanent slides. In such instances students will be charged the current catalogue price for replacement. Students will have little difficulty, however, if they follow the directions in the manual on the use of the microscope and observe the directions indicated in specific exercises.

Demonstrations: Specimens of both types may be used as demonstrations in the laboratory. Since the course cannot hope to cover all the aspects of invertebrate zoology in the exercises, demonstrations will be used to aid the student in gaining the broader aspects of the study and wider acquaintance with the different forms. He should be certain to study any demonstrations made available as they are essential parts of the laboratory exercises for which he is responsible.

Equipment: Each student should provide himself with the following items for use in the laboratory:

- 1 dental probe
- 1 pair curved forceps
- 1 pair straight forceps
- 2 teasing needles
- 2 medicine droppers
- 1 pack of straight pins
- 6 microscope slides
- 12 coverslips
- 1 pair of fine-pointed scissors
- 1 sharp scalpel  
and/or
- 1 razor blade and holder
- 1 eraser
- 1 6" rule
- 1 hard lead pencil (3H or 4H)
- 1 small cloth or towel
- 1 tripod lens (or hand lens)

These materials may be purchased at the bookstores in regular zoology kits or may be bought separately.

Assignments: The mimeographed schedules which are provided for the class should enable the student to keep up with lecture reading assignments, examinations and laboratory exercises. Students will be expected to follow these schedules without notification from the instructor. Students are also expected to attend lectures, laboratories and scheduled examinations. They are expected to account for absences from any of these with a valid excuse.

Seats, microscopes and lockers will be assigned to the students in the laboratory. The seat numbers correspond with the numbers on the microscopes and slides. Students are expected to use these assigned materials properly and are financially responsible for the laboratory equipment during their particular laboratory period.

Lockers will be assigned for use during the term. The student or group of students in each locker is expected to furnish a lock and to remove the latter at the end of the term. Any locks which remain on the lockers after the last laboratory period will be cut off to make room for the students of the following term.

Laboratory Periods: Students are expected to attend the laboratory periods and to remain in the laboratory during the scheduled lab period unless excused by the instructor. Students who do not attend laboratory are expected to explain such absences by a written excuse. Students who accrue four unexcused absences from the laboratory will automatically drop one letter grade in the course.

The laboratory work will consist of scheduled exercises. These exercises are designed to correlate the lecture and text material by allowing the student to observe for himself the animals and structures described previous to the lab. He can thus better understand the material presented in the course.

Insofar as possible each student is expected to perform individually in the laboratory. Individual work is essential to a quiet, scientific atmosphere and the student will gain much more if he will use this means. Conversation is not prohibited, but should be restricted by necessity. The instructor may designate certain students to work together on some exercises. Such arrangements need not entail a breach of the above procedure.

Students are requested to keep the laboratory as clean as possible at all times. Waste and scraps should be disposed of in the proper containers after each exercise; specimens and equipment should be kept in the proper receptacles. Each person is responsible for the cleanliness of his table area in the laboratory and should check to see it is in order before he leaves the room at the end of the period. This includes the placing of his stool under the table and turning off the table light at his place.

Dissecting pans should also be cleaned, washed out and stacked neatly on the table ends of the sink. Caution should be exercised in cleaning these pans. Students may break the wax layer in the pan if they strike the pan against the waste receptacle. Discarded parts of specimens or used specimens should be picked out of the pans and placed in the waste receptacles. The dissecting pan should then be rinsed out. Please do not dump scraps in the sinks and do not leave pans under water faucets.

Drawings: In nearly all of the exercises prescribed in this laboratory manual the student will be expected to make drawings of observed structures or animals. The drawings emphasize the animal and the structures or parts under observation by recording the details. Thus the drawing can be used in general study or review and also gives the student excellent training in the reproduction of what he sees. To the instructor the drawings serve as an index of the student's work in the laboratory and will be used along with other things to determine the grade for the term.



Not every student is an artist capable of excellent drawings the first time he enters the laboratory. To draw well requires practice and persistence. Students will find that their abilities to draw increase in proportion to the time and effort they expend toward improvement. They should make drawings which are neat and accurate in proportion and detail. If they have difficulty in drawing, they should consult the laboratory instructor for help.

Students are expected to make their own drawings from individual observations of the laboratory material. Drawings are not to be copied from texts or the drawings of other students. Such drawings are not acceptable and students who copy will not receive credit for the laboratory exercise.

Drawings are to be handed in at the end of each period, even if incomplete. Generally there will be sufficient time in the laboratory period for all students to complete the drawings and other laboratory work. Students who are absent from class or who do not finish should make up the work in other scheduled laboratory periods. No special make-up laboratories will be held.

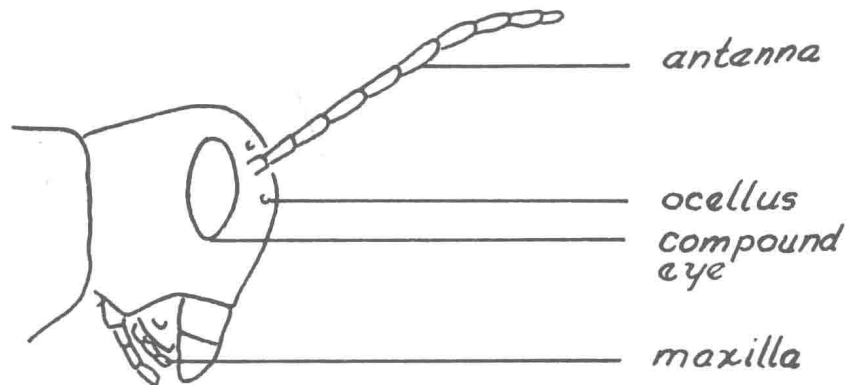
The following suggestions should help the student in drawing and should partially assure neat-looking plates:

1. A good grade of hard-finish, double weight, white paper should be used. This type of paper is supplied in the laboratory manual. The paper of each plate is perforated and punched. The student may thus remove the plate from the lab manual, hand the drawings in for grading and keep the plate in a notebook upon its return.
2. Use 3H or 4H drawing pencils. Ordinary eversharp or pencil lead is too soft and the drawing will smear. Keep the pencil sharp.
3. Drawings should be of the outline type with stippled shading. The lines should be definite, not sketchy. Any necessary shading should be done by stippling, i.e., by making dots with the end of the pencil and placing them closer together to indicate darker shading. Other forms of shading should be avoided unless the student is an expert.
4. Drawings should be neatly arranged on each page. The plates of the lab manual indicate a general arrangement for the drawings, but the student is expected to use his judgment with respect to size and detail. Drawings should not be disproportionate, and should be of a size which allows adequate space for details and labels.
5. Headings, titles, names and labels are to be lettered in either small or capital letters. A mixture of the two is not permissible, except when the initial letter of a word is a capital. Students may have to practice lettering to become proficient at it. Titles and figure descriptions are printed on the plates. The student, however, must provide the labels. Labels should be placed to the right of the drawings insofar as possible. They should be tied to the drawing by horizontal guide lines and should indicate the specific structure which they identify. The guide lines may be solid or broken, but in either case they should be made with a straight edge. The words which are underlined in the text of the manual indicate the important parts or structures which should be labelled on the drawing.
6. The drawing plates will be uniform if all students follow the format suggested on following page. The heading and labels should be accomplished according to this general plan.

# Insect Anatomy

Roe, Ronald F.  
Exercise No. 7  
8-10TTh Seat #  
January 19, 1954

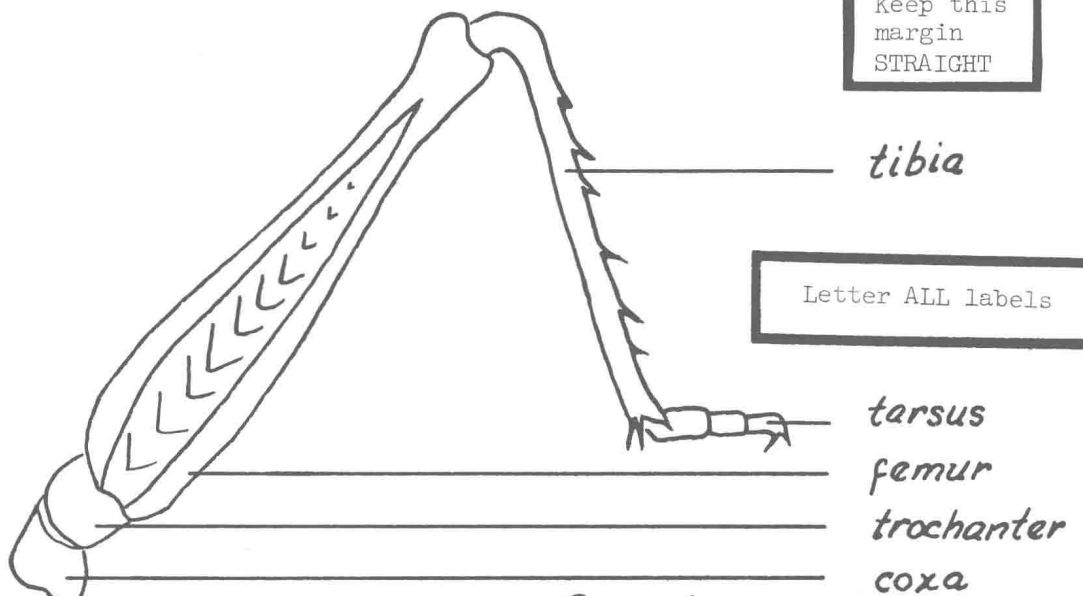
Keep heading uniform  
and up in the corner



Place figure ABOVE  
figure title

Fig 1 Head of Grasshopper

Keep this  
margin  
STRAIGHT



Letter ALL labels

Fig 2 Hind Leg of Grasshopper

Keep guide lines, labels  
and titles HORIZONTAL



7. Sometimes students exhibit the tendency to copy drawings from the text or other sources rather than observe the actual specimens in the laboratory. Students who attempt this lazy method only cheat themselves. Laboratory examinations are based on the specimens. Laboratory grades are determined on the relative accuracy with which specimens are reproduced in the drawings. In addition, the laboratory instructor has seen too many of the drawings in the text not to be able to recognize a modified facsimile. Students should, therefore, draw those structures which are observed in the specimens, even though they may not see all of the features which are described in the lab manual. Accurate representation of observed parts is much better than plagiarism.

Examinations: Scheduled lecture and laboratory examinations are indicated on the class outline sheets. In addition to these scheduled examinations students may expect a series of unannounced quizzes in the laboratory during the term. These will be short quizzes conducted at anytime in the laboratory period and may be followed by a brief discussion of the quiz and the pertinent parts of the exercise. No make-up examinations will be given for the unannounced quizzes or the scheduled laboratory practical examinations. The student who misses these examinations will be graded on the basis of those examinations he has taken.

#### NOTES





## PREVIEW OF THE INVERTEBRATES

## EXERCISE 1

The Invertebrates or the group of "animals without backbones" includes over 900,000 different kinds or species of animals. Many of these animals are little known to most people, but some which are familiar are insects, earthworms, snails, crayfish, clams, oysters, spiders, scorpions and centipedes. As you become more familiar with other animals in this division of the animal kingdom you will learn that all animals are segregated according to definite structural characteristics. The similarities and differences of structure form the basis for the system of classification of animals, which is known as the science of taxonomy. In this study you will learn the similarities and differences of a number of the invertebrates, many of which will be studied in detail in the laboratory. Not all of the anatomical features are external and dissections will be performed to learn some of the internal morphology as well. The study of morphology (Gr., form, discourse) coupled with the study of functions or physiology (Gr., natural qualities, discourse), gives one a rather complete idea of an animal as a whole.

The first laboratory period will consist of a discussion and preview of representatives of the invertebrate group. You will find on the laboratory tables a series of demonstrations of both living and preserved specimens. You are invited to study these and to learn as much as possible about the animals on display. Most of your observations will be concerned with the external structure of these forms. You will notice that there are different degrees of conformity to the descriptive and anatomical terms. Many of the parts you will not recognize at this time; the internal anatomy will be observed in other laboratory periods. In this first period you should concern yourself with the visible structures of the animals, the body regions, the type of symmetry, the number of appendages, etc. The purpose of the period is to allow you to determine for yourself some of the major similarities and differences which exist in the animals of this division.

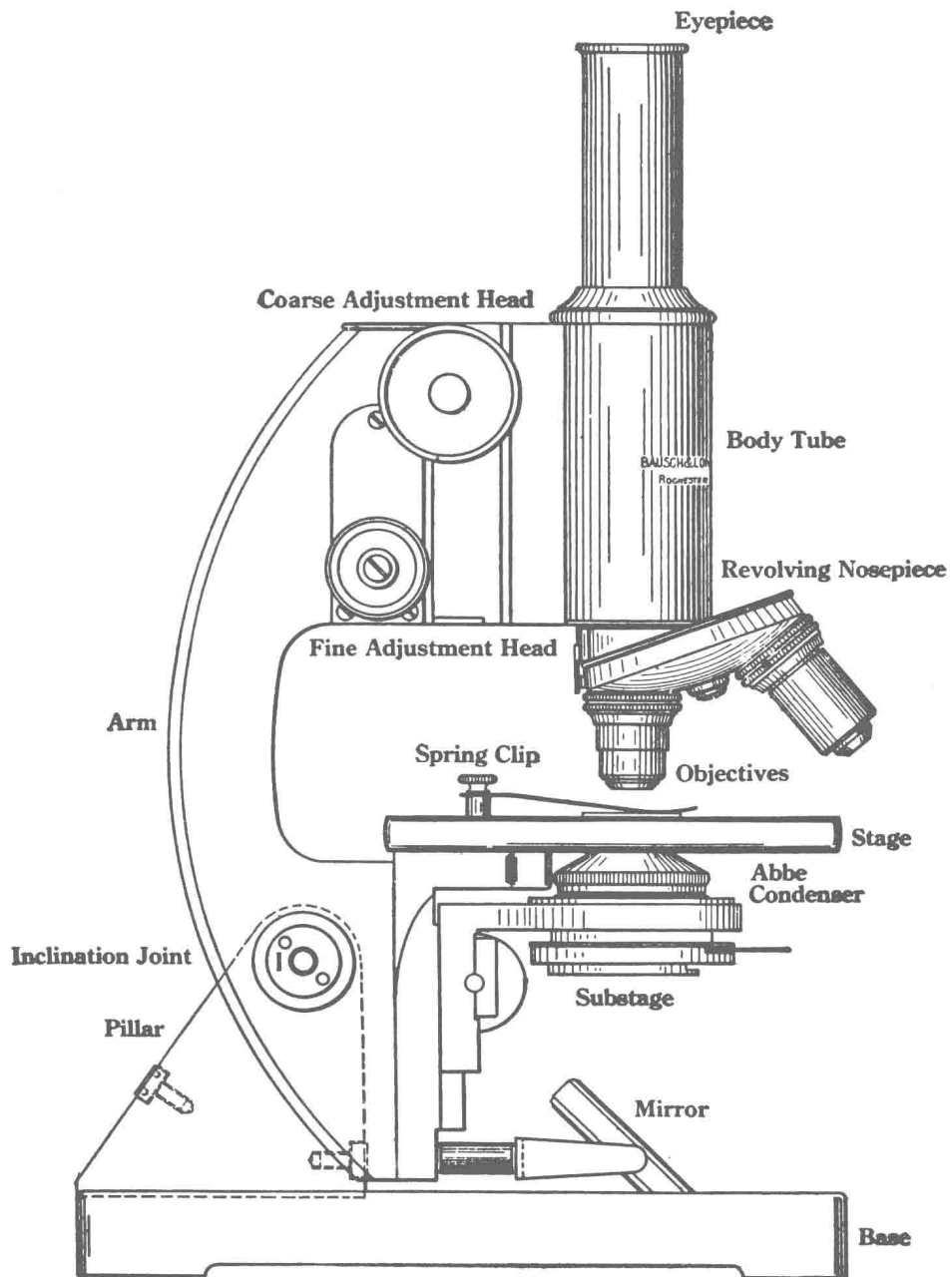
To aid you in this study you will find a chart on the following page which lists certain morphological characteristics. The common names of the animals on display are also listed. As you study the animals note and compare their features with the structures listed on the chart. Place a check in the squares opposite the structures which are applicable. If you check the pertinent features for each animal, it should be relatively easy at the end of the exercise to correlate the similarities in certain groups of animals and the differences with respect to other groups. In addition to the checks you may want to record other information about these animals as you examine them. Not all of the characteristics of these animals will be ascertained this first period. Many of the features will be clarified later and during the subsequent lab periods you will be able to add to the chart. You will also notice that man is listed at the extreme right of the chart. Since we consider ourselves important and frequently compare ourselves with other animals, you will be able to compare the various features of human beings with these lesser lights of the animal kingdom.

At the end of this period your lab instructor will help you correlate and summarize the work of the exercise.

Read the subsequent exercise before coming to the next laboratory period.

[illegible]





**Figure 1. Mechanical Construction of a Microscope**  
(Courtesy of Bausch and Lomb Co.)