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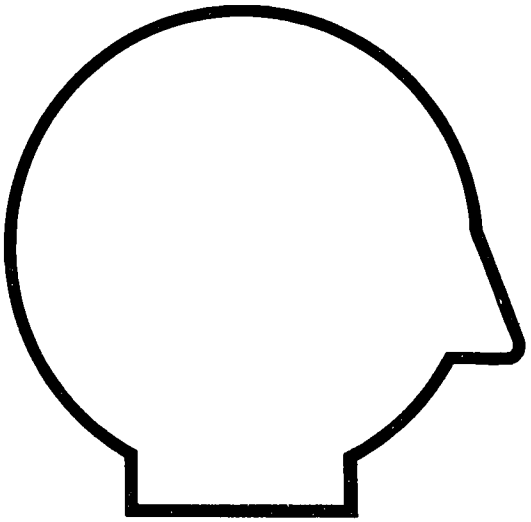
ABSTRACT

This module, one of 25 on vocational education training for careers in environmental health occupations, contains self-instructional materials on using a stereo microscope. Following guidelines for students and instructors and an introduction that explains what the student will learn are three lessons: (1) accurately naming each part of the stereo microscope, stating the function of each part, and properly handling and cleaning the instrument; (2) using the microscope to examine and study various materials and objects; and (3) using the microscope to clasify insects into groups by body structure. Each lesson contains objectives, recommended methods and locations for practice, performance criteria, equipment and supplies to perform a task, detailed step-by-step instructions for learning a task, and performance exercises. A performance test on using a stereo microscope is included. (CT)



Using a Stereo Microscope

Module 22

U.S. DEPARTMENT OF EDUCATION, Office of Vocational and Adult Education

FOREWORD

The Curriculum and Instruction Branch of the Office of Vocational and Adult Education, U.S. Department of Education, identified a need to improve the training opportunities for vocational education students interested in pursuing careers in environmental health. To fulfill that need, Consumer Dynamics, Inc., a Rockville, Maryland, based company, was awarded the contract to develop performance-oriented, competency-based modules in the environmental health sciences.

USING A STEREO MICROSCOPE is one of the modules in the series, "Vocational Education Training in Environmental Health Sciences." The module content is based on selected texts and other materials in the environmental health field. The module is intended to supplement existing course materials.

CONTENTS

USING THES SELF-INSTRUCTION MATERIALS

s self-instruction learning package or module is designed to ow both students and instructors flexibility of use. Although rily intended for use in existing training programs, the e can be used by anyone interested in learning new skills or ng up old ones. Therefore, two sets of guidelines are nted--one set addressed to students and the other set ssed to instructors. First, find out how you, the student, should use the materials in this book.

GUIDELINES FOR STUDENTS

Take the Performance Test as a pretest.

When you pick up this book and work through it, your goal is not a letter grade or a high score on an exam. Instead, you will work to develop skills that you can measure. You will not have to worry about how well someone else is doing. Before you start work on this book, you should, first, find out if you have sufficient skills to start training by reading through the section called PERFORMANCE TEST. If you think you can do all or most of the items in this test, ask your instructor to obtain the necessary equipment and supplies. Although you do not need special preparation in mathematics or physics to do this module, you should have some working knowledge of science. You do not have to have specialized skills to enter training in this module.

Work on parts you need to practice.

If you do everything well, according to the criteria in the Performance Test guidelines, you will not need to spend time working on this module. If after taking the Performance Test you discover there are parts you need to practice, follow the key to each item in FOR FURTHER STUDY.

Work straight through each lesson in the order presented.

Should you decide to completely work through this book, begin with the INTRODUCTION and go straight through each of the three lessons. The lessons begins with the OBJECTIVE of the training. Follow the instruction for each part in the order presented. Practice each step in a lesson until you can do it according to the criteria stated for the step. At the end of a lesson, do the EXERCISES. When there are audio-visuals listed at the end of a lesson, ask your instructor for help in obtaining them.

USING THESE SELF-INSTRUCTION MATERIALS

STEP 4 Take the Performance Test as a posttest.	Finally, after you have mastered all of the exercises in each lesson, ask your instructor to watch you do each item in the Performance Test. The items in the Performance Test are intended for use as a posttest to evaluate the quality of your performance. Turn now to the Performance Test.

GUIDELINES FOR INSTRUCTORS

Approach	The approach of these materials is to provide the students with the skills to accomplish all of the objectives at a satisfactory level of skill. The modules use instrumentation commonly found in technical laboratories. You may find that the instrument(s) found in this module differ from those you have available. You may need to write supplementary instructions to point out the equipment differences. The skills tested in the Performance Test are designed for use with any make and model of instrumentation.
Independent Study	Students can work independently and at their own pace. Depending on the time frame you set for completing each lesson, you may want to start a group off in each lesson with a demonstration and informal presentation.
As a Laboratory Workbook	Alternatively, you may choose to use this module as a laboratory workbook in a structured laboratory session. With this option, you may allow students greater access to your assistance, especially in watching them perform the pre- and posttest portions of the training.
General Instructions	Read through each lesson to anticipate what equipment and supplies you will need to make available for students to use. Also, order any audio-visuals or reading materials you think may present a complementary perspective to the training in this module. Use the items in the Performance Test as the minimum requirements for gauging successful completion of the training.

Specific Instructions

Since students will be working with fruit flies and several species of female mosquitoes, you will need to obtain and provide sufficient numbers of preserved specimens for use in Lesson Three. Refer to "Things You Need" in Lesson Three for the type of insects you will need. For the exercises, number several bottles--one for each student. Into each bottle place a specific number and variant or species of insect. In a notebook record the bottle number and how many insects of which type are in a specific bottle.

BACKGROUND

Biologists, physicists, environmental technicians, and scientists in general have one thing in common. They all need the help of various instruments in their quest for an understanding of the physical world. Almost all scientists have a need at one time or another to "make the world larger." Of course, scientists cannot actually make the world larger, but they can magnify selected portions of the world to better visualize how it operates.

Biologists use electron microscopes, which magnify millions of times; astronomers use telescopes, which magnify thousands of times; and environmental technicians often use stereo microscopes, which magnify in the range of 10 to 50 power (10X to 50X).

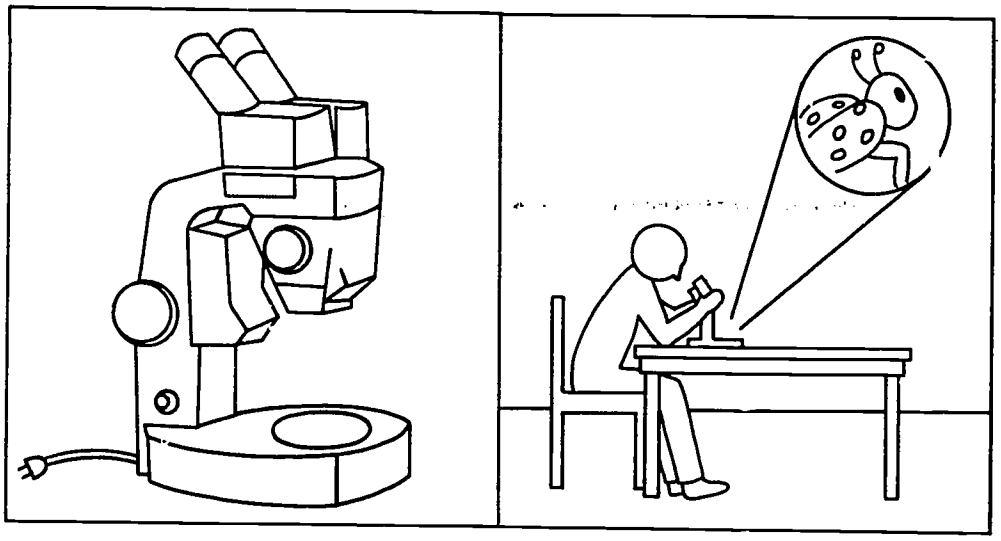
The stereo microscope (or stereoscope) is one of the lower powered magnification instruments, but its versatility should not be underrated. A magnifier is used to do a specific job, and that job often calls for magnification in the range of 10X to 50X. If higher magnification is called for by a study, the environmental technician can use a compound microscope, which magnifies in the range of from 100X to 2000X.

The stereo microscope is an important tool used to observe materials that range from objects the size of a dime to very tiny insects and particles such as grains of find sand. The key to the observation of objects in this range of sizes is clarity. A good stereo microscope will present to the observer an extremely clear view of the object under study. The degree of clarity is what determines the value of a stereo microscope, not its price or magnification capabilities.

In this module, as you learn to use the stereo microscope, you will learn its value for viewing clearly several types of arthropods (insects). As a test of your ability to use a stereo microscope, you will be given an opportunity to sort variants of fruit flies and to identify distinguishing features of medically important mosquitoes.

WHAT YOU WILL LEARN

When you finish working through the steps and exercises in this book, you will be able to correctly use a stereo microscope for observing materials and objects, and to use the instrument to classify insects on the basis of their body form.



Using a stereo microscope, you will learn how to perform these functions in three lessons:

- Lesson One

  You will be able to accurately name each part of the stereo microscope, to state the function of each part, and to properly handle and clean the instrument.

- Lesson Two

  You will be able to use the stereo microscope to examine and study various materials and objects.

- Lesson Three

  Using a stereo microscope, you will be able to classify insects into groups by utilizing the insect's morphology (body structure) as the basis of the classification process.

LESSON ONE

OBJECTIVE

You will be able to accurately name each part of the stereo microscope, to state the function of each part, and to properly handle and clean the instrument.

WHERE AND HOW TO PRACTICE

You can practice this lesson almost anywhere there is a clean tabletop and electric outlet. If you have any questions about anything in the lesson, ask your instructor for help. Practice labeling diagrams of the microscope to learn the names of each part and how it is used.

HOW WELL YOU MUST DO

You must be able to accurately name all the parts of the stereo microscope, correctly tell the function of each part, and be able to handle and clean the instrument.

THINGS YOU NEED

You will need the following equipment:

- o any laboratory-grade stereo microscope
- o lens paper
- o stereo microscope light (if not attached to scope).

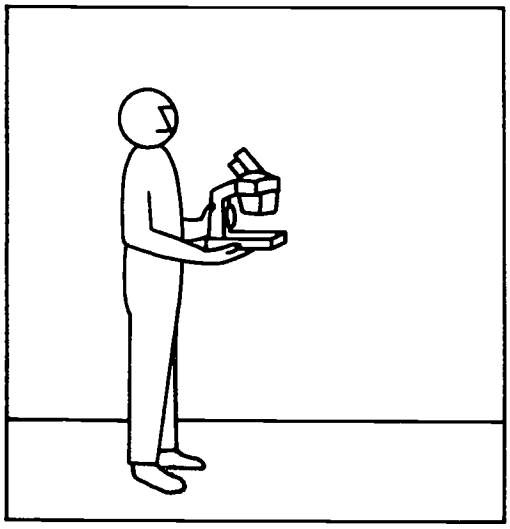
Instructions: Now turn to the next page and begin work on Lesson One, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Obtain a stereo microscope from storage. Secure an illuminator if there is no light attached to the microscope. When you carry the microscope, use the technique shown in the diagram. Be sure to support the microscope from the bottom and with the arm.

KEY POINT 1



Notice that the microscope is carried while supported at two points.

STEP 2

Put the microscope on the tabletop. Look at each part on your microscope, using the drawings in Key Points 2A and 2B to identify the parts. The main parts of the microscope and their functions are listed below:

(1) eyepieces--magnify 10X or 15X

(2) interpupillary adjustment knob--moves the eyepieces apart or together

(3) body--holds the optical parts (lenses) in line

(4) arm--supports the body

(5) objectives--magnify the specimen

(6) power knob--selects which objective to use (or zooms the scope from high to low power)

(7) focus adjustment knob--focuses the scope

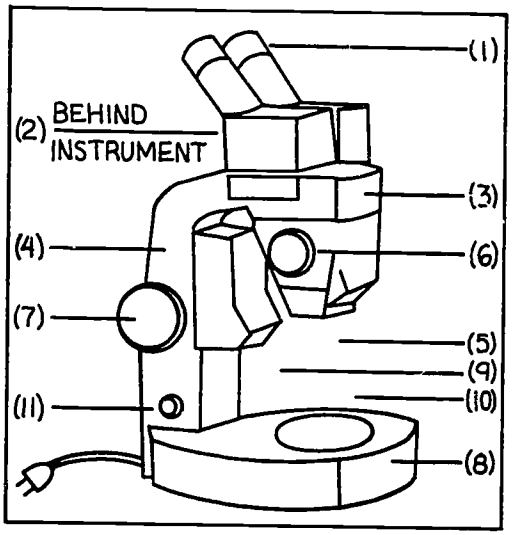
(8) stage--supports the specimen

(9) light source--lights the stage from the top

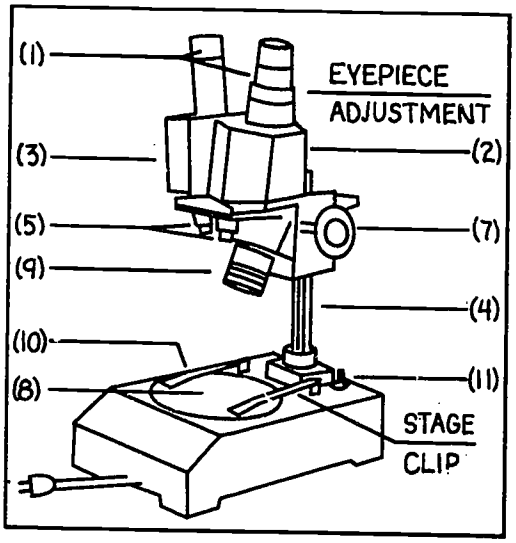
(10) understage light source--lights the stage from below

(11) off/on switch--controls the light source

KEY POINT 2A



KEY POINT 2B

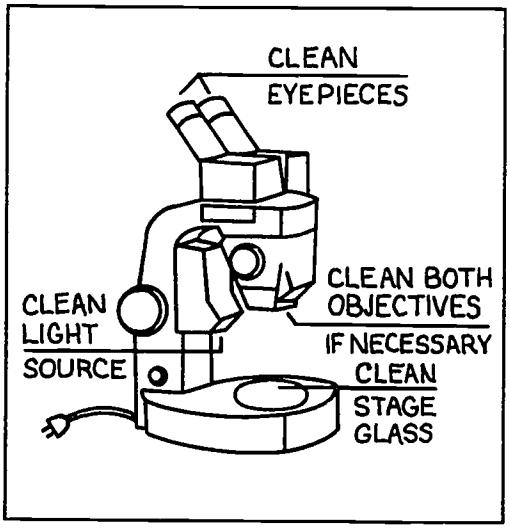


In this model there is no power knob. These two models illustrate the physical differences between microscopes; but as you can also see, the controls allow similar operations to be performed.

STEP 3

Clean the parts of the microscope shown in Key Point 3 with microscope lens paper. Clean the parts gently by rubbing each optical part with a clean portion of the paper. Generally, you will not need to use any cleaner on the optics. If a lens has gotten very dirty, you may use a microscope lens cleaner or eyeglass cleaner. If there seems to be a need to take the unit apart, inform your instructor of the condition of the stereo microscope.

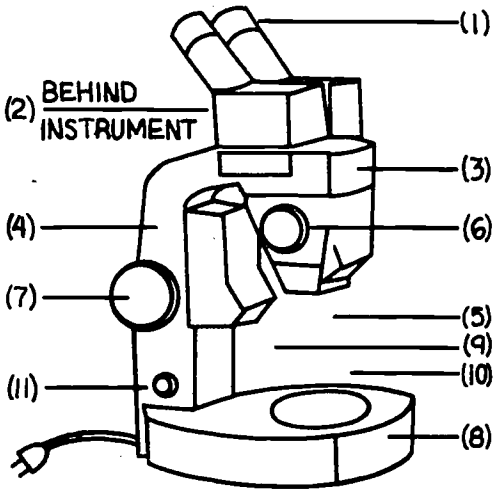
KEY POINT 3

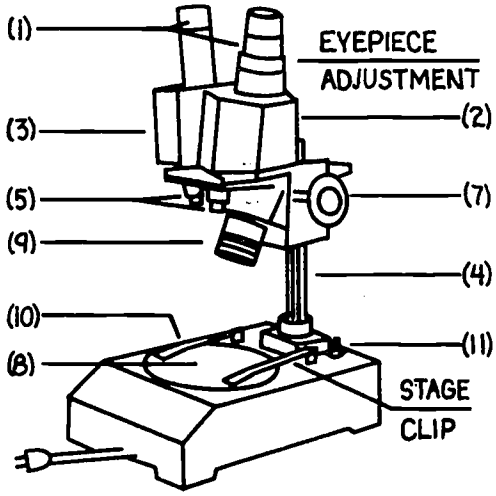


Clean gently. Keep the microscope clean when not in use by covering the scope or by keeping it in a dust-free cabinet.

EXERCISES

Instruction 1: Use the diagram of the stereo microscope to practice naming each part of the scope. As you name each part, state its function. You must know 100% of the parts and their function. When you know each name and function, fill in lines 1 through 11 to test your knowledge.





2A

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(6) _____

(7) _____

(8) _____

(9) _____

(10) _____

(11) _____

2B

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(6) _____

(7) _____

(8) _____

(9) _____

(10) _____

(11) _____

Instruction 2: Name each part of the stereo microscope that should be cleaned with lens paper.

_____

_____

Demonstrate how to clean each part.

Instruction 3: Demonstrate how to clean a lens.

Instruction 4: When you can correctly label each part of the stereo microscope, can describe the function of each part, and can tell how and what parts of the microscope should be cleaned, you are ready to begin work on Lesson Two.

LESSON TWO

OBJECTIVE

You will be able to use the stereo microscope to examine and study various materials and objects.

WHERE AND HOW TO PRACTICE

Use the location specified in Lesson One to continue work presented in this lesson. A 110-AC outlet should be available for the microscope illuminator. Read through the steps in Lesson Two and the exercises at the end of the lesson before starting to work. As you go through the lesson, make sure you understand and can do each step before going on to the next one.

HOW WELL YOU MUST DO

Given any small object suitable for use with a stereo microscope, you must be able to view the object with the microscope and to make simple sketches of what you see under two types of illumination, bottom and top lighting.

THINGS YOU NEED

You will need all of the equipment and supplies used in Lesson One. In addition, you will need the following:

- o 110-AC outlet
- o coin
- o dollar bill
- o scrap of cloth
- o paper
- o blade (knife, razor, etc.)
- o fruit flies (preserved).

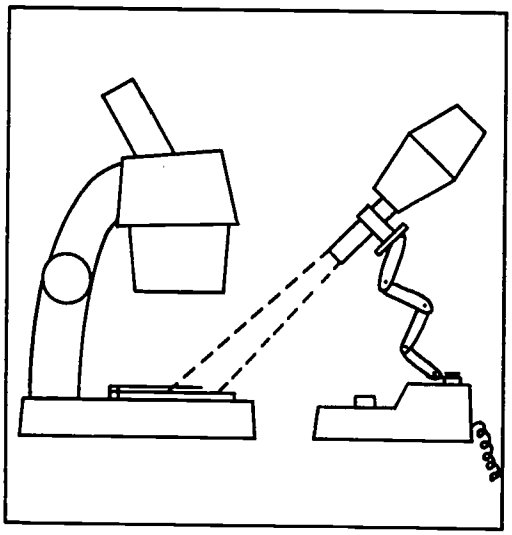
Instructions: Now turn to the next page and begin work on Lesson Two, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Set up and clean your microscope (if it needs cleaning). Plug in your light source. Light your stage from the top. If the light source is on the microscope, it will be properly pointed toward the stage. If your light source is not attached, point the beam of light toward the stage at about a 45-degree angle. You want to light the stage from the top, so make sure the light is properly adjusted.

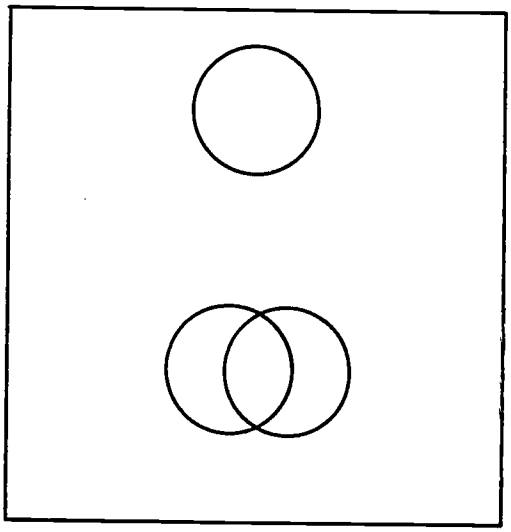
KEY POINT 1



STEP 2

Place a coin on the stage. Light the coin from the top. Look into the eyepieces of the microscope. Adjust the interpupillary adjustment knob to move the eyepieces apart or together to match your eyes. Some microscopes do not have an adjustment knob. You move these eyepieces by pushing or pulling on the eyepieces. Look into the microscope and move the eyepieces until you see one circle of light.

KEY POINT 2



STEP 3

Adjust the power of the scope to the lowest power. You may need to rotate the lower objectives, turn a knob that switches lenses, or turn a "zoom" knob to the lowest setting.

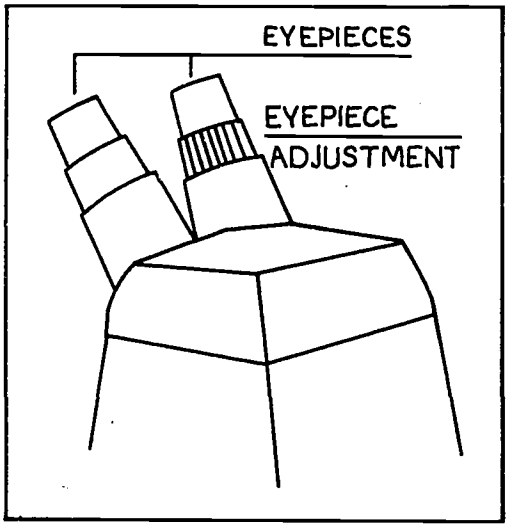
STEP 4

Look into the scope and use the focus knob to bring the coin into focus. Unless you are very farsighted, you should be able to adjust the eyepiece adjustment mechanism until you see only one image of the coin. To use this adjustment for fine focusing, first focus on the coin using only one eye, using the eyepiece without the adjustment. Next, look through the eyepiece with the adjustment. Do not change the focus adjustment of the scope. Turn until the image (coin) is clear and in perfect focus. Now the scope is adjusted for the difference in focus between your two eyes. Observe the surface of the coin using low power and top lighting.

KEY POINT 3

Remember, some scopes do not have multiple powers. If you have trouble with your model, ask your instructor for help.

KEY POINT 4

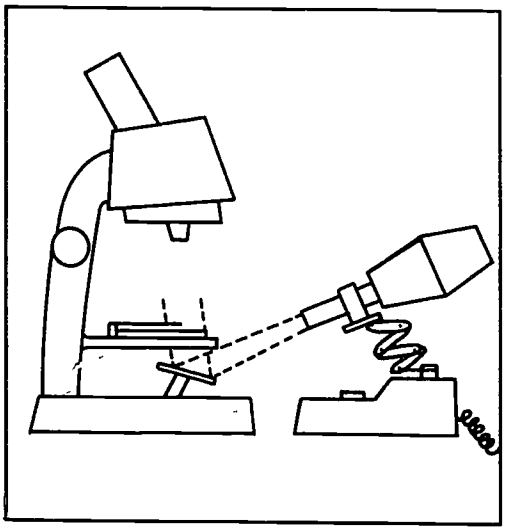


Proper focus is important. Always check to make sure your scope is properly adjusted.

STEP 5

Now you will examine the effect of bottom lighting with an opaque object (the coin). Leaving the coin in focus, change the scope from top lighting to bottom lighting. Observe the coin using low power and bottom lighting.

KEY POINT 5



Generally, bottom lighting is not used with an opaque (solid) object.

STEP 6

Now you will examine the effect of a change in scope power. Change the lighting back to top lighting. Change the scope from low power to high power. Look at the coin under high power. You may need to refocus. Notice what happens to the size of the field of view when you go to a higher power.

KEY POINT 6

High power is generally 20X, 30X, or 45X. Higher power makes the image look larger but you see less of the object. In other words, you see a smaller area but what you see is magnified more.

STEP 7

Now use a piece of cloth as your specimen and put it on the stage. Under low power, focus on the edge of the cloth. Now change the lighting from top lighting to bottom lighting. Observe the difference in the image. Sometimes top lighting gives a clearer image. Sometimes bottom lighting provides a clearer image. Always try both top and bottom lighting to see which is best for the material being viewed.

KEY POINT 7

Compare top and bottom lighting. Decide which is best to use when viewing cloth.

STEP 8

Now change from low power to high power. View the cloth using four viewing combinations:

- o low power/top lighting
- o low power/bottom lighting
- o high power/top lighting
- o high power/bottom lighting

Decide what the advantages and disadvantages of each combination are, and record your observations here:

KEY POINT 8

Each specimen will have a "best" combination of light and power. You must learn to experiment to find that combination.

STEP 9

View a piece of torn paper. Place the edge of the paper under the scope using low power. View the paper under all four viewing conditions. Decide which view provides the best image of the edge of the paper. In the space below, make a simple brief sketch of exactly what you see (the same size as you see it). Look back and forth from the microscope to the drawing.

KEY POINT 9

Keep your microscope in focus. Get the best lighting. Then make a simple drawing of what you see.

EXERCISES

Practice viewing the other materials you have. For each material, you should do the following:

1. Make a decision as to which combination of light and magnification is best for the material.

2. Make a simple brief sketch of the field of view for each of the objects.

The objects are:

- o dollar bill
- o blade
- o fruit flies
- o anything else you are interested in looking at; e.g., hair, fingernails, dirt, leaves, bugs, print, dust, signatures, mold, food, etc.

LESSON THREE

OBJECTIVE

Using a stereo microscope, you will be able to classify insects into groups by utilizing the insect's morphology (body structure) as the basis of the classification process.

In Lesson Three you will be using fruit flies (Drosophila melanogaster). Fruit flies are commonly used in genetics experiments. They are also commonly found in the natural environment. They are an ideal laboratory insect because they breed quickly and simply, and they are easy to culture in pure strains. Many different types of fruit flies have been discovered and created.

WHERE AND HOW TO PRACTICE

Practice at the same location as in the previous two lessons. Practice viewing fruit flies until you can easily tell different types apart.

HOW WELL YOU MUST DO

You will be given a bottle of 20 fruit flies. You will be required to separate the flies into two groups, based on some difference that is apparent in their body structure. You will need to identify the difference and separate the flies into two piles. There is a 20-minute time limit on the identification and separation process. You must be 100 percent accurate in your separation process.

THINGS YOU NEED

In addition to your stereo microscope (with illumination), you will need the following:

- fruit flies, normal and variant types (based on eye color), 20
- fruit flies, variants with two different wing lengths, 20
- adult female mosquitoes, Anopheles, Toxorhynchites, Aedes, and Culex, 3 to 5 of each species for a total of 20 insects
- dissecting needle
- tweezers.

GETTING THERE--STEPS

STEP 1

Prepare your scope for viewing a specimen. Make sure lenses are clean.

KEY POINT 1

Always start a study by checking to make sure your microscope is clean.

STEP 2

Get a bottle of fruit flies from your instructor. Pour a few flies into a petri dish. With the dissecting needle, separate the flies. Find the combination of power and light that allows you the clearest view of the flies.

KEY POINT 2

Do not breathe or blow on the stage. You will not have any specimens left to study.

STEP 3

While moving the dish on the stage, adjust the focus so you can look at the eyes of the flies. One of the simplest variations in fruit flies is in eye color. The normal or "wild" type eye color is red. Many variations on the wild color are known. You have two types of flies. Make sure you can distinguish between the wild type and the other type you have. Separate the flies into two groups on the basis of eye color. You need to be 100 percent accurate in your separation process, so take your time.

KEY POINT 3

When you are finished, bottle up the flies for the next student to use. Return the flies to your instructor.

EXERCISES

Instruction 1: Obtain a bottle of fruit flies containing insects with two different lengths of wings. Examine the flies closely. Then separate them into two groups on the basis of wing length. You must be 100 percent accurate. Check your results with your instructor.

The number of flies of long wing length are _____.

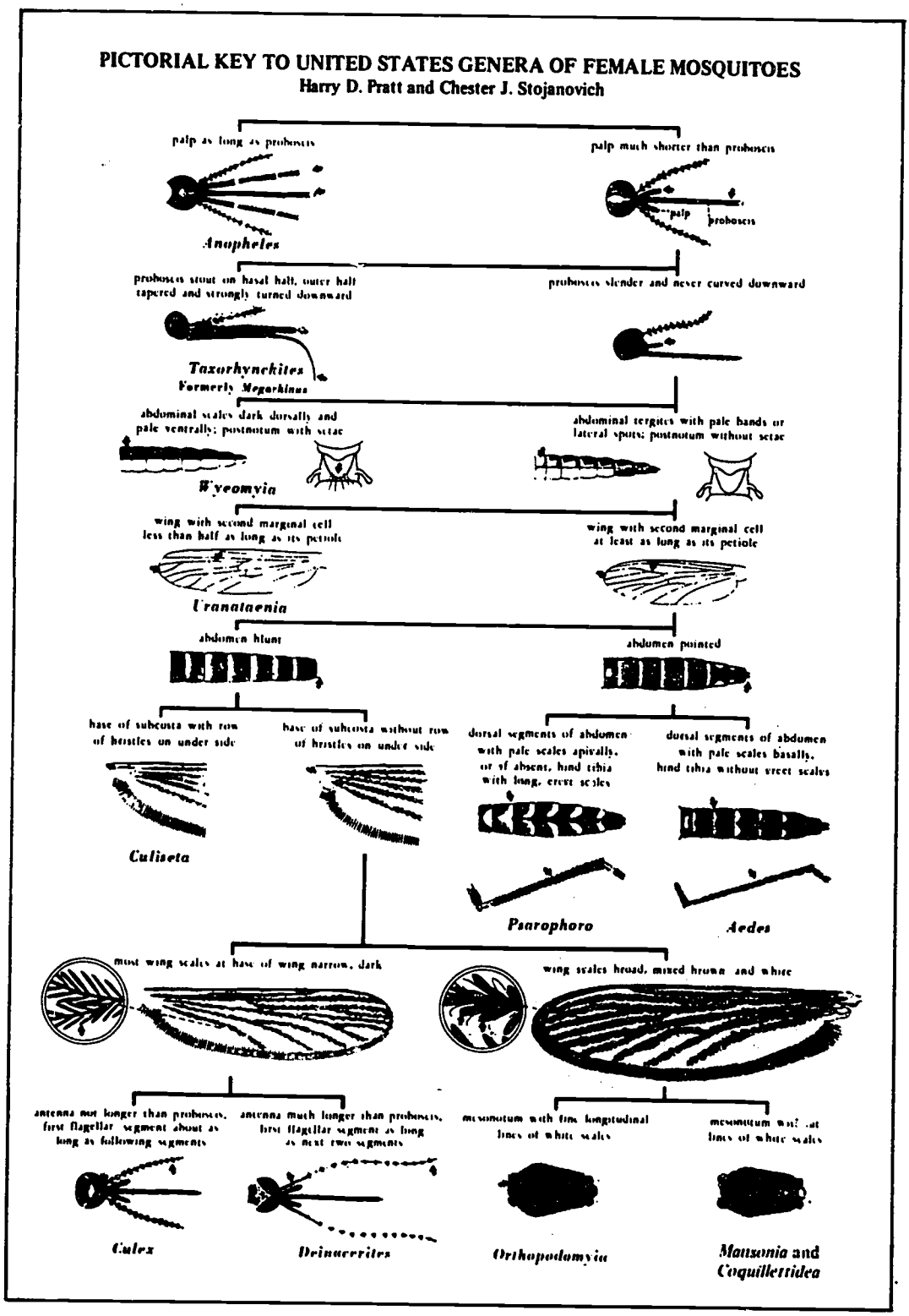
The number of flies of short wing length are _____.

Instruction 2: Obtain a bottle of fruit flies containing a mixture of wing and eye variants. Identify what is different between the two types of flies. Separate them into two piles. Look at each part of the flies and compare one fly with another. Move systematically from one part to the next, i.e., eyes, legs, mouth parts, body, wings, etc. Record your results below. You must be 100 percent accurate in separating the flies. You do not need to identify every difference between the two types of flies in the bottle.

The number of flies of one type is _____.

The number of flies of the second type is _____.

Instruction 3: Obtain from your instructor a bottle containing these species of female mosquitoes: Anopheles, Toxorhynchites, Aedes, and Culex. Use the following pictorial key to identify distinguishing characteristics of each species. Use the methods for separating the insects provided in the steps and other instructions in this lesson.


PICTORIAL KEY TO UNITED STATES GENERA OF FEMALE MOSQUITOES
Harry D. Pratt and Chester J. Stojanovich
palp as long as proboscis
palp much shorter than proboscis
palp
proboscis
Anopheles
proboscis stout on basal half, outer half tapered and strongly turned downward
proboscis slender and never curved downward
Toxorhynchites
Formerly Megarhinus
abdominal scales dark dorsally and pale ventrally; postnotum with setae
abdominal tergites with pale bands or lateral spots; postnotum without setae
Wyeomyia
wing with second marginal cell less than half as long as its petiole
wing with second marginal cell at least as long as its petiole
Uranotaenia
abdomen blunt
abdomen pointed
base of subcosta with row of bristles on under side
base of subcosta without row of bristles on under side
dorsal segments of abdomen with pale scales apically, or if absent, hind tibia with long, erect scales
dorsal segments of abdomen with pale scales basally, hind tibia without erect scales
Culiseta
Psorophora
Aedes
most wing scales at base of wing narrow, dark
wing scales broad, mixed brown and white
antenna not longer than proboscis, first flagellar segment about as long as following segments
antenna much longer than proboscis, first flagellar segment as long as next two segments
mesonotum with fine longitudinal lines of white scales
mesonotum without lines of white scales
Culex
Deinocerites
Orthopodomyia
Mansonia and Coquillettidea

PERFORMANCE TEST

Instructions: Check your skill level or progress by working through each of the items in this test. If you can perform each item as well as required, place a check in the space provided. When all of the items are checked, you are ready to demonstrate your skills to your instructor. You may use the following list if needed. You will be considered trained in the use of the stereo microscope after your instructor approves your performance on each of the following items.

USING A STEREO MICROSCOPE

No. 1 _____ Carry the microscope supporting it with both hands.

No. 2 _____ Name each part of the microscope and state the function of each part.

No. 3 _____ Clean the appropriate parts of the microscope.

No. 4 _____ Utilize the microscope using all four combinations of powers and lighting capabilities.

No. 5 _____ Given any object, choose the combination of light and power that provides the best image of the object.

No. 6 _____ Given arthropods that differ in body form, use the stereo microscope to identify the difference(s).

No. 7 _____ Classify creatures into different groups based on differences in body structure(s), with 100 percent accuracy.

FOR FURTHER STUDY

If you could not perform one or more of the seven items above, review and practice the following lesson steps:

No. 1
Lesson One, Step 1

No. 2
Lesson One, Step 2

No. 3
Lesson One, Step 3

No. 4
Lesson Two, Steps 1 through 8

No. 5
Lesson Two, Step 8

No. 6
Lesson Three, Steps 1 through 3

No. 7
Lesson Three, Steps 1 through 3

REFERENCES

Geisert, Paul, Understanding the Microscope, 2nd ed., Educational Methods Publishing Co., Chicago, IL, 1967.