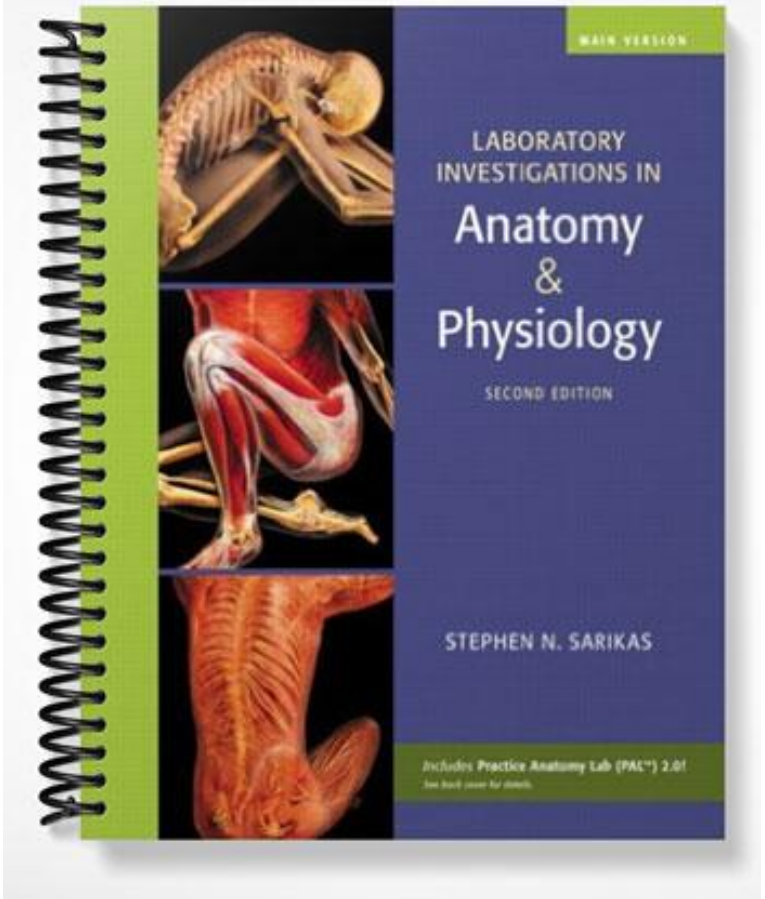
SOLUTIONS MANUAL



Laboratory Exercise 2

Care and Use of the Compound Light Microscope

Time Estimates for Completing this Lab

The activities in this laboratory exercise can be completed in 2 to 2.5 hours. Extra time will be required to complete the review sheets at the end, or they may be assigned as homework. Times listed are only estimates.

Activity 2.1: *Learning the Parts of a Light Microscope*
15 minutes
Activity 2.2: *Viewing a Specimen with the Compound Microscope*
30 minutes
Activity 2.3: *Viewing the Letter "e"*
15 minutes
Activity 2.4: *Perceiving Depth of Field*
15 minutes
Activity 2.5: *Using the Oil Immersion Lens*
15 minutes
Activity 2.6: *Determining the Diameter of the Field of View*
30 minutes

List of Materials

This list of materials shows the quantities needed for a standard 24-seat lab, with six tables and four seats at each table. [*Note:* Other than the microscopes, if resources or space is limited, this lab could be set up with one set of all other items per pair of students, or even one set per table. These would reduce the quantities needed from 24 of each item to 12 of each if shared in pairs, or to 6 of each if shared per table.]

- 24 compound light microscopes
- 24 sets of prepared microscope slides of various tissues
- 24 prepared microscope slides of the letter "e"
- 24 prepared microscope slides of intersecting colored threads
- 24 bottles of immersion oil
- 24 clear millimeter rulers
- 24 pads of lens paper

To Do in Advance

√ ____ 1. Set equipment and supplies on all laboratory tables.
√ ____ 2. Familiarize yourself with the particular model (or models) of microscope your students will be using.

√ ____ 3. Be sure all microscopes are clean and the lowest power objective is in place.
√ ____ 4. Perform Activity 2.4 in advance so you know the correct order of the threads on the particular slides your students are using.

Tips and Trouble Spots

Introduction

Take time at the beginning of your laboratory session to discuss the section, "Care and Use of the Compound Microscope," with your students. This step can help you avoid many problems, including potential damage to both the microscopes and the slides.

You may begin by polling the class to see which students do and do not have microscope experience. Those lacking experience will require more hands-on guidance from you while doing the exercise. If you do not regularly check on your students' progress, they may skip steps or not realize they are not using the equipment appropriately. If many students are lacking experience, it may be worthwhile to provide a class demonstration, showing your students the location of the specific parts of the microscope.

Activity 2.1: Learning the Parts of a Light Microscope

Be familiar with the microscopes in your laboratory. They may not have a mechanical stage. Instead, they may have two movable stage clips. If so, these should be swung out to the side, the slide positioned between them, then the clips rotated in to secure the slide. Students should not lift the stage clips as they will become bent and useless with time.

If more than one model of microscope is in use in your lab, be sure students are aware of any differences and become familiar with them.

Objective lenses may have two numbers stamped on them. The magnification may not have an "X," but typical magnifications are 3X or 4X for a scanning objective, 10X for low, 40X to 45X for high, and 100X for oil immersion. Other numbers, if present, are usually DIN numbers, which refer to the optical standards used for the lens.

Students often have trouble distinguishing between the iris diaphragm and the condenser lens. They may need assistance with this.

Activity 2.2 Viewing a Specimen with the Compound Microscope

Also stress to your students the importance of always starting on low power because they can more easily locate the specimen and should not (usually) be able to plow through the slide. Be sure they know to only use the fine-focus adjustment knob when moving to high power so they do not damage the slide.

Students working with a binocular microscope may need assistance in positioning the two eyepieces so they get a single image. Watch for students closing one eye and using only one eyepiece and help them make the needed adjustment.

ACTIVITY 2.2 ANSWERS

9. Moving the condenser lens will increase or decrease both the total illumination and the resolution of the field of view.
13. Moving to higher magnification decreases the overall size of the field of view.

Activity 2.3: Viewing the Letter "e"

Students may be unclear on how to position the slide on the stage. Tell them to place the slide so the letter "e" appears as it would if they were reading their book.

ACTIVITY 2.3 ANSWERS

9. As the slide moves to the right, the image appears to move left.
10. As the slide moves away, the image appears to move closer.

Activity 2.4: Perceiving Depth of Field

Students should be reminded to only use the fine adjustment knob when they move to high power and to proceed slowly and cautiously. Too often they forget this during this activity and crack the slide while exploring the order of the three threads.

Activity 2.5: Using the Oil Immersion Lens

Stress to your students that oil should only be used with the oil immersion lens, and the slide should be thoroughly cleaned immediately after use so other objectives do not contact the oil. Remind them also to only use the fine adjustment knob when using the oil immersion lens so they do not damage the slide or the objective.

Activity 2.6: Determining the Diameter of the Field of View

Students may be unclear on how to place the ruler through the field of view. Draw an example on the overhead or chalkboard so they see the importance of centering the scale to measure the diameter, and the importance of placing a number at the left edge. Students also need to be reminded that if the diameter falls between marks on the ruler, they estimate the additional distance, not just go by the last whole number. Thinner rulers are best for this.

Students get frustrated when moving to high power as they mostly see part of one of the number markers. It becomes almost impossible to estimate millimeters with high power and oil immersion, but that reinforces the need for other units, such as micrometers, for microscopic measurement.

ACTIVITY 2.6 ANSWERS

5. The diameter decreases as the magnification increases.
6. The magnification of the ocular lens is 10×. If you are using the scanning objective lens, the total magnification will be 10× times 4×, which equals 40×.
13. Answers vary with the structures selected and the individual estimations each student makes.
17. Answers vary with the structures selected and the individual estimations each student makes.

Answers to Questions to Consider

Activity 2.1

1. The iris diaphragm controls the amount of light passing through the specimen. More light is not always better, and the amount of light decreases as the magnification increases. Adjusting the iris diaphragm can improve visibility.
2. The total magnification is 10 x 40 = 400X.

Activity 2.2

1. Answers vary, but if used correctly, binocular observation is better. We are binocular, so our eyes and brain are used to working that way. We have stereoscopic vision, so we gain three-dimensional vision when using both eyes. Using both eyes also reduces eyestrain.
2. Changing the magnification changes the amount of light being transmitted.
3. The entire specimen is illuminated from below. Only the light passing through the particular part of the specimen in the field of view reaches the eye. When moving to higher power, the field of view is reduced. Less specimen is in the field of view, so less light is transmitted.

Activity 2.3

The image is clearly reversed and inverted. When the slide is physically moved in one direction, the image viewed through the microscope clearly moves in the opposite direction.

Activity 2.4

Depth of field decreases with increased magnification. The image is magnified, but the actual diameter of the tube through which the image is viewed is unchanged, so less of it is visible within that space.

Activity 2.5

1. Using the oil immersion lens allows higher magnification and provides greater image resolution.
2. With oil immersion, less light is transmitted. If the specimen is very thick, the iris diaphragm and condenser may not be able to accommodate this decrease. The oil can be messy and extra care must be used to clean the slides and the microscope. Because the objective must be lowered into the oil, great care must be taken to avoid shattering the slide.

Activity 2.6

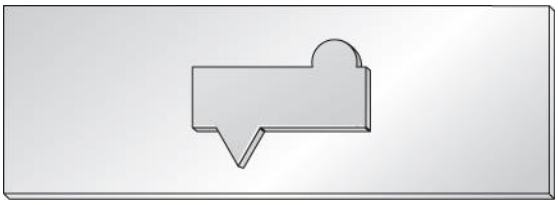
Answers vary depending on students' specific data, but if done correctly, they should support the relationship.

Answers to Review Sheet

1. Resolving power is the ability to distinguish close objects as separate and distinct.

2. e
3. b
4. a
5. f
6. c
7. d

8. The total magnification is 10 × 65 = 650X.
9. {It is inverted and reversed.}



10. The field of view will be smaller and less illuminated.
11. Your fingers would transfer oil and debris to the lenses, and they would impair viewing through the lens.
12. Lenses should always and only be cleaned with lens paper made specifically for high-quality optical lenses and, if needed for removing oil, the lens paper should be moistened with lens cleaner fluid.
13. Depth of field refers to the thickness (depth) of the tissue layer that is currently in focus.
14. e
15. b
16. a
17. g
18. h
19. d
20. f
21. c