Instructor’s Manual  
for the Laboratory Manual

***to accompany***

Hole’s Essentials of Human Anatomy and Physiology

**Fifteenth Edition**

**Phillip Snider**

**Terry R. Martin**



# CONTENTS

[PREFACE iv](#_Toc142272015)

[AN OVERVIEW v](#_Toc142272016)

[iNSTRUCTIONAL APPROACHES vi](#_Toc142272017)

[CORRELATION OF TEXTBOOK CHAPTERS AND LABORATORY EXERCISES vii](#_Toc142272018)

[SUGGESTED TIME SCHEDULE viii](#_Toc142272019)

## Fundamentals Of Human Anatomy And Physiology

[Laboratory Exercise 1 – Scientific Method and Measurements 1](#_Toc142272020)

[Laboratory Exercise 2 – Body Organization and Terminology 2](#_Toc142272021)

[Laboratory Exercise 3 – Chemistry of Life 4](#_Toc142272022)

[Laboratory Exercise 4 – Care and Use of the Microscope 5](#_Toc142272023)

## Cells

[Laboratory Exercise 5 – Cell Structure and Function 6](#_Toc142272024)

[Laboratory Exercise 6 – Movements Through Membranes 7](#_Toc142272025)

[Laboratory Exercise 7 – Cell Cycle **Error! Bookmark not defined.**](#_Toc142272026)9

## Tissues

[Laboratory Exercise 8 – Epithelial Tissues 10](#_Toc142272027)

[Laboratory Exercise 9 – Connective Tissues 11](#_Toc142272028)

[Laboratory Exercise 10 – Muscle and Nervous Tissues 12](#_Toc142272030)

## Integumentary System

[Laboratory Exercise 11 – Integumentary System 13](#_Toc142272031)

## Skeletal System

[Laboratory Exercise 12 – Bone Structure 14](#_Toc142272032)

[Laboratory Exercise 13 – Organization of the Skeleton 15](#_Toc142272033)

[Laboratory Exercise 14 – Skull 16](#_Toc142272034)

[Laboratory Exercise 15 – Vertebral Column and Thoracic Cage 18](#_Toc142272035)

[Laboratory Exercise 16 – Pectoral Girdle and Upper Limb 20](#_Toc142272036)

[Laboratory Exercise 17 – Pelvic Girdle And Lower Limb 22](#_Toc142272037)

[Laboratory Exercise 18 – Joint Structure And Movements 24](#_Toc142272039)

## Muscular System

[Laboratory Exercise 19 – Skeletal Muscle Structure and Function 25](#_Toc142272040)

[Laboratory Exercise 20 – Muscles of the Head and Neck 26](#_Toc142272041)

[Laboratory Exercise 21 – Muscles of the Chest, Shoulder, and Upper Limb 27](#_Toc142272042)

[Laboratory Exercise 22 – Muscles of the Abdominal Wall and Pelvic Floor 28](#_Toc142272043)

[Laboratory Exercise 23 – Muscles of the Hip and Lower Limb 29](#_Toc142272044)

## Surface Anatomy

[Laboratory Exercise 24 – Surface Anatomy 30](#_Toc142272045)

## Nervous System

[Laboratory Exercise 25 – Nervous Tissue and Nerves 32](#_Toc142272046)

[Laboratory Exercise 26 – Spinal Cord and Meninges 33](#_Toc142272047)

[Laboratory Exercise 27 – Reflex Arc and Reflexes 34](#_Toc142272048)

[Laboratory Exercise 28 – Brain and Cranial Nerves 35](#_Toc142272049)

[Laboratory Exercise 29 – Dissection of the Sheep Brain 36](#_Toc142272050)

## Special Senses

[Laboratory Exercise 30 – Ear and Hearing 37](#_Toc142272051)

[Laboratory Exercise 31 – Eye Structure 38](#_Toc142272052)

[Laboratory Exercise 32 – Visual Tests and Demonstrations 40](#_Toc142272053)

## Endocrine System

[Laboratory Exercise 33 – Endocrine Histology and Diabetic Physiology 41](#_Toc142272057)

## Cardiovascular System

[Laboratory Exercise 34 – Blood Cells and Blood Typing 43](#_Toc142272058)

[Laboratory Exercise 35 – Heart Structure 44](#_Toc142272061)

[Laboratory Exercise 36 – Cardiac Cycle 46](#_Toc142272062)

[Laboratory Exercise 37 – Blood Vessel Structure, Arteries, and Veins 47](#_Toc142272063)

[Laboratory Exercise 38 – Pulse Rate and Blood Pressure 50](#_Toc142272064)

## Lymphatic System

[Laboratory Exercise 39 – Lymphatic System 51](#_Toc142272067)

## Digestive System

[Laboratory Exercise 40 – Digestive Organs 52](#_Toc142272068)

[Laboratory Exercise 41 – Action of a Digestive Enzyme 54](#_Toc142272070)

## Respiratory System

[Laboratory Exercise 42 – Respiratory Organs 55](#_Toc142272071)

[Laboratory Exercise 43 – Breathing and Respiratory Volumes 56](#_Toc142272073)

## Urinary System

[Laboratory Exercise 44 – Urinary Organs 57](#_Toc142272075)

[Laboratory Exercise 45 – Urinalysis 58](#_Toc142272076)

## Reproductive Systems

[Laboratory Exercise 46 – Male Reproductive System 59](#_Toc142272078)

[Laboratory Exercise 47 – Female Reproductive System 60](#_Toc142272079)

[Laboratory Exercise 48 – Genetics 61](#_Toc142272082)

## Supplemental Laboratory Exercise

[Laboratory Exercise 49 – Blood Testing 63](#_Toc142272083)

(This lab Is available at www.mcgrawhillconnect.com)

[Appendix 1: Materials Needed 64](#_Toc142272086)

[Appendix 2: Laboratory Suppliers 71](#_Toc142272087)

[Appendix 3: Student Safety Rules Agreement 72](#_Toc142272088)

[Appendix 4: Student Informed Consent Form 73](#_Toc142272089)

PREFACE

This instructor’s manual is designed to assist those who are using the *Laboratory Manual to Accompany Hole’s Essentials of Human Anatomy and Physiology*, thirteenth edition by Terry R. Martin. It describes the purpose of the laboratory manual and its special features and provides suggestions for presenting the laboratory exercises to students. The instructor’s manual also parallels the laboratory manual, exercise by exercise, providing labels for unlabeled diagrams and answers to questions that appear in the laboratory reports. For some exercises, special instructional suggestions that propose alternative procedures, laboratory equipment, or laboratory techniques are provided.

Most of the illustrations and labels parallel the textbook very closely as requested by many of the users of the laboratory manual. Many of the leader lines are arranged differently than the textbook, and several illustrations are different than the textbook. This has been requested also by many of the users of the laboratory manual. I have attempted to reach a balance that will be beneficial for all students and instructors.

AN OVERVIEW

The *Hole’s Essentials of Human Anatomy and Physiology Laboratory Manual*, fifteenth edition, was written to accompany the textbook *Hole’s Essentials of Human Anatomy and Physiology*, fifteenth edition, by Dr. Charles Welsh and Cynthia Prentice-Craver. As in the case of the textbook, the laboratory manual is planned for students pursuing careers in allied health fields who have minimal backgrounds in the physical and biological sciences.

The manual contains forty-nine laboratory exercises that are closely integrated with the content of the textbook. The exercises are designed to review and illustrate various anatomical and physiological facts and principles presented in the textbook and to help students investigate some of these ideas in more detail.

The laboratory exercises include a variety of special features that are designed to stimulate student interest in the subject matter, to involve students in the learning process, and to guide them through the planned experiences. These features include the following:

*Materials Needed*. The laboratory materials listed are those that students require to complete the exercise and to perform the demonstrations and learning extensions.

*Safety*. If the laboratory exercise requires special safety guidelines, this section is included. General safety guidelines also appear as Appendix 1 of the laboratory manual.

.*Purpose of the Exercise*. The purpose provides a statement concerning the intent of the exercise—that is, what will be accomplished.

*Learning Outcomes*. The learning outcomes list in general terms what a student should be able to do after completing the exercise.

*Introduction*. The introduction briefly describes the subject of the exercise or the ideas that will be investigated

*Procedure*. The procedure provides a set of detailed instructions for accomplishing the planned laboratory activities. Usually these instructions are presented in outline form so that a student can proceed through the exercise in stepwise fashion. Frequently, the student is referred to particular sections of a textbook for necessary background information or for review of subject matter presented in some previous part of the course.

The procedures include a wide variety of laboratory activities and, from time to time, direct the student to complete various tasks in the laboratory reports.

*Demonstrations*. Demonstrations appear in separate boxes. They describe specimens, specialized laboratory equipment, or other materials of interest that the instructor may want to display to enrich the student’s laboratory experience.

*Learning Extensions*. Learning extensions also appear in separate boxes. They are planned to encourage students to extend their laboratory experiences. Some of these activities are open-ended in that they suggest how a student can plan an investigation or experiment and carry it out after receiving approval from the laboratory instructor.

*Illustrations*. Diagrams from the textbook are often used as aids for reviewing subject matter. New Images from the *Practice Atlas for Anatomy and Physiology and Anatomy & Physiology Revealed are also used to help students learn basic anatomy.* Other illustrations provide visual instructions for performing steps in procedures or are used to identify parts of instruments or specimens. Micrographs often are included to help students identify microscopic structures or to evaluate student understanding of tissues.

Some figures, such as one involving the skull, are presented so that they are suitable for coloring. You may want to have your students use colored pencils to highlight various parts of these illustrations. This activity should enhance their ability to observe the figures more carefully and help them locate and identify important anatomical features.

*Laboratory Reports*. Immediately following each exercise, there is a laboratory report to be completed by the student. These reports include various types of review activities, spaces for sketches of microscopic objects, tables for recording observations and experimental results, and questions dealing with the analysis of such data.

As a result of these laboratory exercises, students should develop a better understanding of the structural and functional characteristics of their bodies. In addition, their skills in gathering information by observation and experimentation should increase.

INSTRUCTIONAL APPROACHES

### Exercise Selection

Although the laboratory manual contains forty-nine separate exercises, it may not be possible to include all of them in any one program. However, because many of the exercises are relatively short and because the procedures of others are divided into sections, an instructor can easily select those exercises or parts of exercises that best meet the needs of a particular class.

These exercises also vary in the quantities of equipment needed to complete them; if necessary, an instructor can make some selection based upon the amount of laboratory equipment available for use by a class.

### Animal Dissection

In the laboratory manual, detailed instructions for dissecting certain organs, such as the sheep brain, sheep heart, mammalian eye, and pig kidney are also included. If an instructor prefers to have students dissect some animal, appropriate sections of a specialized dissection manual may be added.

A laboratory option is to obtain a cadaver as a demonstration specimen. If this is not possible, consider a field trip to a location that has a prosected cadaver. A minimum of two viewings is recommended—one during muscle study and the other near the end of the course.

### The Use of Animals in Biology Education\*

The National Association of Biology Teachers (NABT) believes that the study of organisms, including nonhuman animals, is essential to the understanding of life on Earth. NABT recommends the prudent and responsible use of animals in the life science classroom. NABT believes that biology teachers should foster a respect for life. Biology teachers also should teach about the interrelationship and interdependency of all things.

Classroom experiences that involve nonhuman animals range from observation to dissection. NABT supports these experiences so long as they are conducted within the long-established guidelines of proper care and use of animals, as developed by the scientific and educational community.

As with any instructional activity, the use of nonhuman animals in the biology classroom must have sound educational objectives. Any use of animals, whether for observation or dissection, must convey substantive knowledge of biology. NABT believes that biology teachers are in the best position to make this determination for their students.

NABT acknowledges that no alternative can substitute for the actual experience of dissection or other use of animals and urges teachers to be aware of the limitations of alternatives. When the teacher determines that the most effective means to meet the objectives of the class do not require dissection, NABT accepts the use of alternatives to dissection including models and the various forms of multimedia. The Association encourages teachers to be sensitive to substantive student objections to dissection and to consider providing appropriate lessons for those students when necessary.

To implement this policy, NABT endorses and adopts the “Principle and Guidelines for the use of Animals in Precollege Education” of the Institute of Laboratory Animals Resources (National Research Council). Copies of the “Principle and Guidelines” may be obtained from the ILAR (2101 Constitution Avenue, NW, Washington DC 20418; 202-334-2590).

\*Adopted by the Board of Directors in October 1995. This policy supersedes and replaces all previous NABT statements regarding animals in biology education.

### Background Information

The procedures of many exercises begin by suggesting that students review specific sections of the textbook. If the subject matter involved in a particular exercise has been covered recently in lecture, the students may be able to accomplish such a review rather quickly. On the other hand, if the material has not been presented previously, this part of a procedure may be used as a means of introducing information needed to understand the ideas presented in the exercise.

When the procedure is used to introduce new material, an instructor may ask students to complete the first section before coming to the laboratory. Following this, some portion of the laboratory time may be needed for class discussion of the new material.

CORRELATION OF TEXTBOOK CHAPTERS AND LABORATORY EXERCISES

| *Textbook Chapters* | *Related Laboratory Exercises* |
| --- | --- |
| Ch. 1 Introduction to Human Anatomy and Physiology | Ex. 1 Scientific Method and Measurements  Ex. 2 Body Organization and Terminology |
| Ch. 2 Chemical Basis of Life | Ex. 3 Chemistry of Life |
| Ch. 3 Cells | Ex. 4 Care and Use of the Microscope  Ex. 5 Cell Structure and Function  Ex. 6 Movements Through Membranes  Ex. 7 Cell Cycle |
| Ch. 4 Cellular Metabolism |  |
| Ch. 5 Tissues | Ex. 8 Epithelial Tissues  Ex. 9 Connective Tissues  Ex. 10 Muscle and Nervous Tissues |
| Ch. 6 Integumentary System | Ex. 11 Integumentary System |
| Ch. 7 Skeletal System | Ex. 12 Bone Structure  Ex. 13 Organization of the Skeleton  Ex. 14 Skull  Ex. 15 Vertebral Column and Thoracic Cage  Ex. 16 Pectoral Girdle and Upper Limb  Ex. 17 Pelvic Girdle and Lower Limb  Ex. 18 Joint Structure and Movements |
| Ch. 8 Muscular System | Ex. 19 Skeletal Muscle Structure and Function  Ex. 20 Muscles of the Head and Neck  Ex. 21 Muscles of the Chest, Shoulder, and Upper Limb  Ex. 22 Muscles of the Abdominal Wall and Pelvic Floor  Ex. 23 Muscles of the Hip and Lower Limb  Ex. 24 Surface Anatomy |
| Ch. 9 Nervous System | Ex. 25 Nervous Tissue and Nerves  Ex. 26 Spinal Cord and Meninges  Ex. 27 Reflex Arc and Reflexes  Ex. 28 Brain and Cranial Nerves  Ex. 29 Dissection of the Sheep Brain |
| Ch. 10 The Senses | Ex. 30 Ear and Hearing  Ex. 31 Eye Structure  Ex. 32 Visual Tests and Demonstrations |
| Ch. 11 Endocrine System | Ex. 33 Endocrine Histology and Diabetic Physiology |
| Ch. 12 Blood | Ex. 34 Blood Cells and Blood Typing  Ex. 49 Blood Testing (available online) |
| Ch. 13 Cardiovascular System | Ex. 35 Heart Structure  Ex. 36 Cardiac Cycle  Ex. 37 Blood Vessel Structure, Arteries, and Veins  Ex. 38 Pulse Rate and Blood Pressure |
| Ch. 14 Lymphatic System and Immunity | Ex. 39 Lymphatic System |
| Ch. 15 Digestive System and Nutrition | Ex. 40 Digestive Organs  Ex. 41 Action of a Digestive Enzyme |
| Ch. 16 Respiratory System | Ex. 42 Respiratory Organs  Ex. 43 Breathing and Respiratory Volumes |
| Ch. 17 Urinary System | Ex. 44 Urinary Organs  Ex. 45 Urinalysis |
| Ch. 18 Water, Electrolyte, and Acid-Base Balance |  |
| Ch. 19 Reproductive Systems | Ex. 46 Male Reproductive System  Ex. 47 Female Reproductive System |
| Ch. 20 Pregnancy, Growth, Development, and Genetics | Ex. 48 Genetics |

SUGGESTED TIME SCHEDULE

Different instructional programs provide different lengths of time for laboratory preparations, work activities, and follow-up discussions. Other factors that influence the time required for each exercise are the availability and variety of laboratory equipment and materials. Consequently, it is difficult to make precise suggestions for the amounts of time that should be set aside for particular laboratory exercises.

The suggested time schedule was prepared with these limitations in mind. The hours listed for each exercise indicate the minimal time that probably will be needed for students who are acquainted with the subject matter of the exercise to complete the laboratory work. Students who lack background information and who have to read various sections of the textbook before beginning an exercises probably will require additional time. Similarly, students who are expected to complete the laboratory reports in class may need more time.

| *Laboratory Exercise* | *Minimal Time* |  |
| --- | --- | --- |
| Ex. 1 | Scientific Method and Measurements | 2 hr. |
| Ex. 2 | Body Organization and Terminology | 3 hr |
| Ex. 3 | Chemistry of Life | 2 hr |
| Ex. 4 | Care and Use of the Microscope | 2 hr |
| Ex. 5 | Cell Structure and Function | 2 hr |
| Ex. 6 | Movements Through Membranes | 3 hr |
| Ex. 7 | Cell Cycle | 1 hr |
| Ex. 8 | Epithelial Tissues | 2 hr |
| Ex. 9 | Connective Tissues | 2 hr |
| Ex. 10 | Muscle and Nervous Tissues | 1 hr |
| Ex. 11 | Integumentary System | 2 hr |
| Ex. 12 | Bone Structure | 1 hr |
| Ex. 13 | Organization of the Skeleton | 1 hr |
| Ex. 14 | Skull | 3 hr |
| Ex. 15 | Vertebral Column and Thoracic Cage | 2 hr |
| Ex. 16 | Pectoral Girdle and Upper Limb | 2 hr |
| Ex. 17 | Pelvic Girdle and Lower Limb | 2 hr |
| Ex. 18 | Joint Structure and Movements | 2 hr |
| Ex. 19 | Skeletal Muscle Structure and Function | 1 hr |
| Ex. 20 | Muscles of the Head and Neck | 1 hr |
| Ex. 21 | Muscles of the Chest, Shoulder, and Upper Limb | 2 hr |
| Ex. 22 | Muscles of the Abdominal Wall and Pelvic Floor | 1 hr |
| Ex. 23 | Muscles of the Hip and Lower Limb | 2 hr |
| Ex. 24 | Surface Anatomy | 2 hr |
| Ex. 25 | Nervous Tissue and Nerves | 2 hr |
| Ex. 26 | Spinal Cord and Meninges | 1 hr |
| Ex. 27 | Reflex Arc and Reflexes | 1 hr |
| Ex. 28 | Brain and Cranial Nerves | 2 hr |
| Ex. 29 | Dissection of the Sheep Brain | 2 hr |
| Ex. 30 | Ear and Hearing | 2 hr |
| Ex. 31 | Eye Structure | 2 hr |
| Ex. 32 | Visual Tests and Demonstrations | 2 hr |
| Ex. 33 | Endocrine Histology and Diabetic Physiology | 3 hr |
| Ex. 34 | Blood Cells and Blood Typing | 3 hr |
| Ex. 35 | Heart Structure | 2 hr |
| Ex. 36 | Cardiac Cycle | 3 hr |
| Ex. 37 | Blood Vessel Structure, Arteries, and Veins | 3 hr |
| Ex. 38 | Pulse Rate and Blood Pressure | 2 hr |
| Ex. 39 | Lymphatic System | 1 hr |
| Ex. 40 | Digestive Organs | 2 hr |
| Ex. 41 | Action of a Digestive Enzyme | 2 hr |
| Ex. 42 | Respiratory Organs | 2 hr |
| Ex. 43 | Breathing and Respiratory Volumes | 1 hr |
| Ex. 44 | Kidney Structure | 2 hr |
| Ex. 45 | Urinalysis | 2 hr |
| Ex. 46 | Male Reproductive System | 2 hr |
| Ex. 47 | Female Reproductive System | 2 hr |
| Ex. 48 | Genetics | 2 hr |
| Ex. 49 | Blood Testing (available online) | 2 hr |

LABORATORY EXERCISE 1

SCIENTIFIC METHOD AND MEASUREMENTS

### Brain icon Critical Thinking Application Answer

Answers and data will vary.

### Laboratory Report Answers

#### PART A

1. (experimental results)
2. (experimental results)
3. Answers will vary, however many students will conclude that the data will support the original hypothesis.

#### PART B

1. Answers will vary

LABORATORY EXERCISE 2

BODY ORGANIZATION AND TERMINOLOGY

### Instructional Suggestion

If a dissectible human torso model is not available, you might want to have students consult the figures in various sections of the textbook, particularly reference plates following chapter 1, to gain some understanding of the organizational pattern of the human body.

### Figure Labels

#### FIG. 2.1

1. Thoracic
2. Abdominal
3. Abdominopelvic
4. Pelvic
5. Cranial
6. Vertebral

#### FIG. 2.2.*a*

1. Visceral pleura
2. Pleural cavity
3. Parietal pleura
4. Visceral pericardium (epicardium)
5. Pericardial cavity
6. Parietal pericardium

#### FIG. 2.2*b*

1. Visceral peritoneum
2. Peritoneal cavity
3. Parietal peritoneum

FIG. 2.5

Instructor check for correct placement of terms and leader lines.

#### FIG. 2.6*a*

Instructor check for correct placement of terms and leader lines.

#### FIG. 2.6*b*

Instructor check for correct placement of terms and leader lines.

#### FIG. 2.7*a*

1. Nasal
2. Oral
3. Cervical
4. Acromial
5. Axillary
6. Mammary
7. Brachial
8. Antecubital
9. Abdominal
10. Antebrachial
11. Carpal
12. Palmar
13. Digital
14. Genital
15. Crural
16. Tarsal
17. Cephalic
18. Frontal
19. Orbital
20. Buccal
21. Mental
22. Sternal
23. Pectoral
24. Umbilical
25. Inguinal
26. Coxal
27. Patellar
28. Pedal

#### FIG. 2.7*b*

1. Otic
2. Occipital
3. Acromial
4. Vertebral
5. Brachial
6. Dorsal
7. Cubital
8. Lumbar
9. Sacral
10. Gluteal
11. Perineal
12. Femoral
13. Popliteal
14. Crural (leg) or sural (calf)
15. Plantar

### Laboratory Report Answers

#### PART A

1. a
2. d
3. a
4. a
5. b
6. d
7. c
8. a
9. e
10. c
11. d
12. d

#### PART B

1. c
2. d
3. h
4. g
5. j
6. i
7. e
8. f
9. k
10. b
11. a

#### PART C

1. Inferior
2. (Correct)
3. (Correct)
4. Anterior
5. (Correct)
6. (Correct)
7. Distal
8. (Correct)
9. (Correct)
10. Posterior

#### PART D

1. e
2. k
3. b
4. i
5. l
6. j
7. g
8. c
9. d
10. h
11. f
12. a

#### PART E

1. l
2. c
3. h
4. i
5. k
6. f
7. j
8. g
9. d
10. a
11. b
12. e

### Brain icon Critical Thinking Application Answers

#### PART F

1. LUQ
2. RLQ
3. Any or all quadrants
4. RUQ
5. LUQ or LLQ
6. LUQ

#### PART G

