Preface

This laboratory manual is designed to serve the lab course that accompanies the two-semester anatomy and physiology lecture course. It provides students with comprehensive coverage of anatomy and physiology, beautiful full-color art and photographs, and an intuitive pedagogical framework. The primary goals of this manual are to provide students with hands-on experiences that reinforce the information they learn in the lecture course and to help them understand three-dimensional relationships, visualize complex structures, and comprehend intricate physiological processes.

The manual is written to correspond to all current two-semester anatomy and physiology textbooks, although those students and instructors using Fundamentals of Anatomy & Physiology, Tenth Edition, by Frederic H. Martini, Judi L. Nath, and Edwin F. Bartholomew will recognize here some of the superb art from that text by William Ober and Claire Garrison, Martini’s renowned biomedical illustrators.

This sixth edition manual is available in three separate versions. The Main Version covers the full two-semester A&P curriculum, including dissections of the cow eye and of the sheep heart, brain, and kidney. The Cat Version includes all of the same material plus an additional section of nine cat dissection exercises encompassing the major body systems. The Pig Version, similarly, includes all of the material from the Main Version with a separate section of nine fetal pig dissection exercises. The Cat and Pig Versions make the manual more useful to instructors whose students perform animal dissections in the lab. The outstanding dissections and accompanying photographs are by Shawn Miller and Mark Neilsen and I thank each of them for their expertise.

Organization

The lab manual contains 47 exercises, plus the 9 additional dissection exercises in each of the Cat and Pig Versions. Large systems, such as the skeletal, muscular, and nervous systems, appear across several exercises, the first serving as an overview exercise that introduces the major anatomical organization of the system. Programs with limited lab time might choose the overview exercises for a hands-on summary of these organ systems that can be completed during a short lab period.

Exercise Organization

Each exercise is organized into a series of Lab Activities that divide the material into natural sets of information to focus students on related concepts. Every exercise begins with a list of the Lab Activities and a set of Learning Outcomes for student learning. A general introduction to the exercise gives students a preview of what they are about to learn; then individual activities focus on more specific study. The activities are self-contained, and instructors may easily assign only certain activities within an exercise.

Each Lab Activity section first introduces the activity and reviews the concepts necessary for understanding it. These are followed by two or three QuickCheck Questions that students can use to gauge their comprehension of the material before proceeding. The activity itself begins with a clearly marked list of Materials and the Procedures for carrying it out. Features such as Clinical Application boxes, Study Tip boxes, Draw It! activities, and Make a Prediction questions provide students with meaningful context and additional practice and review as they complete each activity. Each exercise concludes with a Review & Practice Sheet, which includes data reporting, review questions, and labeling and drawing activities to assess and reinforce student learning.

Cat and Pig Dissection Exercises

Dissection gives students perspective on the texture, scale, and relationships of anatomy. For those instructors who choose to teach dissection in their laboratories, this manual is available in two dissection versions, the Cat Version and the Pig Version, featuring sections at the back of the manual detailing the dissection of the cat or fetal pig. Included are nine exercises that progress through the major body systems, with the goal of relating these exercises to students’ study of the human body. Safety guidelines and disposal methods are incorporated into each dissection exercise.

BIOPAC® Activities

Beginning with the second edition, this manual has featured exercises using the BIOPAC Student Lab System, an integrated suite of hardware and software that provides students with powerful tools for studies in physiology. BIOPAC is used in Exercises 22, 23, 30, 37, and 40, and can be easily identified by the BIOPAC logo to the left of the activity title. All of these BIOPAC activities feature step-by-step instructions, full-color art, and instructive screenshots to walk students through the procedures. The instructions in this lab manual are for use with the BIOPAC MP36 (or MP35/30) data acquisition unit, and Biopac Student Lab (BSL) Software version 3.7.5 or better. Instructions for use of the new two-channel data acquisition unit, the MP45, can be found in the Instructor Resources at MasteringA&P (masteringaandp.com).
New to This Edition

In addition to the many technical changes in this edition, such as updated terminology and internal reorganization of exercises in response to reviewer feedback, this revision focuses on improving the visual presentation throughout and provides students with more opportunities for practice and review. These are the key changes in this new edition:

- **Larger, more visually effective art from Martini /Nath/ Bartholomew Fundamentals of Anatomy & Physiology, Tenth Edition**, appears throughout the manual. Improved text–art integration in the figure layouts enhances the readability of the art. Part captions are now integrated into the figures so that relevant text is located immediately next to each part of the figure. A new two-column design better showcases the Martini art.

- **Over 150 new photographs by author Michael Wood** add an “in the lab” style visual guide to histology, lab models, laboratory equipment, and dissections. The new Dissection Photo Series present a visual sequence of steps for organ dissections and lab instrument use.

- **More labeling activities** are offered within the tear-out end of exercise Review & Practice Sheets throughout the manual, including the dissection exercises. Photographs of laboratory models for labeling are also available at MasteringA&P as self-grading activities.

- **Improved “Draw It!” activities**, complete with blank drawing boxes for the student, are now signaled by a repeating color treatment to call out the hands-on learning opportunity for students. Several Draw It! activities include online video tutorials that demonstrate drawing techniques. See page xiii for more information.

- **New “Make a Prediction” questions** challenge students to think critically by asking conceptual and/or analytical questions. Students are asked to make predictions and propose hypotheses. This feature appears only where relevant—for example, in exercises that require data interpretation and analysis.

- **BIOPAC activities** have been extensively rewritten with an emphasis on streamlining the instructions to enhance usability of the manual in concert with the BIOPAC software. The number of BIOPAC data graphs has been reduced to prompt students to evaluate their own data during these physiological investigations. In addition, a new BIOPAC activity investigates Respiratory Rate and Depth (Exercise 40).

- **This Laboratory Manual comes with MasteringA&P**. MasteringA&P is the leading online homework, tutorial, and assessment system, designed to improve results by engaging students before, during, and after class. Instructors ensure students arrive ready to learn by assigning educationally effective content before class, and encourage critical thinking and retention with in-class resources such as Learning Catalytics®. Students can further master concepts after class through traditional and adaptive homework assignments that provide hints and answer-specific feedback. The MasteringA&P gradebook records scores for all automatically graded assignments in one place, while diagnostic tools offer access to rich data to assess student understanding and misconceptions. See page xii for more information.

- **NEW! Core Lab Topics Coaching Activities** use MasteringA&P data to determine the most frequently assigned exercises. A total of 37 new Coaching Activities tutor students through core lab topics such as blood typing and tracing blood from the heart to the hand. All Coaching Activities ask students to interact with visuals from the lab manual. Varied question types include multiple-choice, art-labeling, ranking, and sorting, as well as wrong-answer feedback and hints.

- **NEW! Exercise-opening MasteringA&P® banner** includes a detailed list of student media resources in the MasteringA&P Study Area, individually tailored to each exercise. The list showcases Practice Anatomy Lab™ (PAL)™ 3.0 navigation pathways, applicable A&P Flix™, and relevant PhysioEx™ 9.0 activities.

- **Updated terminology** throughout follows the nomenclature of Terminologia Anatomica, the standard of anatomical terminology published by the Federative Committee on Anatomical Terminology. Eponyms are frequently included in the narrative to expose students to both scientific and clinical usage of the language.

Exercise-by-Exercise Changes

The following detailed outline summarizes the major changes by exercise:

**Exercise 1**
- The section on microscope safety has been revised for increased clarity.

**Exercise 2**
- Art has been updated.
- The review has a new labeling figure.
- A Study Tip on understanding sectional anatomy has been added.

**Exercise 3**
- A new cadaver photo highlights the major organs of the ventral body cavity.

**Exercise 4**
- The microscope photo has been updated.
- Three new figures highlight key microscope skills.
Exercise 5
- A new activity has been added on observing cells in each of the four major tissue groups. This is an excellent survey of the variety of cells and introduces cells making tissues.
- New mitosis micrographs have been added.
- The cell model labeling activity is new.

Exercise 6
- The new at-the-bench activity allows students to study active transport by examining the thyroid gland on a slide and observing where follicle cells have taken in stored hormone by endocytosis.

Exercise 7
- New micrographs highlight simple squamous, simple columnar, stratified squamous, and pseudostratified ciliated columnar epithelia.

Exercise 8
- New tissue photos feature areolar, adipose, dense regular, hyaline cartilage, elastic cartilage, fibrocartilage, and bone.

Exercise 10
- The neuron micrograph is new.

Exercise 11
- The micrographs have been updated.
- The Clinical Application on acne has been expanded.
- A new skin model for labeling has been added to the Review & Practice Sheet.

Exercise 13
- A new bone model photo for labeling has been added to the Review & Practice Sheet.

Exercise 14
- A new figure for gross anatomy of a vertebra and new figures of the skull have been added.
- The photograph of the floor of the skull has been improved.
- The Review & Practice Sheet has been greatly expanded with photographs for labeling structures of the skull, vertebrae, and thoracic cage.

Exercise 15
- Each labeled structure in the figures is described in text.
- A new description for the pectoral girdles has been provided.
- The Study Tip on the humerus is new.
- The pelvis photo is new.
- The procedure for an articulating skeleton is new.
- A new Laboratory Activity covers sex differences in the human skeleton.
- The expanded Review & Practice Sheet has 11 new labeling activities, one for each appendicular bone.

Exercise 16
- Lab Activity 5 has been expanded with the addition of shoulder and hip joint text and figures.

Exercise 17
- A muscle fiber model for labeling has been added.
- The neuromuscular junction is depicted in a new photo.

Exercise 18
- The Review & Practice Sheet has two new labeling activities with photos of the muscles of the head.

Exercise 19
- The labeling of the abdominal muscles has been rearranged into anatomical layers.
- The muscle model labeling photo in the Review & Practice Sheet is new.

Exercise 20
- A new figure of muscles of the upper limb and a new cadaver photo of the upper limb have been added.
- The rotator cuff is highlighted.
- The muscle model labeling photo in the Review & Practice Sheet is new.

Exercise 21
- Discussion of the thigh is supported with cadaver photos.
- The muscle labels are better sequenced.
- The muscle model labeling photo in the Review & Practice Sheet is new.

Exercise 22
- The number of pages has been reduced to save costs.
- The BIOPAC material has been updated to improve the link between manual and software screen prompts.

Exercise 23
- An application question about myasthenia gravis at the motor end plate has been added.
- BIOPAC material has been updated to improve the link between manual and software screens and prompts.

Exercise 24
- A spinal cord model has been provided for labeling in the Review & Practice Sheets.
- The art has been tightened for better flow and reduced pages.

Exercise 25
- The meninges cadaver photo is new.
- New brain photos provide more useful lab views of the brain.
- A new sheep brain dissection sequence steps students through the dissection process.
Exercise 26
- The number of figures has been reduced to help students focus on the key anatomical differences between sympathetic and parasympathetic divisions.
- New headers in the exercise group important information.
- The Review & Practice Sheet has sections assignable in MasteringA&P.

Exercise 27
- New micrographs of general receptors have been provided.

Exercise 29
- The cow eye dissection now has a new step-wise photography.
- New micrographs of general receptors have been added to the labeling section of the Review & Practice Sheet.

Exercise 30
- The art and text was tightened up to reduce pages and provide cost savings to students.
- The narrative for the BIOPAC activity “Electrooculogram” has been revised for better use in conjunction with current versions of the BIOPAC software.

Exercise 31
- The use of scala vestibuli and scala tympani has been standardized.
- Art has been updated.
- Lab model photos are provided in the lab report.

Exercise 33
- The revised art includes new microphotographs.

Exercise 34
- The blood cell micrographs are new.
- A new lab activity on hemoglobin measurement has been added.

Exercise 35
- The sheep heart dissection photo series is new.
- Art has been updated.

Exercise 36
- The updated art program has flowcharts embedded into the art for better identification of blood vessels in sequence.
- The veins discussion has been reorganized to present lower limb drainage followed by abdominal veins and inferior vena cava.

Exercise 37
- The narrative in both of the BIOPAC activities has been extensively revised for better use in conjunction with BIOPAC software. Fewer BIOPAC graphs are needed, as computer screenshots cultivate data interpretation skills in students.
- Redesign of data tables guides students through the analysis.

Exercise 38
- Updated text uses the more common term lymphatic rather than lymphoid.

Exercise 39
- A new photograph series presents the use of a wet spirometer.

Exercise 40
- A new photograph of a wet spirometer provides a visual reference for equipment used in most A&P labs.
- The narratives for the BIOPAC activity “Volumes and Capacities” and “Respiratory Rate and Depth” have been completely revised for better use in conjunction with current versions of the BIOPAC software.

Exercise 41
- Expanded histological coverage of digestive organs—including salivary glands, stomach, small intestine, pancreas, liver, and gallbladder—is supported with new micrographs and corresponding narrative.

Exercise 42
- The narrative has been reworked for stronger association between the process of chemical digestion and the lab activities using various enzymes and substrates.
- The protein digestion activity has been redesigned to use albumin for a protein source for more consistent results.

Exercise 43
- Expanded histological coverage of urinary organs, including ureters, bladder, and urethra, is supported with new micrographs and a revised narrative.

Exercise 45
- Reorganization offers a better pedagogical sequence of the male and female anatomies with the study of gametogenesis coming after the anatomical studies.
- Expanded histological coverage of male and female organs is supported with new micrographs and a revised narrative.

Exercise 46
- Photographs of popular embryology models have been added to Review and Practice Sheets for labeling.