INSTRUCTOR'S MANUAL

TO ACCOMPANY

ANATOMY & PHYSIOLOGY:

THE UNITY OF FORM AND FUNCTION

NINTH EDITION

Kenneth S. Saladin, Ph.D.
Professor of Biology
Georgia College and State University

Prepared by
David L. Evans, Ph.D.
Professor of Biology
Pennsylvania College of Technology,
an affiliate of Pennsylvania State University

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Preface

Each chapter of this Instructor's Manual includes a Chapter Overview, Topics for Discussion, Learning Strategies and Techniques, Related Readings, Related Films and Videocassettes, Related Software, Critical Thinking Questions and their Answers, and Clinical Application Question. Each **Chapter Overview** includes an **Introduction**, which provides key paradigms related to the major concepts in each chapter, and a summary of **Key Concepts**. The **Topics for Discussion** section provides research ideas and an expanded list of references that instructors can provide to students to track down additional information. Additionally, each chapter includes lists of video and software titles, each accompanied by the name of at least one supplier. The **Learning Strategies** section includes ideas that I have successfully used over the past 40 years of teaching biology in universities and high schools. Not all of these ideas can be implemented because of time constraints, equipment availability, or even teaching style. The final section provides **Critical Thinking Questions and their answers** plus a **Clinical Application Question and Answer**.

I hope the *Instructor's Manual to Accompany Anatomy &Physiology: The Unity of Form and Function* will be of benefit. If I can help you further, or if you would like to forward comments about what I have written, please contact me.

Professor David L. Evans, Ph.D., M.Sc., B.S., F.R.E.S.
E-mail: DEVANS@PCT.EDU
Department of Natural Science, DIF #48
One College Avenue
Pennsylvania College of Technology, an affiliate of the Pennsylvania State University
Williamsport, PA 17701

SUGGESTED COURSE OUTLINES

Two-semester Sequence

In each semester: 40 + 4 hours for exams = 44 hours/semester

First semester

Lecture hours	Topic	Reading in Saladin
1	Major themes in anatomy and physiology	Chapter 1
	General orientation to human anatomy	Atlas A
3	The molecules of life	Chapter 2
3	Cellular form and function	Chapter 3
3	Genetics and cellular function	Chapter 4
3	The human tissues	Chapter 5
3	The integumentary system	Chapter 6
2	Skeletal tissue	Chapter 7
2	Anatomy of the skeletal system	Chapter 8
1	Form and function of the joints	Chapter 9
2	Anatomy of the muscular system	Chapter 10, Atlas B
3	Muscle physiology	Chapter 11
2	Nervous tissue	Chapter 12
1	The spinal cord, spinal nerves, and somatic reflexes	Chapter 13
2	The brain and cranial nerves	Chapter 14
1	The autonomic nervous system and visceral reflexes	Chapter 15
3	The sense organs	Chapter 16
4	The endocrine system	Chapter 17

Second semester

Lecture hours	Topic	Reading in Saladin
3	Blood	Chapter 18
6	The heart	Chapter 19
3	The blood vessels	Chapter 20
4	Lymphatic and immune systems	Chapter 21
3	The respiratory system	Chapter 22
3	Urinary system	Chapter 23
3	Fluid, electrolyte, and acid-base	Chapter 24
4	The digestive system	Chapter 25
3	Nutrition and metabolism	Chapter 26
5	Male and female reproductive systems	Chapters 27-28
3	Human development	Chapter 29

Three-quarter Sequence

In each quarter: 27 lectures + 3 hours for exams = 30 hours

First quarter

Lecture hours	Topic	Reading in Saladin
1	Major themes in anatomy and physiology	Chapter 1
	General orientation to human anatomy	Atlas A
4	The molecules of life	Chapter 2
3	Cellular form and function	Chapter 3
3	Genetics and cellular function	Chapter 4
3	The human tissues	Chapter 5
3	The integumentary system	Chapter 6
2	Skeletal tissue	Chapter 7
2	Anatomy of the skeletal system	Chapter 8
1	Form and function of the joints	Chapter 9
2	Anatomy of the muscular system	Chapter 10, Atlas B
3	Muscle physiology	Chapter 11

Second quarter

Lecture hours	Topic	Reading in Saladin
2	Nervous tissue	Chapter 12
2	The spinal cord, spinal nerves, and somatic reflexes	Chapter 13
3	The brain and cranial nerves	Chapter 14
1	The autonomic nervous system and visceral reflexes	Chapter 15
3	The sense organs	Chapter 16
4	The endocrine system	Chapter 17
3	Blood	Chapter 18
6	The heart	Chapter 19
3	The blood vessels	Chapter 20

Third quarter

Lecture hours	Topic	Reading in Saladin
3	Lymphatic and immune systems	Chapter 21
3	The respiratory system	Chapter 22
3	Urinary system	Chapter 23
3	Fluid, electrolyte, and acid-base	Chapter 24
4	The digestive system	Chapter 25
3	Nutrition and metabolism	Chapter 26
5	Male and female reproductive systems	Chapters 27-28
3	Human development	Chapter 29

CHAPTER 1: MAJOR THEMES OF ANATOMY AND PHYSIOLOGY

Chapter Overview

Introduction

Chapter 1 explores the breadth of anatomy and physiology and the harmony of form and function. Saladin discusses the nature of life in general and humans more specifically. He briefly delves into the evolution of humans as a way of explaining why we have the specific type of structures that we have. Evolution can be a useful framework to make sense out of particular adaptations. The next section addresses the nature of science and the inductive method. The chapter reviews the history of biomedical sciences. History is a useful approach to getting students to understand the way science works. Often students think of science as just an assemblage of facts that they must memorize but lose sight of science as a dynamic process. The chapter highlights the organizational hierarchy of the study of human anatomy and physiology. Finally, the author provides a summary of homeostasis, the primary unifying theme of physiology.

Key Concepts

Here are some concepts that students should come away with after reading this chapter:

- unity of form and function;
- history of biomedical science;
- the modern scientific method;
- human origins and adaptations;
- characteristics of living things that characterize humanness;
- the organizational hierarchy of the body;
- gradients and flow;
- characteristics of living things;
- homeostasis including the importance of feedback mechanisms;
- an introduction to anatomical terminology along with some help with pronunciation;
- and a review of imaging techniques.

Topics for Discussion

1. Investigate the history of science related to activities in the local area. This could be a near-by hospital where an experimental procedure was first carried out, an agricultural experimental farm, or a research lab.
2. List some familiar examples of homeostasis in the body: body temperature, osmoregulation, body weight.
3. How can death be determined in humans?
4. Are viruses living things or not? Recently some very large viruses have been found so the question has been taken seriously by some scientists. Sometimes the discussion of the question is more interesting than the actual answer.
5. What are some of the ways that the environment affects the body? Temperature, humidity, and availability of food are some aspects that might come up.
6. What are some ways that fad diets or excesses of certain foods or dietary supplements might affect homeostasis?
7. How are the form and function of body parts related?
8. What is the history of the light microscope? Get the students to make lists of body and cell imaging techniques.

9. How are businesses like living things? Look over the characteristics of living things and think of analogous functions and units within living things. Some examples: businesses with useful characteristics will successfully adapt, grow and, reproduce (viz.: evolution), individual factories are like cells, and corporate hierarchies are similar to the motor hierarchy in the nervous system.
10. How has society's view of science changed over the past 500 years?
11. If you really want a discussion going, try bringing up the Tuskeegee Study of syphilis-infected African-American men who were denied free penicillin (or, apparently, any other meaningful treatment) in the name of science. Sadly, the study was allowed to continue into the 1970's and was US government funded.

Related Readings

Agur, A. and A.F. Dalley. *Grant's Atlas of Anatomy*, 14th ed. Hagerstown, MD: Lippencott Williams & Wilkins, 2016.

Anon. Scientific *Style and Format: the CSE Manual for Authors, Editors, and Publishers*, 8th ed. Cambridge; New York: Cambridge University Press, 2014.

Anon. *Physicians' Desk Reference*, 71st ed. Oradell, NJ: Medical Economics Company, Inc., 2017. The reference book to get information about legal drugs.

Baigre, B.S. *Scientific Revolutions*. Upper Saddle River, NJ: Pearson, 2004. The author provides the background and then reprints original and translated articles.

Gardner, E. *History of Biology*, 2nd ed. Minneapolis, MN: Burgess Publishing Company, 1965. This book is out of print but it is worth looking for.

Gilroy, A.M., et al. *Atlas of Anatomy*, 3rd ed. New York: Thieme Medical Publishers, Inc, 2016.

Hale, R.B. and T. Coyle. *Albinus on Anatomy*. New York: Dover Publications, Inc., 1988. This 18th Century classic is still in print but downloadable too.

Hellman, H. *Great Feuds in Science*. NY: John Wiley & Sons, Inc., 1998. This book sets the stage for each argument and provides the outcome, if it is known.

Henry, J. *The Scientific Revolution and the Origins of Modern Science*. London: Palgrave Macmillan, 2002.

Hitti, P.K. *The History of the Arabs*, 10th ed. London: Palgrave Macmillan, 2002. There is a section on science in this classic reference.

Larson, E.J. and L. Witham. "Scientists and Religion in America," *Sci. Am*. 281 (1998): 89-93.

Mahsood, E. "Arab Science: Blooms in the Desert," *Nature* 416 (2002): 120-122.

Maziak, W. "Science in the Arab World: Vision of Glories Beyond," *Science* 308 (2005): 1416-1418.

Philippe, N et al. 2014. "Pandoraviruses: Amoeba Viruses with Genomes up to 2.5 Mb Reaching that of Parasitic Eukaryotes." Science 341:281-86, 2013.

Richman, D.D. "How Drug Resistance Arises," *Sci. Am*. 279 (1998): 88-87.

Saladin, K. *Human Anatomy*, 6th ed. Dubuque, IA: McGraw-Hill, 2020.

Serafini, A. *The Epic History of Biology*, New York: Persesus Books, 1993.

Simon, V. "Wanted: Women in Clinical Trials," *Science* 308 (2005): 1517.

Strahlman, E. "Public Disclosure of Clinical Research," *The Lancet* 373 (2005):1319-1320.

Learning Strategies and Techniques

1. Join the Human Anatomy and Physiology Society (HAPS c/o Association Service Group 251 S.L. White Blvd. P.O. Box 2945, LaGrange, GA 30241-2945) and receive the *HAPS Educator* and other publications of the organization. The society is made up of other anatomy and physiology instructors with problems just like yours. Sometimes great teaching tips come along and, by belonging, you can get new ideas. There are additional advantages to joining: the HAPS list server which will allow you to ask questions of others and get authoritative answers within a few days; receive free copies of the American Association of Anatomists journals; attend regional and annual general conventions. Finally, even if you don't join, you need to check out the *What's New* pages—they will provide updates on the newest research as well as teaching resources.
2. If you are teaching primarily first-semester students, you will find that they are very shy about asking you questions. This is a very destructive habit and needs to be eliminated as soon as possible. Try to reward those few students who do ask questions by praise for that vital habit. In addition to a verbal

reward, you might try giving out prizes each class for the best (or any!) question you get. I have used t-shirts and bookmarks (get them printed up with your name and access information) but candy (watch the peanut allergy issue), pencils, and pens do just as well. Some of our most important pieces of equipment in science are questions.

3. Can you set up study groups? Get students that are geographically close to try working together with their self-made flash cards. Some institutions go so far as to hire facilitators for these groups.
4. In the lab: correlate cross-sectional views of a human to that of a dissectible mannequin. Try to get copies of X-rays, MRIs, PET, and CT scans to compare with the images in Atlas A which follows this first chapter.
5. Obtain whole kidneys or brains from sheep or other livestock animals and compare them to dissectible mannequin organs or (if you can get them) actual preserved human organs. Ask your students how confident they would have felt 700 years ago going to a physician who had trained primarily using livestock.
6. Emphasize the organizational hierarchy of the body: i.e., from sub-atomic particles to organ systems.
7. Try to get the students to relate negative feedback mechanisms in familiar physical objects to similar mechanisms in their bodies. Some examples might include thermostats and pressure regulators.
8. Have students bring in newspaper clippings or Internet pages related to new biomedical developments. Assign students to further research the specific topic and critique the article. Sometimes the articles are inaccurate and, as the students gain more knowledge as your course progresses, they should be able to pick up on the errors and propose corrections.
9. As the students become more sophisticated, have them look up the journal articles included in each "Learning Strategies and Techniques" section. You can have them write reaction sheets on these. The reaction sheets would include a summary of the major points of the article, how it relates to your course content, and any specific points the student cannot understand. Challenge the student to find independent means to gain this understanding. In this, as in other matters, keep in mind C.A.R.E.'s motto: "If I give a hungry person a fish, I can feed the person for a day; if I teach a person to fish, I can feed that person for a lifetime." Teach fishing!
10. Try to facilitate study groups of about three students to work together. If students make their own flash cards for studying, they can exchange decks with others after mastering their own set. Try to encourage stronger students to make a cluster with a few weaker students. This latter arrangement can actually help the better students too because it makes the ideas "gel" better when they mentor one another. However, make it clear that the condition should never evolve to parasitism but to mutualism!
11. Some students will be greatly put off at first by those incredible polysyllabic monstrosities that we use every day: terms such as sarcoplasmic reticulum or polymorphonucleocytes. Saladin, in his first chapter, emphasizes the importance of this skill (Deeper Insights 1.4). Convince your students that these terms are really quite easy if one learns the trick of translating them syllable-by-syllable. The words will talk to you and tell you what they mean! Each syllable comes from a Latin or Greek root with a specific meaning. Therefore, these words are actually easier once you get to know them than more familiar English words such as "so," because the scientific words have but one meaning and that meaning is clear to anyone who has taken the time to learn to decode the roots. In lecture, make sure to point out those roots in context as well so that they can add those study habits to their repertoire.
12. Publish or e-mail an anatomy and physiology newsletter every week or so. A desktop publisher would be helpful but is not essential. Other more modern methods of newsletter dissemination could include incorporating social media. The newsletter might have some or all of the following items:
    - recent news items related to the week's work;
    - lab directions and tips (save your voice!);
    - homework questions;
    - safety advice specific to that week's work;
    - additional drawings or information;
    - historical background;
    - and last-minute changes in schedule.
13. If you have long-term and exclusive access to some room space you might try to set up a learning center for anatomy and physiology students. Ideally, this area should not require constant attendance;

however, some colleges and universities have work-study help available who might be qualified to act as docents or tutors. Perhaps your university or college library will lend you space and personnel. Here are some ideas for things that could be available:

- newspaper clippings related to new biomedical developments (make sure the ones you post are accurate!);
- extra copies of hand-outs;
- former student projects and term papers to serve as examples;
- computers with anatomy and physiology software loaded;
- models, specimens, microscopes and slides, displays, and other simple hands-on items labeled appropriately to go with current lecture/lab activities;
- audio-visual equipment with materials corresponding to current or recent course content;
- anatomy atlases, *Physicians' desk reference*, copies of journals such as *Scientific American, The New England Journal of Medicine, Lancet,* and *JAMA*, and medical dictionaries;
- and sample tests.

14. Several times throughout the semester, have a "one-minute quiz" at the end of class. This is done not for a grade but as a means of making sure you and the student are on the same wavelength together. Everyone should write their names on a blank sheet of paper and answer a good summary question. Here are some examples of summary questions: What was the most important thing we discussed in class today? What was the most confusing thing we did in class today? What was the thing most personally useful that we talked about today? Please write one good question about today's material and answer it. After the lecturer looks over these papers, he/she will be able to better address the specific needs of individual learners. When you hand these back at the beginning of the next class, the students will have useful responses that they can use from that point on.
15. The *New England Journal of Medicine* has a great many 35mm slide series of pathological conditions available for purchase. The same journal also offers downloads of articles, including graphics, to on-line subscribers. The content can be included onto PowerPoint™ presentations.

Related Films, DVDs, and Videocassettes

A Brief History of Biology; Hawkhill
Biovideo: The Evidence for Evolution; Carolina
Evolution; Hawkhill
Great Moments in the History of Science; Hawkhill
Homeostasis; Films for the Humanities and Sciences
How Scientists Think and Work; Hawkhill
More Evidence and Human Evolution: Insight media
NOVA; a series from PBS—check them out from time to time for on-line items
Origins of Us; Films for the Humanities and Sciences
Review of Biology: Design for Living; Films for the Humanities and Sciences
Science and Society; Hawkhill
Scientific Method and Values; Hawkhill
The Soul of Science; Hawkhill
What is Science?; Hawkhill
William Harvey and the Circulation of Blood; Films for the Humanities and Sciences
Women in Science; Hawkhill
Working Biologists Today; Hawkhill

Related Software

Acland's Cross-Sectional Navigator; Lippincott Williams & Wilkins
A.D.A.M: numerous products; A.D.A.M.
Anatomica: Digital Atlas of the Human Body; Denoyer-Geppert
Anatomy and Physiology Revealed; available as part of *Connect* from McGraw-Hill
Cat 3D Dissection; Ward's

Human 3D dissection: Ward's
Interactive Functional Anatomy; Denoyer-Geppert
PH.I.L.S.; available as part of *Connect* from McGraw-Hill

Clip Art

Corel Draw; Corel
Netter presenter: Human Anatomy Collection; Elsevier Health

Critical Thinking Questions

1. Why was Avicenna (or Ibn Sina) so much more successful in scientific work than his contemporaries in Europe?
2. There is a claim that lycopene, the reddish substance in tomatoes and peppers, is of value in protecting people from Alzheimer Disease. How would you, as a scientist, go about substantiating or refuting this suggestion?
3. Ground sloths are extinct North American relatives of the Central and South American tree sloth species. The living, tropical species are arboreal and eat leaves. What anatomical differences might you expect in the ground versus tree groups?
4. How would you prove to someone that a plant was alive?
5. Using the information in chapter 1, please identify the receptor and the effector mechanisms in temperature control.

Critical Thinking Answers

1. There were fewer restrictions on free inquiry in the Islamic world, while in Europe, both anatomy and physiology were taught dogmatically. Avicenna was able to challenge accepted classical sources whenever the evidence indicated it.
2. One can study the brains of those having Alzheimer Disease and compare them with those dying of other causes. The researchers then would retrospectively study the diets of those two groups of people. Scientists have followed this approach and found that lycopene does have promise. However, scientists will ideally perform a very extensive double-blind study (including a placebo) involving thousands of people over many years. At the end of the research, the work would have to be examined statistically, an article written, and then published in a peer-reviewed journal.
3. The arboreal species have front and hind paws that are able to grasp branches. The ground species was probably able to stand upright at least some of the time and was also able to become much larger bodied. Tree sloths feed on foliage so there apparently is little adaptive advantage in their having color vision as was true of the primates.
4. The student should check to see if the plant has the properties given in Section 1.6: The plant has a clear organization with flowers, leaves, stems above ground, and roots underground. The whole works together to draw nutrients from the ground and photosynthesize sugars in the leaves. Microscopic examination shows a plant is made of cells. Biochemical studies show the plant has DNA, proteins, lipids, and carbohydrates. Plants can be shown to take molecules from the environment and metabolize them. Plants respond to light, gravity, and water. Obviously, a plant develops from a seed, grows, and reproduces. Plant populations go through evolutionary changes also; just note that some varieties are better adapted to certain environments than others are. You can further challenge your students by giving them some background on virus biology and then asking them to present arguments for or against the question of whether viruses are alive or not.
5. Prof. Saladin identifies the brain as the portion of the body that monitors blood temperature (i.e., the sensor) and vasoconstriction and vasodilation as the mechanisms that actually can cause a change in the temperature (i.e., the effectors).

Clinical Application Question

Sam, 68, suddenly begins to undergo convulsions and is rushed to the emergency room (i.e., the ER). You are the attending physician at the ER that evening and you suspect that he is suffering from a problem in

the brain. What imaging method would be the best choice to try to diagnose the problem? Assume that the PET scanner is absolutely not a possibility that night.

Clinical Application Answer

An MRI will most clearly show views within the brain itself (Deeper Insights 1.5).

Interactive Case Studies and the Human Body (11-20)

The Male Body

Case Study 11

Hematology

Polycythemia

Answers:

1. The disorder of this individual is polycythemia.
2. The arterial O_2 saturation and erythropoietin levels are important in confirming that the increased hematocrit is not due to hypoxemia or an abnormally elevated erythropoietin level. The O_2 saturation level would indicate if there is a physiologic stimulus for the increased erythrocyte production.
3. Phlebotomy is the letting of blood for transfusion pheresis, diagnostic testing, or experimental procedures.
4. Phlebotomy (removal of the whole blood) removes both blood cells and plasma. The plasma volume is replaced within days, whereas the erythrocytes take several weeks to be replaced.
5. Myelosuppressive therapy is therapy for the suppression of the bone marrow's production of blood cells and platelets.
6. Myelosuppressive therapy may be needed to suppress the erythrocyte production in the myeloid tissue if the hematocrit continues to rise after the phlebotomies.

Interactive Case Studies and the Human Body (1-10)

The Female Body

Case Study 1

Hematology

AIDS

Answers:

1. This individual has Acquired Immunodeficiency Syndrome (AIDS) caused by the Human Immunodeficiency Virus (HIV).
2. The hematocrit abnormality is caused by the dehydration.
3. Some current treatments include: AZT (Zidovudine) and ddI (Didanosine), both antiretroviral agents which slow the replication of the virus, prevent occurrence or recurrence of opportunistic infections, and boost the immune system.
4. The individual is experiencing hypokalemia prior to treatment.
5. This abnormal potassium level could cause cardiac arrhythmias due to the hyperpolarization of the resting membrane potential.
