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Welcome

Welcome to the Instructor Resource Manual for Human Physiology: An Integrated Approach, 5th edition. We have written this manual with the hope that it will make teaching your physiology class easier and more fun!

FEATURES OF THE INSTRUCTOR RESOURCE MANUAL

- **Student Learning Objectives** (which are also included in the Student Workbook) present specific, goal-oriented learning tasks for each chapter.
- A **Teaching Summary** highlights key themes within each chapter. When appropriate, suggestions are offered for material that can be omitted if time is limited.
- **What’s New?** offers a quick summary of material that has been added to or removed from this edition.
- The **Teaching Outline** includes references to relevant figures and key words to emphasize the main points within each chapter.
- Within many sections, you will find references, supplemental lecture material, activities, examples, and analogies you might find useful; these segments are preceded by an arrow (►), an icon, or a side-rule.
- **Talk the Talk** is a list of important vocabulary words for each chapter.
- **Focus on Physiology** contains additional quantitative and higher level problems to use as class activities or as test questions.
- **Focus on Graphing** features exercises that develop your students’ graphing abilities and understanding of quantitative physiological data.
- **Running Problems** give additional background information and resources for exploring Running Problem cases presented in the textbook.
- **Quantitative Physiology** provides questions (and rationales) you can use to assess your students’ understanding of quantitative aspects of physiology.
- **Maps** suggest additional mapping activities.
- **Reading** suggests additional literature and online resources.

GENERAL RESOURCES FOR THE INSTRUCTOR RESOURCE MANUAL—ONLINE

Visit the Instructor Resources section of the *The Physiology Place*, www.physiologyplace.com, for the following additional resources written for this Manual:

- Introduction to Multi-Media Resources
- Teaching Higher Thinking Skills
- Mapping Strategies for Physiology
- Active Learning in the Physiology Classroom
- Using Case Studies to Teach Physiology
- Creating Your Own Case Studies and Problems
- Writing Challenging Test Questions
- Media Guide for Instructors using Human Physiology
TEACHING SUMMARY

This chapter introduces your students to key themes in physiology and physiological research. Emphasize to your students that learning basic patterns, themes, and the “big picture” will simplify learning the details of physiology. Here are some ideas for teaching this chapter:

- Throughout this text, the focus is on integration of physiological function. Look for links in the text and in the lecture outlines. These will key you into topics previously discussed that you may choose to integrate into a current lecture.
- If you are interested in comparative physiology, this is a good place to point out that humans are animals, with special physiological adaptations that allow us to survive in a terrestrial habitat.
- If you plan to emphasize problem-solving skills, talking about experimentation and experimental design at the beginning of a course shows students how important this skill is in real life.
- Almost all students have difficulty reading and constructing graphs. Teach them the basics in the first week of class.
- Many students lack the ability to handle large amounts of detailed information. Teaching them how to map and encouraging them to continue mapping throughout the class will provide them with a tool for organizing material.

STUDENT LEARNING OBJECTIVES

These objectives also appear in the Student Workbook.

When students complete this chapter, they should be able to:

- Create a diagram of the different levels of organization for living organisms.
- Name the physiological systems of the human body, their major organs, and their major function(s).
- Contrast the differences between teleological and mechanistic approaches in physiology.
- List and explain the key themes in physiology.
- Describe the key elements of a well-designed experiment and give scenarios for which each design is most appropriate.
- Describe how you would find reliable information on a physiological topic using search terms and web-based resources.

WHAT’S NEW?

- Reversed sections on “Themes in Physiology” and “Physiology Is an Integrative Science”
- Defined difference between “model” and “theory”
- Introduction of term “parameter” deferred until Ch. 6
- Substituted up-to-date meta-analysis for glucosamine-chondroitin studies
NEW TERMINOLOGY
Pharmacogenomics, Evidence-based medicine

DELETED TERMINOLOGY
Glycome

TEACHING OUTLINE

PHYSIOLOGICAL SYSTEMS
Figs. 1-1, 1-2; Table 1-1
Key words: physiology, anatomy, integration, levels of organization, cell, tissue, organ system, integumentary system, musculoskeletal system, digestive system, respiratory system, urinary system, reproductive system, immune system, nervous and endocrine systems

With increasing complexity in design and organization comes increased integration.

First day activity: Begin the first day by asking students what they know rather than by telling them what they should know. Some topics to ask them about might include:

What is physiology? How is it different from anatomy?
Name the 10 physiological organ systems.
What are the characteristics of living organisms?
Which organ systems carry out which functions of life?

If your students have had chemistry and introductory biology and you do not plan to teach Chs. 2–4 to your class, ask them some review questions, such as:

Where does energy for life processes come from? How is energy stored in animals?
List the four primary tissues of the body, their characteristics, and some examples.
Draw a cell, add as many organelles as you can, and give their functions.
List the steps of protein synthesis, including as many details as you can.

Physiologists are interested in everything from the molecular level to how physiological adaptations affect an organism’s ability to adapt to and survive in particular environments.

Some students will separate muscular and skeletal systems. The question sometimes arises about whether the lymphatics are a system. They are an anatomical system, but physiologically, the lymphatics function as part of three systems: circulatory (returning excess fluid and escaped proteins from interstitial space to the plasma), digestive (transporting fats from the intestine to the circulation), and immune (lymph nodes contain clusters of immune cells).

FUNCTION AND PROCESS
Key words: function, teleological approach, mechanistic approach, processes/mechanisms

Discuss teleological vs. mechanistic approaches to science and life. See “A survey of students’ notions of body functions as teleologic or mechanistic,” by D. R. Richardson, Advances in Physiology Education 10 (1990): S79–S80.

1. Ask the students “Why does blood flow?” or “Why do we breathe?” Analyze responses and determine if they’re teleological or mechanistic.
2. Have students ask one of these questions to nonscience friends outside of class. Compile a list of teleological and mechanistic responses.

Be careful not to write test questions that begin with “Why…” when you expect the students to answer with a mechanistic answer. Instead, ask “Explain the mechanism that is the basis for blood flow.”

Not all structures or processes have an obvious or known function. Some may be remnants of organs that are no longer useful (the appendix, the hormone calcitonin in humans), or it may simply be that we do not yet understand what their function is.

This is a good place to point out to students that we do not fully understand the mechanisms for all physiological processes. There are still a large number of “black boxes” where we do not know what is going on, and these are the areas of active research. You may also want to warn them that “facts” that they learn in this course will change in the future as we solve the mysteries of physiology. There is a tendency for students to learn facts and then feel that they are immutable, when this is not the case.

HOMEOSTASIS
Figs. 1-3, 1-4
Key words: homeostasis, intracellular fluid, extracellular fluid, variables, pathological, pathophysiology, diabetes mellitus

Homeostasis is discussed more thoroughly in Ch. 6, in respect to control systems.

PHYSIOLOGY: MOVING BEYOND THE GENOME
Key words: genome, genomics, proteomics, metabolomics, interactomics, transcriptome, lipidome, cellulome, enzyome, unknome

The Human Genome Project, on the web at: genomics.energy.gov
The Physiome Project, on the web at: www.physiome.org

THEMES IN PHYSIOLOGY
Table 1-2

How many examples can your students think of to which these themes apply?

Homeostasis and Control Systems
Fig. 1-5
Key words: regulated variables, physiological control systems, input signal, controller, output signal

Biological Energy Use
See Ch. 4.

Structure-Function Relationships
molecular interactions (Ch. 2), compartmentation (Ch. 3), mechanical properties
Key words: compliance, elastance, pump, filter, motor, compartmentation

Communication
See Ch. 6.
Key words: signal transduction, gradient, selectively permeable, chemical signals, electrical signals
PHYSIOLOGY IS AN INTEGRATIVE SCIENCE

Another example of integration is the regulation of calcium concentrations in the body. The endocrine system acts on bones, kidneys, and intestine to ensure that plasma calcium concentrations remain within a certain range.

A change in special cells that act as sensory receptors can trigger a cascade of neurally- or endocrine-mediated responses that may affect many cells of the body.

THE SCIENCE OF PHYSIOLOGY

Good Scientific Experiments Must Be Carefully Designed

Review the process of science with students and demonstrate the importance of good experimental design and good science.

This is a good place to point out the similarity between scientific research and what should take place in a classroom setting. Students are always asking, “Just tell me the right answer.” It’s important for them to learn that there may be no right answer, or several right answers. When faced with a problem, they should behave like scientists and generate several alternate hypotheses. They can then evaluate the validity of their hypotheses based on their understanding of physiology.

To promote this type of learning in the classroom, the faculty member must be supportive and make students comfortable with the notion that it’s OK to be wrong, as long as they can justify their reasoning. Collaborative groups in the classroom are very valuable in this regard, as students can learn from their peers that they were not the only person who doesn’t understand or have the correct answer.

In more advanced classes that have studied statistics, this would be a good place to talk about which statistical tests could be used with each type of study. For example, crossover studies allow the use of a paired t-test.

The Results of Human Experiments Can Be Difficult to Interpret

Variability, Psychological Factors, Ethical Considerations

Ask students to bring in newspaper/magazine articles about clinical research studies that are related to the use of human subjects.

If you are comfortable, open the floor for ethical debates. See how your students feel about ethical considerations in science and scientific research. Should animals be used in research? What about in the college classroom? In the high school classroom? Are models and computer simulations an adequate substitute for working with living organisms?

To learn more about the use of animals in science, see the American Physiological Society web site:

www.the-aps.org/pa/policy/index.html

Select the topic “Animals in Research.” This site has many links to other resources.

CONTROVERSY IN PHYSIOLOGY

You are the president of a pharmaceutical company that has just won approval from the Food and Drug Administration to sell a drug that can control a degenerative and potentially deadly disease that affects 200,000 people annually. However, half of those afflicted will not be able to afford this drug. Furthermore, your company has invested $25 million in developing this new drug. Does your company have a moral obligation to administer this drug to people that can not afford it?


**Human Studies Can Take Many Forms**

Key words: longitudinal studies, prospective study, cross-sectional studies, retrospective studies, meta-analysis

Have students compare the following two analyses:


Note that the *Journal of the American Medical Association* article is an older meta-analysis of the use of glucosamine. You might also have students Google “NIH GAIT study” to read about the NIH-sponsored Glucosamine/Chondroitin Arthritis Intervention Trial.

**SEARCHING AND READING THE SCIENTIFIC LITERATURE**

Key words: journals, peer-reviewed, review articles

Teaching students to search and critically evaluate resources is an important skill for scientifically literate students. They have an unfortunate tendency to think that if information cannot be found on the web, it doesn’t exist. And if it does exist on the web and sounds authoritative, it must be valid. The three TILT modules (http://tilt.lib.utsystem.edu/) can be assigned for students to work through on their own time. At the end of each module is an automatically scored quiz. You can have students take the quiz, print out their results, and turn the quiz in as a graded homework assignment.

In TILT Module 3, the SiteVision section allows students to evaluate real web resources. Item 4, “Medicine: Aspartame Disease,” takes students to a web site that looks authoritative with an article by “Nancy Markle.” Have students evaluate the site and the article because this is an excellent example of misinformation on the web. Once students have turned in their evaluation (and many of them will probably think this is a good site), have them Google “Nancy Markle” and see what they can learn about this fictitious person.

See pp. x and xi of the Student Workbook for additional resources.