

Review

Ten College Anatomy and Physiology Textbooks

Thematic Organization, Study Aids and Readability

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Like many anatomy and physiology teachers, I recently adopted a new textbook for my course. Naturally, I wanted to choose the best book, the one that would benefit my students most. I considered a number of factors during the review and selection process. Some of these factors were more-or-less objective comparisons: organization and sequence of units in each book; the type of study aids included; and the reading level of the text. Other factors such as content, writing style and quality of illustrations involved subjective decisions. In the end, however, my choice was a compromise and much more intuitive than I would have preferred.

This compromise was not the result of having too many good books from which to choose, although most of the textbooks were excellent productions. Rather, the compromise stemmed from a lack of alternatives. As the results of my objective comparisons show, no textbook was really much different from its competitors, truly innovative in its organization and approach or boldly challenging to the *status quo*. Of course, because such a large component of textbook adoption is necessarily subjective, it is impossible to say, "This is the best anatomy and physiology book on the market." That is the nature of the problem.

The Textbooks and Authors

Ten integrated anatomy and physiology textbooks published since 1980 are compared in this paper. These texts are: Anderson (1984); Anthony and Thibodeaux (1983); Creager (1983); Guyton (1985); Hole (1984); Jacob, Francone and Lossow (1982); Landau (1980); Luciano, Vander and Sherman (1983); Solomon and Davis (1983); and Tortora and Anagnostakos (1984).

With one exception (Anderson 1984), all textbooks were hardbound and 700-900 pages long. All texts were illustrated and indexed.

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Three textbooks were authored by community college teachers, two by university medical school personnel, and the remainder by college or university instructors. Two authors are deceased, and two are former university faculty.

Thematic Organization and Sequence of Units

An old anatomy and physiology book begins, "Anatomy is the science of organization" (Cutter 1884). The hierarchical arrangement of chemicals, cells, tissues, organs and systems composing the human body makes the validity of this statement very clear. The principle of organization is fundamental to anatomy, and this principle should be reflected in the construction of anatomy and physiology textbooks.

At the same time, physiological processes link systems into a functional whole, the organism. Anatomical relationships are hierarchical or "vertical," while physiological relationships are integrative and provide the second, "horizontal" dimension to a "picture" of the human body. Integrative organization—the physiological dimension—should also be evident in the way in which anatomy and physiology books are written.

Collegiate anatomy and physiology textbooks typically are organized according to major organ systems. Usually, these system-based units—which may span several related chapters in a given book—are clustered together in sections corresponding to major themes or physiological processes. This thematic clustering was the only overt reflection of integrative physiological organization in most of the textbooks reviewed in this study. Other attempts at integration were for the most part covert elements of style and content, hidden in system-based chapters and approached with much less consistency than an-

Table 1. Organization and Sequencing.

<i>Anderson (1984)</i>	<i>Anthony and Thibodeaux (1983)</i>	<i>Creager (1983)</i>	<i>Guyton (1985)</i>	<i>Hole (1984)</i>
Note: No thematic grouping was used in this textbook	<i>Body as a Whole</i>	<i>Levels of Organization</i>	<i>Cells and Tissues</i>	<i>Levels of Organization</i>
Cells	Cells	Chemistry	Cells	Chemistry
Tissues	Tissues	Cells	Tissues	Cells
Integumentary System	Integumentary System	Tissues	Cell Physiology	Tissues
Skeletal System		<i>Protection, Movement, and Support</i>	<i>Skeletal System</i>	Integumentary System
Muscular System	<i>Support and Movement</i>	Integumentary System	<i>Skeletal Muscles</i>	<i>Support and Movement</i>
Nervous System	Skeletal System	Skeletal System	Muscular System	Skeletal System
Endocrine System	Muscular System	Muscular System	<i>Nerve-Muscle Unit</i>	Muscular System
Circulatory System	<i>Communication, Control, and Integration</i>	<i>Control and Integration</i>	<i>Nervous System</i>	<i>Integration and Coordination</i>
Lymphatic System	Nervous System	Nervous System	<i>Special Sensory Systems</i>	Nervous System
Respiratory System	Endocrine System	Endocrine System		Endocrine System
Digestive System	<i>Transportation</i>	<i>Homeostatic Systems</i>	<i>Circulatory System</i>	<i>Processing and Transporting</i>
Urinary System	Circulatory System	Circulatory System	<i>Fluids and Kidney</i>	Digestive System
Reproductive System	Lymphatic System	Lymphatic System	Lymphatic System	Respiratory System
	<i>Respiration, Nutrition, and Excretion</i>	Respiratory System	Urinary System	Circulatory System
	Respiratory System	Urinary System	<i>Respiratory System</i>	Lymphatic System
	Digestive System	<i>Continuity of Life</i>		Urinary System
	Urinary System	Reproductive System	<i>Digestive and Metabolic Systems</i>	<i>Human Life Cycles</i>
	<i>Reproduction</i>			Reproductive System
	Reproductive System		<i>Body Temperature</i>	
			<i>General Endocrinology</i>	
			<i>Reproductive System</i>	
<i>Jacob, Francone, and Lossow (1982)</i>	<i>Landau (1980)</i>	<i>Luciano, Vander and Sherman (1983)</i>	<i>Solomon and Davis (1983)</i>	<i>Tortora and Anagnostakos (1984)</i>
<i>Introduction</i>	<i>Introduction and Orientation</i>	<i>Basic Principles</i>	<i>Organization of Body Chemistry</i>	<i>Organization of Body Chemistry</i>
Chemistry	Cells	Chemistry	Cells	Cells
Cells	Chemistry	Cells	Tissues	Tissues
Tissues	Tissues	Integumentary System	Integumentary System	Integumentary System
<i>Framework of Body</i>	Integumentary System	<i>Support and Movement</i>	<i>Support and Movement</i>	<i>Support and Movement</i>
Integumentary System		Skeletal System	Skeletal System	Skeletal System
Skeletal System	<i>Musculoskeletal System</i>	Muscular System	Muscular System	Muscular System
Muscular System	Skeletal System			
	Muscular System	<i>Control Systems</i>	<i>Regulation of Body Activities</i>	<i>Control Systems</i>
<i>Integration and Metabolism</i>	<i>Nervous System</i>	Nervous System	Nervous System	Nervous System
Nervous System	Nervous System	Endocrine System	Endocrine System	Endocrine System
Circulatory System	Endocrine System	<i>Transporting and Processing</i>	<i>Internal Transport and Defense</i>	<i>Maintenance</i>
Lymphatic System	<i>Systems of Transport</i>	Circulatory System	Circulatory System	Circulatory System
Respiratory System	Circulatory System	Lymphatic System	Lymphatic System	Lymphatic System
Digestive System	Lymphatic System	Respiratory System		Respiratory System
Urinary System	<i>Respiration</i>	Urinary System	<i>Obtaining Oxygen, Nutrients and Energy</i>	Digestive System
Endocrine System	Respiratory System	Digestive System	Respiratory System	Urinary System
<i>Reproduction</i>		<i>Reproduction</i>	Digestive System	<i>Continuity</i>
Reproductive System	<i>Metabolic Processes and Energy</i>	Reproductive System		Reproductive System
	Digestive System		<i>Regulation of Fluids and Electrolytes</i>	
	<i>Urinary System</i>		Urinary System	
	<i>Reproductive System</i>		<i>Perpetuating the Human Species</i>	
			Reproductive System	

atomically-oriented organization. Table 1 summarizes the thematic organization of system units for the ten books.

Eight of the books were organized using the same general themes: lower levels of organization (cells and tissues); support and movement; control and regulation; transport and metabolism (sometimes subdivided); and reproduction. One textbook (Anderson 1984) was not arranged in thematic sections but rather had separate chapters for each system, while parts in the remaining book (Guyton 1985) were essentially system-based and contained chapters covering different aspects of one or two systems instead of unifying several systems.

Further, six of the books followed exactly the same sequence of system units when thematic grouping was disregarded. This order was: integumentary system; skeletal system; muscular system; nervous system; endocrine system; circulatory and lymphatic systems; respiratory system; digestive system; urinary system and reproductive system(s). Two of the remaining four textbooks deviated from this sequence by only one unit, and two deviated by two units.

It is rather obvious that thematic organization and sequence of units in anatomy and physiology textbooks are remarkably standardized. Why is this so? Several plausible explanations can be offered:

(1) Logical anatomical, physiological and pedagogical considerations determine organization and sequence. The skin is a good, fairly simple way to show how tissues are organized into organs and systems. Knowledge of bones and articulations is essential to understanding muscular origins, insertions and actions; and, knowledge of musculoskeletal topography is vital to describing body cavities and locations of other organs. The neuromuscular junction demonstrates nervous control. The nervous and endocrine systems are interactive. Circulatory transport is a common denominator for endocrine, respiratory, digestive and urinary systems. The last three of these also are linked by metabolic concepts. Even deviations from this "usual" sequence can be explained logically; Jacob et al. (1982) and Guyton (1985) use the endocrine system to link the urinary and reproductive systems. Nevertheless, there must be myriad other equally valid logical ways to organize an anatomy and physiology textbook or course. Is this "usual" sequence sacred? The teacher who chooses not to follow the beaten path is forced to blaze a new trail alone.

(2) Organization is influenced by tradition and practice. Publishers do poll teachers regarding course organization, and the results are sup-

posedly reflected in the printed product. Actually, tradition and practice as determinants of organization is a circular argument: it is well known that the biggest influence on classroom practice is the textbook. Many teachers do not have the time, energy or inclination to blaze a new trail. Thus, teachers may sequence a course following their textbook and then be polled about their course, reinforcing the textbook organization (for better or worse).

(3) More-or-less tacit imitation occurs. Textbook authors are certainly aware of their competition and draw on its best points. As teachers, many authors have used their competition and succumbed to the "tradition and practice" syndrome. Also, publishers are well aware of sales figures, and the temptation to model on proven success is great. Thus, authors and publishers have few incentives to do any really new trailblazing themselves, and many similarities between textbooks probably result from imitation.

In all likelihood, all of these factors—logical organization, tradition and practice and imitation—influence the organization and sequence of units in col-

Table 2. Pedagogical Devices and Study Aids

	Anderson (1984)	Anthony and Thibodeaux (1983)	Creager (1983)	Guyton (1985)	Hole (1984)	Jacob, Francone, and Lossow (1982)	Landau (1980)	Luciano, Vander, and Sherman (1983)	Solomon and Davis (1983)	Tortora and Anagnostakos (1984)
IN CHAPTER:										
objectives	+		+		+	+			+	+
summary		+	+		+	+	+		+	
questions	+	+	+	+	+	+		+	+	+
outline	+		+		+				+	+
glossary			+		+				+	+
insets			+		+		+		+	+
references			+	+	+					
APPENDICES:										
references	+	+				+	+			+
conversions					+	+	+		+	+
glossary	+		+		+	+	+		+	+
prefix/suffix			+		+	+			+	+
abbreviations			+						+	+
question key									+	
special topic					+				+	+

^a introductory overview
^b word list, no definitions
^c combined with index
^d combined appendix

lege anatomy and physiology textbooks. The great consistency in organization among these textbooks limits a teacher's choices and forces adoption decisions to be based on other considerations such as pedagogical devices, readability, quality of illustration, writing style and actual content.

Pedagogical Devices and Study Aids

The ten textbooks were surveyed for a variety of devices that aid teaching and learning. Individual chapters were reviewed for the presence of outlines, summaries, review questions and problems, glossaries or word lists, bibliographies and special interest insets (usually medical applications). Appendices—bibliographic material, English-metric tables, glossaries, question keys, prefix-suffix lists, abbreviation lists and special interest sections—were also surveyed. Lists or tables printed inside a book's cover were considered appendices. These results are summarized in Table 2.

Considerably more variation among the books surfaced in this survey than in the review of organization. All of the texts included end-of-chapter questions. Most supplied chapter summaries or overviews (70%), learning objectives (60%), chapter outlines (60%), and glossaries or word lists in each chapter (60%). Half of the books included special interest insets, while only three supplied references at the end of each chapter. It should be noted that chapter summaries often take the form of expanded outlines and are difficult to classify accurately; in these cases, the designation provided by the author(s) was used.

Most books (80%) included an appended glossary. In one book (Solomon & Davis 1983), the glossary was integrated with the index. Half of the books supplied appended references, conversion tables and prefix-suffix lists.

This review suggests that the availability of pedagogical devices and study aids is more useful than organization and sequence for text selection decisions. Teachers should know what they will use and what their students are likely to use. There is no reason to assume that "more is better" with respect to study aids in a text; an unused table or appendix will not improve a book's utility.

At the same time, the nature of the study aids provided in most textbooks encourages rote memorization and limitation of learning. Teachers must use lists very carefully as study aids. Further, the only overt evidence of learning psychology found in most books is learning objectives, an old method based in behaviorism. Creager (1983) does apply learning objectives in a fairly effective manner by using them to introduce sections within the text. However, cognitive techniques, e.g., advance organizers, concept

maps, or concept mapping activities, are not used in any of these current texts. Where are traces of all the "recent advances in cognitive psychology" that we read so much about? The teacher who chooses not to follow the well-beaten behavioristic path is also forced to blaze a new trail.

Readability

Three prose passages of approximately 100-120 words were selected from each textbook. To aid comparison, passages selected had roughly the same content: the structure of the pericardial sac; the anatomy of the pharynx; and mitosis. (These specific topics were chosen initially at random.) Each passage was evaluated using a reading level (Fry scale) determination program on an Apple IIE computer (CRPTYC 1982). See Table 3 for the results.

Average readabilities ranged from grade level 13.59 to 15.53 (mean = 14.53), approximately encompassing the college freshman/sophomore level. It is noteworthy that no book had more than one passage above the grade 16 level or more than one passage below the grade 12 level.

A one-way analysis of variance (ANOVA) was performed to compare readabilities. No significant differences in mean text readability were observed among the ten books ($F = 0.0256$; $df = 9, 20$; $p > .05$). Thus, no textbook can be singled out as significantly easier or harder to read. Considering that these textbooks were written specifically for lower division college allied health applications, this con-

Table 3. Readability (Fry Scale).

Textbook	Passage			
	Pericardium	Pharynx	Mitosis	Mean
Anderson (1984)	17.16	10.49	14.62	14.09
Anthony and Thibodeaux (1983)	12.59	19.17	13.75	15.17
Creager (1983)	14.66	12.72	13.72	13.70
Guyton (1985)	15.20	13.07	14.76	14.34
Hole (1984)	15.29	12.36	16.24	14.63
Jacob, Francone, and Lossow (1982)	17.88	14.97	10.61	14.49
Landau (1980)	15.26	14.99	15.76	15.34
Luciano, Vander, and Sherman (1983)	15.15	16.08	15.35	15.53
Solomon and Davis (1983)	13.18	14.98	15.34	14.50
Tortora and Anagnostakos (1984)	12.97	14.63	13.18	14.34
MEAN	14.93	14.34	14.33	14.53
STD. DEV.	0.74	2.37	2.65	0.65

sistency makes good sense. However, readability problems might emerge for instructors in "open door" admissions settings and for high school teachers searching for "crossover" textbooks.

Subjective Factors

There are a number of factors which might influence a teacher's decision to adopt a given textbook that cannot be quantified or compared objectively. Here is where the teacher's own preferences come into play; this is one place that "art" dominates over "science" in teaching. Since direct objective comparisons show little variation in organization and readability, subjective factors are really very important in textbook adoption. Because every teacher's opinions have validity, I offer only the following questions and comments for consideration.

Is the textbook aesthetically appealing? Are headings, colored print and boldface used effectively to draw attention to important information, or do they distract the reader? Are illustrations clear and easy to use, or do they require guidance? Remember that some students may not necessarily be able to follow some types of diagrams without help. Many of my own students have difficulty interpreting graphs. You might prefer semi-diagrammatic art over strict realism.

Is the typeface used in the text appropriate for your students? Many older students have vision problems that make reading small print difficult. Older students are fairly common in allied health programs, particularly nursing, especially in junior/community colleges.

Are ancillary materials available? Some textbooks offer rather extensive collections of transparencies, computer software, laboratory manuals, study guides and teacher manuals. If you need these materials, they must be available. However, don't be afraid to "mix and match." If a textbook you really like does not have an accompanying laboratory manual, for example, there are many other manuals on the market.

Is the writing style used in the book integrative, or are topics isolated in specific chapters? As has been shown, integration in anatomy and physiology textbooks is not overt; the teacher must evaluate the textbook carefully for integrative style. It is not enough to assume that students will make integrative linkages on their own. If the textbook does not integrate physiological processes well, the teacher must do so.

Finally, the most subjective decision of all is, "Do you like the textbook?" Would you feel comfortable with it? Would your students be likely to learn from it? Can you and they use it as a basis for blazing a new trail?

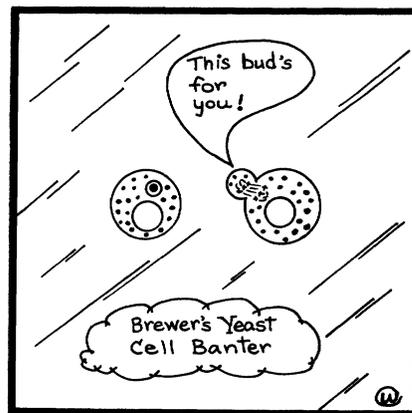
Acknowledgement and Final Note

The ten books reviewed in this paper were graciously provided—sometimes without a request—by publishers' representatives. These individuals are too numerous to list here, but they are thanked. Complimentary textbooks are a valuable resource for teachers even when the book is not adopted; it is a privilege to receive them. Biology teachers should protect this privilege for all by not requesting unneeded books and by not reselling complimentary copies.

References

- Anderson, P.D. (1984). *Basic human anatomy and physiology*. Belmont, CA: Wadsworth.
- Anthony, C.P. & Thibodeaux, G.A. (1983). *Textbook of anatomy and physiology*. (11th ed.). St Louis: Mosby.
- Creager, J.G. (1983). *Human anatomy and physiology*. Belmont, CA: Wadsworth.
- CRPTYC. (1982). "Reading Level Project," *Committee Report on Physics in the Two-Year Colleges* (American Association of Physics Teachers), 10(2):1-3.
- Cutter, J.C. (1984). *Comprehensive anatomy, physiology, and hygiene*. Philadelphia: Lippincott.
- Guyton, A.C. (1985). *Anatomy and physiology*. Philadelphia: Saunders.
- Hole, J.W., Jr. (1984). *Human anatomy and physiology*. (3rd ed.). Dubuque, IA: Wm. C. Brown.
- Jacob, S.W., Francone, C.A. & Lossow, W.J. (1982). *Structure and function in man*. (5th ed.). Philadelphia: Saunders.
- Landau, B.R. (1980). *Essential human anatomy and physiology*. (2nd ed.). Glenview, IL: Scott-Foresman.
- Luciano, D.S., Vander, A.J. & Sherman, J.H. (1983). *Human anatomy and physiology: Structure and function*. (2nd ed.). New York: McGraw-Hill.
- Solomon, E.P. & Davis, P.W. (1983). *Human anatomy and physiology*. Philadelphia: Saunders.
- Tortora, G.J. & Anagnostakos, N.P. (1984). *Principles of human anatomy and physiology*. (4th ed.). New York: Harper and Row.

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