

Sourcebook for Teachers of Physics (University of Wisconsin Press, 2006) is aimed more at generating interest in the subject than at offering experimental experiences to students (see the review in *PHYSICS TODAY*, October 2006, page 67).

Yaakov Kraftmakher, a professor emeritus of physics at Bar-Ilan University in Israel, has written a nearly encyclopedic book containing 88 experiments and demonstrations that he has developed, adapted, or refined for his university. Having published extensively in physics education journals during the past 50 years, he is well qualified for the task. Most of the experiments require a computer and make extensive use of ScienceWorkshop data-acquisition equipment and DataStudio analysis software from PASCO Scientific, a manufacturer of scientific products for instructors; most of the additional equipment mentioned in the book can also be obtained from PASCO.

Kraftmakher's book is a truly impressive work, with something for everyone. The first chapter contains 20 experiments aimed at high-school students; however, many of those experiments involve topics not normally taught in US high schools and thus would be more suited for an introductory-level college physics course. The author then offers 38 experiments that would be appropriate for physics majors: in mechanics, molecular physics, electricity, magnetism, optics, atomic physics, and condensed-matter physics. A chapter on Nobel Prize-winning experiments includes eight experiments that demonstrate the principles for which the award was given, but it does not attempt to replicate the methods and equipment originally used. The final chapter contains 22 relatively straightforward but open-ended student projects, with many of the details left to the ingenuity of the student.

Most of the experiments include a brief description; a list of the required equipment; a short tutorial on the relevant physics, with the essential equations and references; diagrams of the setup; and sample experimental results. The book includes historical notes, approximately 600 annotated references, photographs of historic figures, and definitions of important units. The chapter on Nobel Prize experiments has photographs of the winners and quotes from the people who introduced their Nobel lectures. The book is nicely laid out, although without color, and is well organized and nearly free of typographical errors and inaccuracies. The level of detail varies from 15 pages on thermionic emission to 2 pages for many

of the student projects. A majority of the experiments are more appropriate for the laboratory than the lecture, because they involve detailed acquisition and analysis of data and therefore do not have the pizzazz that makes for a good lecture demonstration.

I have only a few quibbles with Kraftmakher's book. He uses some non-standard terminology; for example, he denotes the voltage by U rather than by V , and he calls μ_0 the magnetic constant rather than the permeability. He rarely discusses sources and analyses of experimental errors and sometimes omits the expected values of the results. He gives no vendor sources for the non-PASCO instruments that are used and rarely mentions hazards or safety issues. Some topics, including plasmas, radioactivity, and chaos, are absent or only briefly discussed. But such concerns are relatively minor and do not diminish my admiration for his book.

Although *Experiments and Demonstrations in Physics* looks and feels like a textbook, it is aimed at anyone who wants to incorporate more and better exercises into the development or the presentation of laboratory courses or lecture demonstrations. And it is especially helpful to those who already use PASCO equipment.

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Chemical Sensors An Introduction for Scientists and Engineers

Peter Gründler

**Springer, New York, 2007. \$99.00
(273 pp.). ISBN 978-3-540-45742-8**

Chemical Sensors: An Introduction for Scientists and Engineers is a 273-page monograph that offers what its subtitle claims. But I would qualify the text even further as an introduction to chemical sensors for undergraduate students studying chemistry, physics, or engineering. At that level of presentation, understanding the subject requires only high-school-level physics and chemistry.

The book is well organized; its 10 chapters include an introduction to and discussion of the fundamentals of chemical sensors. Its coverage of semiconductor structures as chemical sensors and of chemical sensors as detectors and indicators provides some information for novices in the field. The discussion of specific types of sensors is divided into four main princi-

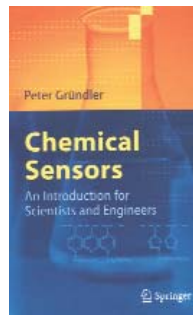
ples of chemical transduction, the conversion of a molecular reaction into a measurable output signal: heat (thermal sensors), inertial mass (mass sensors), electrochemical (potentiometric and amperometric sensors and chemiresistors), and optical (optical fibers and planar waveguides). Surprisingly, capacitive sensors are unnecessarily treated as a separate subgroup of electrochemical sensors; they should have been included under chemiresistors.

Gründler is a professor at the Leibniz Institute for Solid State and Materials Research Dresden in Germany. His book, a translation of the 2004 German edition, is well balanced, without undue emphasis on any specific area but one—the author goes into depth in the final chapter when discussing hybridization sensors, his area of interest. The chapter not only covers each type of hybridization sensor but also contains a brief but useful description of its practical applications. That chapter should create a warm and fuzzy feeling in the hearts of engineers, who otherwise could interpret the book as just another treatise on some abstract instrumentation.

The author covers a few controversial devices, such as microfabricated reference electrodes and potentiometric immunosensors. Microfabricated reference electrodes, although frequently described in the literature, are not realistic due to their small volume and short lifetime. Likewise, alluding to potentiometric immunosensors is misleading because direct potentiometric measurement of a change in charge from immunochemical reaction is not possible. Luckily, those points are not elaborated on in any detail and therefore can be disregarded.

The elementary level at which the book is written leaves the reader with a comfortable feeling that there are no problems left in the field of chemical sensors and that everything regarding sensors works just fine. Interestingly, that characteristic is precisely why the book can serve well as an introduction to chemical sensing but also why it should not be considered as a foundation for graduate research.

Gründler's approach could be a good marketing tool, and it could also lure unsuspecting novices to the field of chemical sensors. Numerous multiauthored books, such as *Sensors Update* (Wiley-VCH, 1996–2003), edited by Henry Baltes, Wolfgang Göpel, and Joachim Hesse, and the many volumes of the Springer Series on Chemical Sensors and Biosensors (2004–2007), edited by



Otto Wolfbeis, discuss chemical sensors in much greater depth. A serious researcher would certainly have to consult those texts, or something similar to them, to find out the complete story of chemical sensors.

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Physics of the Human Body

Irving P. Herman
Springer, New York, 2007. \$129.00
(857 pp.). ISBN 978-3-540-29603-4

Sometime this year the Scientific Foundation for Future Physicians Committee will issue a report reevaluating the basic science training of future physicians. The effort is jointly sponsored by the Howard Hughes Medical Institute and the Association of American Medical Colleges. The anticipated outcome of both the committee's work and a proposed follow-up conference on introductory physics for the life sciences will be a set of recommended competencies in basic science that will most likely define new standards for medical-school admissions and the Medical College Admission Test. Thus Irving Herman's *Physics of the Human Body* comes at a propitious time for a careful rethinking of how physics should be taught to pre-medical students and for designing a curriculum that goes beyond the foundational physics topics clearly required for the study of other sciences.

The text is a welcome alternative approach to introductory physics for pre-medical students and is an excellent prelude to topics in bioengineering. Medically oriented physics texts at the introductory level are few and far between and sometimes out of date, although readers will find in Herman's book a helpful and thorough bibliography of similar works. Herman, a professor in and chair of the applied physics and applied mathematics department at Columbia University, developed the book from lecture notes he used to teach an engineering course. His intensive engagement shows in the quality of the prose and the extensive and interesting set of problems accompanying each chapter.

Because the author's interest is in using physics rather than in teaching the subject from scratch, the level is more appropriate for a second-semester course that follows an introductory me-

chanics course or for a second-year sequence that includes the book's chapters on advanced topics such as feedback and control. The author suggests that instructors use the text as a companion book for a sequence of physics courses for the life sciences. Herman presumes that students will be comfortable with integral and differential calculus and willing to use simple applications of ordinary differential equations.

The book's emphasis is on the macrophysics of body physiology, a subject highly relevant to first-year medical students. However, in a few instances, the microphysics is also described, notably in the chapter on the molecular mechanisms behind muscular activity. The book does not cover topics in biomaterials, biophysics, and medical physics, such as applications of radiation in therapy and imaging. The organization varies appropriately between topics related by a common physical basis (for example, fluids, metabolism, statics of the body, and applications of electricity and magnetism) or by body systems (cardiovascular, respiratory, auditory, and visual).

One novel and useful feature of Herman's book is the first chapter, which is a self-contained guide to medical terminology, including anatomical terms and the systems used by physicians for describing the body's orientation and motion. Students and physics instructors will appreciate the author's inclusion of a pronunciation guide and handy tables of physiological data for modeling a standard (male) human body. Also appealing is the author's canny inclusion of topics engaging to students. He includes the design of sports equipment and apparel to optimize their athletic utility while minimizing the potential for injury, the mechanics of bone fracture, and a thorough analysis of the energetics of weight loss in which Herman wryly defines the "standard donut" as a unit of measurement.

In short, *Physics of the Human Body* contains much to enrich the training of life sciences students and help them appreciate how even basic physics is increasingly important to medicine. Although the book requires a real commitment on the part of physics instructors who are unfamiliar with physiology, its pedagogical approach makes it a suitable textbook.

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acoustics

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astronomy and astrophysics

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Multiple Stars Across the H-R Diagram. S. Hubrig, M. Petr-Gotzens, A. Tokovinin, eds. *ESO Astrophysics Symposia*. Proc. wksp., Garching, Germany, July 2005. Springer, New York, 2008. \$109.00 (303 pp.). ISBN 978-3-540-74744-4

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