Preface

Understanding Physics is a completely revised, updated, and expanded edition of the *Project Physics Course*. It is an integrated introductory physics course, developed with funding from the Carnegie Corporation and the Sloan Foundation and with the close cooperation of Springer-Verlag New York.

In approach and content, *Understanding Physics* follows the trail blazed by the earlier versions, but it includes more recent developments in physics and a stronger emphasis on the relationships among physics, technology, and society. We have sought especially to incorporate the salient lessons of recent physics education research and practical experience gained in the classroom.

The Audience

Understanding Physics is written primarily for undergraduate college students not intending (at least initially) to enter careers in science or engineering. These may include liberal-arts students, business majors, prelegal, and prospective architecture students. We have found that when the course is taken with laboratory work, it has been deemed suitable by medical schools for premedical students.

An important group that this course is intended to serve are persons who plan to teach, or are already teaching, in K–12 classrooms. As has been widely discussed, there is a special need for improvement in the science education of current and future teachers as an important step toward achieving greater scientific literacy in general. Many states have recently incorporated the contextual approach used in *Understanding Physics* into state science education criteria. It is in part to meet the challenges of teacher education that this course was developed as a resource, along with the usual pedagogical training.

Since college students in introductory science courses usually represent a wide spectrum of expertise in science and mathematics, this book assumes no prerequisites in science or mathematics beyond high-school algebra, geometry, and general science. In this text we have taken great care to derive all necessary equations very patiently, but whenever possible we have used narrative text instead of equations to convey the meanings of laws and concepts. Even if students have taken physics in high school, they often still lack proficiency in even the most basic concepts and techniques. One of the aims of this course is to enable all students to gain experience and confidence with physical-science concepts and quantitative methods, and with an understanding of the nature of science itself. Of course, for classes in which the students are sufficiently prepared, instructors may decide to place more emphasis on quantitative or other aspects of physics as appropriate. The course is designed with such flexibility in mind.

The Approach

A unique feature of this text, like its predecessor, is that it places the fundamental concepts of physics within the broader humanistic and historical contexts in which they arose, but without handicapping students in tests that compare their performance with students who have taken a less broadly conceived, conventional physics course. Research has shown that students exposed to our approach gain a much deeper understanding of both the content and the processes of scientific research, as well as an appreciation not only of what we know, but also of how and why we think we know it. This approach has been endorsed by several national organizations, including the National Science Foundation, the Research Council of the National Academy of Sciences, and Project 2061 of the American Association for the Advancement of Science. The National Research Council stated in its *National Science Education Standards*:*

> In learning science, students need to understand that science reflects its history and is an ongoing, changing enterprise. The standards for the history and nature of science recommend the use of history in school science programs to clarify different aspects of scientific inquiry, the human aspects of science, and the role that science has played in the development of various cultures.

Thus, *Understanding Physics* operates on two levels, providing both the fundamental concepts of physics and the humanistic and intellectual contexts in which the concepts developed. In addition to the necessary concepts and equations, intentionally developed patiently, and using easy-to-visualize examples, it aims to convey a real sense of the nature of scientific

* Washington, DC: National Academy Press, 1996; p. 107.

thinking, the way intuitions about science had to be, often painfully, acquired by scientists, and what our current concepts really mean. However, this text is not intended to be used by itself, but rather as part of a program as integrated as possible with hands-on activities, small-group discussions either in or out of class, and other encouragements to active learning that enable the subject matter to come alive. Some of these and other possible activities are suggested in the accompanying *Student Guide*.

Understanding Physics is divided into two parts. Each part is self-contained, with enough material for a course lasting at least one semester. Each part encompasses topics in classical physics along with one of the two contemporary nonclassical physics: relativity theory and quantum mechanics. Both parts taken together may serve for a full one-year course. We have sought from the beginning to provide instructors with maximum flexibility in adapting the course to students of different backgrounds, to different educational settings, to different semester time frames, and to different preferences for course topics. Some suggestions for different scenarios are provided in the accompanying *Instructor Guide*. All of the course's printed materials, as well as links to many related Web sites for both instructors and students, may also be accessed on the World Wide Web via the publisher's site at http://www.springer-ny.com/up.

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