

CONCEPTUAL **Integrated Science** EXPLORATIONS

So, what did you find?

That I LOVE
exploring!

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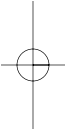
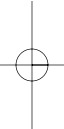


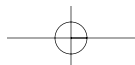
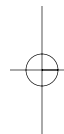
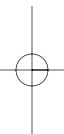
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**To teachers who inspire
open-mindedness and a love of learning,
and who help students add science
to their way of thinking.**





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Paul G. Hewitt

Former silver-medal boxing champion, sign painter, uranium prospector, and soldier (with the help of the GI Bill), Paul began college at age 27. He pioneered the conceptual approach to teaching physics at City College of San Francisco, with guest spots at various middle schools and high schools, the University of California at both the Berkeley and Santa Cruz campuses, and the University of Hawaii at both the Manoa and Hilo campuses. He also taught for 20 years at the Exploratorium in San Francisco, which honored him with its Outstanding Educator Award in 2000.



Suzanne Lyons

Suzanne is an author, illustrator, and developer of educational materials relating to the physical and Earth sciences. Along with Paul, John, and Jennifer, she coauthored the college-level text *Conceptual Integrated Science*. Suzanne earned her B.A. in physics from the University of California, Berkeley, and her teaching credential and master's degree in science education from Stanford University, and she is currently completing graduate studies in integrated Earth sciences. As a high school teacher at Mountain View High in California, Suzanne taught physics, physical science, and general science. She maintains a Web site dedicated to Integrated Science (<http://www.integratingscience.com>).



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John is the author of *Conceptual Chemistry* as well as a coauthor of *Conceptual Physical Science* and *Conceptual Physical Science Explorations*. John obtained his Ph.D. in organic chemistry from Virginia Commonwealth University. He taught chemistry at the University of Hawaii at Manoa and then at Leeward Community College. In addition to authoring textbooks, John is currently an adjunct faculty member at Saint Michael's College in Colchester, Vermont. He also produces science education multimedia through his company, Conceptual Productions (<http://www.cpro.cc>), writes and illustrates science-oriented children's books (<http://www.styraki.com>), and produces music through his recording label (<http://www.cpromusic.com>).



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TO THE STUDENT

Welcome to *Conceptual Integrated Science—Explorations*. The science you'll learn here is INTEGRATED. That means we'll explore the individual science disciplines of physics, chemistry, biology, Earth science, and astronomy PLUS the areas where these disciplines overlap. Most of the scientific questions you're curious about, or need to know about, involve not just one discipline, but several of them in an overlapping way. How did the universe originate? That's astronomy + physics. How are our bodies altered by the foods we eat, the medicines we take, and the way we exercise? That's chemistry + biology. What's the greenhouse effect? Will it trigger irreversible global warming, threatening life on our planet? Physics, chemistry, biology, and Earth science are all needed to understand the answers.

We're convinced that the CONCEPTUAL approach is the best way to learn science. That means that we emphasize concepts *before* computation. Although much of science is mathematical, a firm grasp of its concepts is crucial to understanding. Hence our motto: concepts before computation. If you continue in science, emphasis on computation can come later. Comprehension of concepts underlies success in computation.

This course provides plenty of resources beyond the text as well. The interactive figures, interactive tutorials, and demonstration videos on the companion Website (<http://www.physicsplace.com>) will help you visualize science concepts. This is especially useful when you need to understand processes that vary over time such as the velocity of an object in free fall, the phases of the Moon, or the formation of chemical bonds. The *Practice Book* (which is included with every new Student Edition) provides intriguing exercises that help you “tie it all together.” The activities in the *Laboratory Manual* will build your gut-level feeling for concepts and analytical skills. All these and other ancillaries that support this textbook will increase your confidence and mastery of science.

As with all things, what you get out of this class depends on what you put into it. So study hard and ask all the questions you need to. Most of all, enjoy your scientific tour of the amazing natural world!

TO THE INSTRUCTOR

Conceptual Integrated Science—Explorations provides an introduction to the full gamut of the natural sciences including physics, chemistry, biology, Earth science, and astronomy. These sciences are introduced using a conceptual approach, which is an approach that

- emphasizes central ideas over peripheral detail.
- deemphasizes technical jargon and rote memorization.
- puts concepts ahead of computation.
- relates science to everyday life.
- is personal and direct.

The conceptual approach was defined more than 30 years ago by Paul Hewitt in his groundbreaking and still ever-so-popular text *Conceptual Physics*, which is translated and used worldwide. The conceptual approach is a backbone of this book.

Conceptual Integrated Science—Explorations recognizes that there is a natural overlap among the various science disciplines. For example, how did the universe originate? That's astronomy + physics. How are our bodies altered by the foods we eat, the medicines we take, and the way we exercise? That's chemistry + biology. What's the greenhouse effect? Will it trigger irreversible global warming, threatening life on our planet? Physics, chemistry, biology, and Earth science are all needed to understand the answers. In addition to the conceptual approach, therefore, this textbook also employs an integrated approach, which is an approach that

- first, provides the student with a strong foundation in a particular concept.
- second, shows how other areas of science employ this concept.

Through this approach, the student sees how the concepts of one field are readily applied to another. For example, the inertia (physics) of tiny stones (geology) within the ear (biology) allow us to sense how our bodies are oriented in space. Taking this approach a step further, the student is then brought to learn that most all of science can be understood through a relatively small number of key concepts. So not only does an integrated approach allow for interesting applications of concepts, it simplifies science to its bare essentials. We call the bare-essentials concepts of science *unifying concepts*. Examples include inertia, the electric force, and entropy. They are concepts that underlie each of the sciences, and they are carefully highlighted within this textbook as they keep appearing.

Key Features of the Text

Within each chapter are *Integrated Science* sections that profile topics at the crossroads of scientific disciplines. For example, “What Forces Drive the Plates?” discusses the physics principles underlying movement of

tectonic plates, whereas “How Fast Can Action Potentials Travel?” looks at how electricity determines how fast our neurons can help us move or think. Importantly, the *Integrated Science* sections are embedded within the text. They are not set aside in boxes, as this may suggest to students that these features are optional reading. These sections are essential to this course because they focus on substantive topics; they are not merely interesting asides. All *Integrated Science* sections therefore include questions in the text as well as in the end-of-chapter review material, providing a means for assessing student comprehension.

The *unifying concept icon*, shown here, directs students to places in the text where these concepts occur. Unifying concept icons are dual-purpose, reminding students of the essential, cross-curricular ideas and serving as a cross-reference. The icons tell where each unifying concept is introduced so that students can flip to that section for review.

Throughout the book you’ll find boxed elements that focus on supplemental topics. *Technology* and *Science and Society* are high-interest features that can be used to promote class discussion. *History of Science* boxes emphasize that science is personal—a human endeavor. Also, in studying the history of science through these features (as well as in the text), students learn about the process of science in the manner in which scientific discoveries are made. The *Math Connection* boxes are especially helpful to non-science students; they are nonintimidating and teach basic problem-solving skills. These boxes provide students an opportunity to experience the complementary relationship between mathematics and science.

Each chapter begins with a photo that relates to an attention-getting paragraph. The introductory paragraphs feature interest-piquing questions that relate to the chapter and provide a brief overview of chapter content. At the bottom of the opening page to each chapter is a boxed activity, *Discover!* Most of these are quickie-type activities to promote class interest in the chapter content.

Other helpful pedagogical elements in this book include *Check Your Thinking* questions. These short sets of questions, sprinkled throughout each chapter, allow students to monitor their understanding. Answers are provided below the questions to give students immediate feedback. Also featured are *Check Your Reading* questions, which appear within every section throughout the book. Answers are key sentences conspicuously boldfaced in each section. Students will love the *Insights*, short margin features of quotes from our mascots: Perky the mouse, Sneezlee the bird, and Pico, the penguin featured on the cover of the book. These mascots provide background information, interesting facts, and study tips. The *Media Icons* alert students to relevant media resources they can turn to—interactive figures, tutorials, and videos—for alternative topic presentations.

The art program in this book features engaging Hewitt cartoons that complement text coverage in a student-friendly manner and keep the mood light. In addition to the cartoons is generous use of photographs



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and instructional art. Diagrams are simple and uncluttered, while photographs underscore concepts in an often striking and intriguing way.

At the end of each chapter is an extensive *Chapter Review*. Great attention has been taken in the preparation of this material. It is the cornerstone to student learning and without doubt the most important feature of the textbook. It consists of a listing of *Words to Know and Use* (with definitions), *Review Questions*, *Think and Link*, *Think and Do*, *Think and Explain*, *Think and Compare*, *Think and Solve*, and lastly, a *Multiple Choice Practice* exam.

The *Words to Know and Use* provide a glossary of the key terms that are highlighted in the chapter. This is followed by the easy-to-answer *Review Questions*, cited by section, which frame the important ideas of each chapter. They are not meant to challenge the student's intellect, because the answers can be looked up in the chapter. Next come the *Think and Link* questions that relate to Integrated Science sections in each chapter and promote an understanding of the interdependency of the various sciences.

The *Think and Explain* questions are, by a notch or two, the most difficult questions at the end of each chapter. Many require critical thinking, and others are designed to prompt the application of science to everyday situations. All students wanting to perform well on exams should be directed to the *Think and Explain* questions because these are the questions that directly assess student understanding. Accordingly, many of the *Think and Explain* questions have been adapted to a multiple-choice or true-false format and incorporated into the Conceptual Integrated Science—Explorations ExamView test bank.

Following the *Think and Explain* questions are the *Think and Compare* questions, which ask students to identify trends. For example, students may be asked to rank the momenta and kinetic energies of three vehicles with different masses and speeds. Or they may be asked to rank atoms in order of increasing size based on their understanding of the periodic table. Many chapters feature a *Think and Do* section of activities. A few chapters feature *Think and Solve*, where simple mathematics blends with concepts. In many of these students are asked to “show that” such and such is the answer—providing the numerical answer while putting emphasis on *how* the answer is found. Lastly there appears a set of 10 multiple-choice questions that the student can use as a practice exam or for an easy-to-grade homework assignment.

Units of measurement are not emphasized in this text. When used, they are almost exclusively expressed in SI units. (The few exceptions include units in calories, grams per centimeter cubed, and light-years.) *Appendix A* details systems of measurement. *Appendix B* provides extended coverage of linear and rotational motion. *Appendix C* provides practice with vector components, *Appendix D* treats the physics of fluids, and *Appendix E* develops the concepts of exponential growth and decay. Finally, *Appendix F* is the *Safety Appendix*, which includes safety information pertaining to the Discover! activities.

Organization of the Text

This text is organized into five parts corresponding to the major subject disciplines—physics, chemistry, biology, Earth science, and astronomy. This sequence of chapters is based on increasing complexity and scale from physics to astronomy.

Part One begins with physics, the most fundamental science. The physics chapters are adapted from *Conceptual Physics* but crafted to meet the needs of an Integrated Science course. The treatment of physics begins with Newton's laws followed by a study of energy and momentum with an emphasis on conservation principles. This sets the stage for a study of gravity and its connection to projectiles and satellites. The study of physics continues to heat, electricity and magnetism, wave phenomena (especially sound and light), the atom, and finally nuclear physics.

Part Two explores chemistry by building on the foundation of ideas developed in the physics unit. The overall goal is to enable students to view the macroscopic world in terms of its submicroscopic constituents—atoms and molecules. Chemistry chapters, in the vein of all books in the *Conceptual* series, emphasize concepts over computation. They also emphasize science in everyday life. Relating chemistry to students' familiar world—the fluorine in their toothpaste, the Teflon on their frying pans, and the flavors produced by various organic molecules—keeps chemistry fun and relevant. The treatment of chemistry also connects to social and environmental issues.

Part Three builds on physics and chemistry, taking students to the more complex realm of biology, the study of life and living things. We begin by asking, what constitutes life? We then focus on three key attributes of living things—cells, genes, and evolution. The cell is presented as the basic structural and functional unit of living organisms. This is followed by genetics, the study of heredity, or how traits are passed from parents to offspring. This sets the stage for the concept of evolution, which explains how the diversity of Earth's life is the result of heritable changes in living organisms. The next chapter provides an overview of biological diversity, examining living organisms from bacteria to plants, fungi, and animals. This is followed by a focus on human biology and the human body, in which we examine how the body senses the world, moves, thinks, and maintains itself. Finally, we look at ecology, the study of how living organisms interact with the living and nonliving components of their environments.

Part Four builds on physics, chemistry, and biology to study Earth science. The unit begins with plate tectonics, which provides the basic framework for all the other chapters. The major concept from plate tectonics—that Earth is a dynamic system subject to ongoing change as heat is transferred away from its interior—helps put the subsequent chapter on rocks and minerals in context. After rocks and minerals, the next two chapters concern the surface environment: landforms and the distribution of water, then the surface processes of weathering, erosion, and deposition. Next, students can depart Earth's surface and enter its

atmosphere to analyze weather and climate. The Earth science unit continues with a highly integrated chapter devoted to Earth's history. The unit concludes with a chapter on environmental geology that investigates of geologic hazards including volcanoes, earthquakes, storms, and climate change.

In Part Five, students expand their focus to astronomy and employ important ideas learned in physics, chemistry, Earth science, and even biology. We begin with a study of the solar system and some details of its origin according to the nebular theory. Factual information on the planets and other heavenly bodies is tied to this central concept. The final chapter of this book, "The Universe," provides an in-depth look at the stars with an introduction to the concepts of cosmology, including the Big Bang, Hubble's law, and the search for extraterrestrial life.

Conceptual Integrated Science—Explorations is a wide-ranging course, offering students tools to understand the natural world, and the many scientific issues they will grapple with as citizens of the 21st century. May this be one of the most interesting, amazing, and worthwhile courses your students will ever take!

Supplements

Conceptual Integrated Science—Explorations contains more than enough material for a one-year Integrated Science course. There is also a full suite of ancillary materials for students and teachers in a variety of media developed for this course. Because there are so many resources and because most of the chapters in the text are self-contained, you have great flexibility in tailoring the *Conceptual Integrated Science—Explorations* program to suit your taste and the needs of your students.

Supplements for the Teacher

Most of the teacher supplements and resources for this book are available electronically at the Instructor Resource Center. Upon adoption or to preview, please go to <http://pearsonschool.com/advanced> and click "Online Teacher Supplements." You will be required to complete a one-time registration subject to verification before being e-mailed access information to download materials.

The following supplements are available to qualified adopters:

The **Annotated Teacher's Edition for Conceptual Integrated Science—Explorations** (0-13-700788-4) arms teachers with tips for class lectures, answers to homework problems and Discover! activities, cross-references to related content in other supplements, Check Your Neighbor pointers, and possible misconceptions to watch out for. Each chapter opens with an insightful passage from the authors that gives teachers a new perspective to bring to the classroom.

The **Minds-On, Hands-On Activity Book** (0-13-136356-5) goes beyond the Discover! activities in the textbook and provides teachers a variety of pedagogical approaches for shaping science skills in

diverse settings. Teaching strategies include group work (cooperative learning), concept mapping, student-designed investigations, quick hands-on activities, skill building, activity-based assessment, and oral presentations.

The **Instructor Resource DVD** (0-13-714096-7) contains a rich set of resources to use in classroom presentations and to assess student understanding of material, including the following:

- Art and tables from text in jpeg format.
- An **ExamView test bank** of more than 1000 questions, written by the authors of the textbook, in multiple-choice, fill-in-the-blank formats, allows you to edit questions, add questions, and create multiple test versions.
- **Next-Time Questions**, a collection of illustrated “puzzlers” designed to provoke lively discussion in class. Post them at the beginning of class to focus students’ attention or at the end of class to give students a puzzle to mull over until “next time.”
- **Assessment Masters** include true/false, multiple-choice, and short-answer questions for every chapter in the textbook.
- **Answer keys** are provided for all supplements including the Lab Manual activities, Next-Time Questions, Assessment Masters, the *Practice Book*, and the Guided Reading.

In the back of every Student Edition and Annotated Teacher’s Edition is a **CD-ROM that includes an assortment of interactive figures, videos, and quizzes from the Student Companion Website**. In addition, an **eBook** (accessible online through the Student Companion Web site or on a CD) allows you to read the textbook from your computer and search for content by keyword. Use these assets in classroom presentations or when you cannot access them online. A replacement CD is available (ISBN 0-13-136355-7).

Last, but not least, is the **Student Companion Website (<http://www.physicsplace.com>)**, which includes a rich collection of media to enhance classroom learning. Students can explore a variety of media, including self-paced interactive figures and tutorials; a library of videos created by the authors and other well-known sources; chapter-specific self-study quizzes; an interactive glossary and flash card deck; an interactive periodic table; and the eBook! Teachers can also track students’ completion of select tutorials and all quizzes using the gradebook feature. Access to the Companion Website is provided with every new book.

High school teachers can obtain teacher and student preview or adoption access to the Companion Website in one of two ways:

- By registering online at http://www.pearsonschool.com/access_request.
- Through the use of a physical pincode card. High school adopters will receive an adopter access pincode card (ISBN 0130343919) with their textbook order.

Preview access pincode cards may be requested using ISBN 0131115989. Both adopter and preview pincode cards include follow-on directions and provide teacher and student access.

For questions concerning access, please contact your local Pearson sales representative or e-mail phwebaccess@pearsoned.com.

Supplements for the Student

The **Practice Book** (0-13-700783-3) is filled with computational exercises, misconception-busting questions, analogies, intriguing puzzlers, and straightforward practice questions and problems to help students “tie it all together.” Humorous and insightful cartoons by Paul Hewitt appear on every page. The Practice Book is included with every new Student Edition purchase.

The **Student Companion Website** contains a wealth of media resources to aid study and comprehension, including a complete eBook; self-paced interactive figures and tutorials; a library of videos created by the authors and other well-known sources; chapter-specific self-study quizzes; and much more! In addition, a **CD-ROM** with many of the Website features is included in every new Student Edition.

The following supplements are available for purchase:

The Laboratory Manual for Conceptual Integrated Science—Explorations (0-13-700784-1) was written by the authors and Dean Baird. The book includes a balance of in-depth experiments that allow students to develop laboratory skills and quick activities that use readily available materials.

Section-based worksheets in the **Guided Reading for Conceptual Integrated Science—Explorations** (0-13-245716-4) help students master chapter content, develop study skills, and improve reading comprehension with graphic organizers, fill-in-the-blank questions, true/false questions, puzzles, and illustrations.

Go to it! Your conceptual physical science course really can be the most interesting, informative, and worthwhile science course available to your students.

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