



Preface

A Note to Students

Human beings have been curious about the oceans since they first walked along their shores. As people have learned more about the oceans, they have come to understand more fully and appreciate the tremendous influence these bodies of salt water have on our lives. The oceans cover over 70% of Earth's surface, creating a habitat for thousands of known species and countless others still to be discovered. The sea contains vast quantities of diverse natural resources in the water and on the sea floor; some are actively exploited today, and many more may be recovered in the future with improved technology and greater demand. Global climate and weather are strongly influenced by the oceans as they interact with the atmosphere through the transfer of moisture and heat energy. The ocean basins also serve as the location of great geologic processes and features such as earthquakes, volcanoes, massive mountain ranges, and deep trenches, all of which are related to the creation and destruction of sea floor in the process of plate tectonics.

Much of what happens in the oceans and on the sea floor is hidden from direct observation. Although the *Hubble Space Telescope* can form images from light that has traveled over 10 billion trillion kilometers, we cannot see more than a few tens of meters below the ocean's surface even under the most favorable conditions because of the efficient scattering and absorption of light by seawater. Consequently, most of what we know about the oceans comes from indirect, or remote, methods of observation. With constantly improving technology and innovative applications of that technology, we continue to learn more about the geological, physical, chemical, and biological characteristics of the oceans.

Although careful scientific study of the oceans is often difficult and challenging, it is both necessary and rewarding. Our lives are so intimately tied to the oceans that we benefit from each new fact that we discover. Continued research and a better understanding of the oceans become increasingly important, as the population of this planet grows ever larger. Early in the new millennium, there is both good news and bad news concerning global population growth. The rate of population increase has slowed with falling birth rates, and there is some indication that the human population will level off by the end of this century. But even if the human population does stabilize, it will not do so before there is an increase of several billion people over today's population. We clearly will continue to face difficult environmental decisions affecting the oceans as well as the land in the foreseeable future. Our best chance of dealing wisely and effectively with these challenges is to promote more widespread understanding of the oceans.

Although it is critical that we continue to train marine scientists to study the oceans, it is no less important for people in all walks of life to develop a basic understanding of how the oceans influence our lives and how our actions influence the oceans. In studying oceanography, you are preparing yourself to be an informed global citizen. It is likely that at some point in the future you will have the opportunity to voice your concern about the health of the oceans, either directly or through the governmental process. Your interest in and study of oceanography will help you participate in future discussions and decision-making processes in an informed manner.

The book's website at www.mhhe.com/sverdrup10e provides you with links to Internet addresses relevant to this text. To expand your knowledge of oceanography, Internet exercises for many of these sites are found on the website. Also included is a comprehensive student study guide that includes detailed outlines of the chapters and questions to test your understanding.

A Note to Instructors

A major objective of this text is to stimulate student interest and curiosity by blending contemporary information and research with basic principles in order to present an integrated introduction to the many and varied sciences used in the study of the oceans. To do so, we have extensively reviewed and rewritten material from the ninth edition to produce this new tenth edition. In the face of constant and rapid change, we have added new material for both content and interest. We have also invited six scientists to write guest essays in their fields of specialization. There is also a seventh essay written by a chief scientist and a ship's captain on planning and executing an oceanographic expedition.

We realize that the students who use this book come from diverse backgrounds and that for many of them this is an elective course. The content continues to be reasonably rigorous, but we have chosen to use simple algebra rather than advanced mathematics. For instance, we use centrifugal force to explain tidal principles because most students do not have much background in vectors.

An ecological approach and descriptive material are used to integrate the biological chapters with the other subject fields. We strive to emphasize oceanography as a cohesive and united whole rather than a collection of subjects gathered under a marine umbrella.

In order to understand the constant barrage of information concerning our planet and marine issues, students must have a basic command of the language of marine science in addition to

mastering processes and principles. For this reason we maintain an emphasis on critical vocabulary. All terms are defined in the text; terms that are particularly important are printed in boldface. A list of important terms appears at the end of each chapter, with a glossary included at the end of the book. The website for this text also hosts interactive flashcards of key terms for student study.

End-of-chapter Summaries provide quick reviews of key concepts. Study Problems are included in many chapters, and Study Questions are at the end of each chapter. The Study Questions are not intended merely for review, but also to challenge students to think further about the lessons of the chapter.

This book may be used in a one-quarter or one-semester course. Because the experience and emphasis of faculty using this book will differ, it is expected that each instructor will emphasize and elaborate on some topic at the expense of other topics. We continue to make each chapter stand as independently as possible and encourage instructors to use the chapters in the order that best suits their purposes. Cross-references from one chapter to another indicate discussion of topics elsewhere in the text. Faculty wishing to use a more quantitative approach in some areas are encouraged to make use of appendix C, Equations and Quantitative Relationships. The answers to the Study Questions and Study Problems from the text appear in the Instructor's Manual, within the password-protected instructor's area of the website.

Changes to the Tenth Edition

In this edition of the book we introduce learning outcomes for each chapter. These can be used to guide both the instructor and the students as they study the material. In **Chapter 1** we have included historical information about Thomas Huxley and his identification of *Bathylbius haeckellii* as a suspected primordial form of deep-sea life and we have updated the information about the Argo program. A new, updated “Field Notes: New Approaches to Exploring the Oceans” has been prepared for **Chapter 3**. Several figures in **Chapter 4** have been modified for greater clarity. In **Chapter 5** the discussion of light attenuation in water has been modified and a new figure added to illustrate the difference in attenuation coefficients in open ocean water and coastal water. In addition, information on massive icebergs in the Antarctic has been updated. Details concerning El Niño conditions have been updated in **Chapter 7** along with an expanded discussion of Hurricane Katrina. We have also included a new “Field Notes: The Oceans and Climate Change.” In **Chapter 8** we have expanded the discussion of OTEC plants. In **Chapter 9** we have included a section on current volume transport. We have updated the information about the DART program of buoys in **Chapter 10** and we have expanded our discussion of internal waves. In **Chapter 12** we have updated information on National Marine Sanctuaries and rising sea level. In **Chapter 13** we have extensively updated information on marine pollution, the Gulf of Mexico dead zone, and oil spills. **Chapter 15** has been modified to include a new figure and a new table illustrating the concepts of trophic transfers. A new figure has been added to **Chapter 16** to better illustrate the complexity of the microbial food web. The section Practical

Considerations in **Chapter 17** has been updated with information on the world fish catch over past decades. **Chapters 16, 17, and 18** have been modified to better illustrate the concepts of “top-down” and “bottom-up” controls on food webs.

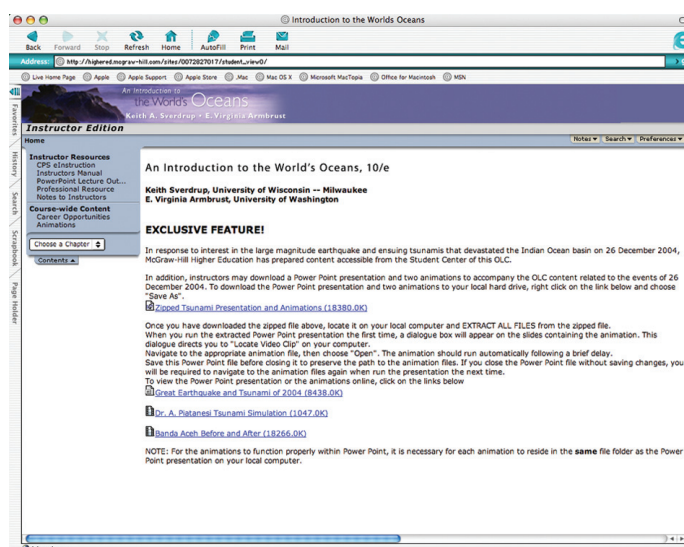
Instructor Supplements

McGraw-Hill offers a variety of supplements to assist instructors with both preparation and classroom presentation.

The 10th Edition Website (www.mhhe.com/sverdrup10e)

The 10th edition website offers a wealth of teaching and learning tools for instructors and students. Instructors will appreciate:

- A password-protected Instructor's Manual with answers to the study questions and study problems in the text
- PowerPoint lecture outlines
- Scripps videos
- Animations
- Access to the online **Presentation Center**, including most of the illustrations, photographs, and tables from the text in convenient jpeg format
- A student center with multiple-choice quizzes, a student study guide, key term flashcards, Internet exercises, and web links to chapter-related material
- A test bank utilizing McGraw-Hill's EZ Test software. EZ Test is a flexible and easy-to-use electronic testing program that allows instructors to create tests in a wide variety of question types.



Presentation Center

Build instructional materials wherever, whenever, and however you want!

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other media types that can be used to create customized lectures, visually enhanced tests and quizzes, compelling course websites, or attractive printed support materials.

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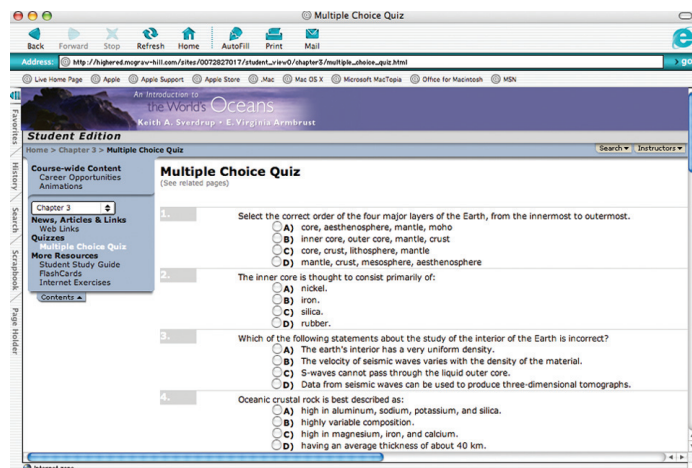
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Student Supplements

The Internet makes oceanographic information and data available to researchers and it also provides images and information in many forms to instructors and students. Public agencies and museums, universities and research laboratories, satellites and oceanographic projects, interest groups, and individuals all over the planet provide information that can be publicly accessed.

The website for *An Introduction to the World's Oceans* is a great place to review chapter material and enhance your study routine. Visit www.mhhe.com/sverdrup10e for access to the following online study tools:

- Multiple-choice quizzes
- Student study guide
- Key term flashcards
- Internet exercises
- Web links to chapter-related material



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