

Marine Science I

Teacher's Guide

Course No. 2002500

**Bureau of Instructional Support and Community Services
Division of Public Schools and Community Education
Florida Department of Education**

2001

This product was developed by Leon County Schools, Exceptional Student Education Department, through the Curriculum Improvement Project, funded by the State of Florida, Department of Education, Division of Public Schools and Community Education, Bureau of Instructional Support and Community Services, through federal assistance under the Individuals with Disabilities Education Act (IDEA), Part B.

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Course No. 2002500

developed and edited by
Angela Breeza-Pierce
Sue Fresen

from
Exploring Oceanography
Revised Edition

graphics by
Rachel McAllister

Curriculum Improvement Project
IDEA, Part B, Special Project



LEON COUNTY SCHOOLS
Exceptional Student Education

<http://www.leon.k12.fl.us/public/pass/>

Curriculum Improvement Project

Sue Fresen, Project Manager

Leon County Exceptional Student Education (ESE)

Ward Spisso, Director of Exceptional Education and Student Services

Diane Johnson, Director of the Florida Diagnostic and Learning Resources
System (FDLRS)/Miccosukee Associate Center

Superintendent of Leon County Schools

William J. Montford

School Board of Leon County

Fred Varn, Chair

Dee Crumpler

J. Scott Dailey

Maggie Lewis

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Acknowledgments

The staff of the Curriculum Improvement Project wishes to express appreciation to the content revisor and reviewers for their assistance in the development of *Marine Science I* from *Exploring Oceanography's* original material by content, instructional, and graphic design specialists from Dade and Leon county school districts.

Content Revisor

Angela Breeza-Pierce
Science Teacher
Department Chair
Chiles High School
Tallahassee, FL

Copy Editor

Deborah Shepard
National Board for Professionals
Teaching Standards (NBPTS)
Certified English Teacher
Lincoln High School
Tallahassee, FL

Review Team

Rich Bray
Biologist
Florida Department of Environmental
Protection
Author and Publisher
www.biobooks.org
Tallahassee, FL

George Shipp
Operations and Management
Consultant
Cedar Key Field Lab
Florida and Wildlife
Conservation Commission
Cedar Key, FL

Dr. Howard J. Fischer
Professor of Geology and Oceanography
Tallahassee Community College
Tallahassee, FL

Doug VanEtten
Developmental Teacher / Science
Schwettman Education Center
New Port Richey, FL

Dr. Susan Mattson
Science Teacher
Leon High School
Tallahassee, FL

Lawrence A. Weiner
Chief Operating Officer
Integrated Environmental
Solutions Corporation
St. Petersburg, FL

Gloria S. McIntosh
Science Teacher
Department Chair
Marine Science Magnet Program
South Broward High School
Hollywood, FL

Margaret Wood
Exceptional Student Education
Teacher
Leon High School
Tallahassee, FL

Production Staff

Sue Fresen, Project Manager
Rachel McAllister, Graphics Design Specialist
Tallahassee, FL

Foreword

Parallel Alternative Strategies for Students (PASS) books are content-centered packages of supplemental readings, activities, and methods that have been adapted for students who have disabilities and other students with diverse learning needs. *PASS* materials are used by regular education teachers and exceptional education teachers to help these students succeed in regular education content courses. They have also been used effectively in alternative settings such as juvenile justice educational programs and second chance schools, and in dropout prevention and other special programs that include students with diverse learning needs.

The content in *PASS* differs from standard textbooks and workbooks in several ways: simplified text; smaller units of study; reduced vocabulary level; increased frequency of drill and practice; concise directions; less cluttered format; and presentation of skills in small, sequential steps.

PASS materials are not intended to provide a comprehensive presentation of any course. They are designed to *supplement* state-adopted textbooks and other instructional materials. *PASS* may be used in a variety of ways to augment the curriculum for students with disabilities and other students with diverse learning needs who require additional support or accommodations in textbooks and curriculum. Some ways to incorporate this text into the existing program are as

- a resource to supplement the basic text
- a pre-teaching tool (advance organizer)
- a post-teaching tool (review)
- an alternative homework assignment
- an alternative to a book report
- extra credit work
- make-up work
- an outside assignment
- part of an individual contract
- self-help modules
- an independent activity for drill and practice
- general resource material for small or large groups
- an assessment of student learning

The initial work on *PASS* materials was done in Florida through Project IMPRESS, an Education of the Handicapped Act (EHA), Part B, project funded to Leon County Schools from 1981–1984. Four sets of modified

content materials called *Parallel Alternate Curriculum (PAC)* were disseminated as parts two through five of *A Resource Manual for the Development and Evaluation of Special Programs for Exceptional Students, Volume V-F: An Interactive Model Program for Exceptional Secondary Students*. Project IMPRESS patterned the PACs after curriculum materials developed at the Child Service Demonstration Center at Arizona State University in cooperation with Mesa, Arizona, Public Schools.

A series of 19 *PASS* volumes was developed by teams of regular and special educators from Florida school districts who volunteered to participate in the EHA, Part B, Special Project, Improvement of Secondary Curriculum for Exceptional Students (later called the Curriculum Improvement Project). This project was funded by the Florida Department of Education, Bureau of Education for Exceptional Students, to Leon County Schools during the 1984 through 1988 school years. Regular education subject area teachers and exceptional education teachers worked cooperatively to write, pilot, review, and validate the curriculum packages developed for the selected courses.

Beginning in 1989 the Curriculum Improvement Project contracted with Evaluation Systems Design, Inc., to design a revision process for the 19 *PASS* volumes. First, a statewide survey was disseminated to teachers and administrators in the 67 school districts to assess the use of and satisfaction with the *PASS* volumes. Teams of experts in instructional design and teachers in the content area and in exceptional education then carefully reviewed and revised each *PASS* volume according to the instructional design principles recommended in the recent research literature. Subsequent revisions have been made to bring the *PASS* materials into alignment with the Sunshine State Standards.

The *PASS* volumes provide some of the text accommodations necessary for students with diverse learning needs to have successful classroom experiences and to achieve mastery of the Sunshine State Standards. To increase student learning, these materials may be used in conjunction with additional resources that offer visual and auditory stimuli, including computer software, videotapes, audiotapes, and laser videodiscs.

User's Guide

The *Marine Science I PASS* and accompanying *Teacher's Guide* are supplementary resources for teachers who are teaching science to secondary students with disabilities and other students with diverse learning needs. The content of the *Marine Science I PASS* book is based on the *Florida Curriculum Frameworks* and correlates to the Sunshine State Standards.

The Sunshine State Standards are made up of *strands, standards, and benchmarks*. A *strand* is the most general type of information and represents a category of knowledge. A *standard* is a description of general expectations regarding knowledge and skill development. A *benchmark* is the most specific level of information and is a statement of expectations about student knowledge and skills. Sunshine State Standards correlation information for *Marine Science I*, course number 2002500, is given in a matrix in appendix E.

The *Marine Science I PASS* is divided into 18 units of study that correspond to the science strands. The student book focuses on readings and activities that help students meet benchmark requirements as identified in the course description. It is suggested that expectations for student performance be shared with the students before instruction begins.

Each unit in the *Teacher's Guide* includes the following components:

- **Unit Focus:** Each unit begins with this general description of the unit's content and describes the student goals. This general description also appears in the student book. The Unit Focus may be used with various advance organizers (e.g, surveying routines, previewing routines, paraphrasing objectives, posing questions to answer, developing graphic organizers such as in appendix A, sequencing reviews) to encourage and support learner commitment.
- **Suggestions for Enrichment:** Each unit contains activities that may be used to encourage, to interest, and to motivate students by relating concepts to real-world experiences and prior knowledge.
- **Unit Assessments:** Each unit contains an assessment with which to measure student performance.

- **Keys:** Each unit contains an answer key for each practice in the student book and for the unit assessments in the *Teacher's Guide*.

The appendices contain the following components:

- **Appendix A** describes instructional strategies adapted from the Florida Curriculum Frameworks for meeting the needs of students with disabilities and other students with diverse learning needs.
- **Appendix B** lists teaching suggestions for helping students achieve mastery of the Sunshine State Standards and Benchmarks.
- **Appendix C** contains suggestions for specific strategies to facilitate inclusion of students with disabilities and other students with diverse learning needs. These strategies may be tailored to meet the individual needs of students.
- **Appendix D** lists suggested Internet sites for *Marine Science I*.
- **Appendix E** contains a chart that correlates relevant benchmarks from the Sunshine State Standards with the course requirements for *Marine Science I*. These course requirements describe the knowledge and skills the students will have once the course has been successfully completed. The chart may be used in a plan book to record dates as the benchmarks are addressed.
- **Appendix F** lists suggested computer software, laser videodiscs, films, and videos for *Marine Science I*.
- **Appendix G** list sources for ordering materials for *Marine Science I*.
- **Appendix H** list reference materials and software to produce *Marine Science I*.

Marine Science I is designed to correlate classroom practices with the Florida Curriculum Frameworks. No one text can adequately meet all the needs of all students—this *PASS* is no exception. *PASS* is designed for use with other instructional materials and strategies to aid comprehension, provide reinforcement, and assist students in attaining the subject area benchmarks and standards.



Unit 1: The Hydrosphere

Unit Focus

This unit describes the waters of the Earth and the science of oceanography. Students will learn the importance of the oceans and how oceans are utilized as a resource.

Student Goals

1. Define oceanography.
2. State the four branches of oceanography and describe each branch.
3. State the importance of the world's oceans.
4. Give examples of how humans use the ocean as a resource.

Suggestions for Enrichment

1. Have students illustrate how oceanography contains many branches of science, and have them cut out pictures depicting sciences used in oceanography to form a collage.
2. To emphasize oceanography and the number of oceanography events that occur throughout the year, have students collect newspaper and magazine articles about oceanography during the school year and construct a scrapbook. Have students prepare a written summary of selected articles and include both the summaries and the articles in a scrapbook.
3. Have students view the video *Earth: Its Oceans*, available from National Geographic, to stimulate discussions on the importance of oceans.
4. Have students discuss their experiences and observations at the ocean. Encourage them to bring in photographs they would like to share or display.



5. Have students construct a papier-maché Earth around a balloon. Let students paint and label the oceans and continents.
6. Have students research a famous marine scientist and write an article about him or her, or conduct a fictitious interview.
7. Have students research careers in ocean science (<http://www.mdsg.umd.edu/NSGOL>) and choose one career to present orally. (Teachers should visit sites beforehand to verify the site address has not changed and contains appropriate information.)
8. Have students select content-related activities and write about the processes used to complete each activity. Have students scan the Sunshine State Standards and identify all standards that apply to the student behaviors demonstrated in completing the selected activities. Ask students to then revise their written explanations to describe how each activity developed or reinforced each identified standard. Collect the students' work samples and the written reflections to form a student portfolio.
9. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.



Lab Preparation

Teacher Preparation for Lab Activity 1: Mapping the World's Oceans (pages 20-23)

Materials:

colored pencils; two copies of a blank world map; globe, atlas, or map to be used by several students

Teacher Preparation for Lab Activity 2: Postcards from the Oceans (pages 26-28)

Materials:

colored pencils or crayons; paper or file folders cut to 8" x 10"; reference books or Internet access to research different oceans or seas; magazines pictures or Internet pictures of oceans and seas

Teacher Background Information:

The postcard lab activity is a very good way to integrate marine science with world geography and social studies. In this lab, postcards are used to describe a location of study and are sent to family or friends. Before the students begin their postcards, review the basics of a postcard. Share examples of real postcards so students can see the different parts of a postcard. Use the following information as a guideline for postcard discussion.

- picture on the front
- description of the picture on the back in the upper left side
- message area on the back on the remainder left side
- place for address of person sending to on the right side of the back of the postcard
- place for stamp in upper right corner of the back of the postcard



Lab Safety Contract



I, _____, have read and do understand the safety rules of the science laboratory and agree to follow them at **all** times. I will follow all instructions given by the teacher and behave responsibly in the science laboratory.

Date

Student's Signature

Parent's Signature

Teacher's Signature





Safety Rules

1. Read and follow all directions while working in the laboratory.
2. Wear protective gear, such as aprons, at all times. Wear goggles when working with dangerous or hot chemicals, or any time your teacher instructs you to do so.
3. NEVER taste or directly inhale chemicals. Test the smell of a substance by wafting or fanning some of the odor to your nose with your hand. Your teacher can show you how.
4. DO NOT bring food or drink into the lab.
5. Wash hands thoroughly after each lab.
6. DO NOT rub eyes or put hands in mouth.
7. Dress in a way that helps you work safely and efficiently in the lab. Tie your hair back. Wear cotton—it doesn't catch fire as easily as nylon or polyester. Always keep your shoes on while in the lab. Roll up long or loose sleeves.
8. DO NOT look directly down into the mouth of a filled test tube. DO NOT point the mouth of a filled test tube at another student. Liquid can splash into eyes.
9. DO NOT perform any experiments unless the instructor is in the room.
10. Report ALL minor and major accidents to your instructor. Remain calm and do not alarm others by shouting or running.
11. Know the location of the safety shower, eye wash, and fire blanket. Know how to use these important pieces of safety equipment.
12. Turn off gas burners and the gas outlets when no one is using them. NEVER leave a lit burner unattended.
13. Use tongs or gloves to handle hot objects.
14. Keep lab tables clean and neat to prevent accidents. Dispose of wastes and used chemicals in appropriate location and manner according to teacher's instruction. Wipe all areas at the end of the lab.
15. MAKE SAFETY A HABIT!



Unit Assessment

Match each **description** with the correct **type of oceanographers**. Write the letter on the line provided.

- | | | |
|----------|--|-----------------------------|
| _____ 1. | scientist who studies the change in seawater and the motion of seawater | A. biological oceanographer |
| _____ 2. | scientist who studies the distribution, natural history, and environment of marine life | B. chemical oceanographer |
| _____ 3. | scientist who studies the chemical composition of seawater and the chemical reactions that occur in seawater | C. geological oceanographer |
| _____ 4. | scientist who studies ocean sediments and the topography of the ocean floor | D. physical oceanographer |

Match each **description** with the correct **type of energy**. Write the letter on the line provided.

- | | | |
|----------|--|-------------------|
| _____ 5. | an energy source obtained from the ocean's tides | A. current energy |
| _____ 6. | an energy source obtained from currents in the ocean, used to turn turbine blades to produce energy | B. thermal energy |
| _____ 7. | an energy source obtained from the ocean's direct absorption of sunlight and transformed to heat | C. tidal power |
| _____ 8. | an energy source obtained from the ocean's waves, used to turn turbine blades to produce electricity | D. wave energy |



Write the **number** of each **location** in the correct place on the **world map**.

Seas		Gulfs		Oceans		Islands	
9	Arabian	13	Mediterranean	18	Antarctic	23	Cuba
10	Black	14	North	19	Arcic	24	Madagascar
11	China	15	Red	20	Atlantic	25	Phillipine Islands
12	Japan			21	Indian		
			16	Gulf of California	22	Pacific	
			17	Gulf of Mexico			





Circle the letter of the correct answer.

26. Geological oceanographers study _____ under the ocean's surface.
- a. rock and rock movements
 - b. seaweed
 - c. fish
 - d. sunken treasure
27. The study of the Earth's oceans is called _____ .
- a. meteorology
 - b. engineering
 - c. oceanography
 - d. Earth science
28. Physical oceanographers study the _____ of oceans.
- a. color
 - b. currents and motions
 - c. size
 - d. depth
29. _____ are smaller bodies of saltwater frequently enclosed by land.
- a. Lakes
 - b. Ponds
 - c. Oceans
 - d. Seas



Answer the following using short answers.

30. What are three reasons the oceans are important to human life? ____

31. What is a common mineral obtained from the ocean? _____

32. Why is the *H.M.S. Challenger* important to the history of oceanography? _____



Keys

Practice (p. 12)

1. Oceanography
2. hydrosphere
3. *Resolution*
4. animals; plants
5. sodium chloride; magnesium
6. thermal
7. Drilling platforms
8. oceans
9. oceanographers

Practice (p. 13)

1. chemical, biological, physical, and geological oceanography
2. Atlantic, Pacific, Indian, Arctic, and Antarctic oceans
3. Answers may include any three of the following: Mediterranean, Caribbean, Baltic, Arabian, Red, Black, North, China, and Japan seas
4. It allowed pioneering scientists to begin exploring the oceans.
5. Answers may include the following: They influence and play an essential role in our climate, water cycle, and weather; they provide us with transportation, recreation, food, medicines, commercial products, minerals, water, and energy.

Practice (pp. 14-15)

1. c
2. a
3. c
4. b
5. d
6. a
7. d
8. a
9. b
10. d
11. c
12. d

Practice (pp. 16-17)

1. 2,225 humans
2. 519 humans
3. 24 Empire State Buildings
4. 10 humans
5. 16 humans
6. 1,528 giraffes
7. 323 blue whales
8. Yes (with 6,769 feet to spare)
9. 31 elephants
10. 11,820 more feet
11. 4,856 more feet

Practice (pp. 18-19)

1. Pacific Ocean
2. Pacific Ocean
3. Indian Ocean
4. Atlantic Ocean
5. Atlantic Ocean
6. Indian Ocean
7. Pacific Ocean
8. Pacific Ocean
9. Pacific Ocean
10. Indian Ocean
11. Atlantic Ocean
12. Atlantic Ocean
13. Atlantic Ocean
14. Atlantic Ocean
15. Pacific Ocean



Keys

Lab Activity 1 (pp. 20-23)

Correct answers on maps will be determined by the teacher.

Practice (pp. 24-25)

1. Pacific Ocean
2. Indian Ocean
3. Arctic Ocean
4. Atlantic Ocean
5. Pacific Ocean
6. Atlantic Ocean
7. Atlantic Ocean
8. Gulf of Mexico
9. Philippine Islands
10. Mediterranean Sea
11. Gulf of California
12. Arabian Sea

Lab Activity 2 (pp. 26-28)

Answers will vary.

Practice (pp. 29-30)

1. topography
2. geological oceanographers
3. tidal power
4. ocean
5. thermal energy
6. drilling platforms
7. biological oceanographers
8. oceanographers
9. hydrosphere
10. chemical oceanographers
11. underwater research vehicle
12. seas
13. oceanography
14. physical oceanography

Unit Assessment (pp. 7-10TG)

1. C
2. B
3. A
4. D
5. C
6. D
7. A
8. B
- 9.-25. Correct answers will be determined by the teacher.
26. a
27. c
28. b
29. d
30. Answers may include the following: They influence and play an essential role in our climate, water cycle, and weather; they provide us with transportation, recreation, food, medicines, commercial products, minerals, water, and energy.
31. sodium chloride
32. The *H.M.S. Challenger* was the ship upon which pioneering scientists began exploring the ocean.



Unit 2: Measuring the Ocean

Unit Focus

This unit describes how oceanographers measure the ocean's chemical and physical characteristics. Students will learn specific oceanic chemical and physical features, such as salinity, density, and temperature, and the instruments used to measure these features.

Student Goals

1. Define salinity.
2. Identify methods used to determine salinity.
3. Recognize the relationship between salinity and density of the oceans.
4. Give examples of how humans employ technology to study the ocean floor.

Suggestions for Enrichment

1. Ask students to select one of the career opportunities discussed in the unit and list the possible advantages and disadvantages of that career.
2. Have students view films about careers in oceanography and discuss the importance of each career.
3. Have students research additional information about Jacques Cousteau and other ocean scientists and share their findings through oral presentations or classroom posters.
4. Ask students to share personal knowledge or experiences they may have with any of the apparatus or careers discussed in this unit.



5. Have students watch science fiction movies focusing on underwater exploration. List the technological equipment used by the characters in the movies.
6. Ask students to draw and label instruments or tools used by oceanographers. Make sure they include the secchi disk, seine net, trawl, plankton net, screen sieve, and corer in the drawings and state how each instrument is used.
7. Have students choose an oceanographic tool (e.g., dredge, Nansen bottle, Niskin bottle, Shipek grab, plankton net, gravity core, secchi disk) and construct a functional replica and demonstrate and explain its use.
8. Have the students simulate the saltwater conditions of oceans by adding salt to fresh water. Have them freeze the mixture in ice cube trays then taste the ice to observe that the salt did not freeze and that the water does not taste salty.
9. Conduct an Internet search on recent oceanographic studies. Have each student print out their findings and present their information in an oral report. Post students' research findings on a research bulletin board.
10. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity: Ocean Depths (pages 50-53)

Materials:

data chart, pencil, paper



Unit Assessment

Circle the letter next to the correct answer.

1. The depth of the ocean floor is studied with equipment such as _____ .
 - a. seismic profilers, satellites, and sonar
 - b. secchi discs, plankton nets, and hydrometers
 - c. SCUBA gear, titration apparatus, and grab sampler
 - d. side scan sonars, Nansen bottles, and corers

2. A device which grabs sediment from the ocean floor is called a _____ .
 - a. secchi disc
 - b. trawl
 - c. salinity
 - d. grab sampler

3. _____ stands for self-contained underwater breathing apparatus.
 - a. diving equipment
 - b. aqualung
 - c. SCUBA
 - d. oxygen tank

4. If you find a drift bottle in the ocean, you _____ .
 - a. should throw it back into the ocean
 - b. should keep it as a souvenir
 - c. should pick up the litter and recycle it
 - d. should return it in the manner requested

5. A _____ measures the density of water.
 - a. titration apparatus
 - b. thermometer
 - c. secchi disc
 - d. hydrometer



6. If you scoop up a handful of ocean water, you may be holding water and _____ .
 - a. oxygen, nitrogen, and carbon dioxide
 - b. sodium chloride (NaCl)
 - c. microscopic organisms
 - d. almost all the known chemical elements

7. An instrument which records the temperature of seawater at the ocean's surface and at various depths below the surface is a _____ .
 - a. secchi disc
 - b. corer
 - c. dredge
 - d. Nansen bottle

8. The group of organisms that live in and on the ocean's bottom are known as _____ .
 - a. trawlers
 - b. benthos
 - c. plankton
 - d. secchi

9. A _____ is an instrument which measures the amount of gases in seawater.
 - a. salinity
 - b. hydrometer
 - c. titration apparatus
 - d. trawl

10. A _____ is a large net pulled along the bottom to gather benthos.
 - a. seine net
 - b. plankton net
 - c. trawl
 - d. grab sampler



11. The term which refers to the depth to which light can travel in the water is _____ .
 - a. density
 - b. clarity
 - c. decompression
 - d. pressure

12. The mass in a particular volume of seawater is called its _____ .
 - a. clarity
 - b. weight
 - c. density
 - d. temperature

13. _____ uses sound waves to view a wide area of the ocean floor.
 - a. Seismic profiling
 - b. Side scan sonar
 - c. Echo sounding
 - d. Technology

14. _____ is the amount of dissolved solids in seawater.
 - a. Clarity
 - b. Salinity
 - c. Density
 - d. Decompression

15. To gather tiny organisms for study, oceanographers tow a cone-shaped _____ net through the water.
 - a. trawl
 - b. seine
 - c. plankton
 - d. butterfly



Use the list below to name an **instrument** or **tool** that measures the following ocean features. Write the correct term on the line provided. **Some features will be measured by more than one instrument or tool as indicated by the number in parenthesis.**

corer	Nansen bottle
dredge	plankton net
drift bottle	secchi disc
echo sounder	sonar
grab sampler	titration apparatus
hydrometer	

16. density: _____
17. temperature: _____
18. substances in seawater: _____
19. clarity of water: _____
20. depth (2): _____
21. currents: _____
22. ocean sediments (3): _____
23. organisms: _____



Keys

Practice (pp. 46-47)

1. drift bottle
2. Salinity
3. density
4. SCUBA
5. decompression
6. sonar
7. benthos
8. sediment samples
9. corer
10. geological
11. Side scan sonars
12. satellites

Practice (p. 48)

1. D
2. F
3. E
4. G
5. C
6. A
7. B
8. I
9. H

Practice (p. 49)

1. They measure the time it takes for the sound wave to bounce off the ocean and return back to the ship.
2. Seismic profiling uses powerful sound waves produced by explosions to chart a deeper profile of the ocean floor. Side scan sonars send sound waves out to the sides of the ship. The waves are received by an instrument towed behind the ship. This provides pictures of objects on the seafloor.
3. Self-Contained Underwater Breathing Apparatus

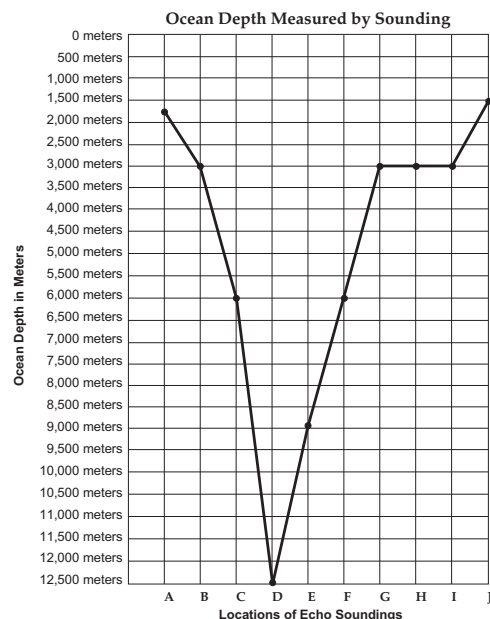
4. Divers can explore marine life at deeper levels of the ocean and for longer periods of time than they could without air tanks.
5. grab sampler; dredge; corer

Lab Activity (pp. 51-53)

1. 1,524 meters
2. 3,048 meters
3. 6,096 meters
4. 12,192 meters
5. 9,144 meters
6. 6,096 meters
7. 3,048 meters
8. 3,048 meters
9. 3,048 meters
10. 1,524 meters

Analysis:

See graph below.



11. The ocean depth is not uniform.



Keys

12. 16 seconds; the depth was the deepest at this point
13. 2 seconds; the depth was the shallowest at this point
14. Echo sounding helps oceanographers get an idea of the shape and depth of the ocean floor.

Practice (p. 54)

1. G
2. B
3. D
4. F
5. H
6. A
7. J
8. C
9. E
10. I

Practice (pp. 55-56)

1. corer
2. decompression
3. SCUBA
4. trawl
5. grab sampler
6. dredge
7. plankton
8. seine net
9. plankton net
10. seismic profiling
11. side scan sonar
12. echo sounding

Unit Assessment (pp. 15-18TG)

1. a
2. d
3. c
4. d
5. d
6. d
7. d

8. b
9. c
10. c
11. b
12. c
13. b
14. b
15. c
16. hydrometer
17. Nansen bottle
18. titration apparatus
19. secchi disc
20. echo sounder; sonar
21. drift bottle
22. grab sampler; dredge; corer
23. plankton net



Unit 3: The Nature of Seawater

Unit Focus

This unit explains the components of seawater and the differences in salinity throughout the world's oceans. Students will gain knowledge about factors such as precipitation, temperature, location, and evaporation, which affect salinity in the oceans.

Student Goals

1. Describe how the oceans became salty.
2. Define salinity.
3. Explain how precipitation, temperature, and evaporation affect the salinity of water.

Suggestions for Enrichment

1. Ask students to draw a diagram of the water cycle.
2. Discuss the elements that are found in seawater and explain how they got there.
3. Discuss electrical conductance and how its used to measure salinity.
4. Have students conduct an Internet search about the impact of precipitation or other factors that affect salinity on marine life. Students should share their findings with the class.
5. Discuss with students that a major factor (besides food) for marine animal migration is due to the changes in salinity. Many marine animals are not tolerant of changes in salinity so they must migrate to areas that have a constant salinity range.
6. Have students set up several saltwater aquariums. Each aquarium should have a different salinity range. Require that the students investigate the animals that are tolerant of the salinity range they



have established for their aquarium. Have students stock the aquarium with the appropriate marine organisms and maintain the water quality and care of the organisms.

7. Review concepts of the unit through a silent *Jeopardy* activity. Select 10 categories of topics, five for the first round and five for the second round. Have each student divide a piece of paper into two columns for the first and second round of *Jeopardy*. Assign point values of 1, 2, 3, 4, 5 for the first round and 2, 4, 6, 8, 10 for the second round. Randomly read questions from any topic and ask students to silently write the answers in the appropriate column. After a set time, do a final *Jeopardy* question and allow students to wager for 0-10 points. Check papers and tally the scores.
8. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity 1: Properties of Water (pages 75-76)

Materials:

beaker; flask; small jar; tap water; saltwater; triple beam balance; graduated cylinder

Teacher Preparation for Lab Activity 2: Comparing Densities (pages 77-81)

Materials:

two Erlenmeyer flasks; hot plate; 3x5 index card; food coloring; cool tap water; granular salt

Teacher Preparation for Lab Activity 3: Water Analysis (pages 82-87)

Materials:

distilled water; tap water; sodium carbonate solution; hydrochloric acid; seawater; barium chloride solution; three small test tubes; nitric acid solution; silver nitrate solution; acetic acid solution; potassium hydroxide solution; potassium permanganate; sulfuric acids; litmus paper; graduated cylinder; hot plate



Lab Chemicals and Materials

To the right are the directions for preparing the chemicals needed for the lab in Unit 3. Dilute/prepare all solutions with distilled water—125 ml makes enough for 4 to 6 sets of small dropper bottles.	1. Acetic acid	22 ml CH_3COOH added to 125 ml distilled water
	2. Sodium carbonate	20 g Na_2CO_3 added to 125 ml distilled water
	3. Hydrochloric acid	32 ml 36% HCl added to 125 ml distilled water
	4. Barium chloride	8 g $\text{Ba}_2\text{Cl} \cdot 2\text{H}_2\text{O}$ added to 125 ml distilled water
	5. Nitric acid	25 ml 69% HNO_3 added to 125 ml distilled water
	6. Silver nitrate	11 g AgNO_3 added to 125 ml distilled water
	7. Potassium hydroxide	22 g KOH added to 125 ml distilled water
	8. Potassium permanganate	.25 g KMnO_4 added to 125 ml distilled water
	9. Sulfuric acid	Concentrated (be careful)
	10. pH or litmus paper	May substitute pH monitor



Unit Assessment

Circle the letter of the correct answer.

1. Extreme shifts in the concentration of either _____ in seawater would threaten or kill many organisms.
 - a. colors or sounds
 - b. acids or bases
 - c. water vapor or gas
 - d. plates or trenches
2. The movement of water from liquid to gas and back to liquid is called _____.
 - a. the hydrologic cycle
 - b. water vapor
 - c. recycling
 - d. a reservoir
3. _____ percent of the water on Earth is saltwater.
 - a. Fifty
 - b. Ten
 - c. Eighty
 - d. Ninety-seven
4. Most of the salts in seawater are made up of _____.
 - a. magnesium ions
 - b. potassium ions
 - c. sulfate and calcium ions
 - d. sodium and chloride ions
5. *Brackish* water is a mixture of freshwater and saltwater and has _____.
 - a. a higher salinity than normal seawater
 - b. no salinity
 - c. a lower salinity than normal seawater
 - d. very dense salinity



6. An example of a *hypersaline* body of water is _____ .
 - a. the Baltic Sea
 - b. the Great Salt Lake
 - c. the Great Lakes
 - d. polar ice caps

7. The ocean area at the equator has a low salinity because _____ .
 - a. precipitation is greater
 - b. precipitation is less
 - c. evaporation is greater
 - d. run-off is less

8. Earth's freshwater supply is continually replenished by the _____ cycle.
 - a. precipitation
 - b. sodium chloride
 - c. hydrologic
 - d. river run-off

9. The temperature of seawater varies depending on the _____ and the season of the year.
 - a. latitude
 - b. color
 - c. dissolved solids
 - d. photosynthesis

10. Beyond about _____ deep in the ocean, light is not bright enough to support photosynthesis.
 - a. 100 meters
 - b. 200 meters
 - c. 1,000 meters
 - d. 10 meters

11. Seawater at lower depths in the ocean is _____ seawater directly above it and on the surface.
 - a. the same temperature as
 - b. not different than
 - c. warmer than
 - d. colder than



12. The three most common gases in the ocean are _____ .
- oxygen, hydrogen, and carbon dioxide
 - nitrogen, carbon dioxide, and oxygen
 - sodium chloride, magnesium, and sulfate
 - calcium, potassium, and sulfate
13. While seawater ranges from brackish to hypersaline, the average is about _____ parts of salt per 1,000 parts of water.
- 250
 - 600
 - 97
 - 35
14. The chemical reaction between carbon dioxide and seawater that maintains the pH level in seawater is a process known as _____ .
- buffering
 - hydrogen ions
 - carbonic acid
 - respiration





Keys

Practice (pp. 69-70)

1. 97 percent
2. Freshwater is always being renewed through a cycling process.
3. sodium, chloride, magnesium, sulfate, calcium, potassium
4. areas along the equator or where water is enclosed and doesn't mix with ocean water
5. areas along the coast
6. evaporation; precipitation; freezing of ice; melting of ice; temperature; location; tides; stream run-off
7. Marine plants use carbon dioxide to produce food.
8. nitrogen; carbon dioxide; oxygen
9. distillation; filtration; crystallization

Practice (pp. 71-72)

1. hydrologic
2. Sodium chloride
3. 35 percent
4. sodium; chloride
5. ground
6. hydrologic
7. salts
8. brackish
9. thermocline
10. Red Sea; Mediterranean Sea; Dead Sea, Great Salt Lake; Gulf of Mexico
11. latitude; season
12. 200
13. pH
14. buffering
15. desalination

Practice (p. 73)

1. condensation
2. precipitation
3. evaporation

Practice (p. 74)

1. True
2. False
3. True
4. True
5. False
6. True
7. True
8. False
9. False
10. True
11. True
12. True

Lab Activity 1 (pp. 75-76)

Answers will vary.

Analysis:

1. Answers will vary.
2. Correct answers will be determined by the teacher.

Lab Activity 2 (pp. 77-81)

Data chart answers will vary.

Analysis:

1. cool; cool water stays on bottom, warm water rises
2. at the surface
3. by the sun's rays
4. cool water; cool water is denser
5. Correct labeling will be determined by the teacher based on student book page 69.



Keys

Analysis:

Data chart answers will vary.

1. saltwater; Saltwater has dissolved solids making it heavier than freshwater.
2. The saltwater will literally hold us up.
3. Answers may include the following: temperature, precipitation, location, evaporation, freezing of ice, melting of ice, or tides.

Pre-Lab Activity 3: Water Analysis (pp. 84-85)

1. so the test tubes will not get mixed up while performing the tests
2. tube filled half way with water sample
3. that the substance is present
4. calcium; sulfates; chlorides; ammonia; organic matter; pH
5. distilled; tap; seawater
6. three drops of acetic acid and three drops of sodium carbonate
7. A white precipitate will form.
8. Add three drops of hydrochloric acid, heat to boiling, add three drops barium chloride.
9. A white precipitate will form.
10. Add three drops of nitric acid and three drops of silver nitrate solution.
11. A white precipitate will form.
12. potassium hydroxide; four drops
13. A white precipitate will form.
14. Add two drops of potassium permanganate and five drops of sulfuric acid. Heat to boiling.
15. purple color changes to clear
16. litmus paper

Lab Activity 3 (pp. 86-87)

Observations will vary.

Analysis:

1. seawater
2. yes; chlorides
3. distilled water
4. Tap water had more chlorine present. Distilled water appeared clearer.
5. Pure in the sense of clean; but not as pure as distilled water which contains no elements.
6. Yes—seawater contains many different substances: Na, Cl, Mg, etc.; freshwater does not.
7. All rivers, streams, stormwater run-off, etc., empty into the oceans, making the oceans a mixture or washbowl of different water types.

Practice (p. 88)

1. F
2. B
3. E
4. C
5. D
6. A

Practice (pp. 89-90)

1. crystallization
2. filtration
3. condense
4. water vapor
5. distillation
6. desalination
7. buffer
8. base
9. ion
10. acid
11. pH



Keys

Unit Assessment (pp. 25-27TG)

1. b
2. a
3. d
4. d
5. c
6. b
7. a
8. c
9. a
10. b
11. d
12. a
13. d
14. a



Unit 4: Waves

Unit Focus

This unit emphasizes wave formation and the parts of a wave. Students will also study a variety of wave types and the impact waves have on the coastline.

Student Goals

1. Define a wave.
2. Identify the parts of a wave.
3. Describe how deep-water and shallow-water waves form.
4. Explain features of the coastline formed by wave action.

Suggestions for Enrichment

1. Ask students to draw a diagram of a wave and label the parts.
2. Have students gather pictures of beaches from around the world and observe the color of the sand and rock, and determine the origin and composition of the beach material.
3. Set up a ripple tank. Construct barriers that would simulate natural barriers that produce various wave patterns.
4. Arrange a trip to the beach or the area of beach where local surfers surf. Have students study the wave patterns, formations, and sets. Have them also observe the erosion of the beach due to wave action.
5. Invite a guest speaker from a local university to discuss coastal morphology.
6. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.



Lab Preparation

Teacher Preparation for Lab Activity: Wild about Waves (pages 110-114)

Materials:

computer with Internet access; Web site: www.pbs.org/wnet/savage seas; data table; pencil or pen.



Unit Assessment

Circle the letter of the correct answer.

1. Energy that moves through the water in an orbital motion is called a(n) _____ .
 - a. food source
 - b. electricity
 - c. light
 - d. wave
2. The lowest point of a wave is the _____ .
 - a. trough
 - b. crest
 - c. amplitude
 - d. wavelength
3. The vertical distance between the wave crest and the trough is the _____ .
 - a. trough
 - b. crest
 - c. amplitude
 - d. wave height
4. Long, low waves with rounded crests and troughs are called _____ .
 - a. tsunamis
 - b. spilling breakers
 - c. swells
 - d. plunging breakers
5. The highest point of a wave is the _____ .
 - a. trough
 - b. crest
 - c. wave height
 - d. wave amplitude



6. Sand bars attached to a mainland or island and extending into open waters are called _____ .
 - a. sea stacks
 - b. spits
 - c. shorelines
 - d. beaches

7. A hollowed-out portion in a sea cliff is called a _____ .
 - a. sea stack
 - b. sea cave
 - c. terrace
 - d. spit

8. The distance from still-water level to the crest of a wave is called the _____ .
 - a. crest
 - b. wave height
 - c. wave amplitude
 - d. trough

9. A large wave usually produced by an undersea earthquake or volcanic eruption is a _____ .
 - a. swell
 - b. plunging breaker
 - c. spilling breaker
 - d. tsunami

10. _____ are the flat-shore areas between the high-tide mark and the low-tide mark.
 - a. Sand bars
 - b. Spits
 - c. Beaches
 - d. Terraces



Match each **description** with the correct term. Write the correct letter on the line provided.

- | | | |
|-----|---|----------------|
| ___ | 11. a flat platform at the bottom of a sea cliff formed by the buildup of rock and sand | A. beach |
| ___ | 12. steep faces of rock formed by wave erosion | B. sand bar |
| ___ | 13. hollowed-out portion of a sea cliff | C. sea cave |
| ___ | 14. underwater deposit of sand | D. sea cliffs |
| ___ | 15. area between high-tide mark and low tide mark | E. sea stacks |
| ___ | 16. columns of hard rock left behind by the erosion of a sea cliff | F. sea terrace |
| ___ | 17. sand bars attached to a mainland or island | G. spits |



Answer the following using complete sentences.

18. What happens to the speed, size, and shape of a wave as it nears the shore? _____

19. What are five reasons shorelines erode at different rates? _____



Write the correct name of each part of the wave on the line provided.

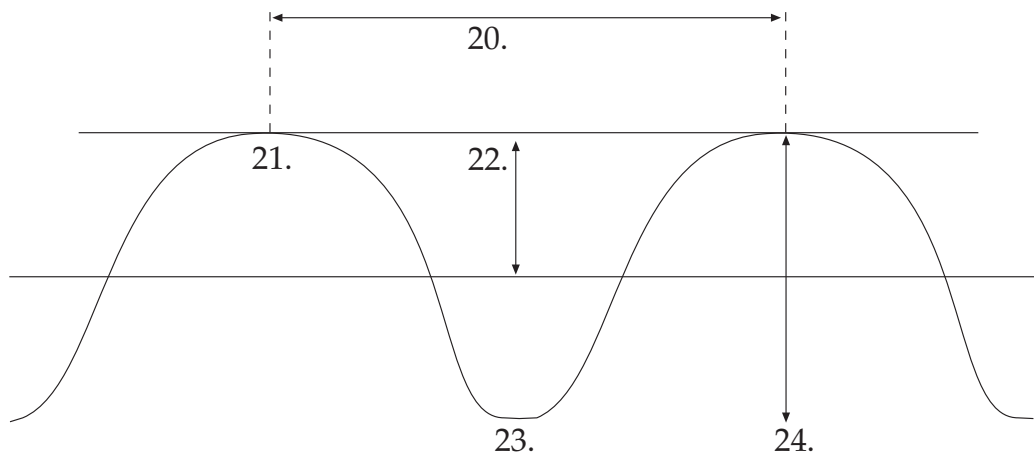
20. _____

21. _____

22. _____

23. _____

24. _____





Keys

Practice (pp. 104-106)

1. b
2. c
3. d
4. a
5. c
6. d
7. b
8. a
9. d
10. d
11. c
12. b
13. d
14. a
15. a

Practice (p. 107)

1. a. crest
b. trough
c. wavelength
d. wave height
2. Spilling Breaker:
 - moves as line of foam
 - quiet wave
 - moves at the same speed as the wave form
 Plunging Breaker:
 - falls into itself
 - collapses
 - destroys the wave form
 - produces a crashing sound

Practice (p. 108)

1. Forms from an undersea earthquake or volcanic eruption on the sea floor.
2. Answers may include the following: type of shoreline; size of waves; force of waves; number and intensity of storms shore area receives per year.

3. breaking waves break off rocks; waves create pressure in cracks in rocks causing rocks to break apart; chemical reaction of seawater dissolves minerals from rocks
4. sea cliff; terraces; sea stacks; sea caves
5. beaches; sand bars; spits

Practice (p. 109)

1. 7 feet
2. 1.5 feet
3. 3 feet
4. crest; trough
5. still-water level

Lab Activity (pp. 110-114)

Procedure:

See chart below.

wind speed	fetch	duration	wave height
small wave, <u>10</u> knots (use the smallest variables possible)	<u>10</u> nautical miles	<u>2.4</u> hours	<u>1.0</u> feet
medium wave, <u>30</u> knots (use the medium variables)	<u>280</u> nautical miles	<u>23</u> hours	<u>14.1</u> feet
large wave, <u>50</u> knots (use the largest possible variables)	<u>1420</u> nautical miles	<u>69</u> hours	<u>97</u> feet
create a wave, <u>10</u> knots (small speed, long fetch, short duration)	<u>1420</u> nautical miles	<u>2.4</u> hours	<u>1.0</u> feet
create a wave, <u>50</u> knots (high speed, short fetch, long duration)	<u>10</u> nautical miles	<u>69</u> hours	<u>9.5</u> feet
create your own wave _____ knots	_____ nautical miles	_____ hours	_____ feet



Keys

Analysis:

1. Wind speed must be very high, the fetch of the wind must be over a great distance, and the duration the wind is blowing must be over a long period of time for a large wave to be generated.
2. Wind speed must be minimal to none, the fetch of the wind must be over a small distance, and the duration the wind is blowing must be over a short period of time for a small wave to be generated.
3. The fetch of the wind is the distance over the water that wind blows.
4. The wind duration is the length of time that the wind blows over the water.
5. Waves are formed by wind blowing over water.
6. The three factors necessary to determine wave height are wind speed, wind duration, and the fetch of the wind.

Wave Descriptions:

1. small swell
2. Ship moves in a gentle up-and-down motion as waves pass the ship.
3. The small wave is not a danger to the ship. It is a gentle swell which is normal for any ocean.
4. Wave height comes to the top deck of the ship. Wave has a forward motion and a visible peak.
5. Wave breaks on the left or port side of the ship with such force that the ship moves rapidly to the right, or starboard. The ship does not capsize.

6. Answers will vary but may include the following: A wave of 14 feet would cause rough seas and a rocky ride. The wave would not be dangerous to a ship with an experienced captain.
7. Wave looms about 40 feet above the ship and has a pointed crest.
8. As the wave approaches, the ship begins to heel (slant sideways) at a 45 degree angle. If the animation were to continue, the wave would break on the ship.
9. Yes, a wave of 97 feet is dangerous. Seas are extremely rough and the waves would break on the ship, resulting in the ship capsizing!

Practice (p. 115)

1. whitecaps
2. rogue wave
3. orbit
4. wavelength
5. elliptical orbit
6. waves
7. crest
8. wave height
9. plunging breaker
10. wave amplitude
11. trough
12. trochoidal
13. spilling breaker

Practice (p. 116)

1. i
2. a
3. h
4. b
5. g
6. c
7. d
8. f
9. e



Keys

Unit Assessment (pp. 35-39TG)

1. d
2. a
3. d
4. c
5. b
6. b
7. b
8. c
9. d
10. c
11. F
12. D
13. C
14. B
15. A
16. E
17. G
18. The speed of the wave slows down, the wavelength gets smaller, and the crest gets higher. The shape of the wave becomes pointed, steeper, and flatter.
19. Shorelines erode at different rates according to the type of shoreline, the size of the waves, the force of the waves, and the number and intensity of storms the shore area receives per year.
20. wavelength
21. crest
22. amplitude
23. trough
24. wave height



Unit 5: Tides

Unit Focus

This unit illustrates the forces that generate tides. Students will investigate how the tides change daily and the impact of tides on marine organisms.

Student Goals

1. Define tides.
2. Explain the forces that cause tides to occur.
3. Describe the differences in tides around the world.
4. Explain how tides influence the survival of marine organisms.

Suggestions for Enrichment

1. Give students tide tables to predict the times of tides at nearby locations.
2. Ask students to diagram the positions of the Earth, moon, and sun that are associated with spring and neap tides.
3. Arrange a field trip to the beach and mark the positions of the tides. Ask students to determine whether the tide is rising or falling and look for associated erosion.
4. Have students create a tide calendar by plotting a month-long tidal curve on a calendar. Discuss the following: What is most noticeable about the behavior of the curve they have traced? How does the curve behave in relation to the phases of the moon? When are the periods of greatest tidal change? When are the periods of the least tidal change?



5. Discuss the tides in terms of what they provide for marine life. Ask if anyone in the class has ever visited a tidal pool area. This is the richest zone of marine life, and yet it is located at the very edge of the sea, not at its depths. What does this indicate about the function of the tides in the evolution between the sea and the land? How might tides have affected the migration of life onto land hundreds of millions of years ago? What are the chances that life would have migrated onto land if there were no tides?
6. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity 1: Predicting Times of Tides (page 130)

Materials:

tide chart from newspaper; pencil; paper

Teacher Preparation for Lab Activity 2: Plotting Tides and Height of Tides (pages 131-132)

Materials:

graph; pencil



Unit Assessment

Use the list below to complete the following sentences.

ebb
flood

neap
spring

tidal range

1. A(n) _____ tide is a tide at its highest point.
2. A(n) _____ tide is a tide at its lowest point.
3. A _____ tide occurs when there is a full or new moon and the Earth, moon, and sun are in a straight line.
4. A _____ tide occurs when the sun and moon are at right angles during the first and third quarters.
5. The _____ is the difference between the heights of the high and low tides.

Circle the letter of the correct answer.

6. Long ago people observed the rhythm of the tides and learned to _____ them.
 - a. decrease
 - b. increase
 - c. predict
 - d. stop



7. When it is low tide on our side of the world, the opposite side of the world has a _____ tide.
 - a. neap
 - b. low
 - c. high
 - d. flood

8. The tides occur about 50 minutes later each day because _____ .
 - a. the sun has a greater influence on the tides
 - b. the sun and moon are in line
 - c. the moon changes phases each day
 - d. the moon completes its orbit at a slower speed than Earth does

9. Neap tides are _____ .
 - a. lower than the height of spring tides
 - b. caused by tidal bores
 - c. due to three full moons a month
 - d. caused when the sun and moon are in line

10. Tide pools might have _____ on a hot sunny day.
 - a. high temperatures and low salinities
 - b. low temperatures and high salinities
 - c. high temperatures and high salinities
 - d. low temperature and low salinities

11. The point on Earth's surface furthest from the moon is called the _____ .
 - a. zenith
 - b. nadir
 - c. phase
 - d. estuary

12. Two early scientists who made discoveries about the tides are _____ .
 - a. Neap and Grunion
 - b. Nadir and Zenith
 - c. Marigram and Isaac
 - d. Aristotle and Newton



13. The gravitational pull of the _____ on Earth's oceans causes the tides.
- a. moon
 - b. sun
 - c. moon and sun
 - d. planets
14. Tides are plotted on a _____ .
- a. marigram
 - b. zenith
 - c. neap
 - d. phase

Answer the following using short answers.

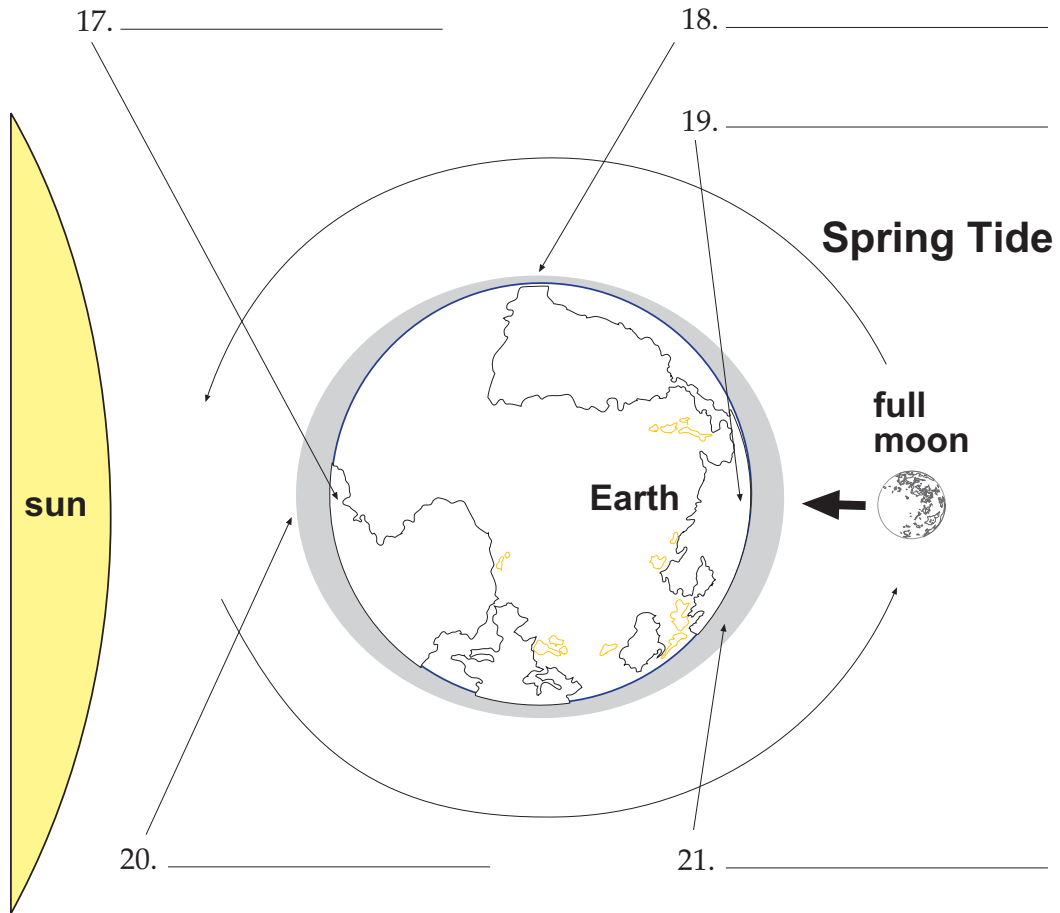
15. Why do the tides change from day to day? _____

16. Why is knowledge of the tides important? _____



Use the list below to label the following diagram.

- | | |
|-----------|--------|
| high tide | nadir |
| low tide | zenith |





Keys

Practice (pp. 128-129)

1. sea
2. two; two
3. moon
4. 50
5. bulge
6. nadir
7. spring
8. neap
9. range
10. semidiurnal
11. diurnal
12. mixed
13. tide pools
14. flood; ebb
15. marigram

Lab Activity 1 (p. 130)

Correct answers to be determined by teacher.

Lab Activity 2 (pp. 131-132)

Correct answers on marigram to be determined by teacher.

Analysis:

1. day 4
2. day 2
3. days 1 and 3
4. 7.0 feet; day 4
5. 2.0 feet; day 3

Practice (p. 133)

1. D
2. I
3. B
4. F
5. G
6. A
7. C
8. E
9. H

Practice (p. 134)

1. tide pools
2. marigram
3. diurnal tide
4. mixed tide
5. semidiurnal tide
6. ebb tide
7. tidal bore
8. flood tide
9. tidal range
10. estuary
11. intertidal zone

Unit Assessment (pp. 47-50TG)

1. flood
2. ebb
3. spring
4. neap
5. tidal range
6. c
7. c
8. d
9. a
10. c
11. b
12. d
13. c
14. a
15. As Earth rotates, different regions of the ocean rise and fall as they move nearer and farther away from the moon and sun.
16. Answers will vary.
17. nadir
18. low tide
19. zenith
20. high tide



Unit 6: Ocean Currents

Unit Focus

This unit focuses on forces that produce ocean currents. Students will also examine the impact ocean currents have on coastlines and marine life.

Student Goals

1. Identify currents of the world's oceans.
2. Understand that currents move in circular paths due to the Coriolis effect.
3. Know the role of currents in providing nutrients to marine life.
4. Understand how currents shape coastlines.

Suggestions for Enrichment

1. Ask students to research the route of the Gulf Stream, then write a report or travel log describing where the current would take them.
2. Give students a world map to label the major current systems in the oceans or a specific area of an ocean.
3. Arrange to conduct a drift bottle experiment for a local current system as follows.
 - **Materials:** clear glass or plastic bottles with screw-on caps (soft-drink type), dry sand, paraffin, and self-addressed postcards (stamps optional).
 - **Procedure:** Have each student prepare a postcard and insert it into bottle.

Add an inch or two of dry sand so that when bottle floats it is partially submerged (about $\frac{1}{3}$ in water).

Seal screw on cap and dip in paraffin to make it watertight.



Have someone (Fisheries Service, a fisherman, etc.) drop bottles from a known location—latitude and longitude.

On a map, plot drop-point and locations where bottles are found to determine movement of currents in your area.

- **Hint:** Drop bottles early in the school year so there is time for them to be returned.

Respond with a letter as a courtesy to all those returning postcards. Don't be surprised where some of them wind up. (Bottles from Godby High School in Tallahassee, Florida were dropped 50 miles south of St. Marks, Florida and one was picked up in Daytona Beach, Florida. It traveled all the way around Florida!)

4. Search the Internet for Web sites that contain data on currents. Find specific Web sites that use the latest technology such as Infrared Satellite Imagery and GIS (Geographic Information System) Mapping.
5. Ask students to list 10 sentences from a news article about marine science and exchange lists. Have them write next to each statement whether they think it is fact or opinion. Then have students choose any three of the statements and explain their reasoning.
6. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity 1: Ocean Currents (pages 148-151)

Materials:

world map on page 149 of student book, globe, or atlas; colored pencils

Teacher Preparation for Lab Activity 2: Beach Currents (pages 152-156)

Materials:

sand; water; wooden blocks; tray; small pebbles



Unit Assessment

Match each **description** with the correct term. Write the letter on the line provided.

- | | |
|---|-----------------------|
| _____ 1. composed of water, sand, and silt | A. equatorial current |
| _____ 2. warm-water current | B. longshore current |
| _____ 3. caused by temperature differences | C. polar current |
| _____ 4. runs parallel to the shore | D. rip current |
| _____ 5. strong, narrow current at or near the surface of the shoreline | E. turbidity current |

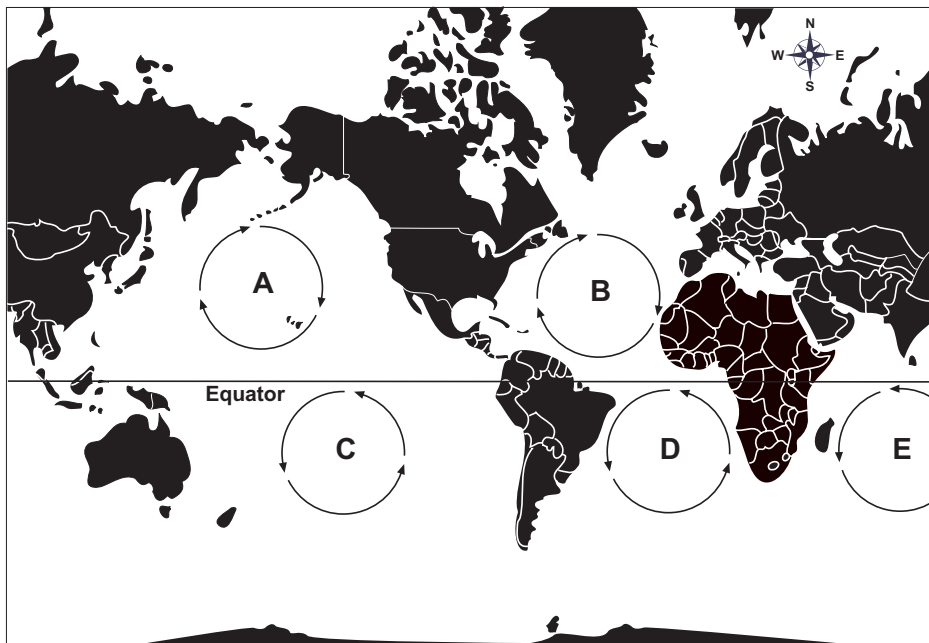
Circle the letter of the correct answer.

6. The _____ is the warm-water current that affects the climate of the eastern coast of the United States.
- Benguela Current
 - North Atlantic Current
 - Canaries Current
 - Gulf Stream
7. Currents moving away from the equator are generally _____ .
- warm
 - cold
 - equatorial
 - none of the above
8. Currents that flow back from land to the sea are called _____ .
- equatorial
 - rip
 - longshore
 - reversing



9. An upwelling is _____ .
- a. a current parallel to the shore
 - b. the rising of cold water and nutrients to the surface
 - c. the result of volcanoes and earthquakes
 - d. the result of trade winds
10. The major cause of currents is _____ .
- a. the moon
 - b. the winds
 - c. earthquakes
 - d. the rotation of the Earth

Use the diagram below of the **ocean gyres** to complete the following statements.
Circle the letter of the correct answer.





11. The letter _____ indicates the location of the North Atlantic Gyre.
 - a. A
 - b. C
 - c. B
 - d. E

12. The gyres indicated by the letters *A* and *C* are located _____ .
 - a. between Australia and South America
 - b. on the same side of the equator
 - c. in the Atlantic Ocean
 - d. on opposite sides of the equator

13. The gyre indicated by the letter *D* is located in the _____ .
 - a. North Atlantic
 - b. South Pacific
 - c. South Atlantic
 - d. Indian Ocean

14. Gyres circulate in a clockwise direction _____ .
 - a. north of the equator
 - b. south of the equator
 - c. in the South Atlantic
 - d. in the South Pacific

15. The gyre indicated by the letter *E* is located in the _____ .
 - a. Arctic Ocean
 - b. Pacific Ocean
 - c. Atlantic Ocean
 - d. Indian Ocean

16. The gyre indicated by the letter _____ includes the Gulf Stream in its circulation.
 - a. A
 - b. B
 - c. C
 - d. D



Answer the following with short answers.

17. What is one way that ocean currents affect us? _____

18. What is a *gyre*? _____

19. How does a longshore current affect the beach? _____

20. What should you do if you are caught in a longshore current?



Keys

Practice (pp. 145-146)

1. currents
2. winds
3. Equatorial
4. gyres
5. Northern; counterclockwise
6. rip
7. Upwellings
8. longshore
9. turbidity
10. reversing
11. winds
12. convection
13. Polar

Practice (p. 147)

1. K
2. J
3. H
4. B
5. G
6. E
7. C
8. F
9. I
10. D
11. A

Lab Activity 1 (pp. 148-149)

Correct answers will be determined by the teacher.

Analysis:

1. clockwise
2. counterclockwise
3. the Earth's rotation
4. the warm Gulf Stream current
5. cold currents meet warm currents
6. warm; cold
7. warm; cold

8. 1. United States; warm
2. California; cold
3. Peru; cold
4. Brazil; warm
5. West Africa; cold
6. Canada; cold
7. Antarctica; cold
8. Europe or North Africa; cold
9. Europe or England; warm

Lab Activity 2 (pp. 150-156)

Procedures:

Correct answers will be determined by the teacher.

Procedures:

Correct answers will be determined by the teacher.

Analysis:

1. build jetties
2. longshore currents; Longshore currents run parallel to, or along, the beach and are responsible for the mass movement of sand and erosion along the beach.

Practice (p. 157)

1. hemisphere
2. trade winds
3. polar currents
4. equatorial currents
5. convection current
6. Coriolis effect
7. gyres
8. course
9. current
10. continental slope



Keys

Practice (p. 158)

1. B
2. D
3. F
4. C
5. E
6. A

Unit Assessment (pp. 55-58TG)

1. E
2. A
3. C
4. B
5. D
6. d
7. a
8. d
9. b
10. d
11. c
12. d
13. c
14. a
15. d
16. b
17. shipping, weather, climate
18. circular pattern of currents
19. erosion, movement of sand with the current
20. Swim or float to shore.



Unit 7: The Ocean Floor

Unit Focus

This unit depicts the topography of the ocean floor and describes how the features of the ocean floor are formed.

Student Goals

1. State the features that make up the topography of the ocean floor.
2. Explain how the features of the ocean floor are formed.
3. Examine a profile of the topography of the ocean floor and label its features.

Suggestions for Enrichment

1. Ask students to draw a topographical diagram of the sea floor and label the parts.
2. Have students create a three-dimensional display of five seafloor features discussed in the unit using clay, Styrofoam, paper, shoe boxes, or any material that can be molded into a specific shape. Label each feature with toothpicks, tags, or provide a key. Have students share their models with the class, explaining how they designed the seafloor features.
3. Have students draw and paint a mural showing the topography of the ocean floor.
4. Discuss current theories regarding the formation of the ocean floor.
5. Discuss the theory of continental drift.
6. Have students imagine that all the water has been drained from the ocean. Ask them to choose a friend to accompany them on a journey across the exposed ocean floor. They will select a starting point and a destination and describe in a report or diary the ocean-floor features they saw on their way. Encourage creativity.



7. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity: Seafloor Contours (pages 171-177)

Materials:

sounding data; scissors or utility knife; colored markers; carbon paper, cardboard or tagboard; pencil; glue



Unit Assessment

Circle the letter of the correct answer.

1. Underwater volcanic mountains with flat tops are called _____ .
 - a. guyots
 - b. upwellings
 - c. atolls
 - d. mid-ocean ridges

2. Submarine canyons are found _____ .
 - a. where the land meets the sea
 - b. along the continental slope
 - c. where there are ridges
 - d. where submarines have run into ridges

3. The study of surface shapes is called _____ .
 - a. geology
 - b. photography
 - c. cartography
 - d. topography

4. Long, narrow cracks in the ocean floor that form the deepest parts of the ocean are called _____ .
 - a. abyssal plains
 - b. ridges
 - c. canyons
 - d. trenches

5. The ocean's topography is studied through the use of _____ equipment.
 - a. photography
 - b. sonar
 - c. x-ray
 - d. fishing



6. At a depth of more than 4,000 meters the ocean floor is called the _____ .
 - a. continental slope
 - b. trench
 - c. basin
 - d. canyon

7. The large, flat regions of the ocean floor are called _____ .
 - a. abyssal plains
 - b. canyons
 - c. trenches
 - d. basins

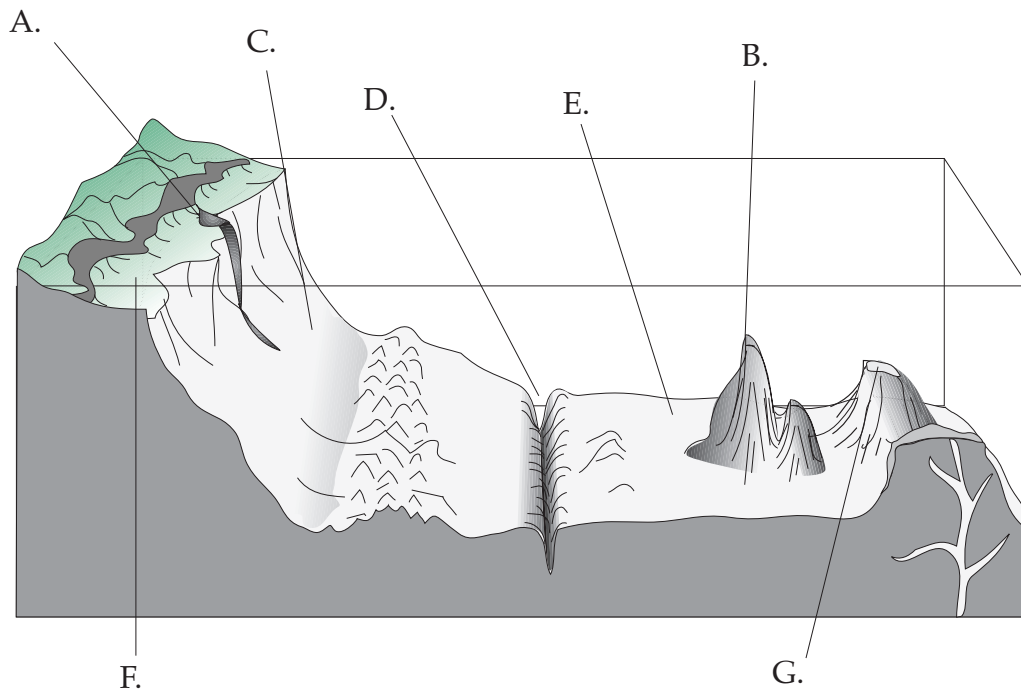
8. The steeply dipping surface between the outer edge of the continental shelf and the ocean basin is the _____ .
 - a. continental divide
 - b. continental ridge
 - c. continental slope
 - d. continental drop

9. Submarine canyons were probably formed by _____ .
 - a. turbidity currents
 - b. volcanic eruptions
 - c. movements of the Earth's crust
 - d. earthquakes

10. Scientists believe that mid-ocean ridges were formed _____ .
 - a. by turbidity currents
 - b. by sediment from the continental slope
 - c. when molten magma from the mantle flowed up to the seafloor
 - d. by land materials carried to sea



Match each **ocean-floor feature** to the correct letter on the diagram. Write the letter on the line provided.



- ___ 11. abyssal plain
- ___ 12. continental shelf
- ___ 13. continental slope
- ___ 14. guyot
- ___ 15. seamount
- ___ 16. submarine canyon
- ___ 17. trench



Answer the following using complete sentences.

18. What are two natural resources found in the area of the continental shelf?

19. What is the difference between a seamount and a guyot? _____

20. What do scientists believe is one reason seamounts are more abundant in the Pacific Ocean? _____



Keys

Practice (p. 167)

1. submarine canyon
2. continental slope
3. trench
4. abyssal plain
5. continental shelf
6. seamount
7. guyot

Practice (p. 168)

1. The theory of plate tectonics suggests that the Earth's crust is separated into plates.
2. The ocean floor has deeper canyons, flatter plains, and higher mountains than continents have.
3. A guyot is a flat-topped underwater volcanic mountain. A seamount is an underwater cone-shaped mountain.
4. Ridges form when molten magma from the mantle flows up to the surface, cools, forming new crustal layers.
5. The continental shelf formed as rivers on land carried tons of particles of sand and soil out to sea.
6. Upper part of submarine canyons formed by rivers; deeper parts formed by undersea currents of sand and silt.

Practice (pp. 169-170)

1. topography
2. Pangaea
3. plates
4. continental shelf
5. continental slope
6. trenches
7. abyssal
8. Marianas Trench
9. basin

10. seamounts
11. guyots
12. Mid-ocean ridges
13. Mid-Atlantic Ridge
14. East Pacific Ridge

Lab Activity (pp. 171- 177)

Pre-Lab Study:

1. shows the features of the ocean bottom and the different elevations
2. bathymetric maps
3. an underwater mountain
4. No. They surround a piece of land and form a continuous line.
5. a gentle slope
6. a steep slope
7. It will be drawn so it goes off the page.
8. The topography shows elevation.

Analysis:

1. the river carrying sediment to the sea
2. No
3. cutting or construction differences
4. 200 meters
5. 700 meters
6. either
7. easier to make, easier to store

Practice (p. 178)

1. H
2. D
3. B
4. I
5. A
6. J
7. G
8. F
9. C
10. E



Keys

Unit Assessment (pp. 63-66TG)

1. a
2. b
3. d
4. d
5. b
6. c
7. a
8. c
9. a
10. c
11. E
12. F
13. C
14. G
15. B
16. A
17. D
18. Answers will vary but may include the following: oil, natural gas, or fish.
19. A seamount is an underwater volcano with a peak. A guyot is a flat-topped underwater volcano.
20. Scientists believe there are more seamounts in the Pacific Ocean because the Pacific Ocean has more plate tectonic activity.



Unit 8: Ocean Sediments

Unit Focus

This unit examines the source of ocean floor sediment and beach sediment. Students will correlate the characteristics of each sediment type to its environment and identify marine organisms that inhabit specific sediment types.

Student Goals

1. Identify the three sediment types that cover the shore and ocean floor.
2. Identify environments that are characteristic of each sediment type.
3. Explain the origin of each sediment type.

Suggestions for Enrichment

1. Arrange a field trip to observe different types of beaches or wetland—sandy or muddy (few rocky areas exist on Florida’s coasts).
2. Ask students to write an advertisement (like an apartment or home sales ad) to attract specific organisms to a habitat (rock, sand, or mud). You may want to subdivide the habitat into high-tide zone, tidal zone, or low-tide zone.
3. Ask students to research the process of *succession* on coastal areas, and report to the class.
4. Have students make a collage of the different zones on a rocky shore or sandy beach.
5. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.



Lab Preparation

**Teacher Preparation for Lab Activity: Sand Observations
(pages 194-196)**

Materials:

sand samples from different areas; white paper; glass slides;
double-sided tape or clear glue diluted 3 to 1 with water;
magnifying glass or microscope; metric ruler



Unit Assessment

Use the list above each section to complete the statements in that section.

beaches	littoral	superlittoral
feldspar	pelagic	terrigenous
hydrogenous	quartz	west
land	sandy	
lava	sediment	

1. The ocean's continental shelf is covered with a blanket of _____ .
2. Three kinds of sediments are _____ , _____ , and _____ .
3. Terrigenous sediments come mostly from _____ which has been eroded and weathered.
4. Sediments deposited on the shores form _____ .
5. Beaches may be rocky, _____ , or muddy.
6. Rocky beaches, such as Pebble Beach, are common on the _____ coast of the United States.
7. Animals that live in or above the _____ , or high-tide zone, must be able to withstand being dry for long periods of time.
8. Barnacles, sea urchins, and flexible algae are common inhabitants of the _____ zone.



9. Black sand beaches, composed of _____ particles, may be found in the state of Hawaii.
10. The two most common minerals found in the United States are _____ and _____ .

clay	manganese nodules	porosity
grasses	ooze	sediment
hydrogenous	permeability	
hydrogen sulfide	phosphorite	

11. Bacteria in mud flats help break down decaying organisms; this produces _____ gas, which smells like rotten eggs.
12. _____ are the types of plants common in a muddy area.
13. _____ refers to the amount of pore space, or opening, in sediments.
14. Pelagic _____ covers most of the deep-ocean floor where terrigenous sediments cannot reach.
15. The two main types of pelagic sediments are ooze and _____ .
16. _____ refers to the rate at which water flows through a sediment.



17. _____ sediments on the deep-ocean floor are rich in mineral deposits.
18. _____, used in making fertilizer, is one example of a valuable mineral found on the ocean floor.
19. The best known of the hydrogenous sediments are the lumps of minerals known as _____.
20. _____ comes from the organic remains of tiny plants and animals.



Keys

Practice (p. 191)

1. M
2. S
3. M
4. R
5. S
6. R
7. R
8. S
9. R
10. M
11. M
12. S

Practice (p. 192)

1. C
2. A
3. B
4. B
5. A
6. C
7. A
8. C
9. B
10. C

Practice (p. 193)

1. terrigenous sediment
2. pelagic sediment
3. hydrogenous sediment
4. pelagic sediment
5. terrigenous sediment
6. hydrogenous sediment
7. pelagic sediment
8. terrigenous sediment
9. hydrogenous sediment
10. pelagic sediment

Lab Activity (pp. 194-196)

Observations:

Answers will vary.

Analysis:

Answers will vary.

Practice (p. 197)

1. F
2. G
3. C
4. A
5. B
6. E
7. D

Practice (p. 198)

1. manganese nodules
2. organic
3. ooze
4. clay
5. dweller
6. porosity
7. feldspar
8. quartz
9. lava
10. composition

Unit Assessment (pp. 71-73TG)

1. sediment
2. terrigenous; pelagic; hydrogenous
3. land
4. beaches
5. sandy



Keys

6. west
7. supralittoral
8. littoral
9. lava
10. quartz; feldspar
11. hydrogen sulfide
12. Grasses
13. Porosity
14. sediment
15. clay
16. Permeability
17. Hydrogenous
18. Phosphorite
19. manganese nodules
20. Ooze



Unit 9: Food Chains and Food Webs

Unit Focus

This unit reviews energy production in plants and animals, feeding relationships, and symbiosis in the ocean. Students will become familiar with the hierarchy in food chains and will become better acquainted with food webs and symbiosis between marine organisms.

Student Goals

1. Define food chain.
2. Identify producers, primary consumers, secondary consumers, tertiary consumers, and decomposers within a food chain.
3. Define food web.
4. Understand that simple food chains are vulnerable to extreme changes and that food webs are more complex and stable.
5. Know that species within a food web may interact with each other through commensalism, mutualism, or parasitism.

Suggestions for Enrichment

1. Ask students to collect pictures of marine organisms and place the photos to form a food chain or construct a mobile. Put the work on display.
2. Have students collect marine specimens from a beach, and classify the specimens as *producer*, *consumer*, or *decomposer*.
3. Have students research Dr. Carl Safina, a marine conservationist, to answer the following:
 - What is Dr. Carl Safina's mission as a marine conservationist?
 - Where and when did Dr. Safina's interest in the sea and fish begin?



- Why does Dr. Safina have a special interest in sharks?
 - What is tagging?
 - What measures has Dr. Safina taken to protect sharks? Other sea life?
 - What progress has been made in managing fisheries and controlling overfishing?
 - What are the apparent drawbacks or obstacles in Dr. Safina's work?
 - How is he attempting to overcome them?
 - What impact does Dr. Safina's work have on society as a whole?
 - Why should we care about overfishing?
 - If you could ask Dr. Safina any questions about his work, what would they be and why?
4. Have students research the theories behind the drastic decline of the wild Atlantic salmon population and the ecological ramifications of this decline. (Note: There are other overfished species to research, such as bluefin tuna, Chilean seabass, Patagonian toothfish, Atlantic cod, lingcod, monkfish, orange roughy, rockfish, sablefish, sea scallops, shark, swordfish.) Have groups focus on one theory to create a "campaign" to persuade the public to help end the destruction of the salmon population. Have groups explain the reasons behind their assigned theories and provide evidence that supports them. Then have groups use this information to create a public information campaign to explain the decline of the Atlantic salmon population and suggest solutions to the problem. Students should include a variety of charts, illustrations, graphs, and tables in their posters, pamphlets, or any other campaign product and present their work in a conference setting.

Assign another group to create a presentation about the wild Atlantic salmon in terms of its place in the food web—what it eats and what eats it. Have the group present the possible consequences



of the disappearance of wild Atlantic salmon to the food chain in both the ocean and in river spawning grounds. On a world map have them mark all the sites where wild salmon spawn and grow. Then have them research and create a visual presentation about the environmental factors necessary for optimum wild-salmon production.

Further questions for discussions:

- What theories and/or other factors may influence the declining wild Atlantic salmon population?
- Why would scientists be concerned about the declining population of wild Atlantic salmon?
- What might be the reaction of aquaculturists? Of animal rights activists? Of strict vegetarians?
- What do you think the criteria should be for placing an animal or plant species on the endangered species list?
- What ramifications might a steady, long-term decrease in the wild Atlantic salmon population have on economic, culinary, and ecological trends?

Optional activities:

- Have students investigate who fishes for wild salmon, both individually and commercially. Write letters to these people, alerting them to the issues and proposing ways they might address the problem.
- Have students investigate the role of the salmon in various Northwest Coast Native American legends, oral history, and everyday life. How do their stories and artwork represent the salmon? Why do the salmon figure so prominently in these people's culture? Are there special ceremonies related to the salmon? How is the salmon cooked and eaten? Are there any similarities with the cultures of Northeast Coast Native Americans who also rely heavily on salmon or did so in the past?



5. Plan a debate on the impact of fishing on the food chain. Select students to represent the pro side and the con side. Present the debate in a courtroom-like setting.
6. Invite a local fisherman and marine biologist to the classroom to discuss the importance of food chains in their professions.
7. See Appendices A, B, and C for other instructional strategies, teaching suggestions, accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity: Ocean Food Webs (pages 217-221)

Materials:

mural page; page of organisms; colored pencils; Inside Scoop chart;
glue or tape



Unit Assessment

Circle the letter of the correct answer.

1. Food-producing organisms at the beginning of a food chain are called _____ .
 - a. primary consumers
 - b. producers
 - c. consumers
 - d. herbivores
2. An animal that will eat a primary consumer is a _____ .
 - a. producer
 - b. tertiary consumer
 - c. secondary consumer
 - d. none of the above
3. Animals that eat only plants are _____ .
 - a. herbivores
 - b. carnivores
 - c. omnivores
 - d. producers
4. Animals that eat secondary consumers but may also eat primary consumers and/or producers are _____ consumers.
 - a. producers
 - b. primary
 - c. secondary
 - d. tertiary
5. A crab that eats fish as well as plants is an example of a(n) _____ .
 - a. primary consumer
 - b. producer
 - c. omnivore
 - d. none of the above



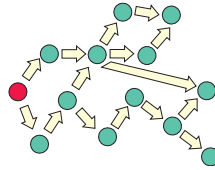
6. The following figure is an example of a _____ .

- a. food link
- b. food web
- c. food chain
- d. food bubble



7. The following figure is an example of a _____ .

- a. food link
- b. food web
- c. food chain
- d. food bubbles



8. The interaction between the remora fish and the shark illustrates the symbiotic relationship known as _____ .

- a. mutualism
- b. commensalism
- c. parasitism
- d. predation

9. The relationship between the zooxanthellae and the coral polyps illustrates the symbiotic relationship known as _____ .

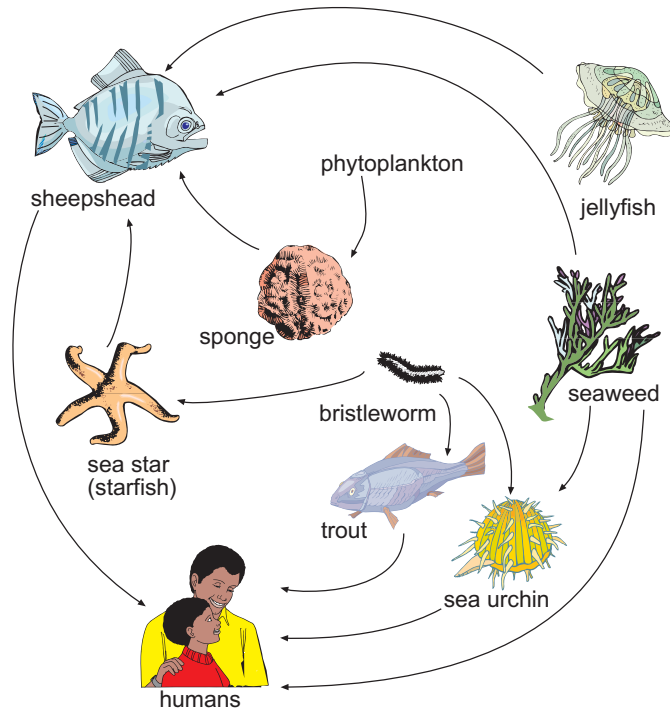
- a. mutualism
- b. commensalism
- c. parasitism
- d. predation

10. The relationship between the marine isopods and fish illustrates the symbiotic relationship known as _____ .

- a. mutualism
- b. commensalism
- c. parasitism
- d. predation



Study the **intertidal food web** below to complete the **food chains** described in the following statements.



11. Phytoplankton are eaten by _____, which are eaten by sheephead.
12. Bristleworms are eaten by _____, which are eaten by sheephead, which are eaten by humans.
13. Seaweed is eaten by _____, which are eaten by jellyfish.



Use the **food chain** below to answer the following.



14. Which organism is the *producer*? _____
15. Which organism is the *primary consumer*? _____
16. Which organism is the *secondary consumer*? _____
17. In which organism is light converted to energy? _____

18. Which organism is not eaten by other organisms? _____
19. Which organism has the least energy available to it? _____
20. Which organism is present in the greatest numbers? _____



Keys

Practice (p. 214)

1. C
2. A
3. B
4. B
5. A
6. C
7. A
8. C
9. B

Practice (p. 215)

1. The ocean's food chain may be broken by disease, by sudden harsh weather changes, or by wiping out lower levels of the food chain through overfishing.
2. We would lose an important source of nourishment and our own food chain would lose a link.
3. A food web is a network of food chains that are linked together.

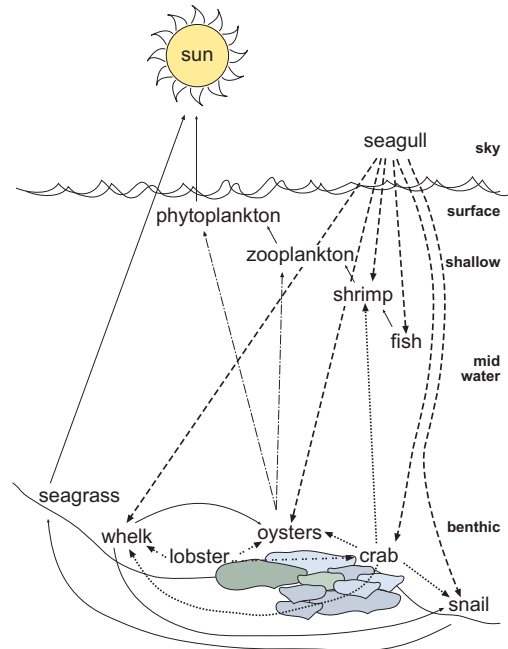
Practice (p. 216)

Answers will vary.

Lab Activity (pp. 217-221)

Procedure:

Ocean food web murals will vary but should include the following: only one of each organism; food lines crossing as few times as possible; color-coded food lines for each organism. See mural in following column.



Analysis:

1. phytoplankton; seaweed
2. sea gull; lobster
3. zooplankton; snail
4. oyster
5. fish, blue crab, shrimp, whelk, sea gull, lobster
6. The rest of the animals in the food chain would perish. Explanations of this will vary but may include the following: If all the producers were wiped out in this food web, then the zooplankton would not have anything to eat and would die. The snails also would not have anything to eat and would die. As a result of this oysters would die because they feed on phytoplankton and zooplankton exclusively. Whelks would die out because they feed on snails and oysters (food sources that are no longer available). The fish would



Keys

die because they feed on shrimp exclusively. The blue crabs would die because they feed on shrimp, snails, oysters, and whelks all of which have perished. The sea gulls and lobsters would also die due to the unavailable food sources. In summary, **all** of the organisms in this marine food web would die as a result of removing the producers. This food web illustrates the **importance** of producers in a food web.

Practice (pp. 222-223)

1. scavengers
2. photosynthesis
3. omnivore
4. carnivore
5. herbivore
6. consumers
7. producers
8. food web
9. food chain
10. minerals
11. lipids
12. hydrolysis
13. carbohydrates
14. metabolism
15. nutrients
16. decomposers
17. protein

Practice (p. 224)

1. I
2. E
3. D
4. B
5. C
6. K
7. F
8. A

9. J
10. H
11. G

Unit Assessment (pp. 81-84TG)

1. b
2. c
3. a
4. d
5. c
6. c
7. b
8. b
9. a
10. c
11. sponge
12. sea star (starfish)
13. sheepshead
14. phytoplankton
15. sponge
16. sheepshead
17. phytoplankton
18. humans
19. humans
20. phytoplankton



Unit 10: Ocean Zones

Unit Focus

This unit describes the marine biome's two major regions: *pelagic* (water) and *benthic* (bottom) environments. Students will learn the characteristics of each of these marine environments and how marine organisms adapt to the pelagic and benthic environments.

Student Goals

1. Identify the pelagic and benthic environments within the marine biome and the zones into which each is further divided.
2. Recognize organisms that live within each marine zone or environment.
3. Give examples of adaptations marine organisms use to live in the pelagic or benthic communities.

Suggestions for Enrichment

1. Discuss the biotic and abiotic factors that affect the distribution of marine life in pelagic and benthic environments.
2. Have students create a large poster that illustrates the various environments in the marine biome. Include all pelagic and benthic divisions.
3. Have students create a poster of those organisms that can be found in various oceanic zones and the adaptations they have made for survival in that zone.
4. Review with students the ocean provinces (neritic and oceanic) and ocean zones (epipelagic zone, mesopelagic zone, bathypelagic zone, abyssalpelagic zone, and hadalpelagic zone) and discuss location of marine life and why certain ocean zones only contain certain types of marine organisms. Have students draw a scene in the ocean which includes at least five marine organisms for each of the five ocean zones.



5. Bioluminescence (light given off by living organisms) is common among creatures of the sea. For example, the hatchet fish is decorated with photophores—specialized light organs. It is believed that the light given off acts to camouflage fish in mid-water depths where some sunlight penetrates and it is necessary for survival to blend an otherwise black silhouette into the background of scattered light.

Have students conduct an experiment to test the function of bioluminescence as camouflage. Ask students to paint the inside of a shoe box black. Use a large-gauge pin to poke holes in one end of the box and then cut a round peephole in the opposite end. Have students fold a black sheet of construction paper in half and cut out two identical fish-shaped silhouettes a few inches in length. Using the same pin, poke lots of holes in one of the silhouettes. Suspend the fish silhouette without holes inside the box so that it hangs perpendicular to the line of sight through the peephole. Use a strip of black paper to suspend the fish and tape it to the inside surface of the box. Close the lid, hold the punctured end of the box up to the light, and peep through the hole of the other end. Ask students to record observations.

Next, have students suspend the fish silhouette with holes inside the box in the same way, repeat their observations, and record. (Observations and conclusions: A fish without photophores is likely to appear as a solid black silhouette, interrupting the background of light. Such a fish is likely to be noticed by predators in the darkness and quickly eaten. On the other hand, photophores can act to blend fish into the background just as the holes in the silhouette will allow light to pass through them as light passes through the box. This principle helps some deep-sea fish use bioluminescence as camouflage.)

6. Have students create sea mobiles of sea animals that live in each zone of the ocean.
7. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.



Lab Preparation

Teacher Preparation for Lab Activity: Something's Environmentally Fishy (pages 250-251)

Materials:

butcher paper or poster board; newspaper; glue; variety of arts and craft supplies; cornstarch; markers and paints; paint brushes or sponges

Grading Rubric:

Use the grading rubric on the next page or design a rubric of your own.



Something's Environmentally Fishy! Grading Rubric

Student Name: _____

Organism Name: _____

Ocean Zone /Marine Environment: _____

	points possible	points earned
1. The model has a clear theme that is appropriate to the concepts being conveyed.	_____	_____
2. The physical objects in the display and mural are well coordinated with the theme.	_____	_____
3. Written descriptions clearly and accurately explain the scientific concepts.	_____	_____
4. The constructed model is sturdy and simulates elements of the real item that it was intended to simulate.	_____	_____
5. Color, labels, and other descriptors clarify what the model is intended to show.	_____	_____
6. The model is neat and presentable.	_____	_____
Total	_____	_____



Unit Assessment

Circle the letter of the correct answer.

1. The water quickly becomes very cold in the area beneath the _____ .
 - a. tropic zone
 - b. benthic zone
 - c. neritic zone
 - d. photic zone

2. Sessile animals depend on _____ .
 - a. other animals to bring them food
 - b. currents to bring them food
 - c. photosynthesis for making food
 - d. waiters to bring them food

3. The intertidal or littoral zone is the area between _____ .
 - a. high tide and sea level
 - b. low tide and sea level
 - c. high tide and low tide
 - d. high tide and flood tide

4. The harshest zone in which to live because of its extreme range in temperature and salinity is the _____ .
 - a. neritic
 - b. photic
 - c. benthic
 - d. intertidal

5. The area of most plant growth is the _____ province.
 - a. neritic
 - b. intertidal
 - c. oceanic
 - d. epipelagic



6. Many animals that live below the photic zone move up to this area to _____ .
 - a. exercise
 - b. reproduce
 - c. sleep
 - d. prey on other animals

7. Most ocean life is found in the _____ zone.
 - a. photic
 - b. hadal
 - c. intertidal
 - d. mesopelagic

8. Most fish are caught in the _____ province.
 - a. photic
 - b. neritic
 - c. twilight
 - d. epipelagic

9. Organisms that swim are classified as _____ .
 - a. benthic
 - b. plankton
 - c. nekton
 - d. sessile

10. Nearly 90 percent of the ocean's surface is in the _____ province.
 - a. oceanic
 - b. epipelagic
 - c. hadal
 - d. neritic



Use the list below to write the correct description of each **organism** on the line provided.

benthic	nekton	plankton
----------------	---------------	-----------------

- _____ 11. shark
- _____ 12. sea star (starfish)
- _____ 13. jellyfish
- _____ 14. oyster
- _____ 15. whale
- _____ 16. Portuguese man-of-war



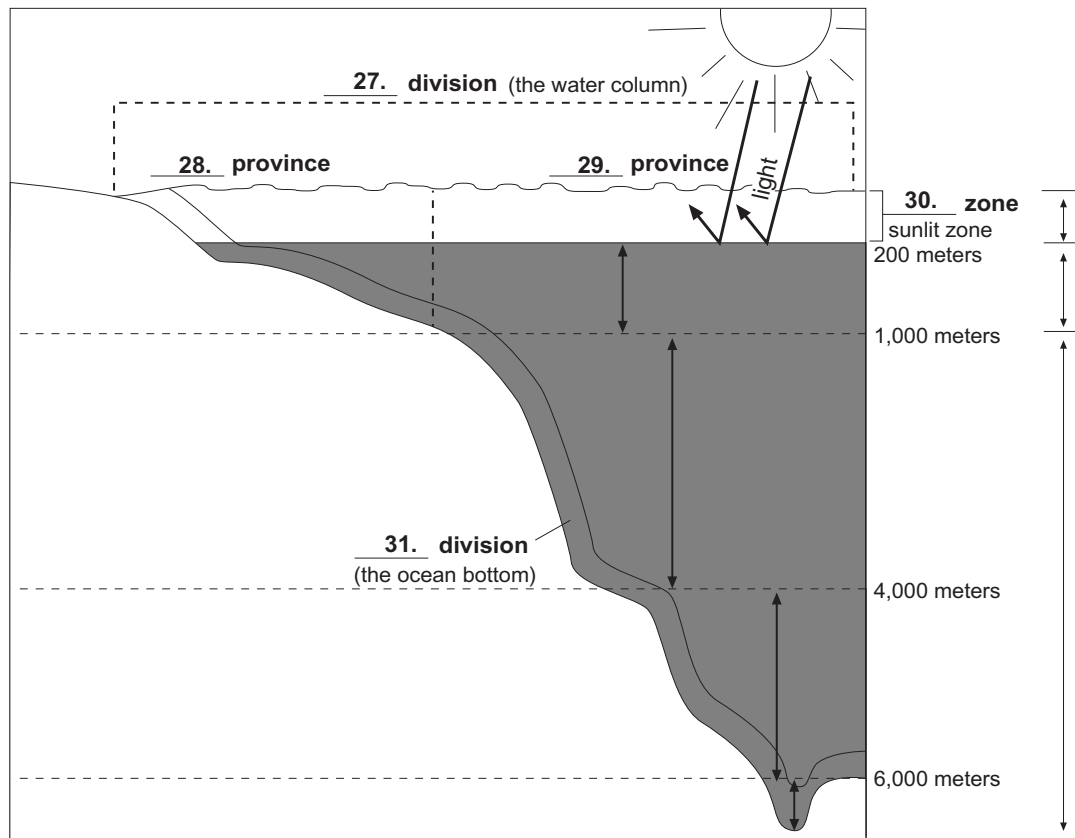
Match each definition with the correct term. Write the letter on the line provided

- | | |
|---|---------------------|
| _____ 17. attached to the bottom; can't move | A. benthic |
| _____ 18. waters over the continental shelf | B. epifauna |
| _____ 19. bottom environment | C. infauna |
| _____ 20. includes all the water of the oceans | D. intertidal zone |
| _____ 21. organisms that float or drift | E. nekton |
| _____ 22. open-ocean zone | F. neritic province |
| _____ 23. organisms that live on the surface of the seabed or sediments | G. oceanic province |
| _____ 24. organisms that live within the sediments of the seafloor | H. pelagic |
| _____ 25. area between the tides; littoral zone | I. plankton |
| _____ 26. free-swimming organisms | J. sessile |



Use the list below to write the name of each **ocean zone** or **division** numbered in the following diagram. Write the correct name on the line provided.

benthic	oceanic	photic
neritic	pelagic	



27. _____

28. _____

29. _____

30. _____

31. _____



Keys

Practice (p. 241)

1. pelagic
2. neritic
3. oceanic
4. photic
5. benthic
6. abyssopelagic

Practice (pp. 242-243)

1. neritic
2. epipelagic
3. abyssal
4. hadal
5. 200
6. supralittoral
7. twilight zone
8. photic or epipelagic
9. It is in the photic or lighted zone where plants can carry out photosynthesis and large numbers of phytoplankton and other marine algae grow and reproduce.
10. bathypelagic; abyssopelagic; hadal
11. hadalpelagic
12. abyssopelagic
13. suction cups for clinging, cementing to rocks, flattened bodies
14. black lava, white quartz, crushed coral
15. Because the sandy beach area is constantly changing due to the wave action and winds moving the loose sand grains around.

Practice (pp. 244-246)

1. pelagic
2. neritic
3. nekton
4. littoral
5. benthic

6. sessile
7. infauna
8. bathypelagic
9. oceanic
10. mesopelagic
11. benthic
12. bathyal
13. epifauna
14. pelagic
15. plankton

Practice (pp. 247-249)

1. biome
2. freshwater; marine
3. pelagic; benthic
4. pelagic
5. neritic; oceanic
6. neritic
7. oceanic
8. neritic; photic
9. photic
10. photic
11. sessile
12. plankton
13. nekton
14. epifauna
15. infauna
16. barnacles
17. intertidal; littoral
18. surf
19. rocky
20. splash
21. algae, small fish, invertebrates
22. tide

Lab Activity (pp. 250-251)

Correct answers will be determined by the teacher using the grading rubric from the teacher's guide on page 90 or one of own design.



Keys

Practice (p. 252)

1. oceanic province
2. neritic province
3. province
4. nekton
5. plankton
6. pelagic
7. benthic
8. biome
9. habitat

Practice (p. 253)

1. A
2. C
3. B
4. D
5. A
6. B
7. E
8. C

Practice (p. 254)

1. tide pools
2. surf zone
3. rocky coasts
4. infauna
5. epifauna
6. sessile
7. sublittoral zone
8. littoral zone
9. supralittoral zone

Unit Assessment (pp. 91-95TG)

1. d
2. b
3. c
4. d
5. a
6. d
7. a
8. b
9. c

10. a
11. nekton
12. benthic
13. plankton
14. benthic
15. nekton
16. plankton
17. J
18. F
19. A
20. H
21. I
22. G
23. B
24. C
25. D
26. E
27. pelagic division
28. neritic province
29. oceanic province
30. photic zone
31. benthic division



Unit 11: Near-Shore Ecosystems

Unit Focus

This unit previews two coastal environments, wetlands and coral reefs. These environments are important in maintaining the balance of life both in the sea and on land. Students will study wetlands such as estuaries, mudflats, salt marshes, swamps, and mangroves. Students will also investigate the formation of coral reefs and the diversity of life in the reef environment.

Student Goals

1. Define wetland.
2. Explain the importance of wetlands.
3. State several examples of wetland environments.
4. Describe the formation of a coral reef.
5. Explain the importance of coral reefs.
6. Describe the negative impact humans have on wetlands and coral reefs.

Suggestions for Enrichment

1. Have small groups of students construct a three-dimensional model or poster of the different marine habitats showing their respective organisms and characteristics.
2. Choose a basic location of underwater ocean life, such as seamounts, coral reefs, or a deep-sea trench to create a class mural. Have students research the underwater structure and ocean life found at the chosen ocean location. Ask students to decide on a particular animal or plant found in the underwater location. Some students can choose the underwater structure. Have students create a rough draft on a large sheet of paper. For larger classes, it may be necessary to create marine organisms on separate sheets of paper, then cut them out and attach them to the painted mural background.



Some of the ocean life-forms can be created three dimensionally using newspaper, string, or foam, so that some of the features extend off the mural background. Hang cut-out images of ocean life-forms from the ceiling to represent objects found in the water around the ocean floor structures, such as over-sized stuffed fish.

(Optional: Ask principal if students can create a permanent mural on the school wall for the ocean scene.)

3. Ask the following questions.

Coral polyps grow very slowly, between 0.5 - 4 inches per year.

- If a coral polyp started to grow the year you were born, what is the greatest size it could reach?
 - What is the smallest size it could reach?
4. Using world maps, have students find and outline the regions in which coral reefs are found. Have groups concentrate on specific threats to the coral reefs in particular regions: the Pacific Ocean, Southeast Asia, the Indian Ocean, the Red Sea and the Persian Gulf, or the Caribbean. Have them consider actions and solutions, including how to address the pollution explosion, industry, fishing, mining, development, and tourism. Ask students to draft letters, based on their conclusions, regarding actions they feel need to be taken to protect coral reefs.
 5. Give students photographs or diagrams of habitats common in Florida coastal areas, and have them construct a food web for one of the habitats.
 6. Ask students to prepare a report on the status of a local habitat.
 7. Ask students to use the Internet to do the following.
 - an analysis of four birds—two aquatic and two inland
 - an analysis of four flowering plants—two aquatic and two inland



- a comparison of one aquatic bird and one inland bird
- a comparison of one aquatic flowering plant and one inland flowering plant

Next have students do the following.

- write a paragraph which describes each bird's classification, characteristics, main features, habitat, offspring, and eating habits
- draw an illustration of each bird
- write a paragraph which describes each flowering plant's classification, characteristics, main features, habitat, and reproductive method
- draw an illustration of each plant
- write at least one paragraph which outlines the major similarities and differences of two birds—one aquatic and one inland
- write at least one paragraph which outlines the major similarities and differences of two plants—one aquatic and one inland

Discuss the following.

- Do animals and plants have adaptive qualities?
- Are the qualities similar or dissimilar?
- What are the adaptive characteristics of plants?
- How important is the biome in adaptation?
- Are plants or animal more efficient in adaptation?



8. Have students role-play various people involved when developers try to build on wetland areas. Some roles to consider: developers, naturalists, Department of Environmental Protection (DEP) or Fish and Wildlife Conservation Commission (FWC) personnel, judge or jury, out-of-work fisherman, or construction workers. Consider both environmental and economic aspects and the impact of the development.
9. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity: Near-Shore Ecosystems (pages 274-278)

Materials:

page of bird bodies; page of bird beaks; page of bird feet; scissors;
glue or tape; colored pencils



Unit Assessment

Match each **characteristic** with the correct **type of habitat**. Write the letter on the line provided. **One or more habitats will be used more than once.**

- | | | |
|-------|--|-----------------|
| _____ | 1. cypress trees common | A. coral reefs |
| _____ | 2. wooded wetland | B. estuaries |
| _____ | 3. requires warm, shallow, clear water | C. Everglades |
| _____ | 4. formed by rivers meeting the sea | D. mudflats |
| _____ | 5. dominated by salt-tolerant grasses | E. salt marshes |
| _____ | 6. mixed wetland; water from rainfall | F. swamps |
| _____ | 7. three types—fringing, barrier, and atoll | |
| _____ | 8. slightly sloping beach with dark, muddy sand | |
| _____ | 9. low, coastal wetland with a muddy area exposed by tides | |
| _____ | 10. where saltwater and freshwater meet | |
| _____ | 11. unvegetated, or lacking seagrasses and marsh grass | |
| _____ | 12. was also called <i>Grassy Water</i> | |
| _____ | 13. high levels of tannic acid | |
| _____ | 14. brackish water | |



Circle the letter of the correct answer.

15. The first link in the food chain for animals in muddy wetlands is _____ .
- a. plankton
 - b. falling leaves
 - c. detritus
 - d. bacteria
16. Wetlands are important because they _____ .
- a. serve as nurseries for young animals
 - b. protect coastal areas from storms
 - c. "clean" sediments carried by runoff
 - d. all of these
17. Salt marshes and swamps have similar _____ .
- a. locations
 - b. sediments
 - c. plants
 - d. salinities
18. In an estuary, salinity is higher _____ .
- a. near the river
 - b. near the ocean
 - c. in the winter
 - d. near the surface
19. The type of coral reef that is separated from a land mass by a lagoon is a(n) _____ .
- a. atoll
 - b. fringing reef
 - c. barrier reef
 - d. lagoon reef



Answer the following using short answers.

20. What kind of reef is attached to a land mass? _____

21. What conditions must exist for coral reefs to grow? _____

22. Where is the Everglades located? _____

23. How are humans destroying wetlands? _____

24. Why are wetlands called *nurseries of the sea*? _____



Keys

Practice (p. 271)

1. an area that is a combination of land and water
2. fringing, barrier, and atoll
3. sunlight, tropical waters, algae, and clear, shallow water
4. because many juvenile organisms depend on them for survival
5. southern Florida
6. maintain food chains and balance of nature; buffer against storms; habitat for various plants and animals
7. development; dredging; diverting water that would drain into wetlands

Practice (p. 272)

Answers will vary.

Practice (p. 273)

1. C
2. F
3. A
4. J
5. B
6. D
7. E
8. H
9. I
10. G

Lab Activity (pp. 274-278)

Analysis:

1. Answers will vary.
2. Answers will vary but may include the following: long pointed beak for digging or

probing in mud or sand; short, curved beak for cracking open small shells or seeds; medium-sized beak for probing in shallow sand; small beak with no curve for eating small insects; medium-sized curved or pointed beak for catching fish and tearing meat.

3. Answers will vary.
4. Answers will vary but may include the following: webbed toes for swimming; long, spread-out toes for walking in mud; curved claws for grasping prey such as fish or for perching in trees; three toes spread open for walking in sand.
5. Answers will vary.
6. Salt-marsh organisms are adapted to their environment by their body structure. If they live in the mud, they may be flat or have a burrow. If they live on top of mud, they may have long toes or webbed feet.

Practice (p. 279)

1. D
2. F
3. E
4. C
5. B
6. A
7. G

Practice (p. 280)

1. atoll
2. lagoon
3. barrier reef
4. fringing reef
5. dredge
6. Everglades
7. mangrove
8. hammock
9. swamp



Keys

Unit Assessment (pp. 103-105TG)

1. F
2. F
3. A
4. B
5. E
6. C
7. A
8. D
9. E
10. B
11. D
12. C
13. F
14. B
15. c
16. d
17. c
18. b
19. c
20. fringing
21. warm, shallow sunlit water; algae
22. southern Florida
23. dredging; diverting water;
pollution; filling in; commercial
development
24. because they provide shelter and
food for large numbers of juvenile
animals



Unit 12: Plankton

Unit Focus

This unit describes the two predominant plankton types: phytoplankton (plant) and zooplankton (animal). Students will investigate the important role of plankton in the food chain and learn that some plankton are larval stages of larger marine organisms such as lobster, fish, and crabs.

Student Goals

1. Define plankton.
2. Identify the two main types of plankton.
3. Discuss the importance of phytoplankton in the ocean environment.
4. Name and describe the two types of zooplankton.

Suggestions for Enrichment

1. Discuss dinoflagellates and the problem of classifying them.
2. Assign an activity to research the importance of phytoplankton in the world's oxygen supply and the ozone layer.
3. Ask students, when given drawings or slides, to identify types of plankton by common and/or scientific names using guide books or keys.
4. Have small groups make a poster of organisms and their meroplankton stages and prepare labels that describe why the planktonic stage is helpful or necessary.
5. Have students build plankton models and compete to see which sinks most slowly. Have them explain the adaptations they incorporated to slow the rate of sinking of their organisms.



6. To review a unit using a *Jeopardy* format, divide topics into five subtopics and students into five groups. Have each group write five questions and answers on index cards with a different color of ink. Assign point values from easiest (100) to hardest (500). Ask students to tape cards on the board under their subtopic. The first group to finish taping cards goes first. Go clockwise from group to group. When a subtopic and point value are chosen by the group, read the question. If correct, assign points; if incorrect, subtract points and put card back on the board. (Students may not choose any questions submitted by their group.)
7. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity 1: Plankton Observations (pages 294-298)

Materials:

EcoVentures CD-ROM (free copies are available from the Florida Fish and Wildlife Conservation Commission in Tallahassee, Florida at 850-488-6058; or for free CDs and teacher workshops for groups of six or more, e-mail: george.shipp@fwc.state.fl.us); computer with CD-ROM drive; Plankton Identification Data Sheet; Plankton Data Sheet; pencil or pen

Teacher Preparation for Lab Activity 2: Plankton Shape and Movement (pages 299-302)

Materials:

Marine Plankton Sheet; Plankton Floating Data Sheet; baby food jars; tissue paper; plastic baggies; toothpicks; clay; cardboard; vegetable oil; stopwatch; pipe cleaners; variety of odds and ends



Unit Assessment

Match each **example** with the correct **type of plankton**. Write the letter on the line provided.

- | | | |
|-------|--|------------------|
| _____ | 1. dinoflagellate algae that produce <i>red tide</i> | A. phytoplankton |
| _____ | 2. some cause painful sting | B. zooplankton |
| _____ | 3. animal plankton | |
| _____ | 4. plant plankton | |
| _____ | 5. copepods | |
| _____ | 6. live only in the photic zone | |
| _____ | 7. float or drift | |
| _____ | 8. primary food producers | |
| _____ | 9. larval stages of crab and fish | |
| _____ | 10. make their own food | |
| _____ | 11. snail larva | |
| _____ | 12. diatoms | |
| _____ | 13. jellyfish larva | |

Circle the letter of the correct answer.

14. Light without heat, or bioluminescence, is given off by _____ .
- a. dinoflagellates
 - b. diatoms
 - c. jellyfish
 - d. meroplankton



15. Water with a milky appearance could mean that _____ are present.
- zooplankton
 - meroplankton
 - phytoplankton
 - dinoflagellates
16. An organism that has characteristics of both plants and animals is the _____ .
- diatom
 - dinoflagellate
 - phytoplankton
 - foraminiferan
17. Zooplankton _____ .
- make their own food
 - are smaller than phytoplankton
 - are diatoms
 - feed on phytoplankton or other zooplankton
18. An example of an animal with meroplankton stages is the _____ .
- crab
 - whale
 - arrow worm
 - diatom
19. Phytoplankton that have a silica shell with two equal halves are _____ .
- dinoflagellates
 - diatoms
 - foraminiferans
 - coccolithophores



Answer the following using short answers.

20. Why do phytoplankton have to remain in the photic zone? _____

21. What are the two main types of plankton? _____

22. What does *plankton* mean? _____

23. What are *meroplankton*? _____

24. Why are dinoflagellates considered to be between plants and animals? _____



Keys

Practice (pp. 291-292)

1. to drift
2. zooplankton and phytoplankton
3. They need light for photosynthesis to make their food.
4. produce oxygen; are primary food producers and are basis of the food chain
5. silica, a glassy compound
6. They have characteristics of both; they make their own food and can capture food to eat, such as other plankton.
7. toxins in the water produced by dinoflagellates
8. phytoplankton and other zooplankton
9. holoplankton
10. meroplankton
11. Answers will vary but may include any two of the following: jellyfish, Portuguese man-of-war, copepods, arrow worms, foraminiferans, or radiolarians
12. remove tentacles; wash with hot water and alcohol; apply paste of meat tenderizer; avoid sun or water and rest; seek medical attention if necessary
13. shrimp, oyster, barnacle, sea star (starfish), sea urchin, many types of fish
14. plankton net

Practice (p. 293)

1. E
2. D
3. F
4. A
5. C
6. B

Lab Activity 1 (pp. 294-298)

Procedure:

Correct answers will be determined by the teacher.

Analysis:

1. seagrass
2. Seagrass areas occur in shallow water that allows more sunlight to penetrate through the whole water column. Seagrass beds are also nursery grounds for many marine organisms. Marine organisms go to the seagrass beds to breed. The result is concentrated larval forms. Larval forms can also find shelter in the seagrass beds until they metamorphosis into their adult stage.
3. Open oceans are not the nursery grounds for many organisms. Marine organisms typically do not breed in the open ocean. Also, the open ocean does not provide shelter for the developing larval stages (plankton).

Lab Activity 2 (pp. 299-302)

Procedure:

Answers will vary.

Analysis:

1. Shapes and designs that are spread out and cover a larger surface area. Shapes and designs with spikes and spines.
2. Yes. Plankton are drifting organisms; they cannot actively



Keys

move themselves. Plankton rely on currents to transport them to coastal areas or to warm or cold waters.

3. Phytoplankton are plantlike plankton. They receive their energy from the sun just as plants do.
4. Phytoplankton need to stay near the ocean's surface; therefore a spiky design that is large and round, covering a large surface area, would be best.

Practice (p. 303)

1. H
2. G
3. F
4. I
5. C
6. B
7. D
8. E
9. A

Practice (p. 304)

1. radiolarian
2. foraminiferan
3. tentacles
4. zoea
5. copepods
6. megalops
7. mesh
8. plankton net
9. mysis
10. pseudopod
11. larva

Unit Assessment (pp. 111-113TG)

1. A
2. B
3. B
4. A
5. B
6. A

7. A or B
8. A
9. B
10. A
11. B
12. A
13. B
14. a
15. c
16. b
17. d
18. a
19. b
20. They need light for photosynthesis, or to make their own food.
21. phytoplankton and zooplankton
22. to drift
23. organisms that spend only part of their lives as plankton
24. They have characteristics of both; they make their own food and can capture food to eat, such as other plankton.



Unit 13: Marine Plants

Unit Focus

This unit focuses on the variety and importance of marine plants. Students will study emergent and submergent marine plants, as well as investigate the single-celled phytoplankton and multicellular marine algae.

Student Goals

1. Describe the process of photosynthesis.
2. Differentiate between submergent and emergent marine plants.
3. State examples of submergent marine plants.
4. State examples of emergent marine plants.
5. Explain why seaweeds are classified as marine algae.
6. State products manufactured from marine algae.

Suggestions for Enrichment

1. If preserved or pressed specimens of marine plants are available, have students draw and identify the different groups.
2. Have students collect and press common seaweeds and/or grasses in your local area. Be careful not to collect plants that preserve habitat areas (e.g., sea oats, some sea grasses).
3. Ask students to construct a poster on the importance of marine plants in preserving habitats.
4. Giant kelp is one of the fastest growing plants in the world, growing as much as two feet a day. Reaching lengths of up to 330 feet, it is also one of the largest. Kelp-forest communities contain a number of individual habitats varying with depth, and they are also home to a



variety of creatures (e.g., garibaldi, senorita fish, halfmoon perch, octopus, moray eel, sea cucumber, sea urchin).

Have students draw the anatomy of a giant kelp plant, labeling the principle parts: holdfast, haptera, stipe, bladders, blades, and canopy. Assign groups a part of the plant to draw. Have students use two rolls of 30-inch by 15-foot brown parcel paper to produce a 30-foot plant. The width of the stipe should measure a couple of inches. There should be scores of blades with an average length of one foot and a bladder at each base.

Carve styrofoam blocks into large rock shapes and paint accordingly. The rocks should be piled at the plant's base and the holdfast (about two feet across) attached to the rockpile. Have students cut out the drawn parts and attach them to the classroom ceiling and wall. Ask students to draw to full scale and cut out various kelp-forest inhabitants using colored construction paper. Attach the creatures to the kelp in the proper positions.

Discuss the function of the kelp forest as a habitat. Consider how the plant's structure works to provide shelter and hunting grounds for the resident creatures. Discuss that the giant kelp is harvested as a commercial resource and that the natural compound algin is extracted from the kelp plant. Algin is used as a thickening, stabilizing, and smoothing agent in hundreds of products ranging from salad dressing to cosmetics. Have students identify products containing algin in their homes or at the supermarket, and report on their uses.

5. Set up an inner circle and an outer circle of chairs. Have students in the inner circle debate a content-related issue for 30 minutes. Then have students in the outer circle respond to what they have heard.
6. Have students research a marine scientist with a partner, formulate marine science questions and answers, role-play an interview of that scientist to the class, and create a timeline of the person's life.
7. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.



Lab Preparation

**Teacher Preparation for Lab Activity: Identify Products with Seaweed
(pages 317-318)**

Materials:

products such as canned food with labels indicating ingredients
from the sea



Unit Assessment

Match the definition with the correct term. Write the correct letter on the line.

- | | |
|---|----------------------|
| _____ 1. red seaweeds | A. algin and agar |
| _____ 2. organisms whose cells are very simple | B. Chlorophyta |
| _____ 3. group of green seaweeds | C. emergent plants |
| _____ 4. brown seaweeds | D. mariculture |
| _____ 5. plants such as seagrass that grow underwater | E. Phaeophyta |
| _____ 6. plants such as mangroves that grow up out of the water | F. protists |
| _____ 7. simple plants with holdfast, stipe, and blade | G. Rhodophyta |
| _____ 8. farming of the sea | H. seaweeds |
| _____ 9. seaweed extract | I. submergent plants |

Circle the letter of the correct answer.

10. The green pigment found in all true plants and marine algae is _____ .
- a. photosynthesis
 - b. chlorophyll
 - c. carotene
 - d. xanthophyll



11. Most of the ocean's true plants are found _____ .
 - a. in deep waters
 - b. in dark, murky waters
 - c. attached to rocks
 - d. near the shore in shallow water

12. All of the following are seaweed extracts *except* _____ .
 - a. stipe
 - b. agar
 - c. algin
 - d. carrageenan

13. The part of seaweed that keeps it attached to the bottom is the _____ .
 - a. blade
 - b. holdfast
 - c. stipe
 - d. air bladder

14. The type of seaweed often found growing on coral reefs or oyster beds in deep waters is _____ .
 - a. brown
 - b. green
 - c. red
 - d. yellow

15. _____ are organisms whose cells are very simple.
 - a. Protists
 - b. Plants
 - c. Sediments
 - d. Seeds

16. An example of an emergent plant is the _____ .
 - a. brown seaweed
 - b. manatee grass
 - c. mangrove
 - d. sargassum



Answer the following with short answers.

17. Why are algae commercially important? _____

18. What type of seaweed commonly washes up on Florida beaches?

19. What functions do submergent plants serve? _____

20. What are the three major parts of the seaweed plant? _____

21. What is sea farming called? _____

22. Why are there laws against picking or pulling up plants growing on the beach? _____



Keys

Practice (pp. 315-316)

1. producers
2. Rhodophyta
3. brown
4. mariculture
5. blade
6. holdfast
7. submergent
8. protists
9. chlorophyll
10. flowering
11. stipe
12. Algin
13. photosynthesis
14. sargassum
15. Kelp
16. erosion
17. salt-tolerant
18. Pioneer

Lab Activity (pp. 317-318)

Analysis:

Correct answers will be determined by the teacher.

Practice (p. 319)

1. stipe
2. blade
3. holdfast
4. emergent
5. submergent
6. algae
7. protists
8. seaweeds
9. chlorophyll

Practice (p. 320)

1. A
2. E
3. G
4. F
5. C

6. B
7. D

Unit Assessment (pp. 121-124TG)

1. G
2. F
3. B
4. E
5. I
6. C
7. H
8. D
9. A
10. b
11. d
12. a
13. b
14. c
15. a
16. c
17. Answers will vary but should include uses in food and industry.
18. Answers will vary but should include the following: brown seaweed, sargassum, or gulfweed
19. maintain water clarity, stabilize soft bottom; provide food and shelter
20. blade, stipe, holdfast
21. mariculture
22. These plants help prevent beach erosion.



Unit 14: Classifying Marine Animals

Unit Focus

This unit covers the hierarchy of marine organism classification. Students will discover that marine organisms are categorized according to their level of organization or complexity. Students will also preview each phylum, beginning with the most primitive (phylum Porifera) to the most advanced marine organisms, the marine mammals.

Student Goals

1. Define phylum.
2. Distinguish between invertebrates and vertebrates.
3. Identify marine organisms by their phylum characteristics.
4. Classify which organisms are primitive and which organism are advanced.

Suggestions for Enrichment

1. Ask students to prepare a poster of phyla including representative examples and characteristics.
2. Have students remove all organisms from a piece of living sponge or a clump of oysters and classify them by phylum.
3. Have students make observations of living organisms in an aquarium comparing movement and feeding.
4. Ask students to collect and/or preserve specimens for observation and identify their common names and scientific names.
5. Have groups choose pictures of marine life so they can create life-size images of the marine organism of their choice. Have students create a grid using a ruler of one inch or one-half inch squares on a copy of the original picture. On a larger piece of blank paper, have



students make a larger scale grid of six inches or one-foot squares, creating the same number of squares as on the original picture. Ask students to choose one square from the original square, paying attention to detail, and transfer it to its corresponding square on the larger paper of the larger scale. Repeat for each square until all of the graphic information has been transferred to the larger grid. Display next to the original picture.

6. Decide what art medium students will use to create a marine science class quilt: cutting and sewing images, drawing images with fabric markers on fabric, creating images with crayon and melted into the fabric with an iron, or using construction paper instead of fabric and gluing images. Regardless of the choice of medium, all squares should be one foot by one foot. Have students choose an ocean life-form that they enjoyed learning about and recreate it and its environment on the fabric or construction paper square. Students' names can be embroidered (or written) on their squares. Teacher, students, or parents can sew the squares together. If using construction paper, students can hang their squares on the wall to recreate the quilt image. (Optional: Ask the yearbook staff to take a picture for the yearbook and/or call the local newspaper.)
7. Have students use marine science information to create poetry. Choose any style of poetry (e.g., limerick, haiku, alliteration, sonnet, basic rhyme patterns). Allow students to illustrate their poetry or have students exchange their poems and illustrate each other's poetic descriptions. (Optional: Have students exchange their unfinished work and finish each other's poems, following the poetic style of the original author. As an alternative, the teacher could create the first stanza and groups would be responsible for adding another stanza.)
8. Have students brainstorm a list of marine animals. Ask students to choose one marine animal and imagine being that animal for a day. Have students list the following 10 aspects of that animal's life: environment; shelter or protection; migration; location in the world; location in the water; coloration and camouflage; how they swim, move, anchor; body type and covering; their predators and/or prey; friends. Using the list of aspects, ask students to write three paragraphs describing themselves as a marine animal. The first paragraph should include the name of the marine animal and a description of its surroundings. The second paragraph should



include information about their predators or prey and friends in its environment. The third and final paragraph should state the student's reason for choosing that animal, based on one of the 10 aspects of that animal's life. Ask students to draw their animal, including the environment around the margins of the paragraphs, and write a catchy title at the top.

9. Allow students to choose at least eight vocabulary words from the unit to use in writing a marine science horror story. They can use their imagination and change one characteristic of an organism, but, aside from that, they must stick to the facts.
10. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity 1: Phyla Identification (pages 339-340)

Materials:

charts; preserved specimens or pictures of different invertebrates; reference books (textbooks, encyclopedias, field guides, etc.)

Teacher Preparation for Lab Activity 2: Crab Observation (pages 341-345)

Materials:

living blue crab (note: blue crabs are quite aggressive, so you may wish to substitute live crayfish, shrimp, or lobsters); tray or small aquarium; saltwater (fresh or prepared from mix)



Unit Assessment

Match the **characteristic** with the correct **animal group**. Write the correct letter on the line provided.

- | | |
|---|-----------------------|
| _____ 1. sponges | A. amphibian |
| _____ 2. fish with flexible skeleton | B. Arthropoda |
| _____ 3. soft-bodied animal | C. birds |
| _____ 4. warm-blooded animal with hair | D. cartilaginous fish |
| _____ 5. animals without backbones | E. Chordata |
| _____ 6. spiny animals with five body parts | F. Cnidaria |
| _____ 7. cold-blooded, air-breathing animals with dry, scaly skin | G. echinoderms |
| _____ 8. stinging celled animals | H. invertebrates |
| _____ 9. joint-footed, segmented bodies | I. mammal |
| _____ 10. lives part of life in water and part on land | J. mollusks |
| _____ 11. warm-blooded animal with feathers | K. Porifera |
| _____ 12. animals with backbones | L. reptiles |
| _____ 13. phylum that includes vertebrates | M. vertebrates |



Use the list below to complete the following.

Arthropoda
clam
Chordata

molting
oyster

Porifera
zoologists

14. Scientists who study animals are called _____ .
15. The phylum _____ includes a range of invertebrates such as crabs, lobsters, shrimp, spiders, and insects.
16. Two examples of a bivalve mollusk are the _____ and _____ .
17. The oldest and most primitive phylum is _____ .
18. To grow larger, arthropods shed their shells in a process called _____ .
19. The phylum _____ includes five classes of vertebrates: fish, amphibians, reptiles, birds, and mammals.



Keys

Practice (p. 335)

1. Porifera
2. Cnidaria
3. Arthropoda or arthropod
4. Mollusca or mollusk
5. Chordata
6. Cnidaria
7. Arthropoda or arthropod
8. Chordata
9. Echinodermata or echinoderms
10. Mollusca or mollusk
11. Annelida

Practice (pp. 336-337)

1. zoologist
2. phyla
3. chordates
4. invertebrates
5. Mammals
6. crustaceans
7. Cnidaria
8. Echinoderms
9. Reptiles
10. jawless; cartilaginous; bony
11. amphibians
12. turtles
13. birds
14. exoskeleton
15. hydrostatic

Practice (p. 338)

Answers will vary but may include the following:

Porifera:

Examples: sponge
Symmetry: none
Skeleton: endo
Segmentation: no
Features: pores, spicules

Cnidaria:

Examples: jellyfish, anemone, coral
Symmetry: radial
Skeleton: jellyfish-hydro, coral-exo

Segmentation: no

Features: tentacles, stinging cells

Annelida:

Examples: earthworm, flatworm

Symmetry: bilatera

Skeleton: hydro

Segmentation: some

Features: elongated body

Mollusca:

Examples: clam, squid, snail

Symmetry: bilateral

Skeleton: exo

Segmentation: no

Features: soft body, mantle foot

Athropoda:

Examples: crab, shrimp

Symmetry: bilateral

Skeleton: exo

Segmentation: yes

Features: jointed legs, exoskeleton

Echinodermata:

Examples: sea star (starfish),
urchins

Symmetry: radial

Skeleton: endo

Segmentation: no

Features: spiny-skinned, tube feet

Lab Activity 1 (pp. 339-340)

Analysis:

Answers will vary.

Lab Activity 2 (pp. 341-345)

Analysis:

Answers will vary based on the condition and size of crabs.

Practice (p. 346)

1. J
2. G
3. A
4. I



Keys

5. F
6. E
7. D
8. C
9. H
10. B

Practice (p. 347)

1. mammals
2. birds
3. reptiles
4. amphibians
5. fish
6. echinoderms
7. crustaceans
8. arthropods
9. mollusks
10. annelids
11. gills

Unit Assessment (pp. 131-132TG)

1. K
2. D
3. J
4. I
5. H
6. G
7. L
8. F
9. B
10. A
11. C
12. M
13. E
14. zoologists
15. Arthropoda
16. clam; oyster
17. Porifera
18. molting
19. Chordata



Unit 15: Fish—Cold Blooded Swimmers

Unit Focus

This unit provides students with an overview of the distinguishing features of the three classes of fish: the Agnatha, the Chondrichthyes, and the Osteichthyes. Students will learn the differences between the three classes of fish and adaptations of fish to the oceans.

Student Goals

1. Name the three classes of fish.
2. State characteristics of cartilaginous fishes.
3. State characteristics of bony fishes.
4. Describe some unusual adaptations in fish.

Suggestions for Enrichment

1. Have students view one of the *Jaws* movies and list all the myths that the media uses to portray sharks. Discuss myths versus facts.
2. Have students compare the cartilaginous and bony fish in regards to swimming, morphology, reproduction, and buoyancy. Ask students to make a chart or compare preserved or dissected specimens.
3. Have students look at different types of fish scales—cycloid, ctenoid, and denticles and then determine the age of fish based on the rings.
4. Discuss the longest bony fish, the oarfish. With its snake-like body sporting a magnificent red fin along its 50 foot length, horse-like face, and blue gills, it accounts for many sea-serpent sightings. Have students hypothesize what the oarfish would look like from your description and then design their own version of what the oarfish looks like. All interpretations are acceptable and no two students' drawings should look the same.
5. Have students write a story using the oarfish as the main character.



6. Rewrite the story of *Moby Dick* using the oarfish to replace the whale.
7. Write an announcement using the oarfish as the new attraction at a tourist site.
8. Create a “wanted” sign with a character drawing, reward, and description, with information on who wants the oarfish and why.
9. Discuss some of the adaptations fish have developed for hiding in the ocean (e.g., small size; transparent body; cryptic coloration; disruptive coloration; mimicry of surroundings; bioluminescence). Ask students to design a well-camouflaged fish and tell how the adaptation helps it hide.
10. Have students observe and record swimming and resting patterns of aquarium fish to determine how different parts of the habitat are used. Have students create a data sheet on the fish they are observing. They should record four-minute observations in 15-second intervals, noting the location of the fish and its activities. Have students compare results.
11. Have students produce a photo-essay on a teacher-approved topic relating to marine science. The photo-essay must include the following.
 - 10 to 12 images related to the chosen topic—they may be actual photographs, hand-drawn pictures, magazine photos, or pictures from the Internet
 - a paragraph explaining each image and elaborating on the topic
 - an interview with a professional associated with the topic
 - an introduction explaining the topic, why it was chosen, and what they hope to learn
 - a conclusion explaining their experiences in making the project, what they actually learned, and the future of the topic they studied
 - a bibliography of at least five sources
12. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.



Lab Preparation

Teacher Preparation for Lab Activity 1: Identify Species of Sharks and Rays (pages 365-367)

Materials:

shark pictures and key

Teacher Preparation for Lab Activity 2: Fish Printing (page 368)

Materials:

whole, intact fresh fish from market; water-soluble ink or paint; newsprint or other grainy paper; small pieces of modeling clay and/or toothpicks; newspapers; piece of sponge

Teacher Preparation for Lab Activity 3: New Millennium Fish (pages 369-370)

Materials:

butcher paper; notebook paper; colored pencils or markers; scoring rubric; textbook or other marine resources



Unit Assessment

Circle the letter of the correct answer.

1. The primary difference between bony fish and cartilaginous fish is their _____ .
 - a. reproduction
 - b. location
 - c. swim bladder
 - d. skeleton
2. The skin of a bony fish is covered with _____ .
 - a. denticles
 - b. scales
 - c. spicules
 - d. pores
3. Sharks locate their prey primarily by _____ .
 - a. seeing
 - b. hearing
 - c. touching
 - d. smelling
4. The tail fin is called the _____ .
 - a. dorsal fin
 - b. caudal fin
 - c. pectoral fin
 - d. pelvic fin
5. Rays are closely related to _____ .
 - a. sharks
 - b. bony fish
 - c. lampreys
 - d. eels



6. All of the following are characteristics of bony fish except _____ .
 - a. schooling
 - b. cartilage skeletons
 - c. swim bladders
 - d. scales, gills

7. If you see a shark in the water while swimming, you should _____ .
 - a. splash to scare it away
 - b. swim quickly to shore
 - c. remain calm and slowly get out of the water
 - d. scream for help

8. Most sharks are _____ to humans.
 - a. dangerous
 - b. not dangerous
 - c. mean
 - d. friendly

9. Fish travel in schools for _____ and reproduction.
 - a. companionship
 - b. feeding
 - c. spawning
 - d. protection

10. The jawless fish belong to the group of fish called _____ .
 - a. bony fish
 - b. Agnatha
 - c. cartilage fish
 - d. eels



Match the **description** with the correct term. Write the letter on the line provided.

- | | |
|--|--------------|
| _____ 11. tail fin | A. caudal |
| _____ 12. chest area | B. denticles |
| _____ 13. depositing eggs into the water | C. operculum |
| _____ 14. covering found on bony fish | D. pectoral |
| _____ 15. stomach side | E. scales |
| _____ 16. gill covering | F. spawning |
| _____ 17. toothlike structures | G. ventral |

Answer the following using short answers.

18. How do fish maintain their buoyancy? _____

19. What is one reason a shark may attack? _____

20. What is unique about a shark's teeth? _____



Keys

Practice (pp. 361-362)

1. cartilage; bony
2. Buoyancy
3. Agnatha; hagfish
4. Sharks
5. sense
6. schools
7. great white shark
8. denticles
9. bottom
10. bony
11. spawning
12. swim bladders
13. size; age

Practice (p. 363)

1. dorsal side
2. first dorsal fin
3. second dorsal fin
4. caudal fin
5. gill slits
6. pectoral fin
7. pelvic fin
8. anal fin
9. ventral side

Practice (p. 364)

1. The fish scales protect the body of the fish. The mucus coating provides a defensive barrier to keep bacteria and diseases from entering the fish's body through its scales. The mucus coating also helps the fish to swim faster.
2. The lateral line of the shark detects vibrations by feeling the pressure changes produced by the vibrations in the water.
3. The swim bladder of the fish allows the fish to maintain its position in the water or move up or down in the water.
4. The ampullae of Lorenzini detect electrical fields produced by the

muscles of fish or other animals in the water.

5. A fish exhibits countershading will appear to be dark on its dorsal side (top) and light colored on its ventral (bottom) side.
6. A fish with countershading will live in the open ocean.
7.
 - a. tuna, shark
 - b. flounder
 - c. butterfly fish, angelfish
 - d. eel

Lab Activity 1 (pp. 365-367)

Analysis:

1. skates
2. thresher sharks
3. sawsharks
4. requiem sharks
5. catsharks
6. whale sharks
7. mako sharks
8. dogfish sharks
9. stingrays
10. goblin sharks
11. false catsharks
12. sevengill sharks
13. hammerhead sharks
14. manta rays

Lab Activity 2 (p. 368)

Art work will vary.

Lab Activity 3 (pp. 369-370)

Analysis:

Answers will vary. Teachers will determine points on rubric or scoring guide, New Millennium Fish Rubric, in student's book page 370, or design own rubric.



Keys

Practice (p. 371)

1. pectoral
2. ventral
3. caudal
4. dorsal
5. denticles
6. scales
7. lamprey
8. cartilage
9. buoyancy
10. cartilaginous
11. Agnatha

Practice (p. 372)

1. H
2. C
3. B
4. D
5. G
6. I
7. A
8. F
9. E
10. J

Unit Assessment (pp. 139-141TG)

1. d
2. b
3. d
4. b
5. a
6. b
7. c
8. b
9. d
10. b
11. A
12. D
13. F
14. E
15. G
16. C
17. B

18. Fish have a swim bladder.
19. Answers will vary but may include the following: it may mistake a human for a wounded marine animal; its territory has been invaded or disturbed
20. The teeth regrow.



Unit 16: Marine Mammals

Unit Focus

This unit provides students with an overview of the basic characteristics of cetaceans, pinnipeds, sirenians, and other marine mammals. Students will learn about the adaptations these mammals have acquired for life in the ocean and about the unique diving responses of marine mammals.

Student Goals

1. Classify marine mammals as cetaceans, pinnipeds, or sirenians and note other marine mammals.
2. Explain the importance of bradycardia for diving marine mammals.
3. Describe the feeding methods of cetaceans, pinnipeds, sirenians, and other marine mammals.
4. Describe the difference in feeding methods between toothed and baleen whales.

Suggestions for Enrichment

1. Arrange for students to engage in hands-on encounters with marine mammals by visiting a local sea aquarium. Touch, feed, and observe marine mammal behaviors of dolphins or whales, and manatees.
2. Have students research animal training techniques; then visit a local sea aquarium or invite a guest speaker to describe behavior characteristics of marine mammals and the responsibilities of a trainer.
3. Have students research rehabilitation techniques for marine mammals. Ask specialists to come to the classroom to discuss rescue methods for beached whales or dolphins and injured manatees.
4. Have the class adopt a manatee through the Save a Manatee program. Become a part of the manatee conservation effort.



5. Have students investigate local laws governing marine mammal protection and industries which may be affected by those laws. Have students debate the pros and cons of the laws. Have class members represent the industries and present how they will be affected. Have class members represent the marine mammals and present how the laws would affect the mammals. Take a vote on what is effective.

6. Have groups research different whale lengths (e.g., toothed whales: bottlenose dolphin—10 feet; beluga or white whale—16 feet; killer whale—18 feet; sperm whale—55 feet; pygmy whale—20 feet; gray whale—40 feet; humpback whale—50 feet; right whale—55 feet; sei whale—60 feet; fin whale—85 feet; blue whale—100 feet) and label an index card for their whale. Prepare a 100-foot-long rope and have each group mark off their whale’s length and attach their index card. Ask groups to prepare a paragraph describing their whale and to draw a picture of their whale to display under their index card on the rope. Display the rope and have groups present an oral report on their whale. People commonly call whales fish.

7. Discuss common marine animals easily misidentified, such as a whale or fish. Discuss differences between whales and fish, such as method of breathing, swimming, feeding, bearing young, and types of skin. Have students create a chart with the names of marine animals along the side of a page and the five categories mentioned above along the top of a page.

Whale or Fish

marine animal	method of breathing	method of swimming	method of feeding	method of bearing young	type of skin	evaluate results
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						



Have students collect information to fill out the chart and then evaluate results of whales versus fish based on background information provided about their differences. Have students rank the top three categories in usefulness of determining whale or fish to use in further evaluations of marine animals.

8. Integrate mathematical word problems using relevant information about whales.
 - A newborn blue whale weighed two tons at birth. It gained 10 pounds per hour.
 - How long did it take the baby to weigh three tons? (one ton = 2000 pounds)
Answer: 200 hours or 8.33 days.
 - A gray whale travels six miles per hour.
 - How long will it take the whale to travel 5,000 miles from the Arctic to Mexico?
Answer: 833.33 hours or 34.72 days.
9. Have students calculate feeding rates of whales and compare this to feeding rates of humans.
 - A sperm whale is 50 feet long and can dive up to 1.9 miles deep.
 - Using this ratio of length versus diving depth, how deep could you hypothetically dive using your height?
 - How many cubic meters of water enter the open mouth of the whale each minute as it moves through the water at 1.5 meters per second?
Answer: 135 cubic meters



- How many plankton can a whale ingest per second if the density is 4,000 per cubic meter? 15,000 per cubic meter?

Answer: 9,000 per second; 33,750 per second.

- How many plankton can a whale ingest per minute if the density is 4,000 per cubic meter? 15,000 per cubic meter?

Answer: 540,000 plankton per minute for density of 4,000; 2,025,000 plankton per minute for density of 15,000.

- If a whale ingests 500,000 calories per day, how many calories is it ingesting per hour? Per minute?

Answer: 12,833.33 calories per hour; 347.22 calories per minute.

- A typical human weighs 150 pounds and takes in 3,000 calories per day. A typical whale weighs 50 tons and needs 395,000 calories per day. A whale may spend 15 hours a day feeding during the summer season. Investigate your own consumption.

- Number of minutes you spend per day eating.
- Number of calories you ingest per day.
- Calculate the number of calories per minute ingested.
- Compare your caloric intake per minute with that of a whale.
- What factors account for the differences in caloric intake?
- How does food availability differ for humans and whales?

10. Have groups research one of the following cetaceans and make a model of it: right whale, blue whale, gray whale, narwhal, sperm whale, common dolphin, killer whale, sei whale, humpback whale, or Amazon River dolphin.



11. Have students choose five cetaceans to research (e.g., killer whales, humpback whales, gray whales, beluga whales, dolphins) and complete the following chart.

Cetaceans					
name of cetacean	ocean home	average size/weight	common diet	endangered	an interesting fact

12. Choose a picture in color of a variety of marine and plant life. Use a ruler and draw a one-inch or two-inch grid to include enough squares for one to two blocks per student. Write a number in each square on the back, starting in the upper right-hand corner and numbering in order to the bottom left-hand corner. Cut out the numbered squares and distribute them randomly to students. Pass out blank white paper pre-cut to one foot by one foot. Ask students to recreate their one-inch square or the one-foot square piece of paper. Once squares are completed, assemble them according to the numbers on the grid.
13. Assign groups one of the following dolphin behaviors as a topic of brief research: communication, feeding patterns, group behaviors, parenting, navigation, and interaction with humans. Have groups create informational posters explaining their assigned dolphin behavior, including pictures and illustrations reflecting the behavior and/or scientific principles behind it (such as echolocation). Discuss



how these behaviors relate to those of other animals and how behaviors are interrelated. What signs of intelligence do dolphins exhibit? Why do you think swimming with dolphins has become such a popular activity? What are the pros and cons of interactions with an animal in the wild?

14. Ask students to research and diagram the evolution of cetaceans, including dolphins, porpoises, and whales. How have these creatures evolved over time to adapt to their environments?
15. Have students investigate and chart the taxonomy of cetaceans. What similarities exist in all of these animals? What differences exist among them?
16. Have students create a comparison chart of dolphins and porpoises, noting their principle similarities and differences.
17. Have students create a chart that compares the intelligence of many different animals, including dolphins, humans, dogs, and chimpanzees. Ask them to include the behaviors of each animal that demonstrate intelligence as well as physical characteristics, such as brain size.
18. Ask students to choose a marine creature, learn about its adaptations and behaviors, and create an informational poster about the marine creature's behavior. Have students include the following: how the creature communicates; what it eats and what its feeding patterns are; how it interacts with others of its species; how it reproduces and how it takes care of its young; how it navigates the waters; how it interacts with humans.
19. Have students illustrate on a map where populations of dolphins and other cetaceans live.
20. Ask students to identify their position on a controversial marine science issue. Have groups of students develop an argument to support an opinion contrary to their own and present the argument to the class.
21. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.



Lab Preparation

Teacher Preparation for Lab Activity 1: Observing Dolphins (pages 392-393)

Materials:

pencil; paper; video or laser disc

Teacher Preparation for Lab Activity 2: Marine Mammals (page 394)

Materials:

reference books; pencil; paper; video programs

Teacher Preparation for Lab Activity 3: Bradycardia (pages 395-396)

Materials:

dish pan; towels; cold tap water; stopwatch or watch with a second hand

Teacher Preparation for Lab Activity 4: Whale Migrations (pages 397-401)

Materials:

map with coordinates of the east coast of the United States; whale migration data; colored pencils



Unit Assessment

Circle the letter of the correct answer.

1. The largest baleen whale is the _____ .
 - a. killer whale
 - b. sperm whale
 - c. humpback whale
 - d. blue whale

2. Whales without teeth are called _____ .
 - a. dentures
 - b. warm-blooded
 - c. baleen
 - d. sperm

3. *Echolocation* is _____ .
 - a. used to locate objects
 - b. found in dolphins and seals
 - c. like sonar and radar
 - d. all of these

4. *Bradycardia* is _____ .
 - a. the slowing of the heart beat
 - b. the increase of the heart beat
 - c. the lowering of blood pressure
 - d. holding your breath

5. Marine mammals that spend their lifetime in the water include _____ .
 - a. whales, dolphins, and manatees
 - b. polar bears and walruses
 - c. seals and sea otters
 - d. whales, seals, and dolphins



6. Marine mammals that live in warmer waters are the _____ .
 - a. whales and seals
 - b. manatees and dolphins
 - c. sea otters and polar bears
 - d. walruses and manatees

7. Dolphins have a keen sense of hearing that depends on _____ .
 - a. the fluke
 - b. the flippers
 - c. blubber
 - d. echolocation

8. The condition of having too little oxygen is known as _____ .
 - a. echolocation
 - b. sonar
 - c. asphyxia
 - d. bradycardia

9. The _____ on the head of dolphins is used to help them “see” their surroundings.
 - a. ear flap
 - b. dorsal
 - c. melon
 - d. fluke

10. Marine mammals are dependent on oxygen in the _____ to breathe.
 - a. water
 - b. atmosphere
 - c. melon
 - d. echolocation



Write **True** on the line if the statement is correct. Write **False** on the line if the statement is not correct.

- _____ 11. Marine mammals cannot remain underwater for longer than five minutes.
- _____ 12. Marine mammals have a very large capacity for storing oxygen and unusually large lungs.
- _____ 13. A dolphin's echolocation can help it find objects smaller than a grapefruit on the ocean bottom.
- _____ 14. Manatees are hostile, dangerous creatures.
- _____ 15. Dolphins can be found in springs and bays along Florida's coast.
- _____ 16. Seals and sea lions were nearly hunted to extinction.
- _____ 17. Seals and sea lions have only ear holes, not flaps, streamlining their bodies for movement in the water.
- _____ 18. Manatees may live for 80 years.
- _____ 19. The most dangerous whale to humans is the killer whale.
- _____ 20. The blue whale may eat three tons of krill a day.



Answer the following with short answers.

21. What are the five distinguishing characteristics of mammals? ____

22. Which marine mammals are protected? _____

How are they protected? _____



Keys

Practice (p. 387)

1. C, E, G, I, J
2. D, H
3. C, E, I
4. A, C, I
5. C, F
6. C, F, G, H, J

Practice (p. 388)

1. the use of sounds to locate objects
2. slowing of heartbeat to slow use of air
3. for valuable fur and oil
4. toothed and nontoothed
5. They have become an endangered species and are protected by the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act of 1978.
6. The blubber protects against cold and serves as a source of reserve energy, buoyancy, and padding.
7. This behavior will later be used in battling for mates. The stronger bull will get to mate with females to produce strong offspring.

Practice (pp. 389-390)

1. 135 cubic meters. (Multiply speed 1.5 meters per second by 60 seconds per minutes, then multiply again by 1.5 square meters for the mouth cavity.)
2. 9,000 per second. (Multiply the speed 1.5 meters per second by the mouth cavity 1.5 square meters by 4,000 plankton per cubic meter.)
3. 33,750 per second. (Multiply the speed 1.5 meters per second by the mouth cavity 1.5 square meters by 15,000 plankton per cubic meter.)
4. 540,000 plankton per minute for density of 4,000. (Multiply 1.5 meters per second and by 1.5

square meters by 60 seconds per minutes by 4,000 plankton per cubic meter.)

5. 20,833. $\bar{3}$ calories per hour. (Divide 5,000,000 calories per day by 24 hours in a day.)
6. 347. $\bar{2}$ calories per minute. (Divide 5,000,000 calories per day by 60 minutes in a hour.)
7. Answers will vary
8. whale
9. Size of animal and energy level required to maintain size.

Practice (p. 391)

Correct answers will be determined by the teacher.

Lab Activity 1 (pp. 392-393)

Analysis:

Answers will vary according to observations made by the student.

Lab Activity 2 (p. 394)

Analysis:

Answers will vary according to the species observed.

Lab Activity 3 (pp. 395-396)

Analysis:

Answers will vary.

Lab Activity 4 (pp. 397-401)

Analysis:

1. whale 1, female;
whale 2, could be an adult male, a nonpregnant female, or a juvenile;
whale 3, juvenile;
whale 4, newborn calf



Keys

2. whale 1: probably an adult female who is pregnant because mothers ready to give birth follow this path; whale 2: an adult male or a nonpregnant female or a juvenile because whales of these genders and ages disappear during the winter months and this particular whale was not sighted during the winter months; whale 3: most likely a juvenile because a juvenile whale would be more likely to take this migration path than a nonpregnant adult; whale 4: a newborn calf born to whale 1 during December because it is migrating northward along the same route
3. See above responses.
4. See above responses.
5. Answers will vary but may include the following: The northern range, where the Right whale migrates in the summer, provides a plentiful food supply to a larger number of whales. These whales typically congregate for mating. The warmer, protected waters in the southern range are well suited for calving.
6. Pollution, entanglement in fishing gear, and collisions with vessels during migration.
7. Large cities with active ports, shipping lanes, military vessels and submarines, and smaller recreational crafts.
8. The average distance whales travel in between sightings can be found by dividing the total number of miles traveled for the trip divided by the total number of sightings:
whale 1: total traveled distance of 1,200 miles divided by 21 sightings = 57.41 miles for the average distance traveled;
whale 2: total traveled distance of

500 miles divided by 10 sightings = 50 miles for the average distance traveled;

whale 3: total traveled distance of 1,220 miles divided by 17 sightings = 70.58 miles for the average distance traveled;

whale 4: total traveled distance of 600 miles divided by 11 sightings = 54.55 miles for the average distance traveled

9. The average speed per day the whale traveled during the entire trip can be found by dividing the total number of miles traveled by the total number of days traveled:
whale 1: 1,200 miles divided by 359 days = 3.34 miles per day for average speed;
whale 2: 500 miles divided by 324 days = 1.54 miles per day for the average speed;
whale 3: 1,220 miles divided by 356 days = 3.37 miles per day for the average speed;
whale 4: 600 miles divided by 174 days = 3.45 miles per day for the average speed

Practice (p. 402)

1. toothed whales
2. blowhole
3. baleen whales
4. moratorium
5. flippers
6. melon
7. blubber
8. fluke
9. echolocation
10. endangered



Keys

Unit Assessment (pp. 153-156TG)

1. d
2. c
3. d
4. a
5. a
6. b
7. d
8. c
9. c
10. b
11. False
12. False
13. True
14. False
15. True
16. True
17. False
18. False
19. False
20. True
21. are warm-blooded; breathe air;
have body hair; have backbones;
nurse their young
22. manatees, dolphins, seals, and sea
lions; by state and national laws



Unit 17: Marine Pollution

Unit Focus

This unit provides students with an overview of the impact of sewage pollution, toxic chemicals, and solid wastes on the marine environment. Students will also have a better understanding of the importance of clean waters to marine organisms.

Student Goals

1. Identify types of marine pollution.
2. Explain the difference between point-source and nonpoint-source pollutants.
3. Describe the effects of pollution on the marine environment and how this impacts humans.
4. Describe efforts to cut down on marine pollution.

Suggestions for Enrichment

1. Have students construct a bulletin board containing newspaper clippings, magazine articles, and pictures that tell or suggest the ways in which humans have changed the natural environment.
2. Have students display photos that show the effects of humans on the marine community.
3. Ask students to construct dioramas illustrating the interrelationships of humans and the sea before and after the growth and development of a human community.
4. Have students contact local government agencies by letter to urge enforcement of existing laws and requirements of penalties for all violations of antipollution ordinances.



5. Ask students to research a variety of detergents and pesticides in stores. Have them list the ingredients and attempt to find out which types may and which types may not be dangerous to marine life.
6. Have students participate in the International Coastal Clean Up Day. This event is usually held in mid-September and is ideal for student participation in an environmental campaign, as well as first-hand experience in collecting and tracking data.
7. Have students use NewsDirectory.com at <http://www.newsdirectory.com> to compare how newspapers and magazines in various countries discuss current topics about marine science. NewsDirectory.com is a resource of English-language newspapers and magazines from around the globe.
8. Discuss natural and human threats to the Earth's marine ecosystem. Have students collect news articles and then write a brief summary and a reflective paragraph on the destruction, by nature and/or by humans, of the world's marine ecosystem.
9. Have students review the food chain and create a food chain chart or poster board labeled as follows.

Food Chain Chart

production/ consumption roles	trophic level number	herbivore or carnivore	example
producers			
primary consumers			
secondary consumers			
tertiary consumers			
quaternary consumers			



Ask students to draw and cut out illustrations of marine animals (e.g., algae, plankton, sardines, mackerel, marlin, birds, sailfish, jawfish, scorpion fish, octopus, shrimp, garden eels, stargazers, grunion, dolphins, sharks, barberfish, chubs, sea turtles) and also consider the placement and role of humans. Have students place the various animal cutouts in the appropriate “Example” box and identify their respective categories. Have students use their charts to consider the flow of pollutants through marine food chains and identify some sources of marine pollution, including chemical effluents, oil spills and sewage. Have students chart likely points where these types of pollution enter the food chain and how high a level of toxicity they may reach. Consider how likely it is that various types of pollution can return to their human sources by traveling through the marine food chain and to what extent pollution in marine food threaten human consumers.

10. Have students research what happened after some recent major oil spills.
11. Have groups chose a geographic area and research the following: What are pollution levels in the ocean around that area? What causes pollution in that area? Who and what is being affected by the pollution? How is the ocean affected? What is your group’s solution to the pollution? Next have students create a newsletter that tells of their findings.
12. Since the beginning of human history, people have been changing their environment to meet their needs. One of the biggest manipulations ever of the natural world was the Panama Canal. Ask students to research and discuss the following: What have the effects of the canal been on ocean life on both sides of Panama? How is the Panama Canal important to us? Would an enlargement of the canal be positive? Is changing the world to meet our needs the right thing to do?
13. Pose the following: The year is 2030. Since the turn of the century, pollution, overfishing, and global warming have dramatically altered the characteristics of oceans. Ask students to come up with 10 characteristics that would describe the Atlantic Ocean in 2030. List them on the board. Then, given the hypothetical condition of the ocean, ask students to create a fish of the future, listing many



different and unusual ways that their fish will adapt to survive. Have students name the fish and create a labeled model of it.

14. Invite a guest speaker from a marine protection agency to talk to your class about the group's objectives. Have the speaker explain how the group presents its issues to government and whether they have met with victory or defeat.
15. Ask students to recall some of the year's biggest local, national, and world marine pollution issues. Which stories affected them directly, indirectly, or not at all?
16. Have one student stand up and start a debate or discussion on a marine pollution issue. The student can outline an opinion or write on the board. Then select the next person to speak or write until all students have had a chance to speak.
17. Present students with the following value examination matrix for analyzing perspectives in editorials (or newscasts) on marine environment topics. Have students record statements or concepts they strongly support (or oppose) and assign these statements a plus or minus value reflecting their opinion. Next have students record the logic behind their assigned value. Point out that there is usually a system of logic or reasoning underlying their values.

Value Examination Matrix for Analyzing Editorials		
statement or concept	assigned value	reasoning or logic behind my value



18. Present students with the following conflict clarification matrix for analyzing values in editorials or newscasts on marine environment topics. Have students record a statement they support (or oppose) in the first row of the matrix and assign a plus or minus value reflecting their opinion beside the “Assigned Value” subheading in the second row. In the third row, have students identify the logic behind their assigned value. In the fourth row, have students identify an opposing value for the concept or statement. In the fifth row, ask students to describe the logic behind the opposing value. In the last row, have students describe their conclusion or a new awareness of the topic of the editorial and identify some current events for which this process might be useful.

Conflict Clarification Matrix for Analyzing a Current Issue	
statement or concept	
assigned value	
reasoning or logic behind my value	
opposing value	
reasoning or logic behind my opposing value	
conclusion/ awareness	



19. Present students with the following decision-making matrix to analyze a teacher-generated “decision question” with choices or alternatives to be considered. Have students rank or weight the criteria in the first column using a three-point numeric ranking or weighting system as follows.

3	=	very important
2	=	somewhat important
1	=	not very important

Next, ask students to determine the degree to which each alternative possesses each of the criteria as follows.

3	=	totally
2	=	somewhat
1	=	a little
0	=	not at all

Finally, have students calculate the quality points each alternative has by multiplying the criterion weights by the alternative weights. (In other words, multiply the number in each cell by the number at the beginning of each row and then enter that product in each cell.) Tally the quality points for each alternative and determine which alternative has the most points. (Explain to students that after seeing the results of the matrix process, they may legitimately change the weights they are assigned.) Have students make a decision based on their quantification and explain the reasoning behind their decision.



Decision-Making Matrix			
Decision Question:			
Criteria	Alternatives		
(rank or weight from 1-3) Criteria Weight =	alternative weight x criteria weight = quality points __ x __ = __	__ x __ = __	__ x __ = __
(rank or weight from 1-3) Criteria Weight =	__ x __ = __	__ x __ = __	__ x __ = __
(rank or weight from 1-3) Criteria Weight =	__ x __ = __	__ x __ = __	__ x __ = __
(rank or weight from 1-3) Criteria Weight =	__ x __ = __	__ x __ = __	__ x __ = __
Total of Quality Points	_____	_____	_____

Criteria Weight

Ranking system:

- 3 = very important
- 2 = somewhat important
- 1 = not very important

Alternative Weight

The degree to which each alternative possesses each criteria:

- 3 = totally
- 2 = somewhat
- 1 = a little
- 0 = not at all



20. Pick an issue of interest and ask students to find articles. List arguments on both sides of the issue. Draw an imaginary line on the floor, with one end representing “for” and the other “against.” Ask students literally to “take a stand” on the line where they feel they belong, depending on the strength of their belief. (If all students stand on one side, play “devil’s advocate” and stand on the other side.) When everyone is standing along the line, open a debate with spokespersons on each side. The goal is to have students move closer to one point of view. At the end, students may stand anywhere but in the “undecided” middle position. After students are seated, have them write their views on the above issue in an editorial.
21. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.

Lab Preparation

Teacher Preparation for Lab Activity 1: An Oily Mess (pages 421-423)

Materials:

two aluminum foil pie pans; water; used motor oil; dropper; cotton ball; nylon string; paper towels; dishwashing liquid; feather; salt (optional)

Teacher Preparation for Lab Activity 2: Deadly Waters (pages 424-428)

Materials:

pollution information sheet; brown paper bag filled with “tokens”—a handful each of M&Ms and Fruit Loops



Unit Assessment

Match each definition with the correct term. Write the letter on the line provided.

- | | | |
|-------|--|-------------------------------|
| _____ | 1. sewage that is drained from sinks and bathtubs | A. biodegradable |
| _____ | 2. able to be broken down by natural process | B. chemical dispersion |
| _____ | 3. interference with marine life cycles by an artificial increase in water temperature | C. chemical pollution |
| _____ | 4. pollution or making impure by contact or mixture | D. contamination |
| _____ | 5. waste containing radioactivity | E. dispersants |
| _____ | 6. method used to clean up oil spills; uses dispersants to break up oil | F. marine pollution |
| _____ | 7. pollution caused by agricultural and industrial activities | G. mechanical containment |
| _____ | 8. chemicals used to destroy insects | H. non-point source pollutant |
| _____ | 9. pollution that comes directly from one source | I. pesticides |
| _____ | 10. pollution that does <i>not</i> come directly from one source | J. point-source pollutant |
| _____ | 11. introduction of harmful substances or energy into the ocean environment | K. radioactive waste |
| _____ | 12. chemicals which break up oil | L. raw sewage |
| _____ | 13. method used to clean up oil spills which uses booms placed around the spill | M. thermal pollution |



Circle the letter of the correct answer.

14. The most tragic oil spill in 1989 was that of the _____ .
- a. *Exxon Falcon*
 - b. *Exxon Tiger*
 - c. *Exxon Valiant*
 - d. *Exxon Valdez*
15. _____ is *not* a commonly used method to clean up oil spills in the sea.
- a. Burning
 - b. Sinking
 - c. Chemical dispersion
 - d. Mechanical containment
16. Chemicals which are used to break up oil are called _____ .
- a. thermal
 - b. chemical
 - c. dispersants
 - d. marine
17. _____ pollution is pollution caused by agricultural and industrial activities.
- a. Thermal
 - b. Chemical
 - c. Oil
 - d. Radioactive
18. Thermal pollution is usually caused by _____ .
- a. the heating of the ozone layer
 - b. the sun's burning rays
 - c. too many boats and people in the oceans
 - d. power plants releasing warm water into the environment



Match each **pollutant** with the correct term. Write the letter(s) on the line provided.

- _____ 19. oil spill from a ship A. biodegradable
- _____ 20. animal waste from marine animals B. nonbiodegradable
- _____ 21. plastic products
- _____ 22. PCBs from runoff
- _____ 23. industrial pesticides
-
- _____ 24. factory waste C. nonpoint source
- _____ 25. raw sewage from a sewage pipe D. point source
- _____ 26. surface water runoff
- _____ 27. acid rain
- _____ 28. heated water from a power plant



Answer the following with short answers.

29. What are some of the effects of oil spills on marine organisms?

30. What happens if too much raw sewage enters a marine environment? _____

31. How does thermal pollution affect the marine environment?

32. What is the newest method for controlling oil spills? _____



Keys

Practice (pp. 415-416)

1. Raw sewage
2. point-source
3. Nonbiodegradable
4. plastic
5. *Exxon Valdez*; Alaska
6. thermal
7. Dispersants
8. The following answers may be in any order: typhoid; cholera; hepatitis A
9. The following answers may be in any order: bacteria; sunlight; oxidation
10. PCBs
11. nonpoint-source
12. Prevention
13. PCBs
14. acid rain

Practice (pp. 417-418)

1. Answers will vary but may include four of the following: oil spills; releasing too much raw sewage into the water; agriculture and industrial production release chemicals into the marine environment; acid rain; thermal pollution caused by industrial production.
2. Answers will vary but may include three of the following with respective explanations: seabirds, sea otters, fish, shellfish, zooplankton. The birds' feathers become coated with oil which keeps them from flying and so they starve to death or die from exposure. They also die from oil ingested when they feed off other animals covered in oil. Sea otters' coats become coated with oil which causes their fur to lose the ability to keep them warm. They also swallow the oil as they groom their

- coats in an attempt to get rid of the oil. Some marine organisms die immediately from exposure, while others die slowly or suffer long-term problems. Shellfish are destroyed by the oil that sinks and covers the ocean bottom.
3. Answers will vary but may include two of the following: requiring tankers and barges that transport oil to have double hulls; better traffic systems to guide tankers; drug and alcohol screening of pilots; requiring oil tankers to carry more oil-spill equipment on board.
 4. Answers will vary but may include two of the following: bacteria in the water can break down organic wastes; nonacidic (basic) substances in the water neutralize destructive acids; sunlight penetrates the water and breaks down certain compounds; some wastes are destroyed by the process of oxidation
 5. The natural purifying system becomes overloaded and cannot break down the pollutants fast enough.
 6. Animals that mistakenly eat plastic starve because the plastic prevents them from digesting real food. Plastic can also get caught in marine animals' throats, causing them to starve or strangle.
 7. Answers will vary but may include the following: raises the temperature of the water which reduces the water's ability to absorb oxygen; reduced oxygen makes it harder for fish to breathe, can interfere with the animal's ability to reproduce, reduces the ability of bacteria to decompose wastes in the water
 8. Answers will vary.
 9. oil-eating bacteria



Keys

Practice (pp. 419-420)

1. D; B
2. H; E
3. C; A
4. F; G

Lab Activity 1 (pp. 421-423)

Analysis:

1. No
2. Answers will vary but should include the following: Oil begins to spread.
3. So the oil does not spread.
4. Answers will vary.
5. they are unable to fly; no warmth
6. Answers will vary.
7. Answers will vary.
8. Answers will vary.
9. Answers will vary.
10. Almost impossible because the oil would spread too much in a wide area.
11. Answers may vary but should include the following: The oil broke up slightly.
12. on top of the ocean surface; onto beaches; slowly settle into the sediments
13. Answers will vary but may include the following: not clean in terms of pure or natural, has broken up the oil, but the water now contains phosphates.
14. oil

Lab Activity 2 (pp. 424-428)

Analysis:

1. the normal allowed level for pollutants
2. yes; higher than the norm

3-9. Answers will vary.

Practice (pp. 429-430)

1. mechanical containment
2. PCBs
3. acid rain
4. biodegradable
5. pesticides
6. contamination
7. thermal pollution
8. point-source pollutant
9. nonpoint-source pollutant
10. pollutant
11. oxidation
12. dispersant
13. raw sewage

Unit Assessment (pp. 169-172TG)

1. L
2. A
3. M
4. D
5. K
6. B
7. C
8. I
9. J
10. H
11. F
12. E
13. G
14. d
15. b
16. c
17. b
18. d
19. B
20. A
21. B
22. B
23. B
24. D
25. D
26. C
27. C
28. D



Keys

29. Answers will vary but may include the following: death; suffer long-term problems; destroys habitat; animals must migrate to new area.
30. Bacteria begins to multiply and consume all the oxygen in the water. Fish and other marine organisms are then starved for air.
31. Heated water is released into bays, raising the water temperature of the marine environment. This reduces the water's ability to absorb oxygen and makes it hard for fish and other organisms to breathe. It may also interfere with organisms' reproduction.
32. the use of oil-eating bacteria



Unit 18: Marine Resources

Unit Focus

This unit introduces the student to the delicate balance between humans' use of the oceans and the amount of use that the ocean can tolerate. Students will investigate the importance of the ocean as a natural resource.

Student Goals

1. Define marine resources.
2. List important living and nonliving marine resources.
3. Distinguish between nonrenewable resources and renewable resources.

Suggestions for Enrichment

1. Have students debate the advantages and disadvantages of using power from waves, tides, and currents.
2. Have students make a collage illustrating various ocean resources.
3. Ask students to make an "infomercial" about one or several of the ocean resources available. Put the "infomercial" on videotape and share with other students or schools.
4. Have students make an "infomercial" about Florida's ocean resources. Send the finished product to the governor.
5. Decide upon a list of food and household items containing algae and nonalgae products. Ask students if and why they would ever eat seaweed. Have students bring in items from your list (or only the containers). Create a data sheet (or use the one on the following page) for students to record their hypotheses about which products they think contain seaweed or algae derivatives such as carrageen (red algae), alginates (brown algae), and beta carotene (green algae).



After they complete data sheets, have students check which products actually contained seaweed derivatives (see above). Ask students if they would eat the seaweed plant itself, knowing now that they already eat algae extracts in many foods. Discuss why some countries eat seaweed more than Americans, using seaweed to wrap vegetables, rice, or raw fish (sushi). (Optional: bring in samples of brown, red, and green seaweed or algae found at health or ethnic food stores. Display the various types of seaweed—mori, kombu, kelp, dulse. Smell and taste if possible.)

6. See Appendices A, B, and C for other instructional strategies, teaching suggestions, and accommodations/modifications.



Unit Assessment

Match each **description** with the correct term. Write the letter on the line provided.

- | | |
|---|---------------------------|
| _____ 1. process by which deep, cold nutrient-rich water is brought to the surface | A. aquaculture |
| _____ 2. sea farming | B. biological resources |
| _____ 3. a juvenile oyster | C. nonrenewable resources |
| _____ 4. sources available in limited amounts; cannot be replenished | D. renewable resources |
| _____ 5. sources that can be replenished | E. reservoir rock |
| _____ 6. thick layer of animal and plant remains that accumulate on the continental shelf | F. spat |
| _____ 7. living organisms from the ocean harvested for commercial use | G. turbine |
| _____ 8. machine driven by pressure or a strong flow of water | H. upwelling |



Circle the letter of the correct answer.

9. The most valuable natural resources from the ocean are _____ .
- a. oil and sulfur
 - b. oil and gas
 - c. manganese nodules and oil
 - d. manganese nodules and sulfur
10. _____ is a nonmetallic element mined from the ocean and used in the production of rubber, insecticides, and pharmaceutical products.
- a. Manganese
 - b. Gas
 - c. Phosphate
 - d. Sulfur
11. _____ are currents from the deep waters bringing nutrient-rich waters to the ocean surface.
- a. Tides
 - b. Tsunamis
 - c. Upwellings
 - d. Tidal bores
12. Organisms which may be raised in an enclosed warm-water system are _____ .
- a. oysters
 - b. spats
 - c. shrimp
 - d. clams
13. Industry is interested in manganese nodules for their _____ .
- a. economic value
 - b. shape
 - c. beauty
 - d. food value



Write **R** if the resource is **renewable** and **N** if the resource is **nonrenewable**.

- _____ 14. shrimp
- _____ 15. manganese nodules
- _____ 16. gas and oil
- _____ 17. phosphate
- _____ 18. oysters
- _____ 19. sulfur
- _____ 20. tidal power
- _____ 21. fish
- _____ 22. seaweeds

Answer the following using complete sentences.

23. How is oil formed? _____
- _____
- _____
- _____
- _____



24. How is energy collected from the ocean? _____



Keys

Practice (p. 441)

1. oil; gas
2. oil
3. nonrenewable
4. upwelling
5. renewable
6. Biological
7. nonrenewable
8. physical
9. aquaculture

Practice (p. 442)

Answers will vary

Practice (p. 443)

1. The remains of plants and animals settled to the ocean floor where heat, pressure, and time transformed the remains into oil.
2. Manganese nodules are round, black mineral deposits on the ocean floor.
3. Oyster farmers grow oysters by placing shells on the shallow-ocean floor or in an estuary, or by attaching a wire in the water column to provide an ideal location for spats to attach and grow.
4. Answers will vary but may include the following: The ocean provides us with tidal energy; industrial, construction, pharmaceutical, and agricultural products; transportation; food; and recreation.

Practice (p. 444)

1. resource
2. manganese nodules
3. upwelling
4. spat
5. renewable resources
6. reservoir rock

7. aquaculture
8. nonrenewable resources
9. biological resources
10. physical resources

Unit Assessment (pp. 179-182TG)

1. H
2. A
3. F
4. C
5. D
6. E
7. B
8. G
9. b
10. d
11. c
12. c
13. a
14. R
15. N
16. N
17. N
18. R
19. N
20. R
21. R
22. R
23. The remains of plants and animals settle to the ocean floor where heat, pressure, and time transform the remains into oil.
24. Energy is collected from the tides and waves by paddle-like wheels called turbines. When high tides come in, the tide water is trapped in an estuary. When the tide water flows out during low tide, the water is channeled through the turbine, which in turn generates electricity.

Appendices

Instructional Strategies

Classrooms include a diverse population of students. The educator’s challenge is to structure the learning environment and instructional material so that each student can benefit from his or her unique strengths. Instructional strategies adapted from the Florida Curriculum Frameworks are provided on the following pages as examples that you might use, adapt, and refine to best meet the needs of your students and instructional plans.

Cooperative Learning Strategies—to promote individual responsibility and positive group interdependence for a given task.

Jigsawing: each student becomes an “expert” on a topic and shares his or her knowledge so eventually all group members know the content.

Divide students into groups and assign each group member a numbered section or a part of the material being studied. Have each student meet with the students from the other groups who have the same number. Next, have these new groups study the material and plan how to teach the material to members of their original groups. Then have students return to their original groups and teach their area of expertise to the other group members.

Corners: each student learns about a topic and shares that learning with the class (similar to jigsawing).

Assign small groups of students to different corners of the room to examine and discuss particular topics from various points of view. Have corner teams discuss conclusions, determine the best way to present their findings to the class, and practice their presentation.

Think, Pair, and Share: students develop their own ideas and build on the ideas of other learners.

Have students reflect on a topic and then pair up to discuss, review, and revise their ideas. Then have the students share their ideas with the class.

Debate: students participate in organized presentations of various viewpoints.

Have students form teams to research and develop their viewpoints on a particular topic or issue. Provide structure in which students can articulate their viewpoints.

Brainstorming—to elicit ideas from a group.

Have students contribute ideas about a topic. Accept all contributions without initial comment. After a list of ideas is finalized, have students categorize, prioritize, and defend their contributions.

Free Writing—to express ideas in writing.

Allow students to reflect on a topic, then have them respond in writing to a prompt, a quotation, or a question. It is important that they keep writing whatever comes to mind. They should not self-edit as they write.

K–W–L (Know–Want to Know–Learned)—to provide structure for students to recall what they know about a topic, deciding what they want to know, and then after an activity, list what they have learned and what they still want or need to learn.

Before engaging in an activity, list on the board under the heading “What We Know” all the information students know or think they know about a topic. Then list all the information the students want to know about a topic under, “What We Want to Know.” As students work, ask them to keep in mind the information under the last list. After completing the activity, have students confirm the accuracy of what was listed and identify what they learned, contrasting it with what they wanted to know.

Learning Log—to follow-up K–W–L with structured writing.

During different stages of a learning process, have students respond in written form under three columns:

“What I Think”

“What I Learned”

“How My Thinking Has Changed”

Interviews—to gather information and report.

Have students prepare a set of questions in interview format. After conducting the interview, have students present their findings to the class.

Dialogue Journals—to provide a way to hold private conversations with the teacher or share ideas and receive feedback through writing (this activity can be conducted by e-mail).

Have students write on topics on a regular basis. Respond in conversational writing to their writings with advice, comments, and observations.

Continuums—to indicate the relationships among words or phrases.

Using a selected topic, have students place words or phrases on the continuum to indicate a relationship or degree.

Mini-Museums—to create a focal point.

Have students work in groups to create exhibits that represent, for example, a display of several electrical experiments that demonstrate concepts related to electricity.

Models—to represent a concept in simplified form.

Have students create a product, like a ball and stick model of an atom, or a model of weather systems.

Reflective Thinking—to reflect on what was learned after a lesson.

Have students write in their journals about a concept or skill they have learned, comment on the learning process, note questions they still have, and describe their interest in further exploration of the concept or skill. Or have students fill out a questionnaire addressing such questions as: Why did you study this? Can you relate it to real life?

Problem Solving—to apply knowledge to solve problems.

Have students determine a problem, define it, ask a question about it, and then identify possible solutions to research. Have them choose a solution and test it. Finally, have students determine if the problem has been solved.

Predict, Observe, Explain—to predict what will happen in a given situation when a change is made.

Ask students to predict what will happen in a given situation when some change is made. Have students observe what happens when the change is made and discuss the differences between their predictions and the results.

Literature, History, and Storytelling—to bring history to life through the eyes of a historian, storyteller, or author, revealing the social context of a particular period in history.

Have students locate books, brochures, and tapes relevant to a science. Assign students to prepare reports on the life and times of scientists during specific periods of history. Ask students to write their own observations and insights afterwards.

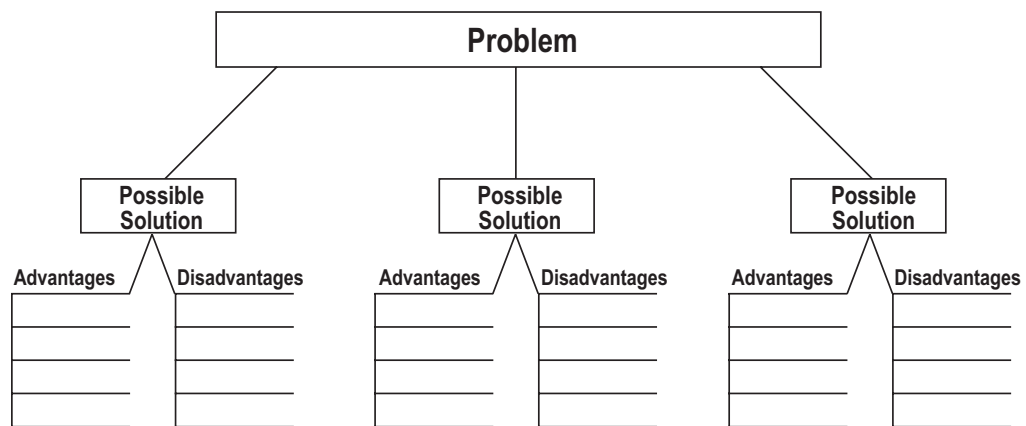
Laboratory Investigation—to involve students with their environment.

Have students propose a question, develop a hypothesis, explore methods of investigating the question, choose one of the methods, then conduct research and draw conclusions based on the information gathered. Ask students to report the results orally, in writing, or with a picture or diagram.

Graphic Organizers—to transfer abstract concepts and processes into visual representations.

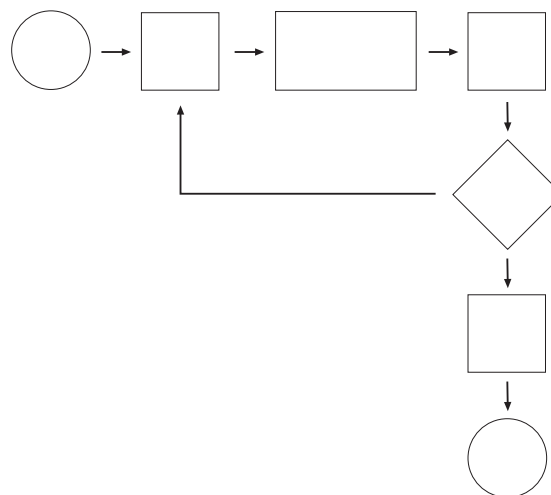
Consequence Diagram/Decision Trees: illustrates real or possible outcomes of different actions.

Have students visually depict outcomes for a given problem by charting various decisions and their possible consequences.



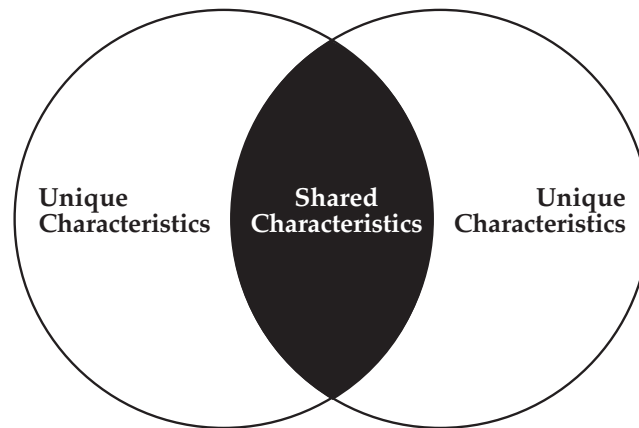
Flowchart: depicts a sequence of events, actions, roles, or decisions.

Have students structure a sequential flow of events, actions, roles, or decisions graphically on paper.



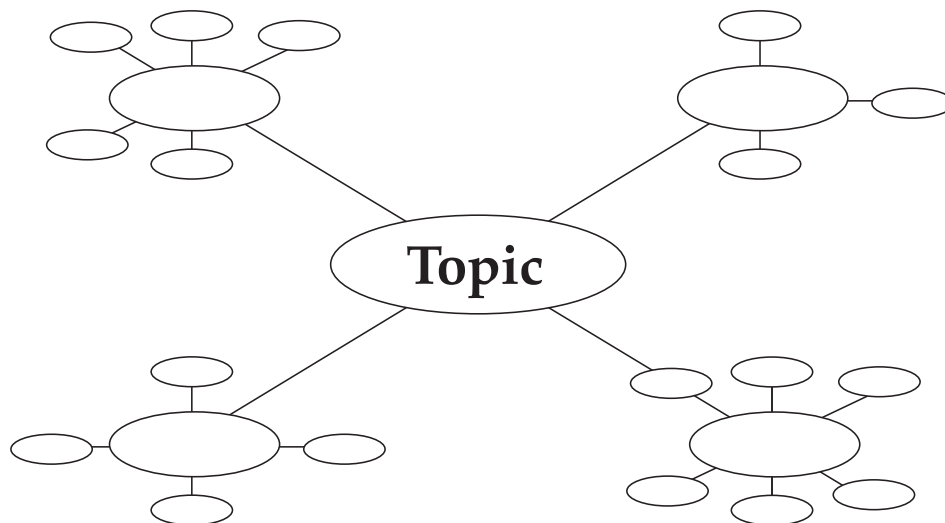
Venn Diagram: creates a visual analysis of the similarities and differences among, for example, two concepts, objects, events, or people.

Have students use two overlapping circles to list unique characteristics of two items or concepts (one in the left part of the circle and one in the right); in the middle have them list shared characteristics.



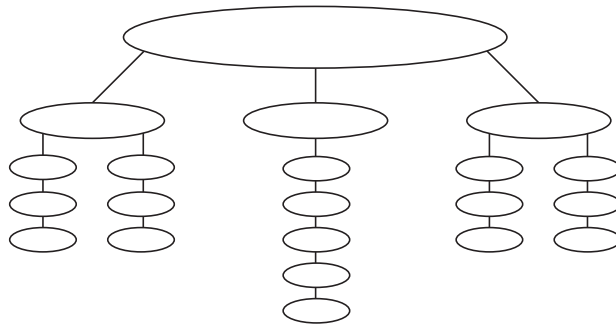
Webbing: provides a picture of how words or phrases connect to a topic.

Have students list topics and build a weblike structure of words and phrases.



Concept Mapping: shows relationships among concepts.

Have students select a main idea and identify a set of concepts associated with the main idea. Next, have students rank the concepts in related groups from the most general to most specific. Then have students link related concepts with verbs or short phrases.



Portfolio—to capture the extent of students’ learning within the context of the instruction.

Elements of a portfolio can be stored in a variety of ways; for example, they can be photographed, scanned into a computer, or videotaped. Possible elements of a portfolio could include the following selected student products.

<p>Written Presentations</p> <ul style="list-style-type: none">• expressive (diaries, journals, writing logs)• transactional (letters, surveys, reports, essays)	<p>Media Presentations</p> <ul style="list-style-type: none">• films• slides• photo essays• print media• computer programs• videotapes• audiotapes
<p>Representations</p> <ul style="list-style-type: none">• maps• graphs• dioramas• models• mock-ups• displays• bulletin boards• charts• replicas	<p>Visual and Graphic Arts</p> <ul style="list-style-type: none">• storyboards• drawings• posters• sculpture• cartoons• mobiles

Learning Cycle—to engage in exploratory investigations, construct meanings from findings, propose tentative explanations and solutions, and relate concepts to their lives.

Have students explore a concept, behavior, or skill with a hands-on experience and then explain their exploration. Through discussion, have students expand the concept or behavior by applying it to other situations.

Field Experience—to use the community as a laboratory for observation, study, and participation.

Before the visit, plan and structure the field experience with the students. Engage in follow-up activities after the trip.

Teaching Suggestions

The standards and benchmarks of the Sunshine State Standards are the heart of the curriculum frameworks and reflect Florida's efforts to reform and enhance education. The following pages provide samples of ways in which students could demonstrate achievement of specific benchmarks through the study of Marine Science.

Energy

1. Have students design, conduct, and report on an experiment to determine the effect of several variables on home or school use of electricity. (SC.B.1.4.1.a)
2. Have students measure and report the energy required to operate an electrical device. (SC.B.1.4.2.a)
3. Have students measure and report latent heat of fusion for an ice cube. (SC.B.1.4.3.b)
4. Have students demonstrate activities that increase the entropy in a system. (SC.B.1.4.3.c)

Processes That Shape the Earth

1. Have students create climatograms and explain why major biomes exist. (SC.D.1.4.1.a)
2. Have students explain how and why the appearance of the surface of Earth is changing. (SC.D.1.4.2.a)
3. In small groups with other students, have students determine the density and porosity of common rocks found in the crust (e.g., granite, basalt, sandstone, and limestone) and explain the significance of their crustal positions. (SC.D.1.4.2.b)
4. Have students develop models that explain the theories of how continents are assembled, altered, and changed over vast amounts of time. (SC.D.1.4.2.c)

5. In small groups with other students, have students develop skits, infomercials, and presentations to governing institutions where laws and decisions are made to describe the systems on Earth and how the decisions made about these systems affect the quality of life on Earth. (SC.D.2.4.1.a)

Earth and Space

Have students identify the properties of Earth that make it capable of supporting life and explain why it is necessary to understand systems that support life. (SC.E.1.4.3.a)

Processes of Life

1. Have students describe biochemical reactions that are common to living things. (SC.F.1.4.1.a)
2. Have students identify the structure and function of the major body systems. (SC.F.1.4.2.b)

How Living Things Interact with Their Environment

1. Have students diagram a food web and describe what occurs when species are removed from the population. (SC.G.1.4.1.a)
2. Have students describe the negative impact of some human beings on biodiversity. (SC.G.1.4.1.b)
3. Have students give an example of a biological situation that clearly demonstrates that matter recycles and energy flows. (SC.G.1.4.2.a)
4. Have students study a school yard plot to determine the components of an ecosystem. (SC.G.1.4.2.b)
5. Have students predict where the oxygen they inhaled last night may be in the morning. (SC.G.1.4.3.a)
6. Have students in a small group build an artificial coal bed in the laboratory, subject it to heat and pressure, measure the amount of energy stored with a bomb calorimeter, and report on the processes used and the findings. (SC.G.2.4.1.a)

7. Have students use two or more data sources to conduct an environmental impact study of a local region and report on the findings. (SC.G.2.4.2.a)
8. Have students compare characteristics of species that live on Earth in great numbers with those whose numbers are decreasing. (SC.G.2.4.3.a)
9. Have students prepare climatograms and compare these with graphs depicting diversity. (SC.G.2.4.4.a)
10. Have students use native plants to explain regional climate and geography. (SC.G.2.4.4b)
11. Have students in a small group, raise generations of fruit flies with nutrient agar in a closed environment until the food is gone. Compare this to the use of natural resources on Earth by the human population and report on processes used and findings. (SC.G.2.4.5.a)
12. Have students in a small group, participate in role playing and/or case studies involving the consequences of human impact on the environment, presenting evidence supporting or refuting both sides of environmental conservation and economic-development issues. (SC.G.2.4.6.a)
13. Have students research and role-play activities that allow the development of a sense of responsibility for future generations to conserve what's left of Earth's natural resources. (SC.G.2.4.6.b)
14. Have students determine cause-and-effect relationships (e.g., predator/prey or climate/population), while tracing the flow of energy and the cycling of matter through the food web, and predict the impact of introducing new species into an ecosystem, given the populations and other pertinent data about an ecosystem. (SC.G.2.4.6.c)

The Nature of Science

1. Have students formulate a testable hypothesis supported by the knowledge and understanding generated by an experiment. (SC.H.1.4.1.a)
2. Have students engage in a debate on changes and continuity that are persistent features of science. (SC.H.1.4.2.a)
3. Have students compare closely aligned theories and identify ways to test the validity of these theories. (SC.H.1.4.3.a)
4. Have students compare the communication methods people use in the cities of Bombay, Sao Paolo, and New York. (SC.H.3.4.5.a)
5. Have students identify practical problems solved with technology and describe the effect of the solutions on human values. (SC.H.3.4.6.a)

Accommodations/Modifications for Students

The following accommodations/modifications may be necessary for students with disabilities and other students with diverse learning needs to be successful in school and any other setting. Specific strategies may be incorporated into each student's individual educational plan (IEP) or 504 plan, or academic improvement plan (AIP) as deemed appropriate.

Environmental Strategies

- Provide preferential seating. Seat student near someone who will be helpful and understanding.
- Assign a peer tutor to review information or explain again.
- Build rapport with student; schedule regular times to talk.
- Reduce classroom distractions.
- Increase distance between desks.
- Allow student to take frequent breaks for relaxation and small talk, if needed.
- Accept and treat the student as a regular member of the class. Do not point out that the student is an ESE student.
- Remember that student may need to leave class to attend the ESE support lab.
- Additional accommodations may be needed.

Organizational Strategies

- Help student use an assignment sheet, notebook, or monthly calendar.
- Allow student additional time to complete tasks and take tests.
- Help student organize notebook or folder.
- Help student set timelines for completion of long assignments.
- Help student set time limits for assignment completion.
- Ask questions that will help student focus on important information.
- Highlight the main concepts in the book.
- Ask student to repeat directions given.
- Ask parents to structure study time. Give parents information about long-term assignments.
- Provide information to ESE teachers and parents concerning assignments, due dates, and test dates.
- Allow student to have an extra set of books at home and in the ESE classroom.
- Additional accommodations may be needed.

Motivational Strategies

- Encourage student to ask for assistance when needed.
- Be aware of possibly frustrating situations.
- Reinforce appropriate participation in your class.
- Use nonverbal communication to reinforce appropriate behavior.
- Ignore nondisruptive inappropriate behavior as much as possible.
- Allow physical movement (distributing materials, running errands, etc.).
- Develop and maintain a regular school-to-home communication system.
- Encourage development and sharing of special interests.
- Capitalize on student's strengths.
- Provide opportunities for success in a supportive atmosphere.
- Assign student to leadership roles in class or assignments.
- Assign student a peer tutor or support person.
- Assign student an adult volunteer or mentor.
- Additional accommodations may be needed.

Presentation Strategies

- Tell student the purpose of the lesson and what will be expected during the lesson (e.g., provide advance organizers).
- Communicate orally and visually, and repeat as needed.
- Provide copies of teacher's notes or student's notes (preferably before class starts).
- Accept concrete answers; provide abstractions that student can handle.
- Stress auditory, visual, and kinesthetic modes of presentation.
- Recap or summarize the main points of the lecture.
- Use verbal cues for important ideas that will help student focus on main ideas. ("The next important idea is....")
- Stand near the student when presenting information.
- Cue student regularly by asking questions, giving time to think, then calling student's name.
- Minimize requiring the student to read aloud in class.
- Use memory devices (mnemonic aids) to help student remember facts and concepts.
- Allow student to tape the class.
- Additional accommodations may be needed.

Curriculum Strategies

- Help provide supplementary materials that student can read.
- Provide *Parallel Alternative Strategies for Students (PASS)* materials.
- Provide partial outlines of chapters, study guides, and testing outlines.
- Provide opportunities for extra drill before tests.
- Reduce quantity of material (reduce spelling and vocabulary lists, reduce number of math problems, etc.).
- Provide alternative assignments that do not always require writing.
- Supply student with samples of work expected.
- Emphasize high-quality work (which involves proofreading and rewriting), not speed.
- Use visually clear and adequately spaced work sheets. Student may not be able to copy accurately or fast enough from the board or book; make arrangements for student to get information.
- Encourage the use of graph paper to align numbers.
- Specifically acknowledge correct responses on written and verbal class work.
- Allow student to have sample or practice test.
- Provide all possible test items to study and then student or teacher selects specific test items.
- Provide extra assignment and test time.
- Accept some homework papers dictated by the student and recorded by someone else.
- Modify length of outside reading.
- Provide study skills training and learning strategies.
- Offer extra study time with student on specific days and times.
- Allow study buddies to check spelling.
- Allow use of technology to correct spelling.
- Allow access to computers for in-class writing assignments.
- Allow student to have someone edit papers.
- Allow student to use fact sheets, tables, or charts.
- Tell student in advance what questions will be asked.
- Color code steps in a problem.
- Provide list of steps that will help organize information and facilitate recall.
- Assist in accessing taped texts.
- Reduce the reading level of assignments.
- Provide opportunity for student to repeat assignment directions and due dates.
- Additional accommodations may be needed.

Testing Strategies

- Allow extended time for tests in the classroom and/or in the ESE support lab.
- Provide adaptive tests in the classroom and/or in the ESE support lab (reduce amount to read, cut and paste a modified test, shorten, revise format, etc.).
- Allow open book and open note tests in the classroom and/or ESE support lab.
- Allow student to take tests in the ESE support lab for help with reading and directions.
- Allow student to take tests in the ESE support lab with time provided to study.
- Allow student to take tests in the ESE support lab using a word bank of answers or other aid as mutually agreed upon.
- Allow student to take tests orally in the ESE support lab.
- Allow the use of calculators, dictionaries, or spell checkers on tests in the ESE support lab.
- Provide alternative to testing (oral report, making bulletin board, poster, audiotape, demonstration, etc.).
- Provide enlarged copies of the answer sheets.
- Allow copy of tests to be written upon and later have someone transcribe the answers.
- Allow and encourage the use of a blank piece of paper to keep pace and eliminate visual distractions on the page.
- Allow use of technology to check spelling.
- Provide alternate test formats for spelling and vocabulary tests.
- Highlight operation signs, directions, etc.
- Allow students to tape-record answers to essay questions.
- Use more objective items (fewer essay responses).
- Give frequent short quizzes, not long exams.
- Additional accommodations may be needed.

Evaluation Criteria Strategies

- Student is on an individualized grading system.
- Student is on a pass or fail system.
- Student should be graded more on daily work and notebook than on tests (e.g., 60 percent daily, 25 percent notebook, 15 percent tests).
- Student will have flexible time limits to extend completion of assignments or testing into next period.
- Additional accommodations may be needed.

Internet Site Suggestions

The following is a listing of suggested Internet sites for *Marine Science I*. These sites may be used to expand and enrich student involvement. For example, sites may be used to stimulate discussion on research or to develop a scavenger hunt for current events. (Teachers should visit sites beforehand to verify the site address has not changed and contains appropriate information.)

Jeff Murphy's Marine Science Home Page

<http://fhs.net/25g/lt/hp.nsf/HomePages/jeffery+murphy>

Savage Seas

<http://www.pbs.org/wnet/savage seas/>

Secrets of the Ocean Realm

<http://www.pbs.org/oceanrealm/intheschool/index.html>

Smithsonian Ocean Planet

http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/search_educational_materials.html

Discovery School.com

<http://school.discovery.com/teachers/index.html>

Ocean Waves

<http://www-sci.lib.uci.edu/SEP/CTS98/Oceanwaves.html>

OceanLink

<http://oceanlink.island.net/>

Teacher's Realm

<http://pao.cnmoc.navy.mil/educate/neptune/teacher.htm>

West Springfield High School - Marine Science Tools

<http://www.wshs.fcps.k12.va.us/academic/science/bjewell/ocean/vocean/tool>

Gulf Specimen Marine Laboratories, Inc.

<http://www.gulfspecimen.org/>

Marine and Environmental Education and Research
<http://www.meer.org/>

Bridge - Ocean Sciences Education Teacher Resource Center
<http://www.vims.edu/bridge/>

Marine Biology Web - An Educational Resource
<http://life.bio.sunysb.edu/marinebio/mbweb.html>

K-12 World Wide Web - Resources about Oceanography
<http://www.ifmt.nf.ca/mi-net/ocean/index.htm>

Learn about Marine Life
<http://www.cyhaus.com/marine/marine.htm>

National Geographic - Blue Frontier: The Sustainable Seas
Expeditions
[http://www.nationalgeographic.com/seas/index.html?classroom:
classroom_keys](http://www.nationalgeographic.com/seas/index.html?classroom: classroom_keys)

Correlation to Sunshine State Standards

Course Requirements for Marine Science I - Course Number 2002500

These requirements include, but are not limited to, the benchmarks from the Sunshine State Standards that are most relevant to this course. Benchmarks correlated with a specific course requirement may also be addressed by other course requirements as appropriate. Benchmarks from Science, Strand H, should not be taught and assessed in isolation, but should be combined with other benchmarks listed for this course.

1. Apply knowledge of the nature of science and scientific habits of mind to solve problems, and employ safe and effective use of laboratory and field technologies.		
Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.H.1.4.1 Know that investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories.	2, 3	
SC.H.1.4.2 Know that from time to time, major shifts occur in the scientific view of how the world works, but that more often, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.	1, 7	
SC.H.1.4.3 Understand that no matter how well one theory fits observations, a new theory might fit them as well or better, or might fit a wider range of observations, because in science, the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not to absolute truth.	1, 2, 3, 7	

4. Describe the unique physical characteristics of the marine environment.		
Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.D.1.4.1 Know how climatic patterns on Earth result from an interplay of many factors (Earth's topography, its rotation on its axis, solar radiation, the transfer of heat energy where the atmosphere interfaces with lands and oceans, and wind and ocean currents).	1, 3, 4, 5, 6, 7	
SC.D.1.4.2 Know that the solid crust of Earth consists of slow-moving, separate plates that float on a denser, molten layer of Earth and that these plates interact with each other, changing the Earth's surface in many ways (e.g., forming mountain ranges and rift valleys, causing earthquake and volcanic activity, and forming undersea mountains that can become ocean islands).	7, 8	

3. Demonstrate knowledge of marine communities, food chains, and food webs.

Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.E.1.4.3 Know the various reasons that Earth is the only planet in our Solar System that appears to be capable of supporting life as we know it.	1	
SC.G.1.4.1 Know the great diversity and interdependence of living things.	9, 10, 11, 12, 13, 14	
SC.G.1.4.2 Understand how the flow of energy through an ecosystem made up of producers, consumers, and decomposers carries out the processes of life and that some energy dissipates as heat and is not recycled.	9	
SC.G.1.4.3 Know that the chemical elements that make up the molecules of living things are combined and recombined in different ways.	9	

4. Describe the physical and biological characteristics of the planktonic, benthic, and nektonic regions of the oceans.

Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.F.1.4.1 Know that the body processes involve specific biochemical reactions governed by biochemical principles.	15, 16	
SC.F.1.4.2 Know that body structures are uniquely designed and adapted for their function.	11, 12, 15, 16	
SC.G.2.4.4 Know that the world ecosystems are shaped by physical factors that limit their productivity.	5, 11	

5. Explain how the physical and chemical properties of seawater and the geology of the ocean basin shape the nature of oceanic life.

Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.B.1.4.1 Understand how knowledge of energy is fundamental to all the scientific disciplines (e.g., the energy required for biological processes in living organisms and the energy required for the building, erosion, and rebuilding of the Earth).	1, 3, 4, 5, 6, 9	
SC.B.1.4.2 Understand that there is conservation of mass and energy when matter is transformed.	4	

6. Compare the diverse characteristics of representatives of the major phyla/divisions represented in marine systems.

Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.G.2.4.3 Understand how genetic variation of offspring contributes to population control in an environment and that natural selection ensures that those who are best adapted to their surroundings survive to reproduce.	15, 16	

7. Describe the interrelationship between man and the ocean environment and the need for protection of the natural systems on Earth.

Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.D.2.4.1 Understand the interconnectedness of the systems on Earth and the quality of life.	17, 18	
SC.B.2.4.5 Understand that the amount of life any environment can support is limited and that human activities can change the flow of energy and reduce the fertility of Earth.	17, 18	
SC.G.2.4.6 Know the ways in which humans today are placing their environmental support systems at risk (e.g., rapid human population growth, environmental degradation, and resource depletion).	18	

8. Describe the present and potential resources of the ocean.		
Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.G.2.4.1 Know that layers of energy-rich organic materials have been gradually turned into great coal beds and oil pools (fossil fuels) by the pressure of the overlying earth and that humans burn fossil fuels to release the stored energy as heat and carbon dioxide.	18	
SC.G.2.4.2 Know that changes in a component of an ecosystem will have unpredictable effects on the entire system but that the components of the system tend to react in a way that will restore the ecosystem to its original condition.	18	

9. Describe how marine science interacts with technology and society.		
Benchmarks	Addressed in Unit(s)	Addressed in Class on Date(s)
SC.H.3.4.5 Know that the value of technology may differ for different people and at different times.	1, 2, 3, 4, 5, 6, 7, 8, 18	
SC.H.3.4.6 Know that scientific knowledge is used by those who engage in design and technology to solve practical problems, taking human values and limitations into account.	1, 2, 3, 4, 5, 6, 7, 8, 18	

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Chatsworth, CA 91311-4409

Allegro Film Productions
201 West 52nd Street
New York, NY 10010

BFA
468 Park Avenue South
New York, NY 10016

Churchill
12210 Nebraska Avenue
Los Angeles, CA 90025

Coastline Community College
14460 Warner Avenue
Fountain Valley, CA 92708-2597

Dallas Community College
4343 North Highway 67
Mesquite, TX 75150

Encyclopedia Britannica Films
(EBF)
425 North Michigan Avenue
Chicago, IL 60611

Journal Films
930 Pitner Avenue
Evanston, IL 60202

Laser Learning Technologies
314 37th Place South
Seattle, WA 98144

Lucerne, Inc.
37 Ground Pine Road
Morris Plains, NJ 07959

National Geographic
17th and M Streets NW
Washington, DC 20036

New Dimensions
85895 Loraine Highway
Eugene, OR 97405

Optical Data Corporation
30 Technology Drive
Warren, NJ 07059

Quercus Video
500 Harbor Boulevard
Belmont, CA 94002-9866

Scholastic, Inc.
2931 E. McCarty Street
Jefferson City, MO 65101

Ventura Educational Systems
910 Ramona Avenue, Suite E
Grover City, CA 93433

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108 Wilmot Road
Deerfield, IL 60202

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