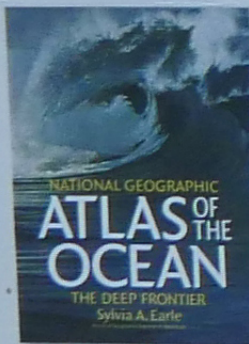


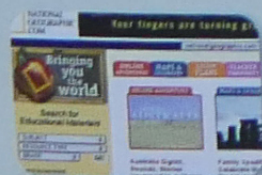
## Related Resources



**OCEAN ATLAS** Internationally renowned deep-sea pioneer and National Geographic Explorer-in-Residence Sylvia A. Earle, in consultation with experts from NASA and the National Oceanic and Atmospheric Administration (NOAA), is our peerless guide. This one-of-a-kind atlas immerses us in the infinite wonders of the world offshore through more than 150 cutting-edge maps, photographs, and satellite images. **Ordering:** call 888-647-6733, or online at [nationalgeographic.com/books/atlas](http://nationalgeographic.com/books/atlas)

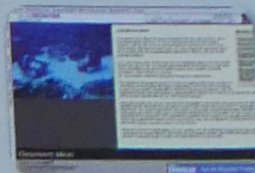


**NATIONAL MARINE SANCTUARIES** The National Oceanic and Atmospheric Administration's National Marine Sanctuary Program serves as the trustee for a system of thirteen underwater parks, encompassing more than 18,000 square miles of America's marine and Great Lakes waters from Washington State to the Florida Keys, and from Lake Huron to American Samoa. Since passage of the National Marine Sanctuary Act in 1972, the sanctuary program has worked cooperatively with the public and its partners to protect and manage sanctuaries while facilitating compatible commercial and recreational activities. Sanctuary staff conduct scientific research, monitoring, explorations, educational programs, and outreach to enhance public understanding of the marine environment. For more information on the ways that the National Marine Sanctuary Program fulfills its mission to protect America's ocean and Great Lakes treasures for this and future generations. [sanctuaries.noaa.gov](http://sanctuaries.noaa.gov)

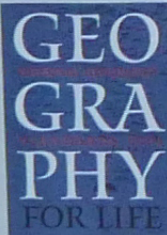


**NATIONAL GEOGRAPHIC EDUCATION** This site puts the National Geographic Society's best educational resources at a teacher's fingertips. Every week, National Geographic features interactive online activities, free downloadable maps, teacher forums, educational opportunities, and award-winning products designed to support the classroom teacher. In addition, the searchable site allows visitors to indicate their grade level and subject area for resources tailored to specific needs. [nationalgeographic.com/education](http://nationalgeographic.com/education)

**NATIONAL GEOGRAPHIC XPEDITIONS** A virtual "exhibit hall," which illustrates the concepts behind the scope and sequence in K-12 geography education. Students can take part in interactive geography adventures, such as exploring weather patterns on a tropical island. Teachers will also find free maps in an online atlas, standards-based lessons, and helpful links to other geography resources on and off the Web. [nationalgeographic.com/xpeditions](http://nationalgeographic.com/xpeditions)

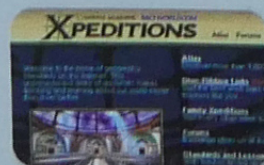
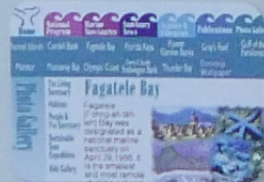


**NATIONAL GEOGRAPHIC BLUE FRONTIER** This site highlights the National Geographic Society's marine education resources, including downloadable lesson plans related to the newly developed *Oceans for Life* Scope and Sequence. New lessons will be added to the site throughout the year. The site also features the work of Dr. Sylvia A. Earle, NGS Explorer-in-Residence, and her books about the ocean, including the *Atlas of the Ocean*. [nationalgeographic.com/seas](http://nationalgeographic.com/seas)



**COMPREHENSIVE GUIDE**  
*Geography for Life: National Geography Standards 1994.* These 18 voluntary standards for geography education specify the essential subject matter, skills, and perspectives that all students should have in order to attain high levels of geographic literacy.

**Ordering:** call 412-357-6290, or online at [nationalgeographic.com/education/standards.html](http://nationalgeographic.com/education/standards.html)



"The oceans belong to everyone.

Teachers are the greatest natural resource  
we have on planet Earth; they are the ones  
who will ultimately save our oceans."

**GIL GROSVENOR**  
Chairman, National Geographic Society

## The Importance of Oceans

Of all the great discoveries about the ocean, the two most significant may be, first, that all life on Earth—including our own—is dependent on the ocean. The second is that the ocean does not have an infinite capacity to absorb the wastes we allow to flow into it, nor can it fully recover from the millions of tons of wildlife that we extract from it. We as a society have the capacity to alter the nature of the ocean and thus affect the basic processes that make Earth hospitable for life. This knowledge alone is reason enough to ensure that our children become ocean literate.

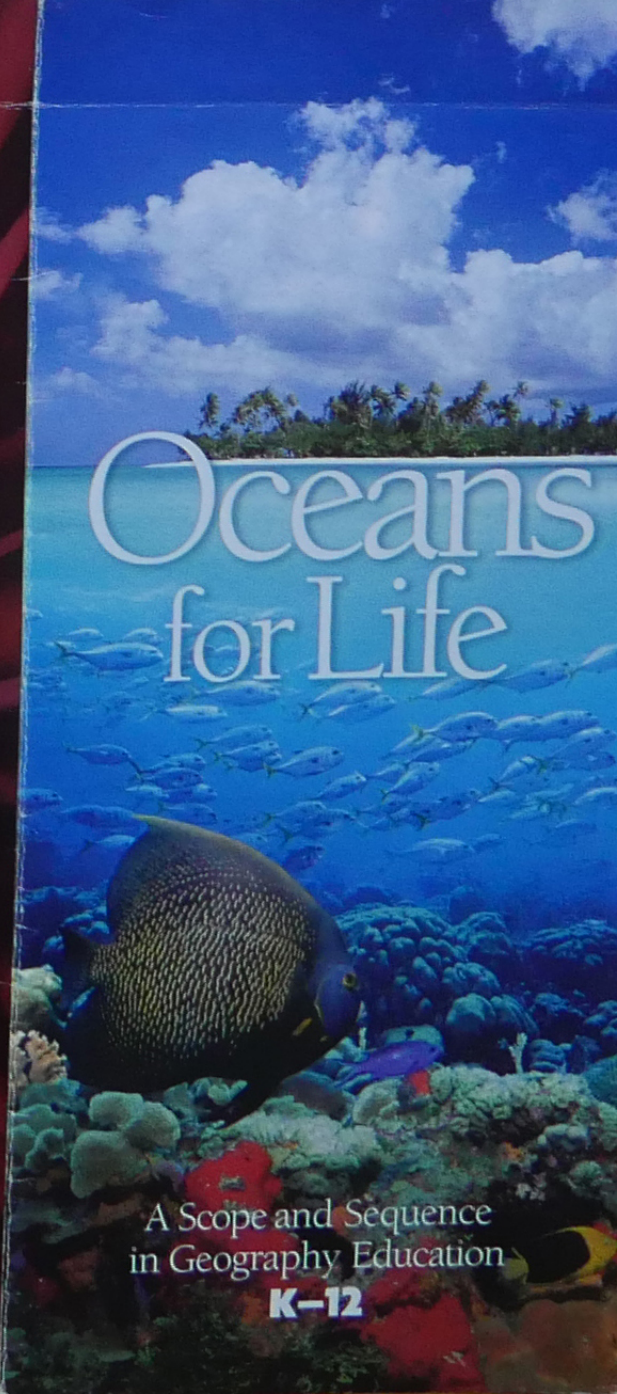
The ocean contains 97 percent of Earth's water and yields vapor to the atmosphere that eventually returns as fresh water in the form of rain, sleet, or snow. The living ocean shapes climate and weather, stabilizes temperature, governs planetary chemistry, comprises more than 97 percent of the biosphere—Earth's living space—and generates more than 70 percent of the atmospheric oxygen. Estimates of the number of distinctive species of organisms in the ocean suggest a much richer and more diverse cauldron of life than had previously been supposed. An estimated 10 to 50 million species are yet to be found in the ocean. In contrast, all known land and aquatic organisms together total only about 1.5 million species.



1145 17th Street NW  
Washington, DC 20036-4688  
[www.nationalgeographic.com](http://www.nationalgeographic.com)



National Marine Sanctuary Program  
1305 East-West Highway  
Silver Spring, MD 20910



# Oceans for Life

A Scope and Sequence  
in Geography Education  
**K-12**



# Our Precious Oceans

Linking oceanography with geography—the study of the oceans with the study of the Earth—is a key step on the path to “ocean literacy.” Indeed, the synergy between the two disciplines invites science and social-studies teachers to enrich and cross-promote one another’s core curriculum. As science teachers learn to present ocean processes and life-forms within a geographic context, their counterparts discover why an understanding of the life, physical, and earth sciences can form such a strong thread in the social fabric.

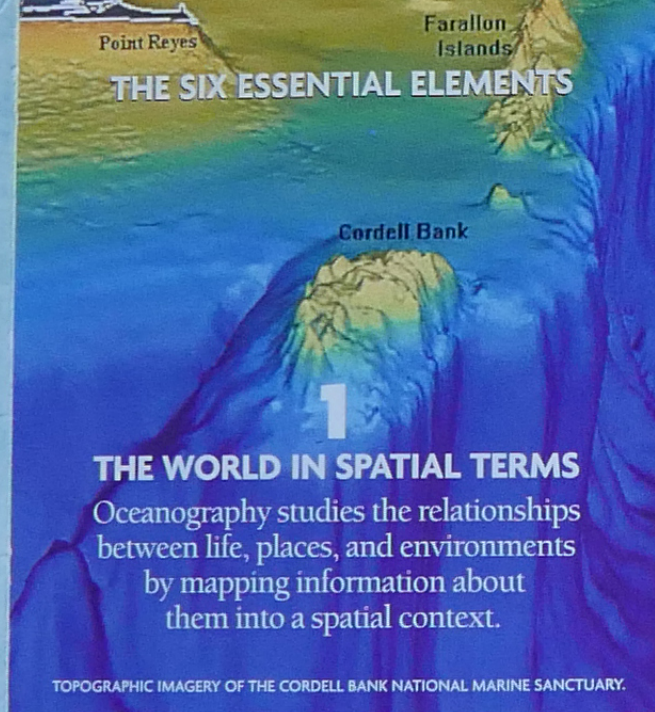
The ultimate goal of this cross-pollination of ideas is a fairly simple one: to help students comprehend how and why all life on Earth arises from—and remains dependent on—our precious oceans.

## About this brochure

In 1994, a broad sampling of educators, parents, and other concerned citizens got together to identify the critical subject matter, skills, and perspectives that all students in the United States should master to achieve a high degree of geographic literacy. These 18 voluntary standards for geography education are organized as six “essential elements”: **1. the world in spatial terms; 2. places and regions; 3. physical systems; 4. human systems; 5. environment and society; 6. uses of geography.**

The **Scope and Sequence Chart** inside was developed using the national geography standards and essential elements as the basis to identify and organize key ocean concepts. These concepts are introduced at various stepping-stones in a child’s voyage of discovery from kindergarten to 12th grade. If you are a teacher, a parent, or a curriculum writer, you can use this tool to monitor and encourage a student’s progress throughout that learning journey.

It may take time for textbooks, curricula, and standard testing regimes to catch up with the needs of a swiftly changing world and impart a sense of the oceans’ significance to all people. Through your immediate impact on the next generation of the planet’s caretakers, you have unique opportunities to shape the future of the ocean—right now.

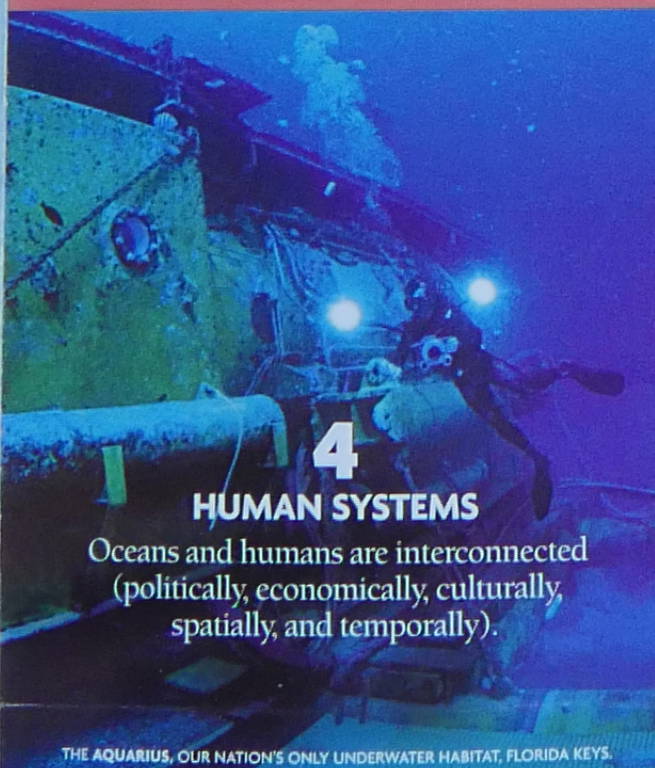


## THE SIX ESSENTIAL ELEMENTS

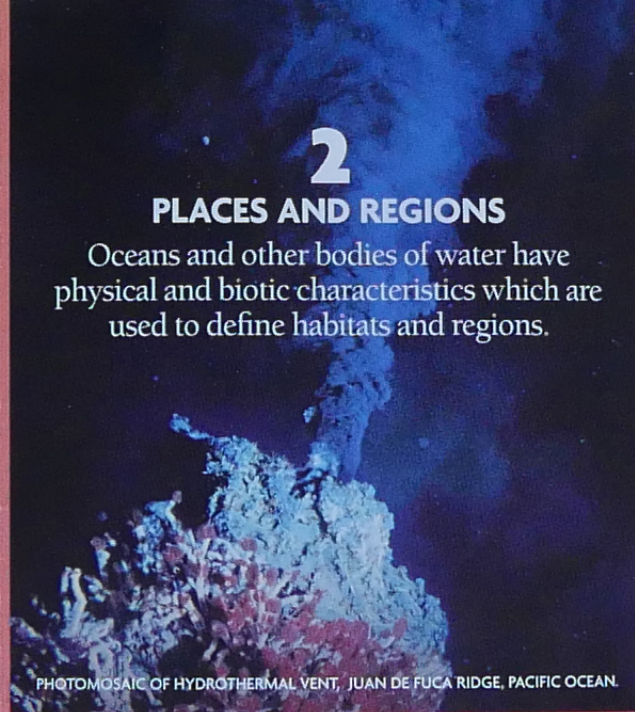
### 1 THE WORLD IN SPATIAL TERMS

Oceanography studies the relationships between life, places, and environments by mapping information about them into a spatial context.

TOPOGRAPHIC IMAGERY OF THE CORDELL BANK NATIONAL MARINE SANCTUARY.



THE AQUARIUS, OUR NATION'S ONLY UNDERWATER HABITAT, FLORIDA KEYS.

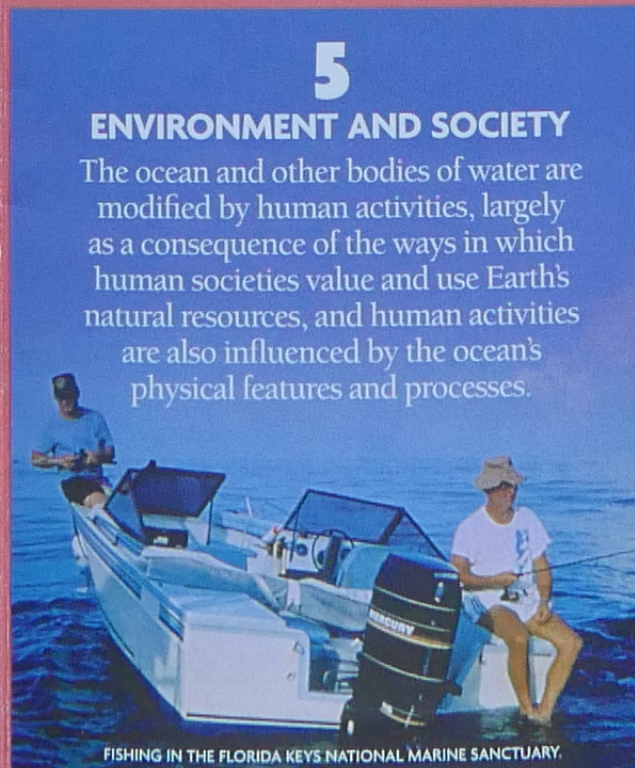


2

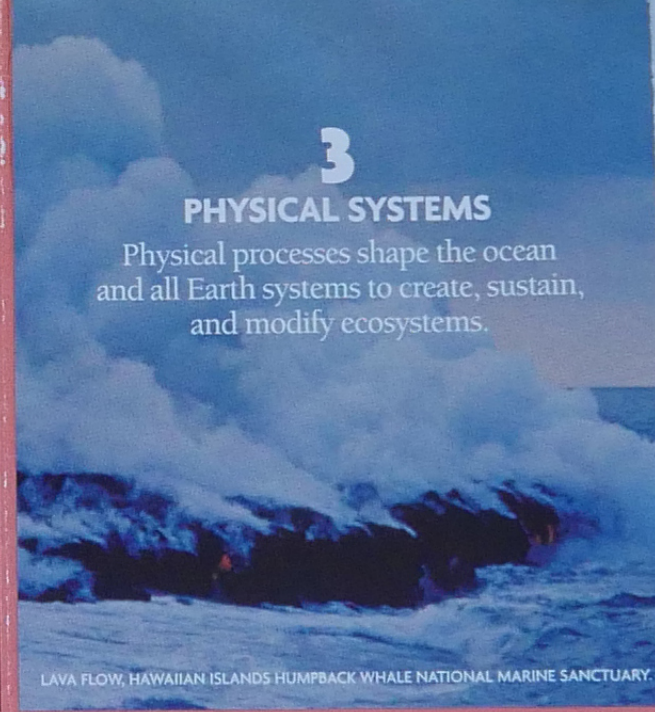
### PLACES AND REGIONS

Oceans and other bodies of water have physical and biotic characteristics which are used to define habitats and regions.

PHOTOMOSAIC OF HYDROTHERMAL VENT, JUAN DE FUCA RIDGE, PACIFIC OCEAN.



FISHING IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY.

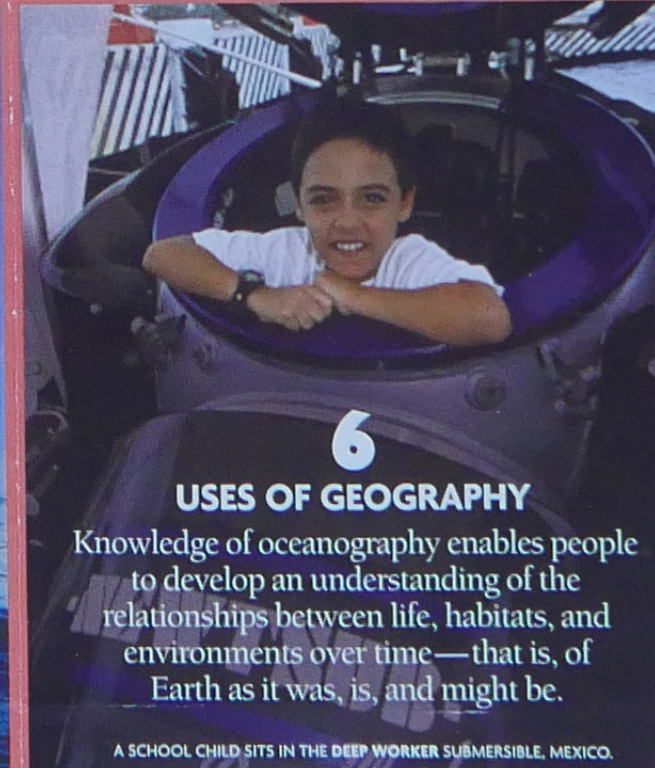


3

### PHYSICAL SYSTEMS

Physical processes shape the ocean and all Earth systems to create, sustain, and modify ecosystems.

LAVA FLOW, HAWAIIAN ISLANDS HUMPBAC WHALE NATIONAL MARINE SANCTUARY.



6

### USES OF GEOGRAPHY

Knowledge of oceanography enables people to develop an understanding of the relationships between life, habitats, and environments over time—that is, of Earth as it was, is, and might be.

A SCHOOL CHILD SITS IN THE DEEP WORKER SUBMERSIBLE, MEXICO.

## Credits

*Oceans for Life* was developed in January, 2002 during an online conference with the following participants:

**Tina Bishop** College of Exploration  
**Sarah Witham Bednarz** Texas A&M University  
**Jen Brady** Center of Image Processing in Education  
**William Bragg** College of Exploration  
**Debbie Brice** San Marcos Middle School  
**Julie Bursek** NOAA Channel Islands National Marine Sanctuary  
**Francesca Cava** National Geographic Society  
**Randy Colton** Weston Elementary School  
**Patricia Dubose** Camden County High School  
**Toni Eugene** National Geographic Society writer/editor consultant  
**Ron Gird** NOAA National Weather Service  
**Lisa Hungness** National Geographic Society technology manager  
**Robert Landsman** ANOVA Science Education Consulting  
**Judy Lemus** University of Southern California Sea Grant  
**Mellie Lewis** Altholton Elementary School  
**Eric Lindstrom** NASA Oceanography  
**Peggy Lubchenco** La Colina Junior High School  
**Joy Martin** Huntington Beach Junior High  
**George Matsumoto** Monterey Bay Aquarium Research Institute  
**Sarah Schoedinger** Consortium for Ocean Research and Education  
**Paul Spring** Grants Pass High School  
**Peter Tuddenham** College of Exploration  
**Sharon Walker** Outreach Institute of Marine Science  
**Lynn Whitley** University of Southern California Sea Grant

External review and expert advice was also provided by:

**Sarah Witham Bednarz** Texas A&M University  
**Roger Downs** Pennsylvania State University  
**Andres Durstenfeld** Monterey Peninsula College  
**Justin Kenney** Pew Foundation  
**George Matsumoto** Monterey Bay Aquarium Research Institute  
**Glenn Schuster** U.S. Satellite Laboratory  
**Jodi Vender** Pennsylvania State University  
**Sharon Walker** J. L. Scott Marine Education Center and Aquarium  
**Lynn Whitley** Sea Grant Program, University of Southern California Sea Grant

The Geography Education National Implementation Project (GENIP) promotes Standards-based geography instruction as an integral part of every student's educational experience. GENIP has endorsed *Oceans for Life* for using geography as a model for the study of Earth's oceans.

Photography Credits:

**Ralph A. Clevenger & Michael Verbois** FRONT COVER: Tropical Island Reef Ecosystem. A composite consisting of six separate images: island, Moorea, Tahitian Islands, South Pacific; fish/horse-eye jacks, blue chromis, rock beauty angelfish, and French angelfish. Caribbean Sea; corals and sponges/Caribbean Sea. (© Ralph A. Clevenger & Michael Verbois)

**Kip Evans** ELEMENT 4; ELEMENT 6; "Our Precious Oceans" panel background: coastal waters of Belize; this panel background: schooling creolefish; Grosvenor quote panel: a scientist counting fish, Fagatele Bay NMS, American Samoa (all photos © Kip Evans, National Geographic Society)

**NOAA** ELEMENT 1: USGS Woods Hole; ELEMENT 3: Susan Scott; ELEMENT 5: Paige Gill; BACK COVER: Red Sea Urchin in the Gulf of the Farallones National Marine Sanctuary.

**University of Washington** ELEMENT 2: J.R. Delaney & D.S. Kelley

Brochure Concept: Francesca Cava NGS

Brochure Design: Marty Ittner M-Art



# OCEANS SCOPE AND SEQUENCE

GRADE LEVEL  
SEQUENCE

K–4

5–8

9–12

## SIX ESSENTIAL ELEMENTS

1

### THE WORLD IN SPATIAL TERMS

Oceanography studies the relationships between life, places, and environments by mapping information about them into a spatial context.

**Location of nearby bodies of water and watersheds** (e.g., ponds, streams, lakes, rivers, inlets, etc.)

**Location of significant rivers, estuaries, and watersheds** (e.g., Ohio/Missouri/Mississippi, Amazon, Chesapeake Bay)

**Location of major world oceans, seas, and gulfs** (e.g., Atlantic, Pacific, Mediterranean Sea, Gulf of Mexico)

**Oceans as three-dimensional habitats** (e.g., area, depth, volume)

**Distribution of water** (e.g., more than 70% of the Earth's surface; relative amounts, location, ice vs. fresh vs. salt)

**Latitude/longitude/depth** (e.g., bathymetry, map and chart reading, navigation)

**Spatial representations and technology** (e.g., ocean atlases, Geographic Information Systems [GIS], Global Positioning Systems [GPS])

**Location of oceanic features** (e.g., seamounts, coral reefs, atolls, deep sea trenches, ridges)

**Location of major U.S. ports** (e.g., New York, Los Angeles/Long Beach, San Francisco, New Orleans, Houston)

**Location of major ocean resources** (e.g., fish stocks, whale migration routes, oil and gas deposits)

**Use of spatial representations and technology** (e.g., apply mapping and GIS/GPS skills to observe and analyze ocean relationships, including distribution of ocean organisms, to map local watersheds, to understand distribution of biomass, changes in shorelines, animal migration)

**Use of other ocean measurement technology** (e.g., underwater acoustics to measure global and physical parameters)

**Location and patterns of ocean characteristics** (e.g., zonation, currents, eddies, sediment transport, physiochemical characteristics, oxygen minimum layer, calcium carbonate)

**World patterns of extreme ocean events** (e.g., El Niño, hurricane intensity)

2

### PLACES AND REGIONS

Oceans and other bodies of water have physical and biotic characteristics which are used to define habitats and regions.

**Characteristics of ocean habitats** (e.g., shorelines, water column, habitats, and ocean life)

**Characteristics of oceans and ocean ecosystems and habitats** (e.g., salinity, density, temperature, pH, food webs)

**Similarities and differences among the world's oceans** (e.g., salinity, depth, size, volume, temperature, organisms)

**Concept of regions as applied to oceans** (e.g., watersheds, continental shelves)

**Changes in places and regions over time** (e.g., coastal erosion, sea level change, sea surface temperature)

**Marine protected areas** (e.g., National Marine Sanctuary system, marine protected area network, National Estuarine Research Reserves)

**Characteristics of shorelines** (e.g., rocky coast, mudflat, sandy beach)

**Characteristics of the water column** (e.g., shallow, mid-water, deep water; major ocean currents, waves and tides)

**Characteristics of near shore habitats** (e.g., coral reefs, kelp beds, mangrove swamps, sea grass beds)

**Characteristics of the sea floor** (e.g., intertidal zone, continental shelf, continental slope, islands, deep ocean, deep ocean trenches)

**Characteristics of ocean biomes** (e.g., major ecological communities, biodiversity, deep sea)

**Interdependence of land areas and the ocean** (e.g., erosion, watershed issues, anadromous fish: salmon, trout)

**Physical and human processes that shape the ocean and coasts** (e.g., erosion, damming rivers, barrier islands, construction of ports and marinas)

**Political and historical characteristics of ocean regions** (e.g., pirates, Japanese Yellow Sea/Korea, whaling, EEZs, fishing rights, Law of the Sea)

**Analysis of regional ocean issues and problems** (e.g., overfishing—Grand Banks/cod, Klamath/salmon; introduced/exotic species; pollution)

3

### PHYSICAL SYSTEMS

Physical processes shape the ocean and all Earth systems to create, sustain, and modify ecosystems.

**Relationship of rivers, estuaries, and oceans and the concept of watersheds** (e.g., interconnectedness of land and sea, changes in one part affect another)

**The hydrologic cycle—relationship to the ocean** (e.g., evaporation, transpiration, condensation, etc.)

**Ocean influence on weather and climate** (e.g., connections to the water cycle)

**Biodiversity** (e.g., classification, interaction of organisms)

**Ocean habitats** (e.g., effects of depth and temperature on habitats)

**Simple ocean dynamics** (e.g., tides and currents, salinity, density, waves)

**Changes in shorelines** (e.g., effects of tides, beach transport, erosion)

**The biological ocean—processes and interactions** (e.g., ocean ecosystems, interdependence of life on Earth and the oceans, food webs, carbon cycling, animal behavior, e.g., bioluminescence)

**Seafloor features and processes** (e.g., general plate tectonics, names of major plates, seafloor spreading, past/present ocean levels, hydrothermal vents, volcanoes)

**Earth/Sun and Earth/Moon relationships** (e.g., rotation, global winds, tidal connection to lunar cycle, gravity, Coriolis effect, carbon sequestration)

**Ocean physics** (e.g., climate, dynamics, atmospheric/ocean linkages, waves)

**Plate tectonics** (e.g., plate names, plate boundary interactions, and evidence for the theory of plate tectonics; Earth layers; Wilson Cycle)

**Processes of ocean physical systems** (e.g., Coriolis effect, thermohaline circulation, chemical cycles, carbon sequestration, ocean physics)

**Ecosystem processes** (e.g., biodiversity/productivity in salt marshes, estuaries, mangroves, coral reefs, hydrothermal vents; nutrient flows, reproduction, dissipation of energy in food chains)

**Processes of extreme ocean events** (e.g., El Niño, hurricane intensity)

**El Niño and impact on organisms** (e.g., fisheries collapse; unusual migrating species; effects of weather changes on all organisms, including humans)

4

### HUMAN SYSTEMS

Oceans and humans are interconnected (politically, economically, culturally, spatially, and temporally).

**The role of the oceans in the migration of human populations, trade, and human settlement patterns** (e.g., commerce and exploration)

**The ocean as a place where people work** (e.g., all careers)

**Traits of various sea-going groups** (e.g., Inuit and Pacific Islanders, Vikings)

**Oceans as providers of goods and services** (e.g., fisheries, transportation)

**Oceans as barriers and conduits for trade and transportation** (e.g., Panama Canal, intercoastal waterways, distance, and climate)

**Ocean resources as a focal point in shaping political and geographic policies** (e.g., ocean management at local to global scales, EEZ, fishing and whaling rights, global oceanic interdependence)

**Exploration and settlement** (e.g., immigration patterns, 1% of ocean explored, underwater habitats)

**The role of oceans in economic development** (e.g., tourism, oil and mineral resources)

**Cooperation and conflict in the division and control of oceans and their resources** (e.g., Antarctica, EEZ, marine protected areas)

**Role of oceans in human demographics** (e.g., demographic shift to coastal cities and increase in coastal commerce)

**Global economic interdependence** (e.g., regional ocean resources, trade, transportation)

5

### ENVIRONMENT AND SOCIETY

The ocean and other bodies of water are modified by human activities, largely as a consequence of the ways in which human societies value and use Earth's natural resources, and human activities are also influenced by the ocean's physical features and processes.

**Introduction to marine resources** (e.g., fishing, aquaculture, minerals, oil, sustainability)

**Human influences on oceans** (e.g., beach closures, marine debris, overfishing, loss of habitat, water quality)

**Ocean influences on humans** (e.g., weather and climate, tidal waves, hurricanes)

**Water as a resource** (e.g., potable water, recreation)

**Human influences on the oceans** (e.g., resource competition, overfishing, loss of habitat, spread of non-indigenous species, agricultural runoff, shoreline impacts, water quality)

**Ocean influences on humans** (e.g., ecotourism, economic development, sustainability, careers)

**Ocean resources** (e.g., fisheries, mining)

**Watershed management** (e.g., dams, forestry practices)

**Freshwater resources** (e.g., urbanization, aquaculture, agriculture, freshwater distribution)

**Interconnections between atmospheric, land, and ocean issues** (e.g., waste disposal, global climate change, non-point source pollution)

**Human influences on a global scale** (e.g., global warming, "tragedy of the commons," population growth)

**Ocean influences on a global scale** (e.g., climate, ocean health/human health relationships, exotic species)

**Ocean policy and regulations** (e.g., fisheries, whaling rights, ocean dumping, oil drilling, coastal development)

**Effects of technology** (e.g., research and exploration, commercial operations)

**Changes in world ocean resources and distribution over time** (e.g., species biodiversity, endangered species)

6

### USES OF GEOGRAPHY

Knowledge of oceanography enables people to develop an understanding of the relationships between life, habitats, and environments over time—that is, of Earth as it was, is, and might be.

**Changes in ocean/land area distribution over time** (e.g., sea level change, plate tectonics)

**Influence of oceanography on past events** (e.g., circumnavigation of Earth, naval warfare, ship groundings)

**Influence of oceanography on current and future events** (e.g., marine mammal groundings, climate and weather predictions)

**Ocean themes in literature, art, and music** (e.g., fish prints, sea shanties, aquaria)

**Impact of ocean processes on the location of and outcome of historic events** (e.g., exploration, migration and settlement, naval activity)

**Applying oceanography to understand the past** (e.g., ocean exploration, shipwreck histories)

**Environmental issues** (e.g., global climate change, effects of ozone, modeling)

**Ocean themes in literature, art, and music** (e.g., fish prints to study anatomy, Jules Verne)

**Influence of ocean features in past events** (e.g., volcanic island formation, continental drift, Siberian land bridge)

**Influence of oceanography in understanding future uses of the sea** (e.g., modeling)

**Using oceanography to integrate multiple disciplines** (e.g., hydrothermal vents, Darwin)

**Ocean themes in literature, art, and music** (e.g., science competitions, compositions, essays, drama)

Note: This matrix is the result of the Ocean Literacy Conference held January 14 through February 1, 2002. It is based on relating ocean content to the 18 standards in *Geography for Life: National Geography Standards 1994*. Throughout this document, the term "oceans" may refer not only to the large bodies of salt water named oceans, but also to other bodies of salt and fresh water (seas, gulfs, rivers, streams, etc.) which together constitute the global system of water on Earth.