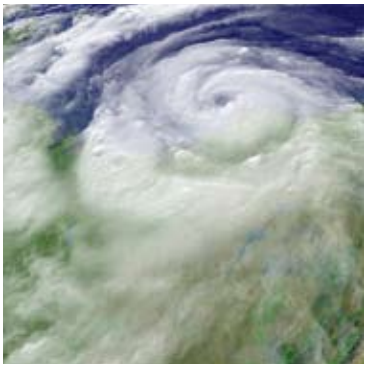
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

EDUCATION STRATEGIC PLAN 2009-2029



FOCUSING ON SCIENCE, SERVICE & STEWARDSHIP

Acknowledgments. The NOAA Education Community extends its thanks and appreciation to the many individuals who contributed to the development of this strategic plan. In a truly collaborative fashion, NOAA educators, staff, administrators, and leadership combined efforts with the broader education and resource management community, nongovernmental organizations, teachers, and the concerned citizenry to produce this strategy for NOAA's future work in education. In addition to the contributions of the NOAA Education Council members, special thanks are extended to the following individuals for their contributions to this document: Kirk Beckendorf, Karen Eason, Jen Faught, Doria Grimes, Sami Grimes, Robert Hansen, Miguel Lugo, Carrie McDougall, John McLaughlin, Elizabeth McMahon, Christos Michalopoulos, Jeannine Montgomery, Bruce Moravchik, Bronwen Rice, Irelene Ricks, Pam Rubin, Stacey Rudolph, Sarah Schoedinger, Bob Steelquist, Steve Storck, and Carla Wallace.

Image Contributors. We would like to thank the NOAA offices, programs, employees, partners and grantees for their contribution of images for this document. These images represent a sampling of the many activities, audiences, and settings which comprise the current educational programming of NOAA and its partners. Individual image credits are listed in the reference section of this document.

DEAR PARTNERS AND FRIENDS OF NOAA EDUCATION,

We find ourselves at a crossroads where many of our Nation's most critical scientific and environmental challenges are occurring when we are not well prepared to address them.

Global climate change, rising sea levels, changing weather patterns, collapsing fisheries, and habitat losses are real threats to the American economy and way of life. At the same time, America's youth continue to fall further behind their global peers in science and math, resulting in the threat of a future where fewer Americans are prepared for careers that will address these challenges.

Congress recognized this perilous track and passed the America COMPETES Act of 2007, which gives NOAA a broad mandate to educate the public about ocean, coastal, Great Lakes, and atmospheric science and stewardship. As a world leader in understanding these realms and how they impact our health, our economy, and our future, NOAA embraces this opportunity to expand the public's understanding and stewardship of the Earth's natural systems.

Built on our long-standing history of educational excellence, this Education Strategic Plan outlines NOAA's approach and continued commitment to educate the American public and increase environmental literacy. The Plan represents an agency-wide collaborative effort of NOAA educators, administration, and staff, and includes significant input from the external community. It presents strategies to motivate our Nation's citizens, and to provide opportunities and incentives for them to pursue careers related to NOAA's mission.

Critical to the success of this Plan are ongoing and growing partnerships with formal and informal educational institutions, businesses, governmental, and nongovernmental organizations, and concerned individuals who share in our mission. We thank you for your interest in NOAA Education and look forward to working with you to improve our Nation's environmental literacy.

Sincerely,

Louisa Koch

LOUISA KOCH
Director, NOAA Education

NOAA EDUCATION COUNCIL

The Education Council members listed below represent all education programs across NOAA. Through their signature, each commits to supporting and enabling the goals and strategies of this strategic plan.

RON GIRD
Outreach Program Manager
NOAA National Weather Service

JENNIFER HAMMOND
Director
NOAA Teacher At Sea Program

MOLLY HARRISON
National Education Coordinator
NOAA National Marine Fisheries Service

ATZIRI IBAÑEZ
National Education Coordinator
NOAA National Estuarine Research Reserve System

NINA JACKSON
Education Program Manager
NOAA National Environmental Satellite, Data, and Information Service

PAULA KEENER-CHAVIS
Director, Education Programs
NOAA Ocean Exploration and Research Program

MARLENE KAPLAN
Deputy Director
NOAA Education

LOUISA KOCH
Director
NOAA Education

JAMIE KRAUK
External Affairs
NOAA Office of Communications

MICHIKO MARTIN
National Education Director
NOAA Office of National Marine Sanctuaries

FRANK NIEPOLD
Climate Education Coordinator
NOAA Climate Program Office

JACQUELINE ROUSSEAU
Assistant Director for Student Opportunities and Educational Partnership Program
NOAA Office of Education

PEG STEFFEN
Education Coordinator
NOAA National Ocean Service

SHARON WALKER
Education Director
Mississippi-Alabama Sea Grant Consortium
NOAA Sea Grant College Program

MARCI WULFF
National Education Coordinator
NOAA Coral Reef Conservation Program

TABLE OF CONTENTS

Acknowledgments	1
Introductory Letter	2
NOAA Education Council	3
NOAA's Vision	5
NOAA's Education Mission	5
NOAA's Mandate to Educate	5
NOAA's Education Goals	6
Foundation for NOAA Education	7
Partnerships and Collaboration	7
NOAA's Education Standards	8
Strategy for Implementation	8
Glossary of Terms	37
References	38

9 **GOAL 1: ENVIRONMENTAL LITERACY**
An environmentally literate public supported by a continuum of lifelong formal and informal education and outreach opportunities in ocean, coastal, Great Lakes, weather, and climate sciences.

15 OUTCOME 1.1
NOAA education programs are developed and refined using the best available research on the effectiveness of environmental and science education.

17 OUTCOME 1.2
Educators understand and use environmental literacy principles.

19 OUTCOME 1.3
Educators, students, and/or the public collect and use ocean, coastal, Great Lakes, weather, and climate data in inquiry and evidence-based activities.

21 OUTCOME 1.4
Lifelong learners are provided with informal science education opportunities focused on ocean, coastal, Great Lakes, weather, and climate topics.

23 OUTCOME 1.5
NOAA works cooperatively to maximize the impact of federal investment in ocean, coastal, Great Lakes, weather, and climate education.

25 OUTCOME 1.6
NOAA's Education Community functions in a unified manner and is coordinated with agency extension, training, outreach, and communications programs to fully engage NOAA audiences.

27 **GOAL 2: WORKFORCE DEVELOPMENT**
A future workforce, reflecting the diversity of the Nation, skilled in science, technology, engineering, mathematics, and other disciplines critical to NOAA's mission.

31 OUTCOME 2.1
A diverse and qualified pool of applicants, particularly from underrepresented groups, pursues student and professional opportunities for career development in NOAA mission-critical disciplines.

33 OUTCOME 2.2
NOAA's employees support programs and activities for students and teachers to learn about and explore NOAA science and stewardship.

35 OUTCOME 2.3
A diverse pool of students with degrees in science, technology, engineering, mathematics, and other fields critical to NOAA's mission connect to career paths at NOAA and in related organizations.

NOAA'S VISION

An informed society that uses a comprehensive understanding of the role of the ocean, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions

NOAA'S EDUCATION MISSION

To advance environmental literacy and promote a diverse workforce in ocean, coastal, Great Lakes, weather, and climate sciences, encouraging stewardship and increasing informed decision making for the Nation.

NOAA'S MANDATE TO EDUCATE

NOAA's role in science education is defined in statute. The America COMPETES Act (P.L. 110-69) provides broad authority for educational activities.

The Act states: "The Administrator of the National Oceanic and Atmospheric Administration shall conduct, develop, support, promote, and coordinate formal and informal educational activities at all levels to enhance public awareness and understanding of ocean, coastal, Great Lakes, and atmospheric science and stewardship by the general public and other coastal stakeholders, including underrepresented groups in ocean and atmospheric science and policy careers. In conducting those activities, the Administrator shall build upon the educational programs and activities of the agency."

Passed in 2007, the statute further directs NOAA to develop a 20-year strategic plan in partnership with ocean and atmospheric science and education experts, and interested members of the public. The Plan is to be evaluated and updated every five years.

The America COMPETES Act complements the standing legislation of the Office of National Marine Sanctuaries, National Marine Fisheries Service, National Estuarine Research Reserve System, National Sea Grant College Program, and the Coral Reef Conservation Program. Together these statutes provide a unifying mandate for educational activities across the agency. The philosophy and priorities of this strategic plan are guided by these statutes and directly support NOAA's 2009-2014 Strategic Plan (2008). The NOAA Education Community has adopted the agency vision, and this strategic plan provides targeted support for each of NOAA's mission goals as well as the cross-agency priorities of environmental literacy and a world-class workforce. Additional guidance was derived from the directives and recommendations of recent reports (see examples listed below) on the need for science education reform and the advancement of lifelong learning opportunities in ocean, coastal, Great Lakes, weather, and climate sciences.

Environmental Literacy. A fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment, and the ability to understand and utilize scientific evidence to make informed decisions regarding environmental issues.

NOAA'S EDUCATION GOALS

In preparing this 20-year vision of education for NOAA, the Education Council considered a broad array of perspectives, research findings, and legal statutes.

Based on the strengths and mission of the agency and the future needs of our society, the agency has established two primary education goals of increasing environmental literacy and workforce development in disciplines related to NOAA's mission.

An environmentally literate public is critical to achieving NOAA's mission goals of managing coastal and marine resources, providing for society's needs for weather and water information, and enhancing society's ability to plan and respond to climate variability. An educated public is needed to serve as stewards of the natural environment, take appropriate action in the case of severe weather, and participate in the national debate on complex issues such as climate change. Recent surveys suggest that participation levels in formal and informal education are strong indicators of the ability of citizens to understand science and technology in order to participate in public policy decisions (Miller, 2006). NOAA plays a key role in advancing this understanding through its educational programs, products, outreach efforts, collaborations, and leadership supported by the agency's extensive breadth and depth of scientific resources.

Accomplishing NOAA's challenging goals requires an inclusive, diverse, highly skilled, motivated, and effective workforce that reflects the communities it serves. To achieve this objective, NOAA must actively engage the education and research communities to ensure that future workforce needs are met. This action not only benefits the agency but further supports the Nation in helping to build a workforce literate in science, technology, engineering, and mathematics (STEM) disciplines, which are crucial to maintaining America's competitiveness in a rapidly changing global economy (National Academy of Sciences, 2005). An analysis of K-12 curriculum standards from across the U.S. found that current standards may not adequately address the need for developing this future workforce (Hoffman and Barstow, 2007). Scientific concepts of interactive Earth systems, integration of 21st century investigative technologies, and ocean and climate literacy principles are all important foundations to NOAA's work. While existing science education standards across the Nation incorporate some aspects of these vital concepts, they do not fully embrace them. Through continued partnerships with formal and informal education institutions and direct engagement and support of teachers and students, NOAA strives to bridge this gap to address the future workforce needs of the agency and the Nation.

STATUTES FOR NOAA EDUCATION

- America COMPETES Act (P.L. 110-69)
- Coral Reef Conservation Act (P. L. 106-562)
- Coastal Zone Management Act (P. L. 109-58); § 1461, National Estuarine Research Reserve System
- Magnuson-Stevens Fishery Conservation and Management Act (P.L. 109-479)
- National Marine Sanctuaries Act (P.L. 106-513, Sections 1431 et seq.)
- National Sea Grant College Program Act (P. L. 107-299)

SUPPORTING DIRECTIVES FOR EDUCATION

- NOAA's 2009-2014 Strategic Plan (2008)
- The Intergovernmental Panel on Climate Change Report: Mitigation of Climate Change (2007)
- Report of the Academic Competitiveness Council (2007)
- Conference on Ocean Literacy Report (2006)
- The President's U.S. Ocean Action Plan (2005)
- National Academies Report: Rising Above the Gathering Storm (2005)
- The U.S. Commission on Ocean Policy, An Ocean Blueprint for the 21st Century (2004)
- Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration (2000)

FOUNDATION FOR NOAA EDUCATION

The foundation for NOAA's educational content is based on the agency's scientific work.

Often referred to as NOAA sciences, the core of this work is the investigation of patterns, features, and interactions of Earth's ocean, coasts, Great Lakes, weather, and climate. The study of these physical systems requires a broad array of scientific disciplines, technology, mathematics, and engineering. Social sciences are also essential in learning how humans interact with these resources and in how to build understanding and encourage environmental stewardship. These Earth systems are complex and no single scientific discipline can capture the causes and effects of changes within them. Observing coral reef health, for example, is a lesson involving global climate, hydrology, land use planning, oceanography, fisheries management, and marine economics. Likewise, projecting future climate is a product of computer science, statistics, sociology, meteorology, climatology, and other sciences. Infusing the findings and research processes of this work into education, and training new generations of scientists to continue the work, are central to the NOAA education mission.

PARTNERSHIPS AND COLLABORATION

As the Nation's leading oceanic and atmospheric science and service agency, NOAA has the responsibility to increase its coordination role and collaboration within the ocean, coastal, Great Lakes, weather, and climate science and education communities.

The passage of the America COMPETES Act further solidifies this role and provides a mandate for the agency to serve as a catalyst to strengthen ocean and atmospheric science education. Central to the success of fulfilling these responsibilities are the agencies, businesses, organizations, and individuals with whom NOAA works in pursuit of a common vision. Important NOAA partners include: museums and aquariums, nongovernmental organizations, educational businesses, professional societies, education associations, state, local, and tribal governments, state and local school systems, academia, and other education practitioners. By participating in planning initiatives, funding agreements, joint research, sharing educational content, and working on other collaborative projects of common interest, NOAA leverages its resources to advance the environmental literacy and scientific knowledge of our Nation and the global community. These partnerships and collaborations set the course to build resilient communities, strengthen stewardship of our natural resources, and secure a healthy economic future.

NOAA'S EDUCATION STANDARDS

NOAA is committed to the development and support of education programs and products that exhibit standards of high quality.

At NOAA, education activities are:

- aligned with the agency's strategic goals and include measurable objectives;
- aligned with appropriate national and/or state education standards;
- based on the best science available;
- reflective of current literacy principles that are relevant to the agency's scientific mission;
- designed to incorporate the needs of the participants;
- designed to be replicable, consistent in quality, and sustainable; and
- continually evaluated and improved.

STRATEGY FOR IMPLEMENTATION

The purpose of the NOAA Education Strategic Plan is to provide high-level guidance for the implementation of the America COMPETES Act mandate toward the realization of NOAA's education vision.

The goals, outcomes, and strategies of this Plan provide a framework to focus and coordinate the education efforts of the agency. This guidance builds on and incorporates the existing capabilities of NOAA education programs and partnerships that form a well established-foundation to accomplish this work. Execution of this Plan requires the development of shorter-term implementation plans that consider the more immediate needs, opportunities, and resources of the agency in support of the long-term strategic goals.

The implementation plans will set forth the programmatic actions that NOAA and its education community will take to implement the goals, outcomes, and strategies established under this strategic plan. Specific performance measures aligned with each outcome will be developed to provide the metrics needed for evaluating the success of the agency in meeting the strategic vision. Suggested metrics for formal and informal education under consideration by the Academic Competitiveness Council (U.S. Department of Education, 2007) will be integrated where appropriate. Implementation plans will be reviewed on an ongoing basis and revised with the five-year review of the broader NOAA Education Strategic Plan.

The active participation of NOAA's education community in developing this strategic plan assures its alignment with the various education mandates of the agency. These strategies and subsequent implementation plans will be integrated with the planning and budgeting processes at NOAA. Through these established processes, NOAA Line and Staff Offices will enable the successful achievement of this Plan's goals, outcomes, and strategies.

GOAL 1

ENVIRONMENTAL LITERACY

An environmentally literate public supported by a continuum of lifelong formal and informal education and outreach opportunities in ocean, coastal, Great Lakes, weather, and climate sciences.

For NOAA to achieve its strategic vision, an environmentally literate and engaged public must be fostered. Leaders in Earth system science education echo this urgent need, stating that public understanding of Earth's interconnected systems is crucial to our ability to apply knowledge and problem-solving skills to real-world issues (Hoffman and Barstow, 2007). NOAA defines an environmentally literate person as someone who has a fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment, and has the ability to understand and utilize scientific evidence to make informed decisions regarding environmental issues. These issues involve uncertainty, and require economic, aesthetic, cultural, and ethical considerations.

The six outcomes and associated strategies presented for this goal outline the interdependent actions that NOAA will pursue to achieve this vision of developing environmental literacy in the Nation's diverse citizenry. The environmentally literate public supported through these actions will also provide a base for a continuous supply of the Nation's future workforce.

The following topics are integral to these actions:

PROMOTING ENVIRONMENTAL STEWARDSHIP

FACILITATING CHANGE IN EDUCATION SYSTEMS

CONNECTING CITIZENS TO NATURE AND THE COMMUNITY

USING EMERGING TECHNOLOGIES

An educated public is needed to serve as stewards of the natural environment, take appropriate action in the case of severe weather, and participate in the national debate on complex issues such as climate change.

PROMOTING ENVIRONMENTAL STEWARDSHIP

In addition to its scientific mandate, NOAA plays a leading role in the conservation, management, and restoration of ocean, coastal, and Great Lakes resources.

The stewardship of these resources for current and future generations is critical to the long-term sustainability of society and the planet. Monitoring the health of these ecosystems and building understanding of the relationships between the ocean and other Earth systems is a core mission of the organization. Over the last 100 years, human actions have greatly altered these natural systems and are seriously threatening our world resources. Scientists and economists recognize that the pressure on the environment is currently increasing with the globalization of world markets, population increases, and competitive economic growth.

NOAA cannot manage these issues alone; the public must be actively involved in stewardship of these shared resources. Environmental literacy is the first step in this process. NOAA embraces effective educational methods that promote stewardship and associated environmental problem-solving efforts; service learning is one method utilized in this approach. Building public understanding and appreciation of the interconnectedness of people and the environment is a critical part of the development of stewardship responsibilities. Education programs and products can provide unique cultural contexts, including fostering understanding and practical use of indigenous knowledge and Native science (including Native Hawaiian, Alaska Native, and Pacific Islander) for the development of environmental literacy.

FACILITATING CHANGE IN EDUCATION SYSTEMS

Developing environmental literacy is a lifelong process involving diverse education systems. The ocean, weather, and climate systems that are the foci of NOAA's scientific endeavors are central to environmental literacy and are inherently of interest to people of all ages, backgrounds, and education levels.

NOAA'S DEFINITIONS OF EDUCATION AND OUTREACH

Formal Education. Learning within a structured education system in which children or adults are required to demonstrate proficiency.

Informal Education. Learning outside the established formal system that meets clearly defined objectives through organized education activities.

Outreach for Education. Activities that are designed to build awareness, develop relationships, promote education products, and inspire educators, students, and the public to pursue further learning opportunities.

The development of a society that is environmentally responsible and utilizes effective, science-based problem-solving skills and stewardship behavior will require significant attention and increased action by formal and informal education systems. Our Nation's K-12 formal education system has not established a strong and comprehensive structure to support this development, particularly in the oceanic and atmospheric sciences. NOAA is committed to supporting and facilitating system-wide change of the formal education system to build future capacity for developing environmentally literate citizens. Such change requires participation across the spectrum of the education community, including policymakers, academic institutions, professional associations, teachers, and students.

Informal education plays a critical role in developing environmentally literate citizens, and more must be done to equip informal education programs and products with contemporary instructional resources and interdisciplinary methods. NOAA must be engaged in the improvement of both formal and informal education systems because these venues are important to the development of literate citizens and to the long-term maintenance of their skills, knowledge, and attitudes. Partnerships and collaboration are integral to establishing these changes.

CONNECTING CITIZENS TO NATURE AND THE COMMUNITY

Building understanding of the connections between individual human actions, governmental policies, economic decisions, and their effects on natural Earth systems is a critical component of environmental literacy.

Framing these connections in a local context within the social framework of one's community and the associated regional resources makes these lessons more powerful and longer-lasting. NOAA embraces two educational methodologies that have been shown to greatly enhance these connections: experiential education and place-based education.

Experiential education programs engage learners in constructing meaning by using real-world issues and hands-on interaction with natural phenomena. Cognitive research provides considerable evidence that these learners become active participants rather than passive recipients of knowledge (Huitt and Hummel, 2003). The experiential learning process is one component of NOAA's repertoire that helps to ensure learners are actively and purposefully engaged in creatively posing questions, investigating, experimenting, developing curiosity, solving problems, assuming responsibility, and constructing meaning.

Place-based education immerses the learner in local heritage, culture, landscapes, opportunities, and experiences as a foundation for the study of language arts, mathematics, social studies, science, history, and other subjects. This interdisciplinary approach encourages participants to use the schoolyard, community, public lands, and other special places as resources, turning communities into classrooms. The NOAA National Marine Sanctuaries and National Estuarine Research Reserves provide excellent place-based locations that serve as "living classrooms," applying real-world contexts for learning and stimulating "hands-on/minds-on" educational opportunities. NOAA facilities throughout the Nation play an important role as well, in imparting the relevance of ocean and atmospheric science to their local communities through these place-based educational experiences. Additionally, NOAA's grants and educational partnerships extend the agency's ability to positively impact communities with this approach.

USING EMERGING TECHNOLOGIES

Advances in technology change the way we interact as a society and impact our view of the world around us. Maintaining a presence in this new information age and keeping educational approaches relevant to new learning modalities are important to the continued success of NOAA's environmental literacy goal.

NOAA science relies on these technological developments, and the agency is committed to building collaborative networks and monitoring systems that utilize current technology to enhance the delivery of comprehensive Earth-system data. To ensure the usefulness of these data, numerous problem-solving, interactive, and multimedia resources are being developed for students, educators, and the public. While NOAA adopts a broad array of methodologies in communicating environmental concepts to the public, the use of new, innovative, and engaging technologies to efficiently and effectively deliver this information is a high priority for the agency.

GOAL 1 OUTCOMES:

1.1 EVALUATING EDUCATION

1.2 LITERACY PRINCIPLES

1.3 INQUIRY-BASED LEARNING

1.4 LIFELONG LEARNERS

1.5 PARTNERSHIPS

1.6 ENGAGING AUDIENCES

OUTCOME 1.1

NOAA education programs are developed and refined using the best available research on the effectiveness of environmental and science education.

Improving the effectiveness of programs and products by using the best practices and the latest knowledge is an important part of NOAA's approach to environmental literacy.

1.1

EVALUATING EDUCATION. Recent years have seen many advances in our understanding of how the mind works and the process of learning. Incorporating this research into the design and implementation of educational programs in both formal and informal settings has begun.

The infusion of this knowledge proves beneficial in creating new programs and revising existing educational efforts targeting increased environmental literacy. A product that is able to bridge the gap between sound scientific principles and practical application in the learning environment is one that is likely to be proven effective (Ritter and Lemke, 2000). Improving the effectiveness of programs and products by using the best practices and the latest knowledge is an important part of NOAA's approach to environmental literacy.

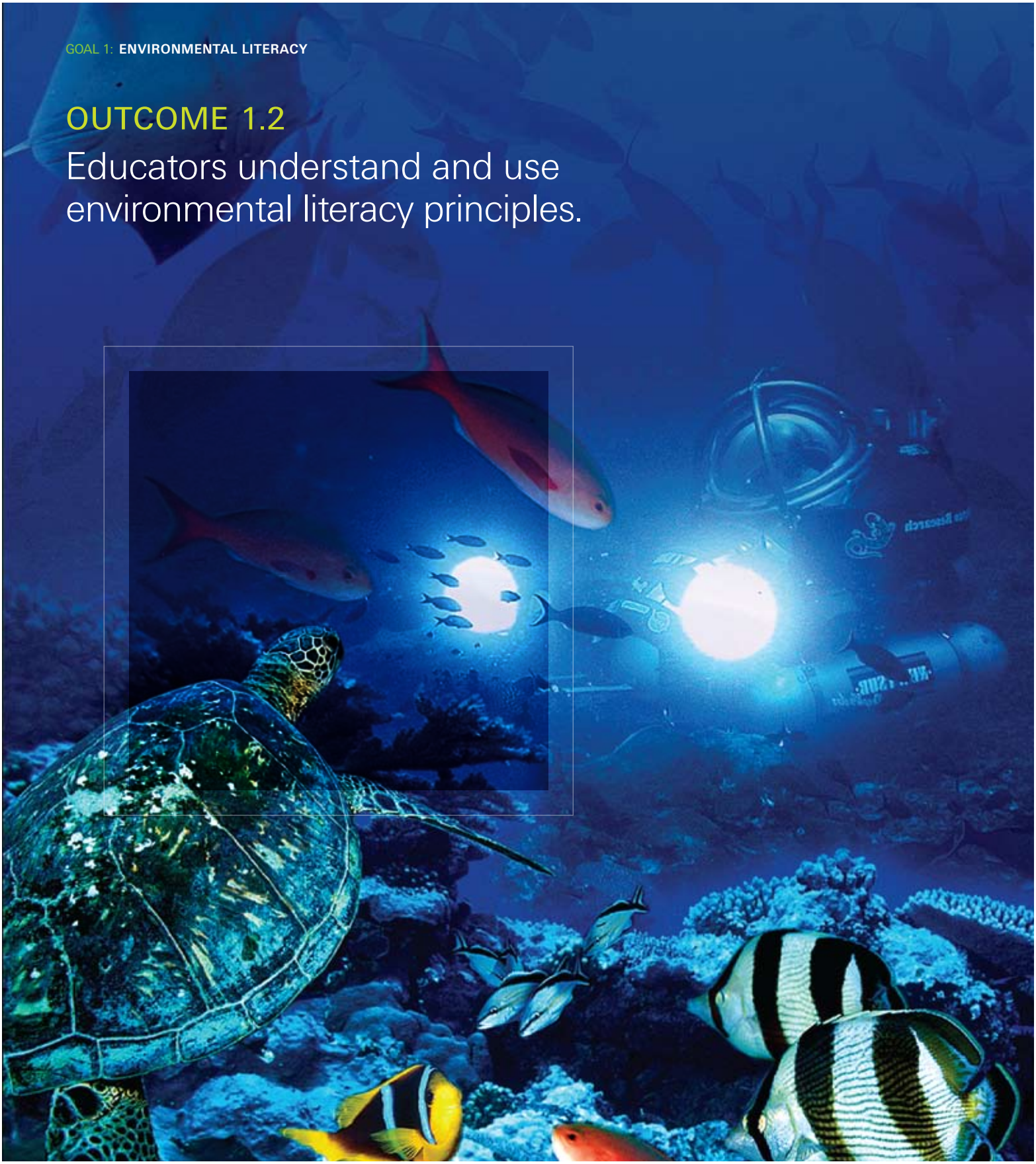
OUTCOME 1.1 STRATEGIES

1. Support and use research-based practices when developing and implementing education programs and products.
2. Develop and implement a framework of assessment and evaluation strategies that add to and are based on educational research findings, and are consistent with interagency assessment and evaluation efforts.
3. Contribute and share research on effective science and environmental education.

In the report *BEST: What it Takes*, (BEST, 2004) a Blue Ribbon Panel reviewing best practices in K-12 education notes: "Evidence matters because outcomes matter and resources are limited. It is important to ensure that the investments in money, time, and human capital have a high probability of paying off. Good intentions and passionate commitment are not enough to fill the science and technology pipeline." Developing methods that accurately and efficiently evaluate the effectiveness of projects is an ongoing challenge in the education community. Much work has been done by Federal agencies and their education partners to advance the evaluation process, and much work remains. As part of the quality standards for NOAA Education, the agency is committed to advancing evaluation practices to improve the results of its efforts and to contribute to the body of knowledge regarding effective environmental and science education. Building the evaluation capacity of NOAA educators and developing a coordinated system to capture and share these findings are key elements in achieving this outcome.

OUTCOME 1.2

Educators understand and use environmental literacy principles.



The development of science literacy principles has gained the attention of the education and scientific communities as a needed component for advancing Earth system science. NOAA played a leading role in the collaborative process to develop essential principles and fundamental concepts for ocean and climate literacy: Oceans for Life, Essential Principles for Ocean Literacy, and Essential Principles for Climate Literacy. These documents are aligned with national education standards to facilitate use of the principles in both formal and informal education settings. As these areas of study are critical to NOAA's mission, they form the central focus of the agency's efforts in developing an environmentally literate society.

1.2

LITERACY PRINCIPLES. An environmentally literate and involved citizenry is essential to protecting human life, conserving fragile ecosystems, and building sustainable communities that are resilient in the face of a changing Earth.

NOAA has joined with partner agencies, organizations, and individuals in the science community to develop several frameworks that identify essential literacy principles and fundamental concepts that individuals need to understand in order to make informed decisions about human activities that affect our planet. These literacy principles have been established to support efforts to improve development of state and national education standards, curricula, assessments, teacher certification, and the informal education landscape.

OUTCOME 1.2 STRATEGIES

1. Support the development and dissemination of environmental literacy principles.
2. Partner with external groups to promote the adoption and integration of environmental literacy principles into state and national standards, curricula, assessments, professional development programs, pre-service education, educator certification, and the informal education field.
3. Expand and strengthen experiential and place-based education using environmental literacy principles.

NOAA is actively involved in creating new frameworks of science literacy principles related to the conceptual understanding of additional aspects of the Earth system (e.g., Earth science, atmospheric science). As these sets of literacy principles are completed, they will be integrated into future educational work supported by NOAA. The agency recognizes that literacy principles are a starting point for building true environmental literacy that encompasses not only the acquisition of essential knowledge, but also the development of skills and attitudes that utilize this knowledge in daily decision making.

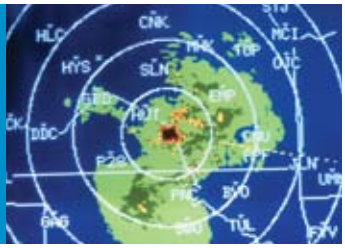
Education researchers have identified a gap that exists between the scientific knowledge and skills most students learn in school and what they will need in 21st-century communities and workplaces (Partnership for 21st Century Skills, 2004). Several national reports recommend significant increases in the number of science teachers and improvement in the quality of their ongoing preparation to address this need (National Academies, 2005; National Commission on Mathematics and Science Teaching for the 21st Century, 2000). NOAA believes that integrating environmental literacy principles into formal and informal education is an important contribution toward addressing this gap in science literacy and developing a robust scientific and engineering workforce.

The agency's support and promotion of experiential and place-based education programs encourage interdisciplinary learning through the active engagement of students in hands-on scientific inquiry. These efforts result in improved understanding of important environmental concepts and stronger environmental stewardship behavior (Penuel et al., 2005). Expanding the awareness of these approaches and literacy principles, building confidence in the application of experiential teaching methods, and providing support services in their application are all part of NOAA's strategy in addressing the need for an environmentally literate citizenry. NOAA cannot undertake these efforts on its own, and, thus partnerships with other organizations, agencies, and institutions will be essential to ensuring that this outcome is achieved.

OUTCOME 1.3

Educators, students, and/or the public collect and use ocean, coastal, Great Lakes, weather, and climate data in inquiry and evidence-based activities.

NOAA is committed to creating and supporting virtual and hands-on experiential opportunities in ocean, coastal, Great Lakes, weather, and climate science disciplines.



1.3

INQUIRY-BASED LEARNING. Technological improvements over the last decade have advanced the ability of NOAA and other agencies to monitor, assess, and make predictions about Earth's changing environmental systems.

Using satellites, aircraft, ships, remote sensing systems, and direct scientific monitoring by a global scientific network, NOAA and other Federal agencies collect data on climate, weather, the ocean, and other natural phenomena through projects such as the U.S. Integrated Ocean Observing System (IOOS®).

NOAA has a long-standing commitment to share this information with scientists, industry, government, and the public through a variety of media and interactive data portals. These data are critical to NOAA products and services that help our society make informed decisions concerning how to conduct business, monitor ocean and human health, and protect life and property.

Developing the ability of learners to formulate and conduct independent scientific investigations to explore relationships within Earth's natural systems is a central goal of environmental science education and supports the advancement of environmental literacy. Ocean, coastal, Great Lakes, weather, and climate sciences provide rich subject matter for learning these skills. By extending existing public portals for accessing imagery, real-time data, and archival data, NOAA has begun the process of creating specialized products designed to facilitate the integration of this material into educational experiences. Programs such as NOAA Data in the Classroom, Project Atmosphere, and the Chesapeake Bay Interpretive Buoy System (CBIBS) provide curriculum modules that utilize NOAA data and visualizations to help learners recognize patterns and processes, and improve their understanding of research discoveries or natural phenomena.

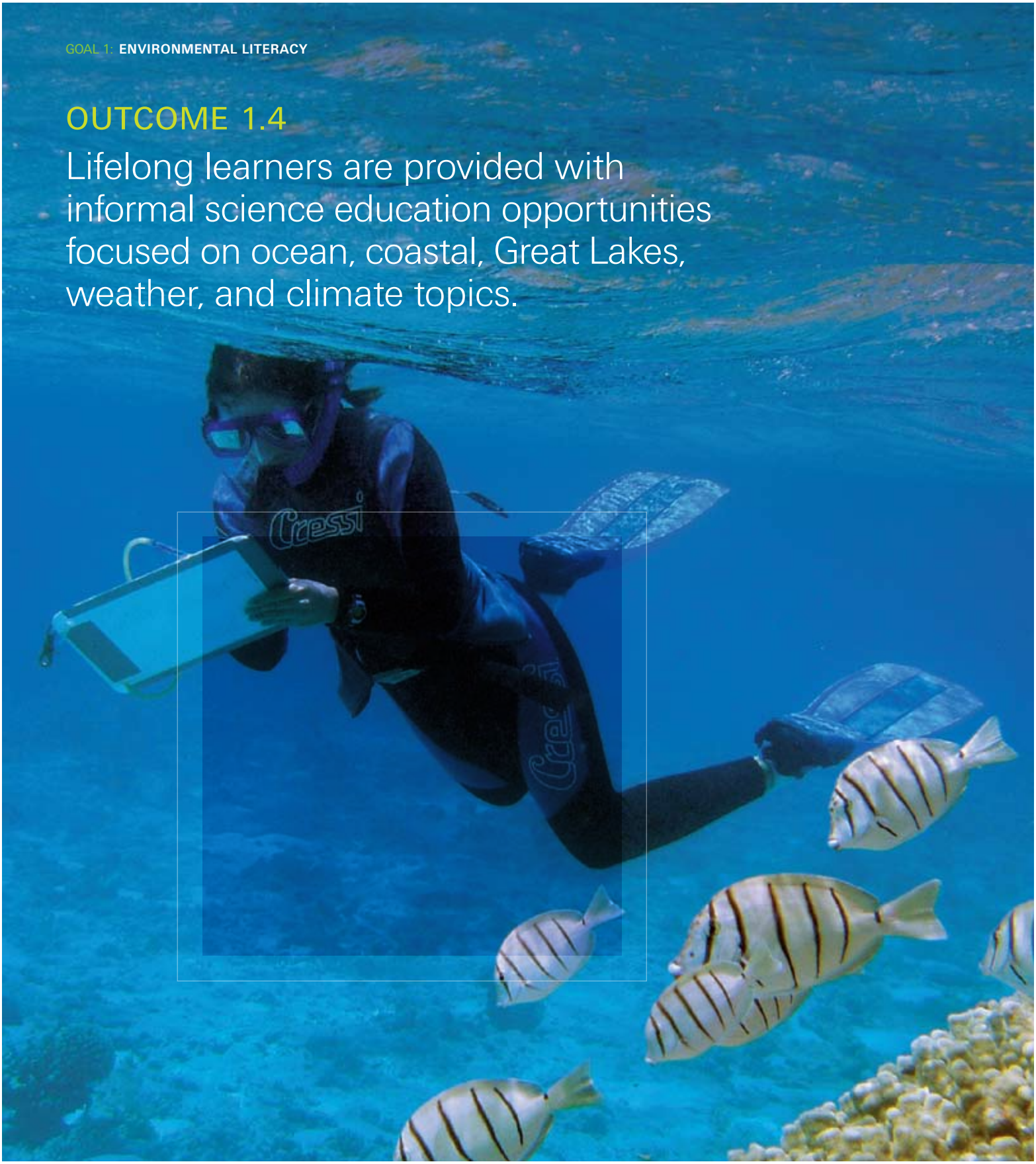
Additionally, NOAA is committed to creating and supporting virtual and hands-on experiential opportunities in ocean, coastal, Great Lakes, weather, and climate science disciplines that focus on user-collected data. Programs such as the Long-term Monitoring Program and Experiential Training for Students (LiMPETS), the National Weather Service's Cooperative Observer Program (COOP), Estuaries 101, and Teacher-at-Sea are current examples of this work. Continued efforts in this area will strengthen the skills and abilities of learners and help them make informed decisions regarding the environment and its resources.

OUTCOME 1.3 STRATEGIES

1. Support and implement professional development to strengthen scientific knowledge and build inquiry and decision-making skills.
2. Create and disseminate audience-appropriate products and services that facilitate access to, and use of, ocean, coastal, Great Lakes, weather, and climate science and data through multiple platforms and emerging technologies.
3. Partner with external groups to maximize the dissemination, integration, and use of data products, curricula, and evidence-based activities.

OUTCOME 1.4

Lifelong learners are provided with informal science education opportunities focused on ocean, coastal, Great Lakes, weather, and climate topics.



NOAA serves as both a catalyst and a valued information source in a lifelong-learning partnership.

1.4

LIFELONG LEARNERS. "Lifelong learning" is an important behavioral component of an environmentally literate citizenry. This process involves the lifelong practice of seeking current scientific, economic, and social data to incorporate into one's personal knowledge base to support daily decisions.

High-quality learning opportunities beyond the K-12 education system and academia must be made available to continue this process. The science-attentive public - those citizens who actively display an interest in learning about the scientific process - provides an ideal target audience for introducing environmental literacy concepts. By expanding this audience through outreach activities and then offering engaging learning opportunities that expand one's knowledge beyond basic awareness, NOAA serves as both a catalyst and a valued information source in a lifelong-learning partnership.

Building public understanding of how our Nation's natural resources are managed and the importance of these resources is a key element in the agency's stewardship mission. To achieve this outcome, NOAA engages in informal science education activities at local, state, regional, and national levels, with particular emphasis on reaching communities that are underrepresented in STEM sciences. NOAA's vast experience and infrastructure for monitoring Earth's systems and modeling future trends uniquely position the agency to provide citizens with the most current information available on the ocean, weather, and climate. To provide for the lifelong learner, NOAA's comprehensive education programs provide a critical connection between the agency and the learning public.

Connecting citizens directly to natural resources through hands-on experiences is a key element of the NOAA educational approach. Place-based and experiential education opportunities provide direct application of the multidisciplinary science that NOAA conducts and promote stewardship. Working in partnership with informal science education centers to infuse Earth system science topics into free-choice learning allows NOAA to extend its ability to reach the public. Application of emerging technologies allows NOAA to increase the impact of the content presented by engaging this community in its preferred methods of learning.

Citizen science networks, comprised of volunteers who often have limited scientific training, assist NOAA in a variety of settings. These groups monitor coral reef health, collect climate and local weather information, assist with maritime archaeology, and conduct estuarine habitat studies, to cite a few examples. Partnering with these groups to increase their knowledge of the scientific process and to support their volunteer efforts that help advance NOAA's mission is another important strategy in achieving this outcome.

OUTCOME 1.4 STRATEGIES

1. Partner with informal science education centers to integrate ocean, coastal, Great Lakes, weather, and climate science content into their programs through multiple platforms and emerging technologies.
2. Establish and collaborate with networks of informal science education institutions to develop effective practices for science content delivery.
3. Collaborate with citizen-science networks to support their participation in the scientific process.
4. Provide place-based experiences that facilitate hands-on exploration of natural environments.

OUTCOME 1.5

NOAA works cooperatively to maximize the impact of federal investment in ocean, coastal, Great Lakes, weather, and climate education.

NOAA contributes unique assets of laboratories, field sites, monitoring systems, and education networks that provide real-world applications and are specific expressions of Earth system and environmental sciences.

1.5

PROMOTING PARTNERSHIPS. Many science and resource management agencies contribute to the goal of enhancing environmental literacy.

NOAA's ocean, weather, and climate education efforts, for example, are complemented by the interpretive education programs of the National Park Service, the Earth science programs of the National Aeronautics and Space Administration and the U.S. Geologic Survey, and the STEM education programs of the National Science Foundation and Environmental Protection Agency, to name a few. NOAA contributes unique assets of laboratories, field sites, monitoring systems, and education networks that provide real-world applications and are specific expressions of Earth system and environmental sciences. Collectively, the science and resource management agencies collaborate in many ways to promote Earth system science and environmental education. NOAA provides leadership or is represented in several formal interagency partnerships such as the Interagency Working Group on Ocean Education, established under the U.S. Ocean Action Plan, and the Interagency Working Group on Climate Education, established under the Climate Change Science Program.

The issues surrounding ocean, coastal, Great Lakes, weather, and climate resources are not confined within the borders of any single country. Raising global awareness of the threats to these resources requires educational efforts around the world. NOAA actively pursues opportunities to work with natural resource and education agencies internationally to increase environmental literacy and stewardship. As global concerns increase and relationships mature, this area of the education portfolio promises to move beyond current professional development opportunities and coordination to incorporate shared global education initiatives. Within the United States, NOAA collaborates with tribal, state, and local governments to improve support for environmental literacy education and to work on educational projects of common interest.

OUTCOME 1.5 STRATEGIES

1. Leverage interagency capabilities and resources to serve as a catalyst for coordinated environmental literacy education.
2. Provide leadership on interagency and intergovernmental working groups to develop and disseminate consistent science literacy principles.
3. Lead and participate in interagency and intergovernmental projects and programs that promote ocean, coastal, Great Lakes, weather, and climate science.
4. Work across agencies to develop consistent performance metrics for formal and informal education in STEM and environmental science disciplines.

OUTCOME 1.6

NOAA's education community functions in a unified manner and is coordinated with agency extension, training, outreach, and communications programs to fully engage NOAA audiences.

Engagement is a two-way relationship between a service provider and society. It implies a commitment of service to society through a partnership based on reciprocity and sharing of goals, objectives, and resources, e.g., between NOAA and the society it serves. Implicit to engagement is a respect for each partner that involves listening, dialogue, understanding, and mutual support.

1.6

ENGAGING AUDIENCES. NOAA is committed to providing educational activities that are well coordinated, efficiently leveraged, and informed by NOAA sciences.

Through agency-wide coordination efforts, these actions ensure consistency, quality, and cost-effectiveness of the agency's education products and services. In addition, education is integrated with other NOAA mission goals to support a broad spectrum of activities focused on engaging constituents and providing effective services and critical information to the Nation.

Coordination of Education

Educational efforts at NOAA are managed and delivered through a structure of programs and projects distributed throughout the agency. Several programs, such as the Office of National Marine Sanctuaries, National Marine Fisheries Service, National Estuarine Research Reserve System, National Sea Grant College Program, and the Coral Reef Conservation Program, have existing, long-standing mandates for education. To assist in the coordination of these diverse entities, the agency established the NOAA Education Council. The Council serves as a forum for the NOAA education community and works to leverage existing capabilities within the corporate infrastructure to provide a comprehensive and targeted education program.

Support of NOAA Engagement Efforts

NOAA strives to establish and further meaningful two-way relationships with audiences at all levels of society. These engagement efforts focus on increasing knowledge, skills, and strategies to responsibly manage ocean, coastal, and Great Lakes resources, and improving preparedness and response to severe weather events and changing climate. Engagement efforts to reach these audiences incorporate several approaches within NOAA and include extension, training, outreach, communications, and education activities. The 2008 NOAA Science Advisory Board report, Engaging NOAA's Constituents, recommended that the agency expand its efforts to collaborate across approaches to fully engage audiences to address the problems and opportunities facing society. Through this process, NOAA can better mobilize both internal and partnership networks to achieve its mission goals.

OUTCOME 1.6 STRATEGIES

1. Coordinate internally to improve the effectiveness of NOAA's collective education efforts.
2. Build collaborative information products that facilitate efficient access to NOAA education resources.
3. Lead and participate in intra-agency projects and programs to develop, direct, and evaluate NOAA-wide education and engagement initiatives.
4. Integrate NOAA-wide engagement themes into educational program activities at national, regional, and community levels.

GOAL 2

WORKFORCE DEVELOPMENT

A future workforce, reflecting the diversity of the Nation, skilled in science, technology, engineering, mathematics, and other disciplines critical to NOAA's mission.

A world-class workforce, with the scientific and technical skills needed to address the daunting environmental challenges confronting our Nation and the planet, is critical to NOAA. The Congressional report, Rising Above the Gathering Storm (National Academy of Sciences, 2005), states that building a workforce literate in science, technology, engineering, and mathematics (STEM) is crucial to maintaining America's competitiveness in a rapidly changing global economy. These skills are also necessary to advance cutting-edge research and to promote enhanced resource management both within and outside of NOAA. As the global population increases, there is a greater demand on the natural systems of Earth; this underscores a greater need for education and research to understand the complexities of human impacts in developing strategies for sustainable solutions.

In recognition of these needs, the America COMPETES Act (2007) mandates NOAA to build on its historic role in stimulating excellence in the advancement of ocean and atmospheric science and engineering disciplines, and in providing opportunities and incentives for the pursuit of academic studies in science, technology, engineering, and mathematics. Through the strategic activities outlined in this goal, NOAA seeks to fulfill this mandate and support the Nation in meeting these many challenges by assisting in the growth of a diverse, future workforce educated in ocean, coastal, Great Lakes, weather, and climate sciences, STEM, and other supporting disciplines.

Succession planning activities at NOAA reveal a critical need for a future workforce in science, technology, education, policy, management, and communication disciplines. The agency is faced with an aging workforce in which nearly 40 percent of its employees are eligible to retire by 2014, including more than 700 meteorologists and almost 300 fisheries biologists. These workforce needs are reflected in the broader science and technology communities of both the private and public sectors with whom NOAA works to fulfill its mission. To ensure an effective pipeline of qualified candidates, NOAA must undertake education and recruitment activities for strategic workforce development. While the outcomes described in the following pages are framed in terms of the agency's needs, NOAA is committed to developing the Nation's workforce beyond the specific needs of the agency. This goal and its supporting outcomes outline a strategy that NOAA will employ to extend the current education and recruitment pipeline to meet the National workforce needs of tomorrow.

The following topics are central to this strategy:

WORKFORCE DEVELOPMENT FOR STUDENTS, EDUCATORS, RESEARCHERS, AND MANAGERS

NOAA MISSION-CRITICAL DISCIPLINES

UNDERREPRESENTED POPULATIONS IN NOAA SCIENCES

Accomplishing NOAA's challenging goals requires an inclusive, diverse, highly skilled, motivated, and effective workforce that reflects the communities it serves.

WORKFORCE DEVELOPMENT FOR STUDENTS, EDUCATORS, RESEARCHERS, AND MANAGERS

In broad terms, workforce development is defined as "education, employment, and job-training systems designed to provide the skilled workers that employers need to succeed and the education and training that individuals need to succeed in today's labor market." (National Governors Association, 2008).

At NOAA, workforce development is conducted through various agency offices and through partnerships with the education and research communities. The focus of workforce development in this Education Strategic Plan is to provide grants, internships, fellowships, and other experiential activities to students, educators, researchers, and managers in support of continued education and professional development in NOAA mission-critical careers.

Environmental literacy and stewardship skills are introduced to the public through the programs developed through Goal 1 of this Plan. Goal 2 programs build students' professional competency in NOAA mission-critical disciplines, further their understanding of agency stewardship responsibilities, and help them transition into the working community. These activities are coordinated with the NOAA Workforce Management Office, which leads NOAA's recruitment, hiring, and employee training.

GOAL 2 OUTCOMES:

2.1 CAREER DEVELOPMENT

2.2 PROGRAMS & ACTIVITIES

2.3 CAREER PATHS

NOAA MISSION-CRITICAL DISCIPLINES

Although NOAA is a science-based agency, to fulfill its mission a workforce with a variety of backgrounds is required. Different skill sets support one another and are considered "mission-critical." Following are several examples of the interdependency of these disciplines:

- NOAA's oceanic investigations require traveling on, under, and above the water utilizing ocean-going vessels, submersibles, airplanes, and satellites. These vehicles require operators, technicians, and engineers with specialized knowledge to chart the ocean floor, monitor ocean currents, investigate fish populations, or explore new habitats;
- Computers and information technology are integral to gathering, processing, interpreting, and publishing data on the ocean and atmosphere. Computer programmers and operators, web developers, geographic information system specialists, and statistical modelers work closely with NOAA scientists to understand and predict changes in Earth's systems;
- Public safety, a global concern, is strongly supported by the scientific research and environmental monitoring conducted by NOAA. Meteorology, hydrology, remote sensing, statistical modeling, satellite communications, and information technology, coupled with public education and media relations, are critical to this work. These disciplines allow for the science of weather events, water supply, river level, and flood forecasts, climate projections, and tsunami warnings to be integrated into actions that save lives, protect property, and enhance the economy;
- Protecting, restoring, and managing coastal and ocean resources require scientific investigations to understand the complex processes at work in these natural systems. This research informs the development of management plans that consider stakeholder interests, including the business community, and drafting of policy to support these efforts. A strong science background that includes social sciences is needed to conduct the type of research necessary to yield better tools for ecosystem assessments and monitoring, better understanding of the coastal and ocean processes and ecosystem dynamics, and better understanding of the linkages between human activities and these ecosystems;
- A workforce skilled in political processes, education, communication, and public engagement, which is also familiar with administrative procedures and adept in strategic planning methods as well as U.S. and international laws and treaties, is necessary to support the implementation of management plans and policy development;
- Responding to the specific demands of air, sea, and surface transportation with consistent, timely, and accurate science information aids in safe, efficient, and environmentally-sound transportation systems that are crucial to the Nation's commerce, and thus, to the Nation's economy. The disciplines of engineering, weather and marine forecasting, coastal planning, and marine charting are all integral to this work.

UNDERREPRESENTED POPULATIONS IN NOAA SCIENCES

As the demographics of the Nation shift, maintaining an interest in careers critical to NOAA's mission is increasingly challenging.

Population growth in the U.S. is increasing most rapidly in demographic groups that have not traditionally selected STEM disciplines as college majors or career tracks (National Science Board, 2008). The NOAA workforce reflects these findings, with only 10% of the employees in STEM-related occupations in 2006 coming from underrepresented groups (Robinson et al., 2007). Given the forecasted need to replace NOAA retirees in the near future, maximizing the candidate pool is essential. Having a workforce that reflects the diversity of the Nation is important to sustain the relevance of NOAA to the public. Additionally, diversity brings a wider variety of perspectives and approaches relative to policy development and implementation, strategic planning, problem solving, and decision making. For these reasons, this workforce-development goal emphasizes efforts to raise awareness of NOAA mission-critical careers and to provide educational support to communities underrepresented in these careers. Working in partnership with Minority Serving Institutions (MSIs), NOAA Cooperative Science Centers, national technical organizations, industrial partners, and nongovernmental organizations that serve underrepresented groups will be essential in achieving this goal and inspiring students to consider this career path.

OUTCOME 2.1

A diverse and qualified pool of applicants, particularly from underrepresented groups, pursues student and professional opportunities for career development in NOAA mission-critical disciplines.

NOAA's career development opportunities: "promote the development of students interested in STEM-related subjects and other NOAA mission-critical disciplines with broader insights regarding future education and career options."

2.1

CAREER DEVELOPMENT. Educators and scientists are influential in guiding students in their education and career choices.

In order to build the future workforce needed to accomplish NOAA's mission, it is essential for both of these communities to be aware of the agency and the academic disciplines needed to support its mission. This knowledge will enable educators and scientists to promote the development of students interested in STEM-related subjects and other NOAA mission-critical disciplines with broader insights regarding future education and career options.

Awareness of NOAA's mission must also be supplemented by awareness of existing opportunities for education and experience including scholarships, internships, research, and fellowships. These opportunities expose promising students to the breadth of fields available to them as future careers and help prepare them as qualified candidates for these positions. A wide range of such opportunities is currently available for educators, K-12 students, undergraduates, and graduate students through NOAA and partner organizations.

Attracting students and professionals into this workforce pipeline through NOAA's career development opportunities and retaining them through completion of these programs further broadens participants' knowledge and understanding of NOAA's mission and supports development of a future employee pool in mission-critical disciplines. To facilitate the preparation of STEM professionals and science educators, NOAA will focus on the full spectrum of education and instruction from kindergarten through post-secondary levels. The agency is particularly interested in bringing awareness and understanding of its mission and opportunities to underrepresented communities in an effort to bolster the number of future workforce members from these demographic backgrounds.

OUTCOME 2.1 STRATEGIES

1. Engage and expand partnerships with educators and researchers, particularly from underrepresented groups, to augment the number of qualified students who apply to NOAA's student opportunities and choose careers that support NOAA's mission.
2. Maintain and enhance resources for students and teachers to access information about NOAA's careers and agency-sponsored career-development programs.
3. Expand partnerships and collaboration with national technical organizations, the business community, nongovernmental organizations, and Minority Serving Institutions to increase the pool of underrepresented students who are educated and graduate in disciplines critical to NOAA's mission.
4. Expand the number of visits by NOAA representatives to campuses, career fairs, and national science and education conferences to increase the public's knowledge of the agency's education resources and opportunities.

OUTCOME 2.2

NOAA's employees support programs and activities for students and teachers to learn about and explore NOAA science and stewardship.

To meet the workforce needs of the agency and to attract a more diverse applicant pool, NOAA works with its employees to create, augment, and diversify educational opportunities for students and teachers.

2.2

PROGRAMS & ACTIVITIES. One of NOAA's strongest recruitment tools is its ability to engage the public through internships, scholarships, fellowships, sabbaticals, and student opportunities.

These opportunities provide an important mechanism for students and teachers to engage with NOAA to learn about and explore NOAA sciences, education, resource management, and stewardship.

Every NOAA employee is a potential recruiter and can independently increase education opportunities for students to learn about NOAA sciences and the agency's mission. NOAA employees serve on the frontline to ensure that students benefit from high-quality opportunities as they intern at facilities nationwide. These opportunities will potentially result in a strong future workforce, particularly from underrepresented groups, trained in disciplines critical to NOAA's mission.

To meet the workforce needs of the agency and to attract a more diverse applicant pool, NOAA works with its employees to create, augment, and diversify educational opportunities for students and teachers. The agency trains its workforce to design successful student opportunities and to enhance teacher fellowships as ways to further connect with diverse communities.

Participation by NOAA's workforce in support of these activities is critical to ensuring a broad array of topics and themes in which students and teachers can get involved. Engagement of the NOAA community is a key element to successful learning experiences for both students and teachers, and will result in enhanced capacity for career development and environmental stewardship.

OUTCOME 2.2 STRATEGIES

1. Increase NOAA employees' awareness of student scholarships and internships, and teacher fellowship opportunities, within the agency.
2. NOAA employees will take an active role in developing career resources and participating in career outreach for students.
3. Utilize research to assess future workforce needs of NOAA and the Nation and ensure that student opportunities are responsive to these findings.
4. Monitor and evaluate NOAA student, teacher, and research faculty experiences to ensure that they are of high quality.

OUTCOME 2.3

A diverse pool of students with degrees in science, technology, engineering, mathematics, and other fields critical to NOAA's mission connect to career paths at NOAA and in related organizations.

The overarching goal of NOAA's workforce development efforts is to increase the number of students who take coursework and graduate with degrees in STEM and other fields that directly support the agency's mission.

2.3

CAREER PATHS. NOAA is committed to helping create a well-educated workforce that reflects the diversity of America.

In support of this commitment, the agency administers programs that create educational and hands-on research opportunities targeted at recruiting students and teachers, particularly from underrepresented groups, to NOAA mission-critical disciplines. These efforts build on the environmental literacy efforts of Goal 1 of this strategic plan and incorporate partnerships and collaboration with public- and private-sector organizations that support NOAA's mission.

The overarching goal of NOAA's workforce development efforts is to increase the number of students who take coursework and graduate with degrees in STEM and other fields that directly support the agency's mission. Building a strong, well-educated, competitive pool of potential new employees interested in ocean, coastal, Great Lakes, weather, and climate sciences, science education, engineering, maritime technologies, and related social sciences requires the involvement of the education and research communities and others concerned with these disciplines. NOAA student scholarship and internship programs allow students to receive focused education and targeted workforce experiences in these disciplines, both at NOAA facilities and at their respective academic institutions, thereby providing both opportunities and incentives to pursue these career paths.

Professional opportunities that support the transition of program participants from their education and training activities to actual careers are essential to the success of this program. In support of this outcome, NOAA participates in the Federal Student Career Experience Program (SCEP), helps establish professional networks, provides support for conference presentations, and participates in mentoring partnerships. Tracking the graduation and career choices of participants to determine the effectiveness of these programs is a key element in assessing the success of this workforce development goal.

OUTCOME 2.3 STRATEGIES

1. Provide scholarship support to students in NOAA mission sciences, management, education, and policy to increase the number of students obtaining degrees in those disciplines.
2. Connect students to professional opportunities that enhance their ability to pursue careers in ocean, coastal, Great Lakes, weather, and climate sciences, science education, engineering, and maritime technology.
3. Work with other agencies, academia, national technical organizations, the private sector, and nongovernmental organizations to increase opportunities for students to transition to careers in NOAA mission-critical fields, and to increase the Nation's STEM graduates.
4. Monitor NOAA-supported students to track graduation and career choices and assess their impacts on NOAA recruitment and retention efforts.

GLOSSARY OF TERMS

CITIZEN SCIENCE. Research collaborations between scientists and volunteers, particularly (but not exclusively) to expand opportunities for scientific data collection and to provide access to scientific information for community members. (Source: Citizen Science Central, http://citizenscience.org)

COMMUNICATIONS. The process of delivering a message or other information through various media, whether verbal or nonverbal. For NOAA, the Office of Communications provides information about NOAA and the products and services it provides to the media, government officials, constituents, and the public (Developed by NOAA Office of Communications).

EARTH SYSTEM SCIENCE. An integrated approach to the study of the Earth that stresses investigations of the interactions among the Earth's components in order to explain Earth dynamics, evolution, and global change. (Source: NASA's Earth Observatory Glossary, http://earthobservatory.nasa.gov/Library/glossary.php3?mode=alpha&seg=e)

EDUCATION. The process by which individuals develop their knowledge, values, and skills. Education encompasses both teaching and learning. (Source: adapted from The Definitions Project, http://www.definitionsproject.com/)

ENGAGEMENT. A two-way relationship between a service provider and society. It implies a commitment of service to society through a partnership based on reciprocity and sharing of goals, objectives, and resources, e.g., between NOAA and the society it serves. Implicit to engagement is a respect for each partner that involves listening, dialogue, understanding, and mutual support.

ENVIRONMENTAL LITERACY. A fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment, and the ability to understand and utilize scientific evidence to make informed decisions regarding environmental problems.

ENVIRONMENTAL STEWARDSHIP. An ethic whereby citizens value and participate in the careful and responsible management of air, land, water, and biodiversity to ensure healthy ecosystems for present and future generations of all life on Earth. Stewardship of the environment can include conservation, protection, regeneration, and restoration of natural ecosystems and incorporates the use of sustainable practices for human actions that impact these resources.

EVIDENCE-BASED SCIENCE EDUCATION. A teaching methodology that requires the learner to consider discrete factual information to support hypotheses about an observable phenomenon. Facts may be collected using a variety of means including hands-on, field and laboratory science, computer modeling, and/or trusted secondary data sources.

EXPERIENTIAL LEARNING. Experiential education programs engage learners in constructing meaning by immersing them in direct and meaningful hands-on experiences. This experiential approach incorporates learning using real-world problems and interaction with natural phenomena. (Source: Association for Experiential Education, http://www.aee.org/)

EXTENSION. Sustained interaction with specific audiences using education techniques to transfer science-based information or skills that inform decision making and/or change behavior.

FORMAL EDUCATION. Learning within a structured education system in which children or adults are required to demonstrate proficiency.

FREE-CHOICE LEARNING. Self-directed, voluntary education guided by an individual's needs and interests.

INDIGENOUS KNOWLEDGE. The traditions, culture, and belief systems of people whose ancestors inhabited a place or country when persons from another culture or ethnic background arrived on the scene. (Source: http://traditionalknowledge.info/glossary.php)

INFORMAL EDUCATION. Learning outside the established formal system that meets clearly defined objectives through organized education activities.

LIFELONG LEARNING. All learning activity, formal and informal, undertaken throughout life, with the aim of enhancing knowledge, skills, and competencies from a personal, civic, social, and/or employment-related perspective.

LITERACY PRINCIPLES. Essential knowledge validated by a community of researchers, educators, and policy-makers that is needed to fully understand a specific content area and apply it in daily decision making. The determination and refinement of literacy principles is a dynamic, on-going process. Ocean and Climate literacy principles are two examples commonly referenced in NOAA Education.

MINORITY SERVING INSTITUTIONS (MSIS). Colleges and universities, including state colleges, private schools, religiously affiliated colleges, liberal arts colleges, and community colleges, that have a special focus on serving the needs of a minority audience. These universities have a historical tradition or mandate to serve a specific demographic of student, but often serve non-minority students as well.

MISSION CRITICAL DISCIPLINES. Occupations, technical skill sets, and academic studies that fully enable the agency to fulfill its mission to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs. These include, but are not limited to, earth sciences, technology, engineering, mathematics, social science, education, marine trades, marine archaeology, and natural resource management.

NATIVE SCIENCE. The knowledge held by indigenous people around the world that has been gathered, adapted, refined, and transmitted following precise protocols, traditions, and values maintained since before written history. The core of Native science is interdependencies and relationships that make up the whole. (Adapted from The Native Science Academy definition, http://www.silverbuffalo.org/NSA-NativeScience.html)

NOAA SCIENCE. The collection of scientific disciplines that NOAA employs in its investigations, monitoring, evaluating, and forecasting of conditions and trends in the ocean, coasts, Great Lakes, weather, and climate and in building understanding of these natural systems and their relationship with human activities.

OUTREACH. Opportunities designed to build awareness, develop relationships, and inspire action (e.g., pursuit of further learning opportunities, behavioral change). Involves information exchange between provider and target audience. Frequently designed to reach diverse audiences, but can be personal and interactive, designed to identify and appeal to an individual's personal interest or motivation for information.

OUTREACH FOR EDUCATION. Activities that are designed to build awareness, develop relationships, promote education products, and inspire educators, students, and the public to pursue further learning opportunities.

PLACE-BASED EDUCATION. Immerses the learner in local heritage, culture, landscapes, opportunities, and experiences as a foundation for the study of language arts, mathematics, social studies, science, and other subjects. This method of instruction encourages participants to use the schoolyard, community, public lands, and other special places as resources, turning communities into classrooms. (Modified from source: Place-based Education Evaluation Collaborative definition, http://www.peecworks.org/PEEC/Benefits_of_PBE-PEEC_2008_web.pdf)

SERVICE LEARNING. A method under which students or participants learn and develop through active participation in thoughtfully organized service that is conducted in and meets the needs of a community; is coordinated with an elementary school, secondary school, institution of higher education, or community service program, and with the community; and helps foster civic responsibility; and that is integrated into and enhances the academic curriculum of the students, or the educational components of the community service program in which the participants are enrolled; and provides structured time for the students or participants to reflect on the service experience. (Source: The National and Community Service Act of 1990 (42 U.S. Code 12511)).

STEM. An acronym for science, technology, engineering, and mathematics – disciplines that are crucial to maintaining America's competitiveness in a rapidly changing global society (Source: National Academies, 2005).

STUDENT OPPORTUNITIES. Internships, grants, scholarships, fellowships, and educational programs provided to students on a competitive basis for introducing them to careers and/or to support their pursuit of higher education in mission-critical disciplines.

TRAINING. A process of transferring knowledge and skills using standardized instructional methods and techniques to targeted professional audiences for the purpose of developing and enhancing professional competencies.

UNDERREPRESENTED POPULATIONS. Demographic groups that have disproportionately less representation in specific workforce occupations than in the populace.

WORKFORCE DEVELOPMENT. Education, employment, and job training systems designed to provide the skilled workers that employers need to succeed and the education and training that individuals need to succeed in today's labor market. (Source: National Governors Association, 2008).

WORKFORCE DEVELOPMENT PIPELINE. Creation of systematic pathways for facilitating movement of future employees from career exploration through training and education to placement in jobs, providing a sustainable candidate pool of diverse, highly skilled workers to support the needs of industry, government, and academia.

REFERENCES

LEGISLATION

- America COMPETES Act (Public Law 110-69). http://www.glin.gov/view.action?glinID=199941.
- Coastal Zone Management Act (Public Law 109-58); § 1461. National Estuarine Research Reserve System (Section 315). http://coastalmanagement.noaa.gov/about/media/CZMA_10_11_06.pdf
- Coral Reef Conservation Act (Public Law 106-562). http://www.coris.noaa.gov/activities/actionstrategy/08_cons_act.pdf.
- Magnuson-Stevens Fishery Conservation and Management Act (Public Law 109-479). http://www.nmfs.noaa.gov/msa2005/docs/MSA_amended_msa%20_20070112_FINAL.pdf.
- National Marine Sanctuaries Act (Public Law 106-513, Sections 1431 et seq.). http://sanctuaries.noaa.gov/library/National/NMSA.pdf.
- National Sea Grant College Program Act (Public Law 107-299). http://www.seagrant.noaa.gov/GreenBook/gb_documents/pdf_otherfiles/public_law_107_299.pdf.

BOOKS, ARTICLES, AND REPORTS

Building Engineering and Science Talent (BEST) (2004). *What It Takes: Pre-K-12 Design Principles to Broaden Participation in Science, Technology, Engineering and Mathematics.* San Diego, CA: BEST. http://www.bestworkforce.org/PDFdocs/BESTPre-K-12Rep_part1_Apr2004.pdf.

Essential Principles of Climate Literacy (2008). http://www.climate.noaa.gov/education/pdfs/climate_literacy_poster-final.pdf.

Essential Principles of Ocean Literacy (2006). http://www.ngsednet.org/community/resource_uploads/OceanLitBrochure.pdf.

Hoffman, M. and Barstow, D. (2007). *Revolutionizing Earth System Science Education for the 21st Century: Report and Recommendations from a 50-State Analysis of Earth Science Education Standards.* Cambridge MA : TERC Center for Earth and Space Science Education. http://www.oesd.noaa.gov/noaa_terc_study_lowres.pdf.

Huitt, W. and Hummel, J. (2003). Piaget's theory of cognitive development. *Educational Psychology Interactive.* Valdosta, GA: Valdosta State University. http://chiron.valdosta.edu/whuitt/col/cogsys/piaget.html.

Intergovernmental Panel on Climate Change (IPCC) (2007). *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC* (B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, and L.A. Meyer, eds.). Cambridge, UK, and New York City: Cambridge University Press.

Miller, J.D. (2006). *Civic Scientific Literacy in Europe and the United States.* Paper presented at the Annual Meeting of the World Association for Public Opinion Research, Montreal, Canada. http://www.arcsfoundation.org/Pittsburgh/JMiller.pdf.

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies (2005). *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.* http://www.nap.edu/catalog.php?record_id=11463.

National Commission on Mathematics and Science Teaching for the 21st Century (2000). *Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century.* http://www.ed.gov/inits/Math/glenn/report.pdf.

National Geographic Society (2002). Our Environment and Oceans for Life Education Network. http://www.ngsednet.org/community/index.cfm?community_id=128.

National Governors Association (2008). Workforce development definition. http://www.nga.org/portal/site/nga.

National Marine Sanctuary Foundation (2006). *Conference on Ocean Literacy Report.* http://nmsfocean.org/chow2006/pdfs/cool2006.pdf.

National Oceanic and Atmospheric Administration (NOAA) (2008). *NOAA Strategic Plan, 2009-2014.* http://www.ppi.noaa.gov/PPI_Capabilities/Documents/Strategic_Plans/FY09-14_NOAA_Strategic_Plan.pdf.

NOAA (2000). *Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration. The Report of the President's Panel for Ocean Exploration.* http://explore.noaa.gov/media/http/pubs/pres_panel_rpt.pdf.

NOAA Research Council (2008). *Understanding Global Ecosystems to Support Informed Decision Making: A 20-Year Research Vision.* http://www.nrc.noaa.gov/plans_docs/final_20_vision.pdf.

NOAA Science Advisory Board (2006). *Engaging NOAA's Constituents: A Report from the NOAA Science Advisory Board.* http://www.sab.noaa.gov/Reports/EOEWG/EOEWG_Final_Report_03_20_08.pdf.

National Science Board (2008). *Science and Engineering Indicators 2008, Vols. 1-2.* NSB 08-01 (vol. 1); NSB 08-01A (vol. 2). Arlington, VA: National Science Foundation. http://www.spaceref.com/news/viewsr.html?pid=26695.

Office of the President (2005). *U.S. Ocean Action Plan: The Bush Administration's Response to the U.S. Commission on Ocean Policy.* http://ocean.ceq.gov/actionplan.pdf.

Partnership for 21st Century Skills (2004). *Learning for the 21st Century: A Report and Mile Guide for 21st Century Skills.* Washington, DC: Partnership for 21st Century Skills. http://www.21stcenturyskills.org/images/stories/otherdocs/p21up_Report.pdf.

Penuel, W.R., Bienkowski, M., Korbak, C., Molina, A., Russo, D., Toyama, Y., et al. (2005). *GLOBE Year 9 Evaluation: Implementation Supports and Student Outcomes.* Menlo Park, CA: SRI International. http://ctl.sri.com/publications/downloads/GLOBE_Year_9_Report.pdf.

Ritter, M.E. and Lemke, K. A. (2000). Addressing the 'Seven Principles for Good Practice in Undergraduate Education' with Internet-enhanced Education. *Journal of Geography in Higher Education* 24:100-108.

Robinson, L. Rousseau, J. Mapp, D. Morris, V., and Laster, M. (2007). An Educational Partnership Program with Minority Serving Institutions: A Framework for Producing Minority Scientists in NOAA-Related Disciplines. *Journal of Geoscience Education* 55(6):486-492.

U.S. Commission on Ocean Policy (USCOP) (2004). *An Ocean Blueprint for the 21st Century: Final Report of the USCOP. Washington, DC: USCOP.* http://oceancommission.gov/documents/full_color_rpt/welcome.html.

U.S. Department of Education (ED) (2007). *Report of the Academic Competitiveness Council.* Washington, DC: ED. http://www.ed.gov/about/inits/ed/competitiveness/acc-mathscience/index.html.

IMAGE CREDITS

(B=Bottom, C=Center (vertical), L=Left, M=Middle (horizontal), R=Right, T=Top)

Alcorn State University, Lorman, MS (28BC)
Getty Images (Cover C, 4, 15T)
Goodge, J., University of Minnesota Duluth, Duluth, MN (Cover TR)
Hampton University, Hampton, VA (14L)
National Aquarium in Baltimore, Baltimore, MD (29L)
NOAA, Aircraft Operations Center (34C)
NOAA, Bay-Watershed Education & Training Program (28T)
- Dungeness River Audubon Cntr., Sequim, WA, Boekelheide, B. (10TL, 10ML, 25C)
- Gulf of Maine Research Institute, Portland, ME (19T)
- Sultana Projects, Inc., Chestertown, MD (10MC)

NOAA, Chesapeake Bay Office (20L, 28T)
NOAA, Climate Program Office (31B)
NOAA, Earth System Research Lab (14RT)
NOAA, National Centers for Coastal Ocean Science (10TC)
NOAA, National Estuarine Research Reserve System (2, 10TR)
- Hudson River National Estuarine Research Reserve (5)
- Appalachicola Reserve National Estuarine Research Reserve (20M)
- Chesapeake Bay - Virginia National Estuarine Research Reserve (21B)
- Weeks Bay National Estuarine Research Reserve (16L)

NOAA, National Marine Fisheries Service (26R, 35B)
- Alaska Fishery Science Center, Csepp, D. (28T)
- NEMO Program/DC Public Schools, Oremland, L. (28ML)
- Southeast Fisheries Science Center, Schull, J. (7M, 22L, 33B)
- Southwest Fisheries Science Center, Adam, U. (18R)

NOAA, National Ocean Service, Hall, D. (22M)
NOAA, National Weather Service (16R)
NOAA, National Severe Storms Laboratory, Clark, C., (10BL)
NOAA, NESDIS (Cover BL, 10ML, 14RB, 19B, 28MR)
NOAA, Office of Education (Cover TL, 13RT, 16C, 25T, 28BL, 32C, 35T, 36L, 36C)
NOAA, Office of National Marine Sanctuaries (7T, 26L, 31T)
- National Office, Fackler, C. (1, 8M, 11L, 11RT, 12, 13RB, 21T, 29TR, 33T)
- Channel Islands National Marine Sanctuary, Francis, L. (6T, 22R, 34L, 34R)
- Monterey Bay National Marine Sanctuary, King, C. (32R)
- Stellwagen Bank National Marine Sanctuary, Smrcina, A. (11RB)
- West Coast Region, Schwemmer, R. (28TR)

NOAA, Office of Ocean Exploration (8T, 20R, 24C, 28M, 29BR), Elliot, K. (18L)
NOAA, Sea Grant College Program (18C)
NOAA, Teacher at Sea Program (10BC, 15B, 32L, 36R)
North Carolina Aquarium, Raleigh, NC (23T, 24L, 24R, 25B)
RFPhotography.com/Orlando Science Center, Orlando, FL (Cover BR)
Reges, H., Community Collaborative Rain, Hail, & Snow Network (13L)
Waikiki Aquarium, Honolulu, HI (23B)

For more information please visit: www.education.noaa.gov/plan/

The NOAA Education Portal provides links to all the major education programs from across the agency. It serves as a gateway to educational resources, student opportunities, grant funding announcements, professional development activities, and more.