



NOAA EDUCATION
Advancing Environmental Literacy

2 National Oceanic and Atmospheric Administration

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NOAA's Education Strategic Plan

Science, Service, and Stewardship

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2008 - 2028

Draft: July 14, 2008

http://www.oesd.noaa.gov/draft_ed_plan.html

1

2 NOAA’s Education Plan: Preface

3 *A world of change...*

4
5 *In 1807, President Thomas Jefferson created America’s Coast Survey in order to identify*
6 *hazards and promote the growth of commerce. In this act were sown the seeds of today’s*
7 *National Oceanic and Atmospheric Administration (NOAA). Now, NOAA scientists study*
8 *the mysteries of our dynamic planet in order to understand and warn us of nature’s hazards*
9 *and guide our prudent stewardship of our ocean and atmospheric resources.*

10
11 *With the pace of global change increasing, the task has new urgency. Mere information is*
12 *not enough. We must promote environmental citizenship and enable each person to act on*
13 *his or her understanding of our ocean’s and atmosphere’s complex, interwoven systems.*
14 *NOAA’s education efforts now reach well beyond coastal hazards and weather warnings.*
15 *The nature of scientific inquiry itself, place-based education, and workforce development*
16 *are all critical components in NOAA’s education mission and to our Nation’s future*
17 *competitiveness. In this endeavor NOAA does not work alone. Creative partnerships both*
18 *within and outside of government are necessary, as well as a focus on the whole individual*
19 *and thriving communities. NOAA’s new strategy for education embraces these challenges*
20 *and mobilizes us to build on our tradition for the benefit of all Americans of the future.*

21
22 *...A new generation of environmental citizens.*

23
24 Throughout its two hundred year history the National Oceanic and Atmospheric Administration (NOAA)
25 has imparted scientific knowledge of Earth’s natural systems to the global community. During this time
26 the endeavor to educate was guided by the mandates of legislation for units within NOAA, the vision of
27 leadership, the findings of researchers, and at the request of its constituency. In 2007, Congress officially
28 recognized the role of NOAA in Earth system science education with the passage of the *America*
29 *COMPETES Act* (P.L. 110-69). This legislation provides a mandate for the entire NOAA community to
30 advance its educational efforts, focus them, coordinate them, and engage a broader community of partners
31 in creating an environmentally literate society and a viable workforce of scientists, managers, and
32 administrators in support of a sustainable future. This strategic plan was developed through a
33 collaborative effort of educators and administrators from across NOAA to guide the implementation of
34 this new mandate and to advance the long standing educational mission of the agency.

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50

1 NOAA's Vision

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

4 NOAA's Education Mission

5 To advance environmental literacy and promote a diverse workforce in ocean, coastal, Great
6 Lakes, weather, and climate sciences to encourage stewardship and increase informed decision
7 making for the Nation.

8 NOAA's Mandate to Educate

9 NOAA's role in science education is defined in statute. Most recently, the *America COMPETES Act*
10 (P.L. 110-69) states:

11
12 *“The Administrator of the National Oceanic and Atmospheric Administration shall conduct,*
13 *develop, support, promote, and coordinate formal and informal educational activities at all*
14 *levels to enhance public awareness and understanding of ocean, coastal, Great Lakes, and*
15 *atmospheric science and stewardship by the general public and other coastal stakeholders,*
16 *including underrepresented groups in ocean and atmospheric science and policy careers. In*
17 *conducting those activities, the Administrator shall build upon the educational programs and*
18 *activities of the agency.”*
19

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

23
24 The *America COMPETES Act* complements the standing legislation of the National Sea Grant Program,
25 National Marine Sanctuaries, National Estuarine Research Reserve System and the Corals Program.
26 Together these statutes provide a unifying mandate for education across the agency. The philosophy and
27 priorities of this strategic plan are guided by these statutes, directly support the strategic vision of NOAA
28 (2008) and guided by the directives and recommendations of recent reports (see examples listed below)
29 on the need for science education reform and the advancement of lifelong learning opportunities in ocean,
30 coastal, Great Lakes, weather, and climate sciences.
31

Statutes for NOAA Education	Supporting Directives for Education
<ul style="list-style-type: none">• National Sea Grant College and Program Act of 1966 (Public Law 89-688)• National Marine Sanctuary Act (16 U.S.C. Chapter 32, Sections 1431 et seq.)• Coastal Zone Management Act (16 U.S.C. 1451 – 1465); § 1461. National Estuarine Research Reserve System (Section 315)• Coral Reef Conservation Act of 2000 (Public Law 106-562)• America COMPETES Act (P.L. 110-69)	<ul style="list-style-type: none">• The U.S. Commission on Ocean Policy, <i>An Ocean Blueprint for the 21st Century</i> (2004)• The President's <i>U.S. Ocean Action Plan</i> (2005)• National Academies Report: <i>Rising Above the Gathering Storm</i> (2005)• The Intergovernmental Panel on Climate Change Report: <i>Mitigation of Climate Change</i> (2007)• <i>Report of the Academic Competitiveness Council</i> (2007)

1 NOAA's Education Priorities

2 In preparing this 20-year vision of Education for NOAA the planning committee considered a broad array
3 of perspectives, research findings, and legal statutes. Based on the strengths and mission of the agency
4 and the future needs of our society the agency has established two primary education goals of *building*
5 *environmental literacy* and *developing a future workforce*.

6
7 Environmental literacy is an integral component needed to achieve NOAA's mission goals to manage
8 marine resources and protect life and property. An educated public is needed to serve as stewards of the
9 natural environment, take appropriate action in the case of severe weather and participate in the national
10 debate on complex issues such as climate change. Recent surveys suggest that participation levels in
11 formal and informal education, particularly higher education, are strong indicators of the ability of
12 citizens to understand science and technology in order to participate in public policy decisions (Miller,
13 2006). NOAA plays a key role in advancing this understanding through its educational programs,
14 products, outreach efforts, collaborations, and leadership supported by the agency's extensive breadth and
15 depth of scientific resources.

16
17 <image – Ocean Exploration and Research graphic showing research vessel, submersible, satellite>

18
19 In the Congressional report *Rising Above the Gathering Storm* (National Academy of Sciences, 2005)
20 building a workforce literate in science, technology, engineering, and mathematics (STEM) is crucial to
21 maintaining America's competitiveness in a rapidly changing global economy. These skills are also
22 critical in the continuation of NOAA's scientific mission. As the population pressures increase on the
23 natural systems of Earth, understanding the complexities of human impacts and developing strategies for
24 sustainable solutions requires the brightest minds. An analysis of K-12 curriculum standards from across
25 the U.S. found that the Nation's educational institutions are poorly positioned to address the preparation
26 of this workforce (Hoffman, Martos and Barstow, 2007). Scientific concepts of interactive Earth systems,
27 integration of 21st century investigative technologies, and ocean and environmental literacy principles and
28 concepts, all important foundations to NOAA's work, were found lacking in the Nation's current
29 educational system. Through continued partnerships with formal and informal education institutions and
30 direct engagement and support of teachers and students, NOAA strives to bridge this gap to address the
31 future workforce needs of the agency and of the broader scientific community.

32
33 <image – Fisheries scientist at work examining live shark specimen.>

34 Partnerships and Collaboration

35
36 NOAA, as the Nation's leading oceanic and atmospheric science and service agency, has the
37 responsibility to increase its coordination and collaboration within the ocean, coastal, Great Lakes,
38 weather, and climate science and education communities. The passage of the *America COMPETES Act*
39 further solidifies this role and provides a mandate for the agency to serve as a catalyst in the
40 strengthening of ocean and atmospheric science education. Rich opportunities are available for
41 integrating the relevance of scientific research concerning the world's weather, climate, ocean, coasts,
42 and watersheds into education products and services for the Nation's citizenry.

43
44 <image – Students receive aquatic ecology lesson at partner aquarium>

45
46 NOAA actively participates in interagency education working groups and committees organized under
47 the *U.S. Ocean Action Plan* (Office of the President, 2005), the Climate Change Science Program, and
48 the National Science and Technology Council. Outside of the Federal arena, partnerships are developed
49 through funding agreements, shared educational content, or collaborative work on projects of common

1 interest. These arrangements allow the Nation to benefit from the considerable capacity for developing
2 and delivering education content that exists within the broader educational community. Important
3 NOAA partners include museums and aquariums, professional societies, education associations, state
4 and local governments, academia, and other education practitioners. The recent publication of the
5 *Essential Principles of Ocean Literacy (National Geographic Society, 2006)* and *Essential Principles of*
6 *Climate Literacy (NOAA, 2008)* are excellent examples of the progressive work that can be
7 accomplished through these types of collaborative efforts.
8

9 NOAA’s Education Standards

10
11 NOAA is committed to development and support of education programs and products that exhibit
12 standards of high-quality. At NOAA, education activities are:

- 13 • *aligned with NOAA’s strategic goals and include measurable objectives;*
 - 14 • *aligned with appropriate national or state education standards;*
 - 15 • *reflective of current environmental literacy principles and concepts;*
 - 16 • *designed to incorporate the needs of the participants;*
 - 17 • *designed to be replicable, consistent in quality, and sustainable; and*
 - 18 • *are continually evaluated and improved.*
- 19
20
21

22 *Editors Note:*

23 *In the final version of this document it is envisioned that images and short sidebar*
24 *examples highlighting longstanding “signature” education programs at NOAA will be*
25 *included throughout. These examples will be used to reinforce the concepts presented*
26 *in the text as well as showcase the breadth of highly regarded education*
27 *programming from across the agency and through NOAA’s education partners. In*
28 *this draft brief references to possible image and graphic composition are denoted by*
29 *<image>.*

1 Goal 1: Environmental Literacy

2
3 **Goal 1: An environmentally literate public developed through a continuum of lifelong**
4 **formal and informal education and outreach opportunities in ocean, coastal,**
5 **Great Lakes, weather, and climate sciences.**
6

7
8 Achievement of NOAA’s strategic vision is dependent upon an *environmentally literate* public who is
9 aware of the agency’s services and understands how scientific observations, forecasts, and regulatory
10 activities affect their personal, business, and community decisions. Leaders in Earth system science
11 education echo this need stating that public understanding of Earth’s interconnected systems is crucial to
12 our ability to apply knowledge and problem solving skills to real world issues (Hoffman, Martos and
13 Barstow, 2007). NOAA defines an environmentally literate person as *someone who has a fundamental*
14 *understanding of the systems of the natural world, the relationships and interactions between the living*
15 *and non-living environment, and is able to understand and utilize scientific evidence to make informed*
16 *decisions regarding environmental problems. These problems involve uncertainty, as well as economic,*
17 *aesthetic, and ethical considerations.* The outcomes and strategies presented for this goal provide a six-
18 tiered approach of interdependent actions the agency will pursue to achieve NOAA’s vision of developing
19 environmental literacy skills and knowledge in the Nation’s citizenry. Provided below are four themes
20 which are integral to these actions.

21 Promoting Stewardship

22
23
24 <image – MERITO program conducting beach cleanup in Monterey Bay National Marine Sanctuary>
25

26 In addition to its scientific mandate, NOAA plays a leading role in the conservation, management, and
27 restoration of ocean, coastal, and Great Lakes resources. The stewardship of these resources for current
28 and future generations is critical to the long-term sustainability of society and the planet. Monitoring the
29 health of these ecosystems and building understanding of the relationships between the ocean and other
30 Earth systems is a core mission of the organization. Over the last 100 years human actions have greatly
31 altered these natural systems seriously threatening the resources under NOAA’s jurisdiction. Scientists
32 and economists recognize that the pressure on the environment will increase with the globalization of
33 world markets, population shifts, and the race for economic growth forecasted for the 21st century.
34 NOAA alone cannot manage these issues. Partnering with the public to share stewardship responsibilities
35 is a necessity; environmental literacy is the first step in that process.

36 Facilitating Change in Education Systems

37
38
39 <image – Sea Grant teacher development field class>
40

41 Environmental literacy is a lifelong process. Developing the skills of locating, evaluating, and integrating
42 current science in the context of prior knowledge is a process involving formal and informal education.
43 Our Nation’s K-12 formal education system has not established a strong framework to support this
44 development particularly in the oceanic and atmospheric sciences relevant to NOAA’s mission. NOAA is
45 committed to support and facilitate system-wide change of the formal educational system to build future
46 capacity for developing environmentally literate citizens. Such change requires participation across the
47 spectrum of the education community including policy makers, academic training institutions,
48 professional associations, teachers, and students. Partnerships and collaboration are integral to
49 establishing these changes.

1 The programs and products of the informal education sector are better developed in the areas of ocean,
2 coastal, Great Lakes, weather, and climate sciences but more must be done to infuse this community with
3 current resources and methodologies. NOAA is committed to facilitating improvement of program
4 effectiveness evaluation in informal settings to enhance environmental literacy. NOAA must be engaged
5 in the improvement of this system as well to achieve this goal because these venues are important to the
6 development of literate citizens and to the long-term maintenance of their skills and knowledge.

7
8 <start text box – title: **Definitions of Education and Outreach**>

9
10 **Formal education:** Learning within a structured education system in which children or adults are required
11 to demonstrate proficiency.

12
13 **Informal education:** Learning outside the established formal system that meets clearly defined objectives
14 through organized educational activities.

15
16 **Free-choice learning:** Self-directed, voluntary education guided by an individual’s needs and interests.

17
18 **Educational Outreach:** Activities which are designed to build awareness, develop relationships, promote
19 educational products, and inspire educators, students, and the public to pursue further learning
20 opportunities.

21
22 <end text box>

23 24 Connecting Citizens to Nature and the Community

25
26 <image – BWET group in National Estuarine Research Reserve planting aquatic plants>

27
28 Making a connection between human actions, scientific information, policy, and Earth’s systems is
29 important to the process of environmental literacy. Framing this process in a local context within the
30 social framework of one’s community and the associated regional resources makes these lessons more
31 powerful and longer lasting. NOAA embraces two educational methodologies which have been shown to
32 greatly enhance these connections: experiential education and place-based education.

33
34 Experiential education programs engage learners in constructing meaning by immersing them in direct
35 and meaningful hands-on experiences. This experiential approach incorporates learning using real world
36 problems and interaction with natural phenomena. A considerable body of cognitive research exists to
37 provide evidence that learners are not passive recipients of knowledge but rather active participants (Huitt
38 and Hummel, 2003). The experiential learning process is one component of NOAA's repertoire that helps
39 to ensure learners are actively and purposefully engaged in posing questions, investigating,
40 experimenting, developing curiosity, solving problems, assuming responsibility, being creative, and
41 constructing meaning.

42
43 Place-based education immerses the learner in local heritage, culture, landscapes, opportunities, and
44 experiences as a foundation for the study of language arts, mathematics, social studies, science, and other
45 subjects. This method of instruction encourages participants to use the schoolyard, community, public
46 lands, and other special places as resources, turning communities into classrooms. NOAA National
47 Marine Sanctuaries and National Estuarine Research Reserves provide excellent venues for applying this
48 methodology, offering a real-world context for learning and stimulating “hands-on/minds-on”
49 opportunities for education. NOAA facilities throughout the Nation play an important role as well in

1 imparting the relevance of ocean and atmospheric science to their local communities through these place-
2 based educational experiences.

3
4 Using Emerging Technologies

5
6 *<image – satellite image of El Niño as viewed in Second Life Virtual world>*
7

8 Advances in technology change the way we interact as a society and impact our view of the world around
9 us. Maintaining a presence in this new information age and keeping educational approaches relevant to
10 new learning modalities are important to the continued success of NOAA’s environmental literacy goal.
11 Many of the advances in NOAA science rely on these technological developments and there is a
12 commitment and directive to build collaborative networks and monitoring systems to enhance the
13 delivery of comprehensive Earth system, ocean, and atmospheric data to the public. While NOAA
14 considers a broad array of methodologies in communicating environmental literacy concepts to the public,
15 the use of new, innovative, and engaging technologies to increase the efficiency and utility of this
16 information is a high priority for the agency.

17
18 *<start text box – Title: **Scientific Foundations for Education**>*

19 *<image – Divers conducting coral reef survey from Corals Program>*

20
21 The foundation for educational content is centered on the scientific work of NOAA. Often referred to as
22 *NOAA sciences*, the core of this work is the investigation of patterns, features, and interactions of Earth’s
23 ocean, coasts, Great Lakes, weather, and climate. The study of these physical systems requires a broad
24 array of scientific disciplines, technology, mathematics, and engineering. Social sciences are also
25 employed both in learning how humans interact with these resources and how to build understanding and
26 partnerships in their long-term stewardship. These Earth systems are complex and no single scientific
27 discipline can capture the cause and effect of changes within. Observing coral reef health is a lesson in
28 global climate, hydrology, oceanography, biology, chemistry, fisheries management, and marine
29 economics. Likewise, projecting future climate is a product of computer science, statistics, sociology,
30 meteorology, climatology, and other sciences. Infusing the findings and processes of this work into
31 education, and training a new generation of scientists to continue this work are central to the NOAA
32 education mission.

33 *<end text box>*

34

1 Outcome 1.1 Evaluation and Research for Effective Programs

2 Recent years have seen many advances in our understanding of how the mind works and the process of
3 learning. Incorporating this research into the design and implementation of educational programs in both
4 formal and informal settings has begun. The infusion of this knowledge proves beneficial in creating new
5 programs and revising existing educational efforts targeting increased environmental literacy. A product
6 that is able to bridge the gap between sound scientific principles and practical application in the learning
7 environment is one that is likely to be proven effective (Ritter and Lemke, 2000). Improving
8 effectiveness of programs and products by using the best practices and the latest knowledge is an
9 important part of NOAA’s education plan.

10
11 In the report “*BEST: What it Takes*,” (BEST, 2004) a Blue Ribbon Panel reviewing best practices in K-12
12 education notes: “Evidence matters because outcomes matter and resources are limited. It is important to
13 ensure that the investments in money, time, and human capital have a high probability of paying off.
14 Good intentions and passionate commitment are not enough to fill the science and technology pipeline”
15 (Partnership for 21st Century Skills, 2004). Developing methods that accurately and efficiently evaluate
16 these outcomes is an ongoing challenge in the educational community. Much work has been done by
17 Federal agencies and their education partners to advance the evaluation process and much work remains.
18 As part of the quality standards for NOAA Education the agency is committed to pursuing this line of
19 investigation to improve the results of its efforts and to contribute to the body of knowledge regarding
20 effective environmental and science education. Building evaluation capacity of NOAA educators and
21 developing a coordinated system to capture and share these findings are key elements in achieving this
22 outcome.

23 24 25 26 **Outcome 1.1: NOAA education programs are based on the best available science related to** 27 **effective environmental and science education.**

28 29 *Strategies*

- 30
31 a) Support and use educational practices based on research to inform the development and
32 implementation of education programs and products.
33 b) Develop and implement a framework of evaluation strategies based on educational research
34 findings and consistent with interagency evaluation efforts.
35 c) Contribute to educational research about effective science and environmental education.
36
37
38

Outcome 1.2 Educators Understand and Use Literacy Principles

An environmentally literate citizenry is essential to protect fragile ecosystems and build sustainable communities that are resilient in the face of a changing Earth. NOAA together with partner agencies and organizations in the science community have developed ocean and climate environmental literacy frameworks that identify the essential principles and fundamental concepts individuals need to understand in order to make appropriate decisions about human activities that affect our planet. These frameworks are designed to support efforts to improve development of state standards, curricula, assessments, teacher certification and the informal education landscape.

< image – *Ocean and Climate Literacy Brochure Covers* >

<start text box – Title: **Ocean and Climate Literacy Principles** >

Development of environmental literacy principles has gained the attention of the scientific, education, and research communities. NOAA played a leading role in the collaborative process to develop principles and conceptual frameworks for ocean and climate literacy. These documents, *Oceans for Life*, *Essential Principles for Ocean Literacy*, and *Essential Principles for Climate Literacy*, are aligned with national education standards to facilitate use of the concepts in both formal and informal education settings. As these two 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. NOAA is also actively involved in other efforts to create new literacy frameworks which incorporate other aspects of Earth system science. As these products are completed they will be integrated into future educational work at NOAA. <end text box>

Additionally, a gap exists between the scientific knowledge and skills most students learn in school and what they will need in 21st century communities and workplaces. 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 of Science, 2005; National Commission on Mathematics and Science Teaching for the 21st Century, 2000). NOAA believes integration of environmental literacy frameworks into formal and informal education is an important contribution towards addressing this gap in science literacy. The agency’s support and promotion of experiential and place-based education programs extends the classroom to teach concepts through interdisciplinary methods that improve the active engagement of students in real scientific inquiry, increase the incorporation of important environmental concepts, and improve environmental stewardship behavior (Penuel et al., 2005). Expanding the awareness of these approaches and literacy frameworks, building confidence in the application of the teaching methods and providing support services in their application are part of NOAA’s strategy in addressing this need.

Outcome 1.2: Educators understand and use environmental literacy principles

Strategies

- a) Support the development, dissemination, and adoption of environmental literacy principles.
- b) Integrate environmental literacy principles into professional development programs.
- c) Improve the quality and reach of these professional development programs.
- d) Strengthen place-based experiences based on environmental literacy principles.
- e) Partner with external groups to infuse environmental literacy principles into state and national standards, curricula, assessments, educator certification, and the informal education landscape.

1 Outcome 1.3 Evidence-based Earth System Science

2
3 *<image - students collecting data as part of Sea Grant program rocky intertidal study to*
4 *demonstrate conduct of scientific investigation>*
5

6 Technological improvements over the last decade have advanced the ability of NOAA and other agencies
7 to monitor, assess, and make predictions about Earth’s changing environmental systems. Through
8 satellites, aircraft, ships, remote sensing systems, and direct scientific monitoring by a global scientific
9 network NOAA and other Federal agencies collect data on climate, weather, the ocean, and other natural
10 phenomena. NOAA has a long standing commitment to share this information with scientists, industry,
11 government, and the public through a variety of media and interactive data portals. These data are critical
12 to NOAA products and services that help our society make better decisions about how to conduct
13 business, monitor public health, and protect life and property.
14

15 Developing the ability of students and educators to formulate and conduct scientific investigations
16 independently to explore relationships within Earth’s natural systems is a central goal of environmental
17 science education and supports the advancement of environmental literacy. Ocean, coastal, Great Lakes,
18 weather, and climate sciences provide rich subject matter for learning these skills. By extending existing
19 public portals for downloading imagery, real time, and archival data, NOAA has begun the process of
20 creating specialized products designed to facilitate the integration of this material into educational
21 experiences. Programs such as the Science on a Sphere[®], NOAA Ocean Data Education (NODE) Project,
22 the U.S. Integrated Ocean Observation System (IOOS), Estuaries 101, and Chesapeake Bay Interpretive
23 Buoys (CBIB) utilize NOAA data and visualizations to help learners recognize patterns and process, and
24 translate research-discoveries or natural phenomenon. Additionally, NOAA is committed to creating and
25 supporting virtual and hands-on experiential opportunities in ocean, coastal, Great Lakes, weather, and
26 climate science disciplines which focus on user collected data. Programs such as Bay Watershed
27 Education and Training Program (BWET), Long-term Monitoring Program and Experiential Training for
28 Students (LiMPETS), EarthLabs, JASON and Teacher-at-Sea are current examples of this work.
29 Continued efforts in this area will strengthen the skills of the abilities of the learners and help build long-
30 term relationships with NOAA.

31
32 **Outcome 1.3: Educators and students collect and use ocean, coastal, Great Lakes, weather,**
33 **and climate science data in inquiry and evidence-based activities to**
34 **understand the Earth’s systems and make informed decisions regarding the**
35 **environment and its resources.**
36

37 *Strategies*

- 38 a) Support and implement professional development to strengthen science understanding
39 and build fundamental decision making skills.
- 40 b) Create and disseminate audience appropriate products and services that facilitate access
41 to and use of current ocean, coastal, Great Lakes, weather, and climate science and data
42 through multiple platforms and emerging technologies.
- 43 c) Partner with external groups to maximize the integration and use of these products.
44

1 Outcome 1.4 Informal Science for Lifelong Learners

2 “Lifelong learning” is an important component of an environmentally literate citizenry. Conceptually this
3 process allows each individual to incorporate current scientific, economic, and social data into daily
4 decision making adding to their personal knowledge base throughout their lives. Quality learning
5 opportunities beyond the K-12 education system and academia must be made available to continue this
6 process. The science attentive public, those citizens that actively display an interest in learning about the
7 scientific process, provide an ideal audience for introducing environmental literacy concepts. By
8 providing this audience with sufficient information to move their knowledge beyond basic awareness,
9 NOAA serves as a catalyst and a valued information source in a lifelong-learning partnership.

10
11 To achieve this outcome, NOAA engages in informal science education activities at local, state, regional,
12 multi-state, and national levels. NOAA’s vast experience and infrastructure for monitoring Earth’s
13 systems and modeling future trends uniquely positions the agency to provide citizens with the most
14 current information available on these resources. This information is also essential in managing the
15 ocean, coastal, and Great Lakes resources in which NOAA is entrusted. Building public understanding of
16 how our Nation’s natural resources are managed and the importance of these resources is a key element in
17 the agency’s stewardship mission. To provide for the lifelong learner, NOAA offers comprehensive
18 education programs that touch on all of these areas and provide a critical connection to the needs of
19 communities.

20
21 *<image - public viewing an exhibit featuring Science On a Sphere® at Free Choice learning center>*
22

23 Connecting citizens directly to natural resources needing protection through hands-on experiences is a
24 key element of the NOAA educational approach. Place-based and experiential education experiences
25 provide direct application of the multi-disciplinary science NOAA conducts and promotes stewardship.
26 Working in partnership with informal science centers to infuse Earth system science topics into free-
27 choice learning allows NOAA to extend its ability to reach the science attentive public. Application of
28 emerging technologies allows NOAA to increase the impact of the content presented by engaging this
29 community in their preferred methods of learning. Citizen scientist networks, groups of volunteers, often
30 with limited scientific training, who conduct scientific research, assist NOAA in a variety of settings.
31 Groups monitor coral reef health, collect local weather information, assist with marine archeology and
32 conduct estuarine habitat studies to cite a few examples. Partnering with these groups to increase their
33 knowledge of the scientific process and to support their volunteer efforts to advance NOAA’s mission is
34 another important strategy in achieving this outcome.
35

36 **Outcome 1.4: Lifelong learners are provided with informal science education opportunities** 37 **focusing on ocean, coastal, Great Lakes, weather, and climate topics.**

38 *Strategies*

- 39 a) Partner with free-choice learning programs to integrate current ocean, coastal, Great
40 Lakes, weather, and climate science content into their programs.
- 41 b) Establish and collaborate with networks of informal science education institutions to
42 identify best practices for science content delivery.
- 43 c) Use innovative technology to reach and impact citizens.
- 44 d) Collaborate with citizen-science networks to support their participation in the scientific
45 process.
- 46 e) Provide place-based experiences that facilitate hands-on exploration of natural
47 environments.

1 Outcome 1.5 Interagency Partnerships

2 Many science and resource management agencies contribute to the goal of enhancing environmental
3 literacy. NOAA’s ocean and climate education efforts, for example, are complemented by the
4 interpretive education programs of the National Park Service, the Earth science programs of NASA and
5 the U.S. Geologic Survey, and the Science, Technology, Education, and Mathematics (STEM) education
6 programs of the National Science Foundation, to name a few. NOAA contributes unique assets of
7 laboratories, field sites, monitoring systems, extension, and education networks that provide real-world
8 applications and are specific expressions of Earth system and environmental sciences.

9
10 <image – group photo showing interagency management partnership at Channel Islands National
11 Marine Sanctuary>

13 **Outcome 1.5: NOAA works cooperatively to maximize the impact of federal investment in 14 ocean, coastal, Great Lakes, weather, and climate education.**

16 *Strategies*

- 17 a) Leverage NOAA’s interagency capabilities and resources to serve as a catalyst for
18 coordinated environmental literacy education.
- 19 b) Provide leadership on interagency working groups to develop and disseminate consistent
20 literacy frameworks for Earth system sciences.
- 21 c) Lead and participate in interagency projects and programs that promote ocean, coastal,
22 Great Lakes, weather, and climate science.
- 23 d) Work across agencies to develop consistent performance metrics for formal and informal
24 education in STEM and environmental science disciplines.

25
26
27 Collectively, the science and resource management agencies collaborate in many ways to promote Earth
28 system science and environmental education. Standing examples of these interagency collaborations are:

- 29 • The *National Ocean Sciences Bowl*, which is jointly funded by eight Federal agencies and
30 supports annual regional and national competitions for high school students.
- 31 • The *Centers for Ocean Science Education Excellence* promote partnerships between scientists
32 and educators to create a more scientifically literate workforce and citizenry.
- 33 • *Partners in Resource Education*, a network of environmental education programs in National
34 Parks, National Wildlife Refuges, National Marine Sanctuaries, National Forests, and other field
35 classrooms.
- 36 • The Smithsonian Ocean Hall, an exciting new venue to promote understanding of *Ocean*
37 *Literacy* concepts.
- 38 • National and international education activities, such as the International Polar Year and
39 International Year of the Reef.
- 40 • *Coastal Ecosystem Learning Centers*, a network of informal centers (museums, aquariums, and
41 science centers) that promote environmental literacy through annual visitation by millions of
42 local, regional, national, and international guests.

1 In addition to informal relationships across agencies, NOAA provides leadership or is represented in
2 several formal interagency partnerships including:

- 3 • The Interagency Working Group on Ocean Education, established under the *U.S. Ocean Action*
4 *Plan*. This body develops implementation plans to: coordinate activities, develop common
5 messages, develop ocean data products for classrooms, and focus on a future workforce. The
6 Ocean Research and Resources Advisory Panel provides guidance for this group.
- 7 • The Interagency Working Group on Climate Education, established under the Climate Change
8 Science Program, coordinates climate education activities across agencies.
- 9 • The Education and Workforce Development Subcommittee under the National Science and
10 Technology Council focuses on STEM education activities, particularly evaluation.

11 12 Outcome 1.6 Coordinated Educational Efforts

13 NOAA provides ongoing support for local, regional, and national decision makers, constituent groups,
14 and the public to contribute to sustaining ocean and atmospheric resources. Because people make
15 informed decisions at the policy, community, and individual level, NOAA strives to engage audiences
16 from Congress to the public to develop knowledge, skills, and strategies to protect ocean, coastal, and
17 Great Lakes resources and prepare for changing weather and climate.

18
19 <start text box – Title: **Engagement**>

20 This term generally applies to an open and ongoing dialogue between NOAA and the public. This
21 dialogue leads to partnerships to address jointly the problems and opportunities facing society particularly
22 in the areas of ocean, coastal, Great Lakes, weather, and climatic sciences. This concept strongly
23 supports the concept of NOAA as a service agency where goals, objectives, and resources of the agency
24 are shared with society. Implicit to engagement is a respect between partners that involves listening,
25 dialogue, understanding, and mutual support (NOAA Science Advisory Board, 2008).

26 <end text box>

27
28 NOAA provides a continuum of activities, from education to outreach, extension, training, and
29 communications that promote environmental literacy and informed decision making. Collectively, these
30 activities reach across a wide array of audiences. The 2008 NOAA Science Advisory Board report
31 “*Engaging NOAA’s Constituents*,” recommended that the agency expand its efforts to collaborate across
32 disciplines to fully engage audiences to address the problems and opportunities facing society.
33 In this way, NOAA can better mobilize internal and partnership networks to achieve mission goals.

34 35 36 **Outcome 1.6: Education is coordinated with extension, training, outreach, and** 37 **communications programs to fully engage NOAA audiences to promote** 38 **environmental literacy and informed decision making**

39 40 *Strategies*

- 41
42 a) Develop and deliver a suite of coordinated activities that reach multiple audiences and
43 promote informed decision making.
- 44 b) Integrate engagement into new program activities at national, regional, and community
45 levels.
- 46 c) Develop a framework to assess NOAA’s ability to engage constituents.

1 <image – collage of 3 images showing public, constituents, and decision makers>
2 <start text box – title: **NOAA Engages Audiences across a Continuum of Activities**>
3 • Extension and training provide science-based information to bring about positive economic or
4 environmental change to targeted *constituents* and *decision makers*.
5 • Education provides science-based information to specific *constituents* (educators and students) and to
6 the *public* to promote environmental literacy and attract a future workforce.
7 • Outreach and communication develops and delivers common messages on priority topics for *all*
8 *audiences*.
9 <end text box>
10

DRAFT

Goal 2: Workforce Development

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

NOAA's employees are its most important asset. With this in mind, the agency requires a skilled workforce that is well-educated in science, technology, education, policy, and management working to fulfill its mandates and mission. Similar to other Federal agencies, NOAA has an aging workforce where nearly forty percent of its employees are eligible to retire by 2014. To ensure a vigorous pipeline of qualified candidates, NOAA must undertake education and recruitment activities for strategic workforce development. This goal and supporting outcomes outline a strategy that NOAA will employ to extend the current education and recruitment pipeline to meet tomorrow's workforce needs at NOAA, and in organizations supporting NOAA's mission. The following concepts and terms are central to this strategy.

<image – Picture of Knauss student(s) at work>

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 employers need to succeed and the education and training individuals need to succeed in today's labor market*” (National Governors Association, 2008). At NOAA these systems are provided through various agency offices and through partnerships with the education and research community. 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 professional development in NOAA mission critical careers. Scientific literacy and stewardship skills are introduced through the programs developed through Goal 1 of this plan. Goal 2 programs build student's professional competency and helps them transition into the working community. These activities are coordinated with the NOAA Workforce Management Office which handles recruitment, hiring, and employee training.

NOAA Mission Critical Disciplines

Although NOAA is known for its scientific work, to fully enable the agency to fulfill its mission requires a workforce with a variety of backgrounds. Different skill sets support one another and are considered “Mission Critical.” Provided here are several examples of the interdependency of these disciplines:

- By nature NOAA's oceanic investigations require traveling on, under, and above the water employing ocean going vessels, submersible craft, airplanes, and satellites. These craft require operators, technicians, and engineers with specialized knowledge without which missions to chart the ocean floor, monitor ocean currents, investigate fish populations, or explore new habitats would not be possible.
- Computers and information technology have become integral in gathering, processing, interpreting, and publishing of data on the ocean and atmosphere. Computer programmers and operators, web developers, geographic information specialists (GIS), and statistical modelers work closely with NOAA scientists to understand and predict changes in Earth's systems.

- 1 • Public safety, a primary responsibility of NOAA, employs concepts of risk management,
2 economic modeling, emergency management, and media relations. These disciplines allow for the
3 science of weather trends, climate projection, tsunami monitoring, and El Niño forecasting to be
4 integrated into actions that save lives and support commerce.
- 5 • Protecting, restoring, and managing coral reef or maritime heritage resources require scientific
6 investigations to understand the processes at work. Development of management plans that
7 consider stakeholder interest and drafting of policy to support these efforts require different skill
8 sets build on an understanding of political processes, public involvement mandates, legal statutes,
9 international treaties, strategic planning methods, and administrative procedures.

10 Underrepresented Populations in NOAA Sciences

11
12
13 <image – Educational Partnership Program Center of Excellence with students and NOAA
14 representative>

15 As the demographics of the Nation shift, maintaining an interest in the careers critical to NOAA’s mission
16 becomes increasingly challenging. Population growth in the U.S. is increasing fastest in communities that
17 have not traditionally selected STEM disciplines as college majors or career tracks (National Science
18 Board, 2008). One reason for this trend is that these groups currently have limited representation in
19 STEM careers. The NOAA workforce reflects these findings having only 10% of the STEM related
20 occupations in 2006 being filled by these underrepresented groups (Robinson et al., 2007). With the
21 forecasted need for replacing NOAA retirees in the near future maximizing the candidate pool is
22 important. Having a workforce that reflects the diversity of the Nation is also important to maintain the
23 relevance of the agency to the citizenry. Additionally, diversity brings a wider variety of perspectives and
24 approaches to bear on policy development and implementation, strategic planning, problem solving, and
25 decision making. For these reasons this workforce development goal emphasizes efforts to raise
26 awareness of NOAA mission critical careers and to provide educational support in communities
27 underrepresented in these careers. Building workforce development education programs in these
28 communities and partnering with Minority Serving Institutions to inspire students to consider this career
29 pathway are two key strategies in pursuing this outcome.
30

1 Outcome 2.1 Engaged Community of Scientists and Educators

2 Educators and researchers are influential in guiding students in their education and career choices. In
3 order to build the future workforce at NOAA, it is essential that this community be aware of the agency
4 and be familiar with the academic disciplines needed to support the agency’s mission. This knowledge
5 allows educators and researchers to provide students interested in STEM-related subjects and other
6 NOAA mission critical disciplines with a broadened insight on future education and career options.
7

8 Awareness of NOAA’s mission must also be supplemented by awareness of existing opportunities for
9 education and experience including scholarships, internships, research, and fellowships. These
10 opportunities expose promising students to the breadth of fields available to them as future careers, and
11 help prepare them as qualified candidates for positions in these fields. A wide range of such opportunities
12 are currently available for educators, high school students, undergraduates, and graduate students through
13 NOAA and partner organizations.
14

15 *<image - Former Senator Ernest F. Hollings in front of NOAA's Hollings Marine Laboratory,*
16 *Charleston, SC.>*
17

18 By highlighting NOAA’s student opportunities, the agency seeks to increase recruitment to the programs,
19 attract and retain students and professionals into the pipeline for mission-critical disciplines, and further
20 broaden the knowledge and understanding of NOAA’s mission and needs. NOAA is particularly
21 interested in bringing awareness of its mission and opportunities to underrepresented communities in an
22 effort to bolster the number of future workforce members from these demographics. For example, NOAA
23 will enhance and expand existing partnerships with Minority Serving Institutions (MSI) primarily through
24 competitive grant funding opportunities. In addition, the MSI community should be invited to participate
25 in all major NOAA events, including stakeholder meetings, to increase collaboration and expand research
26 and education partnerships with the MSI community.
27
28

29 **Outcome 2.1: A diverse and qualified pool of applicants, particularly from**
30 **underrepresented communities, who consider NOAA’s mission, student**
31 **opportunities, and career opportunities as a potential development**
32 **opportunity.**
33

34 *Strategies*

- 35 a) Engage and expand partnerships with educators and researchers, particularly from
36 underrepresented groups, to augment the number of qualified students who apply to
NOAA’s student opportunities.
- 37 b) Maintain and enhance resources for students and teachers to access information about
38 NOAA’s student opportunities.
- 39 c) Expand partnerships with Minority Serving Institutions to increase the pool of
40 underrepresented students that are educated and graduate in disciplines critical to NOAA’s
41 mission.
- 42 d) Expand the number of visits to campuses and career fairs made by NOAA representatives
43 to minority serving institutions.
44

1 Outcome 2.2 NOAA Employees Support Workforce Development

2 One of NOAA’s strongest recruitment tools is the ability to engage the public through internships,
3 fellowships, sabbaticals, and student opportunities. These opportunities provide a mechanism for the
4 public to engage with NOAA to learn about and explore NOAA sciences, management, and stewardship.
5

6 Ultimately, every NOAA employee is a potential recruiter and educator and can independently increase
7 opportunities for students to learn about NOAA sciences, management, and its impact on the
8 environment. NOAA employees serve on the frontline every day to ensure that students get high quality
9 opportunities as they intern at facilities nationwide. These opportunities will potentially result in a strong
10 future workforce, particularly from underrepresented groups, trained in disciplines critical to NOAA’s
11 mission.
12

13 *<image – NOAA Teacher at Sea participant working beside NOAA staff on vessel>*
14

15 To continue to meet the workforce needs of the agency and to attract a more diverse applicant pool,
16 NOAA plans to work with its employees to augment and diversify educational opportunities. The agency
17 will increase the knowledge of its workforce on how to design successful student opportunities and ways
18 to connect with this diverse community.
19

20 Increased participation by NOAA’s workforce in support of these student opportunities will increase the
21 number of available topics and themes in which students can get involved. A more knowledgeable
22 NOAA workforce will translate into a better learning experience for the students. As a result, NOAA will
23 be in a position to increase its environmental stewardship and provide better services to the public.
24
25

26 **Outcome 2.2: NOAA’s employees support opportunities for students and teachers to learn 27 about and explore NOAA science and stewardship.**

28 *Strategies*

- 29 a) Increase NOAA employees’ awareness of student and teacher scholarship opportunities
30 within the agency.
- 31 b) Encourage NOAA employees to create high-quality internship opportunities for NOAA
32 supported students and teachers.
- 33 c) Ensure student opportunities are responsive to NOAA’s future workforce needs.
- 34 d) Monitor and evaluate NOAA student, teacher, and research faculty opportunities to ensure
35 high quality experiences.
36
37

1 Outcome 2.3 Connecting Graduates to Careers

2 NOAA is committed to a workforce that is reflective of the diversity of America and, as such, the agency
3 has put in place education and outreach programs, including the Educational Partnership Program (EPP)
4 and the District of Columbia Metropolitan Consortium for Students in Science, Mathematics, and
5 Engineering (METCON) program to create education and hands on research opportunities targeted at
6 recruiting students and teachers, particularly from underrepresented groups, to participate in programs at
7 NOAA facilities.

8 <image – picture of NERRS Fellowship graduate employed at NOAA >

9
10
11 Succession planning activities at NOAA reveal that 36.8% of its workforce is eligible to retire within the
12 next five years (2008–2014). NOAA needs a multi-faceted approach, including education, outreach, and
13 recruitment to create a pipeline of well-educated students with workforce skills to fill mission critical
14 occupations. This effort will leverage the environmental literacy efforts of Goal 1.

15
16 The overarching goal of NOAA’s workforce development program is to increase the number of students
17 who take coursework and graduate with degrees in STEM and other fields that directly support NOAA’s
18 mission. Building a strong, competitive pool of potential new NOAA employees requires the involvement
19 of NOAA staff with a primary goal to increase individuals trained in these fields from which NOAA may
20 select its future workforce. NOAA will use the current and future student scholarship and internship
21 programs to support students in NOAA mission training programs. The agency will also use the Student
22 Career Experience Programs to increase opportunities that can transition participants to NOAA careers
23 and track the graduation and career choices of participants to determine the effectiveness of its programs.

24
25
26 **Outcome 2.3: A diverse pool of students with degrees in science, technology, engineering,**
27 **mathematics and other fields critical to NOAA’s mission connected to career**
28 **opportunities at NOAA and related organizations.**

29 *Strategies*

- 30 a) Provide scholarship support to students in NOAA mission sciences, education and policy to
31 increase the number of students obtaining degrees in those disciplines.
- 32 b) Connect students to professional opportunities that enhance their ability to pursue careers
33 in oceans, coastal, Great Lakes, weather and climate sciences.
- 34 c) Work with agency, academia, and private sector organizations to increase opportunities for
35 students to transition to careers in NOAA mission critical fields.
- 36 d) Monitor NOAA supported students to track graduation and career choices and assess these
37 impacts on NOAA recruitment and retention efforts.

1 Strategy for Implementation

2 The purpose of the NOAA Education Strategic Plan is to provide high-level guidance for the
3 implementation of the *America COMPETES Act* mandate and the realization of NOAA’s
4 education vision. To encompass a 20-year time-frame, the goals, outcomes, and strategies of this
5 plan provide a framework to focus and coordinate the educational efforts of the agency.
6 Operationalization of this guidance requires the development of shorter-term implementation
7 plans that considers the more immediate needs, opportunities, and resources of the agency in
8 support of the long-term strategic goals.

9
10 NOAA will develop a 5-year Education Implementation Plan as a second step to the planning
11 process which developed this Education Strategic Plan. The implementation plan will set forth
12 the specific programmatic actions the agency will take to implement the goals and strategies
13 established under this strategic plan. Specific performance measures aligned with each outcome
14 will be developed for these actions to provide the metrics needed for evaluating the success of
15 the agency in meeting the strategic vision. Suggested metrics for formal and informal education
16 under consideration by the Academic Competitiveness Council (U.S. Department of Education,
17 2007) will be integrated where appropriate. Implementation plans will be reviewed on an
18 ongoing basis and revised with the five-year review of the broader NOAA Education Strategic
19 Plan.

20
21 This Education Strategic Plan will be fully integrated with NOAA’s planning and budgeting
22 system. To ensure consistency with NOAA’s mission and priorities the goals of this education
23 plan will be integrated into the agency’s annual priorities. Through these established processes
24 NOAA Line and Staff Offices will enable the successful achievement of this strategic plan and
25 subsequent implementation plans. The active participation by members of the NOAA education
26 community in developing this plan assures alignment of this framework with the educational
27 mandates of each office providing better integration with the NOAA planning and budgeting
28 processes.

29

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