Appendix A. DC Environmental Literacy Plan Workgroup

Under the Healthy Schools Act of 2010, the District Department of the Environment was designated as the lead agency to develop the Environmental Literacy Plan, in conjunction with the following agencies:

- DC Public Schools
- DC Office of the State Superintendent of Education
- DC Public Charter School Board
- DC State Board of Education
- DC Department of Parks and Recreation
- University of the District of Columbia.[4]

Other collaborators include members of the DC Environmental Education Consortium, non-profit organizations, and community members.

Strategic Planning Team

In June 2010, the District Department of the Environment and the DC Environmental Education Consortium convened a Strategic Planning Team to develop the process for creating the DC Environmental Literacy Plan. Planning team members participated in North American Association for Environmental Education (NAAEE) workshops and conducted background research on environmental literacy plans. A core team also met with different agency representatives to explain the requirements of the Healthy Schools Act and elements of state environmental literacy plans, describe their potential roles in the process, and form a strategy to develop the plan document. Below are Strategic Planning Team members who attended at least four of the thirteen monthly meetings from June 2010-June 2011.

Members of the Strategic Planning Team

***** Denotes participants who no longer work with the listed organizations.

Gilda Allen, District Department of the Environment*
Rebecca Davis, DC Environmental Education Consortium/Clean Air Partners-MWCOG
Trinh Doan, District Department of the Environment
Matt English, Living Classrooms – National Capital Region*
Matt Gallagher, District Department of the Environment
Christa Haverly, Alice Ferguson Foundation*

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[4] Healthy Schools Act of 2010 (HSA) D.C. Law 18-209, effective July 27, 2010. Codified at D.C. CODE § / 38-821.01 *et seq* or 38-825.02. Section 502.

Jackie Krisch, DC EnvironMentors
Grace Manubay, District Department of the Environment
Steve Rood, Earth Force*
Ariel Trahan, DC Environmental Education Consortium/Anacostia Watershed Society
Dwight Washington, Michigan State University

Workgroup

In June 2011, the District Department of the Environment and the DC Environmental Education Consortium hosted a Summit to officially begin the process of developing the DC Environmental Literacy Plan. At this Summit, 29e representatives from District agencies and environmental non-profit organizations came together to learn about the need for a DC Environmental Literacy Plan and to begin brainstorming about what the plan should include. This Summit formally established the DC Environmental Literacy Plan Workgroup and Task Forces. The Workgroup consists of two representatives designated by each District agency and the two Co-Presidents of the DC Environmental Education Consortium. Additional Workgroup members include non-profit organizations and community members. Below are Workgroup members who attended at least two of the eight monthly meetings from July 2011-April 2012.

Members of the DC Environmental Literacy Plan Workgroup

***** Denotes participants who no longer work with the listed organizations.

Kamili Anderson, DC State Board of Education
Charlotte Cureton , DC Public Charter School Board
Rebecca Davis, DC Environmental Education Consortium/Clean Air Partners-MWCOG
Trinh Doan, District Department of the Environment
Matt Gallagher, District Department of the Environment
Dawanna James-Holly, DC Office of the State Superintendent of Education
Jackie Krisch, DC EnvironMentors
Josh Lasky, University of the District of Columbia
Grace Manubay, District Department of the Environment (Project Lead)
April Martin, Living Classrooms – National Capital Region
Brian Massey, Farm to Desk DC*
Kelly Anne Melsted, DC Department of Parks and Recreation*
Camsie McAdams, DC Public Schools
Taylor Moulton, EarthForce
John Neral, DC Office of the State Superintendent of Education
Natalie Perez, Alice Ferguson Foundation
Keith Roumfort, Alice Ferguson Foundation
James Rountree, DC Public Schools
Irv Sheffey, Sierra Club
Ariel Trahan, DC Environmental Education Consortium/Anacostia Watershed Society

Sam Ullery, DC Office of the State Superintendent of Education
Josh Volinsky, Earth Day Network

Task Forces

To develop the individual components of the Environmental Literacy Plan, members of the Workgroup were required to participate in at least one of the following three Task Forces: Content Standards and Professional Development, Graduation Requirements and Evaluation (Student Assessment), and Implementation and Funding.

Task Force Members

***** Denotes participants who no longer work with the listed organizations.

Content Standards and Professional Development:

Rebecca Davis, DC Environmental Education Consortium/Clean Air Partners-MWCOG
Trinh Doan, District Department of the Environment
Jackie Krisch, DC EnvironMentors
Michelle Lewis, Living Classrooms – National Capital Region*
Grace Manubay, District Department of the Environment
Brian Massey, Farm to Desk DC*
Natalie Perez, Alice Ferguson Foundation
Keith Roumfort, Alice Ferguson Foundation
James Rountree, DC Public Schools
Rebecca Scott, Audubon Naturalist Society
Ariel Trahan, DC Environmental Education Consortium/Anacostia Watershed Society (Chair)
Sam Ullery, DC Office of the State Superintendent of Education
Lori Wilen, DC Public Schools

Graduation Requirements and Evaluation:

Kamili Anderson, DC State Board of Education
Rebecca Davis, DC Environmental Education Consortium/Clean Air Partners-MWCOG
Matt Gallagher, District Department of the Environment
Grace Manubay, District Department of the Environment (Chair)
Taylor Moulton, Earth Force
John Neral, DC Office of the State Superintendent of Education

Implementation and Funding:

Kamili Anderson, DC State Board of Education
Rebecca Davis, DC Environmental Education Consortium/Clean Air Partners-MW COG (Chair)
Matt Gallagher, District Department of the Environment
Dawanna James-Holly, DC Office of the State Superintendent of Education

Grace Manubay, District Department of the Environment
Sean Miller, Earth Day Network
Ariel Trahan, DC Environmental Education Consortium/Anacostia Watershed Society

Appendix B. The District of Columbia's Education Landscape

This section is adapted from the Office of the State Superintendent's* Elementary and Secondary Education Act Flexibility Waiver *submitted to the U.S. Department of Education on February 28, 2011.

The District of Columbia has a unique education landscape that allows for school reform, robust charter schools, and universal preschool. Its 69 square miles of land, divided into eight Wards, contain 54 Local Education Agencies (LEAs). The diversity among the LEAs is extensive – one large, traditional district, District of Columbia Public Schools (DCPS), that is under mayoral control, and 53 individual, independently administered charter LEAs, which can range from single small schools to multi-campus charter networks. Together, these 54 school districts educate 77,000 students mostly from low-income families of color.

For decades, DCPS served as both the state and local education agency. In 2007, the Public Education Reform Act (PERA) created the Office of the State Superintendent (OSSE) to provide leadership in policy for all schools and act as the State Education Agency (SEA) for the District of Columbia. The same law established a State Board of Education, with advisory, approval, and public-engagement mandates.

The District has one of the strongest charter school laws in the country, enacted by Congress in 1995 with the passage of the School Reform Act (SRA). Over the past 15 years, charter schools have grown to serve 41 percent of students, making the District the state with the largest share of publicly educated pupils enrolled in charter schools. Each year, new charter schools open, increasing the number of LEAs providing service to students in the District. Charter schools are also adding grade levels each year. The overall increase in charter schools has had a significant impact on state-level educational policy. Twelve years after the enactment of the SRA, the Council of the District of Columbia passed the PERA. This 2007 law brought about major shifts in management, accountability, and oversight. The PERA turned over control of the DCPS to the mayor. This set the stage for reinvigorated efforts in DCPS including: closing low-performing or under-enrolled schools, a new teacher contract which includes an aggressive teacher evaluation component, the creation of the IMPACT teacher and staff evaluation system, bonuses for highly effective teachers, and new momentum around improvement within DCPS. Additionally, PERA eliminated DCPS as a charter school authorizer, put its charter schools under the Public Charter School Board, and, perhaps most crucially, created the State Education Agency (OSSE) and State Board of Education to provide leadership in policy for all schools.

As DC Council Chairman, Mayor Vincent Gray spearheaded an effort to establish universal high-quality Pre-K that would be available to any District three- or four-year-old. This initiative has been exceptionally successful. According to the *Education Week* for *Quality Counts* report released January 12, 2011, the District has more than 65 percent of three- and four-year-olds enrolled in academic programs, and 87 percent of kindergarten students enrolled in academic programs – the highest participation rates for early childhood education in the nation.

The District became a second-round winner of the Race to the Top (RTTT) grant in 2010. This provides a unique opportunity for collaboration, including sharing best practices across DCPS and public charter schools. Under RTTT, the District was the first state in the nation to implement Common Core standards and quickly move towards implementation.

In 2011, the District led the nation in postsecondary participation, with 71 percent of 17-24 year-old young adults either residing in or relocating to the district having a college degree or enrolled in a postsecondary institution. Yet, many are not graduates of the District's elementary and secondary education sector. Furthermore, the District has a stratified education gap among residents wherein income and educational attainment differs between the upper Northwest and most of the city east of Rock Creek Park.

In recent years, the District has made much progress toward its education reform agenda, significant challenges remain. Despite the renewed focus on raising achievement, many of our schools and students still struggle. Statewide, only 45 percent of District students are proficient in reading and 47 percent in mathematics, with stubbornly persistent performance gaps between subgroups. For students with special needs, only 16 percent are meeting proficiency and 19 percent in mathematics. English language learners (ELLs) perform slightly better, with 25 percent meeting proficiency levels in reading and 36 percent in mathematics. With the District's 2011 proficiency targets set between 70 and 74 percent, only 25 of 187 schools met Adequate Yearly Progress (AYP) benchmarks in both reading and mathematics last year, many because of the "safe harbor" provision that gives credit to schools able to reduce by 10 percent the number of students not meeting proficiency targets. Based on the graduation cohort calculation, which the District will employ for the first time this year, the expected graduation rate is about 51 percent of students graduating within four years.

Appendix C. Status of Environmental Literacy in the District

In the District of Columbia, the earliest indication of collaborative environmental education efforts was the establishment of the DC Environmental Education Consortium (DCEEC) in 1993. Originally, members were teachers interested in creating a network through which lesson plans, ideas, and environmental education provider contacts could be shared. Through a grant from the U.S. Environmental Protection Agency, an environmental education directory, *DC Naturally,* was published in 1997 and disseminated to teachers and organizations throughout the District.

It was not until 1998 that environmental education was formally implemented in the District. Recognizing the value of hands-on environmental education, the governors of the Chesapeake Bay states and Mayor Anthony Williams of the District, signed a commitment in 2000 to provide a meaningful watershed educational experience (MWEE) for every student in the Chesapeake Bay watershed before graduation from high school, beginning with the class of 2005.

As a follow-up to the Chesapeake Bay Agreement, in November 2005, the mayor of the District of Columbia and a representative from District of Columbia Public Schools (DCPS) signed the multi-jurisdictional Chesapeake Watershed Education Agreement. This agreement pledges the following:

- Highlight the importance of geography education and hands-on, place-based education in teaching about natural resources and fostering Chesapeake stewardship; and
- Continually work to ensure that graduating students have been exposed to concepts in environmental literacy, including the Chesapeake Bay and its rivers, and have examined strategies to foster their restoration and protection.

The District Department of the Environment's Watershed Protection Division (DDOE) has led the effort to provide District students with Meaningful Watershed Educational Experiences since 2003. DDOE provides sub-grant awards to local non-profit organizations to provide students with classroom lessons, field experiences, and reflection activities as they relate to the Chesapeake Bay, as well as professional development for teachers. The Office of the State Superintendent of Education (OSSE) Office of Wellness and Nutrition hired a School Garden Specialist in 2011 to support the School Garden Program as well as the Green Ribbon Schools Program. In early 2012, OSSE launched its School Garden Grant to provide funding for school garden programs.

Additional District agencies provide environmental education opportunities to District students and teachers. For youth, the Department of Parks and Recreation has provided environmental education

opportunities at local parks and recreation sites, as well as summer camp opportunities at Lederer Youth Garden in Ward 7 and Camp Riverview on Maryland's Eastern Shore. For teachers, the University of the District of Columbia has a Master Gardener program and a sustainability department that provide resources and technical expertise.

Over the years, DCEEC has remained the strongest network of organizations that assist schools with environmental education programming. Comprised of members from many non-profit organizations and local and federal government agencies, this professional network continues to serve teachers and students in the District. Twenty-three members and 22 other organizations provide District schools with curricular materials, professional development opportunities, in-class presentations, field experiences, community service opportunities, funding, and more.[5]

In 2005, DCEEC recognized the need for the District to have environmental science content standards and convened a group of environmental education providers and science teachers to write draft standards. These environmental science standards were among the new science standards adopted by the DC State Board of Education in 2006.

Members of DCEEC developed supporting documents for the environmental science and earth science power standards to assist teachers with the creation of standards-based lesson plans. These standards-based worksheets indicated the various ways that environmental literacy concepts could be taught in these subject areas. DCEEC members also received training in the creation of these worksheets so their own curriculum documents could be easily transferred into the curriculum format used by DCPS. While these tools may no longer be in use in some schools, they lay the groundwork for showing how environmental literacy is already tied to the current science curriculum.

Many District schools already have environmental education components in their curriculum and/or engage members of DCEEC for environmental programming. Case studies of District schools with examples of best practices are in Appendix G.

[5] Self-reported information collected as part of an on-line survey of environmental literacy organizations. See Appendix F for more information.

Appendix D. Acronyms and Glossary of Terms

CEU: Continuing Education Units

CAS: Comprehensive Assessment System

DCEEC: District of Columbia Environmental Education Consortium

DCPS: District of Columbia Public Schools

DDOE: District Department of the Environment

DGS: Department of General Services

DPR: Department of Parks and Recreation

DRES: Department of Real Estate Services

ELP: Environmental Literacy Plan

HSA: Healthy Schools Act

LEA: Local Education Agency

LEED: Leadership in Energy and Environmental Design

LID: Low Impact Development

NAAEE: North American Association for Environmental Education

NGL: Next Generation Learning

NOAA: National Ocean and Atmospheric Administration

OPEFM: Office of Public Education Facilities Modernization

OSSE: Office of the State Superintendent of Education

PARCC: Partnership for Assessment of Readiness for College and Careers

PCSB: Public Charter School Board

PD: Professional Development

SBoE: State Board of Education

SLED: Statewide Longitudinal Education Data System

SEER: State Education and Environment Roundtable

STEM: Science, Technology, Engineering, and Mathematics

UDC: University of the District of Columbia

DC Comprehensive Assessment System (DC CAS): Assessment of students on reading and mathematics in grades 3-8 and 10, science in grades 5 and 8, biology in high school, and composition in grades 4, 7, and 10. While DCPS oversees the administration of the test, the Office of the State Superintendent of Education (OSSE) is responsible for the overall management of the assessment for all schools in DC.

DC Department of General Services (DGS): District government agency that improves the efficiencies of basic services, while removing redundancies, to provide the most cost-effective management and ensure the best value of the District's property acquisition, construction and maintenance resources. In October of 2011, the agency assumed the functions and responsibilities of the Department of Real Estate Services (DRES), Office of Public Education Facilities Modernization (OPEFM), Municipal Facilities (Non-Capital agency), and the capital construction and real property management functions of several other District agencies. (dgs.dc.gov)

DC Department of Parks and Recreation (DPR): District government agency that enhances the quality of life and wellness of District residents and visitors by providing equal access to affordable and quality recreational services, by organizing programs, activities and events, and by building and maintaining safe and beautiful open spaces and recreational amenities. DPR was designated to collaborate with DDOE on creating the ELP. (dpr.dc.gov)

DC Department of Real Estate Services (DRES): District government agency that (1) manages a portfolio of owned and leased real estate for DC agencies and residents, (2) provides clean and welcoming environments for DC workers, (3) repairs buildings to meet DC facility needs, (4) procures services for DC agencies, and (5) creates atmosphere of safety in DC government facilities. (dres.dc.gov)

DC Environmental Education Consortium (DCEEC): A network of government, non-profit, and community members dedicated to promoting and providing access to environmental education professional development for educators and partners, interactive classroom and outdoor activities, field trips, curricula, and materials in Washington, DC (dcnaturally.org).

DC Office of Public Education Facilities Modernization (OPEFM): District government agency absorbed by DGS in October 2011.

DC Office of the State Superintendent of Education (OSSE): District government agency that sets high expectations, provides resources and support, and exercises accountability to ensure that all residents receive an excellent education. Among other things, OSSE administers the DC CAS testing. OSSE was designated to collaborate with DDOE on creating the ELP. (osse.dc.gov)

DC Public Charter School Board (PCSB): Organization established to provide alternative quality public school options for District students, families, and communities through comprehensive application review process, effective oversight, meaningful support, and active engagement of stakeholders. PCSB was designated to collaborate with DDOE on creating the ELP. (dcpubliccharter.com)

DC State Board of Education (SBoE): Board established as part of OSSE on June 12, 2007, as part of the "District of Columbia Public Education Reform Amendment Act of 2007." Responsible for advising the State Superintendent of Education on educational matters, including: state standards; state policies, including those governing special, academic, vocational, charter and other schools; state objectives; and

state regulations proposed by the Mayor or the State Superintendent of Education. SBoE was designated to collaborate with DDOE on creating the ELP. (http://osse.dc.gov/service/state-board-education)

District Department of the Environment (DDOE): District government agency that improves the quality of life for the residents and natural inhabitants of the nation's capital by protecting and restoring the environment, conserving our natural resources, mitigating pollution, and educating the public on ways to secure a sustainable future. DDOE was designated the lead agency to create the ELP. (ddoe.dc.gov)

District of Columbia Public Schools (DCPS): The District's public school system, the reference of which does not include public charter schools. DCPS was designated to collaborate with DDOE on creating the ELP. (dcps.dc.gov)

Environmental Literacy: The development of knowledge, attitudes, and skills necessary to make informed decisions concerning the relationships among natural and urban systems.

Healthy Schools Act: Landmark law designed to improve the health and wellness of students attending D.C. public and public charter schools. The Act took effect August 2010 and includes a provision requiring the development of an environmental literacy plan. (dchealthyschools.org/)

Inquiry-Based Learning: Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. (National Science Education Standards, pg. 23)

Leadership in Energy and Environmental Design (LEED): Suite of rating systems for the design, construction and operation of high performance green buildings, homes and neighborhoods (usgbc.org/leed)

Meaningful Environmental Experience: An investigative or experimental project that engages students in thinking critically about the environment. These experiences are not intended to be quick, one-day activities; rather, they are extensive projects that allow students to gain a deep understanding of the issue or topic being presented. Students participate in background research, hands-on activities and reflection periods that are appropriate for their ages and grade levels. (Adapted from the NOAA definition of a Meaningful Watershed Educational Experience or "MWEE.")

Next Generation Learning: The intelligent use of technology to develop innovative learning models and personalized educational pathways.

No Child Left Inside: The No Child Left Inside Act aims to ensure every student achieves basic environmental literacy. It would amend the Elementary and Secondary Education Act (No Child Left Behind) to include environmental education for the first time. The legislation would provide new funding for environmental education, particularly to develop rigorous standards, train teachers and to develop state environmental literacy plans. It also proposes giving states that develop such

environmental literacy plans access to additional funds. The No Child Left Inside Coalition is a national coalition of over 2000 business, health, youth, faith, recreational, environmental, and educational groups. The Coalition was formed in 2007 to alert Congress and the public to the need for our schools to devote more resources and attention to environmental education.

Partnership for Assessment of Readiness for College and Careers (PARCC): Consortium of states working together to develop a common set of K-12 assessments in English and mathematics anchored in what it takes to be ready for college and careers. These new K-12 assessments will build a pathway to college and career readiness by the end of high school, mark students' progress toward this goal from 3rd grade up, and provide teachers with timely information to inform instruction and provide student support. The PARCC assessments will be ready to administer during the 2014-2015 school year.

Service Learning: A teaching strategy that connects community service to the academic objectives in a way that students feel greater meaning and relevance to what they learn and in a way that develops strong citizenship skills. The National Youth Leadership Council identified eight components of high-quality service-learning: (1) youth voice, (2) meaningful, (3) link to curriculum, (4) diversity, (5) progress monitoring, (6) reflection, (7) duration and intensity, and (8) partnerships.

Statewide Longitudinal Education Data System (SLED): A single, comprehensive repository of student and education-related data needed to improve education planning, management, reporting, instruction and evaluation. In February 2009, the Office of the State Superintendent of Education (OSSE) deployed the initial release of the SLED system. The primary goal of the initial release of the SLED system was to track student enrollment, demographic data, and assign a Unique Student Identifier (USI) for students that were enrolled in publicly funded DC schools during the 2008-2009 school year.

Sustainability: Nexus of the environmental health, economic prosperity, and social vitality. Sustainability meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable DC: A government plan launched in 2011 to address goals and the interconnections between the built environment, climate, energy, food, nature, transportation, waste, water, and the green economy. There are nine working groups focused on each of the major categories and their recommendations will be analyzed from economic, social, and environmental perspectives. (sustainable.dc.gov)

University of the District of Columbia (UDC): Chartered in 1974, UDC is the only fully-accredited public institution of higher education in the nation's capital. UDC was designated to collaborate with DDOE on creating the ELP. (udc.edu)

Appendix E. Existing Science and High School Social Studies Standards that Support Environmental Literacy

Kindergarten

Scientific Thinking and Inquiry

K.1.2 Raise questions about the natural world and know that scientific inquiry can be used to seek answers to questions about it.

Earth Science

K.2.2 Recognize that seasons repeat in predictable patterns over time.

Life Science

K.5 Broad Concept: Different types of plants and animals inhabit the Earth. As a basis for understanding this concept,

K.5.1 Know there are many different kinds of plants and animals.

K.5.2 Describe that plants and animals are alike in some ways and different in others

Grade 1

Scientific Thinking and Inquiry

1.1.2 Investigate and make observations to seek answers to questions

1.1.3 Recognize and demonstrate what people can learn about plants and animals by observing them closely over a period of time

1.1.4 Use tools, such as rulers and magnifiers, to investigate the world and make observations.

1.1.8 Write brief informational descriptions of a real object, person, place, or event using information from the observations.

Earth Science

1.2 Broad Concept: The Earth is composed of land, air, and water. As a basis for understanding this concept,

1.2.1 Recognize and explain that water, rocks, soil, and living organisms are found on the Earth's surface

1.2.2 Investigate and explain that air is a mixture of different gases that surrounds us and takes up space, and whose movement we feel as wind.

1.2.3 Observe and measure that the sun supplies heat and light to the Earth and is necessary for most life.

Life Science

1.4 Broad Concept: Different types of plants and animals inhabit the Earth. As a basis for understanding this concept,

1.4.1 Explain that most living things need food, water, and air.

1.4.2 Observe and describe that there can be differences, such as size or markings, among the individuals within one particular plant or animal group (e.g., maples trees, zebras). Variation is a normal characteristic of many kinds of living things.

1.4.3 Observe and explain that animals eat plants and/or other animals for food.
1.4.4 Recognize that animals (including humans) and plants are living things that grow, reproduce, and need food, air, and water.
1.4.5 Identify the external features that local plants and animals have (such as found in schoolyards or in city neighborhoods) that enable them to survive in their environment.

Grade 2

Scientific Thinking and Inquiry

2.1 Broad Concept: Scientific progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.
2.1.2 Make new observations when there is disagreement among observers or among successive observations.
2.1.4 Use tools, such as thermometers, magnifiers, rulers, or balances, to investigate, observe, measure, design, and build things.
2.1.7 Recognize and explain that people are more likely to believe ideas when they are supported by observations.
2.1.8 Explain that some events can be predicted with near certainty, such as sunrise and sunset, and some cannot, such as storms.
2.1.9 Explain that sometimes a person can make general discoveries about a group of objects or organisms, such as insects, plants, or rocks, by studying just a few of them, even though the group may vary in details. Understand that this is not inconsistent with the existence of biological variation.
2.1.10 Make simple line and bar graphs (e.g. track daily changes in outdoor air temperature).

Science and Technology

2.2 Broad Concept: Although each of the human enterprises of science and technology has a character and history of its own, each is dependent on and reinforces the other. As a basis for understanding this concept,
2.2.1 Give examples of how our lives would be different without such technologies as automobiles, computers, and electric motors.

Earth Science

2.3 Broad Concept: Weather can be observed, measured, and described. As a basis for understanding this concept,
2.3.1 Explain how weather patterns occur continually on Earth.
2.3.2 Explain that air temperature, humidity, wind speed and direction, and precipitation make up the weather in a particular place and time.
2.3.4 Describe and chart that the temperature and amounts of rain or snow vary in the same months in each place every year.
2.3.5 Explain the difference between weather and climate.
2.3.6 Describe the differences among the various forms of precipitation (rain, snow, sleet, and hail).
2.3.7 Cite specific examples of how human beings protect themselves from adverse weather conditions through different means.

2.4 Broad Concept: The Earth's resources can be conserved. As a basis for understanding this concept,
2.4.1 Recognize and explain how certain materials – such as recycled paper, cans, and certain types of plastic containers – can be used again.
2.4.2 Explain how discarded products contribute to the problem of waste disposal and how recycling and reuse can help solve this problem.

Physical Science
2.5 Broad Concept: Materials come in different states, including solids, liquids, and gases. As a basis understanding this concept,
2.5.1 Recognize that solids have a definite shape; liquids and gases take the shape of their containers.
2.5.3 Investigate and explain that water, like many other substances, can be a liquid, a solid, or a gas, and it can transform from one state to another.
2.5.4 Explain how water can be transformed from one state to another by adding or taking away heat energy.
2.5.5 Describe when water is frozen into ice and the ice is allowed to melt, the amount of water is the same as it was at the beginning.
2.5.6 Investigate and explain how water left in an open container seems to disappear into the air (evaporation), but water in a small, closed container does not disappear.

2.6 Broad Concept: Plants and animals have structures that serve different functions in growth, survival, and reproduction. As a basis for understanding this concept,
2.6.1 Observe and identify the visible, external features of plants and animals and describe how these features help them live in different environments.
2.6.2 Observe and cite examples of how some animals and plants change their appearance as the seasons change.

2.7 Broad Concept: Living things depend on one another and their environment for survival. As a basis for understanding this concept,
2.7.1 Observe and describe how animals may use plants, or even other animals, for shelter and nesting.
2.7.2 Explain that food for almost all kinds of animals can be traced through a food web back to green plants.
2.7.3 Observe and explain that plants and animals both need to take in water, animals need to take in food, and green plants need light.
2.7.4 Recognize and explain that materials in nature, such as grass, twigs, sticks, and leaves, can be recycled and used again, sometimes in different forms, as birds do in making their nests.
2.7.5 Observe and describe how the local environment (water, dry land) supports a wide variety of plants and animals, some unique to the Chesapeake Bay.
2.7.6 Cite examples of how animals and plants sometimes cause changes in their surroundings. While some of these changes are easy to see, some are very small and hard to recognize, even though they can be very important.
2.7.7 Recognize that there is a vast world of living things, called microorganisms, too small to see with the unaided eye.

2.7.8 Recognize that most microorganisms do not cause disease and many are beneficial (e.g., yeasts, bacteria of the soil).

2.8 Broad Concept: Many different types of plants and animals inhabit the Earth. As a basis for understanding this concept,
2.8.1 Recognize and explain that living things are found almost everywhere in the world in habitats such as the oceans, rivers, rain forests, mountain ranges, arctic tundra, farms, cities, and other environments. Recognize that some habitats are extreme, such as the very deepest parts of the oceans or inside hot springs.
2.8.2 Recognize that the numbers and types of living things can vary greatly from place to place.
2.8.3 Give examples of the many kinds of organisms that lived in the past that are now extinct (have died out), and explain how these organisms were similar to, and others very different from, organisms that are alive today.
2.8.4 Describe that plants and animals in our city have habitats that are essential to their survival. For instance, the schoolyard is a habitat that provides the basic needs for a variety of plants and animals.

2.9 Broad Concept: Humans have predictable life cycles. As a basis for understanding this concept,
2.9.1Recognize and discuss that people are more like one another than they are like other animals. Each type of animal is more like its relatives (family) than it is like the animals of other types (or families).
2.9.2 Explain that humans, like all living things, reproduce offspring of their own kind.
2.9.3 Observe that and describe how offspring are very much, but never exactly, like their parents and like other offspring of the same parents.
2.9.4 Recognize that people have a wide but not unlimited range of external features, such as differences in their size, shape, and color of hair, skin, and eyes.

Grade 3

Scientific Thinking and Inquiry

3.1 Broad Concept: Scientific Progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.
3.1.1 Recognize and explain that when a scientific investigation is repeated, carefully and under the same conditions, a similar (but not necessarily identical) result is expected.
3.1.2 Participate in different types of guided scientific investigations (related to content in this grade), such as observing objects and events and collecting specimens for analysis, including longer-term investigations that take place over several days, weeks, or months.
3.1.3 Keep and report records of investigations and observations using tools, such as journals, charts, graphs and computers.
3.1.4 Discuss the results of investigations and consider the explanations of others
3.1.5 Demonstrate the ability to work cooperatively while respecting the ideas of others and communicating one's own conclusions about findings.
3.1.7 Keep a notebook that describes ongoing observations and that is still understandable weeks or months later.
3.1.9 Make sketches and write descriptions to aid in explaining procedures or ideas

3.1.10 Ask "How do you know?" in appropriate situations, and attempt reasonable answers when others ask the same question.
3.1.11 Explain that one way to make sense of something is to think of how it compares to something more familiar (e.g. vibrations of an object in air such as a tuning fork, a plucked string instrument, human vocal cords).

Science and Technology
3.2.1 Define technology as the application of human ingenuity and skill to the solution of practical problems (e.g. typewriter, computer).

Physical Science
3.4 Broad Concept: Energy takes many forms and has many sources. As a basis for understanding these concepts,
3.4.2 Describe basic forms of energy, including mechanical (kinetic and potential), light, sound, heat, chemical, nuclear, and electrical
3.4.3 Recognize that energy can be transformed from one form to another
3.4.4 Describe how people use electricity or the chemical energy from burning fuels, such as wood, oil, coal or natural gas to obtain heat energy for doing tasks, such as cooking their food and warming their houses.
3.4.5 Investigate and describe how moving air and water (carriers of kinetic energy, the energy of motion) can be used to run machines like windmills and waterwheels.

Life Science
3.5 Broad Concept: Plants and animals can be classified according to the physical characteristics that they share. As a basis for understanding this concept,
3.5.1 Demonstrate that a great variety of living things can be sorted into groups in many way using various properties, such as how they look, where they live, and how they act, in order to decide which things belong to which group.
3.5.2 Explain that characteristics used for classification depend on the purpose of grouping.

3.6.2 Broad Concept: Plants and animals have predictable life cycles. As a basis for understanding this concept,
3.6.1 Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.
3.6.2 Describe the life cycle of some living things, such as the frog and the butterfly, including how they go through striking changes.
3.6.3 Compare and contrast how life cycles vary for different living things.

3.7 Broad Concept: Humans have a variety of mechanisms to stay healthy. As a basis for understanding this concept,
3.7.1 Explain that people need food, water, air, waste removal, and a particular range of temperatures, just as other animals do, although different animals can tolerate very different ranges of temperature and other features of their surroundings.

3.7.2 Explain that eating a variety of healthful foods and getting enough exercise and rest help people stay healthy.
3.7.3 Explain that some things people take into their bodies from the environment can hurt them, and give examples of such things.
3.7.4 Recognize that food provides energy as well as materials for growth, maintenance, and repair of body parts.
3.7.5 Recognize that vitamins and minerals are substances required by the body in small amounts to synthesize essentials substances and carry out essential processes.
3.7.6 Describe how, as a person matures, the amounts and kinds of food and exercise needed by the body change.

Grade 4

Scientific Thinking and Inquiry

4.1 Broad Concept: Scientific Progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.
4.1.1 Recognize and describe how results of similar scientific investigations may turn out differently due to inconsistencies in methods, materials or observations or the limitations of the tools used.
4.1.2 Explain that clear communication is an essential part of the process of scientific inquiry because it enables scientists to inform others about their work, to expose their ideas to evaluation by other scientists, and to allow scientist to stay informed about scientific discoveries around the world.
4.1.3 Use numerical data to describe and compare objects and events.
4.1.4 Write descriptions of investigations by using observations and support for explanations.
4.1.5 Support statements with ideas and data found in print or electronic media, identify and evaluate the sources used, and expect others to do the same.
4.1.6 Identify better reasons for believing something rather than citing comments such as “everybody knows that,” “I just don’t know,” or “Because they say” and discount such reasons when given by others.
4.1.7 Explain how scientific thinking can be distorted by strong feelings and explain why and when it is appropriate and necessary to separate emotions from the reasoning process.

Science and Technology

4.2.1 Demonstrate how scientific tools, such as microscopes, telescopes, and cameras can be used to gather accurate information for making scientific comparisons of objects and events.

4.2.3 Describe how human beings have made tools and machines, such as x-ray cameras, microscopes, satellites, and computers, to observe and do things that they could not otherwise sense or do at all, or as quickly or efficiently.

Earth Science

4.3.1 Explain how waves, wind, water, and glacial ice shape and reshape earths' land surface by eroding rock and soil in some areas and depositing them in other areas.

4.3.2 Explain how the surface of the Earth changes over various time scales due to processes, such as erosion and weathering, landslides, volcanic eruptions, earthquakes, and mountain building.

4.4.7 Explain how soil is partly made from rock weathered by water and wind, and partly from decomposition of plant and animal remains, and that it contains many living organisms.

4.4.8 Describe the different properties of soil, including its color, texture (size of particles), and ability to retain water and support the growth of plants.

Physical Science

4.5.1 Explain that energy comes from the sun in the form of visible light and other radiation we cannot see without special instruments, but some of what we cannot see we feel as heating (infrared radiation), and some can cause sunburn (ultraviolet radiation).

4.5.3 Explain when light strikes a surface, it can be reflected, scattered, refracted, and/or absorbed.

4.5.5 Recognize that heat energy can be absorbed or given off by both living and nonliving things.

4.5.6 Explain that energy in fossil fuels comes originally from the energy of sunlight used by plants that grew a long time ago.

4.6.9 Explain that electric current can flow only if there is a complete closed loop of conducting material (called a *circuit*) for it to flow through. Know that a switch is a device for opening and closing a circuit.

4.6.10 Explain how electrical energy can be used to produce light, heat energy, motion (kinetic energy), or sound energy.

Life Science

4.7 Broad Concept: All organisms need energy and matter to live and grow. As a basis for understanding this concept,

4.7.1 Explain that organisms interact with one another in various ways, such as providing food, pollination, and seed dispersal.

4.7.2 Observe and recognize that some source of energy is needed for all organisms to stay alive and grow.

4.7.3 Describe how energy derived from the sun is used by green plants to produce chemical energy in the form of sugars (photosynthesis), and this energy is transferred along a food chain from producers (plants) to consumers and decomposers.

4.7.4 Observe and explain that most plants produce far more seeds than actually grow into new plants.

4.7.5 Describe the structures in plants (leaves, roots, flowers, stem, bark, wood) that are responsible for food production, support, water transport, growth, and protection.

4.7.6 Describe the many beneficial attributes of plants, including trees, in improving and sustaining an urban environment.
4.7.7 Explain how in all environments, organisms grow, die, and decay, as new organisms are produced by the older ones.
4.7.8 Recognize that there are many kinds, and vast numbers, of living things too small to see with the naked eye called *microorganisms,* but they can be easily seen with the aid of various kinds of microscopes.
4.7.9 Explain how dead plants and animals are the food source for many microorganisms.
4.7.10 Investigate the Chesapeake Bay watershed and wetlands, and describe how they support a wide variety of plant and animal life that interact with other living and nonliving things.
4.8.2 Explain that some diseases are caused by germs (harmful microorganisms such as some bacteria and viruses) and some are not, and those caused by microorganisms may be spread to other people.
4.8.4 Recognize that there are beneficial microorganisms, such as normal intestinal flora.
4.8.5 Explain that washing hands with soap and water reduces the number of pathogens that can get into the body or that can be passed on to other people.
4.8.6 Describe the body's defenses against pathogens, including tears, saliva, skin, some types of white blood cells, stomach secretions, and an internal system of chemical testing.

Grade 5

Science and Technology

5.1 Broad Concept: Students should be encouraged to think scientifically: as a basis for developing this set of skills, and to address the content in this grade, students should perform investigations. As a consequence students should be able to:
5.1.1 Evaluate the validity of claims based on the amount and quality of the evidence cited.
5.1.2 Explain that predictions can be based on what is known about the past, assuming that conditions are similar.
5.1.3 Realize and explain why predictions may be more accurate if they are based on large collections of similar events for statistical accuracy.
5.1.4 Determine area and volume of rectangular shapes from linear dimensions, using the expressions A = l x w and V = l x w x h.
5.1.5 Understand how plotting data on a number line helps in seeing where the data lie, including the outliers.

5.2 Broad Concept: Science is based on inquiry: as a basis for understanding the concepts of scientific inquiry, students should be encouraged to develop their own questions in a scientific context. Students should be able to:
5.2.1 Recognize and describe how results of similar scientific investigations may turn out differently because of inconsistencies in methods, materials, and observations, or because of limitations of the precision of the instruments used.
5.2.2 Be able to distinguish inferences from actual observations.
5.2.3 Write instructions that others can follow to carry out an investigation.
5.2.4 Read and follow step-by-step instructions when learning new investigations.

5.2.5 Identify the controlled variable and at least one independent variable in a scientific investigation, when appropriate.
5.2.6 Explain the distortion inherent in using only a portion of the data collected to describe the whole. Understand that it is sometimes acceptable to discard data.

5.3 Broad Concept: Technology provides tools for Scientific Inquiry: Students should be exposed to technology and should use technology in their investigations. Students should be able to:
5.3.1 Give examples of technology, such as telescopes, microscopes, and cameras, that enable scientists and others to observe things that are too small or too far away to be seen without them and to study the motion of objects that are moving very rapidly or are hardly moving.
5.3.2 Give examples of advances in technology that have positively and/or negatively affected society.
5.3.3 Give examples of materials not present in nature that have become available because of science and technology, such as cloth, metal alloys, plastic, ceramics, and concrete.

5.5 Broad Concept: Students will be introduced to Earth Science: Students should relate to the earth as a planet in our solar system. Students should be able to:
5.5.1 Describe the Earth as part of a system called the solar system, which includes the sun (a star), planets, comets, asteroids, and many moons.
5.5.2 Recognize that the Earth is the third planet from the sun in our solar system.
5.5.3 Demonstrate how the Earth orbits the sun in a year's time and Earth rotates on its axis about once every 24 hours.
5.5.4 Explain that the alternation between day and night and the apparent movement of the sun, moon, and stars across the sky depend on the rotation of the Earth on its axis.
5.5.5 Explain that the air around us is matter and has weight (a force) and exerts pressure; explain that air pressure varies a little from place to place and from time to time.
5.5.6 Describe that winds blow from areas of higher pressure to areas of lower pressure.
5.5.7 Explain how global patterns, such as the jet stream and ocean currents, influence local weather and climate in ways that can be measured in terms of temperature, pressure, wind direction and speed, and amounts of precipitation.

5.6 Broad Concept: Students will be introduced to the movement of Water through the Water Cycle and develop an understanding of the physical properties of Water: Students should be able to:
5.6.1 Describe that when liquid water evaporates, it turns into a gas (vapor) mixed into the air, and can condense and reappear as a liquid when cooled or as a solid (ice) if cooled below the freezing point of water.
5.6.2 Explain how water moves in air masses from one place to another in the form of clouds, fog, or as invisible water vapor, and falls to the Earth as rain, hail, sleet, or snow.
5.6.3 Describe that clouds are made of tiny droplets of water or ice crystals.
5.6.4 Explain that water on Earth cycles through different forms and in different locations (e.g., underground water and vapor in the atmosphere).
5.6.5 Using maps and globes, recognize that the Earth's oceans are all connected as one body of water that covers about three-quarters of the Earth's surface.

5.8 Broad Concept: Students will be introduced to concepts of Heat and Energy: Students should be able to:
5.8.1 Describe that heating and cooling cause changes in the properties of substances. For example, liquid water can turn into steam by boiling, and liquid water can turn into ice by freezing.
5.8.2 Explain that many kinds of chemical changes occur faster at higher temperatures.
5.8.3 Explain that when a warm object and a cool one are placed in contact, heat flows from the warmer object to the cooler one until they are both at the same temperature. Know that heat transfer can also occur at a distance by radiation.
5.8.4 Describe how some materials conduct heat much better than others, and poor conductors (insulators) can be used to reduce heat loss or gain.

Life Science
5.9 Broad Concept: Students will be introduced to concepts of Cell Biology and appreciate the function of the cell as the smallest sub-unit of living organisms. Students should be able to:
5.10.1 Describe that some organisms consist of a single cell that needs an environment that can supply food, water, sometimes oxygen, and a way to dispose of waste. (Some single-celled organisms are anaerobes.)
5.10.2 Explain that some organisms are made of a collection of similar cells that benefit from cooperating.
5.10.3 Explain that in complex organisms such as humans, cells can have a very wide variety of forms and perform very different roles (e.g., nerve cells, muscle cells, and fat cells).

5.11 Broad Concept: Students will be introduced to concepts of Inheritance in living organisms and learn about the importance of reliable inheritance mechanism in organisms. Students should be able to:
5.11.1 Explain why there must be a reliable way to transfer information from one generation to the next in order for offspring to resemble their parents.
5.11.2 List some characteristics of plants and animals that are fully inherited (e.g., form of flower, shape of leaves) and others that are affected by the climate or environmental conditions (e.g., browning of leaves from too much sun, language spoken).

5.12 Broad Concept: Students will learn about Adaptation and Survival and its importance to the continuity of life. Students should be able to:
5.12.1 Explain that in any particular environment, some kinds of plants and animals survive well, some do not survive as well, and some cannot survive at all.
5.12.2 Identify organisms that are not native to the Washington, DC, area and how they undergo changes to increase their chance of survival in the area.
5.12.3 Explain how organisms can cause changes in their environment to ensure survival, and these changes may affect the ecosystem (the living and nonliving components of the environment).
5.12.4 Explain that organisms fit enough to survive in a particular environment will typically produce offspring fit enough to survive and reproduce in that particular environment. Over time, these inherited characteristics are carried as the predominant forms (e.g., adaptations such as shape of beak, length of neck, shape of teeth).

5.12.5 Explain how changes in an organism's habitat are sometimes beneficial and sometimes harmful, and how changes in the environment (drought, cold) have caused some plants and animals to die, migrate, or become extinct.
5.12.6 Explain that many plants and animals can survive harsh environments because of seasonal behaviors (e.g., in winter, some trees shed leaves, some animals hibernate).
5.12.7 Recognize that some animal behaviors are instinctive (e.g., turtles burying their eggs, human infants crying when hungry) and others learned (e.g., a wolf's hunting skills, humans' ability to build fires for warmth).
5.12.8 Describe well-defined plant behaviors, such as the way seedlings' stems grow toward light and their roots grow downward in response to gravity.
5.12.9 Examine the information that fossils provide us about living things that inhabited the Earth in the distant past, and describe how they can be compared both to one another and to living organisms according to their similarities and differences.
5.12.10 Recognize and describe how artifacts and preserved remains provide some evidence of the physical characteristics and possible behaviors of human beings and their ancestors who lived long ago.

Grade 6

Scientific Thinking and Inquiry

6.1 Broad Concept: Scientific progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.
6.1.1 Give examples of different ways scientists investigate natural phenomena, and identify processes all scientists use, such as collection of relevant evidence, the use of reasoning, the development and testing of hypotheses, and the use and construction of theory to make sense of the evidence.
6.1.2 Plan and conduct simple investigations based on student-developed questions that pertain to the content under study, and write instructions others can follow in carrying out the investigations.
6.1.3 Identify dependent and independent variables in those investigations that have controls. If no controls are used, explain why.
6.1.4 Recognize and explain that hypotheses are valuable even if they turn out not to be true, but that many investigations are not hypothesis-driven.
6.1.5 Write a report of an investigation that includes the problem to be solved, the methods employed, the tests conducted, the data collected or evidence examined, and the conclusions drawn.
6.1.6 Locate information in reference books, back issues of newspapers and magazines, CD-ROMs, and online databases.
6.1.7 Draw conclusions based on scientific evidence, and indicate whether further information is needed to support a specific conclusion or to discriminate among several possible conclusions.
6.1.8 Record and organize information in simple tables and graphs, and identify relationships they reveal. Use tables and graphs as examples of evidence for explanations when writing essays or writing about lab work, fieldwork, etc. Read simple tables and graphs produced by others, and describe in words what they show.
6.1.9 Read a topographic map and a geologic map for evidence provided on the maps.
6.1.10 Construct and interpret a simple map.

Science and Technology

6.2 Broad Concept: Although each of the human enterprises of science and technology has a character and history of its own, each is dependent on and reinforces the other. As a basis for understanding this concept,

6.2.1 Explain that computers have become valuable in science because they speed up and extend people's ability to collect, store, compile, and analyze data; prepare research reports; and share data and ideas with investigators all over the world.

6.2.2 Explain that technology is essential to science for such purposes as measurement, data collection, graphing and storage, computation, communication and assessment of information, and access to outer space and other remote locations.

The Solar System

6.3 Broad Concept: Astronomy and planetary exploration reveal the structure and scale of the solar system. As a basis for understanding this concept,

6.3.6 Construct models or drawings to explain that the seasons are caused by the tilt of the Earth's axis relative to the plane of its orbit and its revolution around the sun. Explain how this results in uneven heating of the various parts of Earth's surface that varies over the course of the year.

6.3.7 Describe that as spring turns to summer at a particular place on Earth, the days grow longer and the sun moves higher in the sky, resulting in more intense heating. In fall and winter, the opposite occurs. Explain how this variation in heating results in the seasons.

6.3.10 Explain that gravity is a force of attraction that every mass in the universe exerts on every other mass, and everything on or anywhere near Earth is attracted toward and attracts Earth's center by a gravitational force.

Heat (Thermal Energy)

6.4 Broad Concept: The transfer of energy through radiation and convection currents affects many phenomena on the Earth's surface. As a basis for understanding this concept,

6.4.2 Describe that the heat from the sun falls on Earth unevenly because of its spherical shape. Describe that regions close to the equator receive more concentrated solar energy than those closer to the poles.

6.4.4 Explain that much of the heat from the sun is absorbed by the land and oceans and then is released into the atmosphere.

6.4.6 Describe why ocean temperatures, therefore, tend to vary seasonally less than land areas and why coastal areas tend to have cooler summers and warmer winters than inland areas at a similar distance from the poles.

Weather and Climate

6.5 Broad Concept: Weather (in the short run) and climate (in the long run) involve the transfer of energy in and out of the atmosphere. As a basis for understanding this concept,

6.5.1 Explain how different regions receive different amounts of solar heating because of their latitude, clouds, surface water ice, and other variables. Understand that this results in large-scale convective air flow.

6.5.2 Recognize and describe that the currents in the air and ocean distribute heat energy

6.5.3 Explain that a great deal of heat energy is absorbed when water evaporates and is released when it condenses. Illustrate that this cycling of water and heat in and out of the atmosphere plays a critical role in climatic patterns.
6.5.4 Explain how mountain ranges and other major geographical features affect the climate (e.g. mountains produce rain shadows, land masses interrupt ocean currents).
6.5.5 Describe how climates may have changed abruptly in the past as a result of changes in Earth's crust, such as gas and dust from volcanic eruptions or impacts of meteorites, asteroids, and comets from space.

Resources
6.6 Broad Concept: Sources of materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept, students:
6.6.1 Explain that fresh water is limited in supply and uneven in distribution; describe why it is essential for life as we know it and also for most human activities, including industrial processes.
6.6.2 Recognize that fresh water is a resource that can be depleted or polluted, making it unavailable or unsuitable for humans.
6.6.3 Recognize that the Earth's resources for humans, such as fresh water, air, arable soil, and trees, are finite.
6.6.4 Explain that the atmosphere and the oceans have a limited capacity to absorb wastes and recycle materials naturally.
6.6.5 Investigate and describe how pollutants can affect weather and the atmosphere.
6.6.6 Explain that recycling, reuse, and the development of substitutes can reduce the rate of depletion of many minerals.
6.6.7 Describe that most rainwater that falls in Washington, DC, will eventually drain into the Chesapeake Bay.
6.6.8 Explain the important role of the water cycle within a watershed.

The Rock Cycle
6.7.6 Observe and describe common igneous, metamorphic, and sedimentary rocks, including granite, obsidian, pumice (igneous); slate, schist, marble (metamorphic); sandstone, shale, and limestone (sedimentary).

Plate Tectonics
6.8.12 Explain how physical evidence, such as fossils and surface features of glaciations, supports detailed explanations of how Earth's surface has evolved over geologic time.

Earth and Life History
6.9 Broad Concept: Evidence from rocks allows us to understand the evolution of life on Earth. As the basis for understanding this concept,
6.9.1 Explain how the Earth's surface is built up and broken down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.
6.9.2 Describe that the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impact of asteroids.

6.9.3 Explain that although weathered rock is the basic component of soil, the composition and texture of soil and its fertility and resistance to erosion are greatly influenced by plant roots and debris, bacteria, fungi, worms, insects, and other organisms.
6.9.6 Recognize that evidence from geologic layers and radioactive dating indicates that Earth is approximately 4.6 billion years old and life on this planet has existed for more than 3 billion years
6.9.7 Observe and explain that fossils provide evidence of how life and environmental conditions have changed.

Grade 7

Biological Classification

7.3 Broad Concept: Similarities are used to classify organisms because they may be used to infer the degree of relatedness among organisms. As a basis for understanding this concept, students:
7.3.1 Recognize and describe that a key distinction among organisms is between autotrophs, such as green plants (which use energy from sunlight to make their own food), and heterotrophs, such as animals and fungi (which consume other organisms as food and harvest energy from them).
7.3.2 Recognize and describe that biological classifications are based on how organisms are related: Organisms are classified into a hierarchy of groups and subgroups, with species as the most fundamental unit.
7.3.3 Recognize and describe the definition of a species as a group or population of organisms closely resembling one another that can mate and breed to produce fertile offspring.
7.3.4 Describe how similarities among organisms are found in external and internal anatomical features, including specific characteristics at the cellular level, such as the number of chromosomes.

Cell Biology

7.4 Broad Concept: All living things are composed of cells, from just one to many quadrillions, whose details usually are visible only through a microscope. As a basis for understanding this concept,
7.4.1 Investigate and explain that all living things are comprised of one or more cells, that cells are organism's basic units of structure and function, and that cells come only from existing cells (Theodor Schwann's and Matthias Schleiden's cell theory).
7.4.6 Describe that plant cells have chloroplasts and a cellulous cell wall and that animal cells do not
7.4.7 Observe and explain that about two-thirds of the mass of a typical cell is accounted for by water and that water gives cells many of their properties.
7.4.8 Describe how the most basic chemical functions of organisms, such as extracting energy from food and getting rid of wastes, are started or carried out completely within the cell.
7.4.9 Explain how cells in multicellular organisms continually divide to make more cells for growth and repair, and how various organs and tissues function to serve the needs of cells for food, air, and waste removal.

Genetics

7.5 Broad Concept: Every organism requires information in the form of a set of instructions that specifies its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept,

7.5.4 Recognize and describe that new varieties of cultivated plants, such as corn and apples, and domestic animals, such as dogs and horses, have resulted from selective breeding, over multiple generations, for particular traits.
7.5.5 Explain how the use of genetic-engineering techniques can speed the process of creating new varieties and introduce characteristics not easily available by selective breeding, and can make possible more precise modifications involving the manipulation of just one or a few genes.

Biological Evolution
7.6 Broad Concept: Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept,
7.6.1 Describe that biological variation (phenotype variation) is the raw material on which natural selection operates.
7.6.2 Explain how Darwin's research and that of his followers supported a concept of differential survival in terms of fitness (i.e., given the potential exponential increase of offspring and the only linear potential increase of resources, favorable variations that aid individual organisms in their survival in a given environment will confer on those organisms a greater reproductive success for that variety).
7.6.3 Describe how biological evolution results primarily from the action of natural selection on the available variation in a population of organisms.
7.6.4 Explain how independent lines of evidence drawn from geology, fossils, comparative anatomy, and molecular biology provide the firm basis of evolutionary theory.
7.6.5 Using specific examples, explain that extinction of a species is a result of mismatch of adaptation and the environment.

The Human Body
7.7 Broad Concept: Human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions. As a basis for understanding this concept,
7.7.3 Explain how the amount of food energy (usually measured in calories) that a person requires varies with body weight, age, sex, activity level, and metabolic rate.
7.7.4 Research and explain that regular exercise is important to maintain a healthy heart/lung (cardiovascular) system, good muscle tone, and strong bone structure.
7.7.5 Identify specific examples of how viruses, bacteria, fungi, and more complex parasites may infect the human body and interfere with normal body functions.
7.7.8 Recognize that the environment may contain dangerous levels of substances that are harmful to human beings. Therefore, the good health of individuals requires monitoring the soil, air, and water, as well as taking steps to keep them safe.

Ecology
7.8 Broad Concept: Organisms in ecosystems exchange energy and nutrients among themselves and with the physical environment. As a basis for understanding this concept,
7.8.1 Recognize that in all environments, such as freshwater, marine, forest, desert, grassland, mountain, farms, cities, and others, organisms with similar needs and living strategies compete with one another for resources, including food, space, water, air, and shelter.

7.8.2 Describe how two types of organisms may interact in a competitive or cooperative relationship, such as producer/consumer, predator/prey, parasite/hosts, or as symbionts.
7.8.3 Illustrate and explain how plants use the energy from light to make simple sugars, and more complex molecules, from carbon dioxide and water through a process called *photosynthesis.* Understand how this produces food that can be used immediately or stored for later use.
7.8.4 Create a food web to explain how energy and matter are transferred between producers, primary consumers, and secondary consumers.
7.8.5 Describe how organisms that eat plants break down the plant structures to produce the materials and energy that they need to survive, and in turn, other organisms consume them.
7.8.6 Explain how dead plants and animals, broken down by other living organisms (especially microorganisms and fungi), contribute to the cycling of matter through the system as a whole.
7.8.7 Describe how, as any population of organisms grows, it is held in check by one or more environmental constraints (e.g., depletion of food or nesting sites, increased numbers of predators or parasites).
7.8.8 Explain why in urban environments a species (mostly human beings) settles in dense concentrations.
7.8.9 Describe that all organisms, including the human species, are part of and depend on two main interconnected global food webs: the ocean food web and the land food web.
7.8.10 Recognize that entire species may prosper in spite of the poor survivability or bad fortune of individuals.

Grade 8

Scientific Thinking and Inquiry

8.2 Broad Concept: Students at this level should be honing their skills in Experimental Design. Students should be able to:
8.2.1 Describe how if more than one variable changes at the same time in an experiment, the outcome of the experiment may not be attributable to a change in any single variable.
8.2.2 Write clear step-by-step instructions (procedural summaries) for conducting investigations.
8.2.3 Use tables, charts, and graphs in making arguments and claims in presentations about lab work.
8.2.4 Read analog and digital meters on instruments used to make direct measurements of length, volume, weight, elapsed time, rates, or temperatures, and choose appropriate units. Explain how to interpolate on analog scales.
8.2.5 Explain why arguments may be invalid if based on very small samples of data, biased samples, or experiments in which there was no control sample.

High School Environmental Science

Scientific Investigation and Inquiry

E.1 Broad Concept: Scientific progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.

E.1.1 Know the elements of scientific methodology (identification of a problem, hypothesis formulation and prediction, performance of experimental tests, analysis of data, falsification, developing conclusions, reporting results) and be able to use a sequence of those elements to solve a problem or test a hypothesis. Also, understand the limitations of any single scientific method (sequence of elements) in solving problems.

E.1.2 Know that scientists cannot always control all conditions to obtain evidence, and when they are unable to do so for ethical or practical reasons, they try to observe as wide a range of natural occurrences as possible so as to be able to discern patterns.

E.1.3 Recognize the cumulative nature of scientific evidence.

E.1.4 Recognize the use and limitations of models and theories as scientific representations of reality.

E.1.5 Distinguish between a conjecture (guess), a hypothesis, and a theory as these terms are used in science.

E.1.6 Plan and conduct scientific investigations to explore new phenomena, to check on previous results, to verify or falsify the prediction of a theory, and to use a crucial experiment to discriminate between competing theories.

E.1.7 Use hypotheses to choose what data to pay attention to and what additional data to seek, and to guide the interpretation of the data.

E.1.8 Identify and communicate the sources of error (random and systematic) inherent in an experiment.

E.1.9 Identify discrepant results and possible sources of error or uncontrolled conditions.

E.1.10 Select and use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data. (The focus is on manual graphing, interpreting graphs, and mastery of metric measurements and units, with supplementary use of computers and electronic data gathering when appropriate.)

E.1.11 Formulate and revise explanations using logic and evidence.

E.1.12 Analyze situations and solve problems that require combining concepts from more than one topic area of science and applying these concepts.

E.1.13 Apply mathematical relationships involving linear and quadratic equations, simple trigonometric relationships, exponential growth and decay laws, and logarithmic relationships to scientific situations.

E.1.14 Observe natural phenomena and analyze their location, sequence, or time intervals (e.g., relative ages of rocks and succession of species in an ecosystem).

Environmental Systems

E.2 Broad Concept: The environment is a system of interdependent components affected by natural phenomena and human activity. As a basis for understanding this concept,

E.2.1 Understand and explain that human beings are part of Earth's ecosystems, and that human activities can, deliberately or inadvertently, alter ecosystems.

E.2.2 Explain how environmental change in one part of the world can impact seemingly distant places and systems.
E.2.3 Describe how the global environment is affected by national policies and practices relating to energy use, waste disposal, ecological management, manufacturing, and population growth.
E.2.4 Recognize and explain that in evolutionary change, the present arises from the materials of the past and in ways that can be explained (e.g., formation of soil from rocks and dead organic matter).

Ecosystems
E.3 Broad Concept: Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept,
E.3.1 Explain that biodiversity is the sum total of different kinds of organisms in a given ecological community or system, and is affected by alterations of habitats.
E.3.2 Know and describe how ecosystems can be reasonably stable over hundreds or thousands of years.
E.3.3 Understand and describe that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages that eventually results in a system similar to the original one.
E.3.4 Understand and explain that ecosystems tend to have cyclic fluctuations around a state of rough equilibrium, and change results from shifts in climate, natural causes, human activity, or when a new species or nonnative species appears.
E.3.5 Know that organisms may interact in a competitive or cooperative relationship, such as producer/consumer, predator/prey, parasite/hosts, or as symbionts, and explain how these interactions contribute to the stability of an ecosystem.
E.3.6 Recognize and describe the difference between systems in equilibrium and systems in disequilibrium.
E.3.7 Explain how water, carbon, phosphorus, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles via photosynthesis and respiration. Diagram the cycling of carbon, nitrogen, phosphorus, and water in an ecosystem.
E.3.8 Describe the role of nitrogen and carbon cycles in the improvement of soils for agriculture.
E.3.9 Locate, identify, and explain the role of the major Earth biomes (e.g., grasslands, rainforests, arctic tundra, deserts) and discuss how the abiotic and biotic factors interact within these ecosystems.
E.3.10 Explain the process of succession, both primary and secondary, in terrestrial and aquatic ecosystems.
E.3.11 Describe how adaptations in physical structure or behavior may improve an organism's chance for survival and impact an ecosystem.
E.3.12 Describe the concepts of niche and habitat, and explain the effects of loss of habitat on a species' survivability.
E.3.13 Explain how soil, water, and pest management are achieved in various agricultural systems (conventional and organic). Describe the tenets of sustainable agriculture.

Populations
E.4 Broad Concept: The amount of life any environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms. As a basis for understanding this concept,
E.4.1 Explain the concept of carrying capacity.

E.4.2 Demonstrate how resources, such as food supply, the availability of water, and shelter, influence populations.
E.4.3 Demonstrate and explain how fluctuations in population size and population growth rates are determined by such factors as birth rate, death rate, and migration rate.
E.4.4 Describe the effect of overpopulation (i.e., resource depletion and potential elimination of species), the role of predators in maintaining ecosystem stability, and methods of population management.
E.4.5 Describe current and historical trends in human population growth in different regions of the world.
E.4.6 Explain how the size and rate of growth of the human population in any location is affected by economic, political, religious, technological, and environmental factors.

Natural Resources

E.5 Broad Concept: Numerous Earth resources are used to sustain human affairs. The abundance and accessibility of these resources can influence their use. As a basis for understanding this concept,
E.5.1 Recognize that the Earth's resources for humans, such as fresh water, air, arable soil, and trees, are finite. Explain how these resources can be conserved through reduction, recycling, and reuse.
E.5.2 Differentiate between renewable and nonrenewable resources (including sources of energy), and compare and contrast the pros and cons of using nonrenewable resources.
E.5.3 Give examples of the various forms and uses of fossil fuels and nuclear energy in our society, and describe alternative sources of energy provided by water, the atmosphere, and the sun.
E.5.4 Demonstrate knowledge of the distribution of natural resources in the United States and the world, and explain how natural resources influence relationships among nations.
E.5.5 Recognize and describe the role of natural resources in providing the raw materials for an industrial society.
E.5.6 Analyze the trade-offs among different fuels, such as how energy use contributes to the rising standard of living in the industrially developing nations, yet also leads to more rapid depletion of Earth's energy resources and to increased environmental risks associated with the use of fossil and nuclear fuels.
E.5.7 Identify specific tools and technologies used to adapt and alter environments and natural resources to meet human physical and cultural needs.
E.5.8 Understand and describe the concept of integrated natural resource management and the values of managing natural resources as an ecological unit.

Watersheds and Wetlands

E.6 Broad Concept: Water is continually being recycled by the hydrologic cycle through the watersheds, oceans, and the atmosphere by processes such as evaporation, condensation, precipitation runoff, and infiltration. This life-giving cycle is continually and increasingly impacted by human affairs. As a basis for understanding this concept,
E.6.1 Compare and contrast the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.

E.6.2 Describe the physical characteristics of wetlands and watersheds and explain how water flows into and through a watershed (e.g., precipitation, aquifers, wells, porosity, permeability, water table, capillary water, and runoff).
E.6.3 Describe how wetlands store excess water and filter sediments and excess nutrients.
E.6.4 Examine the dynamics of diverse ecosystems in watersheds and wetlands. Identify various organisms found in Potomac River wetlands and watersheds.
E.6.5 Describe the causes of, and the efforts to control, erosion in the Chesapeake Bay.
E.6.6 Investigate and describe how point and nonpoint source pollution can affect the health of a bay's watershed and wetlands.
E.6.7 Collect, record, and interpret data from physical, chemical, and biological sources to evaluate the health of the Chesapeake Bay watershed and wetlands, and describe how the Bay supports a wide variety of plant and animal life that interact with other living and nonliving things.
E.6.8 Explain the dynamics of oceanic currents, including upwelling, density, and deep water currents, the local Labrador Current and the Gulf Stream, and their relationship to global circulation within the marine environment and climate.

Energy in the Earth System
E.7 Broad Concept: Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept,
E.7.1 Explain that energy cannot be created or destroyed; however, in many processes energy is transformed into the microscopic form called *heat energy,* that is, the energy of the disordered motion of atoms.
E.7.2 Explain the meaning of radiation, convection, and conduction (three mechanisms by which heat is transferred to, through, and out of the Earth's system).
E.7.3 Understand and describe how layers of energy-rich organic material have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. Recognize that by burning these fossil fuels, people are passing stored energy back into the environment as heat and releasing large amounts of carbon dioxide.
E.7.4 Describe how the energy derived from the sun is used by green plants to produce chemical energy in the form of sugars (photosynthesis), and this energy is transferred along a food chain from producers (plants) to consumers to decomposers.
E.7.5 Illustrate the flow of energy through various trophic levels of food chains and food webs within an ecosystem. Describe how each link in a food web stores some energy in newly made structures and how much of the energy is dissipated into the environment as heat. Understand that a continual input of energy from sunlight is needed to keep the process going.
E.7.6 Describe how the chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways.

Environmental Quality
E.8 Broad Concept: Environmental quality is linked to natural and human-induced hazards, and the ability of science and technology to meet local, national, and global challenges. As a basis for understanding this concept,

E.8.1 Differentiate between natural pollution and pollution caused by humans, and give examples of each.
E.8.2 Describe sources of air and water pollution, and explain how air and water quality impact wildlife, vegetation, and human health.
E.8.3 Describe the historical and current methods of water management and recycling, including the waste treatment practices of landfills, incineration, reuse/recycle, and source reduction.
E.8.4 Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost.
E.8.5 Compare and contrast the beneficial and harmful effects of an environmental stressor, such as herbicides and pesticides, on plants and animals. Give examples of secondary effects on other environmental components such as humans, water quality, and wildlife.
E.8.6 Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur, as well as the short-term and long-term effects on the environment and on people.
E.8.7 Recognize and describe important legislation enacted to protect environmental quality, such as the Clean Air Act and the Clean Water Act.

Biology

Cell Biology and Bio-Chemistry

B.1 Broad Concept: Students should appreciate that Living things are made of atoms bonded together to form molecules, some of the most important of which are large and contain carbon (i.e., "organic" compounds). In order to demonstrate this, students should be able to:
B.1.2 Describe the structure and unique properties of water and its importance to living things.
B.1.3 Describe the central role of carbon in the chemistry of living things because of its ability to combine in many ways with itself and other elements.
B.1.4 Know that living things are made of molecules largely consisting of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
B.1. 5 Know that living things have many different kinds of molecules, including small ones such as water; midsize ones such as sugars, amino acids, and nucleotides; and large ones such as starches, proteins, and DNA.

B.2 Broad Concept: Students should know that all living things are composed of cells. In order to demonstrate this knowledge students should be able to:
B.2.1 Describe that all organisms begin their life cycles as a single cell, and in multicellular organisms the products of mitosis of the original zygote form the embryonic body.
B.2.3 Demonstrate and explain that cell membranes act as highly selective permeable barriers to penetration of substances by diffusion or active transport.
B.2.5 Describe that all growth and development of organisms is a consequence of an increase in cell number, size, and/or products.
B.2.6 Explain why communication and/or interaction are required between cells to coordinate their diverse activities.

B.3 Broad Concept: Students should know that all the fundamental life processes of a cell are either chemical reactions or molecular interactions. In order to demonstrate this knowledge, students should be able to:
B.3.1 Observe and explain the role of enzymatic catalysis in biochemical processes.
B.3.3 Demonstrate that most cells function best within a narrow range of temperature and pH; extreme changes usually harm cells by modifying the structure of their macromolecules and, therefore, some of their functions.
B.3.4 Explain that complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division.
B.3.5 Explain how cell activity in a multicellular plant or animal can be affected by molecules from other parts of the organism.
B.3.6 Explain the photosynthesis process: Plants make simple sugars and other molecules in their leaves, and chlorophyll found in the leaves can make the food and nutrients that the plant can use from carbon dioxide, water, nutrients, and energy from sunlight.

B.4 *Broad Concept*: Student should have a clear understanding of the relationships between Biological Structure, Organization and how this impacts functionality. Specifically students should be able to:
B.4.1 Explain the hierarchical organization of living things from least complex to most complex (subatomic, atomic, molecular, cellular, tissue, organs, organ system, organism, population, community, ecosystem, and biosphere).
B.4.3 Describe the organelles that plant and animal cells have in common (e.g., ribosomes, golgi bodies, endoplasmic reticulum) and some that differ (e.g., only plant cells have chloroplasts and cell walls).
B.4.4 Describe that the work of the cell is carried out by structures made up of many different types of large (macro) molecules that it assembles, such as proteins, carbohydrates, lipids, and nucleic acids.
B.4.5 Explain that a complex network of proteins provides organization and shape to cells.

B.5 Broad Concept: Students should understand how Chemical Change impacts life. Specifically students should be able to:
B.5.1 Explain how layers of energy-rich organic material, mostly of plant origin, have been gradually turned into great coal beds and oil pools by the pressure of the overlying Earth and its internal heat.

Genetics and Evolution
B.6 Broad Concept: Students should be refining their understanding of Theories of Inheritance. Specifically students should be able to:
B.6.1 Research and explain the genetic basis for Gregor Mendel's laws of segregation and independent assortment.
B.6.2 Investigate and describe how a biological classification system that implies degrees of kinship between organisms or species can be deduced from the similarity of their nucleotide (DNA) or amino acids (protein) sequences. Know that such systems often match the completely independent classification systems based on anatomical similarities.
B.6.3 Explain how the actions of genes, patterns of inheritance, and the reproduction of cells and organisms account for the continuity of life.

B.6.4 Investigate and explain how molecular evidence reinforces and confirms the fossil, anatomical, behavioral, and embryological evidence for evolution, and provides additional detail about the sequence in which various lines of descent branched off from one another.
B.6.5 Explain Gregor Mendel's identification of what we now call "genes," how they are sorted in reproduction, and how this led to an understanding of the mechanism of heredity. Understand how the integration of his concept of heredity and the concept of natural selection has led to the modern model of speciation and evolution.

B.7 Broad Concept: Students should know that Genes are a set of instructions encoded in the DNA sequence of each organism [responsible for inheritance] and be able to apply this knowledge to problems of inheritance. Specifically students should be able to:
B.7.2 Explain how hereditary information is passed from parents to offspring in the form of "genes," which are long stretches of DNA consisting of sequences of nucleotides. Explain that in eukaryotes, the genes are contained in chromosomes, which are bodies made up of DNA and various proteins.
B.7.3 Know every species has its own characteristic DNA sequence.
B.7.4 Explain how biological evolution is also supported by the discovery that the genetic code found in DNA is the same for almost all organisms.

B.8 Broad Concept: Students should know that Genes specify the sequence of amino acids in proteins characteristic of that organism and how this impacts their functionality. Specifically students should be able to:
B.8.1 Explain the flow of information is usually from DNA to RNA, and then protein.
B.8.2. Explain how the genetic information in DNA molecules provides the basic form of instructions for assembling protein molecules and that this mechanism is the same for all life forms.
B.8.3. Understand and explain that specialization of cells is almost always due to different patterns of gene expression, rather than differences in the genes themselves.

B.9 Broad Concept: Students should understand Biodiversity as the result of genetic changes. Specifically students should be able to:
B.9.1 Understand and describe how inserting, deleting, or substituting short stretches of DNA alters a gene. Recognize that changes (mutations) in the DNA sequence in or near a specific gene may (or may not) affect the sequence of amino acids in the encoded protein or the expression of the gene.
B.9.2 Explain the mechanisms of genetic mutations and chromosomal recombinations, and when and how they are passed on to offspring.
B.9.3 Explain how the sorting and recombination of genes in sexual reproduction result in a vast variety of potential allele combinations in the offspring of any two parents.
B.9.4 Explain that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes.
B.10 Broad Concept: Students should be cognizant of the Theory of Evolution. Specifically students should be able to:
B.10.1 Describe how life on Earth is thought to have begun as one or a few simple one-celled organisms about 3.5 billion years ago, and that during the first 2 billion years, only single-cell microorganisms

existed. Know that, once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms could evolve.
B.10.2 Explain that prior to the theory first offered by Charles Darwin and Alfred Wallace, the universal belief was that all known species had been created de novo at about the same time and had remained unchanged.
B.10.3 Research and explain that Darwin argued that only biologically inherited characteristics could be passed on to offspring, and that some of these characteristics would be different from the average and advantageous in surviving and reproducing; over generations, accumulation of these inherited advantages would lead to a new species.
B.10.4 Explain that evolution builds on what already exists, so the more variety there is, the more there can be in the future.

B.11 Broad Concept: Students should appreciate Evolution as the result of genetic changes that occur in constantly changing environments. Specifically students should be able to:
B.11.1 Explain how a large diversity of species increases the chance that at least some living things will survive in the face of large or even catastrophic changes in the environment.
B.11.2 Research and explain how natural selection provides a mechanism for evolution and leads to organisms that are optimally suited for survival in particular environments.
B.11.3 Explain that biological diversity, episodic speciation, and mass extinction are depicted in the fossil record, comparative anatomy, and other evidence.

Multicellular Organisms: Plants and Animals
B.12 Broad Concept: Students should be aware of the unique Biology of The Plant Kingdom. Specifically students should be able to:
B.12.1 Describe the structure and function of roots, leaves, flowers, and stems of plants.
B.12.2 Know that about 250,000 species of flowering plants have been identified.
B.12.3 Explain that during the process of photosynthesis, plants release oxygen into the air.
B.12.4 Recognize that plants have a greater problem with “unpredictable environments” because they cannot seek shelter as many animals can.

B.13 Broad Concept: Students should develop an understanding of Plant and animal interactions and be aware that Plants are essential to animal life on Earth. Specifically students should be able to
B.13.1 Identify the roles of plants in the ecosystem: Plants make food and oxygen, provide habitats for animals, make and preserve soil, and provide thousands of useful products for people (e.g., energy, medicines, paper, resins).
B.13.2 Describe that plants have broad patterns of behavior that have evolved to ensure reproductive success, including co-evolution with animals that distribute a plant’s pollen and seeds.

B.14 Broad Concept: Students should understand how biological Systems function in the mammalian Body. Specifically students should be able to:
B.14.1 Explain the major systems of the mammalian body (digestive, respiratory, reproductive, circulatory, excretory, nervous, endocrine, integumentary, immune, skeletal, and muscular) and how they interact with each other.

Ecosystems

B.16 Broad Concept: Students should understand Classification in systems. Specifically students should be able to:

B.16.1 Using ecological studies, explain distinct relationships and differences between urban environments and other environmental systems.

B.17 Broad Concept: Students should understand Ecosystems as dynamic systems. Specifically students should be able to:

B.17.1 Illustrate and describe the cycles of biotic and abiotic factors (matter, nutrients, energy) in an ecosystem.

B.17.2 Describe how factors in an ecosystem, such as the availability of energy, water, oxygen, and minerals, and the ability to recycle the residue of dead organic materials, cause fluctuations in population sizes.

B.17.3 Explore and explain how changes in population size have an impact on the ecological balance of a community and how to analyze the effects.

B.17.4.Describe how the physical or chemical environment may influence the rate, extent, and nature of the way organisms develop within ecosystems.

B.18 Broad Concept: Students should understand Stability in ecosystems as a specific example of stability in Systems of dynamic equilibrium. Specifically students should be able to:

B.18.1 Describe how ecosystems can be reasonably stable over hundreds or thousands of years.

B.18.2 Explain that ecosystems tend to have cyclic fluctuations around a state of rough equilibrium, and change results from shifts in climate, natural causes, human activity, or when a new species or non-native species appears.

B.19 Broad Concept: Students should understand the effects of Pollution and other Environmental challenges and their longer term consequences. Specifically students should be able to:

B.19.1 Investigate and describe how point and nonpoint source pollution can affect the health of a bay's watershed and wetlands.

B.19.2 Assess the method for monitoring and safeguarding water quality, including local waterways such as the Anacostia and Potomac rivers, and know that macroinvertebrates can be early warning signs of decreasing water quality.

High School Earth Science Standards and Learning Activities

Scientific Investigation and Inquiry

ES.4 Broad Concept: Interactions among the solid Earth, hydrosphere, and atmosphere have resulted in ongoing evolution of the earth system over geologic time. As a basis for understanding this concept,

ES.4.1 Examine and describe the structure, composition, and function of Earth's atmosphere, including the role of living organisms in the cycling of atmospheric gases.

ES.4.2 Investigate and describe the composition of the Earth's atmosphere as it has evolved over geologic time (outgassing, origin of atmospheric oxygen, variations in carbon dioxide concentration).

ES.4.3 Describe the main agents of erosion: water, waves, wind, ice, plants, and gravity.

ES.4.4 Explain the effects on climate of latitude, elevation, and topography, as well as proximity to large bodies of water and cold or warm ocean currents.

ES.4.5 Explain the possible mechanisms and effects of atmospheric changes brought on by things such as acid rain, smoke, volcanic dust, greenhouse gases, and ozone depletion.

ES.4.6 Determine the origins, life cycles, behavior, and prediction of weather systems.

ES.4.7 Investigate and identify the causes and effects of severe weather.

ES.4.8 Explain special properties of water (e.g., high specific and latent heats) and the influence of large bodies of water and the water cycle on heat transport and, therefore, weather and climate.

ES.4.9 Describe the development and dynamics of climatic changes over time corresponding to changes in the Earth's geography (plate tectonics/continental drift), orbital parameters (the Milankovitch cycles), and atmospheric composition.

ES.4.10 Describe the nitrogen and carbon cycles and their roles in the improvement of soils for agriculture.

ES.4.11 Explain that the oceans store carbon dioxide mostly as dissolved HCO_3^- and $CaCO_3$ as precipitate or biogenic carbonate deposits.

ES.4.12 Use weather maps and other tools to forecast weather conditions.

ES.4.13 Use computer models to predict the effects of increasing greenhouse gases on climate for the planet as a whole and for specific regions.

The Hydrologic Cycle

ES.5 Broad Concept: Water is continually being recycled by the hydrologic cycle through the watersheds, oceans, and the atmosphere by processes such as evaporation, condensation, precipitation runoff, and infiltration. As a basis for understanding this concept,

ES.5.1 Explain how water flows into and through a watershed (e.g., properly use terms precipitation, aquifers, wells, porosity, permeability, water table, capillary water, and runoff).

ES.5.2 Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff, and groundwater percolation, infiltration, and transpiration.

ES.5.3 Identify and explain the mechanisms that cause and modify the production of tides, such as the gravitational attraction of the moon, the sun, and coastal topography.

The Rock Cycle

ES.6.1. Differentiate among the processes of weathering, erosion, transportation of materials, deposition, and soil formation.

Plate Tectonics

ES.7 Broad Concept: Plate tectonics operating over geologic time has altered the features of land, sea, and mountains on the Earth's surface. As the basis for understanding this concept,

ES.7.5 Explain why, how, and where earthquakes occur, how they are located and measured, and the ways they can cause damage (directly by shaking and secondarily by fire, tsunami, landsliding, or liquefaction).

ES.7.6 Observe and explain how rivers and streams are dynamic systems that erode and transport sediment, change their course, and flood their banks in natural and recurring patterns.

High School Chemistry Standards and Learning Activities

Scientific Investigation and Inquiry

C.1 Broad Concept: Scientific progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.

C.1.1 Know the elements of scientific methodology and be able to use a sequence of those elements to solve a problem or test a hypothesis.

C.1.6 Plan and conduct scientific investigations to explore new phenomena, to check on previous results, to verify or falsify the prediction of a theory, and to use a crucial experiment to discriminate between competing theories.

C.1.10 Select and use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data. (The focus is on manual graphing, interpreting graphs, and mastery of metric measurements and units, with supplementary use of computers and electronic data gathering when appropriate.)

C.1.12 Analyze situations and solve problems that require combining concepts from more than one topic area of science and applying these concepts.

C.3.4 Describe the observable properties of acids, bases, and solutions.

C.6.3 Know that many naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.

C.8 Broad Concept: The microscopic conservation of atoms in chemical reactions implies the macroscopic principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept,

C.8.6 Explain that in solids, particles can only vibrate around fixed positions, but in liquids, they can slide randomly past one another, and in gases, they are free to move between collisions with one another.

C.8.11 Describe the effect of changes in reactant concentration, changes in temperature, the surface area of solids, and the presence of catalysts on reaction rates.

C.9.1 Explain the kinetic molecular theory and use it to explain changes in gas volumes, pressure, and temperature.

C.10.2 Describe the factors that affect the rate of a chemical reaction (temperature, concentration) and the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).

C.11 Broad Concept: Solutions are mixtures of two or more substances that are homogeneous on the molecular level. As a basis for understanding this concept,
C.11.1 Define solute and solvent.
C.11.2 Predict and describe how the temperature, concentration, pressure and surface area of solids affect the dissolving process.
C.11.3 Explain that, for a closed system at constant temperature and pressure, a solid in contact with its saturated solution may reach dynamic equilibrium when the rate of solid dissolving equals the rate of solid precipitating.
C.11.4 Calculate the concentration units of solutions such as molarity, percent by mass or volume, parts per million (ppm), or parts per billion (ppb).
C.11.6 Calculate the theoretical freezing-point depression and boiling-point elevation of an ideal solution as a function of solute concentration.

C.12 Broad Concept: Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept,
C.12.1 Describe the concepts of temperature and heat flow in terms of the motion and energy of molecules (or atoms).
C.12.2 Determine and explain that chemical processes release (exothermic) or absorb (endothermic) thermal energy.
C.12.3 Explain how energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.
C.12.4 Solve problems involving heat flow and temperature changes, using given values of specific heat and latent heat of phase change.

High School Physics

Scientific Thinking and Inquiry

P.1.6 Plan and conduct scientific investigations to explore new phenomena, to check on previous results, to verify or falsify the prediction of a theory, and to use a crucial experiment to discriminate between competing theories.
P.1.10 Select and use appropriate tools and technology to perform tests, collect data, and analyze relationships, and display data. (The focus is on manual graphing, interpreting graphs, and mastery of metric measurements and units, with supplementary use of computers and electronic data gathering when appropriate.)

Heat and Thermodynamics

P.4.1 Explain that the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced.

P.5.9 Describe that when two objects at different temperatures are in contact, heat energy always flows from the object at higher temperature to the object at a lower temperature by the process of conduction until the two are at the same (intermediate) temperature

P.5.10 Explain the process of convection: Because the density of fluids varies with temperature, the warmer parts of a fluid tend to move into and mix with the cooler parts, resulting in a transfer of heat energy from place to place.

U.S. History and Geography
Grade11

The Rise of Industrial America (1877-1914)

11.2 Broad Concept: Students analyze the transformation of the American economy and the changing social and political conditions in the United States in response to the Industrial Revolution.

11.2.1 Explain patterns of agricultural and industrial development as they relate to climate, use of natural resources, markets and trade, and the location of such development on a map.

11.2.4 Explain how states and the federal government encouraged business expansion through tariffs, banking, land grants, and subsidies.

The Progressive Era (1890-1920)

11.4 Broad Concept: Students analyze the changing landscape, including the growth of cities and development of cities divided by race, ethnicity, and class.

11.4.2 Explain the large-scale rural-to-urban migration, as well as massive immigration from Southern and Eastern Europe.

11.4.3 Explain, with the use of a map, the economic development of the United States and its emergence as a major industrial power, including its gains from trade and the advantages of its physical geography.

The Progressive Era (1890-1920)

11.4.10 Explain the effects of industrialization on living and working conditions, including working conditions and food safety.

The 1920s and 1930s

11.6.2 Describe the rise of mass-production techniques, the growth of cities, the impact of new technologies (e.g. the automobile, electricity, air-planes), and the resulting prosperity, expansion of freedom (derived from the car and the building of roads/highways), and the effect on the American landscape.

World War II

11.8.9 Trace the Manhattan Project, the decision to drop the atomic bombs on Hiroshima and Nagasaki, and the consequence of that decision.

11.8.12 Describe the major developments in aviation, weaponry, communication, and medicine, and the war's impact on the location of American industry and use of resources.

Cold War America to the New Millennium (1947-2001)

11.10.3 Describe the effects of technological developments on society and the economy (e.g. the computer revolution, changes in communications, advances in medicine, and improvements, in agricultural technology) and the increasing role of TV and mass media on the American home.

11.12.2 List and identify the major components of Johnson's Great Society programs: aid to education, attack on disease, Medicare, urban renewal, beautification, conservation, the war on poverty, crime prevention, and removal of obstacles to the right to vote.
11.12.5 Describe the dimensions of the energy crisis, the creation of a national energy policy, and the emergence of environmentalism (e.g., creation of the Environmental Protection Agency; Rachel Carson's Silent Spring; disasters such as Love Canal, Three Mile Island, and the Exxon Valdez).
11.12.8 Identify scientific, technological, and medical advances (e.g., VCR technology, jumbo jets, DNA and genetic engineering, and the first test tube baby).

Contemporary American
11.13.2 Identify recent scientific and medical advances (e.g. Human Genome Project), and explain how medical advances and improves living standards have brought significant increases in life expectancy.
11.13.7 Analyze the social and economic effects of various health crises, including increasing obesity and the AIDS epidemic.

District of Columbia History and Government
Grade 12

Early Settlements and Geography
12.DC.1 Students identify and locate on a map the principal topographical features of the original federal district and surrounding area.
12.DC.2 Students describe the early Native American and English settlements that were established during the 17th and 18th centuries.
12.DC.3 Students explain how and when Africans came to the Chesapeake and Potomac Region, why a number of them were free, the roles they played in the development of the agrarian economy (e.g. tobacco), and how slavery developed as an institution in the region.

Late 19th Century and Early 20th Centuries
12.DC.13.2 Using a map, locate the various parks and playgrounds around the city.

20th Century Expansion and Urban Challenges
12.DC.14.3 Assess the relationships between advancements in transportation technology and the growth of the city and neighborhood development, including the effects of the electric streetcar.

Addressing Opportunities and Problems under Home Rule
12.DC.22.2 Describe and debate whether the city should plan for an increase in population and density to accommodate new residents.
12.DC.22.3 Describe how such regional issues as transportation, water and air quality, and homeland security affect the city.

Grade 9-12 Historical and Social Sciences Analysis Skills

Geographic Skills

1. Students understand the influence of physical and human geographic factors on the evolution of significant historic events and movements.
They apply the geographic viewpoint to local, regional, and world policies and problems.
2. Students use a variety of maps and documents to interpret human movement, including major patterns of domestic and international migration, changing environmental preferences and settlement patterns, the frictions that develop between population groups, and the diffusion of ideas, technological innovations, and goods. Identify major patterns of human migration, both in the past and present.
3. Students relate current events to the physical and human characteristics of places and regions. They identify the characteristics, distribution, and complexity of Earth's cultural mosaics.
4. Students evaluate ways in which technology has expanded the capability of humans to modify the physical environment and the ability of humans to mitigate the effect of natural disasters.
7. Students study current events to explain how human actions modify the physical environment and how the physical environment affects human systems (e.g., natural disasters, climate, and resources). They explain the resulting environmental policy issues.
8. Students explain how different points of view influence policies relating to the use and management of Earth's resources.

Appendix F. Organizations with Environmental Literacy Resources for Schools

To compile these resource lists, the District Department of the Environment created an on-line survey for organizations to complete. Responses were collected from January –March 2012. All of the data in these tables is self-reported.

AIR – includes air quality, climate change

Organization	Curricular Resources	School-based Presentations	Field Experiences	Professional Development	Funding	Community Service	Other
Audubon Naturalist Society		x		x		x	
Cintia Cabib – Doc. Filmmaker		x					
Chesapeake Bay Foundation			x				
Clean Air Partners-MW-COG	x	x		x			
DC Greenworks		x	x			x	x
District Department of the Environment	x						
Earth Day Network	x	x					
Green Living Project		x					
Groundwork Anacostia River DC	x	x	x	x	x	x	x
Izaak Walton League						x	
J. Craig Venter Institute		x		x			
Kid Power Inc.	x	x				x	
Koshland Science Museum				x			
Live It Learn It							x
National Env. Ed. Foundation	x			x			
National Geographic Society	x	x	x	x			x
NOAA	x	x	x	x			x
North American Assoc. for Env. Ed.				x			
Project Learning Tree	x			x	x		
Saturday Env. Academy			x	x		x	x
U.S. Botanic Garden	x	x		x			
U.S. Environmental Protection Agency	x	x		x	x	x	x
U.S. Forest Service	x						

WATER – includes stormwater, rivers, aquatic wildlife

Organization	Curricular Resources	School-based Presentations	Field Experiences	Professional Development	Funding	Community Service	Other
Alice Ferg. Found.	x		x	x		x	
Anacostia Watershed Society		x	x	x		x	
Audubon Naturalist Society		x	x	x	x	x	
Cintia Cabib – Doc. Filmmaker		x					
Ches. Bay Found.	x		x	x		x	x
Ches. Bay Trust							
City Blossoms	x						
DC Greenworks		x	x			x	x
DC Historic Preserv. Office - Archaeology	x	x	x	x		x	
DC Water	x	x	x	x		x	
District Department of the Environment	x	x	x	x	x	x	x
Earth Day Network	x	x					
Earth Force	x	x	x	x	x		
Env. Concern	x	x	x	x			
George Washington Carver Outdoor Sch.	x		x			x	
Green Living Project	x	x					
Groundwork Anacostia River DC	x	x	x	x	x	x	x
Izaak Walton League	x	x				x	
J. Craig Venter Inst.	x	x		x			
Kid Power Inc.	x	x				x	
Live It Learn It	x	x	x	x			x
Living Classrooms	x	x	x			x	
National Aquarium			x	x			
Nat. Env.Ed. Found.	x			x	x		
National Geo Society	x	x	x	x			x
NOAA	x	x	x	x			x
National Park Serv.	x	x	x	x		x	
Natural Partners	x						
North American Assoc. for Env. Ed.				x			
Project Learning Tree	x			x	x		
Saturday Env. Acad.			x			x	
Student Cons. Assoc.		x	x	x		x	
U.S. Botanic Garden	x			x			
U.S. EPA	x	x		x	x	x	x
U.S. Forest Service	x		x				
UDC's Master Gardener Program	x	x					
Wash. Youth Garden	x	x	x				

LAND – includes plants, soil, urban planning, terrestrial wildlife

Organization	Curricular Resources	School-based Presentations	Field Experiences	Professional Development	Funding	Community Service	Other
Alice Ferguson Foundation	x	x	x	x		x	
Arcadia Center for Sustain. Food & Ag.			x				
Audubon Naturalist Society		x	x	x	x	x	
Cintia Cabib – Doc. Filmmaker	x	x					
Casey Trees	x	x				x	
Chesapeake Bay Foundation	x		x	x		x	x
City Blossoms	x	x	x	x		x	x
DC Department of Parks and Recreation	x		x			x	
DC Greenworks		x	x			x	x
DC Historic Preserv. Office - Archaeology	x	x	x	x		x	
District Department of the Environment	x	x	x	x	x	x	x
Earth Day Network	x	x			x		
George Washington Carver Outdoor Sch.	x		x			x	
Green Living Project	x	x					
Groundwork Anacostia River DC	x	x	x	x	x	x	x
J. Craig Venter Inst.		x			x		
Kid Power Inc.	x	x				x	
Live It Learn It	x	x	x	x			x
Living Classrooms	x	x	x			x	
National Aquarium			x	x			
National Env. Ed. Foundation	x			x			
National Geo Society	x	x	x	x			x
National Park Serv.	x	x	x			x	
Natural Partners	x	x	x	x	x	x	x
North American Assoc. for Env. Ed.				x			
Project Learning Tree	x			x	x		
Saturday Env. Academy			x			x	
Student Conserv. Association		x	x	x		x	
U.S. Botanic Garden	x	x		x			
U.S. EPA	x	x		x	x	x	x
U.S. Forest Service	x		x				
UDC's Master Gardener Program	x	x					
Wash. Youth Garden	x	x	x				

RESOURCE CONSERVATION – includes energy, waste, recycling

Organization	Curricular Resources	School-based Presentations	Field Experiences	Professional Development	Funding	Community Service	Other
Alice Ferguson Foundation	x	x	x	x		x	
Anacostia Watershed Society		x	x	x		x	
Audubon Naturalist Society		x	x	x	x	x	
Cintia Cabib – Doc. Filmmaker		x					
Chesapeake Bay Foundation	x		x	x		x	x
City Blossoms	x		x	x		x	
DC Department of Parks and Recreation	x		x			x	
DC Greenworks		x	x			x	x
DC Historic Preserv. Office - Archaeology	x	x	x	x		x	
DC Office of the State Super. of Ed.			x				
District Department of the Environment	x	x	x	x		x	x
Earth Day Network	x	x					
Env. Concern		x					
George Washington Carver Outdoor Sch.	x		x			x	
Green Living Project	x	x					
Groundwork Anacostia River DC	x	x	x	x	x	x	x
Izaak Walton League	x	x				x	
J. Craig Venter Inst.		x		x			
Kid Power Inc.	x	x				x	
Live It Learn It	x	x	x	x			x
Living Classrooms	x	x	x			x	
National Env. Ed. Foundation	x			x			
National Geo Society	x	x	x	x			x
NOAA	x	x	x				x
National Park Serv.	x	x	x				
Natural Partners	x	x	x	x	x	x	x
North American Assoc. for Env. Ed.				x			
Project Learning Tree	x			x	x		
Saturday Env. Academy			x			x	
U.S. EPA	x	x		x	x	x	x
U.S. Forest Service	x			x	x		
UDC's Master Gardener Program	x	x					
Wash. Youth Garden	x	x	x				

HEALTH – includes outdoor physical activity, gardens, food

Organization	Curricular Resources	School-based Presentations	Field Experiences	Professional Development	Funding	Community Service	Other
Arcadia Center for Sustain. Food & Ag.	x	x	x				x
Audubon Naturalist Society						x	
Cintia Cabib – Doc. Filmmaker	x	x					
Casey Trees	x	x				x	
Chesapeake Bay Foundation	x			x		x	x
City Blossoms	x	x	x	x		x	x
Clean Air Partners-MW COG	x	x		x			
DC Department of Parks and Recreation	x					x	
DC Greens				x			
DC Greenworks		x	x			x	x
DC Historic Preserv. Office - Archaeology						x	
DC Office of the State Super. of Ed.	x	x	x	x	x		
District Department of the Environment	x			x	x		x
Earth Day Network	x	x			x		
Green Living Project	x	x					
Groundwork Anacostia River DC	x	x	x	x	x	x	x
J. Craig Venter Inst.				x			
Kid Power Inc.	x	x				x	
Live It Learn It							x
National Env. Ed. Foundation	x			x			
National Geo Society	x	x	x	x			x
National Park Serv.			x			x	
North American Assoc. for Env. Ed.				x			
Project Learning Tree	x			x	x		
Saturday Env. Academy			x			x	x
Student Conserv. Association		x	x	x		x	
U.S. Botanic Garden	x			x			
U.S. Forest Service	x						
U.S. Environmental Protection Agency	x	x		x	x	x	x
UDC's Master Gardener Program	x	x			x		
Washington Youth Garden	x	x	x	x			

OTHER RESOURCES

Organization	Curricular Resources	School-based Presentations	Field Experiences	Professional Development	Funding	Comm. Service	Other
21st Century School Fund		Exterior space planning				Schoolyard planting	Master planning
City Blossoms	Community steward.	arts and nature		arts		outdoor public arts projects	arts-based lessons
DC Historic Preser. Office - Archaeology	Archaeo, indigenous culture	Archaeo, indigenous culture	Archaeo, indigenous culture	Archaeo, indigenous culture			
Earth Day Network					EE	Earth Day	school greening
Earth Force	Env. service-learning	Youth env. action		Env. service-learning			
Env. Concern		Pollinators, conserv.					
G. Wash. Carver Outdoor Sch.				Historical nature walks			
Groundwork Anacostia River DC							comm. outreach & engage.
J. Craig Venter Institute		Metagenomics		Metagenomics genomics			
National Council for Science and the Env.		Scientific research presentations				Env research & elem. sch. outreach	
National Env. Education Foundation	Weather			weather			
National Geographic Society	Tech, science, soc. studies						geo., soc. studies
National Park Service	General science, astronomy					visitor services	custom programs, loc history
North Amer. Assoc. for EE					Capacity building		Interdiscip education
Project Learning Tree	Biotech.			Green Schools	Improve Env.		
U.S. Botanic Garden							botanic education

Appendix G. Case Studies of Environmental Literacy in Schools

There are many elementary, middle, and high schools in the District of Columbia that already engage their students in activities and lessons that foster environmental literacy. Below are just a few examples of DC Public Schools and Public Charter Schools across the District's eight wards that have varying degrees of engagement and integration of environmental literacy. Many partner with organizations listed in Appendix F.

Kimball Elementary School (Ward 7)

Kimball Elementary School partners with Living Classrooms – National Capital Region (LC-NCR) on two different grant-funded environmental education programs that are aligned with science and Common Core standards. The first program is BayWatch, a two-year program for the third, fourth and fifth grades funded by the District Department of the Environment. Over the course of the 2011-2012 and 2012-2013 school years, each grade will go on a field trip to a different part of the Chesapeake Bay watershed. Before and after each field trip, LC-NCR educators come into the classroom and teach an hour long lesson that ties into the lessons taught on the field trip. BayWatch begins with third grade students studying and visiting their local stream, expands on watershed concepts in fourth grade by focusing the students' attention to the Anacostia and Potomac Rivers, and then asks fifth grade students to look at the larger picture of the Chesapeake Bay watershed. This program is considered a "Meaningful Watershed Educational Experience" as defined by the Chesapeake 2000 agreement.

Kimball Elementary School's fifth grade also participates in LC-NCR's schoolyard greening program, District Schoolyard Stewards. This program, funded by the U.S. Environmental Protection Agency, is a continuation of a previous three year program, Schoolyard Stewards, funded by the National Oceanic and Atmospheric Administration (NOAA). As a part of this program, students learn about the Chesapeake Bay watershed and how their school can reduce storm water runoff and pollution entering the local rivers. In May, students will plant an extension of the current storm water management gardens. In addition to the in-class lessons and planting day run by LC-NCR staff, the teachers have also been given several lessons that they can teach in the outdoor space (living classroom) to supplement their curriculum.

Elsie Whitlow Stokes Public Charter School (Ward 5)

At Elsie Whitlow (E.W.) Stokes PCS, environmental literacy is integrated in the school's curriculum and its Wellness Policy. Each trimester, every grade level travels on field trips that further enhance the class's study of its specific thematic unit. Kindergarten and first grade students have visited the Aquatic Resources Education Center, where they learned about amphibian life cycles and other aquatic species that live in the District's waterways. Other grades visit the National Zoo and Smithsonian Museums. In the fourth grade, students visit the Alice Ferguson Foundation's Hard Bargain Farm, where they learn about farm life, food production, and go canoeing on the Potomac River. This program includes a residential component, allowing the students to stay overnight in the farm's dormitory-style cabins. Fifth grade students travel further within the Chesapeake Bay watershed to Virginia Beach. This field experience includes dolphin viewing as part of the school's unit on oceans. Sixth graders travel internationally to Panama and Martinique to experience another culture and practice speaking Spanish or French.

In the 2010-2011 school year, E.W. Stokes launched its Greening Stokes initiative, which trains students to become environmental stewards. Students helped implement a campus-wide recycling program and built a compost heap for kitchen and garden waste. The school also has an Energy Patrol Group, students who volunteer to raise environmental awareness and suggest ways to improve the school's environmental impact. The school worked with Farm to Desk DC, a Seedling Project, to align lessons revolving around the school's garden and food issues with the National Common Core State Standards. E.W. Stokes received a grant in 2012 from the Office of the State Superintendent of Education to continue its gardening efforts.

Hardy Middle School (Ward 2)

Hardy Middle School sits on the outer edges of Georgetown, near Glover Park. The school building was built in 1933 and was recently renovated and reopened in 2007. Beginning in 2008, the science department envisioned the creation of an outdoor classroom for students, with the goal of developing an exciting space that encourages lessons that allow students to investigate problems and determining

solutions, and also serving as a connection between the school and community. In 2010, the science teachers successfully applied for a District Department of the Environment RiverSmart Schools grant to build a model wetland and install a cistern that would capture stormwater runoff from the new tennis courts and nearby 35th Street. In Spring/Summer 2012, the Monarch Sister Schools program will support the butterfly garden and DC Greens will assist with the creation of the vegetable garden next to the tennis courts. The English department is working to be in charge of signage for the various elements of the gardens. In Fall 2012, the school hopes to add a student constructed weather station and alternative energy power station to the outdoor classroom, as well as create an environmental certificate program for Hardy MS students, enabling them to have a better sense of their community and the natural world and become environmental stewards.

Paul Public Charter Middle School (Ward 4)

For two years, Paul Middle School has been working with Project Learning Tree's *GreenSchools!* Program. According to Paul Middle School's Science Coordinator, *GreenSchools!* students have accepted the call of action to change the mentality of youth and adults regarding their environmental practices at school, in the community, and at home. Beginning with the sixth grade class in 2010, the program now reaches two grade levels and will involve the whole school by 2013. Throughout the year, students conduct investigations at their school, and have made improvements to their school by installing energy saving devices, planting trees, and more. Paul Middle School students have also mentored younger students at Barnard Elementary, a nearby DC Public School. Together, students from both schools installed organic, raised-bed gardens and dedicated a new outdoor classroom at Barnard.

Paul Middle School also has a Project Week each year, where teachers have the freedom to conduct a project with their students as long as it is linked to DC school standards. An example of a past project has been taking soil and water measurements in Rock Creek Park. Students also presented their project at the National Science Teachers Association conference in March 2010.

Wilson Senior High School (Ward 3)

The Woodrow Wilson Senior High School Career Technical Education (CTE) Environmental Pathway is an interdisciplinary approach to understanding the planet through the required sciences while focusing on environmental stewardship and meeting the challenges of our future. This four-year long pathway starts with mandatory Biology for all ninth graders, followed by Environmental Science: Sustainable Earth, Chemistry for a Sustainable Future, Marine Sciences: Sustainable Oceans, Urban Ecology: Sustainable Cities, and a capstone project or internship. This project started in the 2011-12 school year, and 300 students are enrolled in this track. There are ten sections of the Sustainable Earth class with students from 10-12th grades enrolled. Courses are supplemented by after school clubs like the NOAA Enrichment in Marine Sciences and Oceanography (NEMO) and DC EnvironMentors.

Cesar Chavez Public Charter Schools for Public Policy: Chavez Prep (Ward 1), Parkside (7), Capitol Hill (Ward 6)

For the last five years, all of the ninth grade students from the Cesar Chavez Public Charter Schools for Public Policy have investigated water pollution in the District of Columbia. As a response to the Common Core State Standards requiring that students apply knowledge to real world problems, the schools created a curriculum unit that investigates the water quality issues in the District of Columbia. In Fall 2011, students participated in a day-long investigation "in the field" that included visits to five locations. At these sites, students learned about water pollution concepts and how each organization is trying to mitigate and curb pollution to our local water ways. The program supported in-class instruction that addressed the science standard on watersheds and the water cycle. The five sites that all groups visited included the following:

1) Aquatic Resources Education Center in Anacostia Park (District Department of the Environment): Students explored local aquatic wildlife exhibits and discussed pollution's impacts on those wildlife species.
2) Trash trap at Watts Branch (Anacostia Watershed Society): Students saw first-hand one way that the District is addressing trash pollution in the Anacostia River.

3) Kenilworth Aquatic Gardens (National Park Service): Students conducted water quality tests.
4) Blue Plains water treatment facility (DC Water): Students were given a tour and learned about water treatment in the District.
5) Students also toured a green roof and were provided information about low impact development strategies that are being used to minimize stormwater runoff in the District.

Most students were required to write a research paper to reflect on the larger concept of water pollution and the various ways agencies and organizations are addressing water pollution. Other students made presentations, and one group wrote an editorial to the *Washington Post*.

Teacher input on this program has been extremely positive. They enjoy the real world connections to learning, and they believe these field experiences have instilled behavior changes in some students.

Thurgood Marshall Public Charter High School (Ward 8)

Thurgood Marshall Academy Public Charter High School (TMA) has been a champion in the environmental education and green schools movement both regionally and nationally over the past five years. In 2007, the students at TMA decided to do something about the lack of fresh food options in the surrounding area by breaking ground on what is today a half-acre organic school garden. The garden (named "The Great Garden of Anacostia") sparked a broader environmental initiative at the school launched on Earth Day 2008 with the support of Earth Day Network. The school also boasts a 2.8 gigawatt solar panel system, a LEED certified (silver) gymnasium, and energy efficient power strips. Through the Project Learning Tree *GreenSchools!* program, students at TMA conducted a school yard inventory which resulted in a decision to install a water-saving drip irrigation system as well as a school wide composting program. TMA has also hosted numerous local and national events including the DC School Garden Week and DC Farm to School Week Kick-Off event in 2010 and the U.S. Environmental Protection Agency and U.S. Postal Service's Go Green! Stamp unveiling in 2011.