Environmental Literacy Plan

Adams County, PA

Partnership for
Adams
County
Environmental Literacy

Partnership for Adams County Environmental Literacy

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Our community partners
Our school district colleagues

Resource Hub to access electronic resources

Scan the QR code or visit the project website to access electronic resources from this guide.
Visit www.advancingscience.org (choose "PACE" from the menu)
or visit https://sites.google.com/view/paceresourcehub/

Contact Us

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Project Endorsements & History

Executive Summary

The Partnership for Adams County Environmental Literacy (PACE) developed a comprehensive environmental literacy plan for Adams County, Pennsylvania school districts. The project was funded by the National Oceanic and Atmospheric Administration (NOAA) Bay Watershed Education and Training (BWET) grant program and included a core team of teachers and administrators from three Adams County school districts and coordination by Advancing Science at Gettysburg College. The plan integrates regional environmental literacy into K-12 education across various academic disciplines and grade levels. Through teacher professional development, partner engagement, and the creation of relevant learning opportunities, the PACE team has created a living document that is a template for sustained environmental education in our region. This includes lesson plans built on the Meaningful Watershed Education Experience (MWEE) model, which integrates novel data collection with civic engagement on pressing regional environmental topics. These included microplastics, stream health, air quality, biodiversity, and erosion. By partnering with facilities crews, administrators, regional non-profits, utilities, media, politicians, academics, and non-formal educators, the PACE program has identified and united a network committed to advancing our students' environmental opportunities. The adoption of this plan by districts in the county will enable the integration of environmental literacy across the curriculum and embed the remarkable nature of Adams County into our students' education.

Adams County teachers practice nature journaling strategies at the PACE Summer Institute.

The PACE Team

Bermudian Springs

Kyla Caruso
Kami Greenawalt
Shane Miller
Anthony Pepoli
Matt Royer

Gettysburg

Chris Biggins
Jen Daniels
Emilie Ketterman
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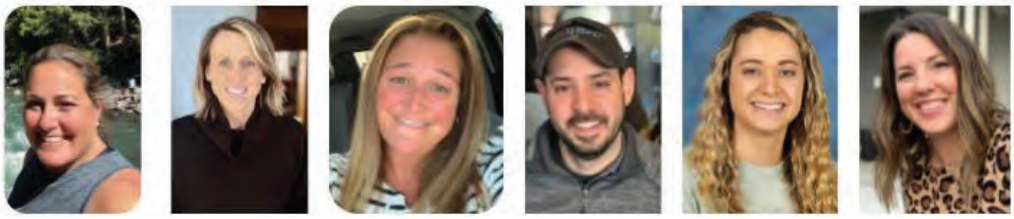

Upper Adams

Emily Kissner
Rachel Ventura
Ashly Wilkinson

Advancing Science

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Val Stone

District Support

Bermudian Springs School District

www.bermudian.org
7335 Carlisle Pike
York Springs, PA 17372-8807
717-528-4113 or 717-624-4231

Brad Sterner, Ed.D., Superintendent
Shannon Myers, Ed.D., Assistant Superintendent

May 2025

As Superintendent of the Bermudian Springs School District, I am pleased to express our strong support for the Partnership for Adams County Environmental Literacy (PACE) and its mission to foster environmental awareness, education, and stewardship among our students and the greater community.

At Bermudian Springs, we are committed to providing our students with rich, real-world learning experiences that extend beyond the classroom and inspire them to become responsible, informed citizens. The work of PACE aligns beautifully with this vision, offering powerful, hands-on opportunities for students to connect with their local environment and develop critical thinking skills related to sustainability and ecological responsibility.

I have been incredibly impressed by the work our teachers have been doing to support this initiative. Their dedication to integrating environmental literacy into their instruction, planning meaningful outdoor learning experiences, and collaborating with community partners has been nothing short of outstanding. Their efforts are making a lasting impact on our students and helping to build a culture of environmental awareness across our district.

PACE's collaborative, county-wide approach enhances our collective ability to create meaningful, interdisciplinary learning experiences that benefit both our students and our communities. We are proud to be part of this important initiative and look forward to continued collaboration and progress in the years ahead.

Sincerely,

Brad D. Sterner

Brad D. Sterner, Ed.D.
Superintendent
Bermudian Springs School District

District Support

GETTYSBURG AREA SCHOOL DISTRICT
900 Biglerville Road • Gettysburg, Pennsylvania 17325-8007
Telephone 717-334-6254 • FAX 717-334-5220

Todd Dishong, Ed. D.
Superintendent of Schools
Joseph L. Albin, M. Ed.
Assistant Superintendent
Shelley L. Hobbs, MBA, PCSBA
Director of Business Operations
Brian Booher, Ed. D.
Director of Students Services
UPPER ADAMS SCHOOL DISTRICT
161 North Main Street, Biglerville, PA 17307
Phone: (717) 677-7191 Fax: (717) 677-9007
www.upperadams.org

June 2025

Our districts enthusiastically support the Environmental Literacy Plan developed by the Partnership for Adams County Environmental Literacy (PACE) project. This collaborative initiative, which brings together the Bermudian Springs, Gettysburg, and Upper Adams school districts, along with Advancing Science, represents a significant step forward in enhancing environmental literacy for all students in Adams County.

We recognize the importance of equipping our students with the knowledge and skills necessary to understand and address the environmental challenges and opportunities in Adams County and beyond. The PACE project, funded by the National Oceanic and Atmospheric Administration (NOAA) Bay Watershed Education and Training (B-WET) grant program, aligns with this commitment.

Adams County has a unique population that faces specific environmental opportunities and challenges. Our students must develop a deep understanding of these local environmental issues and learn how to become responsible stewards of our natural resources.

The PACE project's focus on developing K-12 environmental literacy learning opportunities and aligning with Pennsylvania's Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards (STEELS) is particularly commendable. Integrating environmental literacy across the curriculum, as envisioned by this partnership, will lead to better academic performance and enhanced creativity, critical thinking, and problem-solving skills for our students. Both the new STEELS standards and our literacy plan emphasize Meaningful Watershed Educational Experiences (MWEEs), which connect classroom learning with hands-on outdoor experiences.

The collaborative nature of the PACE team, involved educators and administrators from our three districts and the expertise of Advancing Science, and a wide range of regional non-profits, utilities, waste management, facilities crews, regional media, and politicians to provide teacher professional development and craft a plan that is designed explicitly for Adams County. The resulting environmental literacy plan reflects the needs and priorities of our school districts and the wider Adams County community.

In conclusion, we wholeheartedly endorse the Partnership for Adams County Environmental Literacy (PACE) project. This initiative will have a lasting positive impact on our students, fostering a generation of environmentally literate and responsible citizens. We look forward to the successful development and implementation of this critical work.

Sincerely,

Jason Perrin, D.Ed. Superintendent
Gettysburg Area School District

Sincerely,

Mr. Joseph L. Albin
Assistant Superintendent
Upper Adams School District

The PACE Team and Timeline

Partnership for Adams County Environmental Literacy

With funding from NOAA BWET Grant Number NA22NMF457032, a team of teachers, an instructional coach, a librarian, a K-12 outreach coordinator, and a Biology professor spent 3 years and 1,620 hours of professional development (36 hours annually per teacher) engaged in the development of this plan and supporting resources. Over the course of the 3-year project, the PACE team:

YEAR

01 Developed their understanding of environmental literacy, the new PA science education standards (STEELS), and the MWEE Model.

02 Developed investigations that combine PA's Environmental Literacy and Sustainability standards with the Earth, life, and physical science standards, and provided professional development for district colleagues.

03 Finalized investigations and supporting documentation, engaged in green school conversations to identify connections between facilities and learning, and continued professional development for district colleagues.

The PACE Team

Elementary Representatives

Grades 2, 3, 4, and 5

Gifted/Talented

Instructional Coach

Librarian

Secondary Representatives

Grades 6, 7, and 8

HS Biology

HS Chemistry

HS Earth Science

HS Environmental Science

Science Department Chairs

Other

K-12 Outreach Coordinator

Biology Professor

School District Administrators

02

Environmental Literacy

Environmental Literacy FAQs

What is Environmental Literacy?

The North American Association of Environmental Educators (NAAEE) definition: *"An environmentally literate person, both individually, and collectively with others makes informed decisions concerning the environment; is willing to act on those decisions to improve the well-being of other individuals, societies, and the global environment; and participates in civic life." (NAAEE, 2011)*

How is environmental literacy addressed in Pennsylvania's STEELS standards?

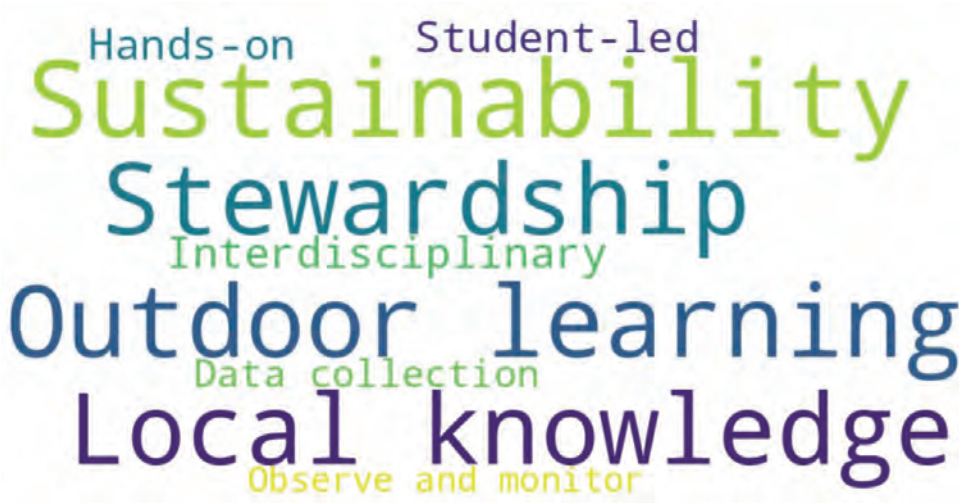
Pennsylvania's STEELS standards include section 3.4, the Environmental Literacy and Sustainability Standards (ELS). The ELS standards are grade-banded (K-2, 3-5, 6-8, and 9-12). Pennsylvania's ELS standards provide a framework to incorporate the MWEE (Meaningful Watershed Educational Experience) model into your curriculum. (*PA Department of Education, 2025)*

How do I incorporate the ELS standards into my science content?

Explore the K–12 PACE Investigations in this guide to find grade-level appropriate opportunities for advancing environmental literacy. Many Earth, life, and physical science concepts—such as ecosystems, biodiversity, energy, Earth's materials, water, weather, and human impacts—can be meaningfully integrated with the ELS standards to support local, place-based learning. Additionally, review the schoolyard learning sections in this guide and on the PACE Resource Hub to identify outdoor learning experiences relevant to your school environment.

What is an Environmental Literacy Plan (ELP)?

States, regions, and individual school districts can develop environmental literacy plans to address the three pillars of green schools (1) reduced environmental impacts and costs, (2) improved health and wellness, and (3) effective environmental and sustainability education. The ELP provides a framework to guide school staff in their efforts to reduce energy and waste consumption, maintain healthy buildings, incorporate strategies for student and staff wellness, and engage K-12 students and teachers in effective environmental and sustainability education and professional learning.



The PACE team's word cloud response to the question "What does environmental literacy education look like?"

Environmental Literacy Goals

1. Engage students in outdoor learning rooted in the local environment and aligned with the STEELS standards.
2. Ensure instructional plans at each grade level include STEELS-aligned environmental literacy investigations that actively engage all students.
3. Support teachers with time, resources, and professional development from community partners.
4. Provide students with MWEE (Meaningful Watershed Educational Experiences) that build knowledge, skills, and a sense of responsibility to become active schoolyard and community stewards.
5. Incorporate renewable solutions, green building, and green classroom principles into district planning.
6. Connect facilities teams with student learning to enhance real-world applications.

Aligning Environmental Literacy with School District Comprehensive Plans

The goals outlined in the Environmental Literacy Plan (ELP) closely support and enhance each district's comprehensive plan by demonstrating how district priorities can be met through strengthened environmental literacy. The ELP emphasizes standards-aligned instruction that incorporates environmental investigations, enabling students to build environmental literacy while engaging with their local communities. This real-world application deepens learning and relevance. Both the ELP and the district plans share a common purpose: preparing students for success in an ever-changing world.

Bermudian Springs team disscussion

Elementary teachers browse the children's nature library at the PACE Summer Institute.

Aligning Environmental Literacy with Local and Regional Strategic Plans

The **Chesapeake Bay Watershed Governor's Agreement,** signed by leaders from PA, DE, MD, WV, VA, NY, and DC, aims to create a healthy watershed that safeguards Pennsylvania waters and the Chesapeake Bay. It sets goals related to habitat restoration, water quality, land conservation, climate resilience, public access, and especially **environmental literacy.** *(CBP, 2022)*

Goal: Ensure every K-12 student graduates with the knowledge and skills to protect and restore their local watershed.

Student Outcome: Increase students' understanding of watersheds through age-appropriate, inquiry-based instruction and at least one MWEE experience per grade band.

Sustainable Schools Outcome: Grow the number of schools implementing environmentally responsible practices and student-led protection and restoration projects.

Planning Outcome: Jurisdictions develop a comprehensive and systemic approach to environmental literacy for all students.

The **PA Department of Education Long Term Transfer Goals** for Environmental Literacy and Sustainability. Students will be able to independently use their learning to: *(PA Department of Education, 2025)*

Be an informed consumer and user of land and water resources and protect biodiversity.

Understand the relationships between humans and the environment, including solutions and consequences.

Recognize that human impacts may affect populations and communities differently.

Engage in conversations about natural resources from a local and global perspective.

Understand how watersheds function and are impacted by external factors.

Understand the interconnectedness of local, regional, national, and global environmental issues.

Adams County, PA **County Comprehensive Plan** - Chapter 3: Growth Management *(Adams County, 1991)*

Development Pattern Goals - Preserve and enhance the physical and environmental characteristics that make Adams County a distinct and identifiable place and provide for the needs of existing and prospective residents, and ensure that development occurs in ways that minimize degradation of natural and cultural environments.

Community Services Goal - Provide public services, facilities, and utilities in the most efficient, cost-effective manner, taking into account community needs and environmental factors.

Resource Protection Goal - Protect environmentally sensitive areas of the county.

Agricultural Resources Goals - Maintain agriculture and businesses that support agriculture as primary components of Adams County's economic base, and preserve highly productive farmland for agricultural use.

03

Community

About Adams County

Population 103,852

5% < age 5, 19% < age 18, 22% > age 65

$73,752 Median household income

10% Persons in poverty

(US Census Bureau, 2025)

91% High school graduate or higher

24% Bachelor's degree or higher

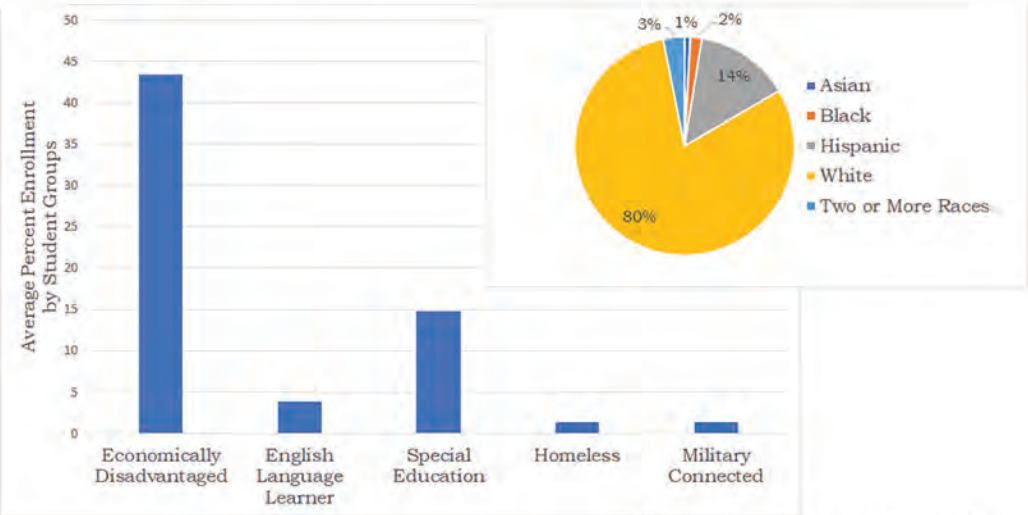
6 School districts

940 - 3,800 District student enrollment range

(Future Ready PA Index, 2025 and US Census Bureau, 2025)

Demographics

Adams County School District - Average Enrollment



(Future Ready PA Index, 2025)

Industry and Workforce

The top industries in Adams County are restaurants, K-12 schools, fruit and vegetable preserving, paper product manufacturing, and fruit and tree nut farming. The largest employers in Adams County are Gettysburg College, Gettysburg Hospital, Federal Government, Motts LLC, and Knouse Foods Cooperative (PA Department of Labor and Industry, 2025). Adams County is the state's leading producer of fruits and berries and the leading seller of horses (USDA, 2024). Adams County receives more than three million tourists annually (Gettysburg Adams Chamber of Commerce, 2025).

History

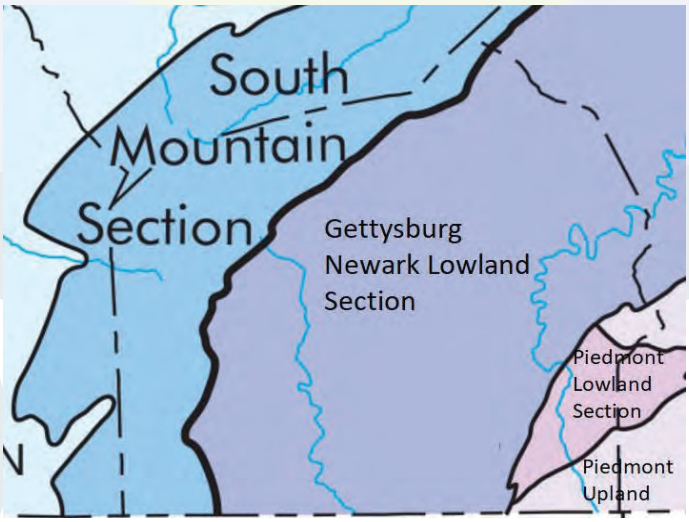
Adams County is renowned for the Battle of Gettysburg in 1863, but the County has a rich history beginning with early humans. The county has been shaped by agriculture, war, transportation, and tourism. A full timeline of the county's history is available in the Adams County Heritage Plan.

The Land

South Mountain, the northern extension of the Blue Ridge Mountains, makes up the western border of Adams County. Strasbaugh Hill, the highest elevation in Adams County at 1,975 feet, is located in the South Mountain section of the county. The fruit belt is located in the foothills of South Mountain. Most of Adams County is located in the Piedmont Plateau, a rich agricultural land that includes the Gettysburg Newark Lowlands.

Adams County covers 522 square miles (or 334,000 acres) of land.

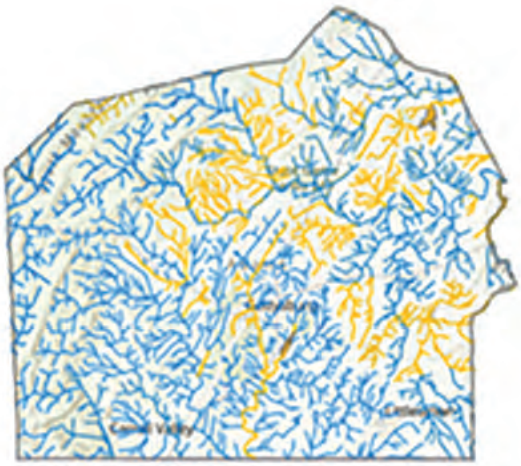
13,819 acres preserved by the Adams County Land Conservancy (2025)
5,700 acres included in the Gettysburg National Military Park (National Park Service, 2025)
183,000 acres of farms (USDA, 2022)
20,000 acres of orchards (Adams County Fruit Growers Association, 2025)

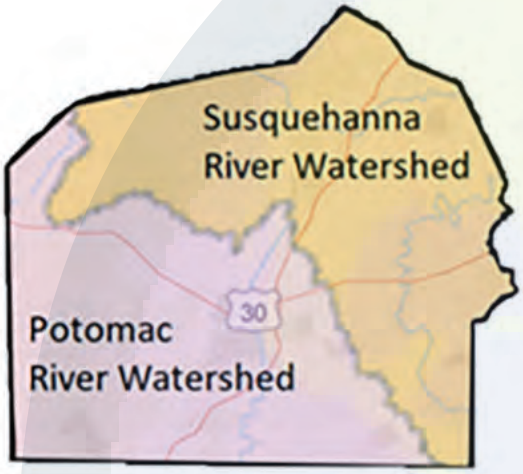


(Sevon, 2000)

The Water

1,270 miles of streams flow through Adams County, and almost all of these streams originate within the county. 30% of these streams (indicated in orange on the map) are impaired for water quality. Adams County is divided into two major watersheds. The water that drains from the land in the northeastern half of the county flows east into the Susquehanna River. The water that drains from the southwestern half of the county flows south toward the Potomac River. The Potomac and Susquehanna River Watersheds are subdivided into smaller watersheds, but all of the water in Adams County ultimately flows into the Chesapeake Bay.





Streams and watersheds of Adams County, PA. Streams in orange (left map) have impaired water quality (PA Department of Environmental Protection, 2024).

Human Impacts

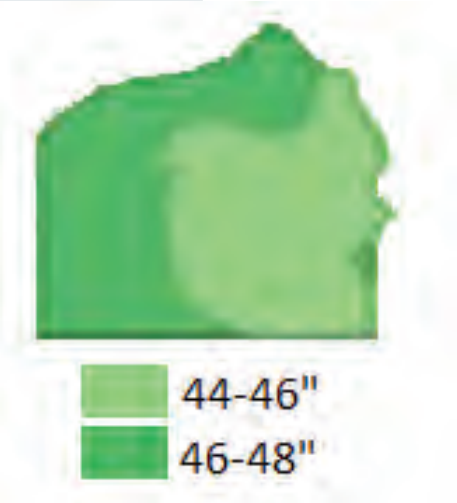
Adams County communities are impacted by pollution and environmental exposures and effects. The darker blue census blocks have a greater PennEnviroScreen Score due to elevated exposure/risks compared to the rest of Pennsylvania. Parameters with elevated risk/exposure (>50th percentile in PA) in Adams County include:

- Particulate matter 2.5
- Traffic
- Flood risk
- Impaired streams

(PA Department of Environmental Protection, 2025)

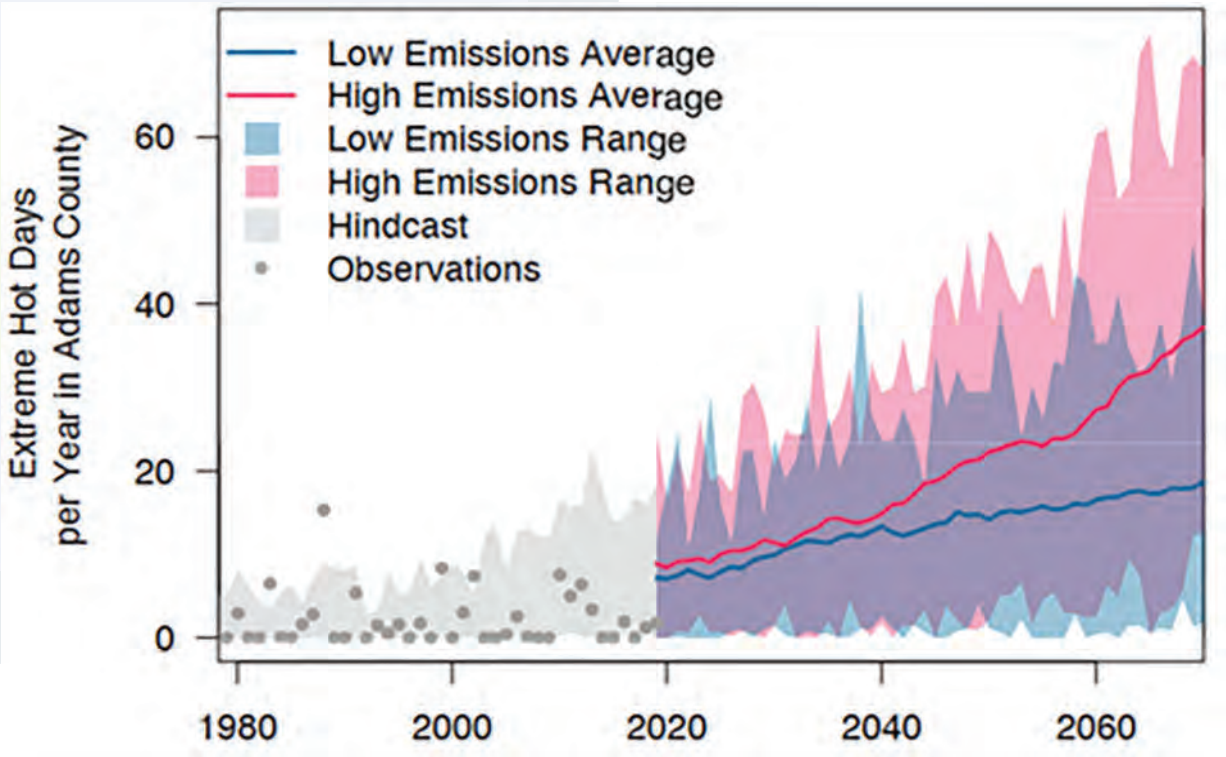
Weather and Climate Risks

Pennsylvania's climate type is continental with distinct seasonal changes. The average high temperature in January is 40°F and 86°F in July. Average annual precipitation ranges from 42-46" with higher amounts in the western and northern parts of the county.



Average annual precipitation in Adams County based on data collected from 1991-2020 (National Weather Service, 2021)

Heat waves, flooding, and shifting seasons are predicted to be the major climate hazards in Adams County within the next 50 years. The graph below depicts measured and predicted extreme heat days with temperatures exceeding 95°F (MARISA, 2022) According to 1st Street, a resource for climate risk financial modeling, Adams County is at major risk for heat and moderate risk for flooding, fires, and winds due to severe storms.



(MARISA, 2022)

Partners to Support Environmental Education

Community partners provide crucial support for environmental education. Partners can provide subject-area expertise, equipment, supplies, teaching support, funding, and more. Locate additional partners and partners beyond Adams County with PAEE's Find EE Near Me map.

	Subject-matter expertise	Classroom Presentations	Teaching assistance for field investigations	Implementation support for schoolyard action projects	Host school groups at our field trip location	Loan equipment and/ or resource kits	Professional learning for teachers
Advancing Science	✓	✓	✓	✓		✓	✓
Adams County Conservation District	✓			✓	✓	✓	
Adams Electric Cooperative, Inc.		✓					
Adams County Trout Unlimited	✓	✓	✓		✓	✓	
Chesapeake Bay Foundation	✓		✓	✓	✓		✓
Codorus State Park (DCNR)	✓	✓	✓		✓	✓	✓
Earth Force	✓	✓		✓		✓	✓
Lincoln Intermediate Unit 12	✓					✓	✓
Master Watershed Stewards	✓	✓	✓	✓	✓		✓
PA Game Commission	✓	✓	✓				✓
PA Fish and Boat Commission	✓	✓	✓			✓	
Pine Grove Furnace State Park (DCNR)	✓	✓	✓		✓		✓
Strawberry Hill Foundation	✓	✓	✓	✓	✓		✓

Advancing Science at Gettysburg College is a K-12 lending library of science kits and lesson plans, and a provider of teacher professional development. Program services are provided at no cost; however, teachers must attend an orientation training to be eligible to submit requests. Visit the website www.advancingscience.org to browse the menu of science kits and complete a request form at least 2-4 weeks in advance. Contact program staff at advancingscience@gettysburg.edu.

Adams County Conservation District can loan classroom kits for wildlife ID, forestry ID, soils, and tree planting tools. Tree seedlings and shelters may also be available. Tours of best management practices at their site are also available. Contact Vy Trinh vtrinh@adamscountypa.gov or 717-334-0636

Adams County Trout Unlimited (ACTU) promotes community, fishing, and conservation. Since 1977, ACTU has engaged 13,000+ youth through programs like Trout in the Classroom, the Latimore Creek Youth Fishing Derby, South Central Outdoors for Youth, and the New Oxford Middle School Environmental Day. The chapter has also improved countless Adams County waterways with the installation of more than 150 stream restoration devices, ensuring reduced sediment erosion, healthier streams, and greater trout populations. For general inquiries, contact Frank Kozak at fmkozak@gmail.com. For Trout in the Classroom, contact Lynn Rebert at lynnrebert@gmail.com

Adams Electric Cooperative can visit K-12 schools with high and low voltage electricity demonstrations. Visit www.adamsec.coop to learn about other educational opportunities and resources. Contact memberservices@adamsec.coop or 1-800-726-2324

Chesapeake Bay Foundation offers student field programs, a student leadership program, and for credit professional learning programs. Fees vary, but donations may be available to defray the costs. Reserve student field programs at the beginning of each season (fall or spring). The PA Professional Learning Coordinator can provide teacher support virtually or in person. For more information www.cbf.org/about-cbf/our-mission/educate/ or contact Jen Peglow at jpeglow@cbf.org

Codorus State Park (DCNR) can support field trips to the park and in-class presentations on a variety of nature topics. For field experiences at the park, contact the educator at least one month in advance, but more notice is recommended; there is no fee. The park can accommodate up to 100 students per day. Contact NRCodorusEEPrograms@pa.gov or 717-637-3454

Earth Force can support stewardship and civic action projects for students in grades 5-12. Program staff can provide virtual assistance for collaborative storytelling, teaching, student coaching, and MWEE curriculum integration. The program can provide funding support for student-led action and free water testing supplies for teachers who sign up for Caring for Our Watersheds Chesapeake Bay. Contact SJ at sjennings@earthforce.org or hello@earthforce.org

Lincoln Intermediate Unit 12 Educational Technology Services Professional Development team can provide MWEE Ambassador trainings, Shared Waters trainings, and other STEELS-aligned professional development experiences. Contact Beth Myers several weeks in advance blmyers3@iu12.org

Master Watershed Stewards (Penn State Extension) can support K-12 schools with watershed education, stream health, water conservation, stormwater management, and trees. Tours of the conservation practices at the Adams County Ag Center are available. Contact the Adams County Master Watershed Steward Coordinator, Karen Kaslow, at least one month in advance for classroom presentations; more notice is needed for project planning support. kek5913@psu.edu or 717-398-3849

PA Game Commission can support K-12 education with programs related to PA birds, mammals, and hunting or trapping workshops. Contact Game Warden TJ Knash tknash@pa.gov

PA Fish and Boat Commission can support K-12 education with aquatic resource conservation, fishing, boating, reptiles, amphibians, and fish programs. Loaner equipment (fishing rods, kayaks, and canoes) is available. Contact Officer Rachael Thurner-Diaz at least one month in advance. rthurnerdi@pa.gov

Pine Grove Furnace State Park can support field trips to the park (no fee), topics may include native and invasive flora and fauna and park-specific recreational learning. For groups larger than 25 students, teachers or partners will be needed to staff the additional stations (reach out to one of the organizations on this list that can provide teaching support for field investigations). Contact Angela King several months in advance to schedule. Angela is seasonal (late March-November) angking@pa.gov

Strawberry Hill Foundation can support field trips to their location (up to 125 students at a time, depending on the program). Their Naturalists can also visit your school for classroom presentations, assemblies, Animal Ambassador programs, and outdoor programs. Visit their website to learn about programs and fees at www.strawberryhill.org. Contact education@strawberryhill.org or 717-642-5840

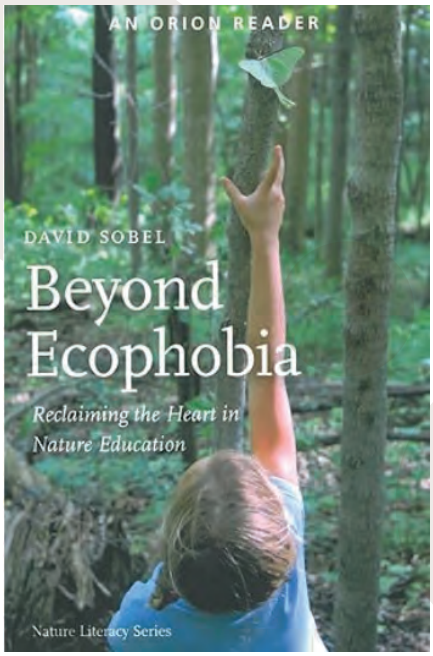
04

Teacher Resources

Professional Learning to Enhance Environmental Education

The PACE team recommends reading *Beyond Ecophobia: Reclaiming the Heart in Nature Education* by David Sobel to begin your environmental education professional development journey. Additional environmental education titles are available from the Advancing Science teacher resource library.

Teacher workshops and conferences are available locally, statewide, and virtually to develop teacher understanding of environmental education concepts and outdoor learning pedagogy.



Provider	Format	Format and Topics
Advancing Science	In-person workshops	K-12 science, Meaningful Watershed Educational Experience (MWEE)
DCNR State Park Environmental Educators	In-person workshops	Project Wet, Project Wild, Project Learning Tree, MWEE, and more. Sign up for their monthly educator mailing list.
NOAA Chesapeake Exploration	Virtual, asynchronous	MWEE 101, Analyzing and Interpreting Climate Data
US Green Building Council	Virtual, asynchronous	Green Classroom Professional
Chesapeake Bay Foundation	In-person workshops	Summer field experiences for teachers and school leaders
PA Gateway to Green	Clearinghouse of PA opportunities	Environmental Education and MWEE training opportunities across Pennsylvania
Pennsylvania Association of Environmental Educators (PAEE)	Annual Conference and Virtual sessions	Annual Conference with vendors and concurrent sessions Virtual meetings on a variety of EE topics
North American Association of Environmental Educators (NAAEE)	Clearinghouse of online courses and webinars	Environmental Education and outdoor learning training online courses and webinars

NATURE CAN IMPROVE ACADEMIC OUTCOMES

Spending time in nature enhances educational outcomes by improving children's academic performance, focus, behavior and love of learning.

BETTER ACADEMIC PERFORMANCE

Learning in natural environments can:

BOOST PERFORMANCE in reading, writing, math, science and social studies [1, 2, 3, 4, 5]

ENHANCE creativity, critical thinking and problem solving [9]

Seeing nature from school buildings can foster academic success [6, 7, 8]

ENHANCED ATTENTION

Spending time in nature can help children focus their attention:

FOCUS AND ATTENTION [10, 11, 12, 13]

ADHD SYMPTOMS [14, 15]

The greener the setting, the better the focus [14, 15]

INCREASED ENGAGEMENT & ENTHUSIASM

Exploration and discovery through outdoor experiences can promote motivation to learn:

INCREASED ENTHUSIASM FOR LEARNING [1, 16]

GREATER ENGAGEMENT WITH LEARNING [17]

IMPROVED BEHAVIOR

Nature-based learning is associated with reduced aggression and fewer discipline problems: [18, 19]

MORE IMPULSE CONTROL [10]

LESS DISRUPTIVE BEHAVIOR [20]

Children & Nature Network

NLC NATIONAL LEAGUE OF CITIES — CITIES STRONG TOGETHER

THE JPB FOUNDATION

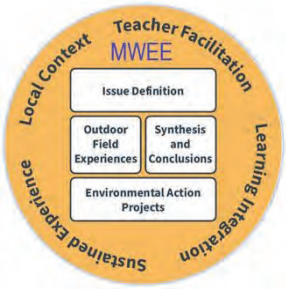
ADDITIONAL RESEARCH ON THE BENEFITS OF NATURE AVAILABLE AT research.childrenandnature.org

SUPPORTING RESEARCH

[1] Lieberman & Hoody (1998). Closing the achievement gap: Using the environment as an integrating context for learning. Results of a Nationwide Study. *San Diego: SEER.* [2] Chawla (2015). Benefits of nature contact for children. *J Plan Lit,* 30(4), 433–452. [3] Berezowitz et al. (2015). School gardens enhance academic performance and dietary outcomes in children. *J School Health*, 85(8), 508-518. [4] Williams & Dixon (2012). Impact of garden-based learning on academic outcomes in schools: Synthesis of research between 1990 and 2010. *Rev Educ Res*, 83(2), 211–235. [5] Wells et al. (2015). The effects of school gardens on children's science knowledge: A randomized controlled trial of low-income elementary schools. *Int J Sci Edu*, 37(17), 2858-2878. [6] Li & Sullivan (2016). Impact of views to school landscapes on recovery from stress and mental fatigue. *Landscape Urban Plan*, 148, 149-158. [7] Wu et al. (2014) Linking student performance in Massachusetts elementary schools with the "greenness" of school surroundings using remote sensing. *PLoS ONE* 9(10): e108548. [8] Matsuoka, R. H. 2010. Student performance and high school landscapes. *Landscape and Urban Planning* 97 (4), 273-282. [9] Moore & Wong (1997). Natural Learning: Rediscovering Nature's Way of Teaching. *Berkeley, CA: MIG Communications.* [10] Faber Taylor et al. (2002). Views of nature and self-discipline: Evidence from inner-city children. *J Environ Psy*, 22, 49-63. [11] Mårtensson et al. (2009). Outdoor environmental assessment of attention promoting settings for preschool children. *Health Place*, 15(4), 1149-1157. [12] Wells (2000). At home with nature effects of "greenness" on children's cognitive functioning. *Environ Behav*, 32(6), 775-795. [13] Berto et al. (2015). How does psychological restoration work in children? An exploratory study. *J Child Adolesc Behav* 3(3). [14] Faber Taylor et al. (2001). Coping with ADD: The surprising connection to green play settings. *Environ Behav*, 33(1), 54-77. [15] Amoly et al. (2014). Green and blue spaces and behavioral development in Barcelona schoolchildren: The BREATHE Project. *Environ Health Perspect*, 122,1351–1358. [16] Blair (2009) The child in the garden: An evaluative review of the benefits of school gardening, *J Environ Educ*, 40(2), 15-38. [17] Rios & Brewer (2014). Outdoor education and science achievement. *Appl Environ Educ Commun*, 13(4), 234–240. [18] Bell & Dyment (2008). Grounds for health: The intersection of green school grounds and health-promoting schools. *Environ Educ Res*, 14(1), 77-90. [19] Nedovic & Morrissey (2013). Calm, active and focused: Children's responses to an organic outdoor learning environment. *Learn Environ Res*, 16(2), 281–295. [20] Ruiz-Gallardo & Valdés (2013). Garden-based learning: An experience with "at risk" secondary education students. *J Environ Educ*, 44(4), 252-270.

C&NN recognizes that not all studies support causal statements.

MWEE FAQs



What is a MWEE?

Meaningful Watershed Educational Experiences, MWEEs, connects standards-based classroom learning with outdoor field experiences to create a deeper understanding of the environment. Through MWEEs, students of all ages develop a sense of environmental ethics and stewardship that will be essential to the long-term sustainability of our local watersheds and will serve as the foundation of a lifelong relationship with the environment. (BayBackpack, 2025)

Why is the MWEE Important?

Pennsylvania's 3.4 Environmental Literacy and Sustainability (ELS) standards incorporate the essential elements of the MWEE model. The Chesapeake Bay Watershed Agreement, signed by the Governors of all 6 watershed states (PA, MD, DE, NY, VA, WV, and DC), includes goals and outcomes related to the watershed's health. The agreement's environmental literacy goal is rooted in K-12 education and specifies the need for one MWEE experience per grade band.

What is a Watershed?

A watershed is a land area that drains into a common body of water. The water that rains onto your schoolyard drains into a nearby lake, stream, or river - this is the start of your "watershed address". The water in that lake, stream, or river keeps flowing into the next water body; that's your larger watershed address. That water continues to flow, and your watershed address gets larger, just like your street, city, state, and country address gets larger. Visit the River Runner website to map your watershed address. You don't need a water body on your school grounds to engage your students in a MWEE. The MWEE is a WATERSHED experience; we all live in a watershed!

MWEE Training and Support

The Chesapeake Bay Program hosts BayBackpack.com, a resource hub for MWEE training, support, and inspiration. NOAA Chesapeake Exploration offers online MWEE training (MWEE 101 and 201). Combine the online module with an in-person experience offered by local providers, including the Department of Conservation and Natural Resources' Bureau of State Parks or Intermediate Units. Review the PACE K12 Investigations for opportunities to engage your students in a MWEE. Reach out to your PACE district representatives and Community Partners for planning and implementation support.

Funding and Awards to Support MWEEs

Adams County Fund for the Environment supports environmental education and local environmental projects with awards of up to $5,000 per year. Submit a letter of intent by February for an invitation to apply for the April award cycle, or by June for the September award cycle.

PA Department of Environmental Protection (DEP) annual grant competition opens in early fall, applications are due mid-November, and awards are announced in late April. Awards are for the following year (July 1-June 30). Mini-grants (up to $5,000) are ideal for local projects.

National Oceanic and Atmospheric Administration (NOAA) Bay Watershed Education Training program offers grant programs to support district capacity planning and MWEE implementation.

MWEE Awards - The PA Association of Environmental Educators (PAEE) presents annual awards for Excellence in MWEEs at the teachers, school, and partner levels. Applications are due in December.

At Bermudian Springs Elementary School, 4th grade students assess the buffer along Mud Run.

Outdoor Learning in the Schoolyard

Nature is all around us, even in our schoolyards. As students learn in their schoolyard, they begin to understand and care about Pennsylvania flora and fauna. Even if your schoolyard feels limited, there are opportunities to investigate the living and non-living world. Take the time to notice and wonder about a patch of dandelions, the critters living in a rotten log, or the seeds twirling from a maple tree. These schoolyard phenomena provide place-based opportunities to engage with the three dimensions of science learning.

As you explore your schoolyard, your students may notice deficiencies, such as a lack of biodiversity and habitat. These are opportunities to engage your students in stewardship and action projects. Students can design and implement schoolyard improvements over time. To get started, review the schoolyard maps, K-12 investigations, and professional learning resources in this document and visit the PACE Resource Hub.

Trees provide great value to schoolyards. Students can study the needs of living things, habitat characteristics, biodiversity, seasonal changes, or sit in the shade of a tree to nature journal. Landscape trees are easily accessible for up-close investigations and measurements, while forested boundaries along the edges of the schoolyard lend themselves to investigating larger-scale ecosystem interactions. Use measuring tools, identification guides, and nature apps to learn more about the trees in your schoolyard.

Gardens (and even lawn weeds) provide opportunities for students to monitor the plant life cycle, observe pollinators in action, and dissect flowers to learn about the relationship between structure and function.

Investigate water runoff and infiltration in your schoolyard, locate storm drains, measure impervious surfaces, and monitor stormwater detention ponds to discover how water moves in your schoolyard.

Adams County teachers take a bird walk at Gettysburg College during the PACE Summer Institute.

Adams County elementary teachers measure impervious surfaces at Gettysburg College during the PACE Summer Institute.

Birds and squirrels are regular visitors to the schoolyard. You may not observe any critters during your first outdoor lessons, but as your students become more accustomed to quiet observation, they will start to notice (and wonder) about the critters that live in your schoolyard. Use binoculars and the Merlin bird app to observe and identify birds. Repeat your observations to observe seasonal changes and migration patterns.

Measure air quality, weather conditions, and heat islands in your schoolyard to monitor changing conditions and seasonal patterns. Use schoolyard weather stations, rain gauges, and hand-held tools to measure weather.

Insects are everywhere – in the air, on the ground, in the soil, and the water. Observe and collect insects to learn about structure and function, and the insect life cycle. Look for insects pollinating flowers, walking along the trunk of a tree, hiding in the shelter of a rotting log, and more. Use nets and magnifiers to explore the diversity of insects in your schoolyard.

Key to Investigations

Key to the Investigations

STEELS are Pennsylvania's new science education standards
Science, **T**echnology, **E**ngineering, **E**nvironmental **L**iteracy, and **S**ustainability

3.4 = The ELS part of the educational standards.
K-2 = The target grade band.
C = There are 4 standards for this grade band, A-D.
The specific standard or performance expectation.

Suggested resource kits and partners to support learning.
Visit www.advancingscience.org to learn more about the "Adv Sci Kits". View the community partner page in this guide for more info on partners.

PA Dept of Education's clarifying details and 3-dimensional learning strategies
DCI = Disciplinary Core Ideas
CCC = Cross-Cutting Concepts
SEP = Science and Engineering Practices

3.4.K-2.C - Explain ways that places differ in their physical characteristics, their meaning, and their value and/or importance.

PDE ELS Framework Clarifying Statement - Emphasis is on making observations of local environments such as schoolyards, streams, mountains, and fields and sharing their value or meaning. Examples of value or meaning could be recreational, aesthetic, economic, and ecological importance.

DCI: Biodiversity and Humans; Human Impacts on Earth Systems

CCC: Patterns; Stability and Change

SEP: Obtaining, Evaluating, and Communicating Information; Analyzing and Interpreting Data

Learning Location: Schoolyard, Classroom, & Field Trip

Resources/Partners: Adv Sci Kit (#261 & 260) Nature Center or Park

Suggested location for learning in this investigation.

Grade-level bundle (STEELS Strands)	Investigations
Grade 2: Exploring Local Habitats & Biodiversity Biodiversity and Humans (3.1.2.C) Environmental Experiences (3.4.K-2.C) Environmental Sustainability (3.4.K-2.D)	**Exploring Local Habitats and Biodiversity** 2nd-graders learn about animal habitats and biodiversity through classroom and schoolyard investigations. Include a field trip to a nature center or park to compare and contrast habitats and biodiversity between the different locations. Extend learning and provide a MWEE experience by including opportunities for students to design or implement schoolyard habitat improvements.

Grade-level related topics and matched STEELS strands to support a cohesive learning sequence.

Investigation summary. Visit the PACE Resource Hub to view lesson plans and other supporting documents. View the MWEE FAQ page in this guide to learn more about the MWEE model.

Review the K-12 Investigations in this guide and then visit the PACE Resource Hub to view lesson plans and supporting documents.

PACE Resource Hub

Elementary teachers from Gettysburg Area School District practice using weather tools.

Grades K - 2 Environmental Literacy and Sustainability Investigations

3.4.K-2.A - Categorize ways people harvest, redistribute, and use natural resources.

PDE ELS Framework Clarifying Statement - Examples could include that trees provide food, fiber, and building materials. Trees are logged, transported, and processed into different products, such as fiber, furniture, and buildings. Fruits and nuts from trees are picked, transported, and processed.

DCI: Natural Resources

CCC: Cause and Effect; Systems and System Models

SEP: Obtaining, Evaluating, and Communicating Information; Analyzing and Interpreting Data

Learning Location: Schoolyard, Classroom, & Field Trip	**Resources/Partners:** Adv Sci Kit (optional) Orchard or Farm
Grade-level bundle (STEELS Strands)	**Grade-level bundle (STEELS Strands)**
Grade K: Living Things in Our Community Organization for Matter and Energy Flow in Organisms (3.1.K.A) Biogeology (3.3.K.B) Natural Resources (3.3.K.C) Agricultural Systems (3.4.K-2.A)	**Exploring Living Things in Our Community** Kindergarten students explore the needs of living things, the relationship between living things and their environments, and how humans interact with natural resources. Students observe in the schoolyard, plant and care for seeds in the classroom, and visit a local orchard to deepen their understanding of plants and natural resource use.

3.4.K-2.B - Examine how people from different cultures and communities, including one's own, interact and express their beliefs about nature

PDE ELS Framework Clarifying Statement - Emphasis is on how students' interactions and beliefs about nature compare to someone living in a different community. Emphasize no judgement.

DCI: Natural Resources; Human Impacts on Earth Systems

CCC: Patterns; Cause and Effect

SEP: Obtaining, Evaluating, and Communicating Information

Learning Location: Schoolyard, Classroom	**Resources/Partners:** Adv Sci Kit (#025 & 2007)
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 1: Inspirations from Nature Structure and Function (3.1.1.A) Environment and Society (3.4.K-2.B)	**Inspirations from Nature** 1st-graders explore the relationship between structure and function in living things. Through schoolyard observations, a flower dissection, and nature stories, students will discover how the natural world influences human problemsolving. They will learn about different ways people interact with nature.

3.4.K-2.C - Explain ways that places differ in their physical characteristics, their meaning, and their value and/or importance.

PDE ELS Framework Clarifying Statement - Emphasis is on making observations of local environments such as schoolyards, streams, mountains, and fields and sharing their value or meaning. Examples of value or meaning could be recreational, aesthetic, economic, and ecological importance.

DCI: Biodiversity and Humans; Human Impacts on Earth Systems

CCC: Patterns; Stability and Change

SEP: Obtaining, Evaluating, and Communicating Information; Analyzing and Interpreting Data

Learning Location: Schoolyard, Classroom, & Field Trip	**Resources/Partners:** Adv Sci Kit (#261 & 260) Nature Center or Park
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 2: Exploring Local Habitats & Biodiversity Biodiversity and Humans (3.1.2.C) Environmental Experiences (3.4.K-2.C) Environmental Sustainability (3.4.K-2.D)	**Exploring Local Habitats and Biodiversity** 2nd-graders learn about animal habitats and biodiversity through classroom and schoolyard investigations. Include a field trip to a nature center or park to compare and contrast habitats and biodiversity between the different locations. Extend learning and provide a MWEE experience by including opportunities for students to design or implement schoolyard habitat improvements.

3.4.K-2.D - Plan an investigation to address an issue in the local environment & community.

PDE ELS Framework Clarifying Statement - Examples could include developing questions ("wonder statements") about a local environmental issue and then letting students decide how to answer them

DCI: Human Impacts on Earth Systems

CCC: Stability and Change; Patterns

SEP: Planning and Carrying Out Investigations

Learning Location: Schoolyard, Classroom	**Resources/Partners:** Adv Sci Kit (#502) School Custodian
Grade-level bundle (STEELS Strands)	**Investigations**
Grade K: Schoolyard Litter Human Impact on Earth Systems (3.3.K.E) Environmental Sustainability (3.4.K-2.D)	**Schoolyard Litter** Kindergarten students examine litter problems in their schoolyard and learn the school rules related to waste. Extend learning and provide a MWEE experience by including opportunities for students to design/implement solutions to litter problems.

Upper Adams Intermediate students model erosion with stream tables.

Grades 3 - 5 Environmental Literacy and Sustainability Investigations

3.4.3-5.A - Analyze how living organisms, including humans, affect the environment in which they live, and how their environment affects them

PDE ELS Framework Clarifying Statement - Emphasis is on how plants and animals impact their environment and how their environment impacts them. Examples include how pollinators impact food, plants prevent erosion, and sidewalks/roads change water flow.

DCI: Human Impacts on Earth Systems

CCC: Cause and Effect; Structure and Function

SEP: Analyzing and Interpreting Data

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#440, 441, 443, 402, 510)
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 4: Schoolyard Erosion Earth Materials and Systems (3.3.4.B) Plate Tectonics and Large-Scale System Interactions (3.3.4.C) Natural Hazards (3.3.4.E) Agricultural Systems (3.4.3-5.A) These investigations also support ELS standards 3.4.3-5.B, C, E, and F (see below).	**Schoolyard Erosion** Through a series of investigations, students learn about erosion and runoff and examine the impact of erosion on their local streams. In this series of investigations, students will manipulate 3D models and computer simulations, collect scientific data in the schoolyard, conduct research, and design solutions to remediate the schoolyard erosion problem. The school does not need a stream on campus to complete this MWEE!

Learning Location: Schoolyard and Classroom & Field Trip	**Resources/Partners:** Adv Sci kit (#503), Shared Waters, State Parks
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 5: Shared Waters Earth Materials and Systems (3.3.5.C) The Roles of Water in Earth's Surface Processes (3.3.5.D) Human Impact on Earth Systems (3.3.5.E & 3.3.5.F) Agricultural Systems (3.4.3-5.A) These investigations also support ELS standards 3.4.3-5.B, C, D, E, and F (see below).	**Shared Waters** In this 10-lesson unit developed by Millersville Univ, Virginia Wesleyan Univ, and Penn Manor School District, students engage in a MWEE as they investigate the driving question: How can we make a positive impact on our watershed? Students investigate concepts including Earth's waters, local watersheds, runoff, stream health, and best management practices to reduce human impact. Take a state park field trip to visit a local stream for water quality investigations.

3.4.3-5.B - Make a claim about the environmental and social impacts of design solutions and civic actions, including their own actions

PDE ELS Framework Clarifying Statement - Emphasis is on investigating the short and long-term consequences or effects of design solutions (i.e., best management practices).

DCI: Human Impacts on Earth Systems; Natural Resources

CCC: Cause and Effect

SEP: Engaging in Argument From Evidence

Grade-level bundle (STEELS Strands)	Investigations
Grade 4: Schoolyard Erosion (see 3.4.3-5.A) **Grade 5: Shared Waters (see 3.4.3-5.A)**	**Schoolyard Erosion (see 3.4.3-5.A)** **Shared Waters (see 3.4.3-5.A)**

3.4.3-5.C - Examine ways you influence your local environment and community by collecting and displaying data.

PDE ELS Framework Clarifying Statement - Emphasis is on analyzing individual student behavior. Data can be collected and displayed using multiple digital and analog tools and formats.

DCI: Natural Resources; Human Impacts on Earth Systems

CCC: Cause and Effect

SEP: Obtain, Evaluate, Communicate Information; Construct Explanations & Design Solutions

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#401 & 400) School Safety Officers
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 3: Monitoring Schoolyard Weather Weather and Climate (3.3.3.A) Natural Hazards (3.3.3.C) Watersheds and Wetlands (3.4.3-5.C)	**Monitoring Schoolyard Weather** 3rd grade students use weather tools to measure and monitor schoolyard weather conditions over time to observe seasonal patterns.
Learning Location: School Building	**Resources/Partners:** Adv Sci kit (#952) School Facility Department
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 4: Can You Hear Me? Sound Audit Conservation of Energy and Energy Transfer (3.2.4.B) Agricultural and Environmental Systems and Resources (3.4.3-5.C) This investigation also supports ELS standards 3.4.3-5.E and F (see below).	**Can You Hear Me? Sound Audit** 4th Grade students use decibel meters to measure sound levels in their school to discover how sound travels and identify noise pollution. Provide a MWEE experience by including opportunities for students to report findings and suggest noise pollution remediation to school stakeholders.
Grade 4: Schoolyard Erosion (see 3.4.3-5.A) **Grade 5: Shared Waters (see 3.4.3-5.A)**	**Schoolyard Erosion (see 3.4.3-5.A)** **Shared Waters (see 3.4.3-5.A)**

3.4.3-5.D - Develop a model to demonstrate how local environmental issues are connected to larger local environment and human systems.

PDE ELS Framework Clarifying Statement - Examples include watersheds, food webs, human food systems, and life cycles. Emphasis is on investigating local environments and understanding how they connect to larger regional, national, or global systems.

DCI: Human Impacts on Earth Systems, Biodiversity and Humans

CCC: Systems and System Models; Cause and Effect

SEP: Developing and Using Models

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#841, 845) School Facility Department Adams Electric
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 4: Energy Transfer and Energy Audits Transfer (3.2.4.B) Energy in Chemical Processes and Everyday Life (3.2.4.D) Natural Resources (3.3.4.D) Investigating Environmental Issues (3.4.3-5.D) Sustainability and Stewardship (3.4.3-5.F & G)	**Energy Transfer and Energy Audits** 4th graders build circuits to investigate conservation of energy principles and renewable energy. They apply their understanding of energy usage to conduct a classroom energy audit. Provide a MWEE experience by including opportunities for students to report their audit findings and suggest energy conservation strategies to school stakeholders.

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#471 optional)
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 5: Earth's Systems & Human Activities Earth Materials and Systems (3.3.5.C) Human Impact on Earth Systems (3.3.5.E and 3.3.5.F) Investigating Environmental Issues (3.4.3-5.D)	**Earth Systems & Human Activities** 5th-graders explore Earth's four systems—the geosphere, hydrosphere, atmosphere, and biosphere—to discover how these systems interact. Through nature journaling, model-building, and a final project, students deepen their understanding of Earth's interconnected systems and consider human impacts and sustainability.
Grade 5: Shared Waters (see 3.4.3-5.A)	**Shared Waters (see 3.4.3-5.A)**

3.4.3-5.E - Construct an argument to support whether action is needed on a selected environmental issue and propose possible solutions.

PDE ELS Framework Clarifying Statement - Using the claim-evidence-reasoning model or other critical thinking processes, students analyze and synthesize data they personally collected or compiled from provided sources to support their claims and proposed stewardship actions

DCI: Biodiversity and Humans; Human Impacts on Earth Systems

CCC: Cause and Effect; Patterns

SEP: Engaging in Argument From Evidence; Obtaining, Evaluating, and Communicating Information

Grade-level bundle (STEELS Strands)	**Investigations**
Grade 4: Schoolyard Erosion (see 3.4.3-5.A)	**Schoolyard Erosion (see 3.4.3-5.A)**
Grade 5: Shared Waters (see 3.4.3-5.A)	**Shared Waters (see 3.4.3-5.A)**

3.4.3-5.F - Critique ways that people depend on and change the environment.

PDE ELS Framework Clarifying Statement - This could include both positive and negative ways that people depend on and impact the environment. Examples include but are not limited to water, fuel, food, land, and recreation.

DCI: Natural Resources; Human Impacts on Earth Systems

CCC: Cause and Effect, Stability and Change

SEP: Obtaining, Evaluating, and Communicating Information; Engaging in Argument From Evidence

Grade-level bundle (STEELS Strands)	Investigations
Grade 4: Schoolyard Erosion (see 3.4.3-5.A)	**Schoolyard Erosion (see 3.4.3-5.A)**
Grade 4: Energy Transfer and Energy Audits	**Energy Transfer and Energy Audits (see 3.4.3-5.D)**
Grade 5: Shared Waters (see 3.4.3-5.A)	**Shared Waters (see 3.4.3-5.A)**

3.4.3-5.G - Investigate how perspectives over the use of resources and development of technology have changed over time and resulted in conflict over the development of societies and nations.

PDE ELS Framework Clarifying Statement - Emphasis is on diverse points of view that may change over time due to new information, developing technology, priorities, or competition for finite resources.

DCI: Natural Resources; Human Impacts on Earth Systems

CCC: Cause and Effect; Stability and Change

SEP: Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information; Using Mathematics and Computational Thinking

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#841, 845)Adams Electric
Grade-level bundle (STEELS Strands)	**Investigations**
Grade 4: Energy Transfer and Energy Audits (see 3.4.3-5.D)	**Energy Transfer and Energy Audits (see 3.4.3-5.D)**

A teacher examines stream bugs under a microscope at the PACE Summer Institute.

Grades 6 - 8 Environmental Literacy and Sustainability Investigations

3.4.6-8.A - Develop a model to describe how agricultural and food systems function, including the sustainable use of natural resources and the production, processing, and management of food, fiber, and energy.

PDE ELS Framework Clarifying Statement - Emphasis is on models that use inputs and outputs to highlight the lifecycle of food and fiber products.

DCI: Natural Resources; Human Impacts on Earth Systems

CCC: Systems and System Models

SEP: Developing & Using Models

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits
Grade-level bundle	**Investigations**
The Apple Orchards of Adams County Structure and Function (3.1.6-8.A) Growth and Development of Organisms (3.1.6-8.D & E) Variation of Traits (3.1.6-8.N) Natural Selection (3.1.6-8.R) Earth Materials and Systems (3.3.6-8.E) Weather and Climate (3.3.6-8.J) Agricultural Systems (3.4.6-8.A)	**The Apple Orchards of Adams County** Students investigate the many factors that influence apple orchards in south-central Pennsylvania, including geology, soils, weather conditions, pollinators, the apple life cycle, fruit tree genetics, and grafting.

3.4.6-8.B - Analyze and interpret data about how different societies (economic and social systems) and cultures use and manage natural resources differently.

PDE ELS Framework Clarifying Statement - Emphasis is on comparing and contrasting data from two or more societies and cultures to draw evidence-based conclusions. Examples could include how different societies and cultures manage agriculture, recycling and waste management, fossil fuels, land development, etc.

DCI: Natural Resources; Human Impacts on Earth Systems

CCC: Cause and Effect

SEP: Analyzing and Interpreting Data

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits
Grade-level bundle	**Investigations**
Drinking Water Disinfection Around the World Ecosystem Dynamics, Functioning, and Resilience (3.1.6-8.L) Structure and Properties of Matter (3.2.6-8.B) Conservation of Energy and Energy Transfer (3.2.6-8.M) Electromagnetic Radiation (3.2.6-8.R) The Roles of Water in Earth's Surface Processes (3.3.6-8.H & I) Environment and Society (3.4.6-8.B)	**Drinking Water Disinfection Around the World** Students explore the science and social impact of water use and treatment. They'll experiment with disinfecting stream water in solar ovens to learn how sunlight can purify water. Students read about global water challenges, especially in developing countries, and compare these with how drinking and wastewater are managed in their community. Using the Enviroscape model, students will simulate the processes of drinking water treatment and wastewater management. They'll also examine local water quality reports and learn about laws that impact water safety.

3.4.6-8.C - Develop a model to describe how watersheds and wetlands function as systems, including the roles and functions they serve.

PDE ELS Framework Clarifying Statement - Examples of models could include pictorial (2D), abstract, concrete (3D), and computer-simulated models.

DCI: Interdependent Relationships in Ecosystems; Ecosystem Dynamics, Functioning, and Resilience; The Roles of Water in Earth's Surface Processes

CCC: Systems and System Models; Structure and Function

SEP: Developing and Using Models

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#141, 150, 155, 430, 433, 500, 542), State Park or Nature Center
Grade-level bundle	**Investigations**
MWEE: Watersheds and Water Quality Ecosystems (3.1.6-8.I, J, & L) Structure and Properties of Matter (3.2.6-8.A) Chemical Reactions (3.2.6-8.C) The Roles of Water in Earth's Surface Processes (3.3.6-8.H) Human Impact on Earth Systems (3.3.6-8.M & N) Watersheds and Wetlands (3.4.6-8.C) These investigations also support ELS standards 3.4.6-8.D, E, G, & H (see below).	**MWEE: Watersheds and Water Quality** Students define their watershed and monitor water quality in local streams. Through a series of investigations, students develop an understanding of the water cycle, watersheds, and stream health. Students will manipulate models and computer simulations, collect schoolyard data, conduct research, and design solutions to address water issues in their community. The school does not need a stream on campus to complete these investigations. Supplement this MWEE with a field trip to a local park or nature center.

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kit (#405)
Grade-level bundle	**Investigations**
Humidity in the Atmosphere Weather and Climate (3.3.6-8.J) Environmental Experiences (3.4.6-8.E)	**Humidity in the Atmosphere** Students plan and carry out an investigation to measure humidity levels in different locations.

3.4.6-8.D - Gather, read, and synthesize information from multiple sources to investigate how Pennsylvania environmental issues affect Pennsylvania's human and natural systems.

PDE ELS Framework Clarifying Statement - Examples could include sediment and nutrient loads in Pennsylvania waterways, indoor and outdoor air quality, urban heat islands, etc.

DCI: Human Impacts on Earth Systems; Ecosystem Dynamics, Functioning, and Resilience; The Roles of Water in Earth's Surface Processes

CCC: Cause and Effect; Stability and Change

SEP: Obtaining, Evaluating, and Communicating Information

Grade-level bundle	Investigations
MWEE: Watersheds and Water Quality (see 3.4.6-8.C)	**MWEE: Watersheds and Water Quality** (see 3.4.6-8.C)
Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#157)
Grade-level bundle	**Investigations**
MWEE: Testing Local Waterways for Microplastics Chemical Reactions (3.2.6-8.C) Human Impact on Earth Systems (3.3.6-8.M) Investigating Environmental Issues (3.4.6-8.D) These investigations also support ELS standards 3.4.6-8.E & H (see below)	**MWEE: Testing Local Waterways for Microplastics** Students investigate the chemistry of plastics, survey their schoolyard for plastic litter, sample local waterways for the presence of microplastics, and generate solutions to reduce plastic pollution.
Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits (#404, 542, 903)
Grade-level bundle	**Investigations**
MWEE: Air Quality and Biofuels Structure and Properties of Matter (3.2.6-8.A) Chemical Reactions (3.2.6-8.C & D) Human Impact on Earth Systems (3.3.6-8.M & N) Investigating Environmental Issues (3.4.6-8.D) These investigations also support ELS standards 3.4.6-8.E, G, & H (see below)	**MWEE: Air Quality and Biofuels** Students explore the chemistry behind the creation of synthetic materials. Students will examine the impact that synthetic materials have on the environment and use the information to determine if synthetic or natural materials are better for society. Students begin by analyzing air quality data collected around the school grounds. Students compare schoolyard data to regional air quality maps to understand particulate matter measurements. Students then investigate how biofuels are created from natural materials and their impact on the environment.

3.4.6-8.E - Collect, analyze, and interpret environmental data to describe a local environment.

PDE ELS Framework Clarifying Statement - Emphasis is on collecting information from a local outdoor area in order to accurately describe that environment. Examples could include weather data, stream studies, data on air quality, biodiversity assessments, etc.

DCI: Interdependent Relationships in Ecosystems, Weather and Climate

CCC: Patterns

SEP: Analyzing and Interpreting Data

Grade-level bundle	Investigations
Watersheds and Water Quality (see 3.4.6-8.C)	**Watersheds and Water Quality** (see 3.4.6-8.C)
MWEE: Testing Local Waterways for Microplastics (see 3.4.6-8.D)	**MWEE: Testing Local Waterways for Microplastics** (see 3.4.6-8.D)
MWEE: Air Quality and Biofuels (see 3.4.6-8.D)	**MWEE: Air Quality and Biofuels** (see 3.4.6-8.D)
Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kit (#403) Master Watershed Stewards, Conservation District

Grade-level bundle	Investigations
MWEE: Heat Islands Conservation of Energy and Energy Transfer (3.2.6-8.N) Electromagnetic Radiation (3.2.6-8.R) Human Impact on Earth Systems (3.3.6-8.M) Weather and Climate (3.3.6-8.O) Environmental Experiences (3.4.6-8.E) These investigations also support ELS standard 3.4.6-8.I (see below)	**MWEE: Heat Islands** Students use infrared thermometers to investigate thermal energy and heat islands in their schoolyard. Students use iTree Canopy to calculate the benefits of trees in their community. Provide a MWEE experience by including opportunities for students to design/implement solutions to schoolyard heat islands.

3.4.6-8.F - Obtain and communicate information on how integrated pest management could improve indoor and outdoor environments.

PDE ELS Framework Clarifying Statement - Examples of methods of integrated pest management may include biological (e.g., managing indoor air quality), cultural (e.g., planting locally pest-resistant crops or crop rotation), mechanical (e.g., trapping pests), and chemical (e.g., cleaning surfaces in schools) treatments of invasives; materials and procedures for cleaning surfaces and air in schools; and maintaining or promoting biodiversity.

DCI: Human Impacts on Earth Systems

CCC: Stability and Change; Cause and Effect

SEP: Obtaining, Evaluating, and Communicating Information

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits School Facility Department
Grade-level bundle	**Investigations**
Invasive Insects and Integrated Pest Management Interdependent Relationships in Ecosystems (3.1.6-8.J) Ecosystem Dynamics, Functioning, and Resilience (3.1.6-8.L) Biodiversity and Humans (3.1.6-8.U) Human Impact on Earth Systems (3.3.6-8.N) Evaluating Solutions (3.4.6-8.F)	**Invasive Insects and Integrated Pest Management** Students examine models to learn how an insect's life cycle, physical adaptations, and feeding behaviors help them survive in various environments. Using real-world data from the Penn State Fruit Research Center, students analyze insect trap data to understand how scientists track insect populations. Students interpret population graphs to identify the arrival patterns of invasive insect species and the extent of their infestations over time. Students are introduced to integrated pest management to weigh the benefits and risks of managing insect pests.

3.4.6-8.G - Obtain and communicate information to describe how best resource management practices and environmental laws are designed to achieve environmental sustainability.

PDE ELS Framework Clarifying Statement - Emphasis is on the intended outcomes of best management practices (e.g., stormwater, forest, land use, wildlife, and waste management) and environmental laws (i.e., international, federal, state, and local jurisdictions)

DCI: Human Impacts on Earth Systems; Developing Possible Solutions

CCC: Cause and Effect; Stability and Change

SEP: Obtaining, Evaluating, and Communicating Information

Learning Location: Classroom	**Resources/Partners:** Adv Sci kit (#542 optional)
Grade-level bundle	**Investigations**
PA Environmental Law Case Studies Select case studies related to your content focus, including water, air, soil, waste, and energy.	**PA Environmental Law Case Studies** Students review case studies of historic Pennsylvania environmental disasters and compare them to present-day environmental laws to understand the conditions that drove environmental legislation.

3.4.6-8.H - Design a solution to an environmental issue in which individuals and societies can engage as stewards of the environment.

PDE ELS Framework Clarifying Statement - Examples of design solutions could include written or drawn plans, as well as implementing project actions.

DCI: Human Impacts on Earth Systems; Developing Possible Solutions

CCC: Connections to Nature of Science (Science Addresses Questions About the Natural and Material World)

SEP: Constructing Explanations and Designing Solutions

Learning Location: Varies	**Resources/Partners:** Varies
Grade-level bundle	**Investigations**
This MWEE Essential Element can be bundled with a variety of different investigations.	Engage your students in a MWEE - civic action and stewardship are essential elements of the MWEE.

3.4.6-8.I - Construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity.

PDE ELS Framework Clarifying Statement - Examples include both current and historical conditions due to systemic inequalities, including but not limited to human health impacted by Superfund sites, air quality, urban heat islands, acid mine drainage, access to green space, biodiversity, and water quality. Explanations could be constructed using primary and secondary sources, both print and digital.

DCI: Biodiversity and Humans

CCC: Cause and Effect

SEP: Obtaining, Evaluating, and Communicating Information

Grade-level bundle	**Investigations**
MWEE: Heat Islands (see 3.4.6-8.E)	**MWEE: Heat Islands** (see 3.4.6-8.E)

Bermudian Springs High School students compare the circumference of different tree species.

Grades 9 -12 Environmental Literacy and Sustainability Investigations

3.4.9-12.A - Analyze and interpret how issues, trends, technologies, and policies impact agricultural, food, and environmental systems and resources.

PDE ELS Framework Clarifying Statement - Emphasize the cause and effect, positive or negative.

DCI: Ecosystem Dynamics, Functioning, & Resilience; Natural Resources; Human Impacts

CCC: Cause and Effect

SEP: Analyzing and Interpreting Data

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits
Grade-level bundle	**Investigations**
Fruit Pests and Invasive Insects Ecosystems (3.1.9-12.I & N) Social Interactions and Group Behavior (3.1.9-12.O) Agricultural Systems (3.4.9-12.A) These investigations can also support ELS standard 3.4.9-12.F (see below)	**Fruit Pests and Invasive Insects** Students explore the ecological and agricultural impact of invasive insect species, with a focus on pest management in fruit orchards. Through fruit pest case studies, students analyze real-world data and develop a deeper understanding of insect population dynamics and the principles of Integrated Pest Management (IPM).

3.4.9-12.B - Apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individuals, groups, and nations.

PDE ELS Framework Clarifying Statement - Emphasis is on the effects of agriculture and natural resource availability, quality, control, and utilization.

DCI: Ecosystem Dynamics, Functioning, and Resilience; Natural Resources; Human Impacts

CCC: Nature of Science - Science Addresses Questions About the Natural and Material World

SEP: Obtaining, Evaluating, and Communicating Information

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kits
Grade-level bundle	**Investigations**
Roadside Pollinator Habitat Ecosystems (3.1.9-12.L, M & N) Adaptation (3.1.9-12.V & X) Human Impact on Earth Systems (3.3.9-12.Q & R) Environment and Society (3.4.9-12.B) These investigations can also support ELS standards 3.4.9-12.D, E, F, G, H (see below)	**Roadside Pollinator Habitat** Students research PA's program to reestablish and protect pollinator habitat along road rights-of-way. Students learn about best management practices that benefit pollinators and the PA Dept of Transportation's Adopt and Beautify Pollinator Habitat program. Students engage in citizen science to monitor invasive species. Provide a MWEE experience that includes opportunities for students to design and implement solutions to improve pollinator habitats and reduce invasive species.

3.4.9-12.C - Analyze and interpret how issues, trends, technologies, and policies impact watersheds and water resources.

PDE ELS Framework Clarifying Statement - Emphasize the cause and effect, positive or negative.

DCI: Ecosystem Dynamics, Functioning & Resilience; Biodiversity & Humans; Natural Resources

CCC: Cause and Effect; Stability and Change

SEP: Analyzing and Interpreting Data

Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kit (#433, 158, 141, 155, 157, 542), Master Watershed Stewards
Grade-level bundle	**Investigations**
MWEE: Water Quality Ecosystems (3.1.9-12.I, L, M & N) Structure and Properties of Matter (3.2.9-12.C) Human Impact on Earth Systems (3.3.9-12.R) Watersheds and Wetlands (3.4.9-12.C) These investigations can also support ELS standards 3.4.9-12.D, E, G, H (see below)	**MWEE: Water Quality** Students define their watershed and monitor water quality in local streams. Through a series of investigations, students develop an understanding of the watersheds, stream health, and best management practices. Students investigate maps, manipulate 3D models and computer simulations, collect scientific data, and design solutions to address water issues in their community. The school does not need a stream on campus to complete these investigations.

3.4.9-12.D - Apply research and analytical skills to systematically investigate environmental

PDE ELS Framework Clarifying Statement - Emphasis is on students' ability to articulate assumptions, goals, priorities, and values that underlie perspectives on environmental issues

DCI: Ecosystem Dynamics, Functioning, and Resilience; Biodiversity and Humans; Human Impacts on Earth Systems

CCC: Cause and Effect

SEP: Obtaining, evaluating, and communicating information

Grade-level bundle	Investigations
Roadside Pollinator Habitat (see 3.4.9-12.B)	**Roadside Pollinator Habitat** (see 3.4.9-12.B)
MWEE: Water Quality (see 3.4.9-12.C)	**MWEE: Water Quality** (see 3.4.9-12.C)

3.4.9-12.E - Plan and conduct an investigation utilizing environmental data about a local environmental issue.

PDE ELS Framework Clarifying Statement - Emphasis is on student-collected data from sources such as outdoor field experiences, media coverage, and data mining.

DCI: Ecosystem Dynamics, Functioning, & Resilience; Biodiversity & Humans; Human Impacts s

CCC: Nature of Science - Science is a way of Knowing

SEP: Planning and Carrying Out Investigations

Grade-level bundle	Investigations
Roadside Pollinator Habitat (see 3.4.9-12.B)	**Roadside Pollinator Habitat** (see 3.4.9-12.B)
MWEE: Water Quality (see 3.4.9-12.C)	**MWEE: Water Quality** (see 3.4.9-12.C)
Bundle this MWEE Essential Element with a variety of different investigations.	Engage your students in a MWEE - outdoor field experiences and student data collection are essential elements of the MWEE.
Learning Location: Schoolyard and Classroom	**Resources/Partners:** Adv Sci kit (#403)

Grade-level bundle	Investigations
MWEE: Heat Islands Electromagnetic Radiation (3.2.9-12.W) Environmental Experiences (3.4.9-12.E) These investigations can also support ELS standards 3.4.9-12.H & I (see below)	**MWEE: Heat Islands** Students use infrared thermometers to investigate thermal energy and heat islands in their schoolyard. Students use iTree Canopy to calculate the benefits of trees in their community. Provide a MWEE experience by including opportunities for students to design/implement solutions to schoolyard heat islands.

3.4.9-12.F - Evaluate and communicate the effect of integrated pest management practices on indoor and outdoor environments.

PDE ELS Framework Clarifying Statement - Emphasis is on assessing and communicating the effectiveness and impact of approaches to integrated pest management. Examples may include biological, cultural, mechanical, and chemical treatments of invasives, materials and procedures for cleaning surfaces and air in schools, and maintaining or promoting biodiversity.

DCI: Human Impacts on Earth Systems; Developing Possible Solutions

CCC: Cause and Effect

SEP: Obtaining, Evaluating, and Communicating Information

Grade-level bundle	Investigations
Fruit Pests and Invasive Insects (see 3.4.9-12.A)	**Fruit Pests and Invasive Insects** (see 3.4.9-12.A)
Roadside Pollinator Habitat (see 3.4.9-12.B)	**Roadside Pollinator Habitat** (see 3.4.9-12.B)

3.4.9-12.G - Analyze and evaluate how best resource management practices and environmental laws achieve sustainability of natural resources.

PDE ELS Framework Clarifying Statement - Emphasis is on assessing the outcomes of best management practices (e.g. stormwater, forest, land use, wildlife, and waste management) and environmental laws (i.e., international, federal, state, or local jurisdictions).

DCI: Human Impacts on Earth Systems; Developing Possible Solutions

CCC: Stability and Change, Cause and Effect

SEP: Engaging in Argument from Evidence

Grade-level bundle	Investigations
Roadside Pollinator Habitat (see 3.4.9-12.B)	**Roadside Pollinator Habitat** (see 3.4.9-12.B)
MWEE: Water Quality (see 3.4.9-12.C)	**MWEE: Water Quality** (see 3.4.9-12.C)
Learning Location: Classroom	**Resources/Partners:** Adv Sci kit (#542)
Grade-level bundle	**Investigations**
Select case studies related to your content focus, including water, air, soil, waste, and/or energy.	**PA Environmental Law Case Studies** Students review case studies of historic Pennsylvania environmental disasters and compare them to present-day environmental laws to understand the conditions that drove environmental legislation.

3.4.9-12.H - Design and evaluate solutions in which individuals and societies can promote stewardship in environmental quality and community well-being.

PDE ELS Framework Clarifying Statement - Examples of design solutions could include theoretical or tangible plans, as well as implementing project actions.

DCI: Human Impacts on Earth Systems; Developing Possible Solutions

CCC: Nature of Science - Science Addresses Questions About the Natural and Material World

SEP: Constructing Explanations and Designing Solutions

Grade-level bundle	Investigations
Roadside Pollinator Habitat (see 3.4.9-12.B)	**Roadside Pollinator Habitat** (see 3.4.9-12.B)
MWEE: Water Quality (see 3.4.9-12.C)	**MWEE: Water Quality** (see 3.4.9-12.C)
Bundle this MWEE Essential Element with a variety of different investigations.	Engage your students in a MWEE - outdoor field experiences and student data collection are essential elements of the MWEE.

3.4.9-12.I - Analyze and interpret data on a regional environmental condition and its implications on environmental justice and social equity.

PDE ELS Framework Clarifying Statement - Emphasis is on formulating a conclusion supported by data. Interpretation could be constructed using primary and secondary sources. Examples include both current or historical conditions due to systemic inequalities including but not limited to human health impacted by superfund sites, air quality, urban heat islands, acid mine drainage, access to green space, and water quality

DCI: Ecosystem Dynamics, Functioning, and Resilience; Human Impacts on Earth Systems

CCC: Cause and Effect

SEP: Engaging in Argument from Evidence

Grade-level bundle	Investigations
MWEE: Heat Islands (see 3.4.9-12.E)	**MWEE: Heat Islands** (see 3.4.9-12.E)

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Notes

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PACE Resource Hub

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