CLARKE COUNTY PUBLIC SCHOOLS ENVIRONMENTAL LITERACY PLAN
Developing environmental literacy through systemic, vertically aligned, integrated curricula, grades K-12

Context. Watersheds, like other Earth systems, consist of a set of complex, interacting, dynamic parts and processes. What are the components and processes that drive these systems and What happens when we alter them? How does investigating these questions help us understand our watershed systems and our role within them? Working in partnership, Clarke County Public Schools (VA; CCPS) and Blandy Experimental Farm/UVA (BEF) are using these questions to guide the creation of a comprehensive, systemic ELIT/MWEE curricula that spans grades K-12. Students engage in activities designed to develop environmental literacy (ELIT) knowledge, skills, and attitudes (KSA) that scaffold in complexity as they move through the grade levels. Students learn about environmental and watershed systems in an interdisciplinary format, using knowledge and skills from the four main content areas to investigate, assess, and synthesize watershed system components, processes, and human impacts. The ELIT foundation, begun in grades K-3, will prepare students to fully engage in the MWEE issue identification, investigation, and synthesis and conclusion learning process. Five grades are targeted for full MWEE, two in elementary, one in middle, and two in high school. Teachers participate in intensive and school-year-embedded professional development trainings designed to provide them with the knowledge, skills, and confidence to fully support this comprehensive ELIT/MWEE curricular plan. Teachers receive 4 hours of professional development annually and will work in professional learning communities where they collaborate on integrating their content areas, discuss effective teaching practices, and design Outdoor Learning ActivitiesMWEE activities using the Environmental Literacy Model (ELM). This plan impacts the majority of K-12 teachers in the Clarke County Public School (CCPS) system, all of the elementary and middle school students, and most of the high school students. This comprehensive ELIT/MWEE design focused on a systems approach could serve as a model for other Virginia school divisions tasked with designing and implementing ELIT plans in accordance with the 2014 Chesapeake Bay Agreement.

Our School Division. Clarke County Public Schools (CCPS) is a small, rural school division located in northwest Virginia with four schools that serve 1,839 students in grades K-12 (Table 1). This plan is a mechanism to support and implement division-wide, cross-curricular initiatives using ELIT curriculum anchors that incorporate MWEE as a catalyst for student and teacher growth and achievement.

Table 1: CCPS Demographics

Total Enrollment	**1839**
Race	
American Indian/Alaska Native	0
Asian	25
Black/African American	46
White	1395
Native Hawaiian/Other Pac Islander	0
Hispanic/Latino	235
Unclassified	0
% Free and Reduced Lunch	20.17%

The division's vision states that "*every student will learn to be a responsible citizen, who will continue to learn, think and create innovative solutions for our ever-changing world.*" CCPS believes "*learning is the*

process whereby knowledge is created through the transformation of behavior through experience. Learning is the ability to compare, question, defend, satirize, illustrate and represent an idea in another medium."[1]

Implementing the systemic ELIT/MWEE curriculum spanning all grade levels engages students in environmental stewardship, relevant problem-solving, and 21st-century learning goals.

ELIT Plan Goal: Institute a school-system-wide integrated instructional approach, grades K-12, to develop students' and teachers' environmental literacy with a focus on watershed system project-based MWEE.

ELIT Plan Objectives

1. **Student MWEE & Environmental Literacy**
   a) Engage elementary, middle, and high school students in locally relevant MWEE and stewardship action projects to develop watershed & human systems knowledge & awareness of resource use impacts
   b) Use environmental literacy as an instructional theme in grades K-3 to establish the foundations for and increase the rigor of MWEE engagement in grades 4-12

2. **Support for MWEE**
   a) Create a scaffolded K-12 ELIT curricula with an emphasis on MWEE in grades 4-5, 6-7, and 9-12
   b) Teachers lead all aspects of MWEE instruction with support from community partners & school support staff

3. **Teacher PD for MWEE**
   a) Provide rigorous 1-3 day and school year embedded professional development to increase teachers' environmental literacy and skill in planning and implementing MWEE
   b) Establish Professional Learning Communities facilitated by a Science leader to provide support throughout the MWEE planning and implementation phases.

Why engage in an ELIT Plan? Implementation of this plan provides the resources needed for CCPS to meet the Chesapeake Bay Watershed Agreement 2014 Environmental Literacy Goal to, "*enable every student in the region to graduate with the knowledge and skills to act responsibly to protect and restore their local watershed"*[2] and to provide a model that other school divisions can use to develop and implement comprehensive ELIT/MWEE plans and successfully achieve the desired Student Outcome:

> *To continually increase students' age-appropriate understanding of the watershed through participation in teacher-supported, meaningful watershed educational experiences and rigorous, inquiry-based instruction, with a target of at least one meaningful watershed educational experience in elementary, middle, and high school depending on available resources.*[2]

CCPS reported in its 2016 Environmental Literacy Indicator Tool (E-LIT Tool) that only 3rd-grade students were engaged in MWEE and that there was no division-wide systemic plan to provide at least one MWEE for students in ES, MS, and HS. For the 2017 ELIT Tool, CCPS reported MWEE occurring in 4th grade, as well as 3rd grade. A mini-grant from C.B. Trust provided the resources to engage 4th-grade students in MWEE.

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[1] *Clarke County Public Schools Strategic Plan*, 2015

[22] Chesapeake Bay Program, 2014. *Chesapeake Bay Agreement 2014*, p. 15

Continuance of the MWEE faltered at the end of each funding cycle, however, mainly because CCPS does not have the resources to provide sustained professional development necessary to firmly establish MWEE teaching practices. CCPS aspires to succeed in meeting the C.B. Agreement ELIT student outcomes. Challenges to plan for and provide systemic, sustained MWEE instruction were:

- insufficient staff time and expertise necessary to develop a systemic MWEE plan;
- the lack of resources to provide sustained MWEE-focused professional development;
- lack of integrated curricula, and insufficient funds to support integrated curriculum planning; and
- the need for outdoor learning spaces for implementing MWEE.

A needs assessment administered in 2018 to CCPS grade 3-5 teachers in (n=21) identified significant deficiencies in content area and pedagogical confidence in MWEE instruction:

- 43% lack confidence in effectively using integrated instructional methods;
- 57% lack confidence in designing problem-based investigations; and
- 81% lack confidence in teaching outdoors.

Clarke County Public Schools is striving to incorporate integrated curricula with indoor and outdoor classroom components designed to increase the environmental literacy of its students and improve benchmark and standards of learning (SOL) test scores in each of the four main content areas (science, mathematics, social sciences and English). From 2014-2018, CCPS and BEF partnered to incrementally introduce integrated teaching strategies and student learning opportunities in its upper elementary grades. Grade-level teaching teams participated in professional development to build expertise in designing and teaching integrative lessons and incorporating outdoor learning experiences across content areas. This effort began in 2014 with 3rd grade; 4th grade was added in 2015, and 5th grade in 2016. As they entered their third year of the integrated curriculum program, 5th-grade students were given a pre-assessment of their science content knowledge and skills. Average pre-test scores for 2016 (n=57) were 12 points higher than 2015 (n=55). The percentage of students with low scores decreased by 54%; mid-level scores increased by 40%, and there was a 14% increase in students with a high pre-test score (Figure 1). These preliminary results indicate that integrative, experiential learning focused on authentic investigation improves student learning and performance.

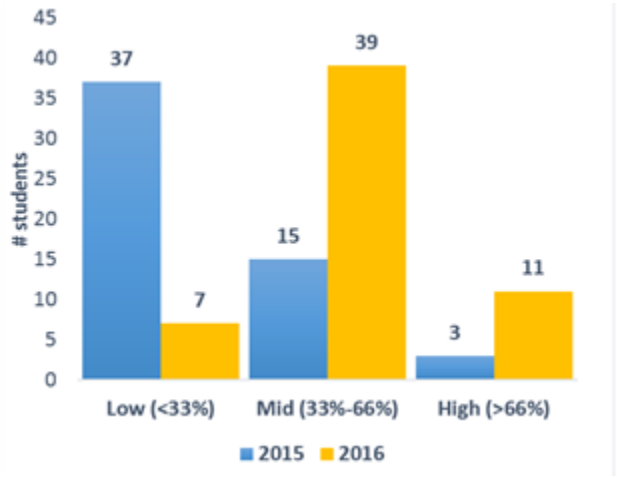


Figure 1. 5th Grade Science Pre-Test Assessment Score Comparison

Implementation Plan. This ELIT plan reinforces and builds upon current CCPS efforts to provide students with outdoor-based, environmentally-focused learning experiences that transcend content boundaries. CCPS is working in partnership with BEF to expand these initial efforts to our entire K-12 student and teacher population. The planning team for this project includes school principals and teacher leaders in each of the three grade bands (Table 2). The Science leader will support MWEE planning and implementation, coordinate all in-school project activities, ensure collaboration within and among the grade 4-12 teaching teams, and coach teachers to implement MWEE teaching practices. Dr. Chuck Bishop, CCPS Superintendent and all four school principals strongly support this ELIT plan.

Table 2. Project Implementation Team

CCPS Team	Curriculum Specialist	School Principals (4)	Lead Teachers: ES (4), MS (2), HS (2), & ITRT (1)	Science leader
BEF Team	Director of Education	Lead Env Educator	Environmental Educators (2)	

Objective 1. Student MWEE & Environmental Literacy

Objective 1a) Engage elementary, middle, and high school students in locally relevant MWEE and stewardship action projects to develop watershed & human systems knowledge & awareness of resource use impacts

Implementation of this plan will provide an opportunity to develop CCPS students' 21st Century Skills via engagement in MWEE watershed system investigations that require problem-solving, collaboration, creativity, critical thinking, and communication. Students will make explicit connections between watershed resources and human use and the impacts on those resources. Students will engage in vertically-scaffolded systems thinking to gain an increasing understanding of Earth's interconnected systems and at each grade level and will apply this knowledge in problem-solving projects focused on locally-relevant environmental issues. They will identify, plan, and implement a MWEE action project each year. These MWEE activities support the CCPS division-level strategic goal to prepare students to graduate as responsible citizens equipped with college and career readiness skills.

At least five fully implemented MWEE will occur: two during elementary school (grades 4 & 5), one in middle school (grades 6 or 7), and two-three in high school (Biology II: Ecology, Agricultural Science, and IB Environmental Science). These MWEE will build on students' prior knowledge and understanding of system components, processes and their linkages; each MWEE will involve issue definition, outdoor field experiences, and action projects. Students will explore the components of a watershed, ongoing processes that shape the way the watershed works, analyze measurable changes that occur within the system (e.g., weather, erosion, phenology, water quality & flow), assess causes of change in the system, examine environmental policies that impact our management of this system, and engage in action projects that model for our community civic stewardship and sustainable resource use practices.

Planned MWEE progression, topical focus:

Grade 4. Watershed definition and boundaries; water flow & Healthy watershed habitats

Grade 5. Our local land use actions affect ocean environments

Grade 6. VA watershed systems: water resources, water quality monitoring, & public policy decisions, & sustainable management

Grade 7. Organism adaptations & interactions in freshwater system & their natural & human threats

Biology II: Ecology. Environmental assessment of schoolyard habitats, biodiversity, and systems

IB Environmental Science. Local river system study; investigation into local management policies & recommendations to reduce or eliminate stream impairment

Agricultural Science. How various soil management & farming practices affect our local & regional watersheds

We are especially excited that students in CCPS's agricultural science career pathway will engage in MWEE. Much of Clarke County's economy is dependent on livestock, grain, and produce farming. It is important to have future farmers engage in investigations of various farming practices and their impacts on the sustainable health of the land and the Chesapeake Bay watershed system.

Objective 1b). Use environmental literacy as an instructional theme in grades K-3 to establish the foundations for and increase the rigor of MWEE engagement in grades 4-12

Beginning in kindergarten and scaffolding through high school, students will learn about the properties of water and its importance for life on Earth and about watershed systems, including components, functions, natural resources, natural and human impacts, and ways these impacts can be mitigated. Integrating knowledge and skills from a variety of disciplines, students will investigate environmental and watershed systems in four main content areas (Table 3). Each school year, grade K-3 students will develop environmental literacy through reading leveled texts and engaging in investigations tied to that book's theme, including at least one outdoor learning experience led by their grade-level teachers each quarter. Additionally, elementary teachers were provided with professional development focused on embedding science themes in literacy. Emphasis will be on engagement in authentic, outdoor-based, data-driven field experiences to provide an investigative and systems-thinking foundation in preparation for MWEE in upper elementary, middle, and high school years (Table 3).

Table 3. Interdisciplinary Curriculum Anchors (based on VA SOL), Scaffolded Grades K-12*

		K-3		4-5		6-8		9-12
		Science- Watershed Systems Thinking						
Systems	***Environmental Literacy Foundations: Supported by Clarke County Public Schools***	What parts make up the whole?	**MWEE**	What happens if we remove a part?	**MWEE**	System inputs & outputs, Subsystems	**MWEE**	Complex systems, Balance & Homeostasis, Feedback loops
Examples		Water, Weather, Organism characteristics, Life cycles		Interactions between organisms, Natural cycles, Human impacts		Energy, Earth's energy budget, Watershed focus, Weather maps & measurement		Transfer & storage of energy among systems, Earth systems, Chemical properties & reactions
Investigation Skills		Build the foundation for observation & investigation.		Develop questioning, measurement, & recording skills.		Develop investigation design & data analysis skills.		Develop independent research skills.
Examples		Water, Life cycles, Organism characteristics		Structure & function in organisms & watershed ecosystems		Relationship between human activity & watershed ecosystem dynamics		Climate science, Economic & public policy impacts, Agricultural Science
		Mathematics Process Skills						
Patterns		Identify & create patterns in the natural world.	**MWEE**	Recognize & display patterns in the natural world.	**MWEE**	Apply & extend natural sequences & patterns to other watershed regions.		Analyze data sets to identify & describe patterns & pattern departures (outliers, centers, etc.).
Examples		Water always flows in a direction.		Water flow can shape our world (rocks, streams, etc.).		Use NOAA buoy data to represent linear equations (ex. water temp. & O_2 levels).		Compile & compare water quality data sets, Assess variables & normal distribution
Data Analysis		Collect & display data in pictographs.		Collect & analyze data using bar graphs.		Compare & predict using a variety of information/data.		Sampling distribution, Dependent & independent variables
Examples		Water usage per month		Compare different uses & impacts of water usage.		Compare water quality data to predict future water quality.		Compile & compare water quality data sets, Assess variables & normal distribution
		Language Arts (Writing & Reading through the Curriculum)						
Writing		Focus on one topic, use complete sentences.	**MWEE**	Narrative & expository writing		Write two or more paragraphs on the same topic.		Thesis statements communicate the purpose of writing.
Examples		Where does water come from? Where does it go?		How does water move from place to place?		What are the impacts of water quality on watershed health?		Compose a statement on the impacts of humans on watershed ecosystems.
Reading		Relate previous experience to what is read.		Use reference materials to answer questions		Demonstrate comprehension of information in reference material.		Use information in text to draw conclusions & make inferences.
Examples		Read *A cool drink of water* or *Down the Drain.* Discuss water usage around the world.		Refer to web resources to explore interactions of organisms in a watershed.		Discuss water health using information from online & text reference documents.		Read water quality report; discuss thoughts for implementing a water quality improvement plan.
		Social Science Process Skills						
Geographic Skills		Develop map skills.	**MWEE**	Use geographic information.		Geographic features, rivers, & oceans influence where civilizations form.		Use geographic information to determine patterns & trends.
Examples		What are the major oceans & continents? What can you learn from a map?		Find major rivers of Virginia & find trade routes of the world.		Use historic maps to compare colonization of Virginia with geographic features.		How does population influence watershed health? How do impervious surfaces affect water health?
Cause & Effect		Recognize direct cause & effect.		Determine relationships among cause & effects.		Distinguish connections among many causes & effects.		Explain indirect cause & effect relationships.
Examples		How does access to water & food affect where people live?		What are the effects of poor water quality on an ecosystem (plants & animals incl. humans)?		How does poor watershed health affect ecosystem & economics?		How might global sea level rise impact local watershed health?

Academic connections outline created by Blandy Experimental Farm Education Program

Objective 2. Support for MWEE

Objective 2a) Create a vertically-aligned K-12 ELIT curricula with an emphasis on MWEE in grades 4-5, 6-7, & 9-12

Collaborative teaching teams (grade level teaching cohorts), BEF Environmental Educators, and the CCPS Science leader will work together to create inquiry-based, vertically-articulating K-12 curricula designed to develop environmental literacy and systems thinking. This interdisciplinary curricula will promote the integration of environmental issues, investigations, social values, and communication to the school and local community. For MWEE, Grade 4-12 teachers will work with ELIT implementation leaders to create vertically and horizontally integrated ELIT/watershed system unit modules connected by common themes that span the grade levels. A systems approach to curricular design (Table 4), the Environmental Literacy Model (ELM)[3], UbD design process[4], and VA Standards of Learning (SOL) will guide instructional design.

Table 4. Project Themes (consistent across all MWEE grades, 4-12)

Theme	Teacher Training & Practice	Student Learning
MWEE	• MWEE planning using the ELM planning document & Educator's Guide • Integrated approach to teaching about watersheds • Indoor & outdoor connections • Action & stewardship project design	• MWEE investigations in three grade bands: elementary, middle, and high school • Engage in action & stewardship projects
Systems	• Gain understanding in human and environmental systems • Develop a systems approach to teaching about watersheds	Learn about system components, functions, and interrelationships in watersheds
Watersheds	• Watershed systems: components, functions, processes • Human use & policy impacts	Watershed systems: components, functions, processes; Human use & policy impacts
Integrated Lessons/Curricula	• Integration strategies • Develop & teach with grade level team	Interconnected learning & problem solving
Outdoors	Teaching strategies/techniques	Authentic, placed-based investigations
Authentic Assessments	Develop authentic performance assessments based on watershed units	Engage in authentic performance assessments

Objective 2b) Teachers lead all aspects of MWEE instruction with support from community partners & school support staff

We will use a co-teaching strategy to build teachers' pedagogical skill and confidence to implement a student-centered teaching practice essential to successful, student-driven MWEE. Some assistance will be provided from the Science leader and Blandy educators. School division instructional support staff will assist with differentiation strategies, incorporating technology into MWEE, and finding additional instructional resources to enhance the MWEE.

Objective 3. Professional Development for MWEE designed to increase teachers' watershed knowledge & instructional skills

Through PD and direct support teachers will gain the requisite knowledge and acquire the skills and resources to facilitate environmental literacy and MWEE across curricular areas. Specific knowledge and pedagogy skill gains anticipated are:

[3] Chesapeake Bay Program. 2017. *Dan Educators' Guide to the Meaningful Watershed Education Experience (MWEE)* www.cheasapeakebay.net/documents2017_MWEE_Guide.pdf

[4] Wiggins G. & McTighe J. 2012. *Understanding by Design Framework*. Association for Curriculum and Development Whitepaper

Knowledge.

- Watersheds interface with natural and human systems
- Each core discipline contributes to understanding watershed complexity and interconnections, and to devising strategies for managing this system using best practices
- A systems conceptual framework naturally connects the disciplines and provides a foundation to build student conceptual and analytical skills as they traverse the grade levels

Teaching Skills.

- Gain skill in transforming static curricular standards into questions designed to stimulate learning, guide investigations, solve problems and engage students in productive discourse
- Use strategies that interconnect disciplines to drive student learning about watershed systems
- Gain confidence in teaching outdoors and alter their perception of classroom space to include the outdoors
- Incorporate reading and writing literacy strategies into science, math, and social science curricula
- Apply 21st Century skills (critical thinking, creativity, collaboration, and communication) to guide student action projects, and seamlessly incorporate these projects into their curricular plans
- Gain experience in creating performance-based assessments for student action projects

Objective 3a) Provide rigorous 1-3 day and school year embedded professional development to increase teachers' environmental literacy and skill in planning and implementing At the beginning of each school year, CCPS will dedicate ½ of a work day so that teachers can attend an intensive PD during which they will build content knowledge in environmental systems, especially watershed systems (including human and natural components), increase pedagogic skills, and explore resources and tools to develop integrated lessons that engage students in outdoor-based learning experiences. Teachers, grouped by grade band (K-3, 4-5, 6-7, 9-12), will align content area pacing guides and map out ELIT/watershed-themed unit plans for the school year. Emphasis for grade 4-12 teachers will include the MWEE definition, identification of local watershed issues relevant to their students, and use of the ELM tool to design a MWEE. School year embedded PD will occur during monthly Professional Learning Community meetings, establishing a year-long cycle of sustained professional learning throughout the CCPS system.

Teachers also will have the opportunity to participate in an intensive 3-day PD during which they will be immersed in watershed system ecology and management engaging in a model MWEE. Workshop driving questions will include: How are watershed boundaries defined? What is in the rain? Where does the rain go? How is streamflow and groundwater quantity and quality monitored? How can we engage in sustainable land use and water practices? Teachers will be given time to reflect on their learning and to consider how they will incorporate what they learned into their MWEE plans and curricula. This 3-day intensive workshop will be offered annually in the spring at UVa's Eastern Shore Research Field Station (aquatic ecosystem emphasis). Our full school year professional development plan is outlined in Table 5.

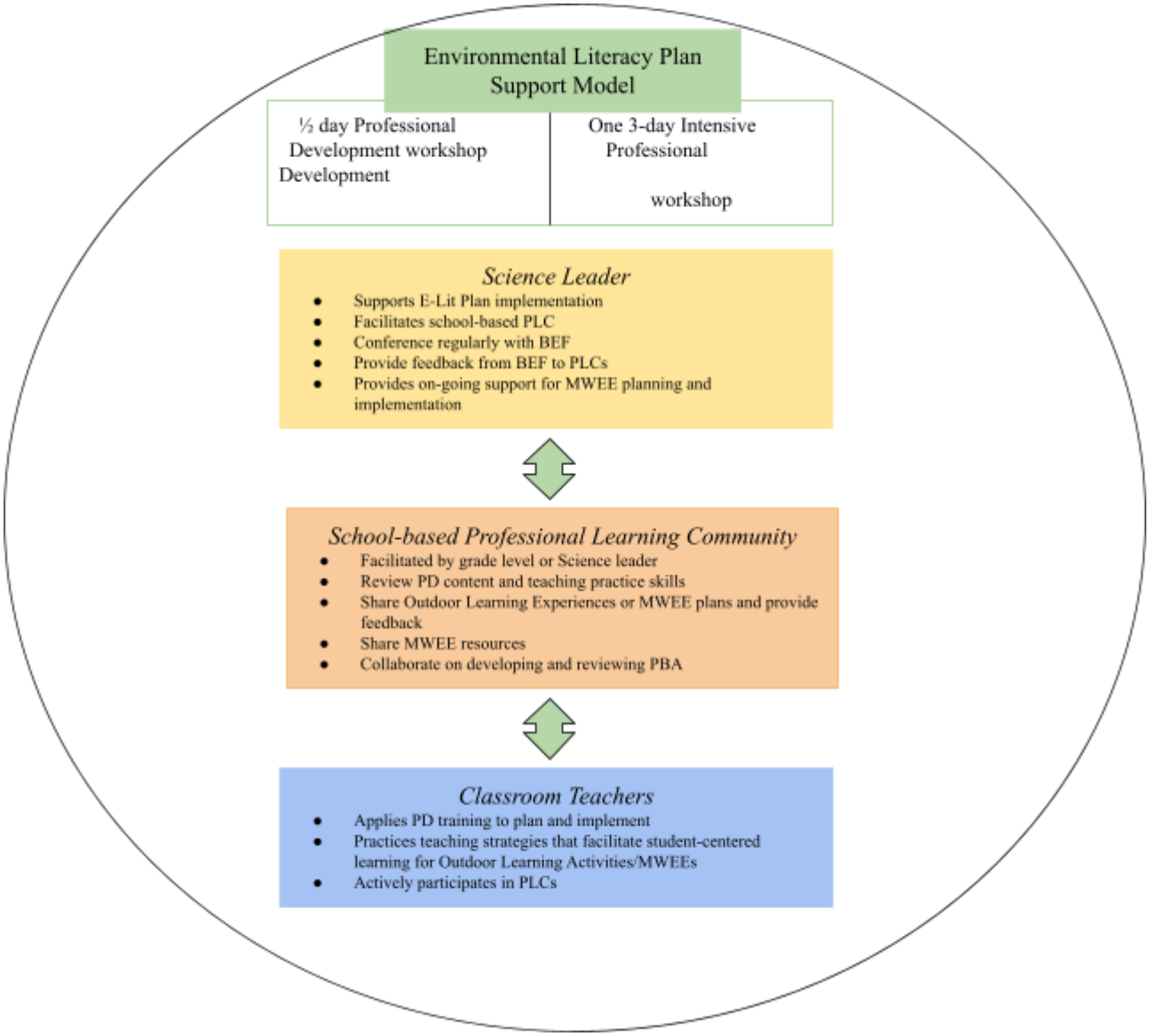
Table 5. Annual Professional Development Plan (22 to 42 total hours)

PD Format	Hours	Focus	Location
Overarching PD themes: watershed systems, questioning strategies & issue identification, MWEE planning using the ELM tool, professional learning communities, performance based assessment, outdoor teaching strategies, integrated lesson & unit planning, differentiation strategies, & 21st Century skills.			
½ day intensive (during opening work week)	4	Watershed systems: social & environmental components, integrative teaching strategies & planning for the school year	Blandy Experimental Farm, School Division
Embedded monthly (2 hrs/month)	18 hours total	Professional learning community meetings with other teachers and/or Science leader; job-embedded learning	At each of the 4 participating schools
3-day intensive	20	Watershed ecology, aquatic & terrestrial ecosystems,	UVA Eastern Shore

(elective); Spring annually	hours	headwaters & coastal connections	

Objective 3b) Establish Professional Learning Communities facilitated by grade level leaders and Science leaders to provide support throughout the MWEE planning and implementation phases.

Figure 2. Annual MWEE PD Support Model



CCPS is committed to providing sustainable professional development designed to develop effective integrative, ELIT-focused & MWEE teaching practices. Our systemic ELIT Plan will provide the opportunity to institute a PD model utilizing professional learning communities engaged in lesson studies within all grade level teams (Figure 2). Research studies and implementation projects demonstrate the effectiveness of professional learning communities in uniting teachers to work toward common instructional goals, support

teachers' continued growth, contribute to colleagues' professional growth, and insure that professional learning is sustained[5]. Evidence also suggests that teacher's individual and collective capacity is linked to school-wide capacity for promoting students' learning.

During the initial project PD, prior to the beginning of the 2018-19 school year, grade-level and vertical teaching team Professional Learning Communities (PLC) was established within each school. Grade level and vertical PLC collaborated to plan lessons and units, team teach and discussed outcomes, made revisions to lessons, and developed a portfolio of best practices (examples of exemplary lessons and successful instruction). Teachers discussed project-related progress, challenges and successes, collectively solved problems of practice, and shared responsibility for colleague and student success. The Science leader may attend each of the PLC planning and reflection sessions to ensure project continuity and assist teachers in gaining skill and confidence in their integrative and outdoor-based ELIT teaching practices.

ELIT Plan Sustainability: Plan to sustain ELIT implementation beyond NOAA funding. The CCPS school culture will be transformed to focus on interdisciplinary problem-based learning with an emphasis on MWEE activities, curricula and action projects. Implementing curriculum innovations concurrent with targeted PD and will firmly establish this systemic instructional and content change within the Clarke County school system. CCPS commits to support these systemic changes by continuing to offer ELIT/MWEE instructional training during its school year, continuing the professional learning communities, using the curricular resources put into practice during this project's funding cycle, and maintaining outdoor learning spaces at each of our four schools.

Development and implementation of the ELIT Plan is supported by NOAA B-WET Award # NA18NMF4570315 to the University of Virginia/Blandy Experimental Farm and Clarke County Public Schools, Virginia

[5] Stoll, L. 2010, *Professional Learning Community*. International Encyclopedia of Education, pp. 151-157