Advancing Environmental & Geographic Literacy through problem-based learning in the middle school grades

A MWEE MODEL THAT BUILDS ENVIRONMENTAL & GEOGRAPHIC LITERACY

What is Geoliteracy & Enviroliteracy?

Geoliteracy		Enviroliteracy
How the world works	**Interactions**	How human activities affect the environment
How the world is interconnected	**Interconnections**	How the environment affects human activities
How interactions & interconnections determine outcomes of actions	**Implications**	Use strategies to make effective environmental decisions

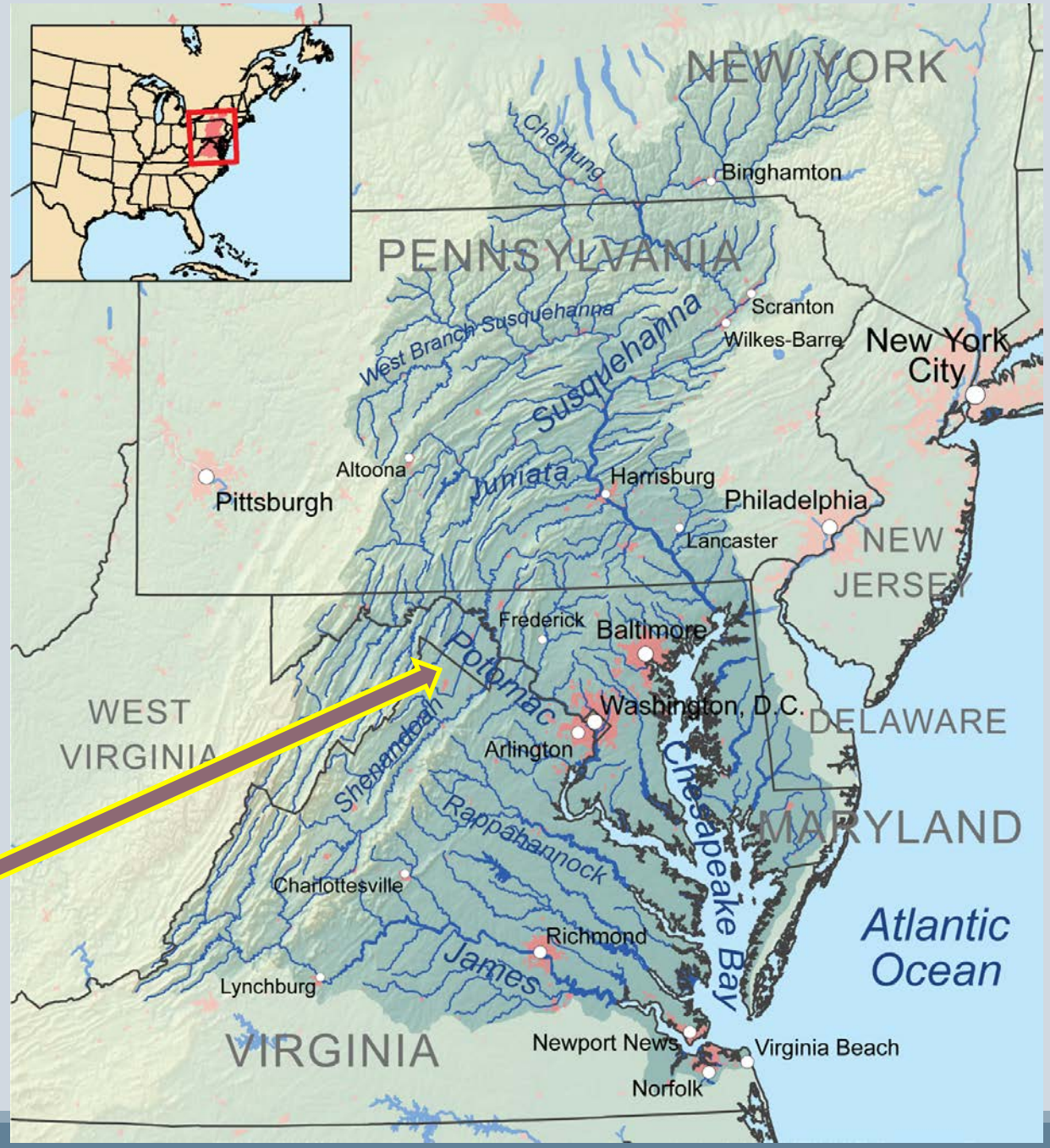
<u>Literacy</u>: Use knowledge & skills to solve problems & make informed decisions

Project Goal

Develop the geographic & environmental literacy of all 6th grade teachers & students through real-world investigations of the local environment using a human-environment systems approach

Our location:

Northern Shenandoah Valley, Virginia, in the Potomac River Watershed



University of Virginia's
Blandy Experimental Farm &
The State Arboretum of Virginia

Role as project partner:

- **Project conception**
- **Project administration**
- **Initial curriculum development**
- **MWEE expertise**
- **Field site**
- **Create & manage a public web site**

Blandy's Mission: *"To advance understanding of the natural world through **education**, **outreach**, and **research**."*

Our project partner: Frederick County Public Schools, VA

A growing rural, small urban, suburban school division in NW VA

Project Audience

All 4 middle schools
All 6th grade students; ~1000
All 6th grade teachers ~ 48

Role as project partner:

- **Lead PD design & instruction**
- **Coordinate school involvement**
- **Develop history field investigations**
- **Develop PBA's & assessment rubrics**
- **Create & manage a division web site**
- **Oversee transfer of project to school ownership**

School Division Specific Goals

1. Students: Engage in an interdisciplinary problem-based MWEE module during which they investigate, analyze, synthesize & communicate (I-ASC) how our land-use decisions influence the environment & how the environment influences our decision making process

School Division Specific Goals

1. Students: Engage in an interdisciplinary problem-based MWEE module
2. Teachers: Foster a collaborative learning community & develop integrative teaching strategies that incorporate outdoor learning experiences into their curricula

School Division Specific Goals

1. Students: Engage in an interdisciplinary problem-based MWEE module
2. Teachers: Foster a collaborative learning environment & develop integrative teaching strategies
3. Division: Create Performance-based Assessments (PBA) for science & social science/history

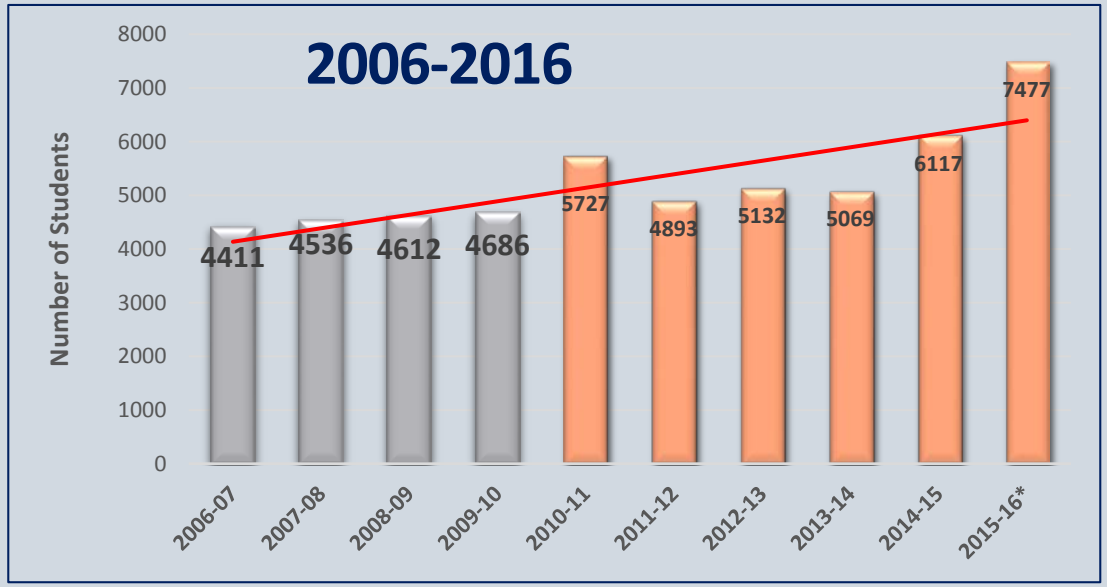
Project Big Idea

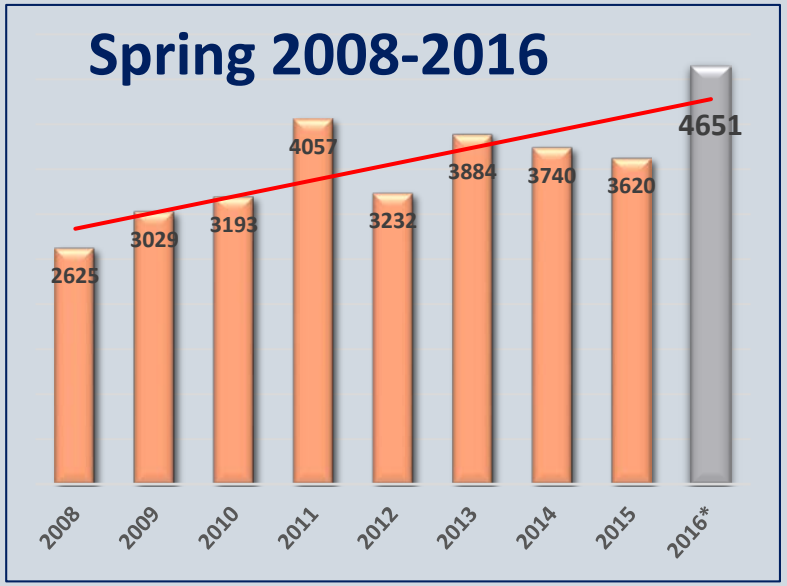
Our land use decisions impact our environment & our environment influences how we can use the land.

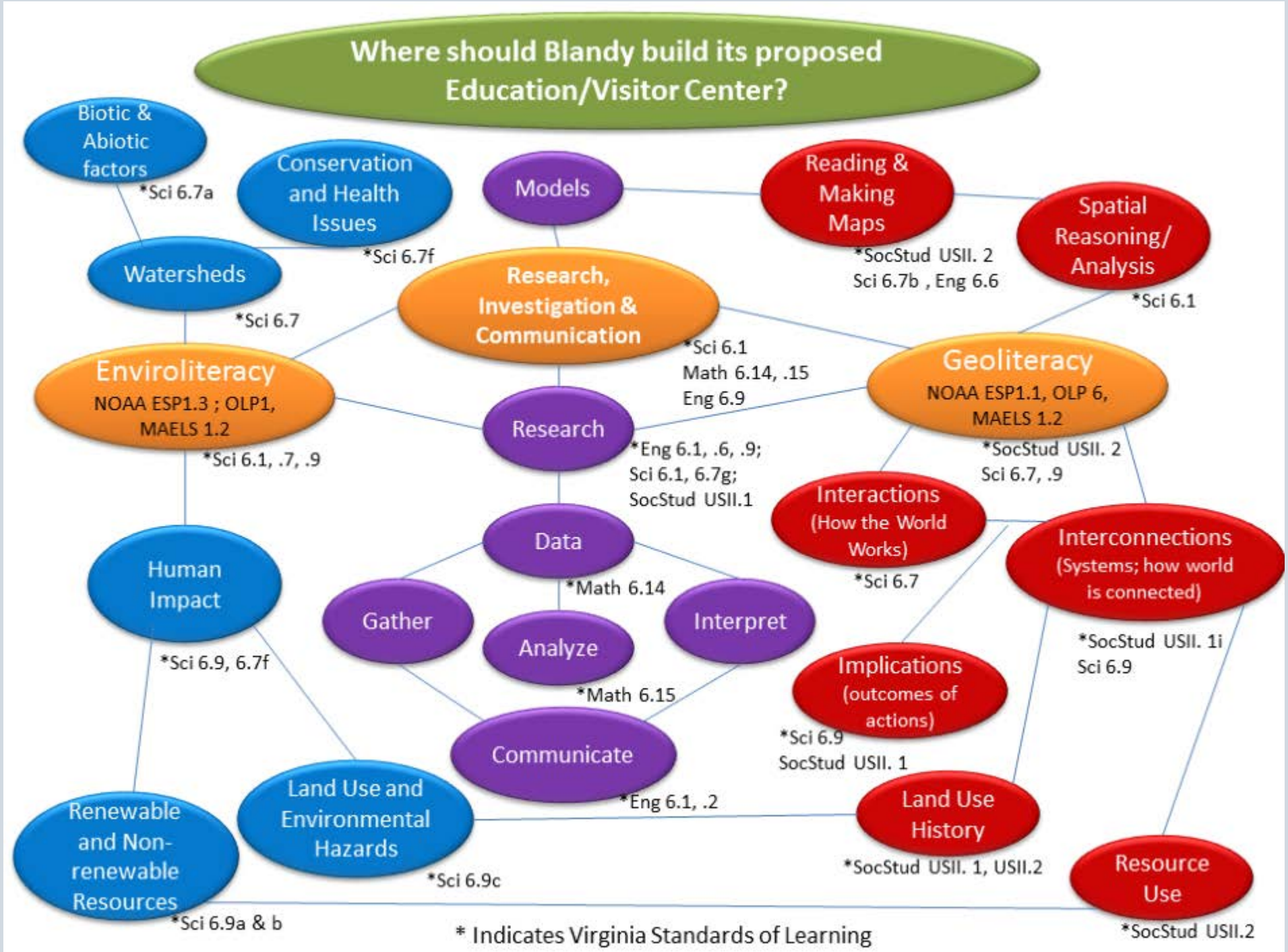
Issue Definition:

Blandy's education programs are at capacity.

We need more teaching spaces to meet our growing needs.





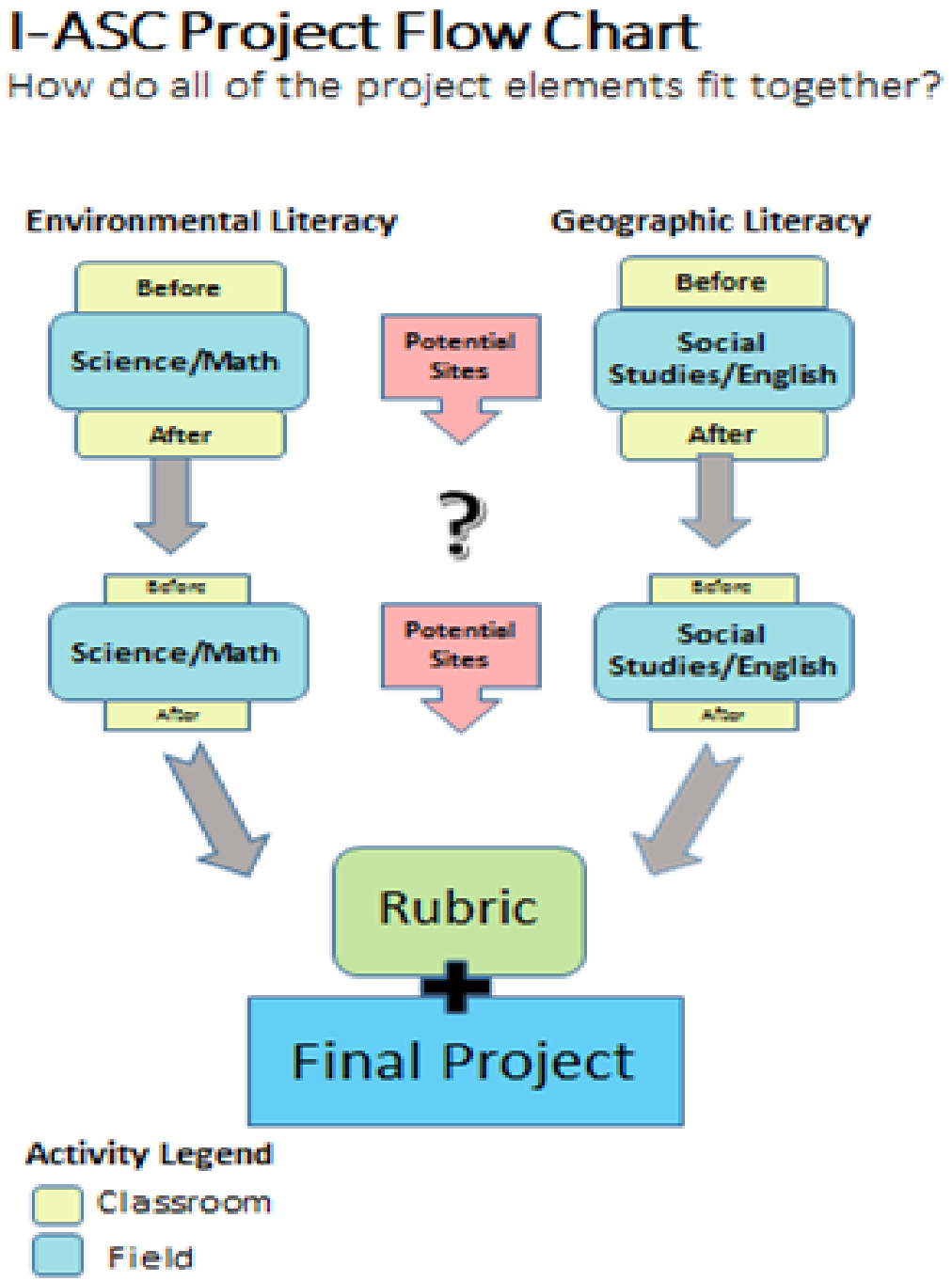

Where should Blandy build its proposed Education/Visitor Center?
Biotic & Abiotic factors
*Sci 6.7a
Conservation and Health Issues
*Sci 6.7f
Models
Reading & Making Maps
*SocStud USII. 2
Sci 6.7b , Eng 6.6
Spatial Reasoning/ Analysis
*Sci 6.1
Watersheds
*Sci 6.7
Research, Investigation & Communication
*Sci 6.1
Math 6.14, .15
Eng 6.9
Enviroliteracy
NOAA ESP1.3 ; OLP1, MAELS 1.2
*Sci 6.1, .7, .9
Geoliteracy
NOAA ESP1.1, OLP 6, MAELS 1.2
*SocStud USII. 2
Sci 6.7, .9
Research
*Eng 6.1, .6, .9;
Sci 6.1, 6.7g;
SocStud USII.1
Interactions (How the World Works)
*Sci 6.7
Interconnections (Systems; how world is connected)
*SocStud USII. 1i
Sci 6.9
Data
*Math 6.14
Human Impact
*Sci 6.9, 6.7f
Gather
Analyze
Interpret
*Math 6.15
Implications (outcomes of actions)
*Sci 6.9
SocStud USII. 1
Communicate
*Eng 6.1, .2
Land Use and Environmental Hazards
*Sci 6.9c
Land Use History
*SocStud USII. 1, USII.2
Renewable and Non-renewable Resources
*Sci 6.9a & b
Resource Use
*SocStud USII.2
* Indicates Virginia Standards of Learning

PBL	MWEE	EIA
Define a problem	Issue based; propose a question	Propose an action (development)
Student centered	Student centered	Audience-centered
Multiple step investigation	Classroom & outdoor investigations	Multiple step investigation
Compose & test solutions	Collect data to answer to question	Collect data to assess proposed action impacts
Multidisciplinary	Multidisciplinary	Expertise from several professions
Analyze & synthesize results	Analyze & evaluate results	Analyze & synthesize results
Communicate results	Communicate results	Communicate results
Project-focused	Action Project	Discourse w/ stakeholders

What are the essential elements of a PBL, a MWEE, and an EIA?

The Environmental Impact Assessment Process

- Investigations are designed to provide students with the skills to assess the potential environmental & cultural/ historic impacts of development at a particular site.
- Students also propose solutions to mitigate the negative impacts of development.



6th Grade Field Investigations

Enviroliteracy

- Watershed models
- **Hydrogeology models**
- Water chemistry
- Macroinvertebrates

Geoliteracy

- Land use history of Blandy
- **Historic scene investigation**
- Land use analysis
- Building site investigation

ALL investigations involved indoor & outdoor learning components.

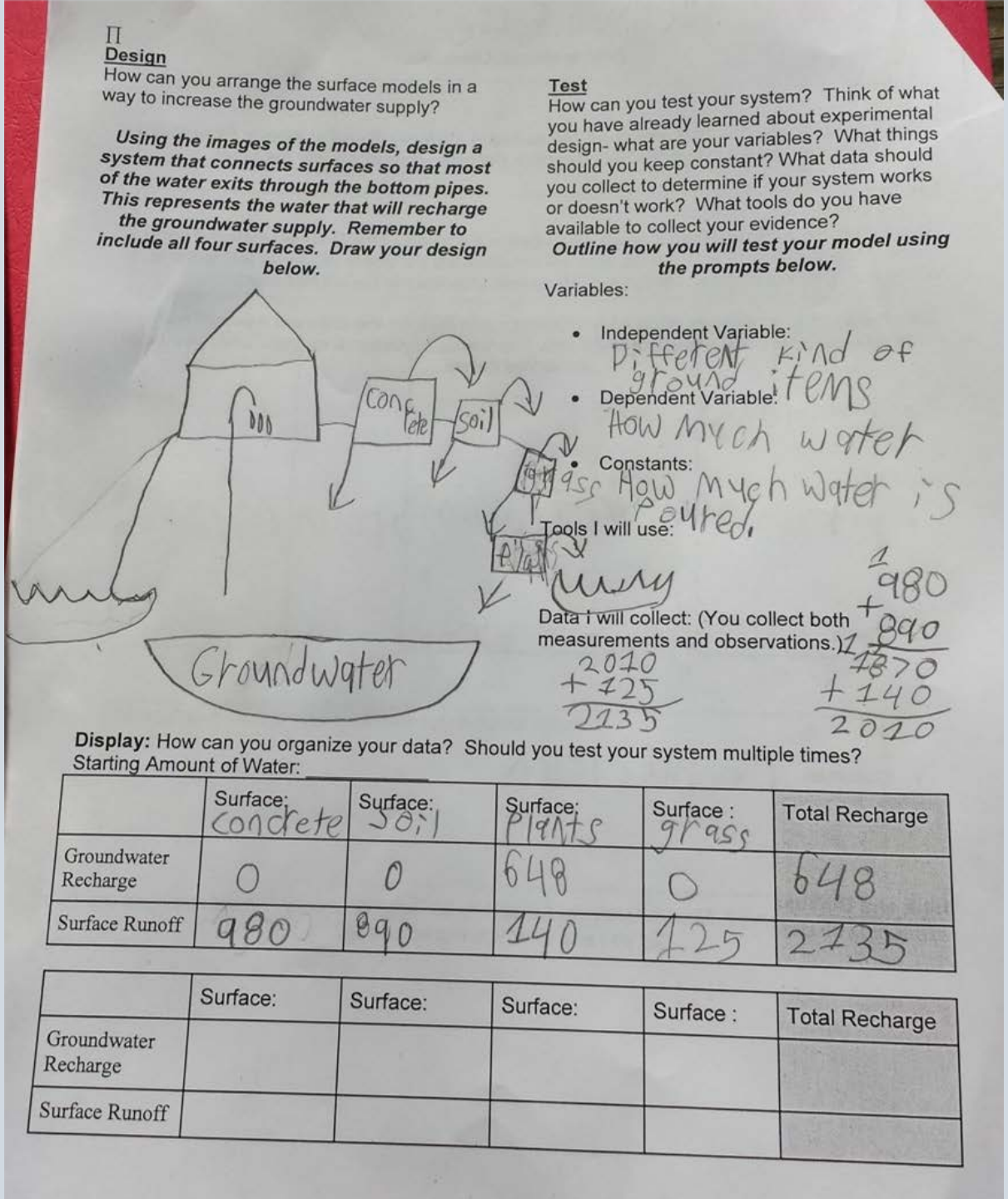
Environmental Literacy Investigation: Hydrogeology Models

How can we use landscape design to control runoff & erosion & maximize groundwater recharge?

Scenario 1. Picnic Grove

The picnic grove is a flat area under the shade of tall deciduous trees. This area is well traveled by school groups and other visitors (approximately 100,000 a year). The area was once grass but due to foot traffic, it is now bare soil that becomes muddy during large rainstorms; this increases erosion. Arrange the models to build a system that **reduces runoff** and **increases groundwater recharge** in this area. You do not have to use all of the models.

Design & test a solution



Π

Design

How can you arrange the surface models in a way to increase the groundwater supply?

Using the images of the models, design a system that connects surfaces so that most of the water exits through the bottom pipes. This represents the water that will recharge the groundwater supply. Remember to include all four surfaces. Draw your design below.

Test

How can you test your system? Think of what you have already learned about experimental design- what are your variables? What things should you keep constant? What data should you collect to determine if your system works or doesn't work? What tools do you have available to collect your evidence?

Outline how you will test your model using the prompts below.

Variables:

- Independent Variable: Different kind of ground items
- Dependent Variable: How much water
- Constants: Grass How much water is poured.

Tools I will use: rulers

Data I will collect: (You collect both measurements and observations.)

2010
+125
2135

980
+890
1870
+140
2010

Display: How can you organize your data? Should you test your system multiple times?

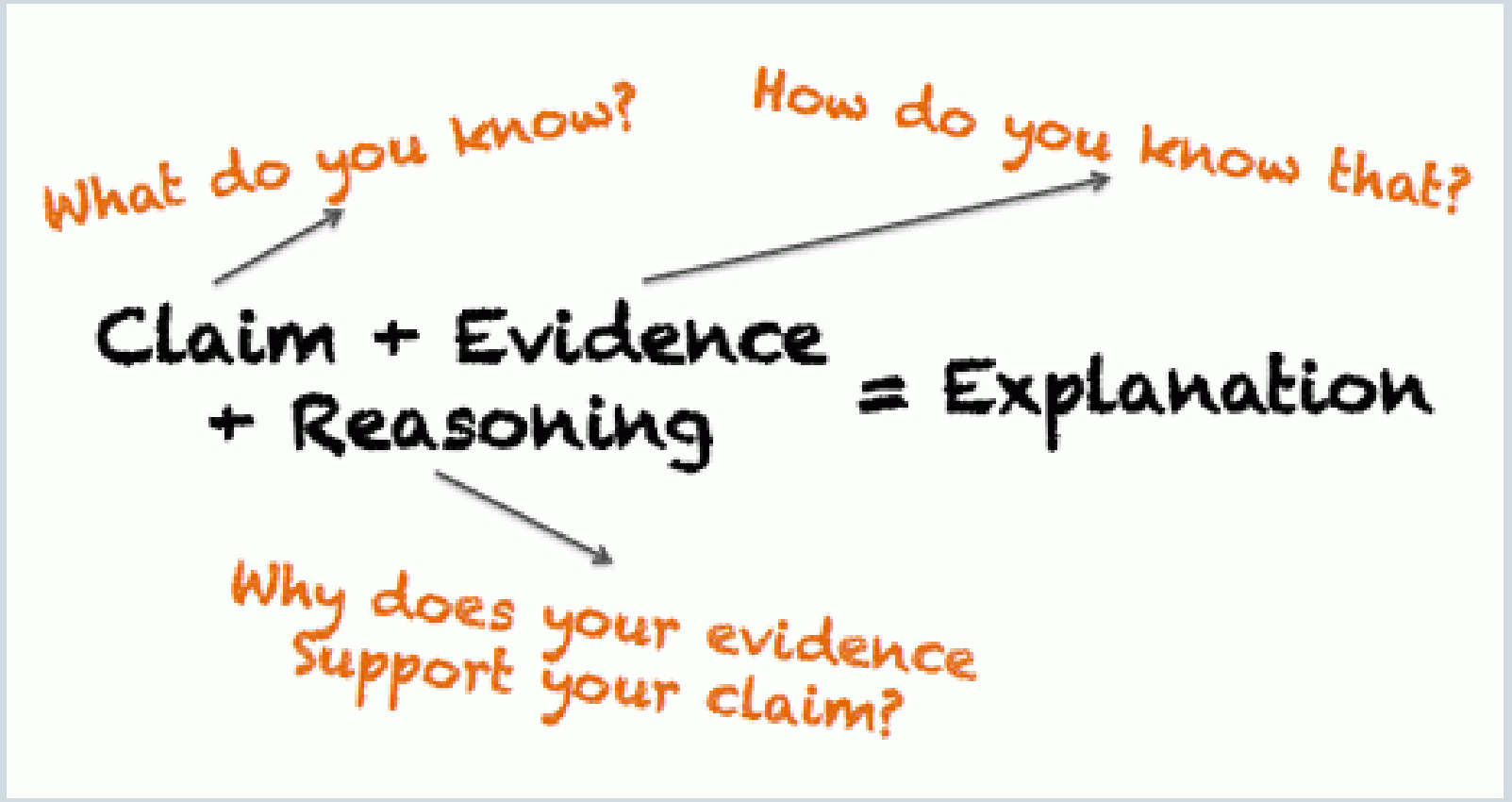
Starting Amount of Water: _____

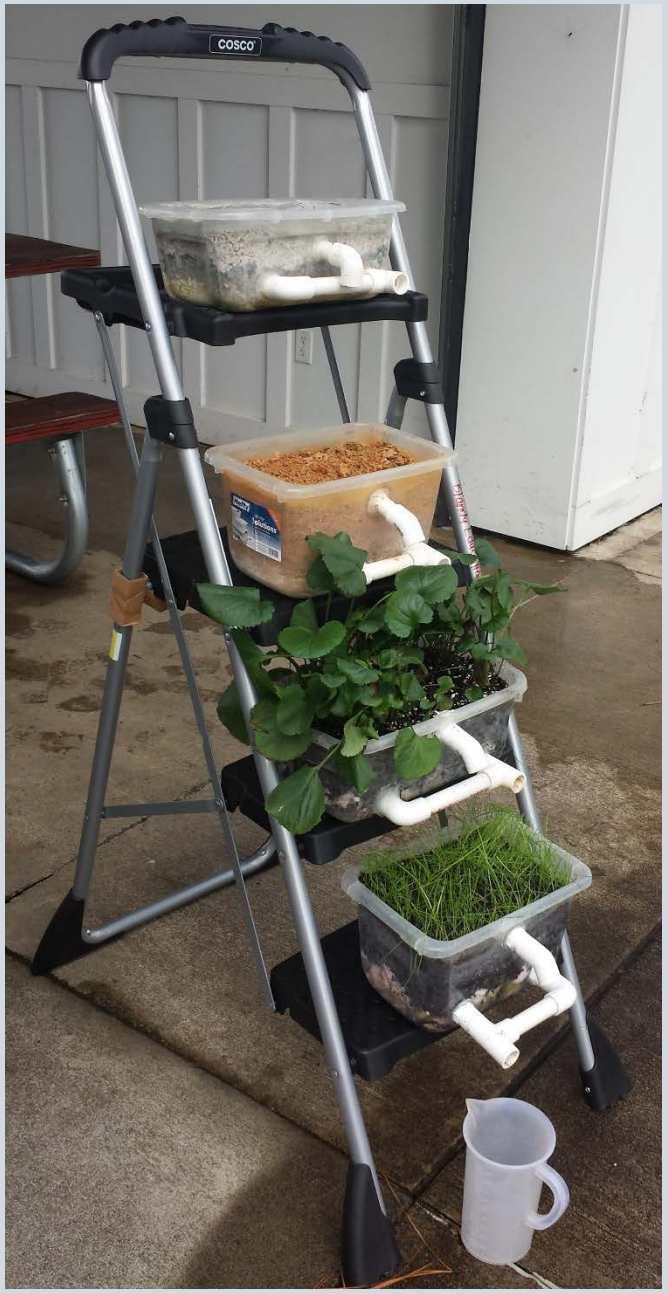
	Surface: concrete	Surface: soil	Surface: Plants	Surface : grass	Total Recharge
Groundwater Recharge	0	0	648	0	648
Surface Runoff	980	890	140	125	2135

	Surface:	Surface:	Surface:	Surface :	Total Recharge
Groundwater Recharge					
Surface Runoff					

Did it work? Propose your solution.

Scenario: Paved Road Extension	Average Runoff (3 trials)	Average Recharge (3 trials)
Order of Models:		
Concrete, Bare Soil, Grass, Native Plants	17 mL	380 mL





<u>Geoliteracy Investigation</u>:

Should it stay or should it go?

Evaluating the historic value of structural features

Why is the Quarters Historically Significant?

Evidence #1
The Quarters

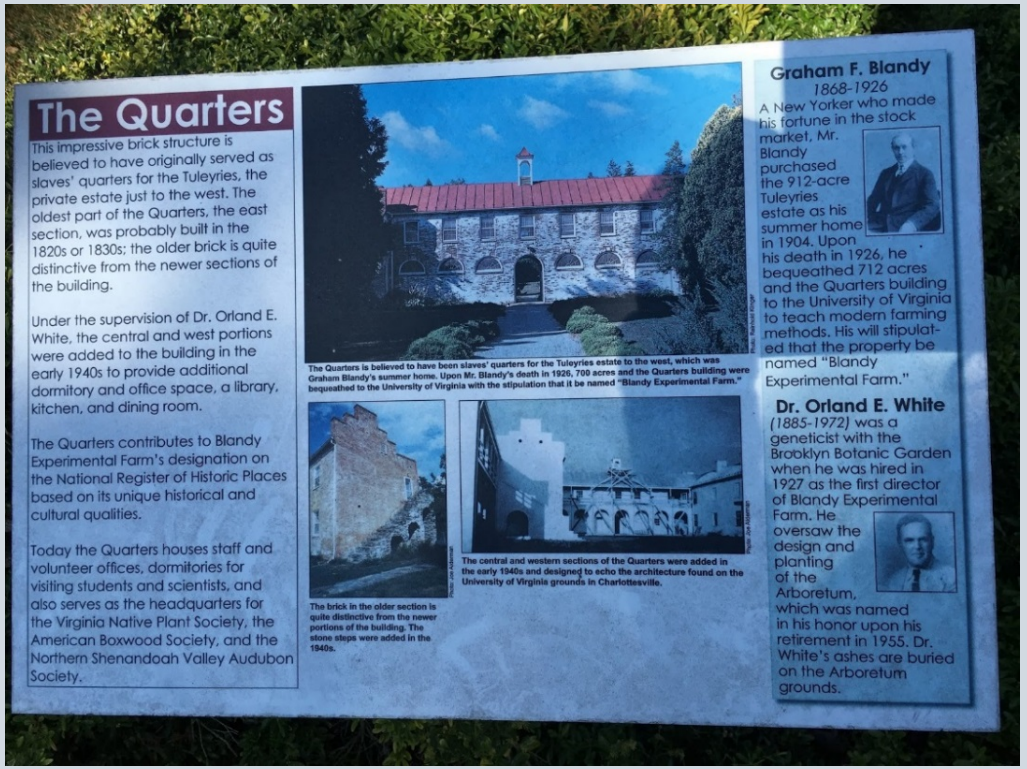
How does this document support the historical significance of the Quarters?

The...Quarters [was] constructed around 1825 and enlarged in 1941. Although the use of this building has changed through time, from slave's quarters to offices and dormitories for faculty and students, the original configuration [arrangement] of rooms and almost all of the exterior architectural details of the Quarters are still intact [not damaged] ..., it is one of the largest and most original surviving examples of nineteenth-century slave's quarters in the northern Shenandoah Valley. p. 16

United States Department of the Interior National Park Service National Register of Historic Places Registration Form September 30, 1992

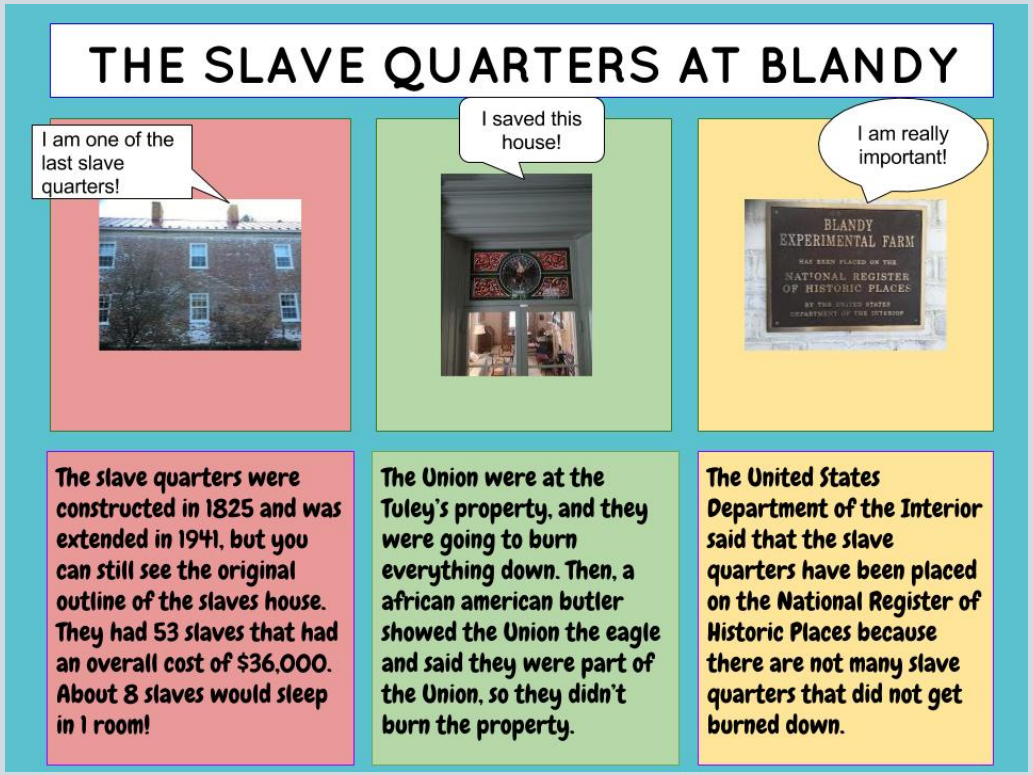
Why is the Quarters historically significant?

BLANDY INTERPRETIVE SIGN



STUDENT HISTORY PBA:

MAKE AN INTERPRETIVE SIGN



Constructing the West Virginia Route 9 Highway to the Shenandoah River

While the snow was still flying and the temperatures were still their typical Cleveland lows this past winter, our estimating department secured the contract and our crews began preparations for the next section of State Route 9 in Charles Town, West Virginia, approximately 40 miles outside of Washington D.C.

The contract is with the West Virginia Division of Highways and includes 2.3 million cubic yards of earthwork, a 415 ft. bridge, and associated drainage and erosion control for approximately a 2-mile stretch of 4-lane road. Our work will move all the dirt and get the grade ready for future packages including a later paving contract in this section, as well as the 1,200 ft. steel bridge to span the Shenandoah River and eventually carry Route 9 to the border with the State of Virginia.

Independence mobilized in March with erosion control, clearing and blasting work leading the charge over the area. Our earthwork crews began a double-shift schedule in April. The main cut on the project is approximately 140 ft. deep through Snyder Hill located on the west side of the Shenandoah River.

As an environmental restriction, we have an intricate schedule for 1,300 ft. of the project to work without disturbing the habitat of an American Bald Eagle nest. The eagle is regularly seen watching over our operations from his nest just outside the project limits. Also, a historic hydroelectric dam on the river and high-voltage line crossings at several locations on the project have added to the complexity in planning our work. These concerns, as well as the overall protection of the Shenandoah River Watershed and the historical significance of the area, add to the challenge and the success of this project.

Additionally, with our bridge sub-contractor, Ahern and Associates (South Charleston, WV), the project team is proceeding on a value engineering proposal to replace the 415 ft. precast concrete bridge with a precast arch-span. The arch culvert will be 293 ft. long in the valley of a 90 ft. fill to convey the existing two-lane County Road 27 beneath the highway.

From working around the spring rains, as well as managing the soil-material that varies from clay and silt to sandstone and hard limestone, the success of this project will ultimately bring the West Virginia Route 9 corridor right to the bank of the Shenandoah River for the Division of Highways to let the bridge crossing still this year.

Everyone's efforts are ensuring an efficient project that we can all take pride in. Thank you to all of those who have contributed to this project thus far, including the West Virginia Division of Highways, Baker Engineering, Operating Engineers Local 132, Laborers District Council Local 379, our sub-contractors, suppliers and Independence team members.

- ✓ Simplify content
- ✓ Reformat text for visual variety
- ✓ Connect facts to students' frame of reference

Constructing the West Virginia Route 9 Highway to the Shenandoah River

http://www.indexc.com/news/story/constructing-the-west-virginia-route-9-highway-to-the-shenandoah

Summer 2009

West Virginia Route 9 acts as the major east–west transportation artery between the eastern counties of WV and Northern Virginia. With increased traffic on the winding Route 9, plans were made to expand and improve the road.

Independence Excavation crews began preparations for the next section of State Route 9 in Charles Town, West Virginia, approximately 40 miles outside of Washington D.C.

Proposed work includes 2.3 million cubic yards of earthwork, building a 415 ft. bridge (that is 1 and ¼ football fields long), and drainage and erosion control for approximately a 2-mile stretch of a 4-lane road.

Our work will:

* move all the dirt
* prepare for later paving
* prepare for the 1,200 ft. steel bridge over the Shenandoah River to expand Route 9 to the Virginia border.

As an environmental restriction, we have to work without disturbing the habitat of an American Bald Eagle nest. The eagle is regularly seen watching over our operations from his nest just outside the project limits.

Also, a historic hydroelectric dam on the river and high-voltage line crossings at several locations makes the project more complicated/complex.

These concerns, as well as the overall protection of the Shenandoah River Watershed and the historical significance of the area, add to the challenge and the success of this project.

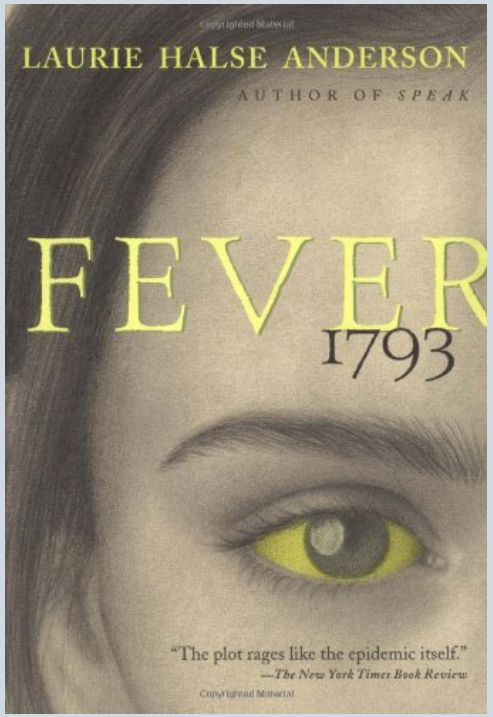
In March the excavation crew began with erosion control, clearing and blasting work. We cut approximately 140 ft. (almost 12 stories of a building) deep through Snyder Hill located on the west side of the Shenandoah River.

The project will bring WV Route 9 to the banks of the Shenandoah River. We will work around the spring rains and manage the soil-material that varies from clay and silt to sandstone and hard limestone to lessen/reduce erosion of the soil into the River.

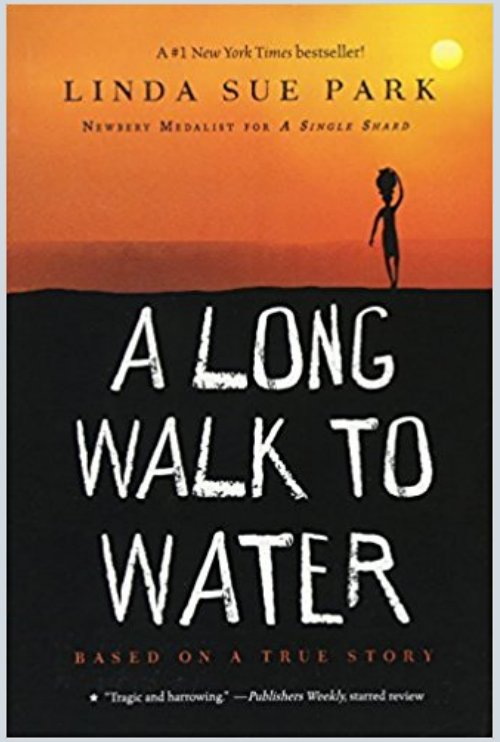
Reading literacy is integral to the project.

Historic fiction deepens understanding about the importance of water & watersheds as natural resources that need sustainable management.

POOR WATERSHED MANAGEMENT IS UNHEALTHY



FRESH WATER IS A PRECIOUS RESOURCE



Synthesis & Conclusions

STUDENT PROJECTS:

LETTER OR A PRESENTATION TO THE BLANDY BOARD

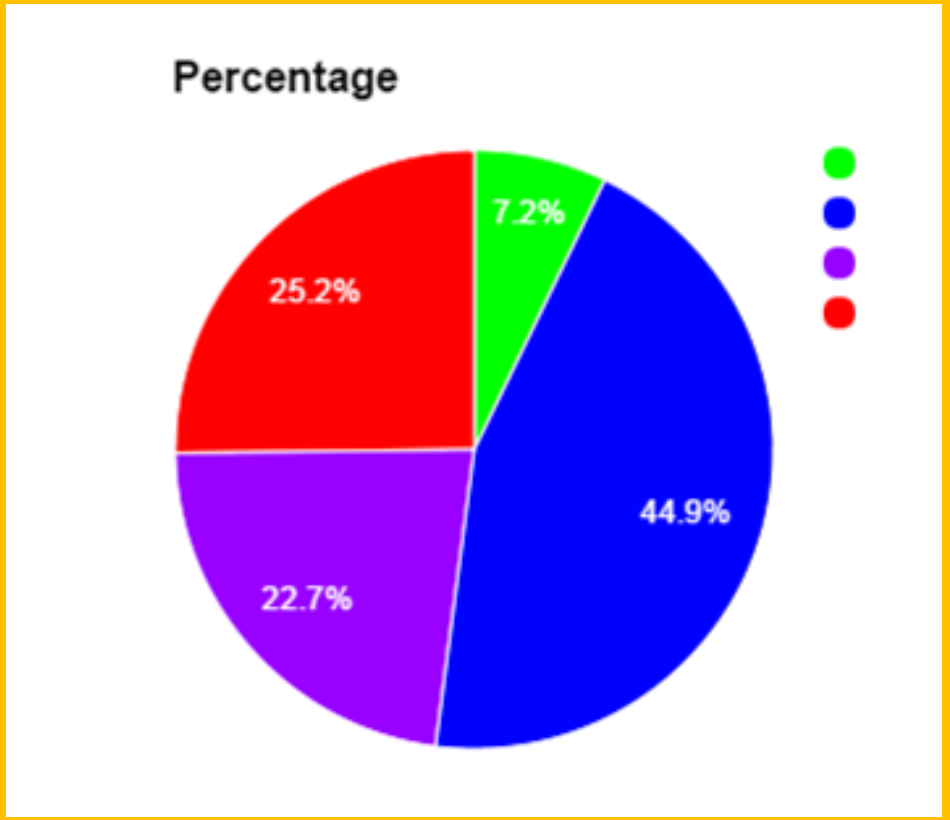
Blandy Experimental Farm Educational Center

ENVIRONMENTAL IMPACT STATEMENT

BY: JAMES WOOD MIDDLE SCHOOL STUDENT

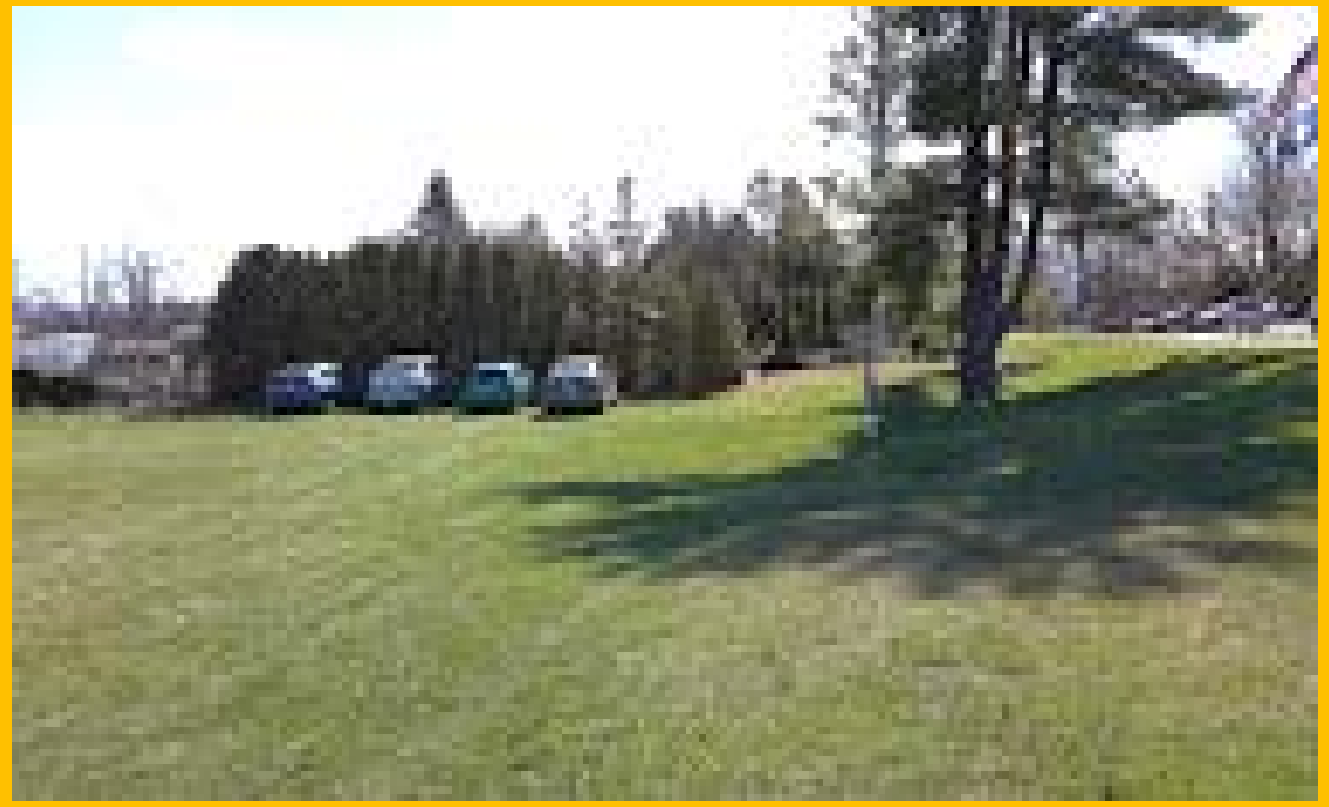
Environmental Literacy

Totals by color	Totals	Percentage
Pollution Intolerant	73	7.19
Somewhat Intolerant	456	44.88
Somewhat Tolerant	231	22.74
Pollution Tolerant	256	25.20
Totals by color	1016	100.00



The graph and chart above shows the macroinvertebrates of Lake Georgette. As you see it is good and healthy. The majority of the macroinvertebrates are somewhat intolerant which is good because they are somewhat not tolerant to pollution. And since there are many that means the water is clean.

Historical Significance



I chose the event parking lot because of its lack of historical significance. We know that Joseph Tuley had slaves and that the parking lot could have been a field but that's not enough to make it on the list of historical places at Blandy like the Slave Quarters. There are no artifacts found in the event parking lot area. Therefore there is a major lack of historical significance.

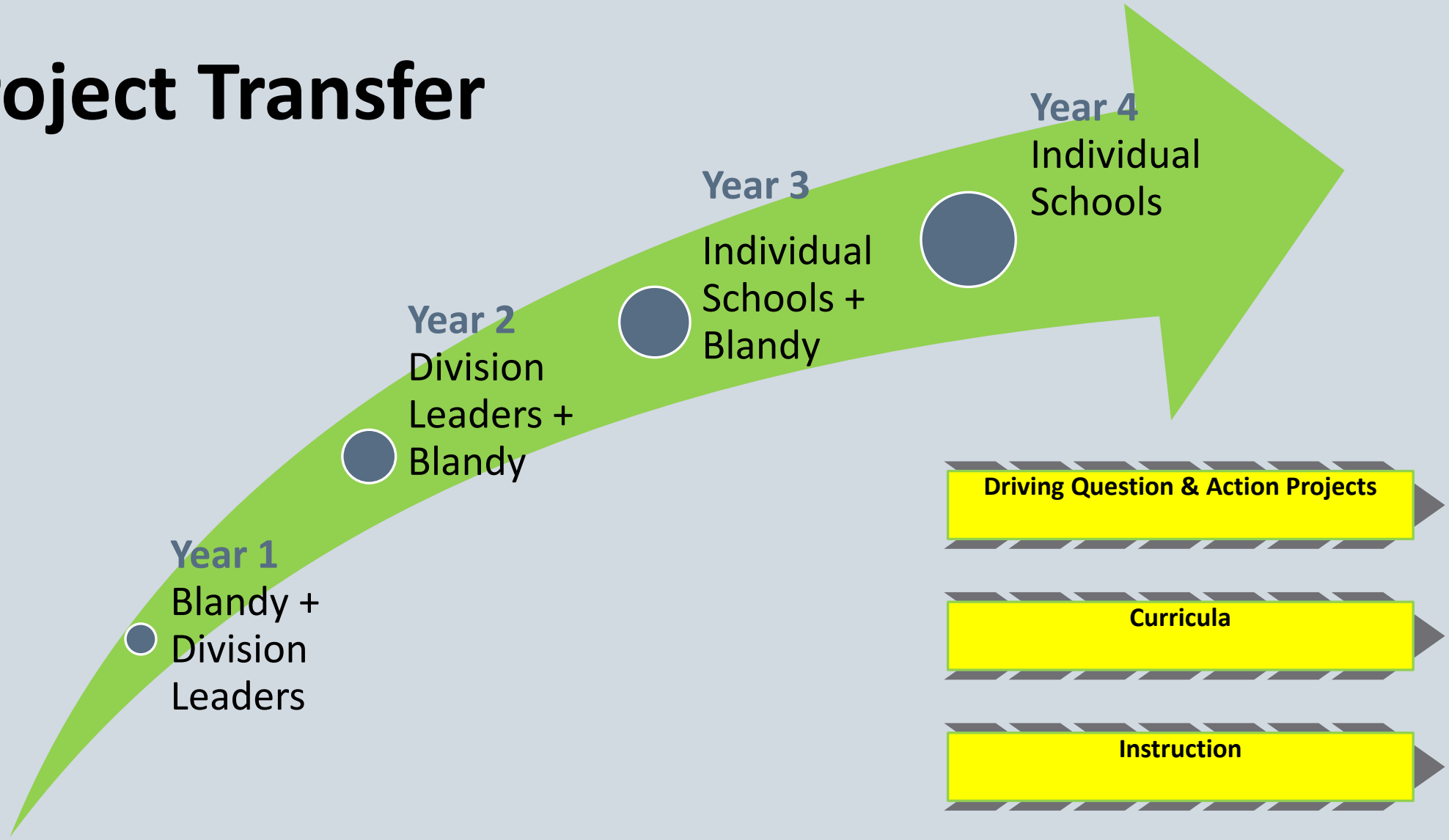
Old Greenhouse

I chose the Old Greenhouse from 1940's as a second choice because of where it is located. The location is ok if only there weren't trees and habitats in the trees. I refer to it as the Old Greenhouse because they are already tearing it down because it's old and unstable. The background is the picnic area just below the hill where the Old Greenhouse is. There would be a lot of runoff because of it being on a hill. The trees surrounding the Old Greenhouse are not a few but many. So if you were to build the building here: one you would kill many trees and two it would block some scenery.

I-ASC Celebration: Student Action Project

Community Engagement

Project Transfer



Geographic Literacy → Environmental Literacy → Coupled Systems Literacy

Project Transfer

Driving Question & Action Projects

Curricula

Instruction

Environmental Literacy

Coupled Systems Literacy

Challenges

1. MWEE Concept
2. Principals providing P.D. time
3. Aligning core curricula
4. Pedagogy Barriers:
    - Perceptions of outdoor learning
    - Professional recognition
    - Indoor & outdoor classroom connections

MWEE Concept

Meaningful **watershed** education experience

<u>Science</u>: MWEE is not in the SOL.

<u>Mathematics</u>: Watershed education does not pertain to math.

<u>Social Science</u>: What does water have to do with history?

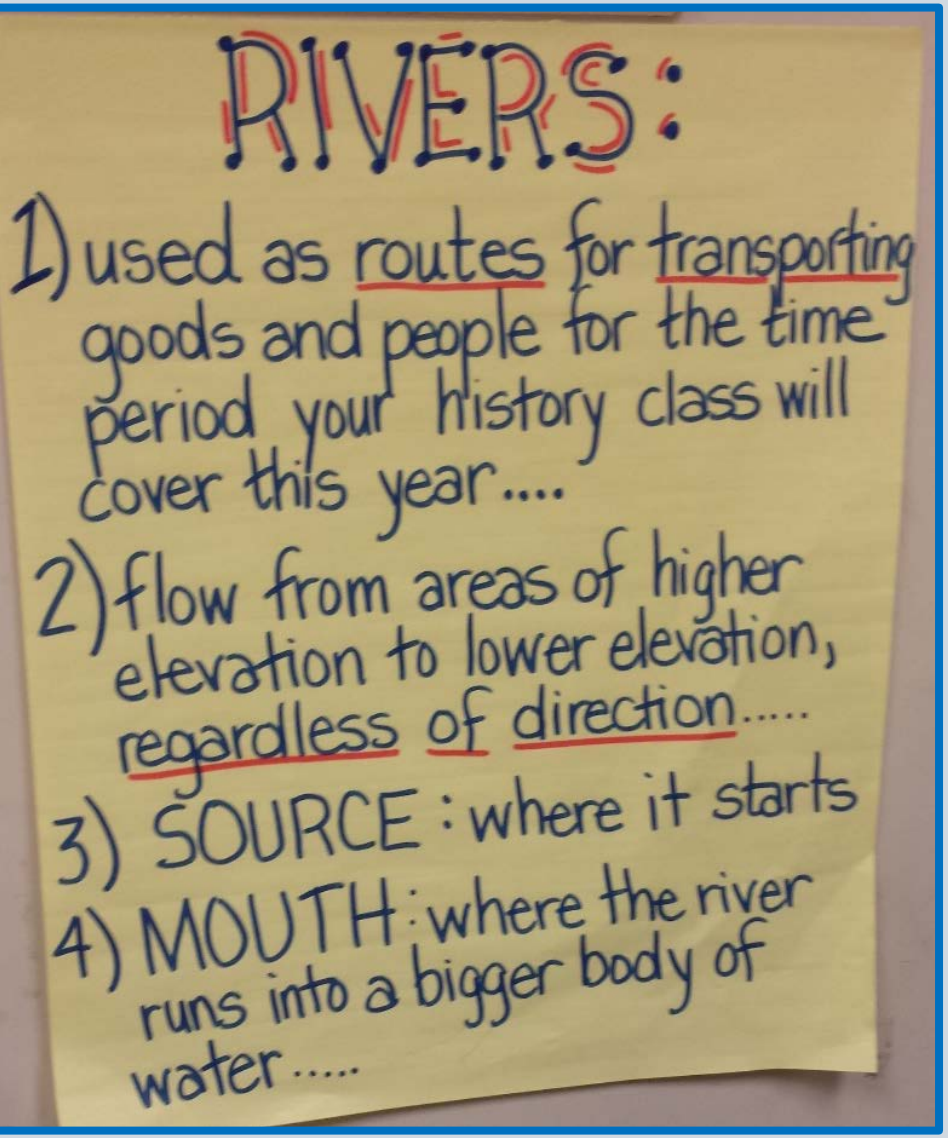
<u>English</u>: We don't see how language arts fits into this project at all.

ALL: This project is not relevant to what I need to teach my students.

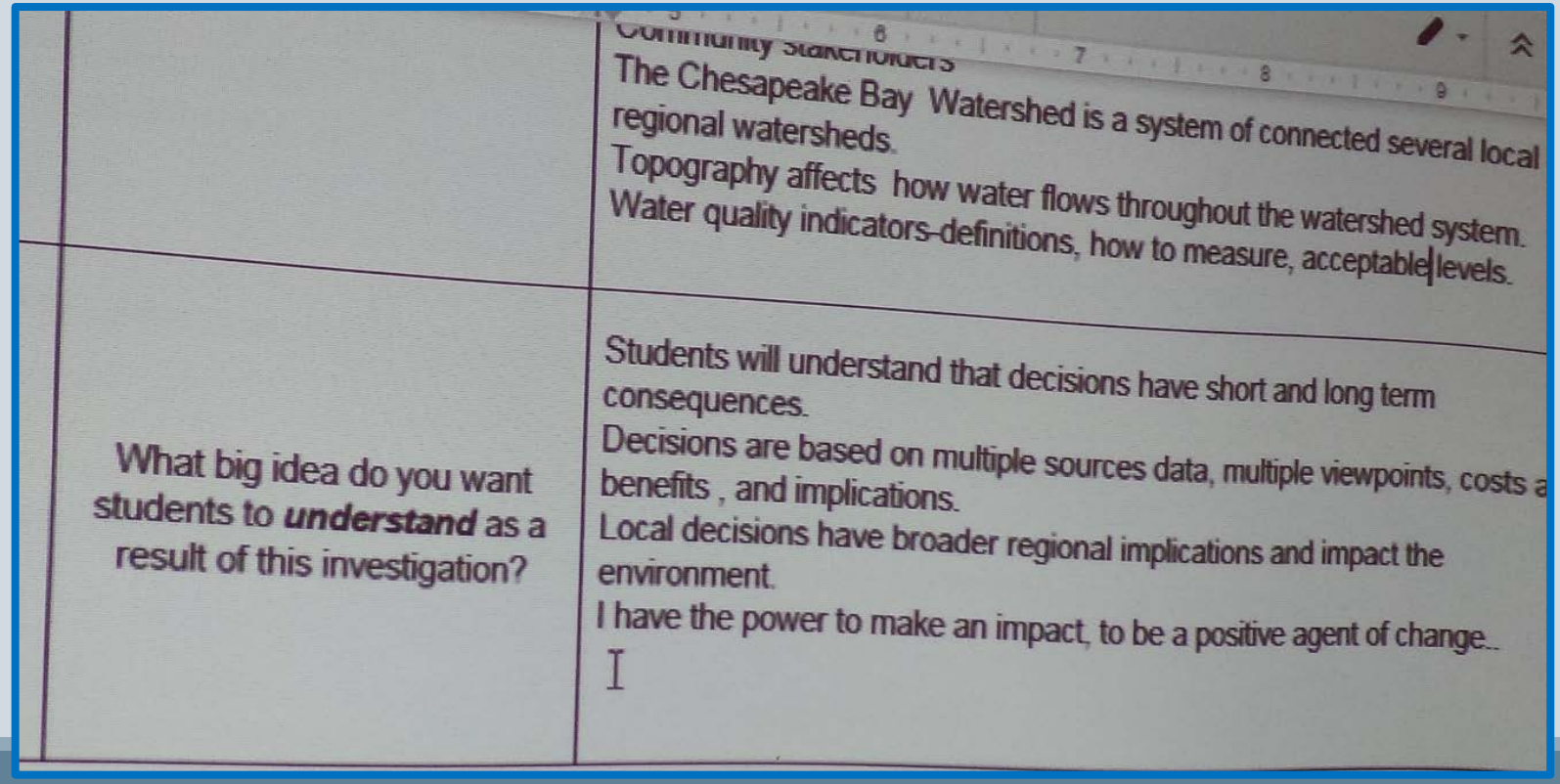
MWEE Concept Solutions…

1. Avoid term “MWEE” until teachers embrace the concepts of geographic & environmental literacy
2. Invite NOAA C.B. Office personnel to participate in a P.D.

…MWEE Concept Solutions



3. Emphasize specific connections among standards in all content areas & investigations.
4. Challenge teachers to create PBL components pertinent to their content areas.
5. Engage teachers in making curricular connections in ALL of the PBL activities (KUD Charts)



	Community stakeholders The Chesapeake Bay Watershed is a system of connected several local regional watersheds. Topography affects how water flows throughout the watershed system. Water quality indicators-definitions, how to measure, acceptable levels.
What big idea do you want students to ***understand*** as a result of this investigation?	Students will understand that decisions have short and long term consequences. Decisions are based on multiple sources data, multiple viewpoints, costs a benefits , and implications. Local decisions have broader regional implications and impact the environment. I have the power to make an impact, to be a positive agent of change..

Principals & Professional Development Release Time

Challenge: After the first project P.D., the principals became concerned about releasing all 6th grade teachers for PDs.

Solution:

1. Hear Principals' concerns
2. Designate 1 teacher leader from each content area/school to attend P.D.'s & share learning during monthly grade level planning times
3. Provide additional content-specific, in-school P.D. during monthly content area meetings

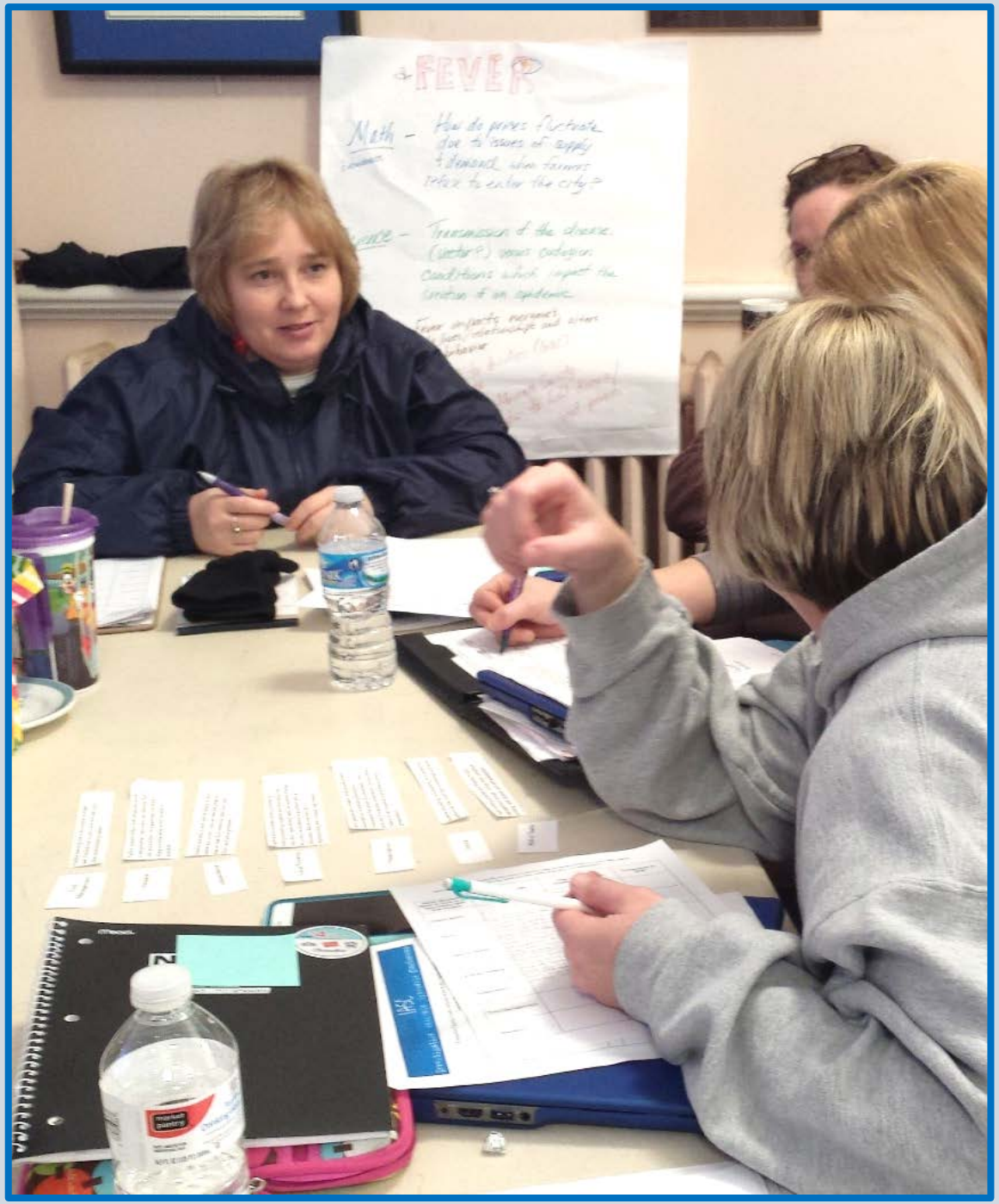
Aligning Core Curricula

Challenges:

1. Teachers do not see connections among the disciplines
2. Pacing guides for the disciplines do not align

Solutions:

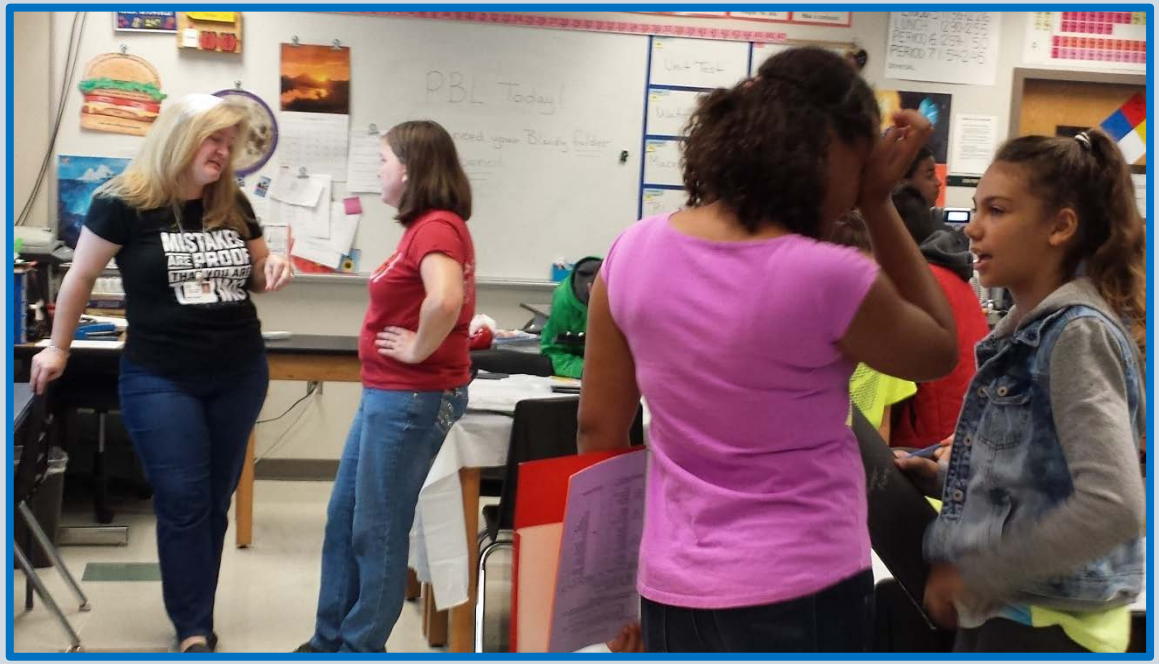
1. Examine standards & identify the natural overlaps in content knowledge & skills
2. Challenge teachers to develop lessons specific to their content areas to enhance &/or extend the field experiences
3. Incorporate these lesson ideas into the project
4. Ask teachers to engage in each of the field experiences, initially as observers then as co-teachers



Pedagogy Barriers

Challenges:

1. Perceptions of outdoor learning
2. Professional recognition
3. Indoor & outdoor classroom connections

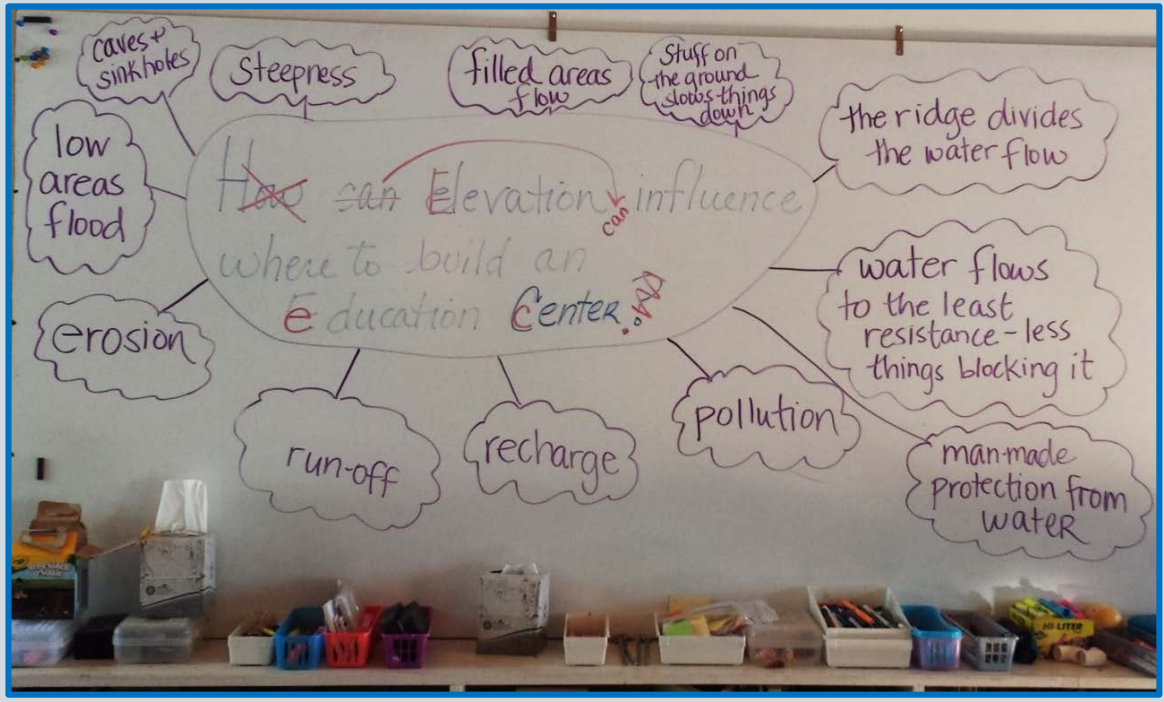


Solutions:

1a. Teachers observe the impact of outdoor learning
1b. Follow up with the Curriculum Supervisors back at their schools

2a. Blandy educators focus on project goals while classroom teachers develop outdoor teaching skills
2b. Provide time for Blandy & FCPS educators to share ideas

3a. Blandy & FCPS educators co-teach at schools & Blandy
3b. In P.D.s, teachers develop classroom lessons to bookend field experiences



I-ASC Project Year 4

PROJECTS DEFINED & LED BY THE SCHOOLS

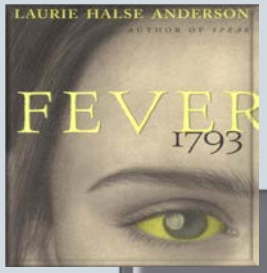
Admiral Byrd Middle School

Big Idea: Water and People are Connected.

Essential Question-EL: What impacts will the addition of the new high school have on the environment around our school?
Essential Question-GL: How can changes to our watershed impact human health?

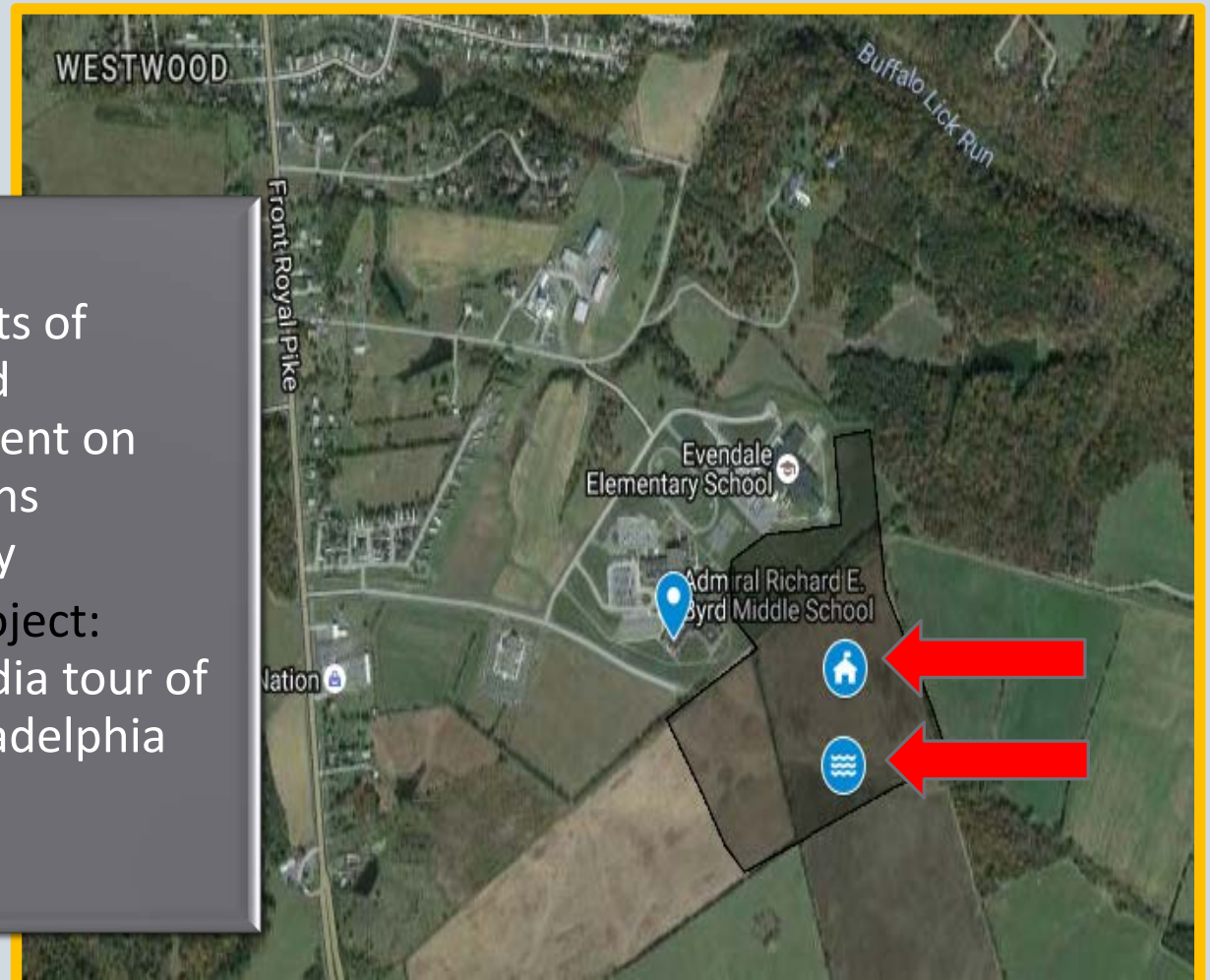
Enviroliteracy

- PBL: Environmental Impact Assessment: impacts of a new high school on water quality
- Action Project: Advocate for wetland restoration



Geoliteracy

- PBL: Effects of watershed management on populations historically
- Action Project: Multi-media tour of 1793 Philadelphia



James Wood Middle School

Big Idea: It is important to conserve environmental and historical resources.

New Partnership: James Wood Middle School & Museum of the Shenandoah Valley

Essential Question-EL: Where will a riparian buffer be most effective along our local Abram's Creek watershed & what plants should we use?

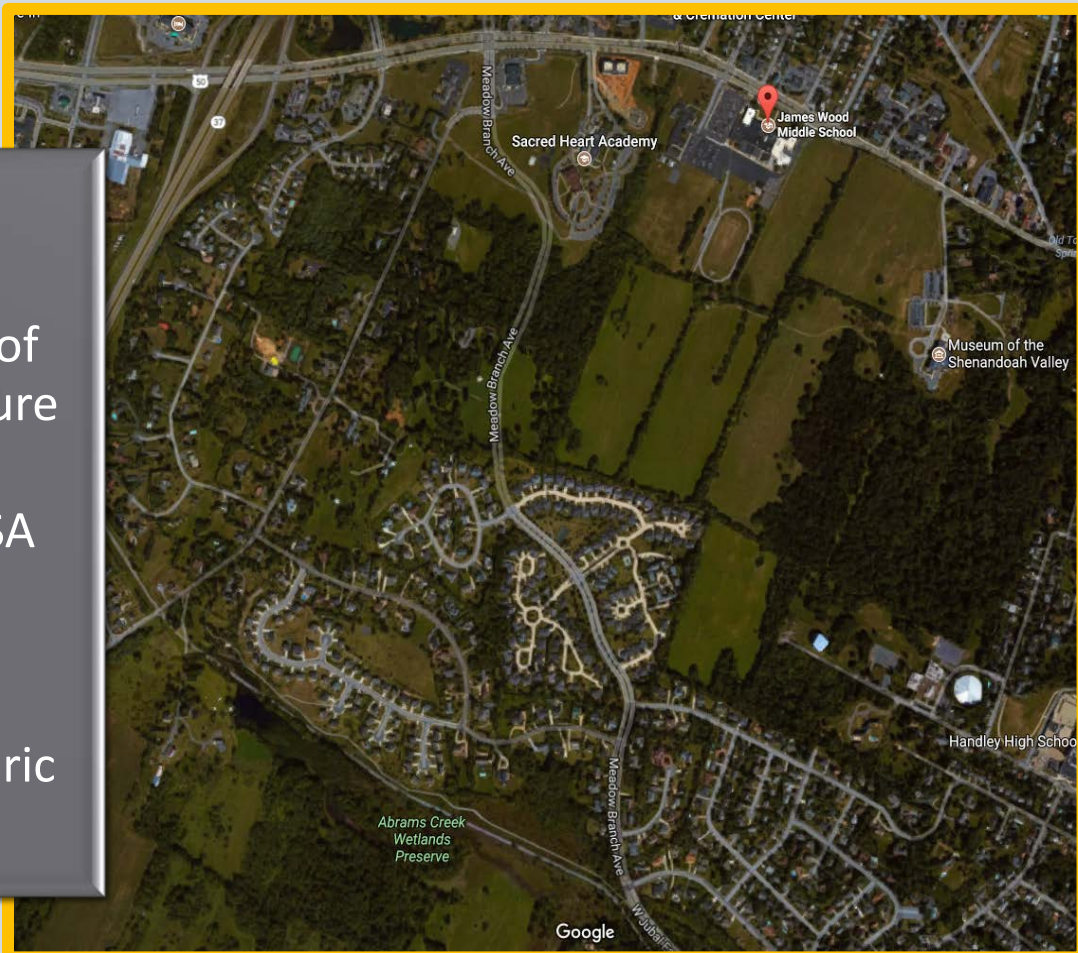
Essential Question-GL: Is our school building historically significant?

Enviroliteracy

- PBL: Environmental Impact Assessment of the health of our local watershed
- Action Project: Designing a riparian buffer

Geoliteracy

- PBL: Assessment of original architecture & school history
- Action Project: PSA advocating for protection of the school & surrounding historic sites



Frederick County Middle School

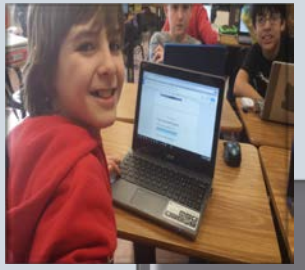
Big Idea: Water is a Precious Resource for ecosystems and human systems.

Essential Question-EL: Can the local watershed support the water use of our school at full student capacity?

Essential Question-GL: How can we help people in Sudan access clean water?

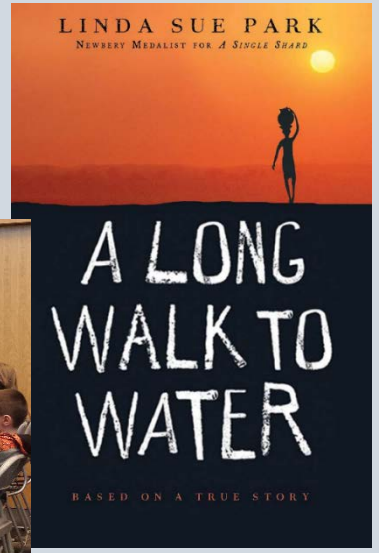
Enviroliteracy

- PBL: Assessing the impacts of the new school on water use & the watershed
- Action Project: Multimedia Tour of the new school grounds highlighting water management systems



Geoliteracy

- PBL: Impacts of water scarcity on populations around the globe
- Action Project: Schoolyard "Walk to Water" Fundraiser to help build wells in Sudan



Big Lessons

- Respect: Listen to all voices
- Engage in collaborative solutions
- Focus on the overall goals
- Be flexible in how to attain your goals
- View challenges as opportunities for innovation

I-ASC Project Web Site

NOAA B-WET Blandy Site

https://sites.google.com/site/noaabwetblandy/

Project:

- Lesson plans
- Resources
- Photos

Student:

- Data
- Work examples
- Final projects


Extra Slides

NGSS DCI emphasized during the I-ASC project

MS-LS2.C	Ecosystem Dynamics
MS-LS4.D	Biodiversity & Humans
ESS2.A	Earth's Systems & Materials
ESS3.A	Natural Resources
ESS3.C	Human Impacts on Earth Systems

Project Big Ideas/Goals

Geoliteracy

- Human impact
- Analyzing Data
- Decision Making
- Interrelationships, cost benefit analysis
- Engage students in PBL, real life learning activities
- Community assessment, lifelong learning outside the classroom (NOAA- community stewards)

Enviroliteracy

- Human Impacts
- Analyzing data
- Understanding watershed
- Decision Making
- Interrelationships, cost benefit analysis
- Engage students in PBL, real life learning activities

3 Is- interconnections, interrelationships, implications

What are the elements of a PBA?

Problem Based Learning:

Students gain knowledge & skills as they investigate & respond to an authentic, complex question, problem, or challenge.

<u>Essential Problem Design Elements include</u>:

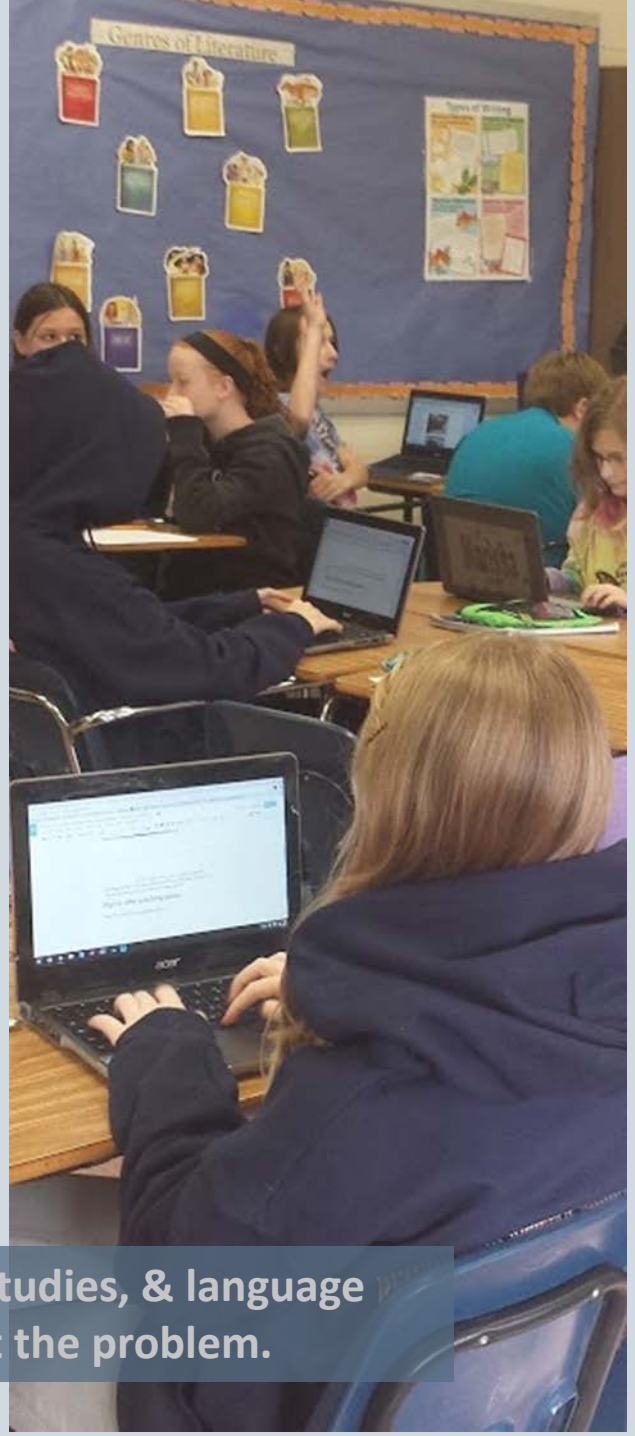
- **Find answers to a problem**
- **Student centered, collaborative investigations**
- **Multidisciplinary: Requires expertise from various career fields**
- **Propose & test potential solutions**
- **Communicate results**

What is an Environmental Impact Assessment?

An **EIA, under United States environmental law**, is a document required by the National Environmental Policy Act (NEPA) for certain **actions "significantly affecting the quality of the human environment."**

An EIA is a tool for decision making. It describes the positive and negative environmental effects of a proposed action, and it usually also lists one or more alternative actions that may be chosen instead of the action described in the EIA.

Source: Wikipedia

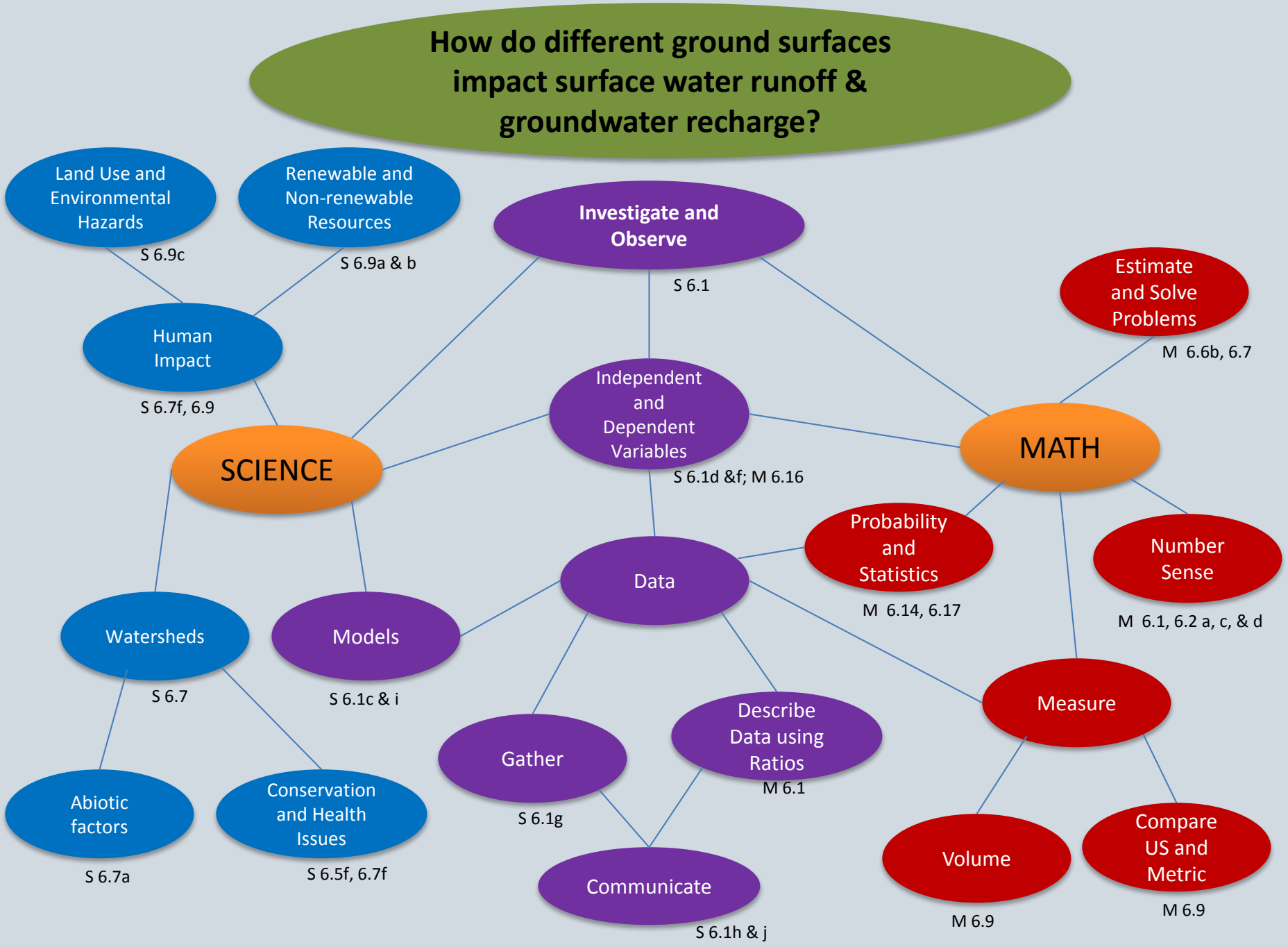


Students integrate knowledge & skills from science, mathematics, social studies, & language arts to investigate, analyze, synthesize, & communicate conclusions about the problem.

Science	Mathematics	Investigation	History/Geography	English
Build a model & examine water flow		**Watershed Models**	Build a topographic map model	Write a descriptive paragraph
Build a system to mitigate surface water run-off & maximize groundwater recharge	Calculate means, per cents; Graph & analyze data	**Hydrogeology Models**		Use Claims, Evidence, & Reasoning process to evaluate how well your system worked
Identify habitat type & biodiversity at each site		**Land use analysis**	Use topographic maps to determine land elevation, slope, & direction of water flow; Investigate historic land use of each site	Write a descriptive paragraph about the land usage at one site
		Historic Scene Investigation	Use 1º & 2º resources to evaluate the cultural significance of a site	Research a historic timeline for the site

Examples of the interdisciplinary components for project investigations

Concept map for hydrogeology investigations



The I-ASC Project Team

Frederick County Public School Curriculum Supervisors:

Kelley Aitken, Dominick Cavalier, Deborah Crawford, & Amy Hall

& **all 48 6th Grade Teachers**

The Blandy Education Team:

Emily Ford, Lindsay Cutchins, Candace Lutzow-Felling, & Lillian Ledford

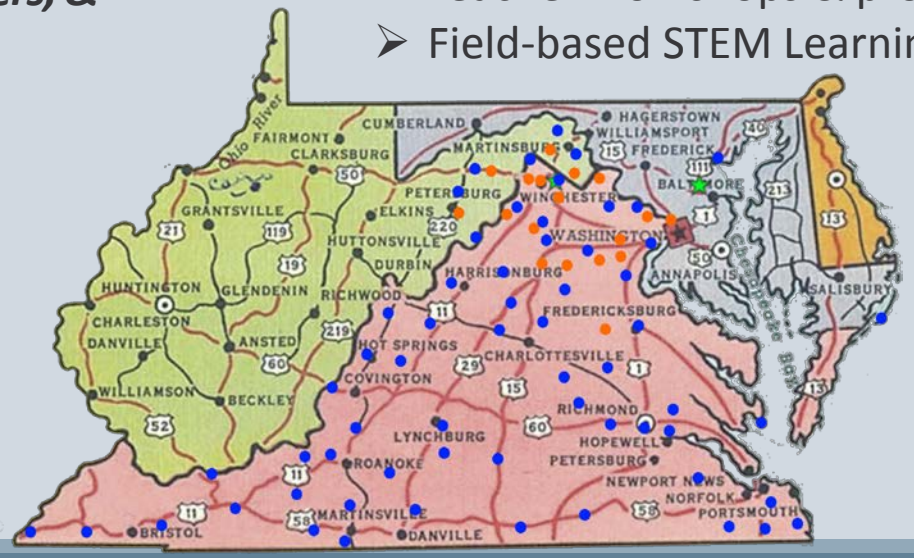
Blandy Experimental Farm Education Department

The mission of the Blandy Education Program is to

stimulate scientific exploration, discovery, & stewardship of our natural world by fostering a learning community among preK-12 students, teachers, & scientists.

Highlights

- Hands-on, outdoor experiential field investigations
- Guided-inquiry programs
  Correlated to state & national standards
- ~7500 preK-12 students per year
- Teacher workshops & professional development
- Field-based STEM Learning



Outreach as of 2016
- **Students reached**
- **Educators reached**