MAPPING OUR PARKS

Understanding by Design Curriculum Framework

Stage 1 – Desired Results			
Established Goals for Maryland High Schools - *What standards will this design address?*			
Learning Goal	**Science Standard**	**Expectation**	**Indicator**
1	Skills and Processes	4	2 Analyze data to make predictions, decisions, or draw conclusions.
			8 Use models and computer simulations to extend understanding of scientific concepts.
			9 Use analyzed data to confirm, modify, or reject a hypothesis.
2	Earth Science	1	2 Describe the purpose and advantage of current tools, delivery systems and techniques used to study the atmosphere, land and water on Earth (e.g., satellite-based delivery system, GIS, GPS and imaging techniques).
6	Environmental Science	3	2 Evaluate the interrelationship between humans and water quality and quantity, considering at least point/nonpoint source pollution, Chesapeake Bay and its watershed.
			3 Evaluate the interrelationship between humans and land resources, considering at least wetlands, land use planning.
Established Goals for Virginia High Schools - *What standards will this design address?*			
Science Standard	**Description of Standard**		
Computer Technology	8	The student will use technology resources for solving problems and making informed decisions. • Use technology resources such as educational software, simulations, and models for problem-solving and independent learning.	
Biology	1	The student will plan and conduct investigations in which appropriate technology including computers, graphing calculators, and probe ware, is used for gathering and analyzing data and communicating results.	
	9	The student will investigate and understand dynamic equilibria within populations, communities, and ecosystems. Key concepts include the effects of natural events and human activities on ecosystems.	
Earth Science	1	The student will plan and conduct investigations in which • technologies including computers, probeware, and global positioning systems (GPS), are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions; • scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted.	
	3	The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery. Key concepts include • maps (bathymetric, geologic, topographic, and weather) and star charts; • direction and measurements of distance on any map or globe; • location by latitude and longitude and topographic profiles.	
	9	The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include • identification of the major watershed systems in Virginia including the Chesapeake Bay and its tributaries.	

Stage 1 – Desired Results, continued			
Established Goals for West Virginia High Schools - *What standards will this design address?*			
Course Title	**Content Standard**	**Objective**	
21st Century Learning Skills and Tech Tools	2	2	Student collaborates with peers, experts and others to contribute to a content-related knowledge base by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works.
Tenth Grade Science	1	6	Use appropriate technology solutions within a problem solving setting to measure and collect data, interpret data, analyze and/or report data, interact with simulations, conduct research, and present and communicate conclusions.
	2	14	Evaluate environmental factors that affect succession, populations and communities.
Conceptual Biology	1	6	Use appropriate technology solutions within a problem solving setting to measure and collect data, interpret data, analyze and/or report data, interact with simulations, conduct research, and present and communicate conclusions.
		8	Draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, predict the influence of external variances such as potential sources of error, or interpret maps).
	2	22	Predict the effects of human activities on biogeochemical cycles of matter and energy in the biosphere over time (e.g., water quality, air quality, recycling and global warming).
Established Goals for the District of Columbia High Schools - *What standards will this design address?*			
Course Title	**Broad Concept**	**Standard**	
Biology	8	9	Investigate and describe how point and nonpoint source pollution can affect the health of a bay's watershed and wetlands.
Earth Science	5	1	Explain how water flows into and through a watershed (e.g., properly use terms precipitation, aquifers, wells, porosity, permeability, water table, capillary water, and runoff).
Environmental Science	2	1	Understand and explain that human beings are part of Earth's ecosystems, and that human activities can, deliberately or inadvertently, alter ecosystems.
	6	2	Describe the physical characteristics of wetlands and watersheds and explain how water flows into and through a watershed (e.g., precipitation, aquifers, wells, porosity, permeability, water table, capillary water, and runoff).
		6	Investigate and describe how point and nonpoint source pollution can affect the health of a bay's watershed and wetlands.

Stage 1 – Desired Results, continued

Students will understand that:
What are the big ideas? What specific understanding about them is desired? What misunderstandings are predictable?

- A stream site is affected by environmental conditions in its upstream watershed.
- Human land use choices can increase stormwater runoff and impact aquatic ecosystems.

Essential Questions:
What provocative questions will foster inquiry, understanding and transfer of knowledge?

What should we consider to understand impacts on the stream ecosystem at a particular site?

Student will know that…
What key knowledge and skills will students acquire?

- A watershed is all the land that drains to a particular site on a stream, lake, bay or ocean.
- Rainwater that falls on natural areas, like forests, meadows and wetlands, is absorbed into the ground, flows downhill through the ground, and slowly seeps into downhill streams as groundwater. Sometimes, a small amount is not absorbed into the ground and instead flows over the land as stormwater runoff.
- Some or all of the rainwater that falls onto developed and agricultural areas cannot absorb into the ground and instead flows downhill over the ground as stormwater runoff.
- Increasing human population in a region decreases the percentage of natural areas (e.g., forests, wetlands) and increases the amount of developed and agricultural areas, which typically increases stormwater runoff.
- Stormwater runoff picks up sediment and other nonpoint source pollutants as it flows over the land. Runoff spills over the land into streams. Too much runoff can negatively impact stream ecosystems by (1) carrying sediment and other nonpoint source pollutants down to the stream; (2) eroding stream banks; and (3) washing away stream organisms and their habitats. This runoff eventually flows down to large water bodies like the Chesapeake Bay and can harm organisms and destroy habitat there as well.
- GIS can be used to visualize, analyze and create spatial data.

Student will be able to …
What should they eventually be able to do as a result of such knowledge and skills?

- Visually interpret environmental and political maps.
- Describe a watershed.
- Describe how different land uses (forest/wetlands vs. developed/agriculture) affect stormwater runoff and ultimately stream ecosystems.
- Calculate stormwater runoff for a watershed.
- Describe how GIS can be used to study watersheds.

Stage 2 – Assessment Evidence

Performance Tasks
Through what authentic performance task will students demonstrate the desired understanding? By what criteria will performances of understanding by judged?

As a GIS specialist, you will use GIS and digital maps to determine the area that impacts a National Park Service stream site and how this area is impacting the stream ecosystem at your site. It is everyone's interest and responsibility to preserve park resources, so you will also determine what other organizations, agencies and neighbors should work to minimize this impact. Lastly, you will compare runoff impacts on your national park site with another national park site. You will summarize your findings in a final report.

Other Evidence
Through what other evidence will students demonstrate achievement of the desired results (e.g., quizzes, tests, academic prompts, observation, homework, journals)? How will students reflect upon and self-assess their learning?

Reflection Questions

- Explain whether stormwater runoff is part of the water cycle.
- Describe why it is important to consider a watershed to reduce impacts of stormwater runoff.
- Explain how human activities can affect stream ecosystems.
- Explain the advantages of GIS over paper maps and the limitations of GIS.

Stage 3 – Learning Plan	
What learning experiences and instruction will enable students to achieve the desired results? How will the design… **W** – help students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge, interest)? **H** – Hook all students and Hold their interest? **E1** – Equip students, help them Experience the key ideas and Explore the issues? **R** – Provide opportunities to Rethink and Revise their understanding and work? **E2** – Allow students to Evaluate their work and its implications? **T** – Be Tailored (personalized) to the different needs, interests and abilities of learners? **O** – Be Organized to maximize initial and sustained engagement as well as effective learning?	
Lesson 1: What area affects your national park stream site? • Introduce unit goal—to determine how the surrounding landscape might be impacting the national park stream site (sampled during a previous field study) (**W**). • Use FieldScope to find your school or house and examine the surrounding landscape. As a class, identify different surfaces that cover the ground, and discuss what happens to rain or snow that lands on them (**H**). • Use FieldScope to determine the location of your national park stream site, and draw a boundary around the area you predict might positively or negatively impact that site. Then use FieldScope to determine the actual watershed for your national park stream site and compare this to the area you drew (**E1**). • Draw a sketch of your stream network and watershed on paper. Then use FieldScope to determine the direction of flow for each stream in your network (**E1**). • Use FieldScope to determine where two raindrops that fall on any land in your watershed flow (**E2**). • Discuss any errors in the flow paths or in your watershed boundary (**R**).	1 class period
Lesson 2: What are the land cover types in your watershed, and how do they impact stormwater runoff? • Use FieldScope to examine different land covers in your watershed. Discuss which land cover types are most common and any patterns you see (**E1**). • Read about how water can infiltrate into the ground or flow over it as stormwater runoff—depending on the land cover—and flow down to a stream. Then predict which land cover types in your watershed produce more stormwater runoff (**E1**). • Use FieldScope to determine the proportion of your watershed each land cover type occupies (**E1**). Then use the land cover proportions and values for proportion of rain as runoff to estimate current stormwater runoff from your watershed (**E1**). • Examine the proportion as runoff values for each land cover type, and compare these relative proportions to your predictions (**E1**). • Examine the flow path from your national park stream site and other points within the entire Chesapeake Bay watershed to the Bay (**E1**).	1 class period
Lesson 3: Who should help reduce runoff to your site, and how does your site compare to another national park site? • Examine your watershed boundary, the national park boundary and other political boundaries (including roads), and determine who may be responsible for reducing stormwater runoff to your stream site (**E2**). • Examine the land cover in another national park stream site's watershed. Compare this land cover with yours, and determine which watershed will have a bigger problem with stormwater runoff (**E2**). • Examine the national park boundary and other political boundaries (including roads) for the second park site, and think about who may be responsible for reducing some stormwater runoff to it. Then determine which park site watershed will be more difficult to manage in terms of stormwater runoff (**E2**).	1 class period