# **VDOE Sample Science/Cross-Disciplinary Performance Assessment**

## Lesson Topic: Meaningful Watershed Education Experience

## Course: 6th Grade Science

## Content Standards:

Science Content

6.8 The student will investigate and understand that land and water have roles in watershed systems. Key ideas include

1. a watershed is composed of the land that drains into a body of water;
2. Virginia is composed of multiple watershed systems which have specific features;
3. the Chesapeake Bay is an estuary that has many important functions; and
4. natural processes, human activities, and biotic and abiotic factors influence the health of a watershed system.

6.9 The student will investigate and understand that humans impact the environment and individuals can influence public policy decisions related to energy and the environment. Key ideas include

1. natural resources are important to protect and maintain;
2. renewable and nonrenewable resources can be managed;
3. major health and safety issues are associated with air and water quality;
4. major health and safety issues are related to different forms of energy;
5. preventive measures can protect land-use and reduce environmental hazards; and
6. there are cost/benefit tradeoffs in conservation policies.

Science Processes

6.1 The student will demonstrate an understanding of scientific skills and processes by

1. asking questions and defining problems

* ask questions to determine relationships between independent and dependent variables
* develop hypotheses identifying independent and dependent variables
* offer simple solutions to design problems

1. planning and carrying out investigations

* independently and collaboratively plan and conduct observational and experimental investigations; identify variables, constants, and controls where appropriate, including the safe use of chemicals and equipment
* evaluate the accuracy of various methods for collecting data
* make metric measurements using appropriate tools
* use tools and/materials to design and/or build a device to solve a specific problem

1. interpreting, analyzing, and evaluating data
   * organize data sets to reveal patterns that suggest relationships

* construct, analyze, and interpret graphical displays of data
* compare and contrast data collected by different groups and discuss similarities and differences in findings
* use data to evaluate and refine design solutions

1. constructing and critiquing conclusions and explanations

* construct explanations that includes qualitative or quantitative relationships between variables
* construct scientific explanations based on valid and reliable evidence obtained from sources (including the students’ own investigations)
* generate and compare multiple solutions to problems based on how well they meet the criteria and constraints

1. developing and using models

* use scale models to represent and estimate distance
* use, develop, and revise models to predict and explain phenomena
* evaluate limitations of models

1. obtaining, evaluating, and communicating information

* read scientific texts , including those adapted for classroom use, to obtain scientific and/or technical information
* gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication
* construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning

Social Studies/Civics:

CE.1 The student will develop the social studies skills responsible citizenship requires, including the ability to

f) identify a problem, weigh the expected costs and benefits and possible consequences of proposed solutions, and recommend solutions, using a decision-making model;

g) formulate an informed, carefully reasoned position on a community issue;

h) select and defend positions in writing, discussion, and debate.

English:

6.7 The student will write narration, description, exposition, and persuasion.

a) Identify audience and purpose.

c) Organize writing structure to fit mode or topic.

d) Establish a central idea and organization.

g) Select vocabulary and information to enhance the central idea, tone, and voice.

i) Revise sentences for clarity of content including specific vocabulary and information.

## Profile of a Graduate Attributes Addressed:

Collaboration

* Generate question within group/classroom
* Field and Classroom activities

Communication

* Communicate within groups in field and classroom activities
* Written and oral communication of results
* Stewardship project
* Performance assessment prompt

Critical Thinking

* Analysis of data
* Application of data in developing and implementing stewardship project

Creative Thinking

* Generation of question based on observations
* Determination of stewardship project

Civic Responsibility

* Stewardship project

## Driving Question (s)

Why are watersheds important?

How does our area (i.e. school, home, community, etc.) affect the local watershed?

## Intended Learning Outcomes

In groups or as a class, the students will work collaboratively to brainstorm a question concerning their local watershed.

Students will identify data needed to answer their question and use scientific tools and processes to collect data through both classroom and field based activities.

Students will analyze the data and based on the results determine a stewardship project that can be conducted in their school or community.

## Overview:

Meaningful watershed education experiences (MWEEs) are composed of three different components. The first component is instruction and classroom activities aligned to the Virginia Standards of Learning with an emphasis on watershed issues. The second component includes outdoor experiences that emphasize the utilization of scientific tools and processes to collect data in order address a student/classroom derived question about their watershed within the context of their local environment. The third component of the MWEE is a stewardship project designed by students and facilitated by the teacher that allows students to address a local watershed issue.

Performance based assessment plays a role in MWEEs in that they can be used to assess the student in their use of science tools as they complete scientific processes in the field as well as assessing the understanding of the content. Science is an active discipline and through assessing both the processes of science and the understanding of content, teachers can ascertain student mastery of a science *Standard of Learning*.

## Background Information:

A *watershed* is the land that water flows across, under, or through on its way to a stream, river, lake, wetland, or other body of water. Small watersheds encompass small land areas and typically drain into small bodies of water. The runoff from small watersheds characteristically joins together with that from other small watersheds to form a larger watershed. Usually, the larger the body of water, the larger its watershed. Areas of higher elevations, such as ridgelines and divides, separate watersheds.

The Virginia Department of Game and Inland Fisheries defines 12 major watersheds in Virginia. The three major regional watershed systems in Virginia lead either to the Chesapeake Bay, the North Carolina sounds, or the Gulf of Mexico. Sixty percent of Virginia is part of the Chesapeake Bay watershed, which covers 64,000 square miles in six states.

River systems are made up of tributaries of smaller streams that join along their courses. Rivers and streams generally have wide, flat, border areas, called *flood plains,* onto which water spills out at times of high flow. Virginia has 497 subwatersheds, which are made up of small creeks and streams that filter into larger ones before merging into rivers.

Watershed areas are ecosystems which are made up of the living community and the nonliving factors that affect the organisms living in it. The nonliving, physical features of the environment are the abiotic factors, which determine ecosystem type and its distribution of plants and animals. Abiotic factors include water quality, topography, landforms, geology, climate, soil types, amount of sunlight, and air quality or oxygen availability.

One thing that all watersheds have in common is people. Human activity can alter abiotic factors and thus accelerate or decelerate natural processes. Human activity can affect water quality in two ways: by changing the ecological processes that naturally purify water, and by adding pollutants. For example, people can affect the rate of natural erosion one way or the other. Plowing cropland can cause greater erosion, while planting trees can lessen it. Preserving or destroying wetlands is another example because wetlands regulate runoff, reduce erosion, purify water by filtering it, and recharge groundwater. Land-use changes upstream can cause runoff pollution problems for people, plants, and animals downstream that depend on clean, usable water. This form of pollution is called nonpoint-source (NPS) pollution, because the pollution does not come from a single source, such as the discharge from a sewage treatment plant or a factory. NPS pollution is caused mainly by storm-water runoff. When it rains hard, water runs off farmland, city streets, construction sites, lawns, and driveways, carrying sediment, nutrients, pesticides, oil and gasoline, bacteria, and other pollutants with it. One of water’s unique properties is its ability to dissolve a wide variety of compounds. Thus, water-soluble materials easily pollute water, which then carries these harmful substances into our waterways and other bodies of water.

The four primary NPS pollutants are sediment, nutrients, toxic chemicals, and disease-causing pathogens. Sediment is soil carried by rainwater into streams, rivers, and lakes. It reduces light needed by aquatic plants, blocks up waterways, and covers up aquatic habitat. Often the sediment from farmland also carries pesticides and nutrients. Toxic chemicals, such as pesticides, herbicides, and oil and gasoline, can damage and/or kill aquatic animal and plant life. Nutrients, particularly nitrogen and phosphorus, over-enrich bodies of water, causing excessive growth of algae. When algae die, bacteria decompose it, decreasing the water’s dissolved oxygen level in the process. Low oxygen can kill or cause distress to aquatic animals. Algae also cloud the water and block much needed sunlight. Pathogens, which cause disease, enter bodies of water primarily through human or animal waste.

Water-quality monitoring is the collection of water samples in order to analyze chemical and/or biological parameters. Simple parameters include pH, temperature, salinity, dissolved oxygen, turbidity, and the presence of macroinvertebrate organisms. In the past, streams and rivers were often used to dispose of human waste, and open sewers were common. During the mid-1800s, public health officials recognized the connection between disease outbreaks and contamination of public wells and drinking water. Advances in water treatment and sanitary sewers have helped eliminate diseases associated with human waste.

## Classroom/Field Work Activities to Support Instruction

* Conduct a School Yard Report Card.
* Analyze results of the School Yard Report Card.
* Brainstorm questions concerning the local watershed based on results of School Yard Report Card (this can be done in small groups or as a class).
* Identify data needed to answer question.
* Design and conduct an outdoor field experience to collect necessary data.
* Analyze data from outdoor experience: does this data answer the question?
* Brainstorm possible stewardship projects to address the question or issue identified by the group or class (i.e. start a recycling program, plant native plants to help restore an area in the school yard, write a letter to the school board concerning and identified watershed issue on the school grounds, create a public service announcement to educate a defined audience concerning the watershed issue identified by the class).
* Conduct stewardship project. Possible stewardship projects:
  + Watershed Restoration or Protection (e.g., create school yard habitat, planting trees or grasses, invasive species removal, community clean up, storm water management)
  + Civic Action (e.g., town meetings, voting, writing elected officials/decision makers, advocating for policy change)
  + Community Engagement (e.g., presentations, social media, event-organizing, messaging at community events/fairs/festivals, mentoring, public service announcements, flyers, posters)
  + Everyday Choices (e.g., reduce/reuse/recycle/upcycle, composting, energy conservation, water conservation)
* Assess student understanding of the concepts covered in the science 6th grade Standards of Learning concerning watershed science.

## Sample Instructional Plan

| Day 1 | Day 2 | Day 3 | Day 4 |
| --- | --- | --- | --- |
| What is a watershed?  What are the watersheds in Virginia? | Activity:  Conduct school yard report card | Group Discussion: What observations did each group make in completing the schoolyard report card?  Based on the observations, brainstorm environmental issues that may affect the area. Identify a question that can be addressed by the group or the class. | Identify data needed to answer the question (by group or class).  Design an experiment that can be conducted in order to collect the identified data. |
| Day 5 | Day 6 | Day 7 | Day 8 |
| Conduct Experiment (may take several days to complete).  \* Consider using outside agencies (4-H, Dept. Game and Inland Fisheries, Department of Forestry, etc. to help with training students with the use of testing methods and tools. | Analyze data from outdoor and classroom experimentation.  Does this data answer the question? Does additional data need to be collected? | Based on the results of the group/class question, data collected, and the school report card, brainstorm environmental issues that can be addressed as a stewardship/action project. Identify one issue that can be implemented by the group/class using resources within the school. | Complete Stewardship Project (may take several days to complete depending on the nature of the selected project). |

## Investigation

Based on data collected in their school yard report card, students will determine a question that can be addressed through investigation. Each group will determine data that will need to be collected to answer their question, what equipment they will need to collect the data, and write procedures that can be used in the investigation. Upon teacher approval, the investigation will be completed and a final report of the findings will be submitted to the teacher.

## Assessment

Assessment for a MWEE can be composed of several components. A rubric can be used during field experiences to indicate the student has applied a scientific skill or process appropriately, the final stewardship project may take a form that can be used for assessment purposes, and/or a writing prompt may be used to determine individual mastery of the concept. This writing prompt could be used in conjunction with a standard assessment to gain a broader snapshot of student understanding.

## Student Prompt

Based on the discussions in class and data obtained through class field experiences, indicate one issue that affects your local watershed. Describe the issue, specify the impact of the issue on the watershed, and indicate at least two practices that a person, school, or community can be put in place to reduce the negative impact of this issue on the watershed. Include an explanation of how these practices will reduce negative impact on the watershed. Please use science terms when appropriate.

## Rubrics

Common Rubric Categories

* Asking Questions and Defining Problems
* Planning and Carrying Out Investigations
* Interpret, Analyze, and Evaluate Data
* Construction and Critique Conclusions and Explanations
* Obtain, Evaluate, and Communicate Information
* Content

## Prompt Rubric

| Category | Emerging (1) | Developing (2) | Proficient (3) | Advanced (4) |
| --- | --- | --- | --- | --- |
| Content Accuracy | The written response describes and environmental issue or impact that is not relevant to the local watershed. | The written response partially describes an issue impacting the local watershed. No detail or data describing the impact of the issue on the watershed is provided. | The written response accurately describes the environmental issue and the impact of the issue on the local watershed. Supporting data is used sparingly or is not accurately applied to the issue. | The written response accurately describes the environmental issue as well as the impact of the issue on the local watershed. Data from laboratory and classroom experiences is accurately used in describing the environmental issue. |
| Proposed Impacts | Practices to reduce impact of the issue to the watershed are either not provided or are not applicable to the local watershed. | One or two practices to reduce the impact are provided with little or no explanation on how these practices will reduce the negative impact on the local watershed. | Two practices to reduce human impact are explained although some details are missing. The practices are feasible and applicable to the local watershed. | A minimum of two practices to reduce human impact are thoroughly explained and are feasible and applicable to the local watershed. |
| Scientific Writing | Scientific terminology and data is not present in the description of the issue or the impact on the watershed. | Scientific terminology is used sparingly in the description of the issue or the impact on the watershed. | Science terminology and |  |

Watershed Investigation

Experimental Design Template

Based on the data collected in your schoolyard report card, what question does your team want to investigate?

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What is your hypothesis?

If\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Independent Variable:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Dependent Variable:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Constants:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What steps will you take to complete your experiment?  
**You may add more numbers, and you may include a labeled sketch/diagram of your set-up.**

| 1 |  |
| --- | --- |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

Conducting the Experiment

Data Collected:

| Qualitative | Quantitative |
| --- | --- |
|  |  |

Did the data collected answer the group question? Provide evidence using group or class data.

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What other information may be needed to answer the group question?

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Impacting Our Watershed

**Student Prompt**

For many of us, water simply flows from a faucet, and we think little about it beyond this point of contact. We have lost a sense of respect for the wild river, for the complex workings of a wetland, for the intricate web of life that water supports. ~Sandra Postel, *Last Oasis: Facing Water Scarcity*, 2003.

* First, describe what is meant by this quote. Do you agree or disagree? Please use evidence to support your position.
* Second, describe an environmental issue that impacts your local watershed.
* Second, specify the impact of the issue on the watershed.
* Third, indicate at least two practices that a person, school, or community can be put in place to reduce the negative impact of this issue on the watershed. Include an explanation of how these practices will reduce negative impact on the watershed.

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