Topography, Land Use, and Stormwater Chemistry Teacher

Objectives: In this 3-part lesson students will:

- Define the school watershed on a topographic map. (If this is too challenging for your grade, use the Score Four Maryland FieldScope Lesson.)
- Investigate land use and stormwater pollution sources in the watershed.
- Collect and test stormwater runoff.

Background: Nonpoint source pollution is a primary factor in the decline of the Chesapeake Bay ecosystem. Nutrients and sediments cause eutrophication in the Chesapeake Bay and river sections. Eutrophication has resulted in hypoxic areas – dead zones where oxygen levels are so low that most aquatic life cannot survive. Stormwater runoff is the fastest growing source of nutrients, sediments, and other pollutants entering the Chesapeake Bay and her tributaries.

Prior Knowledge: Students should have basic knowledge of the Chesapeake Bay's location and the negative effects of pollutants and human activities on the water quality and biodiversity of streams and the Bay. If needed, use this PowerPoint: Score Four: Watersheds, Landuse, and Sustainable Practices.

Materials Needed (sources listed in lesson descriptions):

Segments 1 & 2 Topography & Land-Use Map investigations

- Topographic map of the school's watershed
- Maps of land use or cover near the school
- Student Handout: How to Read a Topographic Map & Delineate a Watershed

Segment 3 Water Chemistry

- Watersafe Science Project kit (about $40 through multiple on-line sources)
- Student Handout Testing Stormwater Chemistry
- Latex-free disposable gloves
- 1 or 2 timers/team
- 1 dropper/team
- Clean container to collect stormwater
- Scissors (optional)

Grades: 10-12, parts adaptable for lower grades.

Time: 3-part lesson: topographic mapping - 60 minutes; mapping investigations - 15 minutes; stormwater chemistry - 60-90 minutes.

Skills Exercised: Mapping, computer research, water chemistry, critical thinking, engineering design.

Standards Met:

Next Generation Science Standards: Earth Systems HS-ESS2-2, Ecosystems: Interactions, Energy, and Dynamics HS-LS2-7.

Maryland State Law: COMAR 13A.03.02, COMAR 13A.04.17.01

Maryland Environmental Literacy: Standard 1: Environmental Issues Topic A, Standard 5 Humans and Natural Resources: Topics A and B, and Standard 8 Sustainability: Topics A, B, and F.

MD Core Learning Goals: Goal 6 Environmental Science 6.2.2 (this lesson can expand upon), 6.2.3, and 6.4

Lesson Overview

This 3-part lesson provides instructional presentations and 2 student handouts.

Introductory Video and Discussion (5 minutes)

A Prezi presentation introduces each of the lesson parts, as well as a concluding video about a youth restoration project. The presentation was developed for St. Mary's County, Maryland, and thus, uses maps from that county. Teachers may substitute maps of their own areas. http://prezi.com/zovrvoopip7n/score-4-workshop-2015/

A two-minute Chesapeake Bay Foundation video on the Prezi presentation is designed to initiate student discussion of stormwater pollution.

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Teachers: Explain the difference between point and nonpoint source (NPS) pollution and introduce the 3 lesson components. NPS pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. As runoff from rainfall or snowmelt flows over and through the ground, it picks up and carries human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and ground water. In urban areas with vast areas of impermeable surfaces precipitation cannot infiltrate into the ground; the excessive runoff is called stormwater runoff. In the following activities students can determine what types of contaminants might be flowing into local waterways from runoff by investigating their watershed and the land uses in their watershed.

Segment 1: How to Read a Topographic Map and Delineate a Watershed (45-60 minutes)

- Preparation: Download a topographic map of the school's watershed at: http*://nationalmap.gov/ustopo*.
  - In the left hand column, click on "Download Maps (Map Store)." Then use the search bar to find your school. Zoom into the area. To download, click on the location marker to view available maps. Download the most recent map available.
- Provide students with the "How to Read a Topographic Map and Delineate a Watershed" handout. Using the next part of the Prezi presentation, go over the handout to help the students understand what the maps mean and the steps in delineating a watershed.
- Provide pairs of students with copies of the school's topographic map and have them delineate the watershed, following the instructions in the handout.
- Have the class share their results and any problems encountered in the process.
- Compare the delineated watershed to the watershed areas found on:

  http://www.cbf.org/about-the-bay/maps/fieldscope.

Segment 2: Investigate Land Use (45 minutes)

- For schools in Maryland, a land-use map is available at: *http://mdpgis.mdp.state.md.us/landuse/imap/index.html*
- For schools in other states, land-use information may be found online through *Chesapeake Bay FieldScope* or search for land-use maps for your county. Provide copies of the land-use maps to your students or work as a class to examine the maps.

  1. Have the students list the different types of land uses by the largest use to the smallest, using percentages found in the map database.
  2. Students should discuss and list possible contaminants from the different land-use areas. Some examples follow. Segment 3 will enable them to add to their list of contaminants.
     - Agriculture or livestock – fertilizer, pesticides, sediment, animal wastes, hormones.
     - Housing developments and urban areas – car fluids, garden fertilizer, pest control, septic systems, and detergents, to name a few.
     - Impervious surfaces – deicers, exhaust, gasoline, oil, asphalt (PAH).

Segment 3: Testing Stormwater Chemistry (60 to 120, including planning, collection, testing)

Teachers, prior to this lesson, you will need to determine where and how to collect stormwater. It is best to involve your students in the planning. In general, collection of stormwater is best during or immediately after a storm, so that it is collected as it is moving down a storm gulley, out of a storm drain, or into a drain. If this is not possible, water can be collected from stormwater ponds or depressions within 12 hours of the last precipitation. Another possibility is for students to

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devise a simple method for collecting stormwater as it enters an open drain. Students should consider where stormwater flows on the campus and plan to collect from different areas for comparison. Students should wear disposable gloves when collecting samples. Teachers might find the following resource useful for planning collection:
https://fortress.wa.gov/ecy/publications/publications/0210071.pdf

The Watersafe Science Project kit will test water for bacteria, lead/pesticides, nitrates, nitrites, chlorine, hardness, and pH. It is recommended that your students work in groups to test for each property. The bacteria test takes 48 hours, and the containers should be labeled appropriately.

Students will:

1. View the **Prezi presentation, Part 2**.
2. Read the **Score Four Testing Stormwater Chemistry handout**. Predict (or create hypotheses) about the types of contaminants in the campus stormwater runoff on the student handout.
3. Collect and investigate the nonpoint source contaminants found in stormwater runoff, record the results on their handout, and compare the results to their hypotheses.
4. Discuss the results with the class and draw connections between the surrounding land uses. Were the class predictions or hypotheses correct? Why or why not? Is more follow-up research needed? Are there failings of how the test was done?

Concluding Prezi Presentation

View a short video about an Alliance for the Chesapeake Bay youth restoration project to reduce stormwater pollution to inspire students to think about and discuss what they could do at the school or in their communities.

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