

# Proposal for 2015 VACO Award: Fairfax County Department of Public Works and Environmental Services

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## Program Title: SCI - Stream Crime Investigation

**State the problem, challenge or situation faced by the locality and how the program fulfilled the awards criteria (innovation, partnering or collaboration and a model for other localities). Tell how the program was carried out, including financing and staffing, and the program's results.**

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Fairfax County is required by the EPA and the Virginia Department of Environmental Quality through its Municipal Separate Storm Sewer System (MS4) Permit to develop a meaningful outreach program addressing the fundamentals of stormwater and watershed science. Providing outreach that actively engages participants while conveying the necessary information can be challenging. While presentations are useful to disperse information, they do not offer the hands-on experience that can effectively connect with students. In recognition of this problem, SWPD staff has developed an innovative high school lab activity entitled *Stream Crime Investigation (SCI)* that couples the informative nature of presentations with the hands-on experience of lab exercises. The low operating cost of the lab promotes partnering and intergovernmental cooperation between Fairfax's schools and the Department of Public Works and Environmental Services. It provides a new opportunity for teachers to make connections between what they teach in the classroom and its application to a real world science field. The lab engages the students in a novel way while meeting the MS4 Permit requirements and reinforcing better environmental behavior choices.

The program opens with an introductory presentation on stormwater, watersheds, and the need for water quality monitoring. It then transitions into a lab exercise which emulates many aspects of stormwater science.

In the lab exercise, the students assume the role of Stream Crime Investigators, a group of scientists tasked with tracking down the sources of waterborne pollutants in a fictional town. While solving the mystery, students utilize real techniques employed by stormwater ecologists. Participants use a map to identify the community's stormwater drainage network (SDN), test water samples for various pollutants, and track those pollutants through the SDN. Students also use fictional hospital records to diagnose sick residents based on the symptoms of previous patients with waterborne illnesses. The lab program relies

on “kitchen chemistry,” the use of food and benign household materials, to safely emulate the reactions of hazardous chemicals not suitable for classroom use.

A new case is presented to the students at the beginning of the lab in which two residents from a fictional town become sick after swimming in a local pond. The students must uncover what is making the residents sick. Students are given a case file that includes instructions, maps, data sheets, hospital records, and a file of common pollutants identified as “Contaminants of Interest.” The Contaminants of Interest file identifies the three pollutants of concern for the lab: excess nitrogen from over-fertilized lawns, bacteria from domestic animals, and soap from car washes. The file also contains information on the effects of these pollutants on aquatic environments and human health. The students use the community’s hospital records to diagnose the two residents based on the symptoms of previous patients with waterborne illnesses. The illnesses are caused by one of the pollutants from the case file. Participants use the map to identify and trace the path of the community’s SDN and track how pollutants from the land enter the system and are carried to local ponds and streams.



To prevent more illnesses, the students must discover where and how each pollutant is entering the SDN. To do this, they must first learn to identify traces of each pollutant within a water sample. Students are given 50 mL glass vials each with ~10-15 mL of the known solutions. Students run through three tests on a known sample of bacteria, nitrogen, and soap and record any notable reactions. A water control is also run. Again, all tests utilize kitchen chemistry reactions.

After the characteristics and reactions of the known pollutants are documented, students are assigned a section of the map’s SDN and provided a series of “unknown” water samples to test. They compare the characteristics of the unknown manhole samples against known samples to identify the type of pollution present. Starting from the outfall of the pond, the students work upstream through the system using their results and their SDN map to identify where in the network the pollution is originating.

Upon solving the mystery, the students are prompted to suggest solutions for the stormwater run-off issues plaguing the town. While not structured, this open discussion proves to be an invaluable piece of the lab, allowing students to make the connection between actions on the land and effects on nearby streams. Presenters challenge students to come up with ideas and practices to prevent future pollutants from entering waterways. This discussion also highlights the difficulty of changing behavior-based problems, especially when stakeholders may be uninformed of the issues

This lab activity promotes the use of scientific principles to answer real-world problems and emphasizes the importance of changing behaviors to encourage environmental stewardship. The activity can be applied to biology, environmental science, and chemistry labs and adapted to different grades as

needed. It conveys that simple behaviors, like picking up dog waste, following the manufacturer's fertilizer instructions, and being conscious of where vehicles wash water flows, can have a direct impact on improving our local waterways and the Chesapeake Bay. Each person, no matter their age, can help protect and preserve our streams.

### *Cost of the Program*

The cost to run the program is minimal, allowing for effective outreach at numerous venues. Most of the program's funding goes toward the purchase of glass vials for the known and unknown samples which can be washed and reused between sessions. Three sets of 50 vials were purchased for around \$175. The cost of lab consumables (baking soda, lemon juice, red cabbage and vinegar) is approximately \$3 per class; less if there are multiple classes on the same day using the products. Most of these items can be purchased for a cheaper unit price in bulk, although standard retail quantities are more than sufficient to run the lab with multiple classes. There is a minimal cost in printing the data sheets (less than 10¢ per page using a laser printer).

Staff time is the most costly aspect of the lab; though the opportunity to educate students on environmental stewardship far out ways the cost of staff. The lab is prepared ahead of time and takes ~30 minutes to prepare samples for the activity. The activity itself takes 45 minutes to an hour to perform. The program is usually run by two employees but can be run with one if cost saving is necessitated. Most importantly, no cost is incurred by the school system due to the low overhead, making this an effective environmental educational activity suitable for even the most financially constrained organizations.

### *Results of the Program*

Within its first year, the SCI lab has been incorporated into four Fairfax County Public Schools reaching over 296 students. The feedback from the student participants and teachers has been overwhelmingly positive. Follows is a review from a FCPS teacher:

*“Stream Crime Investigation is a wonderful, hands-on, student-centered lab activity that truly helps students develop a sense of stormwater management and the effects of stormwater runoff. The labs brilliance is in its simplicity and the attention to detail taken in its creation. The handouts and learning materials are top-quality, realistic, and engaging to students all while being easy to follow and use. The household chemistry used is easily transferable to any age group and is basic enough for all; however, it demonstrates the exact principals that are being targeted in a way that more advanced learners are not bored with its simplicity.*

*For general 9<sup>th</sup> grade Biology, the lab was used as a culminating activity that helped students solidify content and concepts they were learning. Students had a great time learning and definitely improved on their assessments relative to previous students who were not exposed to the SCI lab. In AP Environmental Science, the lab was used as a thought provoking, inquiry activity to allow these advanced learners to make their own connections through observations and inferences before they started water monitoring in the field on and around campus. The problems solving portion of the activity engaged*

*students into thinking about the entire system and not just the local part of any problem. Students were able to apply these principles in order to make deeper meaning with the collected data from their field study work."*

*Include a short overview of the program (no more than one page double-spaced) that can be used as a quick reference guide for judges.*

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The Stream Crime Investigation (SCI) lab is a hands-on exercise for high school students that emulates the process by which real stormwater scientists identify and track the sources of pollutants in a storm drainage network. Participants use kitchen chemistry reactions to identify the cause of mysterious waterborne illnesses in a fictional town. The activity offers a new service to Fairfax County Public Schools and connects students to a real world application of stormwater science presented by specialists in the field. Students who participate in the lab expand their working knowledge of watershed science, practice scientific thinking skills, and have the opportunity to meet county scientists to explore possible career choices. SCI expands the administration of Fairfax County's stormwater outreach program by conveying the complex nature of stormwater science to a new audience. Lastly, the activity promotes further cooperation between the Fairfax County Public School system and the Department of Public Works and Environmental Services. SCI informs residents of the role that Fairfax County's Stormwater Program plays in protecting the county's natural resources with a unique insight into a practical application of science in their community.

*Include a brief summary of the program (3-4 paragraphs) that could be used for press releases, brochures, etc.*

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Fairfax County Stormwater Planning Division has developed an innovative high school science activity that couples the informative nature of presentations with the hands-on experience of lab exercises. The lab, entitled Stream Crime Investigation (SCI), replicates the analytical process of identifying and tracking pollutants in a storm drainage network. Students use kitchen chemistry reactions which emulate the tests conducted by real stormwater scientists to identify the cause of mysterious illnesses in a fictional town.

The lab was created in response to a requirement put forth by the EPA and the Virginia Department of Environmental Quality through its Municipal Separate Storm Sewer System (MS4) Permit to develop a meaningful outreach program addressing the fundamentals of stormwater and watershed science. While satisfying this requirement with basic presentations is possible, county scientists went a step further and created a hands-on program that could be executed with minimal cost. The program provides a new opportunity for teachers to connect subjects like chemistry, biology, environmental science with real world application.

To date, response to this lab has been overwhelmingly positive from teacher and students, alike. Within its first year, the SCI lab has been incorporated into four Fairfax County Public Schools reaching over 296 students. The low operating cost of the lab has promoted partnering and intergovernmental cooperation between Fairfax County Public Schools and the Fairfax County Department of Public Works and Environmental Services. Fairfax County Stormwater Planning Division anticipates participation will continue to increase during the 2015-2016 school year.