Stormwater Investigations on School Grounds: Supporting Secondary STEM Learning

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Background

How can Kitsap County Public Works Stormwater Division (KC Stormwater) best support secondary school science teachers in providing stormwater education?

KC Stormwater has developed a robust elementary school program, providing in-class lessons and field trip opportunities. However, there was low involvement from secondary school teachers (grades 7-12). Unlike elementary school teachers (grades K-6), secondary science teachers are very comfortable teaching science—they needed something more.

Secondary School Program Needs:
• Incorporate field investigations to meet new science education standards
• Opportunities for students to develop solutions to real world problems

KC Stormwater Division Needs:
• Educate citizens about stormwater impacts and issues to improve water quality and meet NOAEP stormwater permit requirements
• Ensure educational opportunities offered to local schools support existing educational standards

Developing a Field-Based Investigations Program

Goal:
To provide effective secondary school education that meets the needs of both KC Stormwater and secondary schools.

Objectives:
• Develop and implement three stormwater focused field investigation projects
• Evaluate the cost, gain in knowledge and behavior change
• Refine the approach, if needed, after the initial three years

The Approach:
• Teachers are offered an opportunity to select a stormwater investigation project. They will receive guidance, mentorship and resources from KC Stormwater.
• Students actively participate to investigate an issue, develop research questions, collect samples, analyze data, and develop conclusions based on their data and observations.
• Pilot three unique projects in 2013, 2014 and 2015. Evaluation is performed each year and the overall program will be evaluated in 2016.

• 2013 – Copper in Stormwater Runoff from the School Parking Lots
• 2014 – Copper and zinc from roof runoff by the Rain Garden in a Box
• 2015 – Storm Insect Abundance and Diversity Related to Cobble Size (Tentative)

Upon completion of the pilot and evaluation, each project becomes available to secondary school teachers in KC Stormwater’s service area. Student project knowledge is used to provide support to their findings at a regional youth summit and pursue a stewardship activity or course of corrective action based upon their findings. Assistance throughout the project is provided from KC Stormwater, local stream steward volunteers, and Washington Department of Ecology’s Manchester Environmental Lab (Manchester Lab).

Stormwater Field Investigation Projects

Project 1: Copper in Parking Lot Runoff

Project Description
Copper pollution in stormwater runoff can negatively impact salmonids. Copper enters stormwater runoff from various sources including rooftops, brake pads and vehicle fluids (gasoline, oil). Students conduct research to learn about potential contaminants in parking lot runoff, the issues associated with those contaminants, and impacts to aquatic life. Students generate their own research questions and collect samples from parking lots and analyze their data to answer those questions. They also determine whether their parking lot runoff meets or exceeds state standards for copper and ways to address the issue if standards are exceeded.

Project Results
Students are excited and engaged when finding identify issues that they can then follow up on. For example, in 2013, Klahowya students found elevated levels at one station and were able to provide BMP recommendations to reduce or eliminate the source of copper.

Sharing Project Results
Students presented their findings at the 2013 West Sound GreenSTEM Youth Summit.

Project 2: Rain Garden In A Box

Project Description
Rain Gardens in a Box are being considered as one option to remove copper and zinc from rooftop runoff. Students will conduct research to learn about potential contaminant in roof runoff, the issues associated with those contaminants, and management techniques to address those contaminants. Students will collect samples and analyze results to determine the effectiveness of one management technique, a Rain Garden in a Box.

The pilot school decided the Technology class would construct the stormwater investigation, lying in additional STEM-type classes.

Project Results
Project currently in progress

Sharing Project Results
It is anticipated that students will present their findings to KC Stormwater staff and school district staff.

WHAT IS STEM?
STEM (Science, Technology, Engineering, and Math) is one of the essential academic learning requirements.

Identifying Challenges and Solutions

Challenge
• Projects need to support state education standards.
• Teaching time is limited.
• Transportation funding and availability is limited.
• Funding for lab analysis and equipment is limited.
• Mentoring is needed to support student learning.

Solution
• Projects support existing state education standards by providing field-based investigation opportunities.
• Projects support on school grounds - no transportation.
• Equipment and lab funding and resources are provided by KC Stormwater and Manchester lab.
• Students are engaged in real-world learning opportunities with guidance from professionals.
• Each project addresses the school district’s NPSDES Stormwater Permit requirements and provides data to school district staff.

Project Partners
Kitsap County Stormwater Division will
• Provide technical assistance for sampling and data interpretation
• Provide standard protocols and assist in developing a sampling plan
• Assist with sampling days
• Coordinate with lab and provide sampling equipment, maps, and forms
• Provide funding up to $1,000 for student analysis per classroom

Funding, Agency Staff Support and Training
• KC Stormwater provides in-kind support (lab staff time (one educator and field technician) and equipment.
• Staff help dedicated at approximately 25-30 hours per project. Staff usually spend 3-4 class periods with students over the course of the project.
• Training for teachers is provided by Manchester Lab and KC Stormwater for up to $1,000 per classroom.

Evaluation Components
• Students knowledge is assessed before and after each project regarding Puget Sound, stormwater, and the fate of stormwater runoff on the school property.
• Feedback from students and teachers is collected at the end of each year to adapt the project for future years.
• Data collected by students is reviewed by KC Stormwater monitoring staff and shared with school district staff as appropriate.
• Evaluate the cost, gain in knowledge and behavior change

Project Outcomes
KC Stormwater’s new stormwater education program targeted for secondary (7-12th grade) classrooms is a more effective way to engage secondary teachers than the traditional in-class lessons and field trips which has worked well with elementary (K-6th grade) students. Teachers are seeking opportunities to meet their new science learning requirements and provide students with a range of authentic and relevant projects that incorporate STEM and project-based experiences. KC Stormwater has the ability to fund these classroom projects and has the resources to support them. By providing teachers with the resources to learn about stormwater education for secondary classrooms and listen to teachers on how best to overcome the challenges that were preventing them from participating.

This program has shown that stormwater issues provide an ideal way to teach STEM concepts—using science and math to define a problem or issue and utilizing technology and engineering to design a solution. Doing a purposeful project-based learning that leads to results that students can showcase and take pride in is more motivating for students and provides for more student engagement. These real world learning opportunities also provide exposure for careers in the natural resources field.

KC Stormwater plans to continue to offer and evaluate this suite of stormwater investigation projects to local secondary classrooms and improve the program based on feedback from participants.

What teachers are saying...
"The exciting thing about the project is that my students get to work with professionals who share the excitement of seeing students learn; that they get to think creatively about experimental set-up, and develop their sense of the environmental issues which directly affect them!" - AF Environmental Science Teacher
"This is my first year teaching, and I feel fortunate to have this great opportunity for students to put into practice the science they have learned" - AF Chemistry Teacher

Evaluation Results:
In 2013 student evaluations demonstrated a 60% increase in students’ understanding of stormwater issues in Puget Sound before and after the project.

Supporting Groups/Agencies:
• Kitsap County Public Works – Stormwater Division
• Kitsap County Extension Stream Stewardship Program
• Kitsap County Public Works – Stormwater Division
• Kitsap County Stormwater Division

Participating Schools:
• Katherine Secondary School
• Viking High School – AF Environmental Science class
• Central Kitsap Junior High School – AF Environmental Science and Technology class

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