**Watershed Monitoring Network Background**

Over the past 16 years, the Vancouver Water Resources Education Center with funding from the City of Vancouver and Clark County, have brought more than 35,000 students to nearby streams, lakes or bioswales to collect watershed data in 12 of the 16 major watersheds in Clark County, Washington. Data collection has focused on physical water quality parameters, macroinvertebrates and fecal coliform.

Annually, between 2500 to 3000 students, grades 1 through 12 participate in this program which includes not only field monitoring but an annual "Congress" at which students present their findings to the broader community of professionals and other citizens. Participating teachers, usually about 50, are invited to a training in early Fall that informs new teachers and provides additional professional development on watershed issues to returning teachers.

**Program Expansion with Washington Department of Ecology (GROSS) grant**

Ecology funding allowed staff to expand student investigations beyond water quality and macroinvertebrates. Eight new investigations were developed: 4 soil, 2 plant, 1 photo point monitoring and an expanded initial site survey. These and the existing water quality investigations were aligned to Common Core standards in use in upper elementary and middle schools and to new Next Generation Science Standards (NGGS) adopted in 2013 by the State of Washington.

Additional program components were three Family Watershed Festivals that were designed to attract the families of monitoring students and the community.

**Evaluation of Investigations**

**Project Goals**

Staff documented metrics of success for the newly implemented Investigations based on the following goals.:

> **Goal 1:** To add plant and soil student monitoring investigations to water investigations of streams, rivers, wetlands and bioswales in Clark County. These and existing investigations will be aligned to state standards.
>
> **Goal 2:** To take students from diverse schools outdoors to a water body and lead them in monitoring land and water to increase understanding of their watershed and natural neighborhood.
>
> **Goal 3:** By developing investigations that explore soil and water, students will begin to understand that what happens on the land impacts water quality in the watershed.
>
> **Goal 4:** To help students make the connection between rain water and stormwater; to suggest ways that student and family activities impact water quality.
>
> **Goal 5:** To inform and train teachers to understand the significance of land monitoring to water quality.

**Goal 6:** To encourage students and teachers in identifying ways to improve the habitat and water quality at their monitoring site.

## Goal 1: New soil and plant investigations; alignment to state standards

**Program Components:**

New (soil, plant, photo point monitoring) investigations
Water quality investigations (redesigned to fit newly developed format)
Alignment of investigations to Common Core and NGGS standards for grades 4-5 and 6-8

### New Investigations

Eight new land and plant investigations were developed:

- Initial Site Assessment and Observations
- Soil Cores: Color, Texture & Moisture
- Soil pH, Temperature and Moisture
- Erosion Sources and Soil Compaction
- Soil Permeability
- Riparian Zone Vegetation Survey
- Riparian Zone Tree Survey
- Photo point monitoring.

### Water Quality Investigations

- Temperature, pH and dissolved oxygen
- Nitrates and phosphates
- Turbidity and stream measurements.

### Alignment to Washington State Standards

The majority of students participating in the Watershed Monitoring Network are in grades 4 through 8. Of the 102 classes monitoring in the 2014-15 school year, 10 do not fall in the grades 4 through 8 range. Therefore, the investigations were written targeting grades 4 through 8 with the suggestion that teachers can pick and choose what level works for their particular grade level/classes. Most investigations can also be easily used with general high school science classes.

Existing essential academic learning requirements (EALRS) and grade level expectations (GLEs) currently are tied to assessment in different grades for different content areas. The Common Core standards have just been fully implemented in the 2014-2015 school year and assess reading, writing and math in grades 4 and 7 and high school. Other assessments, such as the EOC (End of Course) for high school mathematics and biology is only done in grade 10.

The investigations developed by the Watershed Monitoring Network team are aligned in two separate documents: Grades 4-5 and grades 6-8. Each investigation was aligned with current Washington State K-12 learning standards, with math and language arts (ELA) Common Core and with the adopted but not yet implemented Next Generation Science Standards (NGSS). Please note: The Washington State 2009 K-12 Science Learning Standards are being phased out as the State transitions to the newly adopted

Washington State 2013 K-12 Science Learning Standards (Next Generation Science Standards). The new standards describe what students should know and be able to do at each grade level.

**Goal 2: Include diverse schools/students**

About 2600 Clark County students, grades 1 through 12, representing 102 classes from 23 schools participated in the 2014-2015 Watershed Monitoring Network. Schools are located in both urban and rural areas and in Vancouver, the largest city in Clark County and smaller cities like Camas and La Center.

An average of thirty-five percent of students in Network schools participate in the free and reduced lunch program which often is a measure of different levels of diversity in schools. In the two largest school districts, Vancouver and Evergreen, an average of 50% of students participate in the free and reduced lunch program. In most of the other districts, participation in this lunch program is about 30%.

Multiple languages are spoken as first languages in many classrooms. Many participating students fall on the autism spectrum, have physical disabilities and learning challenges. One fifth grade student in a wheel chair does not have much interaction in the classroom with other students. But outside at the testing site, she is the premier macroinvertebrate expert: other students take their bugs to her and she identifies them by whispering their names to her aide who communicates it to the group.

**Goals 2, 3, 4: Understanding stormwater and impacts**

Evaluation components:

- Pre and post surveys
- Anecdotes

**Pre and post surveys**

About three hundred students were given a survey assessing their understand of stormwater before they started the Watershed Monitoring Program and after they had been monitoring in the field. Two of the schools were urban and two were rural. Since many schools have participated in the Monitoring Network over many school years, we selected classes for this survey that are either new to the Network or have probably not participated in monitoring in previous school years.

*Survey hint:* In some districts, permission needs to be obtained from the administration to allow a non-school district education provider to survey students. Therefore, be prepared by sending the survey early to the teacher and administration.

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|---|---|---|---|
| Roosevelt Elementary: | urban | Grade 5 | 82% free and reduced lunch |
| Ogden Middle School: | urban | Grades 6-7 | 80% free and reduced lunch |
| Maple Grove Elementary: | rural | Grade 6 | 52% free and reduced lunch |
| Amboy Middle School: | rural | Grade 8 | 52% free and reduce lunch |

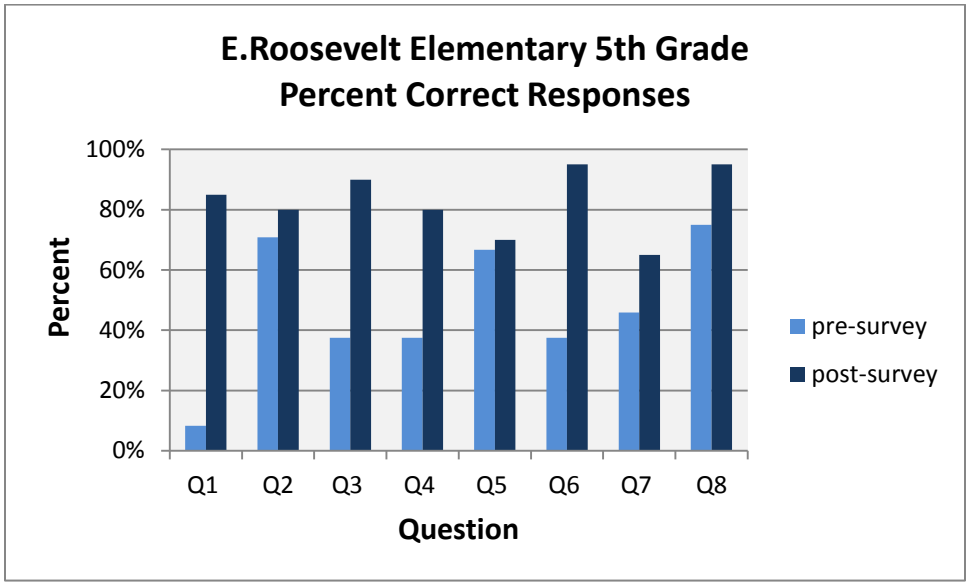
The graphs and analyses below show percent correct response before field monitoring began and again in February, half way through the monitoring season. There appears to be different understanding of what a watershed is in the rural communities. Before monitoring, a higher percent of students answered Question 2 correctly (When rain falls on trees and grass, where does it go?) than after monitoring. After the concept of watershed was introduced, students then saw water as going to the lowest point but not necessary sinking into the ground.

We hypothesize that because many students' homes are on septic systems and that storm drains are open and not piped students understand more about where rainwater goes. After we teach the concept of watersheds, these same students change their thinking about where rain water goes. In a watershed, they think it goes to the lowest point (which of course it does) but they now are not as clear about where rainwater goes.

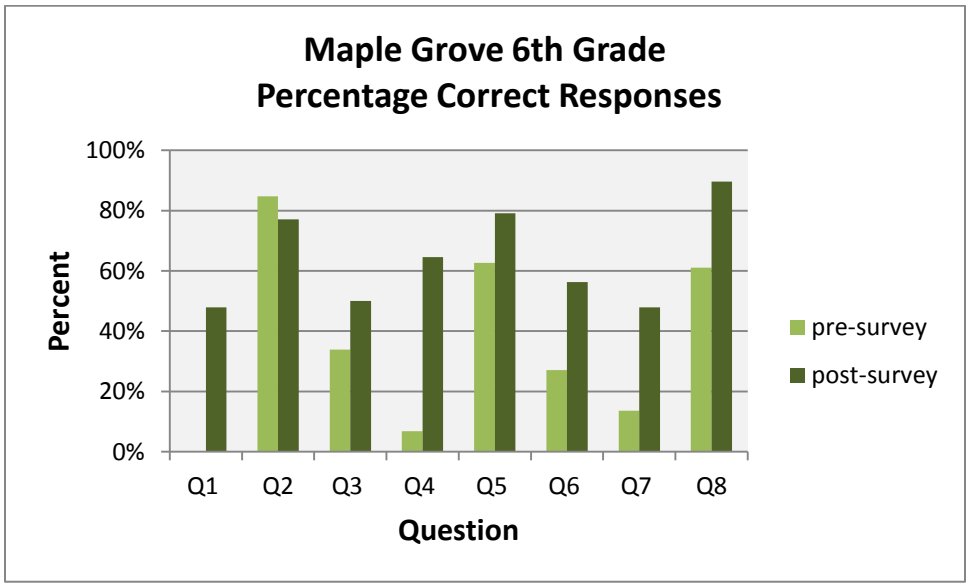
**Pre-and Post-Survey Questions**

Question 1: What is a watershed?
Question 2: When rain falls on trees and grass, where does it go?
Question 3: When rain falls on roofs, streets and parking lots, where does it go?
Question 4: What is stormwater? How does it affect the health of a river, stream or lake?
Question 5: What happens to the water that goes down the toilet or sinks in our house-where does it go?
Question 6: How does dog poop or bug spray put on your lawn end up in the stream?
Question 7: What role do the soil and plants near a stream play in protecting the health of our rivers, lakes and streams?
Question 8: Name three things you and your family can do to keep stormwater and our streams clean.

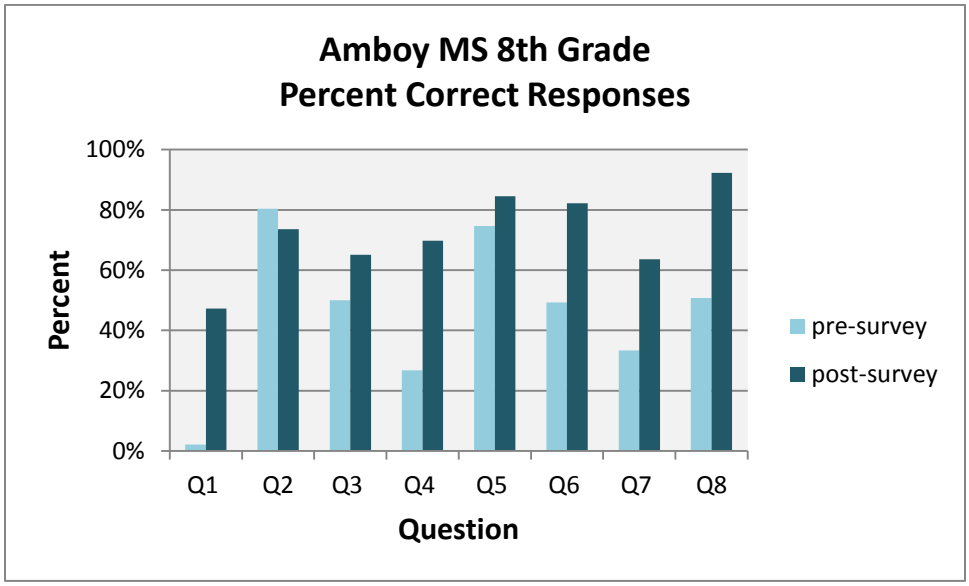
Post survey only
Question 9: Did going down to the stream or pond help you understand more about keeping streams and ponds healthy for fish and people?




- Students showed an increase in correct responses to all questions.
- The greatest increase was in their understanding of the term "watershed" (Question 1).
- Significant increases occurred with Questions 3, 4, and 6, all relating to stormwater and runoff.
- 90% of students indicated that going down to the stream helped them to understand more about keeping streams healthy for fish and people.




- Students showed an increase in correct responses to all but one question.
- Question 2 - Most students already understood that rain on natural areas soaks into the ground. When presented with the concept of a watershed, some students focused on the water moving to the lowest point or ocean and not how it got there (ground versus drains).
- Significant increase in correct responses occurred with Question 4 regarding stormwater. Their monitoring site is really a very large retention pond and physically visiting the site helped the students to visualize the impacts of runoff.
- 85% of students indicated that going down to the stream helped them to understand more about keeping streams healthy for fish and people.

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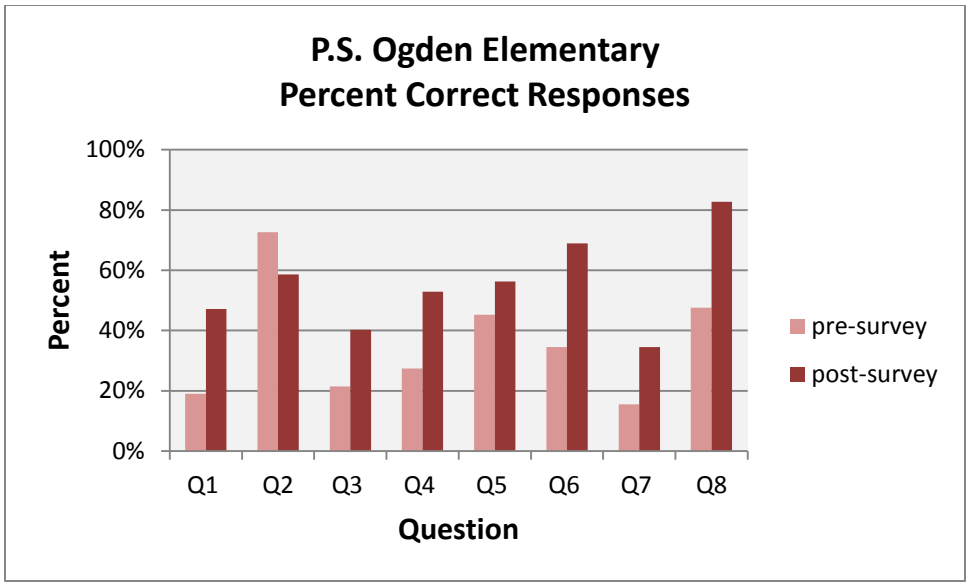


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**Staff observations and anecdotes:**

Comments made by students about going down to their monitoring site told us many were "getting" the message about stream health. The variety of responses told us that student responses were not just rote but that they thought through how they and their families could take care of a stream.

Here are some highlights:

- Many students observed wildlife and macroinvertebrates at their site and this was highly motivating to them to keep their stream/waterbody clean. "…now I know a few of the macroinvertebrates that live there and that we need to protect them."
- "What most caught my attention was how our creek doesn't have many sensitive macros which is something we need so we can secure the health for our creek. I would love to learn how I could contribute to the community."
- Students commented on various changes on their site through different seasons.

Comments made by students about what they can do to keep stormwater and streams clean

- Rural students advised to not use bug spray and lots of chemicals. They also advised to not cut trees and to plant more.
- Urban students focused more on litter. Students who monitored school bioswales took great pride in keeping them clean.
- Other ways students advised to take care of their streams were to pick up dog poop and other animal waste, to check for oil leaks and to wash cars at the car wash.

**Goal 5: Teacher training for land investigations**

Evaluation components

Annual teacher training ("Kickoff")
On site teacher training
Introductory sections in investigations
Teacher evaluations from Congress

**Annual Teacher Training (Kickoff)**

Twenty teachers and 4 partners attended the October 2, 2014 Watershed Monitoring Network teacher "Kickoff." The primary focus for this year was the new investigations which were available in close to final draft form. After introducing the Department of Ecology grant, we informed the group about project funding available for stormwater improvements at their schools or monitoring sites. We allowed time for teachers and partners to try out the activities and give us feedback. Teachers answered the following questions:

1. Did the directions (in the investigations) make sense and did the equipment work.
2. Do you think your students can do the investigations?
3. Does this new investigation fit what you teach?
4. Is there another teacher in your building that might be interested in monitoring since we have added soil and plant investigations?
5. How might this investigation be used with your class?
6. Examples: Split the class and have one group do soil and another group do water each time you go out? …Or focus on water testing one monitoring trip and focus on soil and/or plants the next time?...or something else?

In general, teachers thought the step by step procedures worked well. Some suggestions were to number and mark the trees in the tree survey and to change or offer both metric and English for units. We also identified a need to offer a procedure for measuring DBH for multi-stemmed trees since many willows and other similar trees grow in the riparian areas.

**Teacher training about the rationale for adding land and plant investigations**

We used the first section of each investigation to make the connection between stormwater and the parameter being monitored. Each begins with: How is water quality impacted by…soil erosion, soil texture, etc. After reviewing many soil and plant investigations developed by others, we did not see a strong connection made in the curriculum between various soil and plant investigations and how it impacted streams, water bodies and storm water. Therefore, we made this connection prominent in the investigations and used this information as a teacher training tool.

**At Kickoff: Teachers suggested inquiry studies for new investigations**
Teacher comments showed us that they had internalized many of the new investigations in order to come up with testable questions:

- How does distance away from the stream affect diversity of plant life, pH, moisture, compaction, permeability, type of soil?
- How does erosion affect water quality?
- How does diversity of plants affect macros? How does canopy cover affect number, type, diversity of macros?
- How does canopy cover affect all?
- How does human activity affect plant growth?
- How does slope/soil type affect turbidity after rain?
- What impact does surrounding land use have on plant diversity?

**In the field at monitoring sites: Teacher training**
For teachers that did not attend Kickoff, our team trained teachers in the new Investigations with students at the monitoring sites.

**End of 2013-2014 school year teachers' evaluations**
At Watershed Congress on May 23, 2014, we asked teachers to evaluate both Congress and the program as a whole. Teacher comments are overwhelmingly positive and inspiring. Below are highlights about monitoring with students.

**What benefit is Watershed Monitoring for your students?**
Comments made tell us that students see ways they can positively impact their communities. Teachers see student growth in responsibility and do the program year after year because it allows their students the opportunity to do "real" science. This is a comment that we hear over and over.

- From a teacher new to monitoring: "I am thoroughly impressed by the science these students are taking part in, the higher level analysis they are engaging in and the raised awareness as citizens of the importance of maintaining higher water quality through conscious acts in the environment."

- "Connection to the local environment and knowledge of how everyday habits affect the environment."
- "Students become increasingly comfortable and protective of their monitoring site. Some are very hesitant at first because it is a new environment for them. There is a salmon redd at one of the Brezee Creek sites and students warn each other not to step on it." At other sites, students remind each other to stay on the trail, don't feed the ducks and pick up dropped pencils or trash from their pockets.
- "My students do real hands-on science and feel empowered to make change in the world."
- "Learned about nature and protecting it and how water quality connects to other areas."
- "Familiarization with our pond-next- door connection!"
- "Learning to be an expert and that they make a difference."
- "Environmental awareness and responsibility."
- "The opportunity to do real science."
- "The best part is walking to the creek and watching my students "light up" when they made discoveries."
- "The best part is getting the students outside and excited about science and the environment."

**What benefit is Watershed Monitoring to you?**
The Watershed Monitoring Network also helps teachers meet various district requirements and connections with the community

- "Being part of real-world science with my students."
- For the new teacher evaluation system"…helps meet participation in a professional community and relationship with the community agency."
- "Great connection and relationship with the City of Battle Ground."

Overall evaluation of developing and implementing new investigations
What worked?

1. ***Spending a lengthy amount of time researching tools and equipment is essential.*** I have researched and observed field investigations done in other programs for some of the same activities we chose many times in the past. Often either the equipment didn't work, was too difficult or esoteric to use or wasn't appropriate to use with students.
   We chose equipment based not only on cost but durability, ease of use and value in introducing students to some technology. We try to limit "black box" equipment that just gives a readout without more involved engagement.
   Sometimes we will collect data on the same parameter in a couple of different ways. For soil moisture, we offered a revised moisture test used in agriculture that is a qualitative way to describe a soil sample by hand squeezing. We also offered a moisture meter that allowed students to have experience with this simple technology.
2. ***Supporting teachers in a variety of ways***. Our 3 person team spends a lot of time answering questions, reminding teachers of deadlines, interfacing with school district transportation offices and being the liaison with other community resources. This is all time well spent and we feel this, along with the quality of the program, is why so many teachers continue to do monitoring year after year. Over the years, I have heard other program coordinators lament about the need to "hold teachers' hands," meaning sending out reminders or working behind the scenes to make district requirements like transportation easier. We understand that

teachers are swamped and cannot be expected to remember everything. We are so happy to "hold their hands" if that ensures that they return with next year's students.

3. ***Partnerships with City of Battle Ground and Clark County.*** Although we have partnered with Clark County as a funding source in the past, having technical input from stormwater staff in Vancouver, Battle Ground and Clark County in reviewing the investigations was a plus and improved the investigations.
4. **Working with contractors.** The Watershed Monitoring Network has had the benefit of staff and contractor continuity for many years. The Water Center staff team member and the lead field contractor have been working together for over 10 years. Additional contract educators are selected based on their abilities, education philosophy and how they fit into the team.

**Ways to improve**

1. The grant work window was tight and did not span a complete school year with the same teachers and students. We delivered programs from October to June of 2013-2014 school year and from September 2014 through February 2015 of the 2014-2015 school year. Therefore, we could not assess student learning in a complete school year since we had already started delivering programs by October 2013 and this school year ends in June 2015. The 2015 Watershed Congress will be the first reporting back by students since the new investigations have been implemented. We won't know until June 2015, how many classes developed soil and/or plant inquiries in addition to water testing and macroinvertebrates which classes have traditionally done.
2. Looking for ways to ease many teachers into the new investigations is a good idea. Teachers love to get the kids out monitoring water quality since that is what they know at this point after many years. About half of the teachers were willing to try soil and plant investigations fairly quickly. The other half were eased into these investigations gradually or will be by the end of the school year.
3. Preparing the students for the soil Investigations in the classroom. Unfortunately, our budget cannot pay for additional contractor time to do activities in the classroom with the exception of the introduction to watersheds that we do before field monitoring begins. And many teachers don't have the time or expertise to do classroom soil and other activities. There are many excellent classroom activities in curricula like Project Wet, Project Wild, Project Learning Tree and the Wonders of Wetlands if teachers did have the time.