Building a Bioswale

Albany Options School,OR

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Project Synopsis

Kelly Muller's Ecology class at Albany Options, an alternative high school, set out to solve the problem of a persistent muddy and wet area on their campus. After researching the situation, they decided to create a bioswale to increase the infiltration rate of rainwater, improve the quality of runoff water, and restore wildlife habitat. Without excavation equipment, they removed sod and dug the bioswale by hand but were unable to install gravel, sand and topsoil at the bottom to increase drainage. After creating a berm around the swale to increase its capacity to hold rainwater, the class planted the sides and bottom of the swale with native plants that are tolerant of wet conditions, effective in filtering pollutants, and attractive to native wildlife.

Adapting the Project for Replication

In adapting this project for other sites, it is important to identify local soils to determine whether a bioswale or a rain garden is indicated. (Bioswales require excavation and replacement of clay soils at the bottom of the swale with gravel, sand and topsoil. Rain gardens are located in areas with soils that drain well and do not require excavation and soil amending). The project Kelly Muller's class completed is essentially a rain garden, despite the diligence of students in digging it deeper in the style of a bioswale. The class discovered that soils in the area do not drain well and that their rain garden would have functioned better if they had been able to excavate and amend the soil.

Correlation to NGSS

5-ESS2-1
5-ESS2-2
MS-ESS2-4
HS-ESS2-5

Supplies and Equipment

(per student)

- Rain boots
- Gloves
- Shovels, trowels, and planting tools

(for class)

- Soil test kits (or soil sample bag to send to state extension service for analysis)
- Earth-moving equipment to dig swale deeper
- Gravel, sand and topsoil to bury at bottom of swale
- Native Plants (see lists) that can tolerate wet conditions and absorb pollutants

Project Partners

Captain Planet Foundation
Albany Options School
Pacific Northwest Clean Water Association
Native Grounds Nursery
OSU Extension 4-H
City of Albany Public Works
Eagle Scout candidate
Oregon Green Schools
Ashley Philips

Bioswale Restoration LITE

Planting a rain garden requires no excavation and can take advantage of existing low lying areas, ditches or swales. (Note: Please take care not to destroy existing creekside vegetation to plant new plants, as the loss of roots will contribute to erosion). Other projects to consider include building rain barrels or green infrastructure including low-lying below grade planter beds, tree planting, roof gardens, and paths and parking lots with permeable surfaces.

Procedures

Project Planning

1. Identify native plant species that tolerate wet conditions and pollutants
2. Test soils, drainage and infiltration rate to determine whether bioswale (with excavation) or rain garden needed
3. Calculate potential rainwater harvest volume from site, using SamSam free app

Preparation for Bioswale Project (contractor may be needed)

1. Remove any sod or plants from bioswale area (and re-use elsewhere, if desired)
2. Dig bottom of swale deeper and add gravel, sand and top soil, if needed to promote drainage (clay soils) *Note: Rain gardens are shallower bioswales, where drainage is good without excavating and replacing soils*
3. Obtain appropriate native plants of grow from seed

Conducting the Project

1. Build berms with soil removed from bottom of swale
2. Plant native species on slopes and in bottom of bioswale
3. Collect data on plant viability, changes in water quality and infiltration rate before and after bioswale built and planted

Understanding Hydrologic Cycle Issues (additional activities aligned to NGSS)

1. Research the amounts and percentages of fresh water various reservoirs around the world (lakes, rivers, glaciers, ground water and polar ice caps) and graph the results to show the distribution of fresh water on earth. (NGSS 5-ESS2-2)
2. Repeat the research and graphing activity above for all water (fresh and salt) and compare the differences. (NGSS 5-ESS2-2)
3. Create a working groundwater/aquifer/surface water model to use as a prop while describing how the geosphere, biosphere, hydrosphere, and atmosphere interact, as water moves and changes phases. (NGSS 5-ESS2-1; MS-ESS2-4)
4. Plan and conduct an investigation that explores the effects of earth materials and surface processes on water, by comparing the quality of water as it leaves the rain garden or bioswale to the quality of runoff water that is not similarly filtered. (HS-ESS2-5)

Debriefing

Key understandings that students should have at the end of the project: When it rains, some stormwater infiltrates (soaks into the ground) and becomes groundwater, which is below ground in tiny spaces between particles of rock or soil and in larger underground holes (aquifers). Rain that lands on natural landscapes with plants and trees has a chance to soak in, but rain that lands on roofs and paved surfaces does not. When the

This American Land

This American Land is an original conservation newsmagazine series on public television stations nationwide. Opening windows to our country's amazing natural heritage, the show reports engaging stories on America's landscapes, water, and wildlife, taking viewers to the front line of conservation, science and outdoor adventure with stories that inform and entertain.

This American Land is produced by Environmental New Trust (ENT), a non-profit news venture which has produced and distributed hundreds of environmental news stories for an international broadcast and Internet audience since 2004.

ground is saturated and no more water can soak in, the remaining water flows over land, carrying with it all the contaminants, pollutants, fertilizers, weed-killers, and trash on the ground. It is important to note that one does not have to throw trash or pollutants directly into water for it to end up in the water, because of run-off. All that run-off water heads downhill, where it collects in ditches, streams, lakes, or rivers and flows on towards the nearest ocean, where all water eventually goes - unless it is frozen or trapped in a lake or reservoir with no outlet, evaporated into the atmosphere, drunk by animals (and eventually excreted as urine) or absorbed by plant roots (and eventually transpired into the atmosphere). This movement of water from one place to another and from one phase (ice, water or vapor) to another is called the hydrological (water) cycle.

People used to think the best way to deal with rainwater was to move it out of the area as quickly as possible, using pipes, ditches, paving, and culverts. But fast-flowing stormwater can cause flooding downstream, if there is not enough opportunity for some of the rain to soak into the ground. And run-off water picks up pollutants on the ground, carrying them downstream too. One way for stormwater to have a chance to soak into the ground is to slow it down by creating or taking advantage of existing depressions or low lying areas where plant roots and soils act like a sponge. Roots and soil can also accumulate (filter) pollutants from the water. (Soil and rock bits catch particles of pollutions while water flows through, and roots absorb pollutants into plants). Different types of plants have different abilities to absorb and tolerate specific pollutants. So creating a rain garden or bioswale in a low area and planting plants that can survive wet conditions and absorb pollutants, will slow down storm water, give it a chance to soak into soil and roots, and filter out pollutants. Both rain gardens and bioswales serve the same purpose. A bioswale may be necessary where clay soils or rock formations limit the amount of runoff water that can soak into the ground, necessitating earth moving equipment to dig deep enough to add rocks, sand and topsoil to the bottom for better drainage, before planting plants.

Extensions

The Groundwater Foundation offers several high-quality, hands-on activities for students, including two Science Olympiad events that are fun and informative even if the school is not competing in SO. Awesome Aquifers engages children in building small working models of aquifers, and Hydrogeology enables students to use computers to model stormwater drainage.

The Groundwater Foundation's Get Involved web page can help students identify actions to take to protect groundwater, such as having their school yards certified as Groundwater Guardian Green Sites, stenciling storm drains to increase public awareness that what is dumped down the drain goes to the river, recycling and reducing trash to improve water quality, etc.

Plastic pollution finds its way to the ocean by way of run-off, and harms sealife. The short and powerful film Midway shows how plastics harm birds. The Plastics Pollution Coalition is an organization that provides information and ideas for action. Think Beyond Plastic is a competition for designing alternatives to disposable plastics in everyday life. Of course plastics are only one thing that pollutes water, and students could find many other types of non-point source pollution, as well as point source pollution, to research and take action against.

Environmental Stewardship and Citizen Science

Environmental stewardship projects, such as native fish restoration, are empowering because they offer students a chance to make a difference by solving real-world problems. This is especially important because research has shown that learning about environmental science in the absence of such opportunities to act, can be overwhelming and affect adult attitudes and behaviors. Stewardship projects also cultivate collaboration, communication and other skills that contribute to employability in STEM fields.

Technology Integration

Students can use free SamSamWater apps including the Rainwater Harvesting Tool, Climate Tool and Google Earth Layers to do site specific planning for a rain garden or rain harvesting project. Although these tools were intended to design reservoirs where water would be permanently stored, they can also be useful in planning bioswales where water is not intended to stand long.

Links

Rainwater Harvesting Tool App by SamSamWater
http://www.samsamwater.com/rain/

Other SamSamWater App Tools
http://www.samsamwater.com/tools.php

State Rainwater Harvesting Statutes (it is illegal to catch and store rainwater in some states)
http://www.ncsl.org/issues-research/env-res/rainwater-harvesting.aspx

Best Practices in Designing Green Infrastructure Projects
http://water.epa.gov/infrastructure/greeninfrastructure/gi_design.cfmhttps://www.khanacademy.org/

Rainwater Harvesting for Dry Lands Lessons and Online Calculator
http://www.harvestingrainwater.com/rainwater-harvesting-inforesources/water-harvesting-curriculum/
8.32 min accompanying "muffin tin" video: http://www.youtube.com/watch?v=k9Ku_xpyLK4&feature=related

Green Infrastructure Projects for Healthy Waters by EPA
http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm#rainwaterharvesting

Rainscaping PowerPoint
http://www.slideshare.net/Tobarrett/constructing-rain-gardens-bioswales-powerpoint

Bioswale Brochure by USDA NRCS
ftp://ftp-fc.sc.egov.usda.gov/MT/www/technical/water/Bioswale.pdf

Bioswale Fact Sheet by University of Florida
http://buildgreen.ufl.edu/Fact_sheet_Bioswales_Vegetated_Swales.pdf

Planning Guide for Building a Rain Garden or Bioswale
http://www.asla.org/uploadedFiles/CMS/Meetings_and_Events/National_Landscape_Architecture_Month/Resources/CD_Bioswale.pdf

How to Build a Rain Garden
http://www.lowimpactliving.com/blog/2008/04/14/how-to-build-a-rain-garden/

How to Build a Rain Barrel
http://www.instructables.com/id/How-to-Build-a-Rain-Barrel/?ALLSTEPS

Links

Goundwater Foundation

Awesome Aquifers (SO event involves students building small working groundwater models)
http://www.groundwater.org/kids/getinvolved/so/aa.html

Hydrogeology: Water for the World (SO event involves students in groundwater computer modeling)
http://www.groundwater.org/kids/getinvolved/so/hydro.html

Water Wonder Mobile App (free downloadable game)
http://www.groundwater.org/get-informed/opportunities/water1der.html

Groundwater Research for Students
http://www.groundwater.org/get-informed/

Get Involved! Groundwater Stewardship Projects
http://www.groundwater.org/kids/getinvolved/protect.html

Plastics Pollution Coalition
http://plasticpollutioncoalition.org/

Midway – short, powerful, graphic documentary film about how disposable plastic harms birds
http://vimeo.com/25563376

Think Beyond Plastic competition
http://plasticpollutioncoalition.org/projects/think-beyond-plastic/

Albany Options Bioswale
You Tube video: http://www.youtube.com/watch?v=ovGeFTLLrmI

Albany Options Bioswale Youtube Video:

http://www.youtube.com/watch?v=ovGeFTLLrmI

Albany Options Bioswale Article:

http://democratherald.com/news/local/pbs-films-at-albany-options-school/article_b1e24506-9c22-11e2-a010-0019bb2963f4.html

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PBS films at Albany Options School

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Ecology students from left, Gerald McAlister, Cody Becknal, Matt Susnik and Chance Becknal work on a new bioswale Tuesday morning at Albany Options School. (David Patton/Democrat-Herald)

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April 03, 2013 8:00 am • By Jennifer Moody, Albany Democrat-Herald (0) Comments

Fans of nature shows on the Public Broadcasting Service may catch a familiar face or two when "This American Land" begins its third season this fall.

PBS films at Albany Options School

Ecology students from left, Gerald McAlister, Cody Becknal, Matt Susnik and Chance Becknal work on a new bioswale Tuesday morning at Albany Options School. (David Patton/Democrat-Herald)

April 03, 2013 8:00 am • By Jennifer Moody, Albany Democrat-Herald

Fans of nature shows on the Public Broadcasting Service may catch a familiar face or two when "This American Land" begins its third season this fall. A camera crew visited Albany this week to do a segment on environmental education projects at Albany Options School. The show will be broadcast on public television stations nationwide sometime during the 2013-14 season of the PBS conservation newsmagazine series.

Much of the filming centered on the bioswale AOS ecology students are creating behind the school. A swale is a low-lying piece of land that's wet or marshy at least part of the year. A bioswale is a specifically designed landscape that uses native plants to cut down on water pollution. AOS students are planting sedges, camas, Oregon grape and other varieties of native plants and grasses behind their school to soak up and break down chemical compounds in the runoff from nearby roofs and parking lots.

Help from the city of Albany and Native Grounds Nursery of Brownsville, along with a $500 grant from the Captain Planet Foundation, made the work possible. The alternative high school moved to 701 19th Ave. S.E. in the fall of 2008. The property has a hollow area in its back lawn where water regularly collects. The ground is thick, compacted clay, which just doesn't drain, science teacher Kelly Muller said. "That's our pool," she said wryly, nodding to the puddles that have collected following recent rainstorms. "We've actually had ducks in there. And birds taking baths."

Last fall, Muller and her ecology students did some initial research on creating a "rain garden" in the hollow, but learned that the plants they'd selected wouldn't fare well. They turned their attention to creating a bioswale instead. Kim Kagelaris, an environmental services technician with the city of Albany, worked with students on environmental education. The Pacific Northwest Clean Water Association provided rubber boots for the students.

Muller used part of the Captain Planet grant to purchase some of the plants for the bioswale from Native Grounds Nursery. Owner Mike Nehls donated other plants and provided his expertise. The plants in the AOS bioswale can be deluged with water during Oregon's soggy winters and springs, and drained of every drop during even exceptionally dry summers, and still grow just fine, Nehls said. At the same time, they'll filter any nitrates and phosphates from nearby lawns, and any oil and gas flushed from parking lots around the school and adjacent apartments. Native Grounds specializes in this type of plant and is glad to help students with environmental education, Nehls said, to "hopefully steer them to some kind of career that's environmentally minded."

The PBS show came to Albany because the Captain Planet Foundation recommended the AOS bioswale among its favorite projects, said Marsha Walton, series producer. The community collaboration factor is especially important, Walton added, because that's how real environmental change becomes possible. So is bringing in students. "Getting young people to become conscientious eco-citizens underlies a lot of the things we do," she said.

Captain Planet Foundation
Final Grant Report

Introduction

An important goal of the Captain Planet Foundation (CPF) is to collect and disseminate information about the "best practices" in environment-based education. This information is vital so CPF can help other schools and organizations learn from the experience of CPF's grantees. CPF has recently begun to develop a database of effective program designs and instructional materials.

We understand that projects often do not follow the predicted course but knowledge of your experiences and lessons learned are valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions—remember that all experiences both positive and negative are valuable, as they help us all to learn.

Reporting Requirements[1]

CPF requires all grant recipients to complete a CPF Final Grant Report using the form below. This report must be submitted within 30 days of the end of the grant period specified in the signed Grant Agreement.

In addition to the CPF Final Grant Report, your school/organization has agreed to submit, as part of this final report, photographs and/or other "artifacts" of the project, such as brochures or student-developed websites.

The CPF Final Grant Report must be sent in **Word format**.

The completed report should be sent by e-mail to: grants@captainplanetfdn.org.

Videos, Photographs and/or other "artifacts" should be sent electronically to grants@captainplanetfdn.org or mailed to:

Captain Planet Foundation, Inc.
133 Luckie Street, 2nd Floor
Atlanta, GA 30303

Please contact us if you have any questions about this report.
Thank you for your help and cooperation.

Becca Iverson
Development Coordinator
becca@captainplanetfdn.org
(404) 522-4215

Certification

I certify that the information in this report is true and correct to the best of my knowledge. I also affirm that CPF is licensed to use the enclosed photographs and other "artifacts" for educational purposes on CPF's website, reports, and newsletters, as well as allow them to be shared with other grantees. We have obtained written permission for CPF to use these materials for the purposes listed above.

Signature:_____ Printed Name:__Anna Sokolov_____

Title: _Business to School Liaison_____ Date submitted: ___05/15/2013_____

Name of School/Organization__Albany Options School_____

Address:__701 19th Ave SE_____

City:__Albany_____ State:__Oregon_____

General Project Information
Name of project: ___Bioswale Water Quality and Infiltration Project_____

Date project activity started: ___09/10/12____

Amount awarded by Captain Planet Foundation: $__500____

Amount of grant funds expended: $_500_____

Number of individuals who benefitted from this project:

Students/youth: ___30_____ Grade/age range: ___9-12_____

Teachers: __1_____ Grades: ___9-12_____

Community Members: 2 organizations Age range:___adults_____

Others: _____ Description: _____

Please use as much space as you need to provide complete answers that may benefit others interested in implementing a similar project.

1. **Describe the greatest educational achievements of the project. (Include data you collected related to state/district education standards or the other content and skills that are the focus of student learning.)**
   Students learned the important roll plants play in the urban ecosystem and how they can improve the quality of the water that runs off of the roofs and parking lots on the school grounds before it enters the watershed. Students learned the importance of using native plants in the bioswale.

2. **Describe challenges and/or obstacles related to the educational activities undertaken during the project. How were these handled? What are some of the lessons learned from facing these challenges/obstacles?**
   The greatest obstacle was the hard clay soil, that prevented us from turning the swale into a rain garden. After consulting OSU Extension 4-H we learned that we could turn it into a native plant garden. The students worked with the owner of Native Grounds nursery and chose plants that would thrive and be effective in the bioswale.
   The other major challenge was the weather. The clay was too hard to work in during the Fall following the Summer, and once the Oregon rain began it was difficult to work outside. However, with the support of the Pacific Northwest Clean Water Association the school was able to purchase rain work boots for the students to wear outside while working so that they could return to class for the rest of the day in clean and dry shoes.

3. **What advice would you give another school/organization to help them avoid or resolve the challenges/obstacles you faced while undertaking the educational activities involved in this project?**
   Additional and more thorough planning and testing would have helped avoid some of the obstacles. Receiving the grant from the Pacific Northwest Clean Water Association for the boots ahead of time helped eliminate some of the struggle, but ultimately the weather continued to be an issue. More testing on the soil prior to the project would have helped to come up with an alternative earlier in the game.

4. **Describe the greatest environmental achievements of the project. (Include data you collected related to the environmental benefits, such as the amount of habitat restored, materials recycled, waste removed, gardens planted, etc.)**
   The students took a 1000 sq. ft. plain sod bioswale and created a habitat with native plants. We are already seeing birds and animals using the space! Students used the sod from the bottom of the swale to create berms surrounding it to plant on and have been actively educating their peers and

other schools on the importance of their work. The students also had the opportunity to test the water quality prior and post project to look for any change.
The infiltration rate has improved greatly in the bioswale as can be seen with the naked eye on a daily basis. Compared to previous seasons there has been less standing water and flooding in the swale.

5. **Describe the challenges/obstacles related to the environmental activities undertaken during the project. How were these handled? What are some of the lessons learned from facing these obstacles?**
Due to on-going rain and planting out in the garden, the water has not had the opportunity to settle long enough for the students to take an accurate reading of the water quality. We intend to continue work on the project next year and prior to additional planting or disruption the students will test the water and compare it to the date the previous year at that time.

6. **What advice would you give another school/organization to help them avoid or resolve the challenges/obstacles you faced while undertaking the environmental activities involved in this project?**
Were we to do this project again we would have scheduled "breaks" in the project for a few weeks to allow the soil to settle within the swale long enough for the students to be able to take a better reading of the water quality.

7. **Describe the involvement of students/youth in the project and the benefits they received from their hands-on learning opportunities. (Include data collected related to student involvement in project activities and the effectiveness of hands-on learning during the project.)**
The students were involved in every step of the planning following the structure of Service Learning. The students did all of the sod removal, berm building, planting, and data collection. The students help pick-out the plants and learned the best placement for each type of plant. The students used books and computers to identify native plant species. Effectiveness was especially apparent in that there were almost no absences on "garden" days, and being an alternative school, attendance is something students typically struggle with a great deal.
Students also created plans and blueprints of the entire bioswale area, calculated square footage, and identified all of the native plants.

8. **Describe the challenges/obstacles related to the involvement of students/youth in the project. How were these handled? What are some of the lessons learned from facing these obstacles?**
Initially some of the students were reluctant to get dirty and hands-on in the class. However, the general excitement and enthusiasm for the project surpassed that and that failed to be an issue after the first few sessions. Students became used to working outside, came to school better prepared, and were willing to use the boots and gloves provided.

9. **What advice would you give another school/organization to help them avoid or resolve the challenges/obstacles you faced while involving students/youth in this project?**
Having the boots and gloves really helped. It was also useful to let the students know in advance when we would be working outside so that they had the opportunity to come to school dressed appropriately and mentally prepared to be working outside.

10. **List the names of the community organizations you partnered with and describe how they helped with the project activities (Please add rows if needed).**

Name of organization	How they helped implement the project
Native Grounds nursery	Plants were purchased from this local business. They also assisted in counseling the students on what plants would work, where, and why. Provided on-site assistance.
OSU Extension 4-H	Worked with the school by providing testing materials and assistance is coming up with the plans and solutions. Staff came and worked with the students on the testing process.

City of Albany Public Works	Provided history of the bioswale, why it was created in that shape, location, size, etc. Also provided the original plans for the swale and assistance in how it could or could not be changed.

In addition a local Eagle Scout candidate from the local troop built a great garden shed near the native garden bioswale area with some volunteers as his Eagle Scout project for the school to store the tools and supplies.

11. **Describe the challenges/obstacles related to <u>partnering with community organizations</u> to implement the project. How were these handled? What are some of the lessons learned from facing these obstacles?**
The only challenges were related to schedules. However, the organizations were willing to work around the school schedule to meet with the students during class time.

12. **What advice would you give another school/organization to help them avoid or resolve the challenges/obstacles you faced while <u>partnering with community organizations</u> during this project?**
Provide multiple meeting times in advance. We used "Doodle" so that people could mark which days and times worked best for them, which allowed us to see when the most people were available to meet.

13. **What are your plans for the future of this project? If this project was a part of a larger program, explain how this grant has helped you sustain this project for the future.**
We plan to expand the scope of the planting to include a larger area. We plan to build educational and interpretive signs that explain the native garden concept, the different plants, functions, etc. In addition we plan to have the students build bird feeders, birdhouses, build benches, and create paths and trails in the area so that it becomes a truly educational native area for the school, the neighboring elementary school, and for the whole community.

14. **What, if any, other advice would you give another school/organization trying to replicate your project?**
The most useful thing in completing this project was to build the partnerships who we would not have been able to do it without otherwise. The Native Grounds nursery, OSU Extension 4-H, and the City of Albany Public Works each played a huge role in helping us fulfill our goals and dreams.

15. **What other comments or information can you share, regarding your project that might help the Captain Planet Foundation assist other schools/organizations or improve our grant making process?**
Be sure to take advantage of other community organizations that provide grant assistance so that all of the materials (in our case the boots, gloves, etc.) are already purchased and taken care of prior to the start of the project. That was a huge help for us.

Financial Information
Please copy the two left-hand columns from your proposal and add the information for the expenditures column from your records.

Items	Funds Requested from CPF	Actual Amount Expended	Difference, if any (Funds Requested – Funds Expended)
Funds for plants (see attached invoice)	**$500**	**$500**	**$0**
TOTALS	**$500**	**$500**	**$0**

native grounds nursery

37545 Hwy 228
Brownsville, OR 97327

Invoice

DATE	INVOICE #
1/4/2013	2698

BILL TO

Albany Options School

TERMS

ITEM	DESCRIPTION	QTY	RATE	AMOUNT
Kinnikinnick	Arctostaphylos uva-ursi	18	1.45	26.10
Snowberry	Symphoricarpos albus	3	3.00	9.00
Indian plum	Oemlaria cerasiformis	1	6.00	6.00
Indian plum	Oemleria cerasiformis	1	3.00	3.00
Ribes	Ribes sanguineum	3	3.50	10.50
Camas	Camassia quamash	18	1.50	27.00
Coral Bells	Heuchera sp.	6	3.50	21.00
Repens	Mahonia repens	5	3.50	17.50
Oregon Grape	Mahonia aquifolium	3	3.50	10.50
Silk tassel	Garrya elliptica	1	3.40	3.40
Wax myrtle	Myrica californica	5	3.50	17.50
Rush	Juncus effusus	30	3.00	90.00
Carex	Carex obnupta	12	3.50	42.00
Carex	Carex densa	3	3.50	10.50
Tufted hair grass	Deschampsia caespitosa	6	3.50	21.00
Red Twig Dogwood	Cornus stolinifera	6	3.50	21.00
Twinberry	Lonicera involucrata	3	3.50	10.50
Ninebark	Physocarpus capitatus	3	3.50	10.50
Ponderosa Pine	Pinus ponderosa	1	20.00	20.00
Aster	Aster subspicatus	3	3.50	10.50
Columbine	Aquilegia formosa	1	3.50	3.50
Alder	Alnus rhombifolia	3	3.00	9.00
delivery		1	50.00	50.00
Labor		1	50.00	50.00

Phone: 541-466-3561 | Fax: 541-466-3500 | **Total** $500.00

Pay online at: https://ipn.intuit.com/ng6gfj6p

Albany Options Bioswale PowerPoint

Fall, 2012 – When the students returned to school after the hot summer the clay soil was almost impossible to dig, forcing the students to wait two months for the Oregon rain to return.

Winter, 2013 – The rain returned and the students began to dig the clay sod out from the bottom of the swale.

The sod was used to build up the berms on the side of the bioswale.

Spring, 2013 – Students were able to finally begin planting the native plants in the bioswale!

Spring, 2013 - Throughout April the students continued to plant additional native plants.

Fall, 2012 - Robin from OSU Extension 4-H spent time with the students testing the soil.

Spring, 2013 – By March the student had the berm built up and had deepened the swale to prepare it for planting.

Next Generation Science Standards for Building a Bioswale

5th Grade

5-ESS2.A: Earth Materials and Systems

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)

5-ESS2.C: The Roles of Water in Earth's Surface Processes

- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

Students who demonstrate understanding can:

5-ESS2-1. **Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphereinteract.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: Assessment is limited to the interactions of two systems at a time.*]

5-ESS2-2. **Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** [*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*]

Middle School

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)

Students who demonstrate understanding can:

MS-ESS2-4. **Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [*Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.*]

High School

ESS2.C: The Roles of Water in Earth's Surface Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

Students who demonstrate understanding can:

HS-ESS2-5. **Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.** [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]