Section 1

Title: Sustainability and Restoration – Target Range ECOS Garden

Target Range School
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Target Range ECOS Team:

Melodee Burreson (5th grade teacher)
Jann Clouse (5th grade teacher)
Rachel Loehman (PhD Fellow)
Lauren Priestman (Undergraduate Fellow)
Carl Rosier (PhD Fellow)

Section 2

At Target Range School (TRS) we developed an ecological learning area where teachers and students can explore ecological concepts including plant physiology, plant succession, entomology, nutrient cycling, conservation of resources, and wildlife biology. Our school is located within a suburban area and is backed by open space however, much of the current schoolyard and adjacent areas are devoted to turf playing fields or can be characterized as mono-cultures of invasive plant species. The schoolyard restoration project created a natural area that will increase local floral and faunal while serving as a visible teaching tool for restoration and sustainability of native ecosystems.

Section 3

As defined in our initial mini-grant application, the main goal for the demonstration project was to create a restoration garden. We initially designed this garden in a linear, trail-like format that would have incorporated diverse parts of the schoolyard including a riparian zone, a cottonwood grove, and a prairie area. We quickly determined that our initially defined area presented too large an effort for a first year project, so we reduced our garden plans both in scale and scope to something more manageable for the first year of the program.

Section 4

As part of our restoration garden demonstration project we initiated three main projects within the schoolyard: 1) treated an area of the schoolyard to reduce and contain noxious weed invasion 2) developed a noxious weed biocontrol monitoring and sampling program in cooperation with the Missoula County Weed District 3) restored and revegetated an area within the schoolyard with native northern Rocky Mountain plants, to be used as an outdoor ecological teaching laboratory. As the result of this project, students displayed increased interest in the fauna and flora within their schoolyard. They have assumed ownership of the restoration garden project, and are interested in knowing when we'll next work on the project. They have a far better understanding of ecological concepts now than at the beginning of the school year, especially related to interactions between plants, insects, animals, and abiotic factors. Initially students seemed to only consider those parts of ecosystems that were obvious and visible, but now they also consider soil and microbial interactions, and actions of plants and insects beneath the snowpack and within soil layers. They look forward each week to participating in ECOS inquiries, invest time and attention in interactions with ECOS fellows, and thoroughly enjoy science in the context of ECOS inquiries.

a) The science theme used as the basis for the outdoor demonstration activities was sustainability and restoration of native ecosystems. This theme is especially appropriate given the location of TRS within a semi-rural geographic area, its close proximity to open space and National Forest lands, and the familiarity of most of its students with current environmental issues including logging, hunting, mining, off-road vehicle use, noxious weed management, and invasive species concerns.

b) Although the curriculum pieces we developed this year targeted 5th grade students, the demonstration garden project is a resource that will be utilized by the entire school population (K-8) as part of their teaching curriculum. In addition, local residents and families utilize the schoolyard fairly heavily, and have already taken an active interest in our restoration activities. We hope that in the coming years community members, teachers, students, and parents will participate in restoration activities.

C) Supplies purchased for the restoration garden include the following:

Item Description	Cost	Comments
Irrigation materials	**$500.00**	**This component is critical to the success of our project - previous native plant gardens at TRS have failed due to lack of proper irrigation.**
Compost	**$300.00**	**Currently there is a large population of knapweed at our garden site, and in order to limit the use of herbicides we have decided to use extensive layers of compost to prevent re-growth of weed species.**
Planting mix (soil)	**$200**	**Used as a growth medium for garden plants, to limit germination of noxious weeds from the seed bank within the existing garden soil matrix.**
Native plants and seeds	**$70.00**	**These are in addition to $500.00 worth of plants donated by Bitterroot Restoration, Inc. Students grew native plants from seed as part of a lesson on native seed germination and biology.**
Security equipment	**80.00**	**Due to the remote location of our garden project, there was a need to establish a system to prevent vandalism.**
Full-spectrum grow lights (bulbs and	**$200**	**Allowed the students to grow native plants from seeds, study physiology of native vs. invasive plants, and learn about seed germination and**
Enclosed barrel composter	**$150**	**In association with ECOS microbiology inquiries students developed a composting system using food waste from the cafeteria. This compost was added to the garden.**
Total	**$1500**	

D1) We established a 5000 (ft^2) native plant garden in an abandoned section of schoolyard. Currently the garden contains four sections each designated for a particular use (pollinator, medicinal etc.). The garden is equipped with a fully automated irrigation system that needs only minimal maintenance, large teaching area and access trails. Since our project is based in a remote portion of the school yard we have taken the necessary measures to prevent potential vandalism events.

D2) During the course of several months the students and ECOS team removed a large assembly of noxious and invasive weeds from an area of the schoolyard proposed as the site of the Restoration Garden (see photos). We also removed large quantities of concrete building material, rock fill, and soil. Next we covered the area with cardboard (recycled from the University of Montana and local businesses) which will serve as biodegradable weed matting; the cardboard was then covered with layers of compost mulch. Several planning sessions with students and teachers allowed us to design a garden that includes central teaching/viewing area with benches, handicapped-accessible paths, and several garden theme areas including a pollinator and butterfly garden, medicinal and useful plant garden, prairie garden, and a water-wise, dry-land garden. With the help of local experts we selected native Montana forbs, shrubs, and trees appropriate to each area, and acquired them either as seeds, cuttings, or juvenile plants.

We used gravel from the schoolyard to create garden paths and the central teaching area, and rocks removed from the garden site to build low walls to demarcate paths and garden beds. By tying into the school's main irrigation line we were able to install a low-water-use irrigation system that will deliver water on a timed system to the garden beds. Because previous garden efforts at TRS failed partially due to lack of irrigation, this was a critical part of our project.

During the final weeks of school we established deep planting beds within our garden sub-areas (pollinator, medicinal, prairie, arid) using a mixture of compost and soil. We planted the appropriate native plants within these areas. We created benches in the teaching area using large downed logs from a wooded section of the schoolyard, and partially fenced the garden to protect it from local wildlife and causal visitors, who use the area as access to open space.

D3) Several local business provided donations to this project. This enabled us to efficiently utilize the funding we were given to complete the project. Furthermore we were able to restore a greater portion of the schoolyard due to these donations.

Company name	Donation description	Estimated Cost
Bitterroot Restoration Inc.	**Native plants**	**$200.00**
EKO Compost	**10 (yd^3) compost**	**$250.00**
JTL Group Inc.	**½ Days rental/driver 5 ton dump truck**	**$300.00**
Rainmaker irrigation	**Provided irrigation equipment at cost**	**$ 150.00**
Total		**$900.00**

D4) Our demonstration project was completed during the last week of the school year. As a result few teachers were able to incorporate the project into their curricula this year. However, Miss Purdy (4^{th} grade teacher) did involve her students in the garden construction process and plans to utilize the garden next school year. Also Melodee Burreson (current ECOS teacher) teaches three summer camps at TRS. She has currently begun to utilize the garden project as part of her camp curricula.

E) This section of our demonstration project is complete. Over the next several months we will monitor the garden for irrigation system failure, invasive weed spread, and vandalism. Currently our project is in good shape and we anticipate successful establishment of the garden project.

F) Not applicable

Section 5

The following community members and organization representatives were valuable participants in the development of ECOS programs and projects at Target Range School:

Name	Affiliation	Contribution
Helen Atthowe	Missoula County Extension Service, Horticultural Extension Agent	Consulted on native plant restoration, noxious weed control, and garden construction
Len Balleck	Bitterroot Restoration Inc.	Donated materials for the restoration garden

Jim Corbett	TRS Block Student	Participated in ecology inquiries and demonstration project activities
Leigh Ann Valiton	TRS Block Student	Participated in ecology inquiries and demonstration project activities
Bill Otton	Missoula County Extension Service, Weed Supervisor	Consulted on noxious weed management
Marijka Wessner	Missoula County Extension Service, Weed Education Coordinator	Cooperated on the TRS knapweed biocontrol monitoring and sampling effort
Lisa Mills	ECOS Coordinator/Missoula County Extension Service, 4H Coordinator	Consulted on garden plan and plant list
Ellen Buchman	University of Montana undergraduate student	Volunteer assistant
Daniel Warnock	University of Montana graduate student	Volunteer assistant
Conor Gelderman	Missoula County Extension Service intern	Assisted with knapweed biocontrol monitoring and sampling effort
Gabrielle Rosier	PhD students daughter	Garden construction volunteer
Gavin Rosier	PhD students son	Garden construction volunteer

Section 6

For the TRS restoration garden demonstration project to be sustained in the coming years requires the following:

- Support from the ECOS program or other external group, to supplement time and resources provided by Target Range teachers and students.
- Additional funds for weed control, irrigation, plants, garden supplies (compost, soil, fencing, interpretive signs).
- Firm commitment from Target Range teachers, administration, and school board to support the restoration garden project (past efforts have failed because expansion or development of schoolyard areas damaged or obliterated garden projects).
- Integration of the garden into school curricula as an ecology teaching resource – will create a sense of ownership and respect among students.
- Coordination of the project and associated ecology curriculum development between TRS participants, University of Montana students and faculty, and community members.

Ideally the 2005-2006AY cohort of ECOS fellows and teachers will integrate the restoration garden project as part of their science curriculum and associated activities. Efforts should include both basic garden maintenance (weeding, composting, planting, etc) and expansion of the garden as a whole to include additional areas of the schoolyard not currently under development. Some coordination between current and past ECOS fellows, students, and teachers will enhance the utility of the area, and facilitate its upkeep: 5^{th} graders from this year want to be involved next year as 6^{th} graders, incoming 5^{th} graders can continue to participate with the original ECOS teachers, and next year's 4^{th} grade students, as the current ECOS participants, will also be involved in all phases of the project.

Section 7

The goal(s) of the demonstration project at TRS were to develop a sustainable restoration garden, incorporate student ideas into its construction, and establish several curricula pieces that would utilize the garden project. During this year we were able to construct a 5000 (ft^2) garden utilizing the ideas and designs of the students involved. Furthermore several curricula pieces were developed to aid support to the garden project these include: propagation of plants via cuttings, plant microbe interactions, winter entomology, and Knapweed biocontrol. Students and teachers at TRS are very proud of their garden, as well as the time and effort invested to create it. Students have also asked to be allowed to participate next year as 6^{th} graders, and we will work with their teachers to make that possible. We feel that the project was successful and we look forward to seeing its utilization as a teaching tool.

Appendix 1 – Curricula

Rachel Loeham (inquires)

1. Winter Entomology Inquiry v2.doc
2. Knapweed Biocontrol Inquiry v2.doc

Carl Rosier (inquires)

1) Microorganism units

- Isolation of microbes from the environment
- Brewing Rootbeer
- Microbial Decomposition
- Plant Microbe interactions

2) Garden units

- Plant propagation via cuttings

3) Teacher requested units

- Water rockets

Lauren Priestmen (inquires)

1. Adaptation

ECOS Demonstration Garden – Before Restoration (October 2004)

ECOS Demonstration Garden – During Restoration (November 2004)

ECOS Demonstration Garden – During Restoration (April 2005)

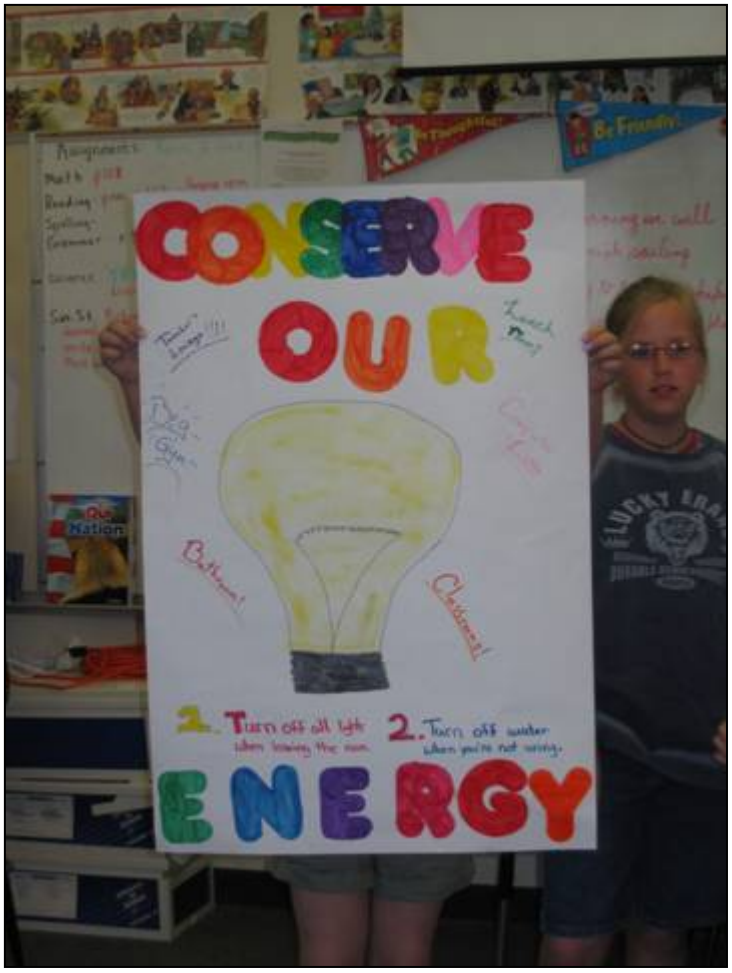
ECOS Demonstration Garden – During Restoration (May 2005)

ECOS Demonstration Garden – After Restoration (June 2005)

Knapweed Biocontrol Monitoring and Sampling (May 2005)

Knapweed Biocontrol Monitoring and Sampling (May 2005)

Earth Day 2005
Students formed groups to develop conservation and recycling projects



Knapweed Biocontrol Inquiry (February 2005)
Students learned about control of invasive weeds found in their schoolyard, and collected data on biocontrol insects in those weeds

Winter Entomology Inquiry (February 2005)
Students learned about adaptations and survival mechanisms of insects

Microbe Isolation Inquiry (November 2005) Students discuss where to sample for microbes

Root beer inquiry (February 2005) Students begin setting up root beer fermenters

Water Bottle Rocket Inquiry (April 2005) Students designed their own rocket io order to achieve maximum flight.

Water Bottle Rocket Inquiry (April 2005) Student discuss final water to air ratio needed to achieve maximum distance.

Water Bottle Rocket Inquiry (April 2005) Student prepares to launch rocket.

Microbial Decomposition Inquiry (May 2005) Students observe how microbes are able to degrade materials