



## **UNIVERSITY OF MONTANA GK-12 PROGRAM Annual Report for 2004**

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And with contributions from the 2004 cohort  
of GK-12 fellows at The University of Montana

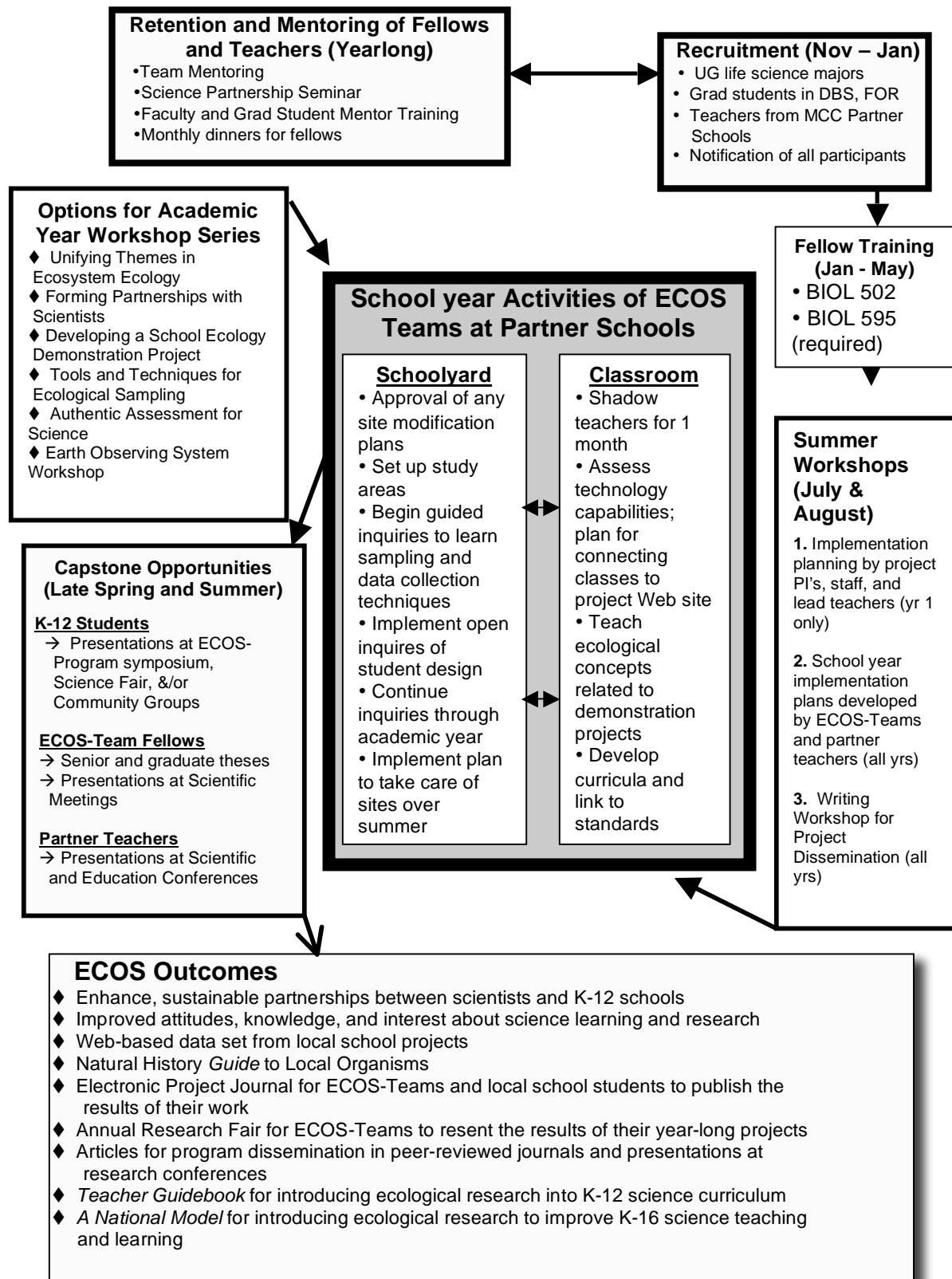
## **ECOS – Ecologists, Educators and Schools**

**Goals and Objectives of Montana ECOS Program:** The **Ecologists, Educators and Schools (ECOS) – Partners in GK-12 Education** Program brings together teachers and administrators in the Missoula Curriculum Consortium (MCC) and University of Montana (UM) faculty to create authentic research experiences for K-12 students using schoolyards and nearby open areas as outdoor research laboratories. Furthermore, ECOS places scientists in residence (two doctoral level graduate students and one undergraduate) to work with partner teachers to develop science demonstration projects related to local ecology and conservation biology. Throughout the academic year and summer, K-12 students and their teachers will interact with UM faculty, postdoctoral scholars, and graduate and undergraduate students conducting research in ecology.

To meet the need for enhanced understanding of environmental sciences in the Northern Rockies, the ECOS Program will 1) develop scientific ways of thinking and understanding in K-12 students through authentic research experiences in their schoolyards and adjacent habitats; 2) promote teaching practices focused on “learning by doing” and inquiry instruction for both teachers and future science faculty (ECOS Fellows); 3) develop and model linkages between educators in the K-16 continuum; and 4) identify project indicators to make the program sustainable at UM, and facilitate transfer to other sites in Montana and around the country. An overview of ECOS is presented in Figure 1.

Our experience with previous partnership programs showed us that recruitment of teachers and their principals is facilitated by ensuring that any new curricular themes associated with these schoolyard research sites tie in with individual school missions, curriculum standards, and local interests. Thus, the way ECOS is implemented at a particular school may vary slightly. However, ECOS fellows at all schools will serve as “Scientists in Residence” and develop demonstration research sites/laboratories on the grounds of their “residency” school to provide school-based authentic research experiences for local K-12 students. The demonstration projects currently in development at the 2004-2005 partner schools are described in more detail later in this report.

**Figure 1. Summary of ECOS Activities**



## **ECOS Staff**

ECOS is being directed by Drs. Carol Brewer (Division of Biological Sciences) and Paul Alaback (Department of Forestry), PI's on the grant. ECOS started with an excellent staff, many of whom had worked on previous ecology education programs at the University of Montana.

*Lisa Mills, ECOS Program Coordinator (through October 31, 2004):* As Program Coordinator for ECOS, Lisa developed program support materials and a wide range of ECOS events, publications, and resources. She also provided support for fellows and teachers as they implemented ECOS program activities. In the past she has worked with teachers in the University of Montana's NSF-funded MT-TIE as staff and NSF-funded REAP Program as a co-PI. Lisa is a former K-12 science curriculum coordinator and teacher, and has directed a range of science and environmental education programs, teacher training programs, and science fairs.

*Josh Burnham, ECOS Web Master:* Josh is responsible for the design, management and maintenance of the ECOS website. This includes programming the ECOS assessment log, the online Natural History Guide, and the Ask An Ecologist programs. He also provides technology support to ECOS staff, fellows, and teachers. Over the last four years, Josh has worked as a web developer for numerous NSF funded programs at the University of Montana.

*Kim Failor, ECOS Administrative Assistant:* Kim is a first year Masters student in the College of Forestry and Conservation under the direction of Carol Brewer. She plans to focus her thesis on conservation efforts in Latin America. ECOS is providing part time work as well as a valuable experience in ecology education.

## **ECOS Center and Resources**

ECOS Office: The University of Montana ECOS Program took over the office infrastructure in place at the end of Project IBS-CORE, a curriculum innovation program funded by the Howard Hughes Medical Institute. When the previous program came to

an end, UM remodeled the space to better meet the needs of ECOS.. Currently, three ECOS staff members (program coordinator, web master/technology support specialist, and administrative assistant) and the program director (Brewer) are housed in the ECOS office. As part of the documentation of the project set-up and direction, we have created a policy manual. This manual is updated as needed and will be invaluable as we prepare to disseminate the ECOS model at the end of the program.

Lending Library: During the first months of ECOS, we developed a lending library of resources, and are in the process of putting the catalog on-line. The library consists of a broad array of books including references on ecological curricula, pedagogy, assessment, science programs, and mentoring, as well as dozens of text books. ECOS fellows and teachers can check references out, or use them in the office work area. We have also developed an extensive collection of field keys and guides to local flora, fauna, and geology.

Computer Hardware and Software Support: ECOS participants have three computer stations for their use in the ECOS office. These computers are networked to the internet and have a broad array of software available. ECOS participants also have access to a slide scanner and a document scanner at the computer stations. ECOS also purchased a new Macintosh computer with software for capturing video images so that fellows can create video clips illustrating their work in the participating schools. Moreover, we purchased a video projector for use in making presentations about ECOS, and for use in ECOS related courses and institutes. We have also been able to make two computer stations available for use in participating schools. Currently these machines are being used in an interactive remote sensing demonstration at a local K-8 school.

Equipment and Supplies Support: The ECOS office maintains a wide assortment of supplies and equipment for loan to fellows and local schools. This equipment has been collected through the support of past ecology education grants and a grant from the Howard Hughes Medical Institute. Fellows, teachers and students can use a variety of

weather sensors, field microscopes, general ecology field gear (tapes, compasses, etc.), and some specialized instrumentation such as portable infrared gas analyzers. We plan to continue to enhance the equipment available for ecological investigations throughout our project.

Brochures and Publications: ECOS has developed an informational brochure describing the Montana GK-12 program. This brochure has been widely distributed to local superintendents, principals, teachers, and parents.

ECOS Toolbox: The ECOS toolkit (red toolbox icon) is a helpful feature on the ECOS website ([www.BioEd.org/ECOS/](http://www.BioEd.org/ECOS/)). In this toolkit, users will find copies of all the ECOS application materials, assessment tools, forms, and policies, as well as templates for making professional large-format posters and tips for preparing a PowerPoint presentation for a conference. All of these materials are available for no charge and can be easily downloaded from the website.

### ***Recruiting***

Within two weeks of start-up of the GK-12 award in January, 2004, we began an aggressive recruiting campaign for both fellows and partner teachers and schools. An ECOS color brochure, informational materials, and application packets were developed for regular and email distribution. An online application process was developed for the teachers, which will serve as a format for online applications by fellows in future years. To recruit student fellows, our efforts entailed sending announcements over e-mail to all PhD students in the Division of Biological Sciences and College of Forestry and Conservation. We also talked with faculty during faculty meetings, and made announcements in targeted undergraduate courses. To recruit schools and teachers, we worked with the Missoula County Curriculum Consortium science curriculum coordinator. Through this key contact, we made presentations to the board of superintendents and school principals. A broadcast email with information and application packet went out to all school principals in Missoula County and in surrounding rural school districts, and follow-up calls were made to ensure that

principals were distributing information to school site teachers and encouraging them to apply for the program. We sent out a press release which resulted in a feature in the *Missoulian*, the major newspaper in this region, recruiting schools to apply to participate in ECOS. A local TV news broadcast featured the ECOS program and highlighted the application process and timelines. We also contacted teachers who had participated in previous programs we have run directly, including *Montana Partners in Ecology*, *Montana Teachers Investigate Ecology*, and *Schoolyard Ecology for Elementary School Teachers* (all programs funded by the NSF).

Applicants for the fellowships were asked to complete the application materials detailed on our website at [www.BioEd.org/Ecos/](http://www.BioEd.org/Ecos/). Potential fellows were asked to write an essay detailing their interest in participating in ECOS and provide evidence of their academic standing and approval to participate from their academic advisor. Teachers were asked to describe how Scientists in residence at their schools would advance science education. Once selected, teachers and fellows signed a contract detailing expectations over the academic year for their participation.

### **ECOS Fellows and Partner Teachers**

In this first year of the GK-12 program at the University of Montana, we successfully recruited a very strong pool of PhD and undergraduate fellows representing a wide diversity of life science departments and programs in two colleges. Students were recruited from the Organismal Biology and Ecology Program and Integrated Microbiology and Biochemistry Programs in the Division of Biological Sciences graduate programs (College of Arts and Sciences) and from the Departments of Ecosystem and Conservation Sciences and Wildlife Program (College of Forestry and Conservation). The undergraduate fellows are majoring in Botany, Human Biology, Science Education, and Microbiology. The teachers have between 4 to more than 30 years of teaching experience. Information on all of the participants is provided in Table 1.

Table 1. ECOS Participants in Year 1.

NAME	ROLE	YEAR IN SCHOOL/ WORK	ECOS TEAM/ ROLE	TIME IN ECOS	BRIEF DESCRIPTION OF ROLES AND INTERESTS
<b>ECOS STAFF</b>					
<b>Carol Brewer</b>	Project Director and Associate Professor of Biology	11 years at UM	ECOS Director	10	PhD in Botany. Her areas of research are plant physiological ecology and functional plant morphology; and ecological and conservation education.
<b>Paul Alaback</b>	Project Co-director and Associate Professor of Forestry	11 years at UM	ECOS co-director	10	PhD in Forest Science. His research centers on structure and function of forests and their relation to wildlife across a range of scales.
<b>Lisa Blank</b>	Project Co-director and Associate Professor of Education	7 years at UM	ECOS co-PI	10	PhD in Science Education. Her research interests are in metacognition and nature of science.
<b>Mike Plautz</b>	Project Co-director and 7 <sup>th</sup> grade teacher	7 years	ECOS co-PI	10	7 <sup>th</sup> grade science teacher at Hellgate Middle School. He holds a BS.
<b>Lisa Mills</b>	Program Coordinator	13 years in K12 administration	Office staff	10	M Ed. Former science curriculum coordinator and education director in schools in California, and former executive director of the Montana Natural History Center.
<b>Josh Burnham</b>	Web development & Technology support	6 years	Office staff (thorough 10/04)	10	BA in Political Science, he currently works as a technology specialist.
<b>Kim Failor</b>	Office assistant and graduate student in Forestry	1 month	Office staff	1	MS student in Department of Society and Conservation. Her thesis work will focus on conservation efforts in Latin America
<b>ECOS PhD Fellows</b>					
<b>Megan Parker</b>	PhD Fellow	5 years	Florence Carlton School	3	Organismal Biology and Ecology PhD student, with a range of experience in wildlife biology. She is currently studying conservation and behavior of African wild dogs.
<b>David Nicholas</b>	PhD Fellow	3 years	Florence Carlton School	3	Biological Science PhD student studying microbial ecology. His thesis work investigates the cycling of arsenic by bacteria in contaminated lakes and reservoirs.



<b>Jennifer Woolf</b>	PhD Fellow	1 year	Big Sky High School	3	Wildlife Biology/ Organismal Biology and Ecology PhD student working in conservation research applied to management. Her thesis focuses on management techniques of fire-associated species.
<b>Andrew Whiteley</b>	PhD Fellow	5 years	Big Sky High School	3	Organismal Biology and Ecology PhD student working in the ecology and genetics of fish, patterns of genetic relatedness among populations of both mountain whitefish and bull trout.
<b>Tammy Mildenstein</b>	PhD Fellow	2 years	Lewis and Clark School	3	Wildlife Biology PhD student working on conservation management of flying foxes in the Philippines
<b>Jeff Piotrowski</b>	PhD Fellow	2 years	Lewis and Clark School	3	Integrated Microbiology and Biochemistry PhD student working on the ecology of arbuscular mycorrhizal communities.
<b>Margie Kinnersley</b>	PhD Fellow	3 years	Sussex School	3	Integrated Microbiology and Biochemistry PhD student studying microbial biology and ecology. Her research focuses on evolutionary changes in E. coli populations
<b>Wendy Ridenour</b>	PhD Fellow	2 years	Sussex School	3	Organismal Biology and Ecology PhD student working on the ecology of invasive species, in particular knapweed species.
<b>Carl Rosier</b>	PhD Fellow	2 years	Target Range School	3	Integrated Microbiology and Biochemistry PhD student studying how Arbuscular Mycorrhizal fungi influence the phytoremediation of radionuclides
<b>Rachel Loehman</b>	PhD Fellow	4 years	Target Range School	3	Department of Ecosystem and Conservation Sciences PhD student studying within the Numerical Terradynamic Simulation Group. Her research focuses on using remote sensing to predict vector-borne diseases.
<b>ECOS Undergraduate Fellows</b>					
<b>Lauren Priestman</b>	Undergraduate Fellow	4 years	Target Range School	3	Ecology major with extensive naturalist work experiences
<b>Frank James</b>	Undergraduate Fellow	4 years	Big Sky High School	3	Microbiology major planning to attend medical school

<b>Dianna Fairchild</b>	Undergraduate Fellow	4 years	Sussex School	3	Working towards a BA in Biological Sciences and a certificate in secondary teaching in biology and general science. Her senior thesis is on the effects of spotted knapweed on grassland bird foraging
<b>Sarah Keller</b>	Undergraduate Fellow	4 years	Florence Carlton School	3	Biology major and avid birdwatcher
<b>Hollie Sexton</b>	Undergraduate Fellow	4 years	Lewis and Clark School	3	Biology pre-medical major
<b>ECOS Partner Teachers</b>					
<b>Dave Oberbillig</b>	Teacher/ Co-PI	9 years	Big Sky High School	3	10th thru 12h grade teacher at Big Sky High School. Holds a BS in Biology and M Ed; currently he teaches Integrated Biological and Ecological Sciences and Ecology
<b>Kathleen Kennedy</b>	Teacher	4 years	Big Sky High School	3	10th thru 12th grade science grade teacher at Big Sky High School. Holds a BA in Biology and currently teaches Integrated Biological and Ecological Sciences II and Anatomy
<b>Nancy Adams</b>	Teacher	10 years	Florence Carlton School	3	Kindergarten teacher at Florence Carlton School. She holds a BS in Nutrition and a BA in Education.
<b>Lisa Verlanic</b>	Teacher	10 years	Florence Carlton School	3	T1 teacher at Florence Carlton School.
<b>Kathy Dungan</b>	Teacher	20 years	Lewis and Clark School	3	1st and 2nd grade teacher at Lewis and Clark School. She holds a BA in Social work and MS in Fine Arts in Integrated Curriculum.
<b>Mary Jane McAllister</b>	Teacher	19 years	Lewis and Clark School	3	4th grade teacher at Lewis and Clark School. She holds a BS in Education, MA in Fine Arts and MA in Integrated Arts and Education
<b>Maree Mitchell</b>	Teacher	9 years	Sussex School	3	6th-8th grade teacher at Sussex School. Holds MS, Ed. M. degrees, which focused on environmental education and science education
<b>Lisa Hendricks</b>	Teacher	10 years	Sussex School	2	
<b>Jann Clouse</b>	Teacher	23 years	Target Range	3	5th grade teacher at Target Range School. She holds a BS in Elementary Education
<b>Melodee Bureson</b>	Teacher	28 years	Target Range	3	5th grade teacher at Target Range School

### ***Retention and Mentoring***

During the first year of ECOS, we have been developing and implementing a co-mentoring program for all participants that includes directed mentoring activities, peer coaching between fellows and between teachers, and formative assessment components. As part of our mentoring program we have developed a web-based log where participants write about their work and get direct feedback on their activities and concerns. Although several fellows have commented that daily logs are hard to keep up with time-wise, we have found that timely feedback on their experience and communication regarding events and meetings is extremely important. We are seeking ways to make the log even more time efficient and useful to everyone in the program. We also have a mentoring handbook nearing completion for use with fellows and teachers, which provides guidelines and resources for quality mentoring of K-12 students, Undergraduate Fellows, PhD Fellows, and classroom teachers. As the ECOS program completes its first year, we will offer periodic mentoring potluck meetings during which the ECOS Teams can interact and troubleshoot based on the participants needs. We also are beginning the implementation of a rotating leadership plan whereby each PhD Fellow and Undergraduate Fellow has the opportunity to be the ECOS Team Leader, gaining experience in meeting facilitation and effective collaboration with colleagues. Retention of fellows and teachers is critical to the success of ECOS, and the ongoing mentoring structure provides ongoing support and professional growth opportunities for the fellows and teachers.

### ***Training***

Orientation: ECOS undergraduates began their year on June 1, 2004, and PhD fellows began on July 1, 2004. During the first week for each group, fellows attended an orientation workshop where the ECOS program was described in more detail and expectations were discussed. During these orientations, fellows were introduced to ECOS Program projects, such as the Natural History Guide for Schoolyards in the Northern Rockies and the “Ask an Ecologist” Web Site.

ECOS Training Institutes: During the summer of 2004, two two-week training institutes were held. The goals of these institutes were to build the school teams, introduce the teams to inquiry investigations in Ecology, and to plan for the upcoming school year. Agendas for the institutes are attached in Appendix 1.

During the first institute in July, school teams were formed. Each was comprised of two teachers, two PhD fellows, and one undergraduate student. As part of the institute kick-off, each fellow prepared a poster to describe their research to the ECOS teachers and fellow students. Then student teams made PowerPoint presentations illustrating how their expertise could be linked to the national science standards. The institute also featured extensive field experiences. One day was spent conducting an open inquiry in a local natural area near Missoula, MT. Each school team developed a researchable question, devised a plan to collect preliminary data, conducted the investigation, and then presented their results at the end of the day. During the remaining days of the institute, ECOS leaders led investigations with all the fellows in each participating schoolyard. Throughout the institute, teams planned for the upcoming schoolyear.

During the second institute in August, each team presented an investigation they had designed for their schoolyard. Teams also had planning time each day, and by the end of the institute, teams presented a proposal for an ecological teaching demonstration project for their school.

Biology 595 – Conservation and Ecological Education Seminar: During the academic year, ECOS fellows are required to take a graduate seminar on conservation and ecological education. The seminar meets for two hours once per week. The objectives of the seminar are to: 1) Determine the status of education about issues in conservation biology, ecology, and biodiversity, at all levels of education, from k-12, university, graduate, and adult education; 2) Explore appropriate teaching strategies for ecology and conservation education; 3) Review the literature to assess what strategies in conservation and ecological education have and have not worked by looking at selected case studies from local, regional, national and international scales; 4) Explore the roles of scientists and science educators in developing ecological and conservation literacy;

and 5) Outline opportunities for improving the status of conservation and ecological education. The format is a combination of lectures and student-led discussion. Each week, the discussion leader(s) prepares an outline based on a short review of the recent literature. After a 20 – 30 minute overview of the topic, the presenter leads a discussion of the papers with all seminar participants. The last 30 minutes of each seminar are reserved to talk about ECOS implementation in local schools. The syllabus for the seminar is attached in Appendix 2.

### ***Outreach***

Missoula County Curriculum Consortium: The superintendents of Missoula County and surrounding rural areas meet on a regular basis to coordinate curriculum efforts and special programs in all subject areas. This organization serves as the primary partner for the ECOS GK-12 grant at the University of Montana, providing the school leadership to ensure effective integration of the GK-12 grant program into the local region schools. Within two months of the GK-12 funding announcement for ECOS, Program Coordinator Lisa Mills worked with the Superintendents to review plans and begin the school recruitment and selection process for the first year of the program.

Missoula Science Teachers Meeting: On August 26, 2004, ECOS Director Carol Brewer and co-PI David Oberbillig met with high school science teachers from the Missoula Curriculum Consortium. Brewer made a presentation describing the ECOS program, and detailing the benefits to teachers and students about becoming a partner school. Teachers' questions were answered and they were given information about how to apply to the program for the 2005 – 2006 school year.

#### School boards:

*Target Range School Board:* On September 21, 2004, ECOS fellows Rachel Loehman, Carl Rosier, and Lauren Priestman, along with the program director Carol Brewer, and Target Range teacher, Melodee Smith-Burreson, introduced themselves and presented their ideas for the future and achievements thus far to the school board. The focus of the presentation was the partnerships that the University ECOS students and directors

hope to foster with the school, parents, and the Target Range community. This presentation was received with positive comments as well as an invitation to return in the future to request assistance with future projects. Another school board meeting appearance is scheduled for ECOS later in the school year.

#### Teachers and Students at Schools:

1. *Big Sky High School*. *Title of presentation:* What We Do and Why We Do It. The audiences have been Sophomore classes of the two partner teachers at Big Sky High School, Missoula, MT. The fellows gave their team's presentation to a total of 10 separate classes. Fellows Andrew Whiteley, Jennifer Woolf and Frank Janes presented about past experiences that got them interested in ecological research and briefly outlined current research interests.
2. *Florence Carlton School*: The first event was a Faculty and Staff meeting at Florence-Carlton School, August 30, 2004. The audience was teachers and staff, who were introduced to the new ECOS Fellows. ECOS also had an organizational meeting with FC faculty on September 21, 2004. During this meeting, they discussed the ECOS demonstration projects with interested teachers. On September 21, fellows also conducted "Outdoor Classroom Tours" to introduce the outdoor demonstration project and planned activity centers, garden plots, etc. Finally, ECOS Fellow Sarah Keller has developed a regular column in the community newspaper (Falcon View) about ECOS activities and the outdoor classroom at FC. This column will run from September 2004 - May 2005.
3. *Lewis and Clark School*: ECOS fellows presented the goals of the Lewis and Clark ECOS team in a PowerPoint presentation to teachers, faculty, and staff at school the day before classes started.
4. *Sussex School*: Introduction of the Fellows to Lisa Hendricks's 4<sup>th</sup> and 5<sup>th</sup> grade class (September 10, 2004). The ECOS fellows brought "tools of their trade" Margie Kinnersley brought a turtle to show as well as agar plates to help explain her research on enteric bacteria and its significance. Wendy Ridenour brought a knapweed plant with biological control agents (weevils) on it, which exhibited an aspect of her research. Finally, Dianna Fairchild shared skulls of wild animals, antlers and a

taxidermy bird to show. She discussed her degree in Wildlife Biology and concurrently described some of the research in which she has participated.

### Parents' Nights:

1. *Target Range School Open House:* The annual Target Range Open House was held on September 14, 2004. The main purpose of this event was to give parents a chance to meet their child's teachers, and to get a glimpse of the activities and events that occur throughout the school year. ECOS fellows had a table in the main hall of the school, on which materials and supplies were displayed, including scales and microscopes, posters, and a list for interested parents to offer their input on future projects and provide their contact information if they wanted to become involved. The undercurrent of the evening was one of support and excitement. Each parent that approached the table offered encouragement and/or praise, as many of them had already heard about the program from their children at home.

2. *Florence Carlton School Open House:* This event, on September 15, 2004, provided an opportunity for the fellows to host a table, hand out brochures and talk with parents and students from the entire Florence-Carlton school about ECOS and their planned demonstration project.

3. *Lewis and Clark School:* During the New School Year ice cream social, the ECOS team manned a booth to tell the community about the goals of the Lewis and Clark ECOS project. The audience was parents and teachers.

### ***Technology***

The ECOS web site was developed within the first month of the grant, and continues to build in new and improved elements nearly every week. Some of the features of the web site to date include access to ECOS publications, fellowship and teacher applications, a program-wide calendar, participating school web pages featuring ECOS projects, tools and resources (e.g., a template for making a scientific poster or power point presentation), a web-based log for teachers and fellows to report and reflect on

ongoing ECOS program activities, and links to educational resources for developing ecological investigations and projects. This fall we will add the following sections to the web site, which are currently under development: Ask an Ecologist page for K-12 students in and beyond the ECOS participating schools, a news feature, the online [Guide to the Natural History of the Northern Rockies](#), a bulletin board for fellows and teachers to share ideas with each other and with others beyond our program, and a Mentoring page with tools and techniques for effective mentoring and coaching.

### **Assessment**

ECOS assessment activities began in July 2004 with the first orientations. Tools were developed that asked all participants to report on their comfort with various science topics, and to describe their goals for participating in ECOS. An end-of-institute reflection also was conducted. We have contracted with Dr. Deborah Morris, Director of Program Development at Florida Community College in Jacksonville, FL to be our external program evaluator. Dr. Morris has extensive experience in education assessment, having recently evaluated Workshop Biology at the University of Oregon (Funded by the Howard Hughes Medical Institute) and Project TIEE (Teaching Issues and Experiments in Ecology), a joint project of Hampshire College and the Ecological Society of America (funded by the National Science Foundation). Currently, data from the surveys are being entered into a database by staff at UM and will be forwarded to Dr. Morris for analysis in the coming months. All of the ECOS assessment tools are attached in Appendix 3. We currently are working on making our assessment tools web based for easier implementation, and data collection and analysis.

### **Natural History Guide for Schoolyards in the Northern Rockies**

Overview: The *Guide to the Ecology of the Northern Rockies* will be a key resource for teachers and students in the ECOS program as well as for professional and amateur naturalists and scientists, and the interested lay public in the Northern Rocky Mountain region. By providing resources for classroom activities, this guide will make it easier for teachers and students to learn the common species that inhabit schoolyards and



surrounding ecosystems in our area, and also to engage them with the many unique adaptations and historical connections our fauna and flora provide with the natural environment here.

The specific goals of the *Guide* are to: 1) describe common species of plants, animals and their habitats in the northern Rockies region; 2) provide interactive and more intuitive means to identify species accurately in the region; 3) improve scientific accuracy of field experiments and overall educational value of field oriented studies by making natural history information on ecosystems around our region more accessible to both teachers and students; and 4) provide ecological information about each species or species group to help identify topics for student field investigations and to stimulate greater interest in the natural history and ecology of this region. Edited by Paul Alaback and Carol Brewer, the *Guide* is an on-line database that includes photographs, drawings, and descriptions of the most common species of plants and animals in our region and their habitats, as well as information on how to use these species for schoolyard ecology investigations, and references for further information. Each year we will build on the great foundation started by our first group of ECOS fellows. By the end of our 3-year grant cycle the ECOS nature guide should include useful information about the rich assortment of plant and animals species not only in the schoolyards in this area, but in the region in general.

Resources will include an online guide to each species group, including high quality original digital photos, descriptions, identification information, habitat information, natural and human history associated with each species. A hard copy (notebook) will also be available for classroom use in each participating school and in our main office. In addition, these resources will be linked to verified specimen collections which will be available in each participating school (for plants and insects). The on-line guide will also feature links to other websites that provide high-quality scientific information on our species including bird calls, animal tracks, behavioral information, taxonomy, and nomenclature, among others.

The *Guide* will provide a state of the art synthesis of information about the natural history of the most common species of plants and animals in this region which has been carefully reviewed by the scientific and naturalist community here so will be of high

quality and scientific accuracy. The *Guide* will also showcase new approaches to making natural history information more accessible to general audiences including interactive keys and databases which in most cases allow users to determine the identity of species (or groups) even with poor specimens or incomplete descriptions of a plant or animal. The *Guide* will also serve as a central location for making new knowledge about the natural history of this region more accessible to the general public. The online version of the *Guide* will be continually updated as new locational, taxonomic or ecological information becomes available in this region.

There are a number of private and commercial websites that include some information about species groups that occur in our area, but none are as complete or consistent between species groups as our guide will be for this area, nor do they provide the scientific consistency that is requisite for accurate identification and reference. Most natural history guides in this region feature species that are common in national parks, high elevation forests, alpine or mountain areas. In contrast where most people live and where most schools are located in this region include ecosystems which are poorly described in most published field guides. These overlooked ecosystems include grasslands, disturbed areas, riparian areas, and ecotones between open dry habitats and forests. We will also include coverage of species groups that are often poorly represented in other natural history guides including grasses, invertebrates, and other speciose groups. Our guide will also be unique in the degree of documentation of references and sources of information provided so that interested members of the public as well as students participating in our program can easily find more specific information about any given species mentioned in the guide.

#### Status as of October 1, 2004:

*Voucher Collection* - Undergraduate fellows collected over 500 plant specimens that will be used to create durable three-ring binder plant specimen books for each of the five participating ECOS schools, and for the main ECOS office. Initially spring wildflowers were collected, then plants blooming in the summer, as well as leaves and fruits of trees and shrubs. Specimens were then identified, pressed and dried. From these collections and other sources of data a list of the 150 most important species was developed.

*On-Line Guide to Plants* - ECOS undergrad fellows worked over the summer months to develop descriptions of each of the species in the voucher collection by combing the library, the web, published field guides, and ethnobotanical sources. To date, the fellows have described more than 150 of the most common plant species around Missoula and Ravalli Counties. We now have digital photos for the most common 300 species of plants in our area. We plan to have photos of each plant including general habit, seedling stage, flowers, fruits, leaves, mature stage, and other features needed for identification.

Beginning in September the editors of the guide have been working with the technology support specialist, Josh Burnham, to design the format of the guide and start posting information on plant species. Before posting, all plant descriptions are being double checked, and information on closely related species (from technical floras, such as *Flora of the Pacific Northwest*) are being added so that teachers and students in ECOS as well as naturalists and scientists in the northern Rockies will have accurate information on at least our most common and characteristic species in low elevation areas. The first on-line elements of the guide can be found at [www.bioed.org/ecos/](http://www.bioed.org/ecos/) . When completed this website will be a unique source of information for both students and teachers on the most common and important species of plants and animals in the U.S. northern Rockies region as well as a rich source of information on how to use these species for education projects in the region.

*Animals* - Several groups of animal species will also be featured in the ECOS nature guide including birds, mammals, fishes, amphibians, reptiles, some invertebrate families and others. We are now compiling species lists starting from those covered in the *Schoolkids Guide to Neighborhood Nature of Western Montana* (developed with the NSF-Funded Montana TIE Project) and including an additional 20-30 species or families in each group.

Future Plans: By the end of this schoolyear we plan to have posted descriptions of about 200 species or groups of animals and 150 species of plants (and some information on additional 100-200 species of closely related plant species) in our ECOS region. In the spring we will also be designing an easy to-use online key or search engine which will allow people to identify plant or animal species by listing

characteristics, habitat and other features. The web interface will provide lists of species that share the characteristics provided by a user to easily narrow the search down to the most likely species. Then the user can then check the digital photos against the descriptions of these species to identify the plant or animal of interest.

We will be adding instructional material for the most common and interesting species. This will be in the form of study questions and ecological studies that class projects could use to work with these local species. ECOS teams will provide these curricular links as they develop instructional materials for use in their schoolyards.

### ***Schools and Demonstration Projects***

We were successful in recruiting five schools in western Montana as our first ECOS partners, representing the entire K-12 grade band. Four of the schools are public and one is private, allowing for comparisons of program success and sustainability in two different types of schools. Two of our schools are K-8 (Target Range, public; Sussex, private). We are working with one “urban” elementary school (Lewis and Clark, K – 5), and one “suburban/rural” high school (Big Sky High School, 9-12). Our fifth school is a rural K-12 school (Florence Carlton School). Details of the students served and their standardized test results are shown in Table 2.

ECOS Demonstration Projects are being designed and implemented to 1) take advantage of unique ecological features in a given schoolyard or adjacent “natural area” to develop sustainable outdoor research laboratories, 2) integrate technology, and 3) sustain long-term use of these resources for teaching and learning about science and allied fields in general, and ecology in particular. The projects will serve as models for schoolyard research and science education that can be readily transported to other sites and schools within and beyond the region. Fellows began their projects in late August, 2004. Each of the ECOS school teams has compiled a short report describing their demonstration project and its status after 6 weeks.

Table 2. Demographics and Academic Standing of Participating ECOS schools.

School	Grade Range	Rural Suburban or Urban	Ethnicity*	# of Students	% Free/ Reduced Lunch**	Academic Standing*** % Proficient by district and AYP****
Lewis and Clark Elementary	K-5	Suburban	AA <1% AI 6% H 2% W 90% AS 1%	448	35%	Reading 76% Math 74% AYP: No
Big Sky High School	9-12	Suburban	AA <1% AI 3% H 1% W 94% AS 2%	1403	21%	Reading 82% Math 77% AYP: No
Florence Carlton School	K-12	Rural	AA 1% AI 1% H <1% W 97% AS 1%	473	25%	Reading 79% Math 71% AYP: No
Sussex School (private)	K-8	Suburban	W 100%	72	N/A	Not Available
Target Range Elementary	K-8	Rural	AA <1% AI 2% H <1% W 94% AS 3%	452	16%	Reading 85% Math 81% AYP: Yes

\*AA= African American, AI= American Indian, H=Hispanic, W= White, AS= Asian

\*\*Indicator of Socioeconomic Status

\*\*\*For most recent year information available 2002-03

\*\*\*\*AYP= Adequate Yearly Progress per No Child Left Behind

### **Lewis and Clark School**

Demonstration Project Title: Bancroft Pond Project

Ecological Themes: Biodiversity, Seasonal Changes in Communities, Habitat Restoration, and Invasive Species.

Target Grades: K-5 (the whole school)

Project Description: The Lewis and Clark team is focusing their school demonstration project on a small pond/wetland ecosystem within a short walk of Lewis and Clark

Elementary School. This pond has often been used as an ecological field trip site for the school, and the faculty as a whole has shown interest in developing it as a showcase demonstration project for their science classes. In addition, the pond has recently been added to the agenda of the Missoula Parks and Recreation Department, who hope to “restore” the pond for its value as a natural ecosystem and for use by the local community. Given the timing of the Missoula Parks and Recreation’s attention to the pond and the teachers’ collective interest in playing an active role in the ponds’ restoration, this has proved a great opportunity for ECOS. The ECOS Team has provided the leadership for Lewis and Clark School’s use of the site in a demonstration project that will have sustained long-term impact on both the school’s science curricula and on the neighborhoods surrounding the pond, where many students and faculty live.

The ECOS Team’s work at Bancroft Pond will include everything from providing feedback to Missoula Parks and Recreation engineers on their restoration design plans, to making name plates for plants and ecological features in the area, to guiding classes in ecological experiments. Most of the Bancroft Pond activities will involve Lewis and Clark students/teachers, from surveying with classes to document plant, bird, herpetological, and mammal species to recording how seasonality affects the biological community at this wetland area.

There are a few permanent features we plan to add to the pond area, which will promote future scientific investigation of the area. 1) Plant identification name plates will be placed by trees and plants of interest; 2) a bird blind at the pond will enable students and community members to view birds with minimal disturbance. The blind’s structure will have built-in bird identification photos/descriptions, so observers can learn more about the ecology of the birds they are looking at; and 3) animal track plates, which when accompanied with a track identification guide will be a useful way to show the use of less conspicuous mammals and other fauna.

#### Timeline:

September: Initial surveys of the pond and an informational meeting with representatives from the Missoula Parks and Recreation Department.

October: Provide comments to Missoula Parks and Recreation on restoration plans, begin acquiring materials for name plates, bird blind, and track plates, and conduct baseline biodiversity surveys with classes.

Status: The team has met with representatives from the Missoula Parks and Recreation Department and obtained a copy of their restoration plans. They also have conducted preliminary surveys of the pond's biota, including plant species, birds, reptiles and amphibians, and mammals, and began research for interpretive signs to be installed at Bancroft pond. Finally, the team has begun gathering information to provide feedback to Missoula Parks and Recreation Plan.

### ***Sussex School***

Demonstration Project Title: Montana Habitats - If we build it they will come!

Ecological Themes: Restoration, Biodiversity

Grades: K – 8 (Whole school)

Project Description: Restoration of the schoolyard from a non-native to a native environment, and monitoring of biodiversity and ecological health before, during, and after restoration is the theme for Sussex School. Sussex is a K-8 school and all of the grades will participate in project activities.

The Sussex ECOS Team will create a native ecosystem out of the weed-invaded schoolyard environment and facilitate an increase in ecological research by students. Prior to restoration, the Team and students will conduct surveys of the schoolyard to quantify the organisms residing there, including plants, invertebrates, mammals, birds, reptiles, and amphibians. In addition, these surveys and other investigations will be conducted throughout the restoration period and again once restoration is complete. The desired outcomes of these activities consist of helping students acquire skills in performing outdoor research, examining and comparing the non-native with the native environments.

The main themes are broken down into the following topics:

1. Native vegetation including identification, disturbance, succession, adaptations, a butterfly garden, medicinal plants, and studying tree rings and decaying logs.

2. Experimental vegetable garden and the development of an on-site greenhouse for further studies.
3. Riparian habitat, which will provide areas to conduct water quality studies and aquatic macroinvertebrate surveys. A pond zoo will be created to expand the opportunities.
4. Weather monitoring and alternative energy.

The restoration project will be an ongoing project for years to come. This year's goals are to plan for the demonstration project; plant a butterfly garden; write a grant proposal to fund the project; develop investigations and experiments; map the schoolyard; conduct initial surveys of schoolyard; and develop online invertebrate field guide for ECOS.

Status: Six investigations have been developed by the Sussex Fellows and three have been conducted to date. Plans for the butterfly garden are currently being developed. Contacts have been made with professionals and resource providers for the butterfly garden. Curriculum for investigating the biodiversity prior to implementation of the butterfly garden are currently being created by the teachers and fellows.

### ***Target Range School***

Demonstration Project Title: Schoolyard Restoration/Montana Garden Project

Ecological Themes: Recycling and Composting, Weed Management, Biome Inventory, Water Cycle, and Land Restoration

Target Grades: K – 8 (Whole School)

Project Description: Target Range School has a large area of vacant land located within its school grounds. Approximately two years ago a native plant garden representing the biomes of Montana was established in this area. Due to lack of funding and support, this project has had many setbacks. Fortunately the ECOS team will collaborate on this project, and be able to provide the leadership that will result in the design and implementation of a sustainable native plant garden that will be available to all grade levels at Target Range.

Five ecological themes have been selected as focal points for the project. Each of these areas is essential for developing a native plant garden as well as teaching the



importance of ecology to a wide range of students. Creating a native plant garden will act as the focal point from which all-ecological themes and inquiries will be developed. This will aid in providing each student a sense of ownership into the project as well as giving them a real world of how ecological principles can be applied in the field. Each ecological theme has a goal and links to the curriculum at target grade levels, as follows:

- *Recycling and composting* (K-8) - To introduce the importance of recycling and composting in sustainable systems. The curriculum links include whole-ecosystem concepts and resource management.
- *Weed management* (4-8) - To create a weed management plan for the schoolyard and promote a greater understanding of strategies in weed management. Curriculum links include native plant ecology and human-environment interactions.
- *Biome inventory* (K-8) To define statewide biome types for Montana garden map and inventory plants existing in the garden area. Curriculum links include biodiversity and distribution of organisms, mapping, math and graphing exercises, and technology applications.
- *The water cycle* (K-8) - To promote the understanding of the properties of water as it relates to physics, plant physiology, chemistry, and hydrology. Curriculum links include resource distribution, management, and conservation of water.
- *Restoration* (K-8) - To create a sustainable native plant garden. Curriculum links will include plant diversity, physiology and genetics, soil ecology; historical plant uses, and disturbance ecology.

#### Timeline:

September-November: Set up irrigation, weed control, obtain plant materials, and conduct soil sampling

December-February: Plant propagation, seed experiments

March-May: Out-planting projects, garden restoration

### ***Big Sky High School***

Demonstration Project Title: To burn or not to burn - what is the question?

Ecological Themes: Disturbance as an ecological process, prescribed burning for

control of invasive weeds

Target Grades: High School Sophomores and Juniors

Project Description: This demonstration project will introduce students to the scientific process in a hands-on manner using a subject that is extremely relevant locally.

Prescribed burns of field plots will be conducted with varying levels of fuel augmentation, and observations of the subsequent succession of plants and insects will be made.

Because the team is working with teachers who are teaching in an interdisciplinary curriculum, there are exceptional opportunities to integrate statistics and mathematics into the plan. A sampling design has been developed for monitoring the burn. There will be a total of nine plots, each one 20 X 20 meters. There will be 10 meters of buffer in between adjacent plots. The area around the plots will be thoroughly cleared of plant matter to prevent the spread of fire. Three of the plots will serve as controls, and the remaining six plots will be divided into two groups, one of which will received a moderate amount of fuel augmentation, and the other will received heavy augmentation with light fuels such as grass. Before the burn, transect sampling will be performed to determine which plants are present as well as their abundance. Insects also will be captured using pit fall traps and sweep nets. The burns themselves will be conducted by trained firefighters handling drip torches with a fire engine present. Paint tablets will be used to determine the heat of the fire and how deep the heat penetrates the ground.

Afterwards the ground will be partially seeded with native plant species. The students will return to the site periodically during the year to observe how plant and insect succession differs depending on the treatment.

Timeline: The experimental plots have already been located on public land managed by the Department of Natural Resources and Conservation (DNRC). We signed a memorandum of understanding with the DNRC, defining the project timeline as September 22, 2004 through June 30, 2005 with an option to renew for two additional years. We will prepare the plots for burning, conduct pre-treatment sampling, and coordinate volunteer fire-fighter efforts in late September to early October. The ECOS Team has obtained a public burn permit from the Missoula County Health Department that allows for the burn to occur on any day with high air quality before October 31,

2004. The goal is to conduct the prescribed burn treatments in mid- to late October. Nearby households will be notified of the project so they are prepared to expect a small amount of smoke on the day of the fire; pamphlets will be developed and be available on site for public education purposes. Big Sky High School students will write about the project in the school newspaper and have posters describing the project in the school. If the burns cannot be conducted in the fall due to poor air quality, we will conduct them in the early spring.

Status: A memorandum of understanding has been prepared with the DNRC to conduct the prescribed burns and have the students collect data on their land. The ECOS Team is currently working with the DNRC to design signs for trail closures to reduce public use of the experimental site. These signs will serve as public education tools as well. The Missoula County Health Department granted a permit to conduct the prescribed burns between September 4 - October 31, 2004, which requires a minimum of three professional firefighters and the presence of a fire engine. Currently, five firefighters have volunteered for the project and coordination to assign a fire engine for the project is underway. The treatment plots have been designated and plants identified within these plots. The team has an exercise planned to train the students in sampling techniques. The students will use this knowledge to conduct pre-treatment sampling on the experimental plots.

### ***Florence – Carlton School***

Demonstration Project Title: Restoration and Development of An Outdoor Classroom

Ecological Themes: Restoration and Biodiversity

Target Grades: K-12 (whole school)

Project Description: The demonstration project and ecological themes for Florence-Carlton School focus around the “outdoor classroom”. Currently, the area referred to as *Our Outdoor Classroom* (OOC) is an undeveloped natural area adjacent to the school. This area provides habitat for native Montana flora and fauna—as well as noxious weeds—and is an excellent site for outdoor learning. The ECOS Team’s focus this year will be assisting the Florence-Carlton community and school in the development and utilization of the OOC as an outdoor classroom.

The demonstration project, to transform the Florence-Carlton site into an outdoor classroom that can be sustained beyond the ECOS grant involves a first step of elevating awareness of the resource within the school community. Some teachers use this area in its current state, but ECOS fellows have taken a leadership role in the development of ecologically themed projects that will transform the site. The fellows will serve as ecological interpreters for the teachers and role models for students, maximizing the potential of the site as an educational resource.

A project currently under way is the mapping of the OOC to serve as a basis for future planning of site improvements. The mapping process will provide abundant opportunities for ecological study. Florence-Carlton teachers have requested that the ECOS Fellows help determine the best places for trails to preserve and highlight the most unique ecological features—which includes the nest cavity of a pair of kestrels. The high school geography and biology classes are making plans for mapping the classroom using GIS tools, followed by trail placement and construction. The ECOS fellows are also working with the teachers to have the outdoor classroom certified by the National Wildlife Federation as an official *Schoolyard Habitat*.

This year's ecological themes are restoration and biodiversity. One of the long-term goals is removal of invasive weeds from the OOC. As this restoration program progresses, there will be opportunities to encourage students to begin thinking about research projects that monitor the effects of the restoration efforts on the abundance and distribution of native species. Weed removal has already begun, with even kindergarteners taking part and getting their hands dirtied.

Specific research projects will be shaped by student and teacher interests and needs, yet also be connected to the rich biodiversity of Florence-Carlton's outdoor classroom. Many of the grade levels will be involved in ecological monitoring as the seasons change and as invasive plants are removed from the site. The OOC contains moisture and elevation gradients across which students may investigate ecological differences. Teachers and students are being recruited to participate in the initial planning for construction of butterfly, native plant and farm crop research gardens.

The Florence-Carlton School community has grown aware of the opportunities available for ecological study right in their own backyard as a result of the ECOS

program. The ultimate goal is to leave the school with lasting resources: a permanent and formal outdoor learning area; an in-depth species inventory of the region; ongoing biodiversity monitoring programs; a culture of inquiry-based learning and investigation; and curricula for use in ecological studies.

*ECOS Activities by Grade Level:*

**K-1:** The ECOS partner teachers teach kindergarten and first grade. Each ECOS fellow is with these classes on a weekly basis teaching the students about nature both indoors and outside the classroom.

**2-5:** Currently, students in these grades have been introduced to the OOC and have been out on “ecotours” (as have K-1 students). ECOS Fellows are working with a third grade teacher to engage students in individual research projects, as well as mentoring individual students in science and nature.

**High school:** ECOS fellows are working with the geography teacher to involve students in site mapping. The biology teacher has expressed interest in research projects related to plant and bird diversity in the outdoor classroom. The English teacher is interested in integrating ecological themes into her curriculum. The social study teacher will use ECOS fellows as a contact for students interested in community service and we will involve them in the development of a demonstration project.

*Ongoing priorities:*

1. Encourage and help teachers and students to conduct ecology research projects in OOC.
2. Outreach by ECOS fellows to bring K-12 teachers into contact with research and teaching faculty from the University of Montana.
3. Mentoring of students interested in ecology.
4. Fellows are present at the school during regular ECOS hours at a station in the library so that they are available to students and teachers.

Timeline:

*September:* Introductions between ECOS Fellows and the school community occur. Fellows meet with teachers and students, sparking interest in the OOC by leading nature tours and initiating collaborations for restoration and research projects.

*October:* Continue to map site and determine ecologically important areas for preservation. Continue trail design and start trail construction with high school volunteers. Meet with landscape architect to help plan for enhancement of OOC. Continue trash collection. Start research projects with third-graders.

*November:* Continue mapping site, continue trail construction.

*December:* Design garden plots.

*January:* Serve as mentors/advisors for science fair projects.

*February:* Start planning for Earth Day festivities.

*March:* Planning for native species plantings. Construct new fencing around OOC.

*April:* Begin constructing and placing interpretive signs. Conduct Earth Day activities.

*May:* Begin new weed pulls.

### **Other ECOS Collaborators and Contacts**

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Gail Gutsche, State Representative(D): Guest speaker (planned Fall 2004) for Target Range School

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Bitterroot Restoration Inc 406-491-4991  
500 dollars of plants donated from next year's stock; irrigation components scavenged  
from their outdated material; 200 one gallon plants