3735 SE Clay Street
Portland, OR 97214
503-239-1820
Fax 503-239-1183
www.beoutside.org

Lynn Wilson
Metro Regional Parks and Greenspaces
600 NE Grand Ave.
Portland, Oregon 97232-2736

December 20, 1999

Dear Lynn,

Enclosed you will find the final report information for the Metro Greenspaces Environmental Education grant for Wolftree, Incorporated. The dollars provided by Metro will afford the cost of bus transportation for students who attended the Cascade Streamwatch Program in 1999. Thanks to your support many Portland Metro Area students were able to take part in exceptional science education in the outdoors.

There are 5 attached documents to the Metro final report: (1)1999 busing bills, (2)In-kind totals-hours and dollar amounts, (3)1999 Schools and Student Information, (4)Cascade Streamwatch Program Evaluation, and (5)Wolftree's Ecology Field Guide. There are 4 copies of the Cascade Streamwatch Program Evaluation, each completed by different teachers. If you would like additional evaluations those can be forwarded to you. The Ecology Field Guide you have received was distributed to Cascade Streamwatch teachers and mentors this fall in a draft form, and is currently being revised by the Education Specialist at Wolftree. When our completed version of the Ecological Field guide is finished I will send one to you at your request. In addition, Cascade Streamwatch slides and a Wolftree 1998 annual report will be sent to you in the following weeks.

Please don't hesitate to contact me about any information you need or any questions you have. Thank you.

Sincerely,

Joellen Shannon

Joellen Shannon
Cascade Streamwatch Program Manager

a charitable non-profit that provides educational programs in the ecological sciences

DOCUMENTATION MUST BE ATTACHED FOR ALL COSTS

	Description of Services or Materials Purchases	Cost or Cash Value *(cash, in-kind materials & services; volunteer labor)	Request for Reimbursement from Metro*
PERSONNEL COSTS Volunteer hours are valued at $5.50 per hour. Attach time sheets or receipts for in-kind and reimbursements.	Staff : Specialized in-kind services: Non-specialized in-kind services: (see attached In-kind hours and dollar amounts information sheet) **Total:**	$58, 000(ytd) $36, 160* $ 8, 228 **$87, 924** *Specialized in-kind dollars are based on an auditor estimated specialized labor cost($20/hour). This estimate may change from year to year.	$0
MATERIALS & SUPPLIES Briefly describe. Attach receipts for in-kind and reimbursements.	Equipment(waders, water quality kits): Rent: Utilities: Telephones: Insurance: Postage/delivery: Travel: Training: Program expenses: **Total:**	$ 1, 250.00 $ 7, 875.00 $ 500.00 $ 1, 697.50 $ 2, 806.25 $ 566.25 $ 2, 781.25 $ 488.75 $ 4, 246.25 **$22,211.25**** **Program materials and supplies are based on ¾ year expenses, a ¼ of the year is estimated from the ¾ year totals.	$0
EQUIPMENT RENTAL Briefly describe. Attach receipts for in-kind and reimbursements.	none		$0
PROFESSIONAL or OUTSIDE SERVICE(S) Briefly describe. Attach receipts for in-kind and reimbursements.	Transportation Costs for schools attending Cascade Streamwatch	$6,620.29	$6,620.29
TOTAL REIMBURSEMENT REQUESTED:			$6,620.29

***Reimbursement cannot exceed more that 50% of total project cost or more than total cash outlay and all must have a 1:1 match.**

1999 School and Student Information

Students Served by Cascade Streamwatch in 1999: 1572

1999 Summer

Portland Boys and Girls Club field day: 150
Independent Living Skills Group:10

1999 Spring and Fall Counts: 57 classes/1412 Students served

46 Classes/ 1159 Oregon Students
11 Classes/ 253 Washington Students

Spring 1999
23 Oregon Field Days/557 students
6 Washington Field Days/124 students
29 Total Days/ 681 Students

Fall 1999
22 Oregon Field Days/602 students
5 Washington Field Days/129 students
27 Total Days/ 731 Students

Grade Level
All Schools

	Spring 1999		Fall 1999	
School type	**# schools**	**%**	**# schools**	**%**
Elementary	4	14%	4	15%
Middle	12	41%	11	41%
High	12	41%	12	44%
Home	1	3%	0	0%

Grade Level
Oregon Schools

	Spring 1999		Fall 1999	
School type	**# schools**	**%**	**# schools**	**%**
Elementary	4	17%	4	18%
Middle	9	40%	9	41%
High	9	40%	9	41%
Home	1	4%	0	0%

Grade Level
Washington Schools

	Spring 1999		Fall 1999	
School type	**# schools**	**%**	**# schools**	**%**
Middle	2	33%	2	40%
High	4	66%	3	60%

Public/Private
Oregon Schools

	Spring 1999		Fall 1999	
School	**# schools**	**%**	**# schools**	**%**
Portland Public	12	52%	13	59%
Other Public	8	35%	7	32%
Private	3	13%	2	9%

Public/Private

Washington Schools	Spring 1999		Fall 1999	
School	# schools	%	# schools	%
Vancouver Public	1	14%	1	20%
Other Public	6	86%	4	80%
Private	0	0%	0	0%

CSW Spring 1999 Schools

Environmental Middle-30
Binsmeed Middle-24
Winterhaven Middle-23
Centennial High-25
Fowler Middle-18
David Douglas High-17
Hall Elementary-28
Portsmouth Middle-24
Welches Middle-19
Grant High-26
West Gresham Elementary-23
Jesuit High-27
Cleveland High-20
Mt. Tabor Middle-27
West Lynn High-22
Kelly Elementary-27
Jefferson High-16
Faubion Elementary-28
Parkrose High-18
George Middle-24
Fernwood Middle-26
Home School Group(k-12)-32
Portland Jewish Academy (k-8)-33
Battleground High.-10
Washugal High-31
Prairie High-26
Lewisville Middle-16
Vancouver School of Arts&Academics-34
Green Mountain Middle-7

CSW Fall 1999 Schools

David Douglas High-20
Grant High-17
George Middle-21
Byrom Elementary-25
Franklin High-21
Welches Elementary-21
Reynolds High-32
Madison High-26
Sandy High-30
Mt. Tabor Middle-27
Binnsmead Elementary-31
Kellogg Middle-26
Kelly Elementary-26
Molalla River Middle-23
Marshall High-30
Jefferson High-21
Faubion Elementary-28
Ockley Green Middle-31
Centennial High-25
Portsmouth Middle-31
Lewisville Middle-28
Pacific Middle-30
Ft. Vancouver High- 24
Evergreen High-22
Battleground High-25
Catlin Gabel Middle-60
The Madeleine Elementary-30

Exibit 3
Greenspaces Environmental Education Projects
Final Report Format-Wolftree Inc.

1. Cascade Streamwatch is an aquatic ecology program that serves elementary, middle and high schools in Northwest Oregon and Southwest Washington. The program is designed to complement, supplement, deepen and enhance classroom science studies. The program's goals are to: (1) enhance young people's awareness and appreciation of Pacific Northwest aquatic ecosystems, while cultivating skills in science, math, and problem-solving and (2) to develop and maintain ecosystem monitoring programs aimed at restoring fish and wildlife habitats in the Pacific Northwest. These goals are accomplished through hands-on field studies with professional scientists.

After an in-class preparation by Wolftree staff, students embark on a field investigation of wetland, stream and river habitats. With the help of volunteer professional biologists, students observe, make hypotheses, collect and interpret data and come up with their own conclusions about the system. Students then present their findings to their peers.

Cascade Streamwatch participants gain an understanding of the framework for monitoring local aquatic ecosystems and in turn become stewards of their environment. In addition, the program: (1) provides an exciting and challenging introduction to watershed science (2) yields data on critical watershed parameters for watershed analysis (3) increases teacher and student confidence and competence in science (4) meets students' needs for achieving Science Benchmarks and fulfilling CIM/CAM requirements (5) provides an opportunity for quiet contemplation in nature (6) builds self-esteem through teamwork and creative problem-solving and (7) yields a model for helping teachers design performance tasks for Science Inquiry Benchmarks.

The program has been educating youth about watershed science for over 5 years and has served 8,250 students and teachers. As our program grows to meet its demand, our curriculum and education methods improve with each season. Students were better served in 1999 with written curriculum (see attached Ecology Field Guide) and additional study sites (Three Creeks, OR, Pierce National Wildlife Refuge, WA). In addition, more students were served in 1999 than any previous year. From January of 1999-December 1999 CSW served 1572 students and 45 teachers (see attached 1999 Students Served)

2. The 1999 spring and fall Cascade Streamwatch seasons were highly successful in serving students and in achieving program goals and outcomes. We are able to evaluate our program and its achievements through internal and external evaluations. Internal evaluations consist of a formal exit assessment of the program by the Cascade Stramwatch Program Manager, the Assistant Manager and the Education Specialist. External evaluations consist of a written evaluation that all participating teachers must complete at the end of their field experience. These evaluations give us information about the effectiveness of the in-class preparation, curriculum materials, field day (program goals and outcomes), and overall program structure. (See attached Cascade Streamwatch Program Evaluation). Through both internal and external evaluations we

found numerous successes within the program, as well as a few items that need improvement.

In the spring of 1999 the program emphasized its field studies on 5 ecological concepts: disturbance, food web, species diversity, species relationships and species adaptation. (See attached Ecology Field Guide). This emphasis proved helpful for students and focused and distinguished our curriculum. This ecological focus spurred a change in our in-class prep, and in the end of the day wrap-up, both of which aided the students we served.

The changes in the in-class prep included an introduction to the 5 ecological concepts, an introduction to the activities through hands-on work with the data collection materials, and general introduction to the research site. Giving students a background in aquatic ecology helped them to understand the big picture, and allowed them to make connections between living and non-living components in the ecosystem. Giving students the data collecting tools prior to their field experience also better prepared students for their field study. According to teachers, "the hands-on introduction to activities... gave the kids a great focus".

Wrap-ups were also improved in 1999. Instead of just discussing what students discovered in a large group, we offered 3 wrap-up options from which teachers could choose. This allowed us to serve our diverse population of students better, and it focused the field study for students, not leaving it broad nor undefined. Teachers could choose to focus on: (1) the 5 ecological concepts, (2) hypothesis testing, or (3) salmonid habitat. Although each option had success, each one also needs some improvement. We need to increase involvement from all students during the wrap-up, and we need to improve the structure of student presentations. In addition, time restraints are always an issue in this category. This was a common complaint expressed by teachers in their evaluations.

The Wolftree Ecology Field Guide improved and standardized Cascade Streamwatch curriculum materials. Teachers reported that the guide was "useful", and effective in preparing students for the field experience. The Ecology Field Guide that was distributed this fall was in a draft form. Wolftree is in the process of completing the final edits on this guide and the final format will be complete for the spring of 2000.

Through further analysis of compiled teacher evaluations, the fall 1999 *field day experience* and *overall program experience* rated a 5.4 on a scale of 1-6 (1 being poor, 6 being excellent). *Field day experience* consisted of program goals/student outcomes and program structure, while the *overall program experience* consisted of teacher expectations, student reactions, and curriculum enhancement.

Although the evaluation systems in place have proven to be effective, Wolftree has begun developing additional evaluation tools for our programs. Wolftree is working with Portland State University staff to develop a longitudinal evaluation process. This will focus on: (1) changes in students' skills, knowledge, attitudes, and behaviors and (2) the efficacy and efficiency of the program's structural and functional features. This information will be helpful to assess the long-term effectiveness of Wolftree programs on its participants. Wolftree is also developing mentor and student evaluations to better understand the benefits and shortcomings of our programs.

Cascade Streamwatch Program Evaluation

WOLFTREE

Teachers–We need your feedback to continually improve our programs. Your completion of this evaluation is required. We appreciate your investing this time to help our future students. **Thank You!**

School: Portsmouth Teacher's Name: Wickham Grade level(s) 8

Prior to CSW, how much time had your class spent in the field : ❒ no time ❒ some time ❒ lots of time

Check wrap- up option of your class: ❒ Coho (concepts games) ❒ Chinook (hypothesis) ❒ Steelhead (salmon habitat)

Use the following scale for this evaluation

1	2	3	4	5	6
Poor	Inadequet	Adequet	Good	Very Good	Excellent

In-Class Preparation Visit by the Wolftree Staff

Please rate the effectiveness of the in class prep by Wolftree staff in preparing students for the field day.

	1	2	3	4	5	6
Introduction to the site	❒	❒	❒	❒	❒	☑
Ecological concepts overview	❒	❒	❒	❒	❒	☑
Small group activities	❒	❒	❒	❒	❒	☑
Overall effectiveness in preparing students for the field day	❒	❒	❒	❒	❒	☑
Overall effectiveness in building excitement about the field day	❒	❒	❒	❒	❒	☑

Comments/Ideas for improvement/enhancement:

I like the slide show - it doesn't have to be so long but kids like to know what it will look like & whats happening.

Ecology Field Guide

Please rate the effectiveness of the Ecology Field Guide in preparing your students for their field study.

	1	2	3	4	5	6
Ecological concepts	❒	❒	❒	❒	❒	☑
Water quality sections	❒	❒	❒	❒	❒	☑
Macroinvertebrate section	❒	❒	❒	❒	❒	☑
Streamflow section	❒	❒	❒	❒	❒	☑
Wetlands background section (Wildwood classes only)	❒	❒	❒	❒	❒	❒

Comments/Ideas for improvement/enhancement:

I really think it helped me prepare the student big improvement

FIELD DAY EXPERIENCE

Program Goals/Student Outcomes: Please rate the degree to which the following program goals and outcomes were accomplished/achieved FOR STUDENTS:

	1	2	3	4	5	6
Provide an exciting & challenging intro to aquatic ecology	☐	☐	☐	☐	☐	☑
Gain confidence and increased knowledge in science	☐	☐	☐	☐	☐	☑
Meet needs for fulfilling Science Benchmarks or CIM/CAM	☐	☐	☐	☐	☑	☐
Enhance awareness of and appreciation for nature	☐	☐	☐	☐	☐	☑
Build self-esteem through teamwork and creative problem-solving	☐	☐	☐	☐	☐	☑
Have fun while learning	☐	☐	☐	☐	☐	☑
Examine and observe patterns in aquatic ecosystems	☐	☐	☐	☐	☑	☐
Formulate hypotheses /ask questions	☐	☐	☐	☐	☑	☐
Test hypotheses/answer questions	☐	☐	☐	☑	☐	☐
Collect and organize data	☐	☐	☐	☐	☐	☑
Analyze data and interpret results	☐	☐	☐	☐	☐	☑
Formulate and debate conclusions	☐	☐	☐	☐	☐	☑
Communicate results and conclusions effectively	☐	☐	☐	☐	☑	☐
Articulate connections between themselves &watersheds	☐	☐	☐	☐	☑	☐

Comments/Ideas for improvement/enhancement:

I think we need to present at another day or time. They are so tired that I think they could do some writing alone + then present at school the next day maybe to another class - the students always struggle

Program structure: Please rate the degree of effectiveness of the field day:

	1	2	3	4	5	6
Amount of time spent on field work	☐	☐	☐	☑	☐	☐
Staying at one site (as opposed to rotating)	☐	☐	☑	☐	☐	☐
Amount of time spent on summarizing data (working lunch)	☐	☐	☐	☐	☑	☐
Post it up sheets	☐	☐	☐	☐	☐	☑
Student presentations	☐	☐	☐	☐	☑	☐
Student to mentor ratio	☐	☐	☐	☐	☐	☑
Mentor Teaching	☐	☐	☐	☐	☐	☑
Small group learning	☐	☐	☐	☐	☑	☐
Equipment	☐	☐	☐	☐	☐	☑
Research site	☐	☐	☐	☐	☐	☑
Integration of Ecological Concepts	☐	☐	☐	☐	☐	☑

Comments/Ideas for improvement/enhancement:

I would like to see student getting more experience doing field work + reflecting on what they have done. It just isn't the best use of the site to do presentations.

Overall Cascade Streamwatch Program

Please rate the degree of effectiveness/success :

	1	2	3	4	5	6
Your Expectations of the program met	☐	☐	☐	☐	☐	☑
Coordination of program by Wolftree	☐	☐	☐	☐	☐	☑
Student reaction to the experience	☐	☐	☐	☐	☐	☑
Student interest in science & nature enhanced	☐	☐	☐	☐	☐	☑
Complements and supplements your science curriculum	☐	☐	☐	☐	☐	☑
Deepens and enhances your classroom teaching	☐	☐	☐	☐	☐	☑
Helps meet state science standards/benchmarks	☐	☐	☐	☐	☐	☑

Comments/Ideas for improvement/enhancement:

The people were great JoEllen was extremely organized - all staff had excellent student rapport interaction - Very positive

---

Do you plan on returning to the program next year? ☑ YES ☐ NO

Comments:

Do you plan on having your students engage further in field ecology this year? ☑ YES ☐ NO

Comments:

Do you plan to extend the Cascade Streamwatch experience back in the class room? ☑ YES ☐ NO

Comments:

Please indicate about how long it took you to fill this form out: 15 minutes.

Thank you so much for your time and effort!

Please send or fax this evaluation to:

Wolftree, Inc.
Cascade Streamwatch
3735 SE Clay Street
Portland, OR 97214

Fax #: 503-239-1183

Cascade Streamwatch Program Evaluation

WOLFTREE

Teachers–We need your feedback to continually improve our programs. Your completion of this evaluation is required. We appreciate your investing this time to help our future students. **Thank You!**

School: Kelly Teacher's Name: Julie Barbour Grade level(s) 5th

Prior to CSW, how much time had your class spent in the field : ☐ no time ☑ some time ☐ lots of time

Check wrap-up option of your class: ☒ Coho (concepts games) ☐ Chinook (hypothesis) ☐ Steelhead (salmon habitat)

Use the following scale for this evaluation

1	2	3	4	5	6
Poor	Inadequet	Adequet	Good	Very Good	Excellent

In-Class Preparation Visit by the Wolftree Staff

Please rate the effectiveness of the in class prep by Wolftree staff in preparing students for the field day.

	1	2	3	4	5	6
Introduction to the site	☐	☐	☐	☐	☒	☐
Ecological concepts overview	☐	☐	☐	☐	☒	☐
Small group activities	☐	☐	☐	☐	☐	☒
Overall effectiveness in preparing students for the field day	☐	☐	☐	☐	☐	☒
Overall effectiveness in building excitement about the field day	☐	☐	☐	☐	☐	☒

Comments/Ideas for improvement/enhancement:

I loved the "hands on" introduction to activities, tests, etc! It gave Th kids a great focus.

I missed some type of slide show, or overall picture of Wildwood. (I agree, though, if there's only time to do one aspect, do it thoroughly, and make it "hands-on" interactive.)

Ecology Field Guide

Please rate the effectiveness of the Ecology Field Guide in preparing your students for their field study.

	1	2	3	4	5	6
Ecological concepts	☐	☐	☐	☐	☒	☐
Water quality sections	☐	☐	☐	☐	☒	☐
Macroinvertebrate section	☐	☐	☐	☐	☐	☒
Streamflow section	☐	☐	☐	☐	☒	☐
Wetlands background section (Wildwood classes only)	☐	☐	☐	☐	☒	☐

Comments/Ideas for improvement/enhancement:

The sections were all useful - because some of my students are very young 5th graders, I focused on some sections more than others. I focused on student interest & previous experiences & adapted materials. Materials are a great guide.

FIELD DAY EXPERIENCE

Program Goals/Student Outcomes: Please rate the degree to which the following program goals and outcomes were accomplished/achieved FOR STUDENTS:

	1	2	3	4	5	6
Provide an exciting & challenging intro to aquatic ecology						X
Gain confidence and increased knowledge in science						X
Meet needs for fulfilling Science Benchmarks or CIM/CAM					X	
Enhance awareness of and appreciation for nature						X
Build self-esteem through teamwork and creative problem-solving					X	
Have fun while learning						X
Examine and observe patterns in aquatic ecosystems					X	
Formulate hypotheses /ask questions					X	
Test hypotheses/answer questions					X	
Collect and organize data					X	
Analyze data and interpret results						X
Formulate and debate conclusions				X		
Communicate results and conclusions effectively				X		
Articulate connections between themselves &watersheds						X

Comments/ideas for improvement/enhancement:

The program is a dream-come-true for teachers, and teacher prep. is vital. My students are novices with re: to analyzing/interpreting data, etc. - I want to focus on that more. Because of time constraints I've placed on the program (due to school schedule, buses, etc.) I've generally had a "big picture" focus, which has been great, but I'd like to "expand" on my end —

Program structure: Please rate the degree of effectiveness of the field day:

	1	2	3	4	5	6
Amount of time spent on field work				X		
Staying at one site (as opposed to rotating)				X		
Amount of time spent on summarizing data (working lunch)					X	
Post it up sheets						
Student presentations					X	
Student to mentor ratio						X
Mentor Teaching						X
Small group learning						X
Equipment						X
Research site						X
Integration of Ecological Concepts						X

Comments/ideas for improvement/enhancement:

Again, our school schedule has affected the CSW schedule - I would love to see a little more field time, students rotating or at least visiting other sites - but I recognize our responsibility for this. I appreciate the "wrap up" presentations - it brings a stronger summary focus for the kids. Seeing it this first time, I would prepare my students to be more serious next time.

OVERALL CASCADE STREAMWATCH PROGRAM

Please rate the degree of effectiveness/success :

	1	2	3	4	5	6
Your Expectations of the program met	☐	☐	☐	☐	☐	☒
Coordination of program by Wolftree	☐	☐	☐	☐	☐	☒
Student reaction to the experience	☐	☐	☐	☐	☐	☒
Student interest in science & nature enhanced	☐	☐	☐	☐	☐	☒
Complements and supplements your science curriculum	☐	☐	☐	☐	☐	☒
Deepens and enhances your classroom teaching	☐	☐	☐	☐	☐	☒
Helps meet state science standards/benchmarks	☐	☐	☐	☐	☒	☐

Comments/Ideas for improvement/enhancement:

I don't need to add much – The program is wonderful! As the science benchmarks become clearer, I am becoming more clear as to how I can continue to connect the CSW to other class experiences.

Do you plan on returning to the program next year? ☒ YES ☐ NO

Comments: We would love to –
we feel privileged to be able to participate – it's an experience for life-long-learning, something our students constantly need modeled.

Do you plan on having your students engage further in field ecology this year? ☒ YES ☐ NO

Comments: Yes, we're participating in further "forest" experiences: tree planting, visit to Old Growth forest; hopefully, further water ecology experiences, as well.

Do you plan to extend the Cascade Streamwatch experience back in the class room? ☒ YES ☐ NO

Comments: Definitely – we will continue discoveries of food chains/webs, invertebrates, forest ecology.

Please indicate about how long it took you to fill this form out: 30 minutes.

Thank you so much for your time and effort!

Please send or fax this evaluation to:

Wolftree, Inc.
Cascade Streamwatch
3735 SE Clay Street
Portland, OR 97214

Fax #: 503-239-1183

Cascade Streamwatch Program Evaluation

Teachers–We need your feedback to continually improve our programs. Your completion of this evaluation is required. We appreciate your investing this time to help our future students. **Thank You!**

School: Centennial H.S. Teacher's Name: Carolyn Smithee Grade level(s) 9-10

Prior to CSW, how much time had your class spent in the field : ☒ no time ☐ some time ☐ lots of time

Check wrap- up option of your class: ☐ Coho (concepts games) ☒ Chinook (hypothesis) ☐ Steelhead (salmon habitat)

Use the following scale for this evaluation

1	2	3	4	5	6
Poor	Inadequet	Adequet	Good	Very Good	Excellent

In-Class Preparation Visit by the Wolftree Staff

Please rate the effectiveness of the in class prep by Wolftree staff in preparing students for the field day.

	1	2	3	4	5	6
Introduction to the site	☐	☐	☐	☐	☒	☐
Ecological concepts overview	☐	☐	☐	☒	☐	☐
Small group activities	☐	☐	☐	☒	☐	☐
Overall effectiveness in preparing students for the field day	☐	☐	☐	☒	☐	☐
Overall effectiveness in building excitement about the field day	☐	☐	☐	☐	☐	☐

Comments/Ideas for improvement/enhancement:

This is a great idea. It helps kids to think in advance about the field trip objectives & activities. When splitting into two groups, it might be helpful to advise students that each group would cover the same material. Students were having a hard time concentrating on their group only.

Ecology Field Guide

Please rate the effectiveness of the Ecology Field Guide in preparing your students for their field study.

	1	2	3	4	5	6
Ecological concepts	☐	☐	☐	☐	☒	☐
Water quality sections	☐	☐	☐	☐	☒	☐
Macroinvertebrate section	☐	☐	☐	☐	☒	☐
Streamflow section	☐	☐	☐	☐	☒	☐
Wetlands background section (Wildwood classes only)	☐	☐	☐	☐	☐	☐

Comments/Ideas for improvement/enhancement:

FIELD DAY EXPERIENCE

Program Goals/Student Outcomes: Please rate the degree to which the following program goals and outcomes were accomplished/achieved FOR STUDENTS:

	1	2	3	4	5	6
Provide an exciting & challenging intro to aquatic ecology	☐	☐	☐	☐	☐	☒
Gain confidence and increased knowledge in science	☐	☐	☐	☐	☒	☐
Meet needs for fulfilling Science Benchmarks or CIM/CAM	☐	☐	☐	☐	☒	☐
Enhance awareness of and appreciation for nature	☐	☐	☐	☐	☐	☒
Build self-esteem through teamwork and creative problem-solving	☐	☐	☐	☐	☐	☒
Have fun while learning	☐	☐	☐	☐	☐	☒
Examine and observe patterns in aquatic ecosystems	☐	☐	☐	☐	☒	☐
Formulate hypotheses /ask questions	☐	☐	☐	☐	☒	☐
Test hypotheses/answer questions	☐	☐	☐	☐	☒	☐
Collect and organize data	☐	☐	☐	☐	☐	☒
Analyze data and interpret results	☐	☐	☐	☐	☐	☒
Formulate and debate conclusions	☐	☐	☐	☐	☒	☐
Communicate results and conclusions effectively	☐	☐	☐	☐	☐	☒
Articulate connections between themselves &watersheds	☐	☐	☐	☐	☒	☐

Comments/ideas for improvement/enhancement:

This was an excellent program. It is the best type of science education. Students who marginally participate in class were actively collecting data and interpreting results, and it was fun! Thank you

Program structure: Please rate the degree of effectiveness of the field day:

	1	2	3	4	5	6
Amount of time spent on field work	☐	☐	☐	☐	☒	☐
Staying at one site (as opposed to rotating)	☐	☐	☐	☐	☒	☐
Amount of time spent on summarizing data (working lunch)	☐	☐	☐	☐	☒	☐
Post it up sheets	☐	☐	☐	☐	☐	☒ good idea
Student presentations	☐	☐	☐	☐	☒	☐
Student to mentor ratio	☐	☐	☐	☐	☐	☒
Mentor Teaching	☐	☐	☐	☐	☐	☒
Small group learning	☐	☐	☐	☐	☐	☒
Equipment	☐	☐	☐	☐	☒	☐
Research site	☐	☐	☐	☐	☐	☒
Integration of Ecological Concepts	☐	☐	☐	☐	☐	☒

Comments/ideas for improvement/enhancement:

Flawless. thank you to Joellen, Jennifer & volunteers. A beautiful day too!

OVERALL CASCADE STREAMWATCH PROGRAM

Please rate the degree of effectiveness/success :

	1	2	3	4	5	6
Your Expectations of the program met	☐	☐	☐	☐	☐	☒
Coordination of program by Wolftree	☐	☐	☐	☐	☐	☒
Student reaction to the experience	☐	☐	☐	☐	☐	☒
Student interest in science & nature enhanced	☐	☐	☐	☐	☐	☒
Complements and supplements your science curriculum	☐	☐	☐	☐	☐	☒
Deepens and enhances your classroom teaching	☐	☐	☐	☐	☐	☒
Helps meet state science standards/benchmarks	☐	☐	☐	☐	☐	☒

Comments/Ideas for improvement/enhancement: Keep up the good work. Thank you

Do you plan on returning to the program next year? ☒ YES ☐ NO

Comments:

Do you plan on having your students engage further in field ecology this year? ☒ YES ☐ NO

Comments:

Do you plan to extend the Cascade Streamwatch experience back in the class room? ☒ YES ☐ NO

Comments: I plan on doing more field trips, as well as using concepts in ongoing classroom activities.

Please indicate about how long it took you to fill this form out: 15 minutes.

Thank you so much for your time and effort!

Please send or fax this evaluation to:

Wolftree, Inc.
Cascade Streamwatch
3735 SE Clay Street
Portland, OR 97214

Fax #: 503-239-1183

Cascade Streamwatch Program Evaluation

WOLFTREE

Teachers–We need your feedback to continually improve our programs. Your completion of this evaluation is required. We appreciate your investing this time to help our future students. **Thank You!**

School: Faubion Teacher's Name: Carolyn diStasio, and Gayle Quigley Grade level(s) 4–5

Prior to CSW, how much time had your class spent in the field : ☐ no time ☒ some time ☐ lots of time

Check wrap- up option of your class: ☒ Coho (concepts games) ☐ Chinook (hypothesis) ☐ Steelhead (salmon habitat)

Use the following scale for this evaluation

1	2	3	4	5	6
Poor	Inadequet	Adequet	Good	Very Good	Excellent

In-Class Preparation Visit by the Wolftree Staff

Please rate the effectiveness of the in class prep by Wolftree staff in preparing students for the field day.

	1	2	3	4	5	6
Introduction to the site	☐	☐	☐	☐	☒	☐
Ecological concepts overview	☐	☐	☐	☐	☒	☐
Small group activities	☐	☐	☐	☐	☐	☒
Overall effectiveness in preparing students for the field day	☐	☐	☐	☐	☐	☒
Overall effectiveness in building excitement about the field day	☐	☐	☐	☐	☐	☒

Comments/Ideas for improvement/enhancement:

Your prep lesson with our students was excellent. You were able to cover the studies they would be doing in all three sites very effectively in a short amount of time.

Ecology Field Guide

Please rate the effectiveness of the Ecology Field Guide in preparing your students for their field study.

	1	2	3	4	5	6
Ecological concepts	☐	☐	☐	☐	☐	☒
Water quality sections	☐	☐	☐	☐	☐	☒
Macroinvertebrate section	☐	☐	☐	☐	☐	☒
Streamflow section	☐	☐	☐	☐	☐	☒
Wetlands background section (Wildwood classes only)	☐	☐	☐	☐	☐	☒

Comments/Ideas for improvement/enhancement:

The guide is very well written. I added to the stream flow by using pictures, newsarticles and discussion about how much the streams are affected by weather and seasons. We drew pictures and wrote stories from the view point of fish during drought / flood times.

FIELD DAY EXPERIENCE

Program Goals/Student Outcomes: Please rate the degree to which the following program goals and outcomes were accomplished/achieved FOR STUDENTS:

	1	2	3	4	5	6
Provide an exciting & challenging intro to aquatic ecology	☐	☐	☐	☐	☒	☐
Gain confidence and increased knowledge in science	☐	☐	☐	☐	☐	☒
Meet needs for fulfilling Science Benchmarks or CIM/CAM	☐	☐	☐	☐	☐	☒
Enhance awareness of and appreciation for nature	☐	☐	☐	☐	☐	☒
Build self-esteem through teamwork and creative problem-solving	☐	☐	☐	☐	☒	☐
Have fun while learning	☐	☐	☐	☐	☐	☒
Examine and observe patterns in aquatic ecosystems	☐	☐	☐	☐	☒	☐
Formulate hypotheses /ask questions	☐	☐	☐	☐	☒	☐
Test hypotheses/answer questions	☐	☐	☐	☐	☒	☐
Collect and organize data	☐	☐	☐	☐	☒	☐
Analyze data and interpret results	☐	☐	☐	☐	☒	☐
Formulate and debate conclusions	☐	☐	☐	☐	☒	☐
Communicate results and conclusions effectively	☐	☐	☐	☐	☒	☐
Articulate connections between themselves &watersheds	☐	☐	☐	☐	☒	☐

Comments/ideas for improvement/enhancement:

The shortage of time is the limiting factor -- otherwise all of these would be 6's. Unfortunately, because of test scores being the only thing considered to be important nowadays our schedule at school devotes most of our time to math, reading, and writing blocks. We no longer have the flexibility needed to do as much science as we need to do.

Program structure: Please rate the degree of effectiveness of the field day:

	1	2	3	4	5	6
Amount of time spent on field work	☐	☐	☐	☐	☒	☐
Staying at one site (as opposed to rotating) There isn't time.	☐	☐	☐	☐	☐	☒
Amount of time spent on summarizing data (working lunch)	☐	☐	☐	☐	☐	☒
Post it up sheets	☐	☐	☐	☐	☐	☒
Student presentations	☐	☐	☐	☐	☒	☐
Student to mentor ratio	☐	☐	☐	☐	☐	☒
Mentor Teaching	☐	☐	☐	☐	☐	☒
Small group learning	☐	☐	☐	☐	☐	☒
Equipment	☐	☐	☐	☐	☐	☒
Research site	☐	☐	☐	☐	☐	☒
Integration of Ecological Concepts	☐	☐	☐	☐	☐	☒

Comments/ideas for improvement/enhancement:

The time is well-spent. I don't know any way to have more time at the field work or for student presentations. Don Mack and I talked about having students stay longer and having parents come up in the late afternoon to carpool them home -- but decided that would be complicated to arrange. Don left Faubion and teaches at Sitton School now.

Overall Cascade Streamwatch Program

Please rate the degree of effectiveness/success :

	1	2	3	4	5	6
Your Expectations of the program met	☐	☐	☐	☐	☐	☒
Coordination of program by Wolftree	☐	☐	☐	☐	☐	☒
Student reaction to the experience	☐	☐	☐	☐	☐	☒
Student interest in science & nature enhanced	☐	☐	☐	☐	☐	☒
Complements and supplements your science curriculum	☐	☐	☐	☐	☐	☒
Deepens and enhances your classroom teaching	☐	☐	☐	☐	☐	☒
Helps meet state science standards/benchmarks	☐	☐	☐	☐	☐	☒

Comments/ideas for improvement/enhancement:

Cascade Streamwatch is an excellent focus for many classroom activities in science.
I wonder if some kind of open House evening for parents from various schools could be held at the Wolftree house or a district location where the slides could be shown, the program explained and coffee & cookies served.

Do you plan on returning to the program next year? ☒ YES ☐ NO

Comments: Cascade Streamwatch and my association with Wolftree has been a highlight of my teaching career.

Do you plan on having your students engage further in field ecology this year? ☒ YES ☐ NO

Comments: We have taken part in the Headwaters to Ocean program and did a study of the Willamette with the Jet Boat Tours.

Do you plan to extend the Cascade Streamwatch experience back in the class room? ☒ YES ☐ NO

Comments: We have used the concepts learned for a number of classroom writing and drawing activities.

Please indicate about how long it took you to fill this form out: 30 minutes.

Thank you so much for your time and effort!

Please send or fax this evaluation to:

Wolftree, Inc.
Cascade Streamwatch
3735 SE Clay Street
Portland, OR 97214

Fax #: 503-239-1183

Wolftree's Ecology Field Guide

A Way to Find Out About the World

Wolftree programs engage the people in the process of **science inquiry**. Science inquiry is an investigation of how nature works. You engage in the process of science inquiry when you go into the field, and as you go about life. Science inquiry involves a step-by-step process for solving problems based observations.

Here's how it works:

(1) Gather background information on a topic.

(2) What do you want to know more about? Come up with a question.

(3) Use background information to guess the answer to your question (form a hypothesis).

(4) Design an investigation to test the hypothesis.

(5) Conduct the investigation and gather data.

(6) Describe the results and look for relationships in your data.

(7) Accept your hypothesis or throw it out, based on your analysis.

(8) Tell people about it.

When you design and conduct your own investigations, you gain a better understanding of the world.

Educated Guess	**Pretty Sure**	**Really sure**
• Hypothesis implies insufficient evidence to provide more than a tentative explanation;	• Theory implies greater range of evidence and greater likelihood of truth;	• Law implies a statement of order and relation in nature has been found to be invariable under the same conditions.

Ecology

The word ecology is derived from the Greek root "oikos", meaning "house". Simply put, ecology is the study of houses, or more broadly, of organisms and their relationships to their environment. The modern scientist defines ecology as "the study of the structure and function of nature".

What Is An Ecosystem?

An ecological system, **ecosystem**, is one of the most basic units in the study of ecology. While "eco" refers to environment, "system" refers to a collection of related parts that work as a whole. Some parts in an ecosystem are **abiotic**, or non-living, such as solar energy, water, rock and minerals. Other parts are **biotic**, or living, such as plants and animals. The ecosystem is the place where abiotic and biotic parts interact.

The Living Parts of the Ecosystem:

Biotic parts of the ecosystem are separated into **autotrophs** (self-nourishing) and **heterotrophs** (other-nourishing). Plants are generally autotrophs in the ecosystems. They are also referred to as the primary producers in the ecosystem. Plants use solar energy to produce food from simple non-living materials like soil nutrients, $CO2$, and water. Heterotrophs are the consumers in the ecosystem. They directly or indirectly derive their energy from the products of the autotrophs. You, for example, are a heterotroph.

Species and Their Habitats:

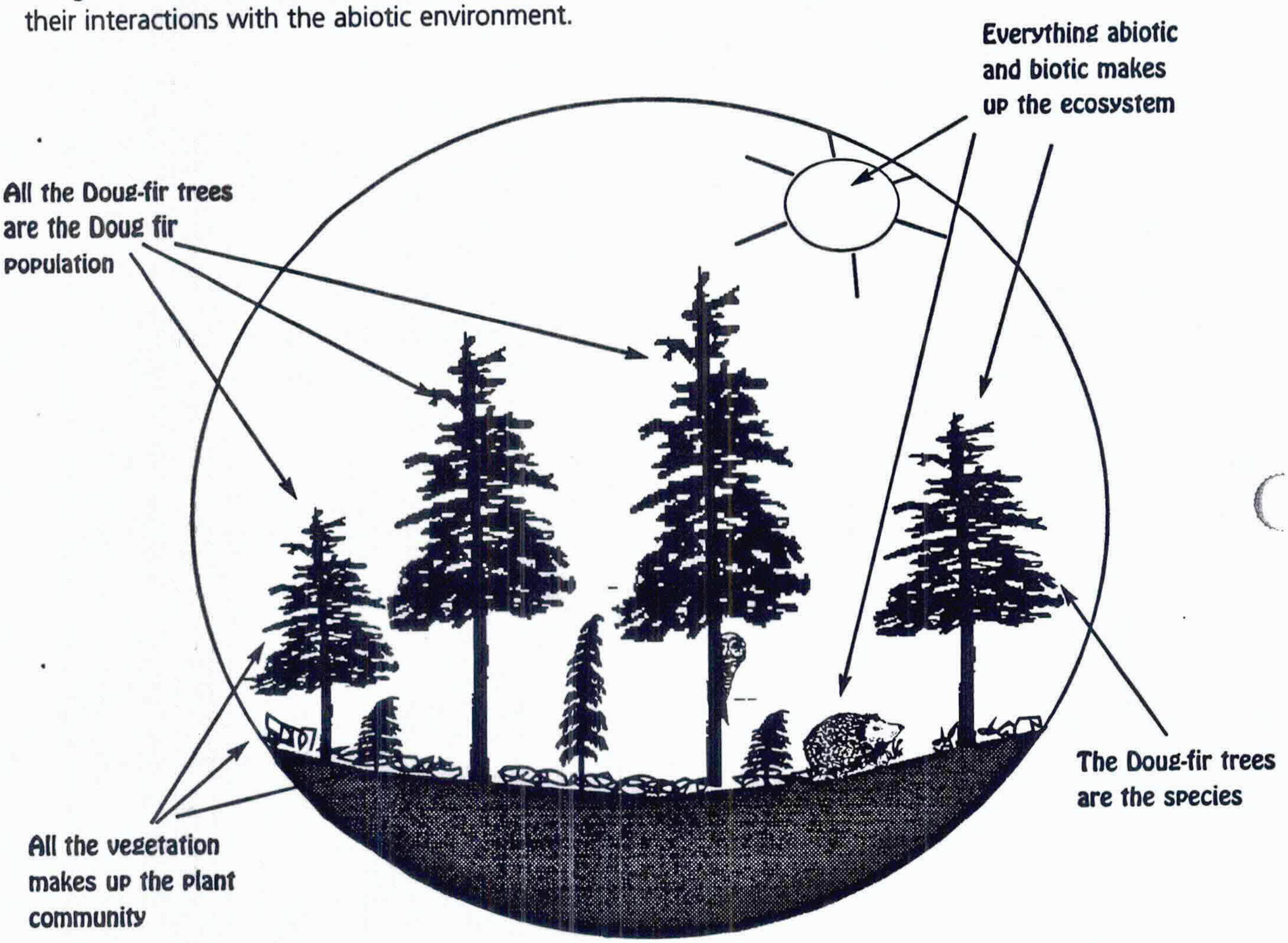
Biologists examine the biotic parts of an ecosystem as species, their habitats, populations, and communities. A **species** is the smallest unit of classification for biological organisms. Individuals of a species are alike in structure and function. Individuals of the same species can successfully breed with each other. Each species needs specific conditions to survive and reproduce. The place, or location, where an organism can meet these needs is called its **habitat**. Habitat can be described in terms of its structure. Habitat structure describes the shape, size and placement of abiotic and biotic features of an ecosystem. The structure of habitat changes as vegetation grows over time or the ecosystem is altered by disturbance (more talk about disturbance on the next few pages).

When Species Come Together:

A group of individuals that live in a particular habitat is called a **population**. A **community** is formed when the habitats of many different species overlap.

For Example:

Consider a Douglas-fir tree at the top of the forest canopy. In this location (the Douglas-fir habitat), the tree captures sunlight and uses water and soil nutrients to grow. The tree makes seeds in cones to reproduce, creating many other Douglas-fir trees. All of the Douglas-fir trees together are the population. Other plants that are tolerant of shade can grow and reproduce in the understory, below the Douglas-fir trees. The understory plants and the Douglas-fir trees together are called the community. In this example, the forest ecosystem is made up of the Douglas-fir trees, understory plants, all other organisms, their interactions with each other, and their interactions with the abiotic environment.



How Big is an Ecosystem:

Ecosystems have various sizes and shapes. Because some organisms can move among ecosystems, it is difficult to mark the boundaries of an ecosystem. Defining ecosystems with loose boundaries helps us investigate the different ways that the natural world functions. For example, the red legged frog reproduces in a wetland ecosystem, but also lives in a forest ecosystem. The wetland ecosystem has a specific function for red legged frogs as breeding habitat.

Jargon You'll Need To Proceed:

- ecosystem
- biotic components
- abiotic components
- habitat
- species
- populations
- communities

What is a Disturbance?

An ecological disturbance is an event that disrupts or changes all or part of an ecosystem. Storms, volcanic activity, tsunamis, floods, droughts and fire are examples of natural ecological disturbances. In addition, consider the less obvious disturbances such as the gradual erosion of a hillside, a slight change in the temperature of a stream, or the introduction of nutrients to soil or water. Over time, these minor events may have a significant influence on the ecosystem.

Disturbance in the Ecosystem

Events that cause disturbance alter the structure and function of ecosystems. They can change the species present in the ecosystem, the size and health of populations, and where communities are located. When you study an ecological disturbance, consider the type of disturbance, the intensity (how severe the changes are) and the frequency (how often it occurs). The frequencies, types, and intensities of past disturbance events provide key information about why the ecosystem looks the way it does today, and how it might develop in the future.

Consider how the types of disturbances may have arranged, destroyed or removed different biotic components - like the plants, soil, animals and insects - in the ecosystem that you are studying. Also, consider how the abiotic components have changed - like the rocks, water, light, temperature - as a result of the disturbances. How would a large fire that removes all the trees in a forest be different from a clearcut? How would organisms survive in an ecosystem that is regularly disturbed? How would the structure of a habitat develop with no major disturbance for an extended period of time?

Disturbing Thoughts

- What natural event in May 1980 caused a major disturbance in a large area of Washington State? How did that event change the biotic and abiotic components of ecosystems in the region? How may the disturbing event have changed ecosystems all over the world?
- What major event in 1996 resulted in changes to many local stream ecosystems? How did that event change the biotic and abiotic parts of ecosystems in the region? How may the event have changed ecosystems all the way down to the ocean?
- Describe disturbances that you might observe in a river ecosystem high in the mountains (headwaters) and in a river ecosystem as it passes through a big city. What disturbances might occur in a natural grassland on the plains of South Dakota? In a suburban backyard lawn?

Jargon You'll Need To Proceed:

- ecological disturbance
- species
- population
- community
- ecosystem

What is a Food Chain?

A **food chain** is defined as the one-way transfer of energy and matter from one organism to another in an ecosystem. Food chains are described using trophic levels. A trophic level is a category of organisms classified by what they eat.

A food chain begins with the transfer of energy from the sun into food by **primary producers**. Plants are usually the primary producers that make up the first **trophic level**. The next trophic level is made up of first level consumers, or plant-eaters. **Herbivores** eat live plants; **detritivores** recycle nutrients by eating dead plants. The next trophic level is made up of animals that feed on herbivores; Animals in this trophic level are called second level consumers and first-level **carnivores**. The next trophic level is made up of animals that eat other carnivores. Organisms in this level are called second level carnivores and third level consumers.

Chains connect to Make Webs:

Food chains are connected to other food chains, usually by upper level carnivores. The interlocking, complex pattern of food chains is defined as the **food web**. A food web is often used to describe the flow of energy and nutrients among all the organisms in an ecosystem.

A food web can have an infinite number of trophic levels. Some organisms can exist in many different trophic levels. For example, a consumer that eats both plant and animal material, **omnivores**, can be first and second level consumers. Animals that recycle nutrients by eating dead animal and plant materials (scavengers) also exist in many different trophic levels.

"World Wide Web"

Humans occupy a position near or at the top of a number of food chains.

- Suppose you ate an adult chinook salmon that you caught in the local river. Describe the possible organisms in your food chain (begin at the bottom with plants and end with yourself).
- Trace your food chain for the following: a medium-rare New York steak; a bowl of Sugar Frosted Flakes and a steaming plate of sauteed Morels (mushrooms).

Jargon You'll Need to Proceed

- food chain
- food web
- herbivore
- carnivore
- omnivore
- scavenger
- detritivore
- primary producer

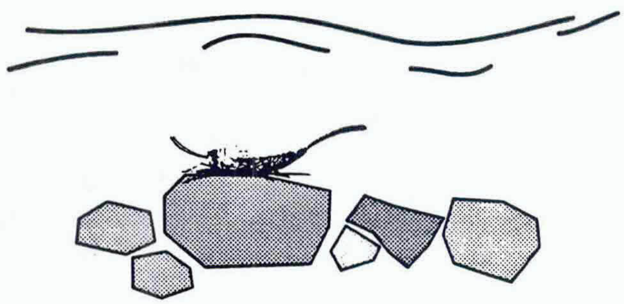
The way things change:

An **adaptation** is a genetically-controlled characteristic that helps organisms survive and reproduce in their environment. Species often evolve similar adaptations to survive in the abiotic and biotic conditions of the ecosystem. Adaptations may occur in an organism's behavior, body structure, or body processes. For example, if the ecosystem has long, cold winters, a species may hibernate (behavioral adaptation), have thick fur (a body structure adaptation), or have the ability of store a lot of fat (a body process adaptation). The characteristics of plants and animals offer huge insights to the physical and biological conditions of the ecosystem.

Examples of species adaptation:

1) Plants that experience drought - water or heat stress - usually have some or all of the following characteristics: thick leathery evergreen leaves, reduced leaf area, deep root systems and thick white hair or wax on their leaves. These adaptations reduce water loss, increase heat loss or reduce the amount of light absorbed by the leaf.

2) Some aquatic insects have evolved to live in fast-moving water. Their bodies are flat, allowing water to flow over them. Strong body parts, such as hooks on their claws, help them cling to rocks in a swift current. How would it help an aquatic insect to survive to be able to live in fast moving water habitat?



Survival Tactics

Can you figure out why each animal's adaptations evolved? Were they in response to abiotic or biotic parts of the ecosystem? How do the adaptations relate to the animal's lifestyle?

- Rabbits species often have large ears that can point in all directions, eyes located on the outside of their face, a low body profile when on all four legs and the ability to stand upright on large rear legs. Why?
- Many birds associated with aquatic environments such as herons and swans have long necks. Why?
- Stand in front of a mirror. Explain yourself. Include your skeletal structure, skin, hair (or lack of), position of your sensory organs, and any other characteristics that have been important to the survival of the human species.

Species Relationships

Jargon You'll Need To Proceed:

- Adaptation
- Species
- Populations
- Communities

How we get along:

Organisms of the same species and of different species are constantly interacting. The relationships between species have a large affect on the size of populations and how communities change over time. Species relationships are investigated based on the affect the relationship has on each species. Positive affects encourage the growth and reproduction of a species. Negative affects inhibit the growth and reproduction of a species. Some species relationships have no affect on one or both of the species.

The following examples illustrate five types of species relationships:

Mutualism

A honey bee is feeding on flower nectar. While the bee flies is eating from different flowers, it transfers pollen from one plant to another of the same species. While the bee pollinates the flowers, the flower provides a food source for the bee. This is **mutualism**.

Commensalism

A lichen attaches itself to the trunk or branch of a tree. The lichen enjoys a place to capture light, feed on nutrients from the air and receive moisture from water running down the tree. Although the tree provides resources for the lichen, the tree is unaffected. This is **commensalism**.

Competition

White bark pine trees produce large seeds within their cones. These seeds are collected and consumed by squirrels and grizzly bears. When the demand for the seeds is greater than the amount produced by the trees, these two organisms will compete for the same food resource. This is **competition**.

Predation

You are walking along the stream behind your house. You look up and watch an osprey fly down and take a fish out of the water and eat it. This is **predation**. **Herbivory**, in which an animal eats a plant or plant part, is considered to be a special variation of predation. **Cannibalism** is another form of predation in which one species eats an individual of the same species.

Parasitism

The tick, a small arthropod, lives on the skin of some species of mammals such as mice, deer and chipmunks. The ticks bites through the mammal's skin and eats the blood. The tick swells with blood and falls off. The tick itself does not usually kill the host mammal. This is **parasitism**. The key distinction in this relationship is that, unlike predation, the parasite derives resources from its host without killing it.

In a Nutshell:

The table below outlines the different types of relationships and the response of each organism in that relationship. Positive effects are marked with a (+), negetive effects are marked with a (-) and no effect with a (0).

Type of Interaction	Effect on Organism A	Effect on Organism B
Neutral	0	0
Mutualism	+	+
Commensalism	+	0
Competition	-	-
Predation	+	-
Parasitism	+	-

Role Playing

Here are three examples of species relationships. See if you can characterize them.

- Two trees are growing next to each other in the forest. They are the same height and their branches are growing into each other. What type of relationship is this?
- You are at a lake in the late afternoon. You notice fish jumping to the surface to eat insects. How would you describe this relationship?
- A mosquito begins to suck blood from your arm. You grab the pest and eat it. Is this parasitism, predation, cannibalism, all of these? (hint: You are eating human blood).

Habitat and Species Diversity

Jargon You'll Need To Proceed:

- species
- habitat
- population
- community
- ecosystem
- trophic levels

Habitat Diversity

Diversity applies to the habitat and species in an ecosystem. **Habitat diversity** refers to the variety of different habitats within an ecosystem. Habitat diversity is often determined by the types of plant species, arrangement of plant species, soil types, bodies of water and landforms (cliffs, rocky outcrops, etc.)

Species Diversity

Species diversity is the variety of species in an ecosystem. There are two important components of species diversity-richness and evenness. Species richness is the number of species in an ecosystem. Species evenness is the number of individuals within each species. An ecosystem with a few individuals of many species is considered to have high richness and high evenness. An ecosystem with few species with equal numbers of individuals per species, is considered to have low richness and high evenness. Low evenness occurs when some species have many individuals, and some species have few.

Habitat Diversity ←and→ Species Diversity:

Different habitats feed and provide shelter for many different species. Therefore, ecosystems with high habitat diversity often have high species diversity. An ecosystem with fewer habitat types may support a lower species diversity.

Diversity ←and→ Stability

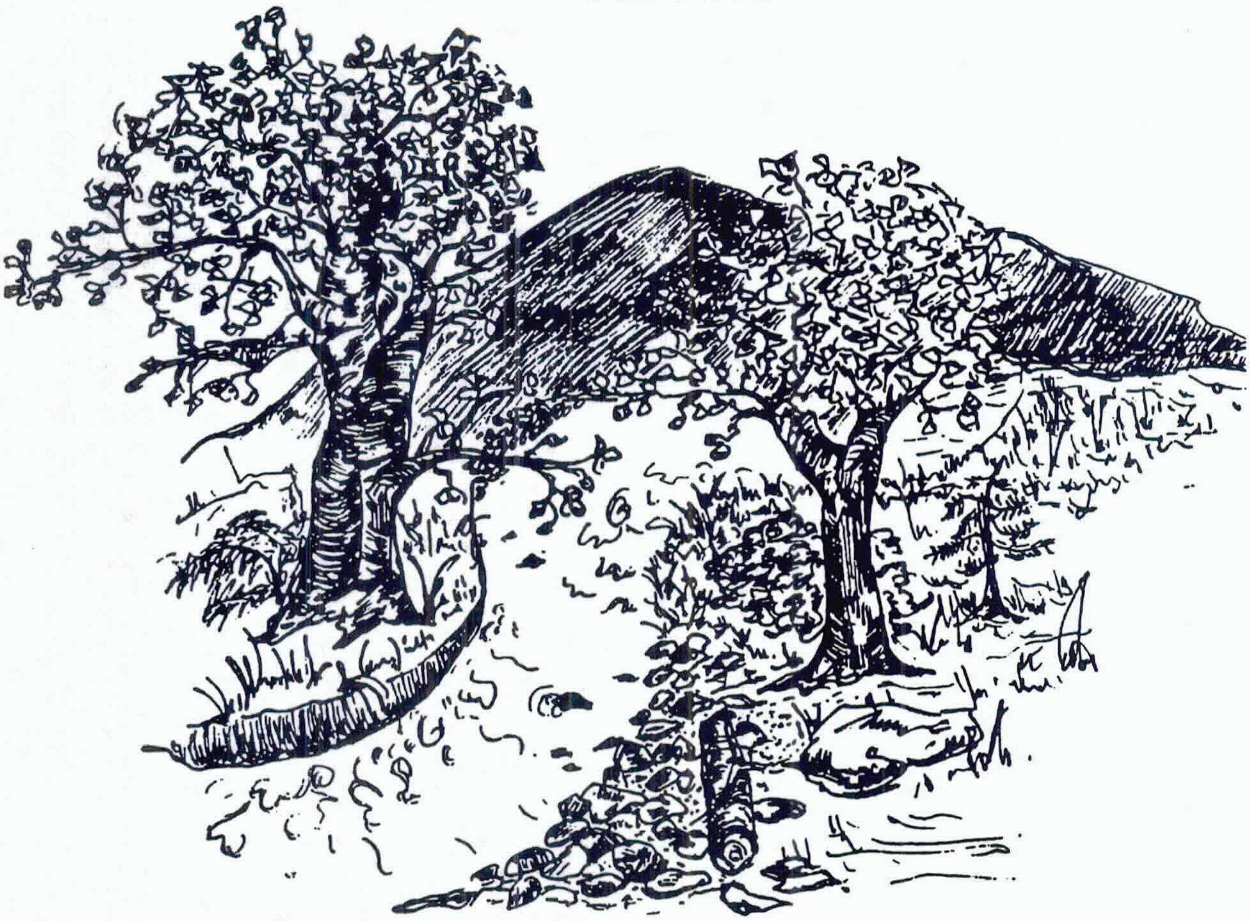
Species diversity helps determine the stability of an ecosystem. Each species differs in its ability to survive. Some species may be more well-suited to conditions after a disturbance. A diverse community is often able to recover more quickly from disturbance.

A Diverse Pot or Not?

See if you can figure out if the following examples represents diverse populations:

- You are standing in your back yard watching about 50 birds. You determine that there are four small black-speckled birds (starlings), one large blue bird (scrub jay) and 45 pigeons. Is this high or low species richness? Evenness? Why?
- You are surveying plants in a wetland community. At the end of the survey, you have recorded ten species of aquatic grasses, three species of algae, eight species of aquatic shrubs, and five species of wetland trees. There are between two and five individuals of every species. Is this high or low species richness? evenness? Why?

Cascade Streamwatch



Cascade Streamwatch is an exploration of the physical, chemical, and biological components of aquatic ecosystems. This exploration is lead by asking questions and gathering data to answer those questions. Through analysis of collected data, Cascade Streamwatch participants investigate how humans and other species affect and depend on streams, rivers and wetlands.

CSW research activities include water quality testing, macroinvertebrate sampling, and habitat sampling in streamflow and wetland transects. Research activities are fully explained in background, procedures and key questions sections. Background sections define the concepts in each activity and explain their relationship to the rest of the watershed. The procedures section explains how to perform the activity. Key questions point out how collected data may relate to other components of the watershed.

Check out the background section before the research field day. Procedures and key questions can be used on the field day.

Temperature

Objectives:

- accurately measure the temperature of air and water, and
- draw conclusions about how air and water temperature affects life in the aquatic system.

Students required: 1-2

Time required:
10-15 minutes

Materials:
Pencil, water quality datasheet, and thermometer

What temperature is:

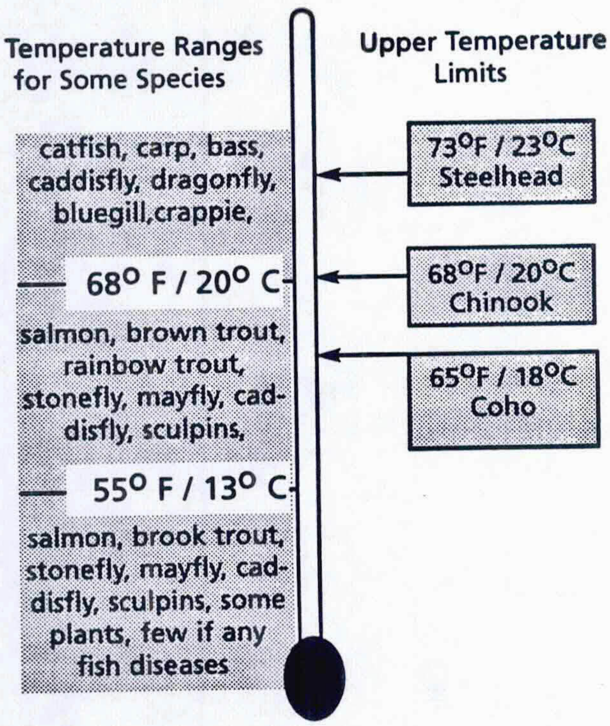
Temperature is the measurement of the average kinetic energy contained in the moving molecules within a substance. As the kinetic energy in a substance like water rises, the molecules move faster, and the temperature rises. As with all substances, the temperature of water determines whether it exists as a gas, liquid or solid.

Temperature is Affected by:

Many factors influence water temperature in an aquatic system. Water temperature will rise as air temperature rises. The temperature of a body of water also rises as it absorbs direct sunlight. Streamside plants can block direct sunlight and keep water temperatures cool. Streams that lack overhanging trees and shrubs receive high doses of sunlight and tend to be warmer. Shallow bodies of water absorb sunlight and heat up more readily. Slow-moving water in lakes or ponds heats up more readily than fast-moving water in streams and rivers. Melting snowfields as the headwaters of a stream provide cool water. The dark color of highly turbid water absorbs more heat than clear water.

Temperature Affects:

All organisms have a unique range of temperatures in which they best operate. Thus, water temperature can determine what kinds of organisms can live in a particular ecosystem. For example, salmon species are adapted to fresh water temperatures ranging from 40-60 degrees Fahrenheit. Warmer temperatures increase the spread of fish diseases, cause eggs to hatch too early and can harm their food supply. As temperature rises, water can hold less dissolved oxygen. Therefore, in warm water, the respiration rates of fish will rise to obtain oxygen from the water (which makes the fish work harder to stay alive).



Procedures for Measuring Temperature:

1) Measure air temperature.
- Hold the thermometer in the shade (if the sun is out).
- Expose the thermometer bulb to the air in the reading site for one minute.
- Read the thermometer and record the data.

2) Repeat measurements. Take a few more air temperature readings in different locations or different times of the day to note change.

3) Measure water temperature.
- Submerge the bulb of the thermometer into the water for at least five minutes. (Hold on to the thermometer so it doesn't float away!)
- Remove the thermometer from the water by the top of the thermometer
- Read it immediately and record the data.

4) Repeat measurements. Take a few more water temperature readings in different areas, at different depths and at a different time of day.

5) Convert units of measure. If your thermometer reads in degrees Fahrenheit (^{O}F), convert to degrees Celsius (^{O}C) and vice versa. To convert:

$$^{O}F=(9/5 \times {^{O}C}) + 32 \qquad {^{O}C}=5/9({^{O}F}-32)$$

Key Questions to Answer:

- How are water and air temperature related?
- What effects does streamside vegetation have on water temperatures?
- How do water temperatures vary with different bodies of water?
- Why do water temperatures vary with depth?
- What kind of human activities affect water temperature in the watershed?
- How does temperature affect dissolved oxygen?
- How do the ecosystem components at your study site affect water temperature, such as velocity and streamflow? water source? plant cover? streambed materials ?
- How will these components compare with the components your colleagues will find in other habitats?
- How do you think water temperature affects the presence or absence of different macroinvertebrates? fish?

pH

Objectives:

- accurately measure pH of a water sample, and
- investigate how pH affects life in an aquatic system.

Students required: 1-2

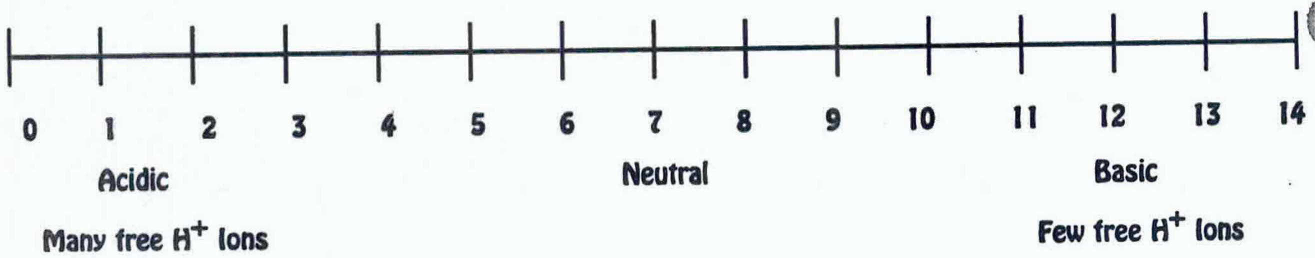
Time required:
10-15 minutes

Materials:
Pencil, water quality datasheet, two glass sample tubes, pH indicator solution, color wheel.

What pH is:

A water molecule is made up of one positively charged hydrogen ion (H^+) and one negatively charged hydroxyl ion (OH^-). Because particles with opposite charges attract, these ions are loosely bound together. These hydrogen and hydroxyl ions break apart and reunite many times per second. At any given moment, there are always bound H-OH molecules, and free H^+ and OH^- ions in water. Hydrogen (H^+) and hydroxyl (OH^-) ions can also attach to other charged particles that enter water. As ions separate and attach to each other, hydrogen ions may be left free of any other charged particle. pH is a measure of the potency of free hydrogen (H^+) in water. Water with few free H^+ is basic or alkaline. In contrast, water with many free H^+ ions is acidic.

How pH is Measured - pH ranges on a scale from zero to 14. A solution with a pH from 0 to 7 is acidic (many H^+ ions) Solutions with a pH of 7-14 is basic (few free H^+). A pH of 7 is said to be neutral--neither basic or acidic.



pH is Affected by:

The tannic acids released during decomposition of dead plant or animal material can cause the pH of aquatic systems to decline. Any input of a an acidic solution - such as average rainfall at a pH of 5.6 - can also cause a decrease in pH. Acid rain, caused by air pollution, can further reduce the pH of aquatic systems. Fertilizers and other human-made substances that enter the aquatic system have varying effects on pH, and usually tend to make waters more acidic. Naturally, water erodes the rock materials it travels over. The charged particles in weathered rock (such as magnesium (Mg^{++}), calcium (Ca^{++}) or sodium (Na^{++})) can alter pH levels.

pH Affects:

The pH of aquatic systems affects the diversity and productivity of aquatic life. Organisms are adapted to specific ranges of pH. The organisms cease to function and reproduce when the pH is outside their range of tolerance. Fish, for example, can survive in systems with a pH range of 5.0 to 9.0. Low pH can impair their sense of smell and prevents eggs from hatching. pH levels above 9.0 impairs the bodily functions of certain fish.

Procedures for Measuring pH:

1) Clean glassware. Rinse and clean the two glass sample tubes.

2) Collect a water sample. Fill both tubes to the first line (5ml) with your water sample.

3) Add six drops of pH indicator solution to one of the tubes. Swirl to mix.

4) Set up samples in color wheel. Insert the tube with indicator solution into the right top opening of the color wheel. Insert the tube containing only water into the left top opening of the color wheel.

5) Determine the pH. Match the color of solution with the appropriate color in the color wheel. Hold the color wheel up to a light source, such as the sky, or a white piece of paper. Rotate the disc on the color wheel until you see the closest color match. When they match, read the number indicated in the scale window next to the selected color. This number is the pH of your water sample.

6) Record your data.

Key Questions to Answer:

- What ion does pH measure?
- What processes in your study site affect pH?
- How do you think your system's pH would differ from other systems? For example, a river from a wetland?
- Is the pH in this habitat suitable for aquatic life?
- How do humans effect pH?

Objectives:

- accurately measure dissolved oxygen of a water sample, and
- investigate how dissolved oxygen varies in an aquatic system and affects life in an aquatic system.

Students required: 1-2

Time required:
30 minutes

Materials:
Pencil; waste container; 1 Liter bottle; DO pouches 1, 2 and 3; sample bottle with glass stopper; sub-sampling tube; mixing bottle; nail clippers or scissors; sodium thiosulfate bottle with dropper on the lid; water quality datasheet;.

What Dissolved Oxygen is:

Dissolved oxygen (DO) refers to the O_2 molecules that are separate from water molecules (H_2O) in solution.
We measure the DO of water samples in our aquatic ecosystem to see how well it can support life. DO is usually measured in parts per million (ppm). So for example, 8 ppm of O_2 means that there are 8 parts of oxygen in one million parts of water. That seems like a tiny amount of oxygen, however aquatic organisms in most northwest water systems need 8-12 ppm of DO to survive.

Dissolved Oxygen and Temperature:

Water temperature determines the maximum amount of oxygen that can be dissolved in water, called the "saturation level" of DO. As the temperature rises, the saturation level of DO water goes down. If there is a difference between the measured DO and the saturation level, ecosystem processes are actively influencing the oxygen status of the aquatic ecosystem.

Relationship Between Saturation Levels of Dissolved Oxygen and Water Temperature

Saturation DO (ppm)	15	14	13	12	11	10	9	8	7	6	5
Water Temperature (°F)	32	36	39	45	50	59	68	77	90	92	117

Why Dissolved Oxygen is Important:

Aquatic organisms consume oxygen through their gills, or directly through their skin. Oxygen is essential to break down food, and to maintain and build cells. Aquatic organisms cannot survive with no or low levels of oxygen.

Procedures for Measuring Dissolved Oxygen:

1. Rinse glassware. Fill the 1-liter bottle with water to rinse the DO bottle. Make sure to dump used contents into the waste bottle, and not in or near the stream.

2. Collect a water sample. Take the glass stoppered DO bottle to the water and hold it completely under the water. Fill it to the brim. This is your water sample. DO NOT PUT THE STOPPER ON YET!!

3. Add chemicals. Using nail clippers or scissors, open a DO 1 and DO 2 pouch. CAREFULLY add contents of both pouches to the water sample. It is important to get all of the chemicals in the pouches into the sample bottle.

4. Stopper the bottle. There is a special technique for properly putting the stopper on the bottle. Stand up with the bottle, hold it away from your body at arms length and insert stopper with a quick thrust. This will force the air bubbles out of the bottle. If bubbles are present, pour the contents in your "toxic waste bottle" and start again. Repeat until you have a sample with no bubbles.

5. Shake it up. Holding the stopper in place, shake the bottle vigorously to mix your solution. If the cloudy material inside turns a brownish-orange color, then oxygen is present in the water sample.

6. Let it stand. Allow the sample to stand undisturbed for a few minutes until the material has settled out halfway, leaving the upper half of the sample clear. Shake the bottle again; then let it stand undisturbed until the upper half clears a second time. While you are waiting for it to settle, observe your sample site. What around you can increase the amount of oxygen in the water? What things or processes can remove oxygen from the water? What is the water temperature, and what is the saturation DO at that temperature? (see chart)

7. Add DO 3 chemical. Once the sample has settled, use the nail clippers to open a DO 3 pouch. Remove the stopper and add the contents of the DO 3 pouch to bottle. Carefully re-stopper the bottle and shake to mix. This material will dissolve. If a yellow color develops, oxygen is present.

8. Take a subsample. Over the toxic waste container, fill the plastic sub-sampling tube to the brim with the yellow sample; pour the remaining yellow sample into the toxic waste container.

9. Pour the subsample into the mixing bottle.

10. Add (titrate with) sodium thiosulfate. Fill the dropper with sodium thiosulfate. Test your ability to drop one drop at a time by dropping a few drops back into the sodium thiosulfate bottle. Then, holding the dropper vertically above the mixing bottle with your yellow water sample, add ONE drop of Sodium thiosulfate at a time to the bottle until the sample turns clear. Swirl the bottle between each drop. MAKE SURE TO COUNT EACH DROP, INCLUDING THE FIRST ONE. Each drop of sodium thiosulfate used is equal to 1 ppm (part per million) of DO.
So, if it took 8 drops to turn the sample clear, there are 8 parts of oxygen in a million parts of water.

11) Record your data. If there is time, repeat this procedure.

Key Questions to Answer:

- What do your measurements of dissolved oxygen indicate about water quality?

- What is the water temperature, and what is the saturation DO at that temperature? Does your DO reading differ from the saturation level? Why?

- What processes are occuring at your research site that could be affecting DO levels? What habitat features in your site contribute to adding DO to the water? Using or removing DO from the water?

- How does your estimate of DO compare to that which is needed by fish and other aquatic organisms?

- How could the characteristics of your research site be altered to increase DO?

- How do humans effect DO?

Objectives:

- accurately measure the turbidity of a water sample, and
- investigate how watershed conditions affect turbidity and how turbidity affects life in an aquatic system.

Students required: 1-2

Time required:
20 minutes

Materials:
Pencil, water quality datasheet, Hach Model 2100P Portable turbidimeter.

What Turbidity is:

"Turbidity" is an indicator of the how much light can pass through water. Highly "turbid" or murky water has floating soil particles, micro-organisms or plant materials that block light. Clear water has a turbidity near zero because there are no materials in the water that scatter or absorb light.

Turbidity is Affected by:

The turbidity of a river, stream or wetland is affected by conditions in the entire watershed. Vegetation on the hills in a watershed hold soils in place. If vegetation is removed, soil can slide downhill during heavy rainfalls and into river systems. Soil erosion is a key process that can increases turbidity. As runoff flows over roads and homes, it carries dirt, oil, and any other debris with it to rivers. Floods and sudden high streamflows stir up the fine sediments on the bottom of a stream and can cause turbidity to rise. When humans or other large mammals walk in the stream, fine sediments on the streambed are disturbed, causing a rise in turbidity. As the temperature in slow-moving or stagnant water rises, algae populations may explode. Turbidity of waters skyrocket when these "algal blooms" occur.

Turbidity Affects:

Turbidity in water can affect many parts of the aquatic ecosystem. Turbid water usually warms up because the floating materials absorb heat from the sun. Warmer water holds less oxygen, so dissolved oxygen levels (DO) often begin to drop in turbid water. Less light reaches aquatic plants in highly turbid water; this can decrease the amount of oxygen created by photosynthesis. In addition, the floating materials in highly turbid water can get caught in the gills of fish and amphibians. Clogged gills hinder an organism's ability to use oxygen in the water. High turbidity directly affects the food chain by prevent organisms from seeing or smelling their food.

Procedures for Measuring Turbidity:

1. Clean sampling tube. Thoroughly clean the turbidity tube. Dirt or materials in or on the outside of the bottle can produce an inaccurate reading.

2. Collect water sample.

- Fill this clean sampling tube to the brim.
- Screw on the cap.
- Dry the outside of the bottle thoroughly

3. Observe your research site. Record the speed of the water, the presence of vegetation, or any disturbance to the bottom caused by you or your teammates at the sample location.

4. Insert the tube inside the turbidometer. Make sure there are no fingerprints or any other materials on the sample bottle. Line up the triangular arrow on the tube with the indicator mark on the turbidometer. Close the lid.

5. Turn power on. Wait for 00.0 to appear on screen.

6. Press read, and wait for results. The number that appears represents Nefala Turbidity Units, and indicates how much light was able to pass through the sample of water. A low turbidity reading means a large amount of sunlight can pass through the water. A high reading indicates light can not readily pass through the water.

7. Record your data.

8. Repeat the procedure 2 times. Record the sample location for each sample.

Key Questions to Answer:

- What features in the research site affect turbidity most?
- How might turbidity levels vary among wetland, river, and side channel?
- What are the most common materials floating in your water sample that are affecting the turbidity - sediments, algae, organic matter?
- How does turbidity relate to other water quality measurements?
- How could aquatic organisms be affected by turbidity? How do humans affect turbidity?
- How might your turbidity reading be different three months from now? three months ago?

Cascade Streamwatch
Water Quality Datasheet

School: ______________________________ Date: ____________

Weather: ______________________________

Your Research Site: ______________________________

Water Temperature

Celsius or Fahrenheit (circle one)

1) ________ Time: ____________

2) ________ Time: ____________

Air Temperature

Celsius or Fahrenheit (circle one)

1)________ Time: ____________

2) ________ Time: ____________

How much shade is the riparian area providing for your water system?

none _____ trace _____ some_____ a lot _____

How deep is the water where you are sampling?

very deep(over 3 feet)____ somewhat deep(1-3 feet)____ shallow(less than a foot) ___

Think about how this may affect your temperature.

pH

pH Recordings	Location\Time
1) __________	________
2) __________	________

What kind of organic materials are present in your system? i.e.-woody debris, leaves

____

____

Think about how this may affect your pH.

Turbidity

Recordings sample site conditions (notes)

1) ____

2) ____

3) ____

4) ____

How fast is the water moving in your water system?(Circle your answer)

not moving slow moving quick moving

Are the banks stable(secured by vegetation) in your water system?

yes somewhat no

Think about how this may affect your turbidity.

Dissolved Oxygen

DO Recordings Location\Time

1) __________________________________

2) __________________________________

What kind(s) of vegetation is growing in the water system?(indicate with a check)

rooted live plants _____ floating live plants _____ algae_____ none_____

How fast is the water moving in your water system?(Circle your answer)

not moving slow moving quick moving

Think about how this may affect your dissolved oxygen.

Objectives:

• investigate the relationships between macroinvertebrate adaptations and their environment, and

• draw conclusions about water quality, the food web, and aquatic ecosystem function from the analysis of macroinvertebrates.

Students required: 3-5

Time required: 1-2 hours

Materials:
Pencil, datasheet, 2 large collection nets, 2 small collection nets, 2 1-gallon white open-ended tubs, 2 white ice cube trays, wader boots, waterproof gloves, hand lens, tweezers, turkey baster, field guides.

What they are:

A macroinvertebrate is an organism that lacks a spine and is big enough to see with the naked eye. Types of macroinvertebrates include flatworms, crayfish, snails, and clams. Many aquatic macroinvertebrates are insects, such as mayflies, caddisflies, stoneflies, and dragonflies. These aquatic insects live as juveniles in the water, and become flying insects as adults.

Where they live:

Macroinvertebrates adapt to the type of water movement, the type of substrate (or stream bottom), and the amount of organic materials in the aquatic system. Macroinvertebrates found in fast, white water areas of the stream, or riffles, may stick to rocks with suction devices. Organisms found in moving, but less choppy water, or glides, may be flat to prevent getting swept downstream. In slow moving pool areas, organisms may only be able to crawl on the substrate. The size of substrate materials affects the amount of hiding places from predators and the presence of live plants. Organic materials, such as live water plants or debris inputs from the surrounding riparian vegetation, serve as a food source for macro-invertebrates.

The rocks and materials on the bottom

The size of the substrate

Substrate	Diameter
Fine Sediment	Too small to measure
Gravel	Under 2 inches in diameter
Cobble	2 - 10 inches in diameter
Boulder	Over 10 inches in diameter
Bedrock	Big slabs of rock on the stream bottom

How the water moves

riffle - fast moving water where the water surface is broken waves or white water

glide - areas where the water is moving, but not broken into waves

pool - areas where water is relatively still or swirling

Sensitive species - An adaptation

Some species of macroinvertebrates – called "sensitive" species-- can not survive in pollution, such as high levels of sediments, high water temperatures, or low levels of dissolved oxygen. Other species of macroinvertebrates, referred to as "tolerant" species, can survive in poor water quality conditions. The presence or absence of tolerant and sensitive species in a macroinvertebrate sample indicates the water quality conditions of the aquatic system.

The Food Web

Each macroinvertebrate species plays a unique role in the aquatic and terrestrial food web. Macroinvertebrates can be separated into feeding groups based on the types of food they eat and the ways that they get their food.

Collectors feed on tiny food particles such as dissolved organic material, small pieces of plant parts, algae, bacteria, feces, or dissolved organic materials. Collectors may physically gather their food or construct special net-like structures to gather food in moving water.

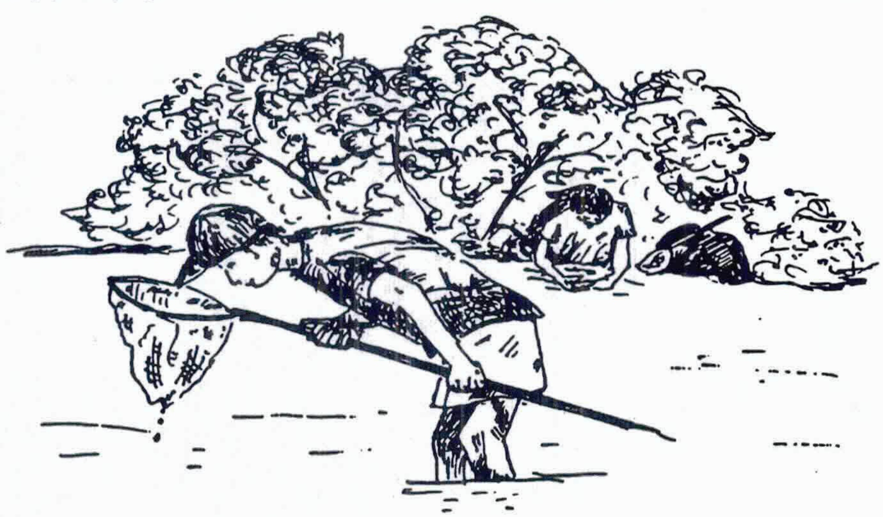
Predators catch and eat live organisms. Their bodies are designed to chase, capture and kill their prey. Predators survive where there is an abundant population of their prey.

Shredders feed on leaves and other parts of vegetation that have fallen into the water. Their mouthparts are designed to shred, cut, bite, or bore. Shredders tend to be most abundant in water systems with high amounts of organic materials.

Scrapers scrape algae off of rocks in the aquatic system with their special razor-like mouthparts. Scrapers thrive where there is enough light to make algae grow.

Why sample Macro's:

The pollution sensitivity and feeding group of macroinvertebrate samples offer clues of how the aquatic system is functioning. For example, a sample taken from a pool area with a sandy substrate is rich in shredders tolerant of sediment pollution. This sample may indicate that the pool area is functioning as a holding spot for organic debris and sediments. The numbers and kinds of macroinvertebrates in a sample also informs aquatic biologists whether or not the ecosystem can support populations of amphibians, fish, birds, and other wildlife species.



Procedures For Sampling Macroinvertebrates in Slow or Still Moving Water Systems (Wetlands)

1) Choose a sample area. Record sample site information on the datasheet.

- Record the water movement in the sample area.
- Record the substrate in the sample area.
- Record the types and amounts (approximately) of organic materials in the sample area.

2) Collect macroinvertebrates. Macroinvertebrates can be free swimming, crawling, attached to vegetation or along the bottom of the pond or wetland. Gently, sweep net through the water and along vegetation (Be careful not to uproot or crush the vegetation.) Sample each area for about 2 minutes.

3) Place macroinvertebrate samples in holding containers. Rinse all invertebrates from the net into a large Tupperware container.

4) Sort the macroinvertebrates. Using a turkey baster or eye dropper, suck individual specimens up and dispel them into separate cube compartments of the ice cube trays. Place similar-looking specimens into the same compartment to count them.

5) Characterize specimens.

- Note where insects where collected - water movement, substrate, organics
- Imagine how the insects make their living. Speculate on whether they are a predator, shredder, scraper or collector by looking at mouth parts and other body parts that might help them eat.

6) Identify the specimens. Use field guides to identify macroinvertebrates. Note the total number of species in the sample.

7) Record the name, feeding group, pollution sensitivity and total number of that species in the sample.

8) Set the specimens free. These organisms are alive and very important in the aquatic system. Return the macroinvertebrates from the area that they were collected.

9) Repeat the process in a different sampling area.

Procedures For Sampling Macroinvertebrates in Swift-Moving Water Systems (Rivers and Streams)

1) Choose a sample area. Record sample site information on your datasheet.

- Record the water movement in the sample area.
- Record the Substrate in the sample area.
- Record the types and amounts (approximately) of organic materials in the sample area.

2) Collect your sample.

- Deploy nets: Place the bottom of the net on the stream bottom, with the opening of the net facing upstream. The handle should be sticking straight up, perpendicular to the surface of the water.
- Pick up the rocks, one by one, in the sample area. Hold each rock upstream of the net opening, and rub the surface to dislodge the small insects that are clinging to the rock's surfaces. Replace each rock where you found it.
- Sample each area for about 2 minutes.

3) Place samples in holding containers. Rinse all of your invertebrates from the net into a large Tupperware container.

4) Sort your macroinvertebrates. Using a turkey baster or eye dropper, suck individual specimens up and dispel them into separate cube compartments of the ice cube trays. Place similar-looking specimens into the same compartment to count them.

5) Characterize your specimens.

- Note where insects where collected - water movement, substrate, organics
- Imagine how the insects make their living. Speculate on whether they are a predator, shredder, scraper or collector by looking at mouth parts and other body parts that might help them eat.

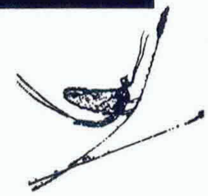
6) Identify the specimens. Use field guides to identify macroinvertebrates. Note the total number of species in the sample.

7) Record the name, feeding group, pollution sensitivity and total number of that species in the sample.

8) Set the specimens free. These organisms are alive and very important in the aquatic system. Return the macroinvertebrates from the area that they were collected.

9) Repeat the process in a different sample area.

Cascade Streamwatch
AQUATIC BIOTA (LIFE FORMS) DATASHEET



Habitat Site:______________________________________

Date: ___________________________ School: ___________________________________

Weather: ____

Sample Number : ________

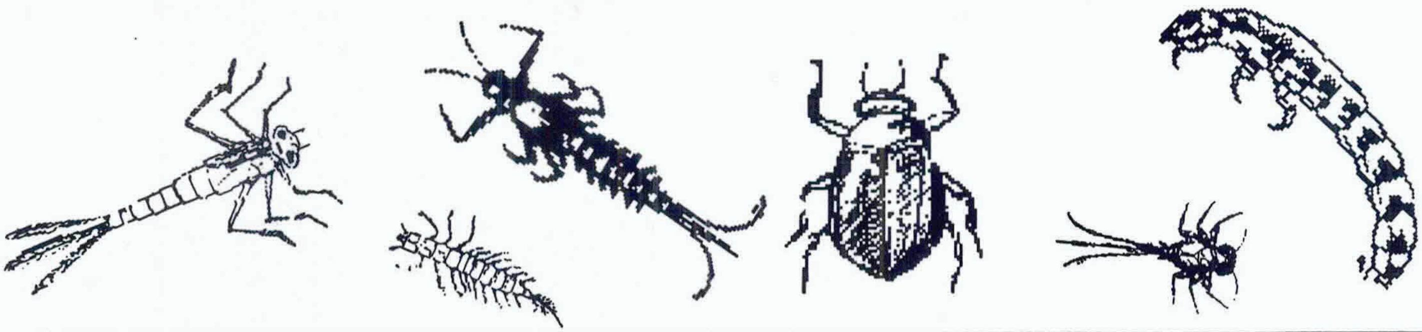
Water movement: ______________________________________

Substrate : ______fine sediments ______gravels ______cobbles______boulder

Organic materials (leaves, twigs, large wood) ____

____

Total number of species found: __________



Common Name______________________________

Pollution Sensitivity: ___________________________

Feeding type: ______________________________

Number you found per sample: __________

Approx. % of sample:________________________

Key ID Features: ___________________________

____

____

____

legs body shape

color

pattern

shape

gills

size tails

Common Name__________________________

Pollution Sensitivity: ___________________________

Feeding Type: ______________________________

Number you found per sample: __________

Approx. % of sample:________________________

Key ID Features: ___________________________

____

____

____

legs body shape

color

pattern

shape

gills

size tails

Key Questions to Answer:

- How are the different macroinvertebrates you sampled connected to other organisms in the aquatic ecosystem?

- How do the different body parts of macroinvertebrates--their shape (skinny and flat, or round and large), presence or absence of wings, mouthparts, special appendages, outside covering--relate to what they eat? How do different body parts relate to where they were found? How do different body parts relate to how they live?

- How does stream velocity affect the kinds of invertebrates species that live in different parts of the aquatic system? The presence or absence of overhanging vegetation? Dissolved oxygen?

- What does your macroinvertebrate diversity tell you about the types of food (energy) available in different parts of the system? What does it tell you about water quality?

- What did the pollution sensitivity of the macroinvertebrates tell you about your system?

- How will your sample of macroinvertebrates compare with those collected in other habitats?

- How do humans affect macroinvertebrates?

Objectives:

- accurately measure stream flow and features in the riparian zone of a stream, and
- investigate how stream flow and riparian features influence the structure and functioning of aquatic ecosystems.

Students required: 3-5

Time required:
1-2 hours

Materials:
Pencil, datasheet, stopwatch, 100-foot measuring tape, height pole or other stream depth measuring device, stick, plant guide.

What streamflow is:

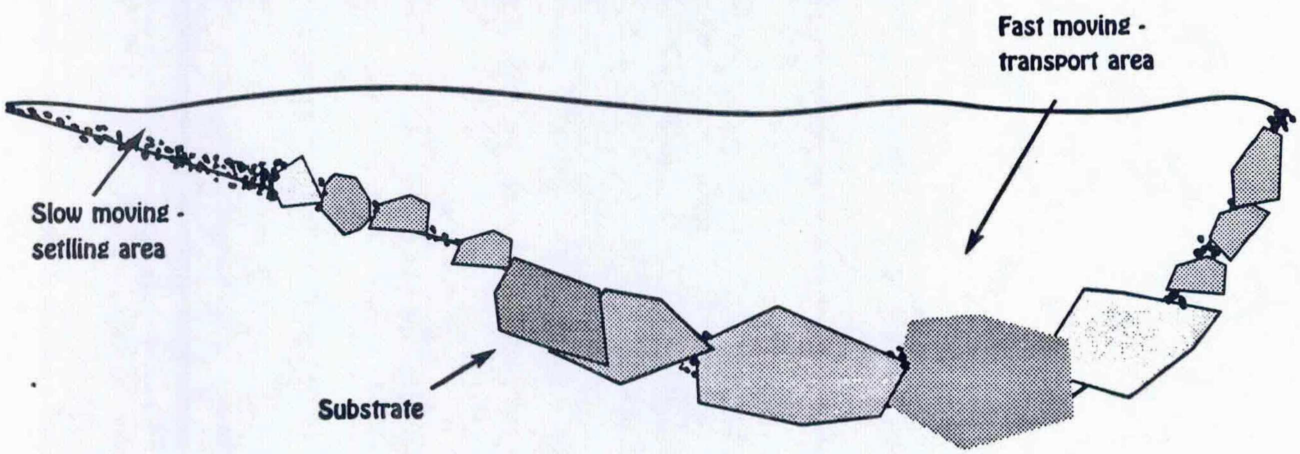
Streamflow is the total amount of water that passes by a given spot each second. The two main components of streamflow are the **velocity**, how fast the water is flowing, and the **cross-sectional area**, how deep and wide the stream is.

Streamflow is Affected by:

Many factors influence streamflow. As precipitation falls from the sky, it travels over the land to the lowest point. Water forms channels which connect into larger river systems. Precipitation therefore is a major determinant of streamflow. Upland conditions greatly affect the extent and timing of flows during heavy rainfalls. The vegetation in forested watersheds holds water in the uplands, moderating increases in stream flows during heavy rain events and maintaining flows more readily during dry summer months. If vegetation is replaced with hard surfaces (such as roads and houses), water flows directly into the rivers. A lot of hard, impermeable surfaces in a watershed can increase stream flows during rain events and lower flows during dry months.

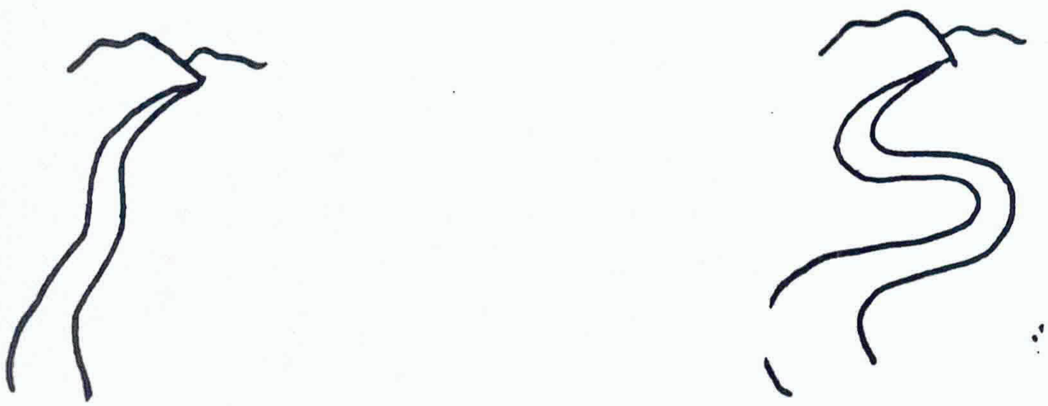
Streamflow and the Shape of the Stream Channel

As streams carve their paths down through a watershed, they naturally pick up and carry rocks or sediments. This is called erosion. In sections of the stream where the channel is steep, fast moving water can transport large boulders or trees for miles down the river channel. Rocks and sediments then settle out of the water in flat, slower moving areas of the stream. This is called deposition. Streamflow determines the amount of erosion and deposition in a stream and, as a result, the types of materials found on the substrate, or stream bottom.



Streamflow and the Path of the Stream:

As materials are moved from one side of a stream to the other over time, the stream may carve a meandering path for itself. Riparian vegetation may get carried downstream as a river erodes the side of the streambank. Regular deposition of rocks and sediments on the side of a stream may increase the riparian area. Vegetation can begin to grow in the increasing amount of riparian area caused by deposition.



Over time, erosion and deposition in a straight stream channel —— may create ——> **a meandering stream channel**

Streamflow Affects:

Streamflow affects the kinds and amounts of organisms and habitat in the aquatic ecosystem. Water systems become wider or deeper as streamflow rises, increasing the amount of available habitat for aquatic organisms. When streamflow rises during storm events, an area in the river that was a pool, or resting area for fish may become a fast moving riffle type habitat. Faster moving water associated with increasing streamflow alters habitat by transporting dissolved oxygen, food particles and pollutants in aquatic systems. Aquatic organisms have specific adaptations to the habitat influenced by streamflow. For fish, streamflow affects access to spawning gravel, expenditure of energy and the amount of oxygen available to eggs.

Procedures for Measuring Streamflow:

1) Measure stream area.

- Measure the stream width with a tape measurer. Record stream width.
- Determine how wide individual areas will be (Hint: Check out your total stream width - it might help to keep the math easy and divide the stream into equal parts.)
- Record depth measurements at each individual areas.
- Calculate the area of each individual section by multiplying depth x width.
- Calculate the total stream area by adding the individual areas.

2) Measure stream velocity. (the velocity of the water passing through the stream area)

- With the measuring tape, establish a distance in the stream to determine velocity.
- With a stopwatch, record how long it takes a stick to travel your measured distance in the stream.
- Water moves at different speeds across the stream channel. Record at least three velocity measurements to account for the different stream velocities along the transect.

3) Measure channel slope.

- Standing at one end of the distance used to measure velocity, look into the hole in the clinometer with one eye and site a teammate at the other end of the distance used to measure velocity. If your teammate is the same height as you are, site directly to their eyes; If your teammate is a different height, determine where your eye level is on your teammate and site to that spot.
- Using the scale on the left side of the clinometer, read the percent slope.
- Use the chart on the side of the clinomenter to convert percent slope to degrees slope.
- Record the degrees slope on the datasheet.

4) Total streamflow. Calculate the total streamflow of the stream by multiplying velocity and total area. Record streamflow on the data sheet.

5) Investigate the riparian area:

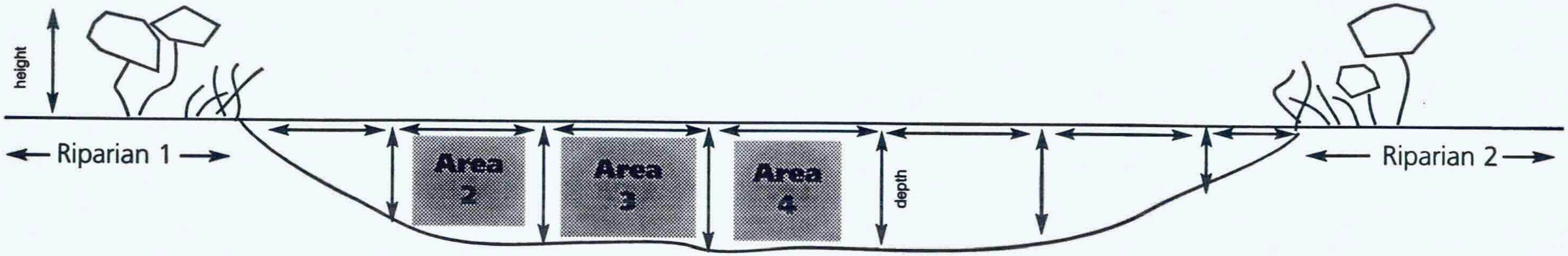
- The riparian area starts at the edge of the stream and ends on land where river water does not influence vegetation. Look for a terrace or hill that would hold water in as flows rise. Also, look for a change in the vegetation to determine where the riparian area ends.
- Record the width of both riparian areas.
- Record of main overstory (above you) and understory (below you) species.
- Record if riparian vegetation is deciduous or evergreen. Estimate and record the height of riparian vegetation.

6) Record Large Woody Debris: Record the number of large logs in the stream at the research site.

Cascade Streamwatch • Streamflow Data Sheet

RESEARCH SITE: ______________________ School: ______________________

Date: ______________ Weather: Now and last 24 hours: ______________________



Stream Area (a cross-section)

Stream channel width: ________ ft

Individual areas will be ______ ft wide

Area #	Depth	Width	Product
Area 1			ft^2
Area 2			ft^2
Area 3			ft^2
Area 4			ft^2
Area 5			ft^2
Area 6			ft^2
Area 7			ft^2
Area 8			ft^2
Area 9			ft^2

Total Stream Area = ________ ft^2

Stream Velocity

Distance you're measuring: ______ ft

Time it takes the object to travel:

Trial #1: ______ seconds

Trial #2: ______ seconds

Trial #3: ______ seconds

Average time = ______ seconds

Stream velocity = ______ ft / second

Channel slope: ______

Total Discharge = ______ ft^3/sec

Riparian 1

______ ft
width

Riparian 2

______ ft
width

Overstory species: ______________

____

____

Evergreen or Deciduous
Height: ______ ft

Understory species: ______________

____

____

Evergreen or Deciduous
Height: ______ ft

Pieces of large woody debris :

______

E X A M P L E

Stream Area (a cross-section)

Area #	Depth		Width		Product
Area 1	1 ft	x	10 ft	=	20 ft^2
Area 2	1.5 ft	x	10 ft	=	15 ft^2
Area 3	2 ft	x	10 ft	=	20 ft^2
Area 4	2.5 ft	x	10 ft	=	25 ft^2
Area 5	3 ft	x	10 ft	=	30 ft^2
Area 6	3 ft	x	10 ft	=	30 ft^2
Area 7	2 ft	x	10ft	=	20 ft^2
Area 8	1 ft	x	10 ft	=	10 ft^2
Area 9	1 ft	x	10 ft	= +	10 ft^2

Total Stream Area = 180 ft^2

Remember!

Area=Depth x width

Total Area= A1+A2+A3...

Velocity

Distance you're measuring: 100ft

Trial #1: __19____ seconds

Trial #2: __18____ seconds

Trial #3: __20____ seconds

Average time = 19+18+20= 57

57sec / 3 trials=19sec

Stream velocity = 100feet/19sec

= 5.3 ft / sec

Total Discharge = 180 ft^2 x 5.3 ft / sec

= **954.0 ft^3/sec**

Velocity= measured distance /average time

Total Area x Total Velocity= Total Discharge in Cubic Feet / Second

Key Questions to Answer:

- Why do we study streamflow?
- Where is erosion happening in the stream cross section? Where is deposition happening?
- How does streamflow effect the path of a stream down through a watershed?
- How does streamflow affect a riparian area?
- How do evergreen or deciduous trees in the riparian area affect stream habitat?
- How does streamflow affect the amount of large woody debris in a river system?
- How do seasonal, storm related, and other changes in streamflow impact aquatic organisms?
- How can estimates of streamflow vary?

Objectives:

- determine how soils and water affect plant communities in wetland ecosystems, and
- examine how wetland diversity affects wildlife habitat and watershed conditions.

Students required: 3-5

Time required:
1 1/2 - 2 hours

Materials:
Pencils, datasheet, soil auger, 100 foot measuring tape, yard stick, wetland plant field guide.

What wetlands are:

Wetlands are areas that are adapted to the presence of water for some time during the growing season. Some common wetland types are marshes, bogs and swamps. Wetlands offer huge benefits to the ecosystem. Due to the slow moving water in wetlands, pollution and sediments settle to the bottom of the system. Aquatic vegetation also traps sediments in wetlands that would otherwise flow directly into streams. Therefore, wetlands help "clean" rivers and streams by filtering sediments and pollutants. The wetland habitat provides food and shelter for many wildlife species including fish, water-fowl, and amphibians. Wetlands are also habitat for larger mammals such as deer, elk, and bears. Wetlands help control flooding during high flow events by storing water. In dry summer months, wetlands maintain streamflows by slowly releasing water stored in thier vegetation and soils.

The Parts of Soil:

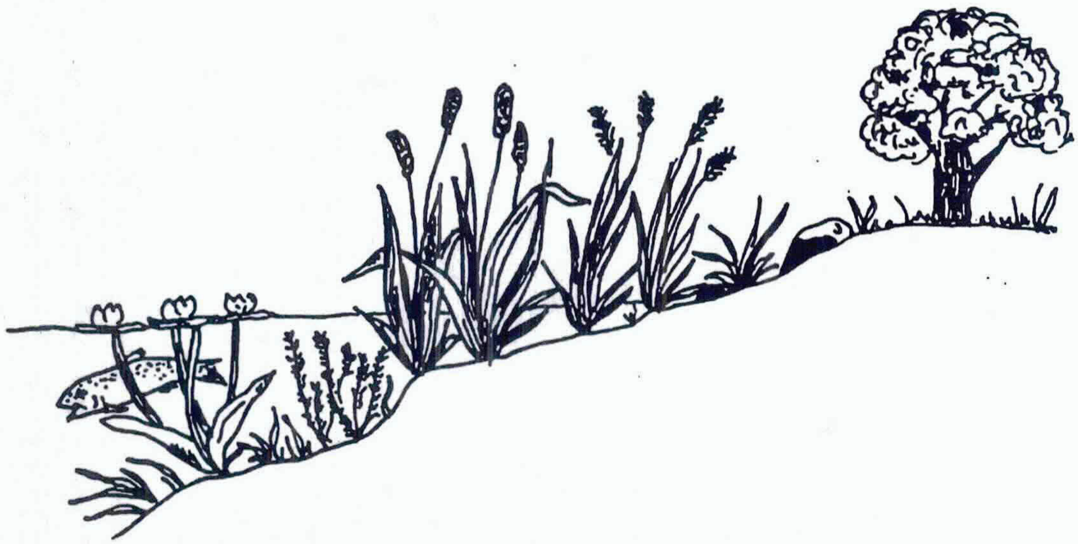
Soil plays a large role in the types of plant communities we find in a wetland. In general, soils are made up of plant materials (organic soils) and weathered rock materials (mineral soils). The largest mineral materials are sand, middle sized mineral particles are silt, and the smallest measured mineral soil particles are clay. Each of these materials feel different. Sand feels gritty; silt feels smooth; and clay feels sticky. The relative amounts of organic and mineral materials in soil is called soil texture. Soil texture affects the amount of water and support available for plants.

Wetland Soils:

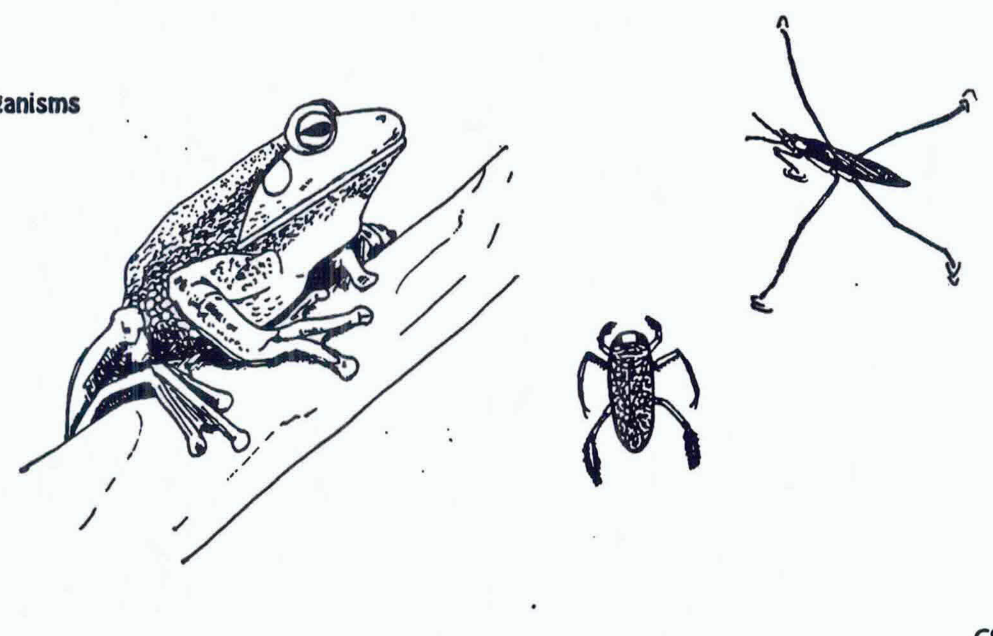
Wetland soils can be saturated all year long or for a portion of the growing season. Wetland soils can be different than upland soils in their odor, texture, feel, and color. Often, wetland soils have a strong rotten egg or an earthy smell associated with a high amount of decomposing plant materials. These decomposing materials can also make the soil feel very slimy. Soils that are wet for long periods of time often have a blueish-gray color (this is called gleying).

Wetland Vegetation:

Wetland vegetation has evolved over time to survive in either standing water, or saturated soil conditions. Many of these adaptations are visible on the plant. Wetland habitats with a few feet of standing water can provide little support for heavy woody vegetation. Plants in this type of habitat are often herbacious, without woody stems. Some plants in standing water have their roots under water and leaves above the water. Air pockets or holes in plant stems help transport oxygen and other gases through the plant. As water becomes more shallow in wetlands, woody vegetation is able to survive. To prevent falling over in loose, wet soils, woody shrubs often branch many times. Wetland habitats with saturated soil may have a few inches of dry soil on the ground surface. Wetland plants in these areas have developed shallow root systems.



Other Wetland organisms



Procedures for the Wetlands Transect::

The wetland habitat along the boardwalk changes from the wettest area to the driest area. The wetland team researches why and how the wetland changes along the boardwalk.

1) Set up your transect. Begin the transect at the end of the board walk by the deepest water. Stretch out the measuring tape along the boardwalk towards the forested area until you reach the main boardwalk trail. The length of the tape measurer will be the transect.

2) Determine your plot. The plot is a circle, 20 feet in diameter. Any distance on the transect can be the plot center. Chose your plot and record the transect distance of the first plot.

3) Record water depth: Take water measurements off the boardwalk at the plot center.

- Measure and record the depth of the free standing water to loose sediments.
- Measure the depth from the top of the water to the bottom of the loose sediments.
- Calculate loose sediment depth.

4) Investigate the plant species in the plot area.

- Record the plant's position in the system (overstory or understory).
- Record plant characteristics of the most dominant species.
- Look for and record wetland plant indicators.

5) Investigate soils. Screw the auger into the ground in a clockwise direction. Pull the auger straight out of the soil. Observe and record the texture, color and odor of soils.

6) Investigate the wildlife. Take five minutes to quietly observe the plot area for bird, insect or other wildlife species. Also record any sign of animals including tracks, nests, calls, etc.)

7) Plots 2 and 3: Move further along your transect and examine a different wetland habitat at plot 2. If you have time, move further along you transect and examine a different wetland habitat at plot 3.

Key Questions to Answer:

- What is a wetland?
- Why do the plant communities change at this wetland site?
- Are their differences in the density of the plant species in the communities? Why?
- How do the soils differ among research plots? Are the soils wetland soils? Why?
- How do we know when we are no longer in a wetland habitat?
- Why are wetlands important?
- What types of organisms use wetland ecosystems?

Cascade Streamwatch Transect Datasheet

Research Site: ______________________ School: ______________________

Date: __________ Weather (now and last 24 hours): ______________________

Plot #: ______ Plot center on transect: ______ (ft)

Water:

Depth to standing water (Measure to loose sediments): ________ (ft)

Depth to hard ground: ________ (ft) Calculate loose sediment depth ________ (ft)

Plant Communities:

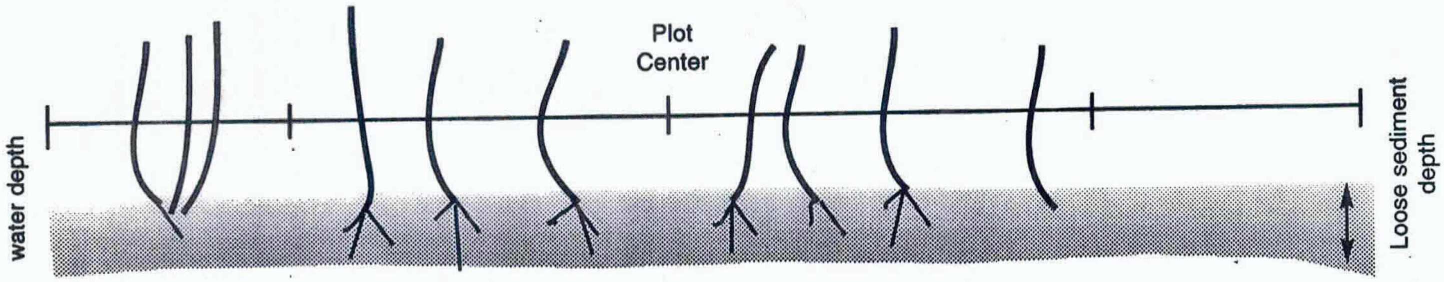
	overstory	understory	height	fully underwater	floater	emergent	herbacious stem	woody stem	pores in stems	spongey middle	smell ____	multiple branching	shallow roots	Other Key ID Features
1.														
2.														
3.														
4.														

Notes:

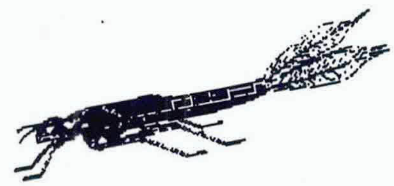
Soils:		Sample 1	Sample 2
Clay	(feels sticky, stains)		
Silt	(feels smooth/slippery)		
Sand	(feels gritty)		
Organic material	(feels slimy, look for partially decomposed plant materials)		
Blue or Green / gray color			
rotten egg smell			
gray and brown patches (mottles)			

Notes:

The plot



is Habitat for



Birds:	Flyer	Wader	Perching	Calls	Beak holes	Cavity nests	Other
Number:							
Notes:							

Insects:	Aquatic	Terrestrial	Flying	Soil	Other
Number					
Notes:					

Other Wildlife	Sign	Sighting	Tracks	Call	Other
Amphibians					
Mammals					
Notes:					

Appendix A:

Benchmarks

		Cascade Streamwatch				Highland Ecology			
		Streamflow	Wetlands Transect	Macro invertebrates	Water Quality	Plants	Insects	Forestry	Wildlife
Science Inquiry	Ask questions and form hypotheses that are based on observations and scientific concepts and that can be explored through scientific investigations	✓	✓	✓	✓	✓	✓	✓	✓
	Design a scientific investigation to answer questions or test hypotheses	✓	✓	✓	✓				
	Collect sufficient data to investigate a question, clarify information, & support an analysis	✓	✓	✓	✓	✓	✓	✓	✓
	Analyze & summarize data including possible sources of error. Explain results & offer reasonable & accurate interpretations & implications	✓	✓	✓	✓				
Life Science	Identify and describe the factors that influence or change the balance of populations in their environment;	✓	✓	✓	✓	✓	✓	✓	✓
Unifying Concepts	Identify and describe relationships between structure and function;		✓	✓		✓		✓	✓
	Identify and describe patterns of change;		✓			✓	✓	✓	✓
	Identify and explain evidence of physical and biological changes over time;	✓	✓	✓	✓	✓	✓	✓	✓
	Identify a system's inputs and outputs. Explain the effects of changing a system's components	✓			✓	✓		✓	
Earth and Space Science	Explain the water cycle and its relationship to weather and climate patterns	✓							

'98 Wolftree Moments

Opening day celebration for the Cascade Streamwatch Education Center

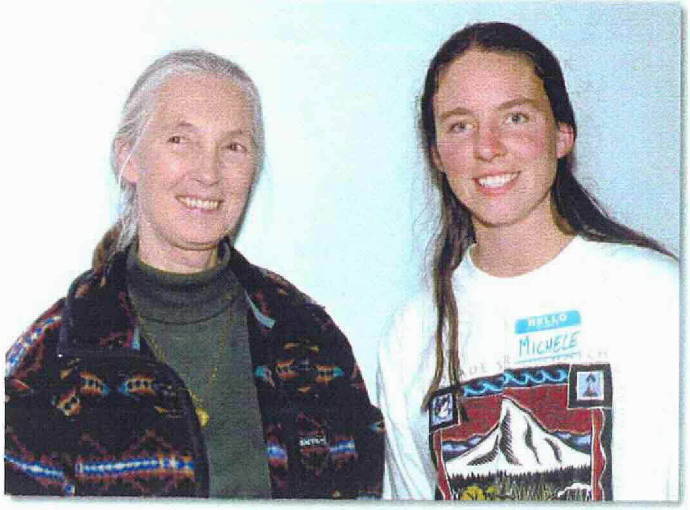
Dennis Norton (employee of PGE & Wolftree board member) speaks to the audience at the CSW opening

Timber Lake Civilian Conservation crew prepared food for the hungry guests

Over 400 people attended the Cascade Streamwatch celebration

Local volunteers completed several restoration projects

Roots and Shoots students from all over North America attend Wolftree's Cascade Streamwatch and Highland Ecology Programs



Jane Goodall (Jane Goodall Institute) and Michele Ferry (Wolftree Program Manager) talk about the day.

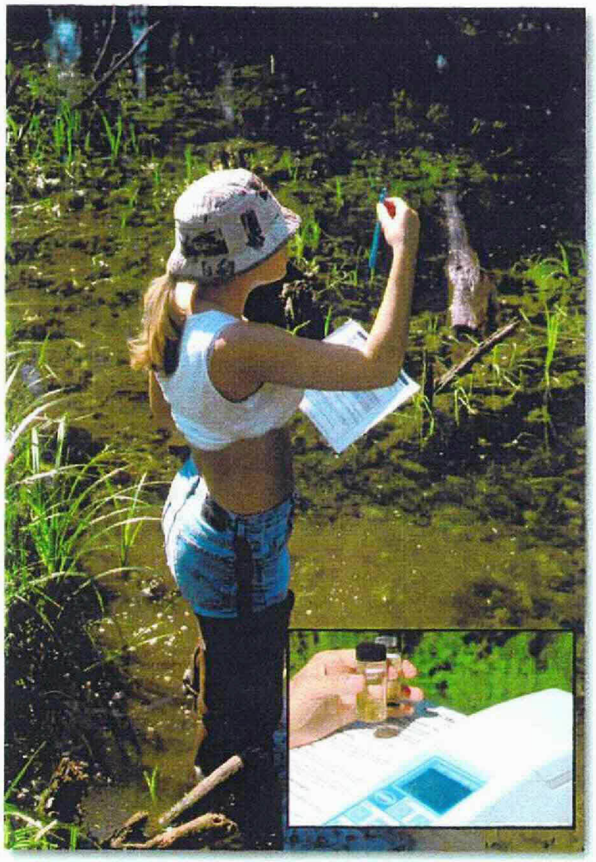
Dale Baer (Wolftree mentor and Forester with PNW Research Station) with a few of the Roots & Shoots students

Grant Mcomie visits Cascade Streamwatch

Film crew knee-deep in the Salmon River.

Students are eager to answer questions about aquatic ecology

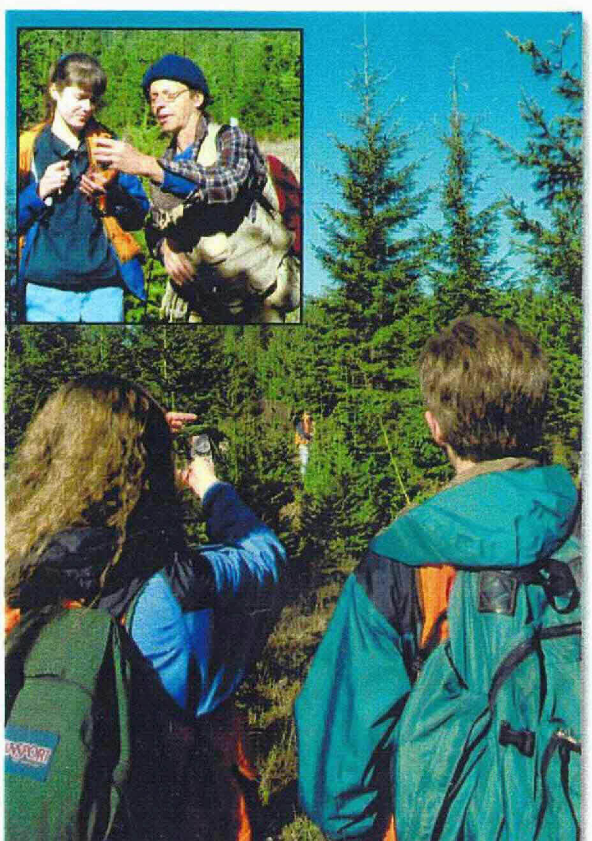
CASCADE STREAMWATCH AND HIGHLAND ECOLOGY GET PEOPLE EXCITED ABOUT SCIENCE



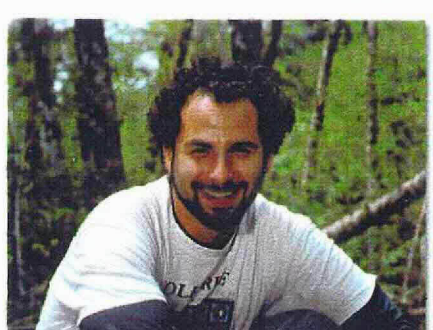
Cascade Streamwatch Managers — Joellen Shannon & Michele Ferry

An advanced science student tests water quality in the Wildwood wetlands.

Student explores the biology of a wild stream



Students learn basic forestry skills at Molalla Tree Farm.



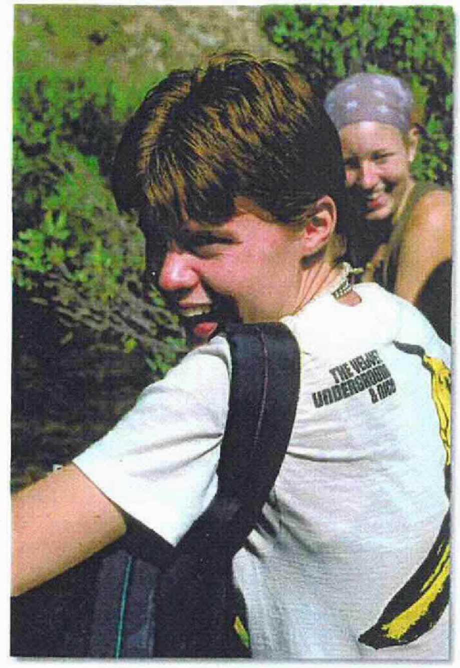
Highland Ecology Manager — Russell Hirschler

Near Dream Lake, Wyoming

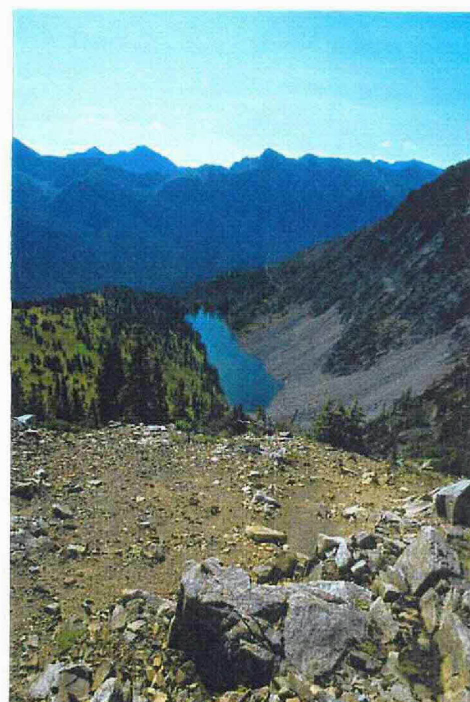
Team reaches 13,000 feet in the Wind River Range

North Cascades Science Expedition

Rocky Mountain Team



People having fun



Buckskin lake

Wolftree, Inc.

Annual Report for 1998

3735 SE Clay Street • Portland, Oregon 97214
(503) 239-1820 • fax (503) 239-1183 • www.beoutside.org

~ a charitable non-profit that provides educational programs in ecology ~

Our Mission & Goals

Wolftree is a non-profit 501 (c)(3) corporation whose mission is to serve people, their communities, and the Earth through science education in the outdoors. Wolftree carries out this mission through the design and implementation of three programs; Cascade Streamwatch, Highland Ecology, and the Science Expeditions. These programs focus on the science of ecology, are hands-on, community-based, and take place in the outdoors. Wolftree programs seek to foster within participants:

- a deeper understanding of the science of ecology;
- enhanced skills necessary to solve complex problems;
- a stronger desire to think creatively and critically, and
- a greater respect for themselves and their environment.

Highlights for '98

Innovation, Growth, and Efficiency

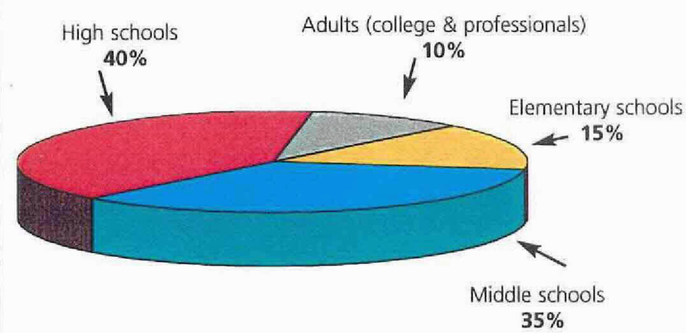
Recent mandates for education in both Oregon and Washington require students to reach new performance standards in science and math. These new standards (benchmarks) come at a time when funding for education is inadequate to support the achievement of old standards. State educational requirements call for "real-world" and "service learning" experiences. They prescribe student outcomes that can only be met through educational opportunities that are provided by the community and are beyond the limitations of a classroom (Oregon Department of Education, 1996).

In 1998, Wolftree focused on increasing science rigor in our programs while providing opportunities for *real world learning experiences*. As a result, Wolftree programs are positioned to help satisfy both the need for vehicles of achievement (benchmarks) in science and community service learning. Our programs will help Oregon teachers provide opportunities for younger students to satisfy requirements for their *Certificate of Initial Mastery* (CIM) in general science and for older students to satisfy their *Certificate of Advanced Mastery* (CAM) requirements for community-based learning experiences in Natural Resources.

Enrollment increased by ten percent in 1998 when compared to 1997. Guided by volunteer (professional) biologists and equipped with contemporary science techniques, 2,200 Wolftree students studied the streams and forests of the Pacific Northwest *(see figure 1 for details).*

Innovations in the programs and growth in enrollment were made possible through increased support in both financial and in-kind donations. Over 50 public and private organizations contributed

Figure 1. Who we served in '98



$335,677 in cash, $131,560 in specialized volunteer labor (mentors), $50,448 in non-specialized volunteer labor, and $21,236 in donated supplies. Our cash contributions were up $82,000 from 1997 and were in-line with our projected revenue (budget) of $325,000 for the year.

Over the last year, Wolftree became stronger by lowering the costs of general administration and development. As a result, a larger percentage of the total revenue went into the operations of the education programs.

Field operations were enhanced with the addition of a new outdoor classroom and storage facility located at the Wildwood Recreation Area. The quality of our in-class and field activities were significantly improved by the addition of 70 new mentors along with several college interns and Capstone students[1]. To insure Wolftree will successfully keep current employees and compete for new talent in the future, we upgraded our benefit packages for healthcare and retirement.

1 If you would like to learn more about our intern program or the the Capstone class held at Portland State University, please contact Dr. Lauri Shainsky, Education Director, at (503) 239-1820.

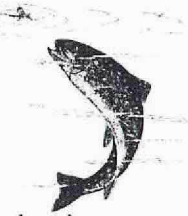
Cascade Streamwatch

The goal for the Cascade Streamwatch Education Program (CSW) is to enhance people's awareness of and appreciation for Pacific Northwest aquatic ecosystems, while cultivating skills in science, math, and problem-solving. Our program goal is accomplished by engaging students in *"hands-on"* field studies with the help of professional scientists.

Jeff Uebel learning about aquatic insects with a group of young scientists.

CSW served 1,305 students and teachers from 38 schools in 1998. The participating schools were a mix of high (36%), middle (36%), and elementary schools (28%). Over 40 organizations participated by providing funding, equipment, and volunteers. All programs were conducted at the Wildwood Recreation Area in Welches, Oregon.

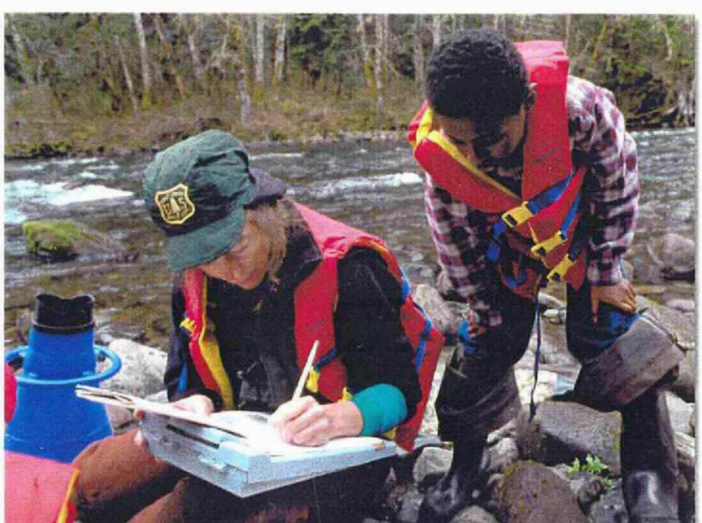
Program Improvements in '98



More Mentors

The pressure to do more with less is growing in government and private organizations. As a result, mentors are less able to take time away from work to help guide students at CSW. The 5:1 student to mentor ratio in the CSW program is essential to achieving a high quality educational experience. Over 30 new mentors were recruited before the start of the spring season through extensive outreach to public and private organizations.

With the help of CSW teachers and veteran mentors, a training in March of 1998 introduced new mentors to program activities and to Wolftree's education goals and philosophies. A total of 65 teachers and resource professionals spent time at Wildwood for the day-long training. New mentor recruitment was successful, the 5:1 ratio was maintained throughout the season.



Deb Urich, a fisheries biologist, mentors a young scientist at CSW.

Better Safety in the Field

To ensure that our participants were safe at all times, potential hazards were discussed with mentors every morning prior to the arrival of each school. Safety protocols were designed specifically for each research location (ie. river, stream, and wetland sites). Later in the morning, mentors discussed safety issues with every student. In the event of an accident, two-way radios provided constant communication between mentors and the program manager. Random field checks by Wolftree senior staff were used to guarantee our success in implementing the new procedures. In 1998, Wolftree was accident free. In post-season evaluations, all teachers expressed that they felt their students were safe and that our safety protocols were appropriate for the field conditions encountered at CSW.

Custom Programs

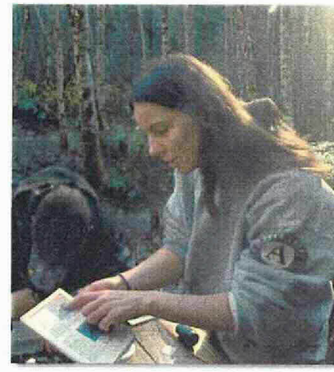
CSW was updated with three new learning modules (emphasis groups) that addressed the wide diversity of experience and knowledge exhibited by our students concerning aquatic ecosystems. Specifically, the degree of rigor in data collection and the discussions at the end of the field day (*the wrap-up*) were modified for each class depending on their level of scientific knowledge. The needs of a scheduled class were assessed through discussions with the teacher and the Wolftree program manager several weeks before the field day. A class with little science or outdoor experience worked on basic awareness and observation skills during the field study. Students with more experience investigated the relationships among components of a watershed, while the advanced class conducted intensive research on ecological concepts within a research area.

(continued on the next page)

The appropriate mentors for an emphasis group (class) were then scheduled. Emphasis groups proved to be a positive, productive program innovation for both students and mentors. Mentors became more successful educators with a better understanding of what information was valuable for students. As a result, the students received a more meaningful education. Further enhancements in the wrap-up sessions are planned for 1999.

Wolftree has designed Cascade Streamwatch to provide an exciting and challenging introduction to watershed science. Participation in CSW results in greater teacher and student competence in science and will help participants fulfill CIM/CAM requirements.

In addition, CSW provides an opportunity for quiet contemplation in nature, and builds self-esteem through teamwork and creative problem-solving.



Michele Ferry, CSW program manager

If you would like to know more about CSW please call: Michele Ferry (*Program Manager*) or Joellen Shannon (*Assistant Program Manager*) at 239-1820 or visit our web site at www.beoutside.org

Highland Ecology

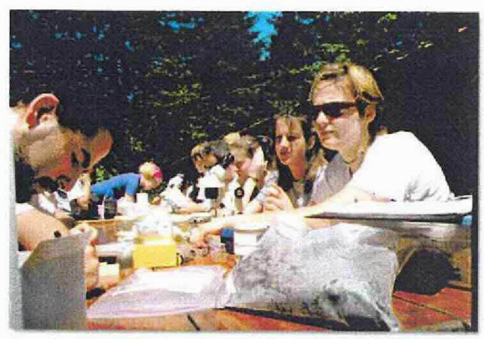
During a time in the Pacific Northwest when the main focus was on the aquatic systems, specifically salmon, Wolftree noticed a need for a land-based (terrestrial) ecology program. All too often, the term "watershed" leads people directly to the rivers, streams, and lakes. Because the land, in terms of area, is the largest component of a watershed and often defines the character of an aquatic system, Wolftree designed a program that considered the ecology of the terrestrial component — the plants and animals.

The goals of Highland Ecology (HE) are to create a stimulating and supportive environment where people: gain an understanding of how organisms interact with each other and their environment; ask and answer questions about the natural world, and have fun while they learn about ecology. As with our CSW program, HE gets students out of the classroom and allows them to learn new things about science, themselves and the people they spend time with (mentors, teachers, and fellow students).

Dr. Lauri Shainsky, Education Director, guides students through the plant ecology module.

Growth in Enrollment

In 1998, HE served nine schools, 10 classes, and 210 students. Nine of the 10 field days were held at Wildwood Recreation Site near Welches, Oregon and one was held on Willamette Industries properties near Molalla, Oregon.



Gayle Bigham (a mentor and employee of Coffey Laboratories) with Russ Hirschler (HE Program Manager) help students key insects during Highland Ecology.

Support from the Community

The mentor volunteer base was expanded from 10 (1997) to 50 mentors. The increase in the number of mentors allowed HE to continue the Wolftree goal of a maximum of 5:1 student:mentor ratio. In fact, 75% of the field days had a 3:1 student mentor ratio or lower.

The program had a trained cadre of 10 interns from local organizations, universities and high schools that were present as mentors and provided logistical support in the field. Additionally, the interns accompanied the program manager into the classroom and assisted in the in-class sessions.

For the first time, Wolftree offered a field day where 25 students went to HE and 25 students went to CSW. At the end of the day, the research teams joined together for a discussion of both terrestrial and aquatic systems. The outcome was extremely positive for the mentors, teachers and students. This option will be offered to more schools next year.

In 1999, Wolftree will incorporate several key ecological concepts into the HE curriculum. The concepts will include the food web, disturbance, adaptation, populations, and species diversity. In addition, the program will offer 12 field days for both spring and fall. Our goal is to serve 720 students for the year.

If you would like to know more about Highland Ecology please call:

Russ Hirschler(*Program Manager*)
(503) 239-1820 or
visit our web site at
www.beoutside.org

Science Expeditions

The goal of the program is to renew the spirit of discovery and explore the ecology of the natural world. Expeditions are designed to enhance participant's understanding of ecological principles, strengthen inquiry skills (observation, analysis, and communication), and connect participants with the natural world.

Erin Edwards, veteran Wolftree participant and college student, high in the Wind River Range of Wyoming.

Wolftree expected participants to achieve five outcomes on the expeditions: (1) explore and use contemporary techniques in forest ecology; (2) increase their skills of observation, communication, and analysis; (3) gain a deeper understanding of the science of ecology, (4) improve their ability to use their senses in a wild setting; and (5) obtain the skills necessary to plan and execute a wilderness trip (with an emphasis on safety and minimal environmental impact).

In 1998, Wolftree successfully organized two expeditions in the Western United States (Pasayten Wilderness in the North Cascades of Washington and the Wind River Range in the Rocky Mountains of Wyoming).

Designed for participants with a keen interest in the ecology of timberline communities, these expeditions provided both mental and physical challenges.

The team was introduced to a variety of disciplines including orienteering, tracking, birding, geology, plant taxonomy, and forestry. Participants were encouraged to use these and other topics to reflect on their personal connections to the natural world.

"What an amazing self-confidence boost this expedition has been for me! I have never undertaken such an adventure and right now lack the words to say thank you deeply enough to all the crew. I am so grateful that the Wolftree family is an inspirational, integral part of my life."

— Jennifer Hopp, Teacher

If you would like to be a part of Wolftree's Science Expeditions, please contact Russ Hirschler at: (503) 239-1820 or visit our Web site (www.beoutside.org)

Rocky Mountain research team — Dream Lake, Wyoming

Financial Information

Wolftree continued to experience healthy growth in 1998 (see figure 2 below). As in previous years, Wolftree's revenue came primarily from a few large private and public organizations. In fact, the top ten donors accounted for 87% of the total cash revenue.

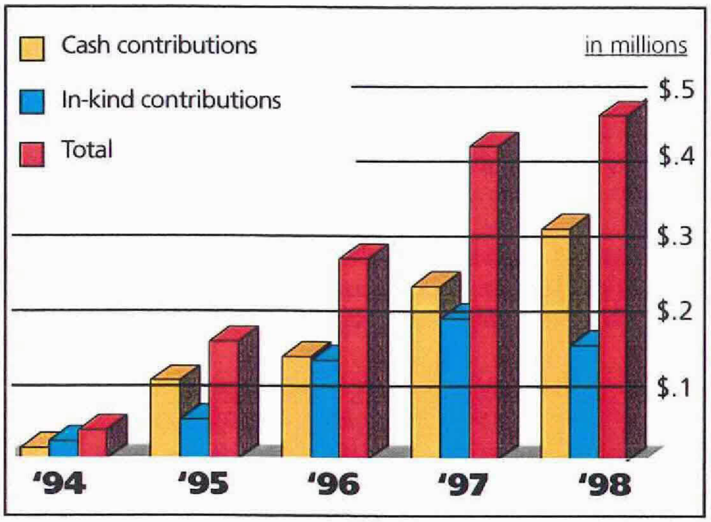


Figure 2. *Five years of growth*

Overall, 65% of the total contributions originated from private sources (see figure 3) while the remaining 35% came from public organizations (a mixture of federal and local government).

The *Statement of Financial Position* and the *Statement of Activities* for the year are presented in Tables (1) and (2). If you would like a copy of the full financial audit performed by the firm *Bottaini, Gallucci & O'Hanlon, P.C.*, please contact: Dale Waddell, Executive Director, at (503) 239-1820.

Figure 3. *Contributions by donor categories*

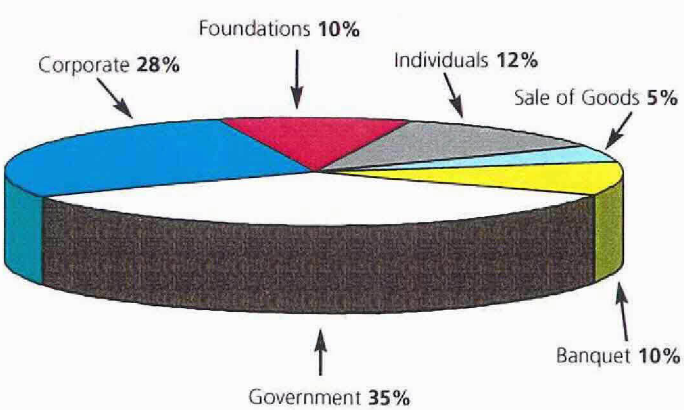


TABLE 1. STATEMENT OF FINANCIAL POSITION
Modified Cash Basis

ASSETS	
Current assets	
Cash and cash equivalents	$ 5,191
Total current assets	5,191
Fixed assets	
Equipment	19,720
Vehicle	17,103
	36,823
Less accumulated depreciation	15,854
	20,969
Other Assets	
Organizational costs	1,520
Less accumulated amortization	1,520
	$ 26,160
LIABILITIES AND UNRESTRICTED NET ASSETS	
Current liabilities	
Current maturities of long-term debt	$ 1,688
Current maturities of lease obligation	2,865
Accrued payroll taxes	5,573
Pension payable	496
Total current liabilities	10,622
Long-term debt	
Long-term debt, net of current maturities	7,146
Lease obligation, net of current maturities	4,045
	11,191
Unrestricted net assets	4,347
	$ 26,160

What's up in 1999

In September of 1998, we updated our strategic plan to include an increase in the annual enrollment from 2,200 students to 2,800 students in 1999. Resources are in place for a spring expansion into new schools located in southwest Washington. Funding from the USDA Forest Service (Gifford Pinchot National Forest), USDI Fish and Wildlife Service and Weyerhaeuser has been secured. In addition, feasibility studies will be conducted to consider expansion into eastern Oregon (the Bend area).

TABLE 2. STATEMENT OF ACTIVITIES — Modified Cash Basis
Year Ended December 31, 1998

Unrestricted net assets		
Revenues		
Government agencies	$	148,452
Donated services[1]		131,560
Foundations		54,000
Corporations		53,311
Community development fund		37,000
Donated supplies		21,236
Individual contributions		16,314
Special events		13,918
Program fees		9,120
Board contributions		2,300
Miscellaneous		1,256
Interest income		6
Total revenues		488,473
Expenses		
Salaries		175,223
Donated services expense		131,560
Community development fund expense		37,000
Rent		23,000
Donated supplies expense		21,236
Payroll taxes		18,879
Supplies		14,191
Student travel (bus)		11,895
Insurance		9,470
Depreciation		9,243
Instructional materials		6,680
Professional fees		6,550
Pension expenses		4,563
Cost of events		4,239
Travel		3,757
Miscellaneous		3,625
Telephone		3,418
Benefits		3,085
Interest expense		1,456
Utilities		1,225
Printing and publications		999
Training		825
Bank charges		715
Membership fees		335
Amortization		253
Postage and delivery		246
Contracts		244
Conference and meetings		230
Online service		137
Total expenses		494,279
Decrease in unrestricted net assets		(5,806)
Unrestricted net assets, beginning of the year		10,153
Unrestricted net assets, end of the year	$	4,347

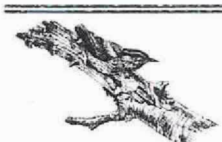
1 donated services did not include non-specialized labor of $50,448 during 1998.

Support from Organizations in 1998

AlpineAire Foods
Aon Risk Services of Oregon
AT&T Wireless Services
Bank of America*
Bonneville Power Administration
Bob's Red Mill Natural Foods
Brenthaven
Bridgetown Coffee
Cascadian Farms
CH2M HILL
City of Portland Water Bureau*
Clif Bar
Coffey Laboratories
Crazy Creek Products
Emerald Valley Kitchen
Executive Officers Club
Fred Meyer
Gardenburger
JWA (Silva/Camptrails Products)
KATU Channel 2
Kelley Family Fund (OSU Foundation)*
Lakeville Growers*
Merrill Lynch
METRO Greenspaces
MFA Consultants
Multnomah County School District 1 (TAG)
Northwest Natural*

Northwest Steelheaders
Oregon Forest Resource Institute
Oregon Dept. of Fish and Wildlife
Oregon Dept. of Environmental Quality
Patagonia
Petaluma Poultry Processors
Portland General Electric\ENRON*
Portland State University
PNW Welfare Fund
PUR Drinking Water Systems
Rose E. Tucker Charitable Trust
SRI/Shapiro Consultants
Symonds & Associates
Tazo Tea
The Collins Foundation*
The Oregon Community Foundation*
The Resort at the Mountain
Timber Lake Civilian Conservation Center
Timberline Lodge
Trader Joe's
US Bank*
USDA Forest Service*
USDI Bureau of Land Management*
USDI Fish and Wildlife*
USDI Geological Survey
Web Steel
Willamette Industries*

(bold) indicates cash contribution — (*) cash contribution is equal to or greater than $5,000



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