Middle Fork Watershed Stewards

Watershed and Restoration Ecology
Project-Based Curriculum for High School Students

MIDDLE FORK
WILLAMETTE
WATERSHED COUNCIL

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Acknowledgements

Middle Fork Watershed Stewards is a collaborative project made possible by the efforts and contributions of many organizations. The program is maintained and run by the Middle Fork Willamette Watershed Council and overseen by the MFWWC Education and Outreach Committee. The MFWWC would like to thank the many project partners who have contributed to the project.

US Forest Service, Middle Fork Ranger District
US Army Corps of Engineers, Willamette Valley Project
Oregon Parks and Recreation Department
Oregon Department of Fish and Wildlife
Oregon Watershed Enhancement Board
Oregon Community Foundation
Springfield School District
Mary's River Watershed Council
South Santiam Watershed Council
Oakridge School District
Southern Willamette Forest Collaborative

The Middle Fork Watershed Stewards curriculum was designed and written by Erika Coyer for the Middle Fork Willamette Watershed Council.

Welcome

The Middle Fork Watershed Stewards Program is a project based watershed education curriculum. Students are given the background, knowledge, and tools necessary to build an understanding of habitat protection and enhancement through classroom instruction, coupled with a field-based restoration project at a local site. Students will work as a team to design, implement, and monitor a project. They will work with restoration specialists and be exposed to professional skills. Once students have completed their project, they will have the opportunity to mentor the elementary level Watershed Rangers in a variety of classroom and field-based activities.

Program Structure:

-Phase 1: Watershed Ecology:

Students build background knowledge in Watershed Ecology; become familiar with the project site

-Phase 2: Project Design:

Students select and design a project, prepare the site, and collect pre-project data

-**Phase 3: Project Implementation:**

Students organize logistics and implement the project

-**Phase 4: Monitoring, Maintenance, and Project Evaluation:**

Students collect post-project monitoring data and do site maintenance; use data analysis to evaluate the project, and create a presentation

-Phase 5: Mentorship and Leadership Development:

Students participate in leadership development activities and facilitation training; mentor Watershed Rangers in classroom and field experience

IMPORTANT UPDATE

The following curriculum was built under a model that provided considerable support from the Watershed Education Program (WEP) staff. While our education staff are happy to support, lead, and coordinate field trips and activities; we no longer provide training workshops, resource kits, classroom support for every lesson, and we might have limited availability for field trips. The curriculum remains relevant and applicable for student groups and provides a thorough guide to provide hands-on and immersive lessons with paired field experiences. The Watershed Council's Education Program Manager and Education Project coordinator are happy to offer support and answer questions as needed.

Education Program Manager: Emma Garner- emma@middleforkwillamette.org

Education Project Coordinator: Dassy Smolianski- dassy@middleforkwillamette.org

Instructor Introduction

Much of the curriculum is designed to be directly placed in the hands of your students. Instructors should also feel free to pull key concepts from each lesson and present the materials in the most suitable format for their group. Each lesson has a few suggested discussion questions that can also be used as homework and/or assessment. Each lesson is designed to meet Next Generation Science Standards, and those standards are listed at the bottom of each lesson. Some activities and background materials are meant to be seen by instructors only, and will be noted.

Teacher Support:

The curriculum guide gives teachers the background information and tools necessary to implement the Watershed Stewards in their classrooms. The MFWWC Education Coordinator, Land Managers and Specialists, and resources kits are available to support implementation.

Role of the Specialists:

The Specialist is a professional who works with the agency that manages the site where the student restoration project occurs. They understand the big picture of the site, including site history, maintenance requirements, past restoration projects and future restoration plans, and the challenges present at the site. Specialists have a limited amount of time available to contribute to each student group. Specialists will collaborate with the Education Coordinator to:

-establish a complete set of background information that can be shared with instructors and students

-assist with field trips for site tour, assessment, monitoring, and project implementation serve as a resource for questions about the site and project implementation as they arise

In addition to providing guidance for project implementation and monitoring, the specialist also gives students the opportunity to observe a professional working in the field of land management and habitat restoration. The specialist will take opportunities to share aspects of their job as they apply to the project, as well as share information about their background, education, and general work responsibilities.

Role of the Watershed Education Program Coordinator:
The Education Coordinator oversees the logistics of the program. The goal of the coordinator is to empower teachers to feel confident using this curriculum. The coordinator is available to support teachers as they learn about the program, including teacher training sessions and classroom support as needed.
Responsibilities include:
Assist in planning the logistical details of field trips
Manage activities during field trips
Coordinate with the Specialist as noted above
Be liaison between the teachers, specialists, and MFWWC

Role of the Middle Fork Willamette Watershed Council:
The MFWWC, in addition to providing curriculum support, can also help offset the cost of the program by covering the cost of substitute teachers and transportation for field trip days.

Resource Kits:

Resource kits can be borrowed from the MFWWC and your specialist:
Tools for Field Work
Monitoring equipment
Maps and field guides

Timeline:

The core curriculum is designed in phases that can be implemented in a variety of time frames to suit the needs of teachers and students. For some teachers, it may work best to participate in the program over the course of a single school year. Benefits of consolidating the program into a single school year may include: decreased student turnover, better retention of topics due to more regular engagement with the materials, and focused fulfillment of NGS Standards for a particular year-long science class. For teachers who choose to participate in the program for more than one year, benefits include: opportunities to spend more time on project planning and monitoring, more time in the field, opportunity for a deeper leadership development and mentorship experience, and option to fulfill more Next Generation Science Standards as well as cross-curricular standards. The Education Coordinator can help teachers consider the time line that works best for their individual needs, including meeting specific standards. The Middle Fork Watershed Stewards Program is also suitable as an extra-curricular program with a qualified instructor.

Professional Skills:

The program is designed to expose students to professional positions in project-based resource management. Collaboration with a specialist over the course of the program gives students the opportunity to observe aspects of their job and professional skills. Program activities offer hands-on experiences to develop skills that are utilized by restoration and land management professionals. Ask the Program Coordinator about current internship opportunities for students who have completed the Watershed Stewards Program.

The program offers exposure to the following professional skills:

Knowledge of watershed ecology and healthy habitats
Knowledge of restoration ecology: purpose, goals, and methods
Knowledge of monitoring: purpose, goals, and methods
Experience with restoration and monitoring methods used in the project
Ability to conduct a site assessment
Ability to work collaboratively to design a project
Ability to write a project description and outcome statement
Data analysis skills
Project evaluation skills
Presentation and public speaking skills
Small and large group communication skills
Awareness and development of leadership skills
Facilitation skills
Mentorship experience

Program Assessment Options:

Pre and posttest on Watershed and Restoration Ecology
Assessment/ Discussion questions at end of lessons throughout curriculum
Student data analysis assessment
Project presentation assessment
Watershed journals

Middle Fork Watershed Stewards Assessment

Name:

1. What is a watershed?

2. What is the name of the watershed you live in?

3. Name 3 bodies of water in your watershed.

4. Name a major habitat zone in your watershed, and describe some of its elements.

5. Describe how are native habitats are threatened by:

- Invasive Species

- Dams

- Agriculture

6. Name 3 invasive plant species.

7. Name 3 native plant species.

8. Name 3 native wildlife species.

9. What is the purpose of habitat restoration?

10. Give an example of a restoration project. What was the problem and how was it addressed?

11. What is monitoring? Why is monitoring an important part of a restoration project?

Instructors: In addition to these general questions, there are lesson specific discussion questions at the end of lessons throughout the curriculum that you may choose to focus on for program pre- and post-assessment.

Resources and Links:

PLANT AND WILDLIFE RESOURCES

Guide for Using Willamette Valley Native Plants Along Your Stream
http://www.linnswcd.oacd.org/NativePlantGuide05.pdf

Riparian Plant Zones and plant lists
https://www.nrcs.usda.gov/plantmaterials/wapmstn13160.pdf

The Native Plant Society of Oregon
www.npsoregon.org

Native Fish Society
http://nativefishsociety.org

Conserving Oregon Native turtles
http://dfw.state.or.us/wildlife/living_with/docs/ODFW_Turtle_BMPs_March_2015.pdf

LOCAL WATERSEHD ECOLOGY RESOURCES

Middle Fork Willamette Watershed Council
mfwwc.org

Willamette Riverkeeper
https://willamette-riverkeeper.org/

GENERAL WATERSHED ECOLOGY RESOURCES

EPA's Intro to Watershed Ecology
http://cfpub.epa.gov/watertrain/pdf/modules/watershedecology.pdf

Huge list of links for river ecology!
http://chamisa.freeshell.org/link.htm#study

STUDENT WATERSHED RESTORATION PROJECTS

The WELL Project (Water and Energy Learning Lab)
http://www.thewellproject.education

OSU database of student restoration projects and data reports
http://www.streamwebs.org

South Santiam Watershed Council:
www.sswc.org

MONITORING & DATA FORMS

Data collection forms
http://www.streamwebs.org/resources/data-sheets

GLOSSARY

Aquifer: Any geological formation containing or conducting ground water

Biodiversity: There are 3 types of biodiversity, Ecosystem Diversity (a variety of natural systems), Species Diversity (a variety of species in an area), and Genetic Diversity (genetic diversity within a species)

Ecosystem: An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. Ecological Resiliency: The capacity of an ecosystem to respond to a disturbance by resisting damage and recovering quickly

Equilibrium: The condition of a system in which all competing influences are balanced

Erosion: Processes which remove soil and rock from one location, transport it, and deposit it at another location. For example, water flow or wind.

Forage: To search for wild food resources

Habitat: An ecological area that is inhabited by a particular species. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light, as well as biotic factors such as the availability of food and the presence of predators

Habitat diversity: A wide variety of habitats to support a diverse population of species Impervious: A surface that fluid cannot pass through, such as concrete

Keystone species: Those species whose functions are so intertwined with the lives of other animals in a system that their disappearance will cause the system to become imbalanced or even collapse. For example, a beaver dam's rivers, creating ponds and wetlands that support an entire system of stream organisms. When beavers are removed from a stream, the habitat they create is lost and many of those stream organisms are displaced or die.

Metamorphosis: A biological process by which an animal physically develops after birth or hatching, involving a conspicuous and relatively abrupt change in the animal's body structure through cell growth and differentiation.

Niche: How an organism or population responds to the distribution of resources and competitors (for example, by growing when resources are abundant, and when predators, parasites and pathogens are scarce) and how it in turn alters those same factors (for example, limiting access to resources by other organisms, acting as a food source for predators and a consumer of prey). The environment shapes the life forms that occupy it, and each species occupies a niche within the range of environments in which it is found.

Nitrogen fixation: The process by which plants convert atmospheric nitrogen into soil nitrogen, which is then available as a nutrient for plants

Photosynthesis: A process used by plants and other organisms to convert light energy, normally from the sun, into chemical energy that can be later released to fuel the organisms' activities

Salmonid: a family of ray-finned fish, including salmon, trout, chars, freshwater whitefishes, and graylings

Sediment: A naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice, and/or by the force of gravity acting on the particles.

Silt: A granular material of a size somewhere between sand and clay. Silt may occur as sediment suspended in water, or as soil deposited at the bottom of a water body.
Snag: A standing dead tree

Tributary: A stream or river that flows into a main stem (or parent) river or a lake
Topography: The three dimensional description of the Earth's surface shapes and geographical features

Turbidity: The cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Water Table: The water table is the surface where the water pressure head is equal to the atmospheric pressure. It may be visualized as the "surface" of the subservice materials that are saturated with groundwater in a given vicinity.

FIELD NOTES

Guidelines for Successful Field Trips

Before You Go

- Notify the WEP Coordinator if any of your students have accessibility needs, allergies, medications, or other considerations that may influence field trip planning.
- Schedule the school bus(es) for the day. If needed, the WEP Coordinator can provide a map or directions to the site. Generally, the bus is not needed during the trip, so drivers may leave and come back.
- Send home a note and, if required, permission slip. Important: For service projects, host agencies may require a separate waiver form for each student. For liability reasons, students without signed waivers will not be allowed to participate in the volunteer activity.
- Contact and line up school approved chaperones. A 6-to-1 ratio of students to adults is advised. Any teacher who will be leading a station activity should not be counted in the chaperone total. The WEP Coordinator may be able to assist in lining up volunteers, as members and staff of the MFWWC, college students, and community volunteers are sometimes available to volunteer.
- Instruct students to dress appropriately. Closed-toe shoes and long pants are a must; if rain is forecast, students should bring rain gear and warm clothing for the trip and have a change of clothes back at school.

The Day of the Trip

- Make nametags for students to assist instructors and volunteers in communicating with students and getting their attention when needed.
- Orient students and school proved chaperones to the day's activities. On-site, the field trip leader (usually the WEP Coordinator) will start the field trip with a brief introduction describing the day's activities, introducing guest instructors, and giving instructions.
- Exchange cell phone numbers with the WEP Coordinator and key volunteers, particularly if activities will take place any distance apart.
- Remind students to exhibit good behavior as needed. Guest instructors have varying levels of experience with classroom management and may need a hand at times. Clear behavior expectations and interventions from teachers and parent volunteers can make all the difference in maintaining an orderly atmosphere for learning.

Phase 1: Watershed Ecology and Restoration Instructor Introduction

Curriculum Overview

In the Classroom:

1.1 Introduction to Watershed Ecology~45 min

Major habitat types: riparian, stream, and upland.
Elements of healthy habitats, and how they are interrelated
Threats to habitats, and how those threats are addressed

1.2 Middle Fork Willamette Watershed~45 min

Watershed Mapping Activity: Students create an interactive map of the watershed.
Overview of Middle Fork Willamette Watershed

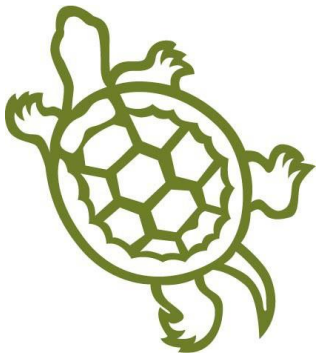
1.3 Restoration Ecology~45 min

Purpose, goals, and methods of protecting and restoring habitats.
Habitat restoration field examples.
Practical aspects and considerations of habitat restoration

In the Field~3 hours

1.4 Field Day 1

Site tour, guided by a specialist: Look at examples of restoration projects.
Conduct site assessment: pairs or small groups work with specialists to identify key elements of the site and fill out assessment form.
Discuss options for restoration methods to address site needs identified through site assessment.



Phase 1: Instructor Notes

The Watershed Ecology curriculum is designed to give an introduction to general concepts in watershed ecology, and apply those concepts on a local level. In order to build a sense of connection to the local watershed and create a sense of program continuity, teachers may choose to begin with the mentorship questions in Phase 5's Sense of Place, where students are encouraged to share meaningful local outdoor experiences. This creates a sense-of-place foundation for the ecology lessons that follow. Students will then have the opportunity to revisit these questions near the end of the program, as mentors with the Watershed Rangers.

There is a lot of content in the Phase 1 curriculum. Teachers can choose to use the content in Introduction to Watershed Ecology, Middle Fork Willamette Watershed, and Restoration Ecology to create their own lessons, have the students read parts for homework, and/or have small groups focus on specific sections and present them to the whole class. The content is provided for you to utilize as you see most suitable for your group and your time needs. The time estimates for each lesson are for a minimum classroom investigation of each topic.

The Middle Fork Willamette Watershed curriculum begins with a watershed mapping activity. The success of this activity depends on the students using only prior knowledge, before they have looked at the MFWW maps provided in the Watershed Stewards manual. In an exercise in teamwork, leadership, and communication, students will create a large map of the watershed and identify population centers, major geographical features, and habitats. This activity builds a sense of place and a sense of wonder. When they are able to view the true map of the watershed, the cognitive disequilibrium experienced when trying to create the map on their own allows them to see the details of the map through new eyes.

The students' knowledge of watershed ecology and healthy habitats will help them to understand the purpose and goals of restoration work. Riparian habitats are the focus of the restoration study, because the methods used in riparian restoration are best suited for work with student groups, and address multiple needs of the watershed. Therefore, if you feel the need to trim content in 1.1: Introduction to Watershed Ecology, it makes sense to focus on riparian habitat more than upland and stream habitat.

Field Trip Guidelines are located in the introductory section of the MFWS manual, to give you general tips on planning a smooth, safe, productive field day. Each phase of the curriculum contains a Field Guide to prepare students and instructors for the field work day.
The Field Guide 1: Site Tour and Site Assessment provides an overview of the field day, as well as some questions for students to keep in mind in order to maximize their opportunity to work with a specialist in the field.

1.1 Introduction to Watershed Ecology

A watershed is an area of land that collects, stores, and drains water (both surface and subsurface water), sediment and dissolved materials to a common receiving body or outlet, like lakes and streams. Watersheds are separated by mountain ridge lines. The watershed's natural processes - rainfall runoff, groundwater recharge, sediment transport, plant succession, and many others - provide beneficial services that are crucial to the health of the planet. It is important for people to understand how watersheds work before they make decisions that may affect important watershed characteristics.

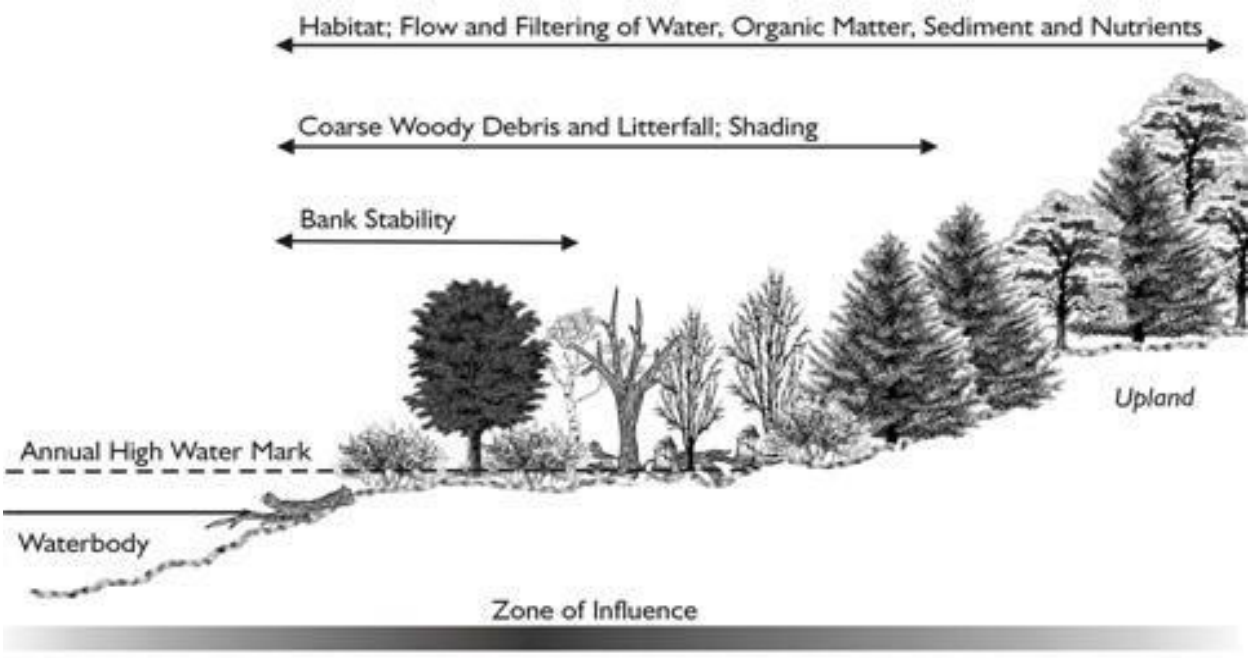
From an aerial view, drainage patterns in watersheds resemble a network similar to the branching patterns of a tree. The point where a stream originates is called the headwaters.

These small streams are only a few feet wide with a fairly steep gradient, or vertical drop. Water cascades over logs and boulders, forming deep step pools. Downstream, many stream tributaries, similar to twigs and small branches, flow together to form larger streams, like the main branches of the tree. These streams have a wider, deeper channel, with a defined flood plain. Larger streams eventually empty into the mainstem river, comparable to the tree trunk, where the river flows in a wide, meandering fashion, through a flat flood plain and a broad valley. Stream ordering is a way to cassify streams by size. The smallest streams that have year round water and no tributaries (headwaters) are first order streams. When two first order streams come together, they form a second order stream. Further along, a second order stream may join another second order stream to form a third order stream, and so on.

Watersheds vary from the largest river basins to just acres or less in size. For example, large watersheds, like the Columbia River watershed, are made up many smaller watersheds consisting of all the tributaries to the Columbia. To better classify watersheds they are commonly divided into size categories called fields. The largest classification of this kind is termed a 1st field watershed (also called a Region). As part of the ranking system, 1st fields break down into smaller 2nd fields (Sub-Regions) which then can be broken into 3rd fields (Basins) and then 4th fields (Sub-Basins). As a general rule, each 4th field is subdivided into roughly 5 to 15 new units called 5th fields (Watersheds). A typical size for this watershed drainage area is from 40,000 to 250,000 acres. The typical size of a 6th fields unit (Sub-watershed), a subdivision of a watershed, is 10,000 to 40,000 acres.

Stream, Riparian, and Upland Zones

The three major zones in a watershed are Stream, Riparian, and Upland. The three zones are distinct and also interdependent. The Riparian zone is the transition zone between stream and upland.



I------Stream------I I----------Riparian----------I I-----Upland-I

The Stream Zone

A stream is more than meets the eye. Its bottom extends down beneath the ground, and its sides stretch out into its floodplains. It is dynamic, constantly changing its course, water levels, and temperatures. It contains a multitude of different habitats for plants and animals. It is a source of food for animals as well as people. It carries glacial silt and sediment down from the mountains, creating rich agricultural lands by depositing them on its floodplain and fertilizing the ocean.

When water rolls down the slopes of a watershed, it carries things with it. Beginning with small matter like tiny bits of leaves and bacteria, as it flows and grows it carries larger and larger matter. By the time the water gets all the way down to the river, it is full of whatever was a part of the land around it. The river can carry sticks, leaves, logs, brush, and even sand, pebbles, rocks, and boulders. Rivers are also closely tied with the atmosphere. Gases from the air, like oxygen, carbon dioxide, and nitrogen dissolve into the water. The colder the water is, or the more it churns as it flows downhill, the more gases there will be in it.

Characteristics of a Healthy Stream

*High water quality (eg. water temp, dissolved oxygen, and pH)
*Connection to a floodplain
*Trees, shrubs and grasses on the floodplain
*A variety of features such as riffles, runs, and pools
*A variety of insects and fish as well as salamanders and frogs
*Minimal algae growth, minimal stream bank erosion, minimal sediments
*Room to adjust to changing landscape or climate conditions
*Room to flood

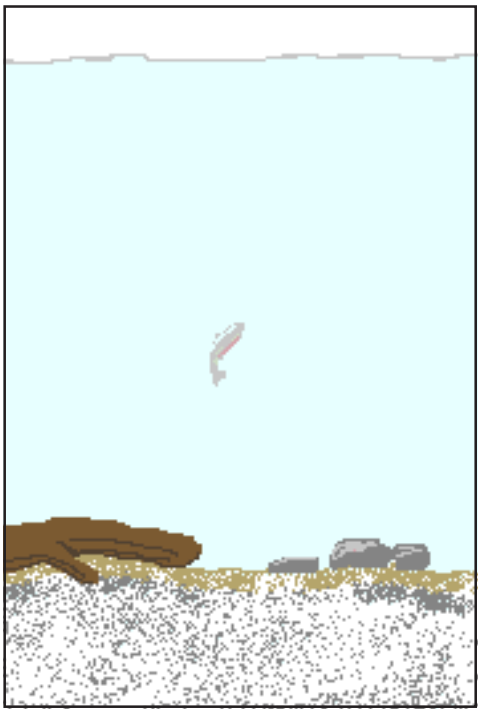
Stream Habitat

Each stream contains many different habitats and microhabitats, utilized by everything from tiny diatoms to large mammals. A single species may require several different habitats to carry out its life functions, and each habitat is inhabited by its own species that cannot live elsewhere. The casual visitor would not see more than water and rocks, yet the stream is filled with unseen creatures. Some general stream habitat examples are rocks and large woody debris.

Rocks provide several different microhabitats. Animals cling to the side that faces upriver. The side that faces downriver provides a certain degree of shelter from current, while still allowing an animal to hunt for food. The top of a rock, if it is contacting air in some places, will be a good place for animals that can't breathe underwater and need to surface now and then. The underside of a rock makes an effective hiding place for prey.

Large woody debris, such as fallen logs and branches, provide a place for some animals to burrow into and surfaces for others to attach themselves. Streams clogged with natural debris form countless small pools, waterfalls, and other features that provide habitat and hiding places for young fish. They also create areas where small detritus, such as leaf litter, can pile up underwater, providing shelter for many creatures.

Other habitats include debris, leaf litter, and algae floating downstream; animals cling to them or burrow into them, as well as eat them. Parasites make their host their habitat.



Surface

Water Column

Benthic Zone

Hyphoreic Zone

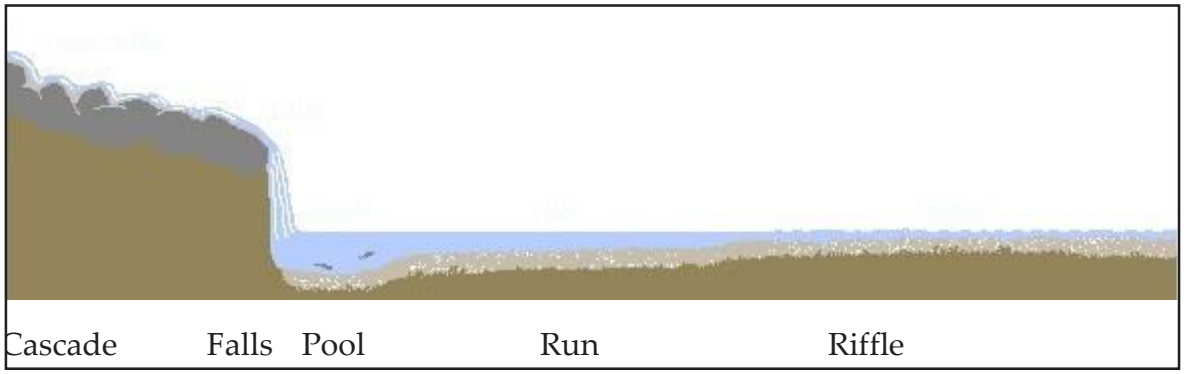
A cross section of a stream can be divided into four habitat classifications, Surface, Water Column, Benthic Zone, and Hyphoreic Zone. Each section provides unique services and habitats.

Surface: The surface is where the stream breathes, exchanging gases with the atmosphere, including nitrogen, oxygen, carbon dioxide, and carbon monoxide. The surface of a stream is home to algae, frogs, ducks, otters, muskrats, turtles, beavers, skaters, and whirligig beetles. Insects come to the stream's surface to drink or reproduce, or fall in from overhanging branches, and may be caught by fish coming to the surface to grab quick breaths of air or a snack. While they are there, the fish may be preyed upon by eagles and osprey.

Water column: Insects and mammals found in the water-column are often on their way between the surface and the bottom (benthos). Terrestrial bugs and organic material (detritus) microscopic rotifers, protozoa, and bacteria may often be found drifting downstream in the water-column. The stems, leaves, and roots found in the water column are habitats for microscopic organisms and algae (making a fuzzy coating called aufwuchs), snails, flatworms, and insects. Schooling minnows, parr, trout, bass, and sunfish have specialized to stay in the water-column, eating algae, macro-invertebrates, and detritus, or lurking and waiting for a meal to show up on the surface. Kingfishers, otters, muskrats, turtles, and frogs dive from the surface and hunt for food in the water-column.

Benthic zone: The river bed is called the benthic zone. Many creatures live here on the substrate (mud, sand, rock, and organic debris). Coating the substrate may be found diatoms, aufwuchs, and fungi. Diatoms are responsible for the yellow or brown coloring of rocks, and for the slimy feel of rocks when you first pull them out of a stream. Fungi help break down wood and leaves. Clinging to and eating from all these slimy, edible surfaces are larvae and nymphs of all sorts of insects, water mites, snails, clams, worms, leeches, and flatworms. Also spending their time in the benthic zone and feasting on these many small creatures and algae are crayfish, salamanders, and bottom fish. Large trout and catfish hide in dark places like underwater ledges, log-dams, and pools to hunt their prey. The benthic zone is a popular place for many fish to spawn, too. Salmon and trout create nests out of gravel, sculpins attach eggs to the undersides of rocks, and catfish nest in holes in the banks.

Hyporheic zone: The hyporheic zone is the rock and sand beneath the stream bottom. Many of the organisms that are found on the stream bottom may also be found beneath it. Most of them live within the top 20 inches or so. Here they remain safe from predators. Very small insect larvae and nymphs often begin their lives here, to keep from getting swept away by strong currents. As streams undulate up and down, diving into their hyporheic zones and re-emerging downstream, there is a constant supply of fresh water, oxygen, and food flowing through the hyporheic zone. The hyporheic zone also offers refuge from extreme temperature changes and drought. Female salmon built large nests of gravel and bury their fertilized eggs in the hyporheic zone, keeping them safe from predators and assuring that they will have plenty of oxygen and nutrients. Because the hyphorheic zone is such important habitat, adding extra silt to a gravelly or sandy stream has a significant impact.



You can also look at stream habitats from a birds eye view, called a *longitudinal cross section*. The major habitat classifications are Cascades, Falls, Pools, Runs, and Riffles.

Cascade: When water flows over larger rocks and boulders, it becomes a cascade. Cascades are rough places to live. If you've seen one, you know that water often beats onto rocks so hard that it creates foam and spray. But there is a lot of life in cascades because of the high oxygen levels. To live in cascades, insects stick themselves to rocks. Trout and young salmon travel up and down cascades. A few birds can be found hunting for food in cascades, hopping from one boulder to the next and suddenly diving in, like the American Dipper. Bears and cougars often fish in cascades.

Falls: As harsh as the environment is in a cascade, it is even more brutal in a falls. But like the cascade, the water is highly oxygenated. Diatoms and black fly larvae are able to cling to vertical services quite well. During spawning season, trouts and salmons leap up and over falls to get upstream. Sometimes it takes many tries. And while they're trying, bears, cougars, lynxes, and other fishers catch them.

Pool: Pools provide darkness and slow moving of water. Their oxygen levels are often low. During droughts, pools are sometimes the only parts of a stream that stay wet. When the stream's water suddenly slows down, it drops silt and organic materials. The layer of silt and organic materials at the bottom of a pool is an environment that is friendly to plants and animals which can't tolerate higher water velocities. Aquatic earthworms, salamanders, frogs and snails are often found in pools. Large fish, such as adult trouts, salmons, and catfishes hide from their prey in the dark depths, under pieces of wood and ledges.

Run: Most of the big fish that we associate with streams and rivers can be found in runs, including sturgeons, bass, sunfish, salmon, catfish, and trout. They prey on aquatic invertebrates and smaller fish. Bald eagles usually fish for salmon from runs, and kingfishers dive from trees into runs to catch fish. Raccoons often find crayfish, frogs, and other prey at the edges of runs.

Riffle: Riffles are a rich part of any stream. Because the water is not deep, there is plenty of sunshine, encouraging a rich growth of diatoms on rocks and organic debris. Oxygen levels are high. Large, predatory fishes are too big to travel across them. Current velocities are lower than in cascades and runs. Raccoons, with their nimble feet and "hands," sharp intelligence, and quick eyes, are very good at finding their meals in riffles.

Oregon Chub: A local habitat restoration success

The Oregon Chub has recently been removed from the Endangered Species List, thanks in part to restoration efforts throughout the Middle Fork Willamette Watershed

The Riparian Zone

A riparian zone is the interface between land and stream. It connects the upland zone (the area of the watershed that does not receive regular flooding by a stream) to the aquatic zone (the area of the stream channel covered by water), controlling the flow of water, sediment, nutrients, and organisms between the two. "Riparian" is derived from the Latin word ripa, meaning river bank.

Characteristics of a Healthy Riparian System:

Vegetation & roots present to protect & stabilize banks
Sediment filtering
Water storage and release
Aquifer recharge
High water table & increased storage capacity
High forage production
Good shade-Cool water
Diverse fish and wildlife habitat
Higher late summer stream flows

Riparian vegetation and root systems, combined with the meandering curves of a river, dissipate stream energy and trap sediment. The decreased rate of flow decreases soil erosion and flood damage. When sediment is trapped it decreases the turbidity of the water, replenishes soils, and builds up the stream banks. In the Pacific Northwest, riparian corridors tend to include willows and alder. Both of them like to have wet roots. Alder provides nitrogen fixation, taking nitrogen gas out of the air and make it into biologically useful nitrogen in the soil. This makes the soil near streams and on floodplains more fertile.

The riparian zone acts as a natural sponge, soaking up water as it runs off the land, and slowly releasing that water back into the stream. The riparian zone can improve the water quality of the stream by filtering out nutrients and surface runoff pollution that would otherwise enter the stream. Riparian zones assist in providing the correct stream acidity and assist in recharging aquifers.

Streams flowing through healthy riparian zones are superior habitat for fish because (1) the riparian trees provide shade and buffer temperatures, (2) inputs of woody debris creates fish habitat, (3) inputs of organic matter via leaf fall provides food sources for invertebrates and fish, and (4) invertebrates that fall into the stream from the surrounding riparian vegetation provides food for other organisms.

Healthy riparian zones also provide excellent wildlife habitat, due to the availability of water, high plant productivity (amount of carbon fixed by photosynthesis) and habitat diversity. Riparian zones provide reliable sources of water for wildlife, and the greater productivity allowed by the high moisture content of the soil allows for more potential food for wildlife. In addition, the habitat diversity of riparian vegetation provides many potential niches for wildlife to fill. Riparian zones serve as wildlife corridors that give animals uninterrupted movement along river systems. The riparian zone is also home to many animals that move between land and water, such as insects, amphibians and waterfowl.

Natural Factors that Affect Riparian Zones:

Water supply is the major factor that regulates the growth of riparian vegetation. Flood waters transport nutrients, sediment and new seeds from upstream. Floods also strip away larger, established vegetation and allow new seedlings to establish. Soil type in the riparian zone influences the amount of water and nutrients available. Organic-rich soil holds water and provides abundant nutrients to plants, without releasing these nutrients to the water. Gravely soil with little water-holding capacity and few nutrients will have less dense vegetation. Topography, or the shape of the land, affects the location and abundance of plants in the riparian zone. Climate affects the appearances of riparian zones. In the desert, riparian zones are like a green oasis in sparse, dry surroundings. Where precipitation is more abundant, like in the mountains, the upland vegetation, beyond the riparian zone, remains relatively lush.

Riparian Hydrologic Zones:

When planning riparian restoration projects, it is important to understand the unique characteristics of the different Riparian Hydrologic Zones. The zones are determined by measuring the elevation above the average water line, as well as looking at where native species are already established at the site. Plants with flexible stems and rhizomatous root systems are usually located from the water line to the top of the bank zone. Larger shrubs are found from the bank zone to the overbank zone and beyond. Tree species are usually found above the overbank zone in the transitional zone and the upland zone.

Toe Zone:

The toe zone is the zone that is located below the average water elevation or the baseflow. The baseflow is that level where there is flow all summer long. Generally, this is the zone of highest stresses and the most erosion. It is also described as the scour zone because streamflow velocities are constantly scouring the banks and bed movement is at its highest. This zone is critical to successful treatment of streambank erosion. The toe zone will rarely have much vegetation in it due to frequently flowing water.

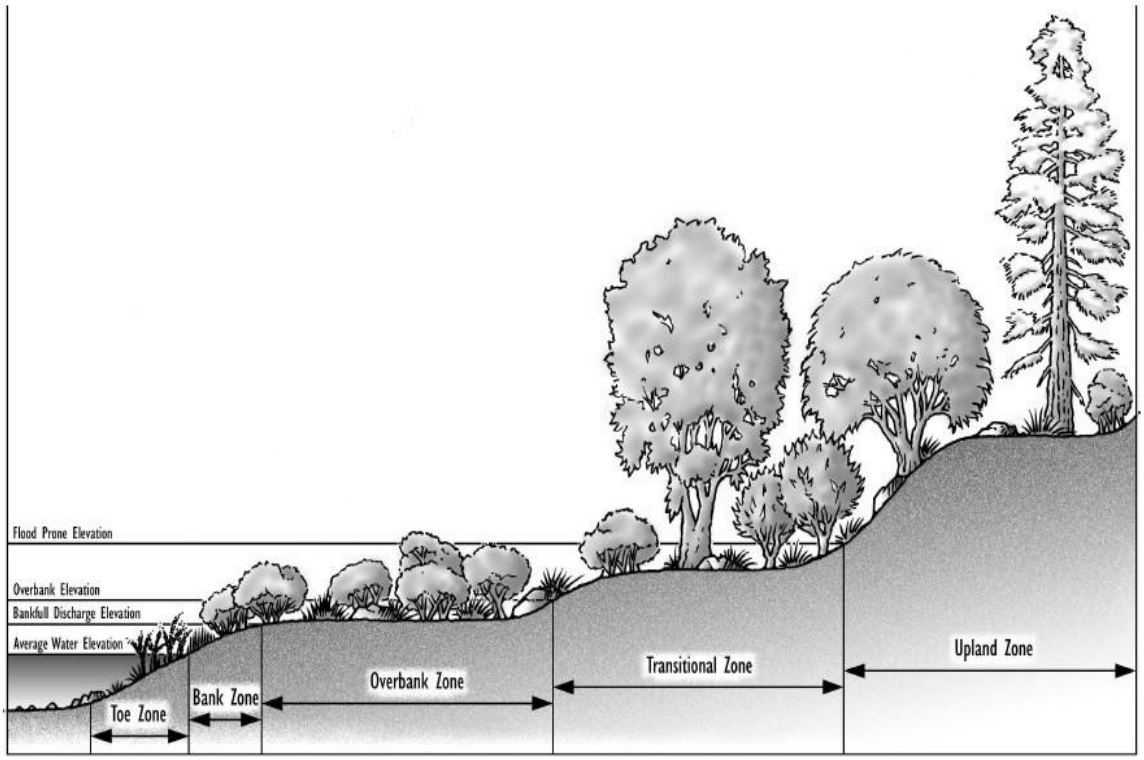


Figure1: Riparian Planting Zones can be used to determine where riparian species should be planted in relation to the waterline. This is a general depiction of a riparian zone. Not all streams look like this one. In the real world, some of these zones may be absent. (From Hoag 1999, Hoag and Landis 1999)

Bank Zone: The bank zone is the area between the average water elevation and the bankfull discharge elevation. It is less erosive than the toe zone. It will be exposed to erosive river currents, wind generated waves, wet and dry cycles, and freezing or thawing cycles. The bank zone will generally be vegetated with early seral or colonizing herbaceous species, flexible stemmed willows, and low shrub species. This zone will be inundated far less frequently than the toe zone. Soil moisture levels in this zone will be much lower after spring runoff and fall rains.

Overbank Zone: The overbank zone is located between the bankfull discharge elevation and the overbank elevation. This zone is usually formed from water transported deposits. It is generally flat and often has layered soils. It is sporadically flooded, usually about every 2-5 years. This zone is occasionally exposed to erosive water currents, ice and debris deposition and damage, freeze – thaw cycles and some wind generated wave erosion. Vegetation in the overbank zone should be flood tolerant. Normally, the vegetative composition is about 50% hydrophytic plants (able to grow in saturated soil). Shrubby willows with flexible stems, dogwoods, alder, birch, and others will predominate here.

Transitional Zone: The transitional zone is located between the overbank elevation and the flood prone elevation. The floodplain elevation is flooded about every 50 years. This zone is usually not subjected to erosive water currents except during high water events. For the most part, species in this zone are not extremely flood or inundation tolerant. This is the zone where the larger tree species are typically found.

Upland Zone: The upland zone is found above the flood prone elevation. Erosion in this zone is due to overland water flow, wind erosion, and elimination of vegetative buffers from improper farming practices, over grazing, logging, and development. Vegetation in this zone is predominantly upland species. Drought tolerance is one of the most important factors when determining what species to plant here. (Hoag, et. al., 2001)

Hoag, J. C., F. E. Berg, S. K. Wyman, and R. W. Sampson. 2001. Riparian Planting Zones in the Intermountain West. Riparian/Wetland Project Information Series No. 16. March 2001. USDA-NRCS Aberdeen Plant Materials Center. Aberdeen, Idaho. Accessed at: http://plant-materials.nrcs.usda.gov/pubs/idpmcarwproj16.pdf

The Upland Zone

What do Ponderosa pine, Poison oak, and huckleberries all have in common? They all reside in the upland zone. The upland zone encompasses all the land beyond the stream and riparian zones, and includes a diverse array of habitat types. In the Middle Fork Willamette Watershed, upland habitats include old growth conifer forests, high rocky openings and meadows, oak woodlands, and stands of ponderosa pine, aspen, and Alaska yellow cedar.

Upland habitats are home to countless plant and animal species and can be over-wintering habitat for many reptiles and amphibians who utilize riparian and aquatic habitats in the warmer months. Small natural clearings and rocky openings in upland areas provide unique habitats for uncommon or locally rare plant and animal species. The headwaters of rivers are often found in the Upland Zone.

In the Middle Fork Willamette Watershed, notable upland wildlife species present include: great gray owl, flammulated owl, northern goshawk, harlequin duck, common merganser, black-backed and three-toed woodpeckers, American marten, fisher, Pacific western big-eared bat, red tree vole, peregrine falcon, bald eagle, northern spotted owl, elk, and mountain lion. There are hundreds of plant species, with more than 75 species that are sensitive, threatened or endangered. Threatened and endangered species include northern spotted owl, gray wolf, Bradshaw's lomatium, and Willamette Valley daisy.

Jim's Creek: A Local Upland Restoration Case Study

The West Cascades foothills once had extensive woodlands and savannas of widely-spaced large Oregon white oak, ponderosa pine and Douglas-fir trees with a grass and wildflower understory. Native peoples are thought to have maintained these habitats through the use of fire, which produced forage for big game, improved traveling conditions, and selected for important subsistence plants such as camas, tarweed, and desert-parsleys. As a result of changes in fire frequency and intensity after European settlement, Douglas-fir now dominates in many of these areas, and many of the open woodlands and savannas converted to forests. Almost 95 percent of open oak and pine habitats have been lost in this ecoregion. Currently, remnant patches of oak-pine woodlands and savannas are found on the margins of the Willamette, Umpqua, and Rogue valleys and some dry, south-facing mid-elevation slopes.

One site with a remnant oak-pine woodland and evidence of Native peoples' use is the area around Jim's Creek, on the Willamette National Forest near Oakridge. The site's important ecological and cultural value has inspired a comprehensive planning effort to restore some of the oak-pine habitat. Once a savanna with large, scattered oak, pine, and Douglas-fir trees, the area is now dominated by a relatively dense Douglas-fir forest. Several of the large ponderosa pines have scars characteristic of bark removal. Traditionally and presently, Native peoples remove the inner bark (cambium) for medicine, so these large trees are considered "medicine trees." However, the large pines are declining in health, and oaks are now restricted to the margins of small, rocky openings. With no pine or oak regeneration occurring, the site will convert to a Douglas-fir forest if no actions are

In response, the Willamette National Forest began an extensive outreach effort to the communities of Oakridge and Eugene, including political leaders, Native American leaders, the timber industry, and environmental groups to discuss the issues and ask people how they thought the landscape should be managed. Ecological studies on current and historic vegetation, small mammal populations, and fish populations were initiated to determine restoration opportunities and to guide management in an adaptive management approach. These ecological studies also will provide valuable lessons that could be applied to other sites. The Jim's Creek project is a comprehensive approach to building partnerships and planning science-based restoration that will hopefully restore an important cultural and ecological landscape for future generations to enjoy. (excerpt from MFWWC 10 year action plan)

The Jim's Creek Project started in 2001, and in the end, over 60 stakeholders participated in project planning, with the Middle Fork Willamette Watershed Council acting as the primary facilitator. The project area was thinned of encroaching species such as Douglas Fir. Stand density was reduced from 80 trees per acre to 15 trees per acre. The leave priorities were first for oak and second for ponderosa pine. The timber harvest was completed in 2011. Oak trees have been planted in the project area, but natural oak regeneration has been just as successful. Pine grass has also returned post fire treatments, even in areas that it wasn't anticipated to abundantly respond, such as in an old pine planation that was burned.

Fuel reduction will make the entire area resistant to catastrophic wildfire. Reintroduction of prescribed fire was a major objective of the project. Prescribed fires, similar to the methods traditionally and presently used by Native peoples, are used to improve the composition, structure, condition, and health of stands or to improve wildlife habitat. Recovered elk and game habitat will be maintained through fire intervals. Riparian zones were left untouched based on North West Forest Plan prescripts. A local contractor is currently creating snags for wildlife habitat.

Threats to Habitat

Many of the systems and structures that humans utilize in order to improve our quality of life, like dams, urban development, and agriculture, can negatively impact wildlife habitat. As people become more aware of the impacts we are having on the environment, and the importance of maintaining biodiversity, efforts are made to decrease those impacts with creative solutions. Some impacts can be prevented through modifying the system or structure. For example, building a fish ladder in a dam, treating stormwater runoff, or maintaining riparian buffers for development. Other impacts can be addressed after they occur, through restoration.

Dams:

People dam rivers for drinking water storage, recreation, agriculture, and countless other uses. Dams also provide flood control, and can produce electricity. Dams change the river's ecological community by altering habitat, blocking fish passage, and preventing floods. Important habitat features, like large woody debris, minerals, and other materials, are blocked from flowing downstream. Large woody debris has been intentionally placed in many local streams, downstream of dams, during recent restoration efforts.

Dams block salmon and other fish that migrate up rivers in order to reproduce. If fish can't get all the way up a river, or if their offspring can't get all the way back down, reproduction fails. Many species of salmon have recently been listed as endangered species, primarily for this reason. Some dams feature a fish ladder, which enables fish to pass around the barriers by swimming and leaping up a series of relatively low steps. Hatcheries play an important role in mitigating the effect of blocked fish passage. They transport live fish to upstream habitat, in order to spawn and provide food for other fish and wildlife. Fish carcasses that are produced during hatchery spawning are also placed upstream of dams to add vital nutrients back into the ecosystem, which would have been there naturally if the fish had returned to spawn.

Dams prevent floods, which is beneficial to people who live in flood prone areas. However, because floods are such an important event for stream and riparian health, flood prevention can have detrimental effects to wildlife and their habitats. Riparian corridors depend almost exclusively upon their streams' flooding cycles for their existence. Many fishes wait until the first sign that the annual spring flood has begun to start breeding. Many insect larvae wait for flooding to begin to lay eggs, hatch, or metamorphose. Floods flush insects, bugs, and worms that used to be on land into the stream, which are eaten by fish. Flooding results in increased fertility for the river, by washing nutrients out of the soil and animal feces. The more fertile a river, the more invertebrates will be able to live in it--and invertebrates form the base of the food chain. Floods also wash dead brush and trees into the stream, providing habitat for countless animals.

The Middle Fork Willamette Watershed Dams:

Despite the negative ecological impact of dams, they provide many benefits to our local communities. Hills Creek, Lookout Point, Dexter, and Fall Creek dams were built and are maintained by the US Army Corps of Engineers. The dams are operated primarily for flood control, and have cumulatively prevented over 14 billion dollars of potential flood damages since they were built. The hydropower generated from the Hills Creek, Lookout Point and Dexter dams provides a clean, renewable form of electricity for the people living in the region. The reservoirs upstream of each dam are popular recreation sites for fishing, boating, and swimming, and the numerous visitors they attract provide economic benefits to the local communities. In order to mitigate the impacts of the dams on salmon, the Corps spends millions of dollars each year transporting adult fish upstream, supporting the hatchery program, and conduct research on how to improve conditions for fish.

Development and Urban Runoff

Urbanization results in an increased amount of impervious surfaces such as roads, rooftops, and parking lots instead of pervious surfaces like forests, wetlands, and agricultural lands. In a natural ecosystem, a stream's riparian zone acts as a biofilter, cleansing water before it enters the stream. In developed areas with impervious surfaces, pollutants can run directly into streams.

Impervious surfaces decrease the amount of rainwater available to percolate into groundwater, lowering the amount of groundwater available to augment summer streamflows. Increased runoff also results in more frequent flash flooding in waterways. High streamflow has a scouring effect, eroding inadequately vegetated riverbanks, which results in increased water turbidity. Pollutants from urban runoff include chemicals that fertilize the river, changing its ecological balance, chemicals that kill bugs and algae that form the bottom of the food chain, and chemicals that build up in animal tissues, potentially poisoning humans and other predators.

Urban structures can be built differently to make them function more like naturally pervious soils; examples of such alternative structures are green roofs, porous pavements, and bioswales. Individuals can choose non-toxic, biodegradable cleaning and yard care products to prevent these chemicals from entering local streams.

Development of riparian zones for housing or commercial development often causes removal of vegetation and alters the stream banks. These changes can increase the intensity of floods and the direct input of pollutants into water. Vegetation removal significantly affects habitat. Falling leaves and insects from riparian trees are the foundation of the stream's food web. Tree removal leads to decreased shade, causing the stream to become too warm for the fish that belong there, and choked with algae. Without the roots of vegetation to anchor streamside soil, the soil will become eroded away by the stream--forcing homeowners to channelize the stream. Developers can decrease their impact by maintaining riparian buffers between streams and development. Some developers are required to enhance wetland habitat if their development affects a natural wetland.

Channelizing

The natural course of a river is meandering, with a floodplain area beyond its banks. Streams in developed areas are sometimes manipulated to flow straight, and stream banks can be lined with concrete or small boulders to try to keep the banks in place. Channelization allows for more development along the stream, but leads to loss of both stream and riparian habitat. It also increases the destructive potential of the river.

A channelized stream becomes poor in nutrients and habitat. Without periodic flooding, its riparian zone is starved of water and nutrients. Stream inhabitants depend on the riparian zone for food, shade, and debris. Channelization eliminates the natural variations such as backwaters, riffles, embayments, and large woody debris that stream inhabitants depend on for shade, protection, and food.

Ironically, flooding becomes more catastrophic when streams are channelized. Water gathers energy as it flows downhill. When the water pushes against naturally meandering stream banks, it swirls in eddies, and the energy of the flowing water is decreased. When a stream is channelized, however, it gathers more and more energy as it flows downhill. In addition, a healthy floodplain acts as a sponge, soaking up floodwaters, while channelized rivers simply forward the extra water downstream where it can overwhelm dams and walls. Finally, when rivers are channelized, people are encouraged to live on floodplains, risking lives and property in the event of a catastrophic flood.

Agriculture

When riparian areas are cleared for use as agricultural land, stream bank erosion increases, because the riparian zones are not able to stabilize banks. Farmland is lost where the erosion occurs and downstream sediment increases. Agricultural fertilizers have a greater likelihood of entering the stream when the riparian zone is not able to filter them out. More farmers now maintain the health of their riparian areas to ensure long-term sustainability of their land and water.

Overgrazing of the riparian zone can cause changes in the density and diversity of vegetation, increase erosion, and introduce increased amounts of nutrients and fecal coliform bacteria to the stream through manure. However, if cattle are managed correctly (herded or fenced out after a short time) they can be a part of a healthy riparian zone.

Other aspects of agriculture that can affect watersheds include excess application of herbicides, pesticides, fertilizers, and other chemicals to crops. These chemicals can leach into the streams and rivers, leading to algae blooms, and other potential problems. Farmers can decrease the impact of agriculture by maintaining a riparian buffer between waterways and adjacent farmland (pictured below), practicing rotational grazing practices, and using organic fertilizers and pest control methods.

Logging

Forest is the natural state of most of the region. Forested areas with multiple vegetation layers are best suited to buffer watercourses from drastic changes in water quality and quantity. This is especially true of mature or old growth forests. When upland vegetation is removed, increased volume of water can enter the stream at one time, which can lead to bank erosion, deep and narrow channels, increased sediment load, and shrunken riparian zones. Since the riparian zone acts as a biofilter, when it is damaged, oil and other pollutants from logging are more likely to enter the stream. Forest practices such as selective cutting and riparian buffers can reduce these impacts.

Silt from logging roads poses a threat to watershed habitat long after timber has been removed. Silt washes down the hillsides with the rain and enters the river, choking the substrate by filling in the spaces between gravels and cobbles of the streambed. This eliminates an important habitat of many of the aquatic insects that fish eat. It also makes the maturation of salmon and trout impossible. Salmonid eggs (and later the very small juvenile salmon, or alevins) spend their early lives buried in streambed gravels, sheltered from the river's current and hidden from predators. They live off their yolks until they are large enough to fend for themselves, before emerging into the water column. While they are still in the gravels, water must flow rapidly over them to bring them fresh, dissolved oxygen and to carry their wastes away. When silt from development fills in the spaces between the rocks, salmon and trout can no longer grow there. Another issue with silt is that it can cloud up the river, blocking light. When light is blocked from a river, a whole different set of plants and animals grows and the original community is lost. Logging roads can also cut off subsurface water flow into the stream. Due to the financial and environmental impact of maintaining logging roads, the USFS and other land managers are starting to decommission roads that are no longer necessary for logging or transportation.

Invasive Species

Perhaps the greatest effect that humans have had on watershed habitats is the introduction of plants and fish that don't belong there. When an invasive species is not contained, it has the ability to outcompete natives, due to lack of predators and other advantages outside of its native ecosystem. Invasives often outcompete native species for resources like food, water, and sunlight. When invasives crowd out native plants, it can limit the food supply and habitat for the native animals that depend on those native plants.

Invasive plants and animals can travel long distances on the underside of boats and vehicles. Animals from peoples' bait buckets or aquariums have entered wild habitats. Species like the zebra mussel have been transported from ship's holds. Sometimes a plant is introduced into an area for some desirable attribute, like its flowers or fruit. Local examples include Scotch Broom and Himalayan Blackberry

Hatcheries breed fish to enhance dwindling populations, and stock fish in the river for the benefit of fishing enthusiasts. While these fish are not considered an invasive species, they are different in some ways than the wild stock, and have an effect on habitat. These fish, often larger than their wild counterparts, can compete for finite resources with wild fish, prey upon wild juveniles, spread disease, and attract predators. Hatchery fish do not reproduce as effectively, and sometimes introduce new pathogens to rivers, causing illness and death of the resident fish. When hatchery fish do interbreed with natives, the offspring are more susceptible to disease.

Hatchery methods have progressed to address some of these impacts. Many trout bred in Oregon hatcheries are triploided, so they cannot reproduce, to prevent them from interbreeding with natives. Numbers of diseased fish being released into the wild has been decreased by regular monitoring while in the hatchery. If disease is detected, the fish will not be released into the wild. In addition, biologists survey watersheds to determine native populations and to determine what impact stocking will have on the ecosystem.

1.1 Introduction to Watershed Ecology
Discussion:

1. Discuss the interrelation between the stream, riparian, and upland zones.
For example, how does the riparian zone affect stream habitat?

2. In what ways do riparian zones provide excellent habitat for fish and wildlife?

3. How does silt enter the stream, and why is it a concern for fish and plant habitat?

4. How do invasive species outcompete native species?

5.The threats to habitat discussed in this section include dams, development, channelizing, agriculture, logging, and invasive species. For one of these habitat threats, consider the following questions:

a. This threat exists because it provides a significant benefit to society. What are the benefits to humans?

b. Humans' role as stewards require that we look for ways to balance these benefits with the need to protect habitat and biodiversity. What steps can humans take to address and minimize the threat?

6. Why is it important to protect habitats and biodiversity?

NGSS Suggestions: LS 2-6, LS 2-7, ESS 3-2, ESS 3-4

For Instructors:

1.2 Middle Fork Willamette Watershed Watershed Mapping Activity

This activity is designed to get students thinking about their sense of place in the watershed. Without looking at a map, it highlights their current knowledge of the watershed's major features, and how they are connected. Students will have an opportunity to reflect on the places they've been and meaningful experiences they've had there.

Time: 30-45 minutes

Materials:

Sidewalk chalk
OR
Yarn/thick string, scissors, and masking tape

The sidewalk chalk is easier to use for this activity, if you have an appropriate outdoor space available. If you need to be inside, students can use the string, taped to the floor, to outline features on the map.

Outcome:

Students gain a greater awareness of their local watershed by working as a team to share knowledge and create a large map.

Drawing the map:

Teacher instruction should be minimal, as this is an exercise in teamwork as well as a pre-assessment of prior knowledge. Ask students to draw a large map of the Middle Fork Willamette Watershed. Let them know that the map needs to be big enough that they can stand in it at various places.

Depending on their background knowledge, you may want to give them some key elements to include in their map. You can choose from the following options, giving them just categories, or specific places to include:

Cities: Oakridge, Westfir, Dexter, Lowell, Fall Creek, Pleasant Hill, Springfield, Eugene...
Lakes and Reservoirs: Hills Creek, Lookout Point, Dexter, Fall Creek, Timpanogas Lake, Waldo Lake
Rivers and Creeks: Middle Fork Willamette, North Fork Willamette, Salmon Creek, Salt Creek
Geographical Features: Diamond Peak, local mountains and buttes, etc.

Exploring the map:

Once the students have drawn their map, ask them to stand in a place where they have had a meaningful experience. Choose a few volunteers to share where they are and what happened there. Next, ask students to stand in a place they would like to visit in the future. Choose a few volunteers to share where they are and why they want to go there.

Have a photographer document the process and the finished product.

Discussion Questions:

How did the group work together?
Did you come up with a plan first?
What roles did people take?
What was it like for you to draw the map?
Who jumped right in? Who stood back a bit? Why?

After the activity, or the next time the group is together, look at the provided map of the watershed. Have students reflect on what parts of the map they were able to create accurately, and what parts were new to them.
Which parts of the watershed were the most familiar to the group?
What features would they change on their map?
What features were missing that they would add

1.2 The Middle Fork Willamette Watershed: There's No Place Like Home

Imagine yourself standing at the summit of snow crested Diamond Peak, looking northwest. Taking in the expansive view is like looking at a map of the Middle Fork Willamette Watershed. You can see the topographic diversity of mountains and valleys, forests, rivers, and lakes, that make up the pristine place that fish, wildlife, plants, and people call home. The snow underfoot, when it melts, will begin its long journey from high elevation springs to mountain streams, surrounded by steep coniferous forest. It will provide habitat for fish, quench the thirst of many mammals, and supply water to plants' roots. As steep mountain valleys converge, their streams come together in a branching pattern that resembles the branches of a tree, and the veins in the human body. Where mountains meet valleys, streams converge into meandering rivers, becoming wider and deeper, providing habitats for different types of plants and animals. All of the water in the streams and creeks drains into the Middle Fork Willamette, bringing all the rich nutrients from the mountains above, down to the fertile Willamette Valley, and eventually meeting up with the Columbia river and flowing into the ocean.

You are privileged to call this abundant landscape home. The watershed provides your community with opportunities to recreate on beautiful mountain trails and clear lakes; opportunities to observe wildlife, hunt, and harvest timber. Ecosystem services keep air pure and water clean. You live in a pristine place that is unique and worthy of protection. When you see a bald eagle flying overhead, a fish swimming in a deep clear pool, or a butterfly sipping nectar from a native wildflower, you are experiencing the results of the healthy habitats of our watershed. You have the opportunity to be a steward to the watershed, to protect native habitats and keep our water clean. Your experience participating in the Middle Fork Watershed Stewards program will give you important background knowledge to understand your local ecosystems, and tools to protect and enhance these ecosystems for future generations.

The Middle Fork Willamette Watershed (MFWW) is approximately 865,920 acres, comprised of 95% forest land (72%public, 28% private). Land use in the watershed consists of agriculture, industry, timber production, conservation, public water supply, rural/residential and recreation. The population within the watershed is close to 24,000 and includes the communities of Oakridge, Westfir, Dexter, Lowell, Springfield, Jasper, Pleasant Hill, Lost Creek, Fall Creek and Little Fall Creek.

The Middle Fork Willamette River (MFWR) forms the headwaters of the Willamette River, which has the 13th largest stream flow in the United States, and is one of few rivers that flows south to north. The MFWR has its origins in the volcanic rocks in the west Cascades. Near the crest of the Cascades is Waldo Lake, which has some of the purest water anywhere in the world. Heavy precipitation in the form of rain and snow seep into the Cascades aquifer and deliver high quality water in steady quantities to dozens of stream networks that flow to the MFWR and sup- port multiple beneficial uses such as drinking water and habitat for salmonids and bull trout.

The MFWW is a biologically rich watershed that supports healthy populations of aquatic, terrestrial and avian species. Species of concern, such as, bull trout, Oregon chub, spring Chinook, brook lamprey, western pond turtles, northern red-legged frogs, Northern Spotted Owl, bald eagles, and migratory birds utilize the rich habitats and corridors in the watershed. In recognition of the rich habitat and potential for ecological uplift through habitat enhancement, biologists from State, Federal and private organizations have considerable interest and commitment in coordinating restoration efforts with the Middle Fork Willamette Watershed Council and stakeholders in the MFWW. The Oregon Chub has recently been delisted from the Endangered Species Act, partly in thanks to restoration efforts throughout the watershed.

The Middle Fork Willamette Watershed Council

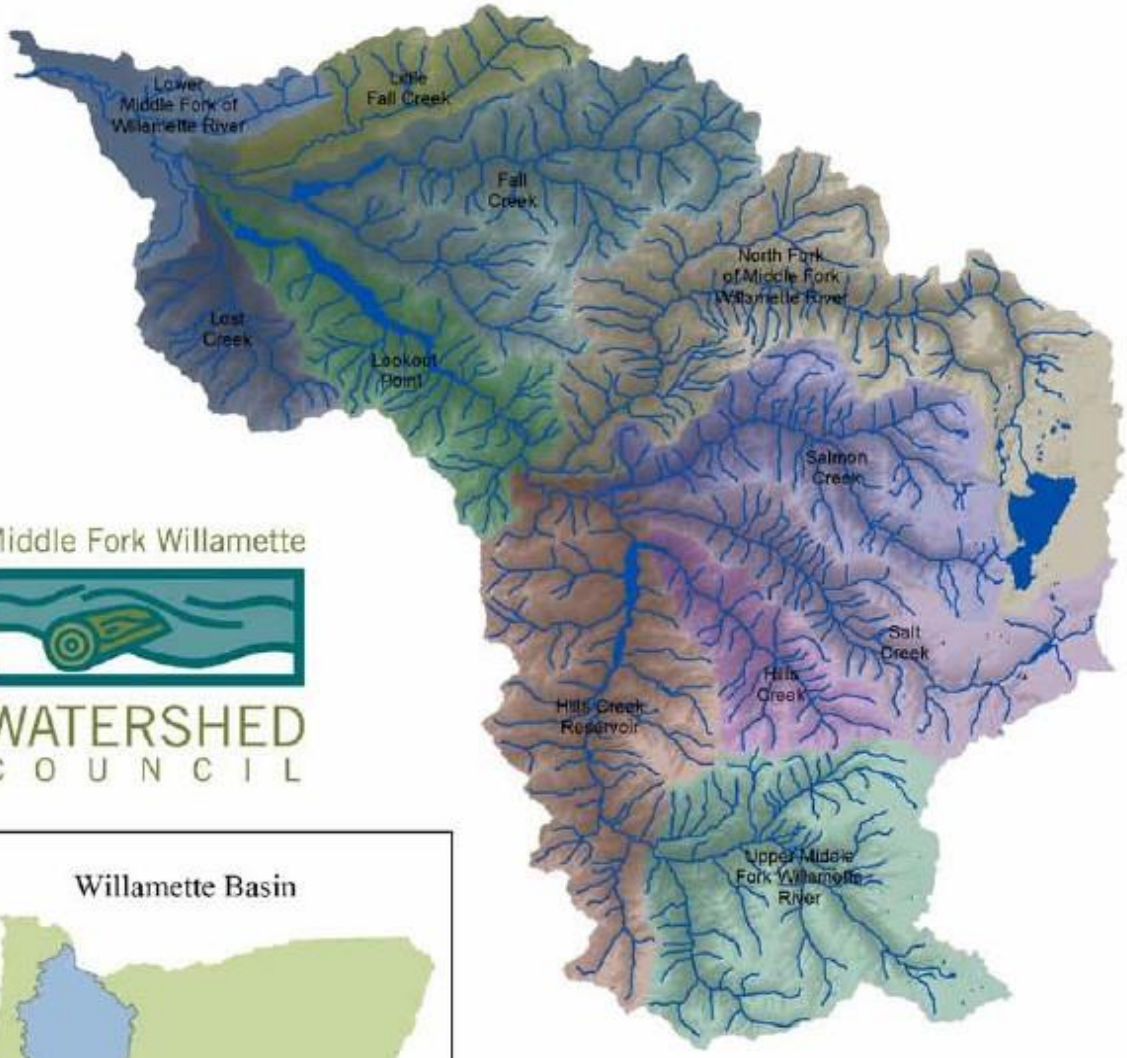
The Middle Fork Willamette Watershed Council (MFWWC) mission is to work together as a community to restore, enhance and sustain the ecological integrity and economic viability of the watershed. The MFWWC is a 501c3 non-profit organization with a volunteer-based partnership of diverse watershed stakeholders that focus on promoting sustainability and making the Middle Fork Willamette Watershed (MFWW) a better place to live, work, and visit; for current and future generations. The MFWW supports a diversity of ecosystems and species: natural assets that define the character of the region, deliver ecosystem services, and provide value as working landscapes and recreational hotspots.

Climate Change and Future Restoration Efforts

Although it is unclear exactly how global climate change will impact the Middle Fork Willamette Watershed, the MFWWC is planning for the future by incorporating strategies that focus on ecological resiliency. Climate models agree that the Pacific Northwest will experience an increase in temperatures, a shift in seasonal patterns of precipitation, and increased frequency and severity of extreme weather events (Battin et al. 2007; Doppelt et al. 2009).

Despite uncertainty in climate change models, projected impacts on salmon habitat and productivity have been negative across-the-board (Battin et al. 2007). Higher water temperatures are projected to seriously impact native aquatic species that are sensitive to high temperature, such as salmonids, trout, and amphibians. (Mantua et al. 2009). Increased temperatures will result in a significantly declining snowpack in the Pacific Northwest (Doppelt et al. 2009), which will produce lower summer and fall flows that will reduce spawning habitat and exacerbate water temperature issues (Battin et al. 2007). Changes in seasonal precipitation patterns will alter the timing and magnitude of peak flows (Doppelt et al. 2009). Native species and populations that are most at risk from climate change are those at high elevations, dependent on old-growth, associated with maritime evergreen communities, are moisture dependent (water birds, snails, amphibians, etc.), and species that are already rare or declining (Doppelt et al. 2009). In addition to negative impacts to native species, climate change will also likely find new conditions favorable for non-natives. For instance, increases in water temperature will favor exotic warm water fish species such as bass, while on land, increased temperatures may benefit insect pests, invasive plants, and diseases. However, some native habitats could benefit from climate change, like the unique Ponderosa pine/white oak community at Jim's Creek, which prefers warmer, drier conditions.

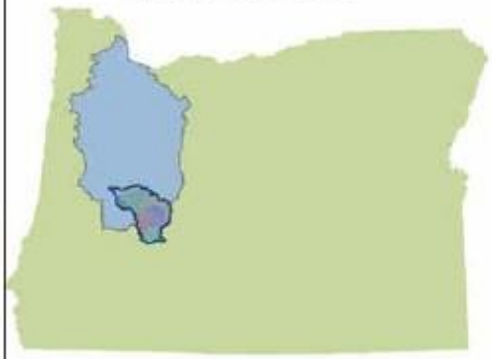
Middle Fork Willamette Watershed Subbasins (HUC 5)



Middle Fork Willamette

WATERSHED COUNCIL

Willamette Basin



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Map created by Middle Fork Willamette Watershed Council
Data Source: USDA NRCS Watershed Boundaries Dataset 1:24k
Map Date: 2012
Projection: Lambert Conformal Conic

The Sub-watersheds of the Middle Fork Willamette Watershed

Sub-watersheds exist for each of the major waterways that are a part of the greater watershed. The Middle Fork Willamette Watershed is made up of 11 sixth field (or sub) watersheds as defined by the USGS. The sub-watersheds of the Middle Fork Willamette Watershed are Upper Middle Fork, Hills Creek, Hills Creek Reservoir, Salmon Creek, North Fork, Salt Creek, Lookout Point, Fall Creek, Lost creek, Little Fall Creek, and Lower Middle Fork. It can
also be helpful to look at the MFWW in terms of Upper, Middle, and Lower Watersheds, since the ecosystems and influences change as the river flows downstream.

The Upper Watershed is comprised of the following sub-watersheds:

Upper Middle Fork, Hills Creek, Hills Creek Reservoir, Salmon Creek, North Fork, Salt Creek
Communities: Oakridge, Westfir

The Upper Watershed is also known as the Western Cascade Ecoregion. Steep, often inaccessible wild streams and rivulets follow gravity down from the higher elevations toward the lower valley floors. The headwaters of the Upper Middle Fork Willamette are predominantly spring-fed and often have sections that are subterranean due to highly porous volcanic material at the crest of the Cascades. Warmer headwaters also flow from Timpanogas lake. Hills Creek, Salmon Creek, North Fork Willamette, and Salt Creek, also with headwaters at the crest of the Cascades, all flow into the Middle Fork Willamette in the Upper Watershed, near Oakridge. The upper watershed has many alpine lakes and trails, making it a popular destination for recreation.

Keystone Species: Oregon chub, western pond turtle, lamprey, salmonids, pileated woodpecker, peregrine falcon & bald eagle (foraging), northern spotted owl, Northern red-legged frog, red tree vole, elk, mountain lion, gray wolf

Primary Invasive plants: Scotch broom, Himalayan blackberries, Japanese knotweed, Potentilla recta, rose campion, English Ivy, False Brome

The Middle Watershed is comprised of the following sub-watersheds:

Lookout Point and Fall Creek
Communities: Fall Creek

Due to its close proximity to the Eugene-Springfield metro area and the high percentage of federal lands, the Middle Watershed is a destination for recreation. An aerial view shows a patchwork of recent clear-cuts, tree plantations, and mature forest, including old growth. The lower part is within the Willamette Valley ecoregion, and contains oak savannas and grasslands. Most of this watershed is within the Western Cascades ecoregion, and is dominated by Douglas-fir/Western hemlock forests. There are areas of ponderosa and sugar pine, a quaking aspen grove, and several upland meadows and outcrops.

Keystone Species: Western pond turtles, Oregon chub, Northern spotted owls, Townsend's big-eared bats, and Roosevelt elk, Northern red-legged frog, bald eagle
Primary Invasive Plants: Scotch broom, Himalayan blackberries, Japanese knotweed, Potentilla recta rose campion, English Ivy, False Brome

The Lower Watershed is comprised of the following sub-watersheds:

Lost creek, Little Fall Creek, Lower Middle Fork
Communities: Pleasant Hill, Dexter, Lowell, Jasper, Springfield

The lower watershed falls within the Willamette Valley Ecoregion. It encompasses the area downstream of the Lookout Point Dam. Along the valley floor, roads, communities, infrastructure, and larger order rivers and creeks exist. There are significant urban areas as the Middle Fork Willamette reaches the confluence with the mainstem of the Willamette River. Impacts from the urban areas, agriculture, dams, and high road density are significant, however, water quality remains in relatively good condition.

The Lower Middle Fork Watershed provides important habitat for spring Chinook salmon, rainbow and cutthroat trout, Pacific and brook lamprey, and Oregon chub, in addition to a host of other native species. Bull trout have been extirpated from the lower Middle Fork. There are many non-native fish species present which compete with native species for limited habitat and/or prey upon native fish. Non-native fish species include largemouth and smallmouth bass, panfish such as bluegill and crappie, as well as mosquitofish.

Primary Invasive Plants: Himalayan blackberry, Scotch broom, English ivy, knotweed, false brome, as well as aquatic weeds like Eurasian watermilfoil and yellow flag iris.

1.2 Middle Fork Willamette Watershed
Discussion

1. List 3 new statistics you learned about your local watershed.
2. Use the lists of plants and wildlife species prevalent in the Middle Fork Willamette Watershed to answer:
    - Which plants and wildlife species have you seen?
    - Which ones do you hope to see?
    - Which ones were you surprised to learn live in the MFWW?
3. Which sub-watersheds have you visited?
4. Describe one of the places you visited, including details like
    - plants and wildlife present
    - bodies of water
    - observable sign of human impact (dams, stumps, invasive species, litter...)
    - what makes the place special?

1.3 Restoration Ecology

A healthy ecosystem contains many elements that work together in a delicate balance. When the ecosystem is functioning optimally, it provides habitat for native plants and animals, and ecosystem services for humans and the planet. When any one of those elements is out of balance, it affects the entire system.

Ecosystem Disequilibrium

There are many factors that could disrupt the balance of an ecosystem. Natural events like fires, floods and landslides can drastically alter geography as well as vegetation and habitat. While these events appear to have a drastic impact, they are a part of the ecosystem's natural cycle, and the system can usually recover on its own over time. The impact of human development and invasive species, however, can alter an ecosystem beyond its ability to regain equilibrium.

Invasive species are species that are non-native, and introduction of the species is likely to cause environmental or economic harm or harm to human health. Non-native species are defined as those not naturally occurring in an ecosystem. A species can be non-native, but not considered invasive if it does not spread aggressively or cause harm. Invasives have been transported to an ecosystem either intentionally or accidentally by human causes. Invasive plants and animals can travel long distances on the underside of boats and vehicles. Sometimes a plant is introduced into an area for some desirable attribute, like its flowers or fruit. When an invasive species is not contained, it has the ability to outcompete natives, due to lack of predators and other advantages outside of its native ecosystem. Invasives often outcompete native species for resources like food, water, and sunlight. When invasives crowd out native plants, it can limit the food supply and habitat for the native animals that depend on those native plants.

As discussed in *Introduction to Watershed Ecology*, in addition to invasive species, other human-caused threats to habitat include dams, development, channelizing, agriculture, and logging. Each on of these threats, by altering one component of an ecosystem, can have a ripple effect on the entire system. For example, when trees are cut for timber harvest, or cleared to make space for development and agriculture, this can affect aquatic habitat in many ways. Less downed trees in the river over time causes a decrease in important fish habitat. It also leads to increased flow rates, which can increase erosion along the river banks. Increased erosion adds sediment to the water, which can also affect the fish and insects that live in the water. There will be less shade, which will increase the temperature of the water, which at some point makes it uninhabitable for certain species of fish and their prey. The increased sun may also allow new invasive species to thrive and outcompete natives. Downstream habitat is also affected by increased temperature, sediment, and flow rates, and spreading invasive species.

Decreasing Human Impact

Development and agriculture are vital to human society. As humans are becoming more aware of the importance of ecosystem services and how humans impact ecosystems, there are many methods arising to help maintain ecosystem balance. Scientists are continually working to develop healthier ways to practice agriculture, harvest timber, build homes, and reduce waste. Doing these activities in a more conscientious way can greatly decrease our impact on the watershed. In addition to decreasing future impacts, humans can use restoration methods to help restore balance to natural areas that have already been impacted.

Restoration Motivation

Restoration is an evolving science that looks at long term solutions to restore habitats back to a balanced state in which native species can thrive. When species become endangered, it is often because their native habitat has been so severely compromised that they can no longer survive. For example, the Fenders Blue Butterfly feeds on, and lays its eggs in, just a few specific plants, one of which is called Kincaid Lupine. The Kincaid Lupine is being crowded out of its native prairie habitat by development and invasives, threatening the survival of the Fenders Blue Butterfly. When a species becomes extinct, it significantly alters the balance of its ecosystem.

Ready, Set, Restore!

There is no restoration road map. The science evolves as each restoration project is monitored to determine if the objectives were met. Each site presents a unique set of habitats, challenges, and potential solutions. Therefore, the restoration process often begins with a series of questions, called an assessment, to determine the current state of the site and identify objectives. For example: What types of habitat are present? What habitat characteristics support the plants and animals that utilize that habitat? What are some of the limiting factors for those plants and animals?

If invasive plants are present, their removal is a restoration priority. Removing invasives and replacing them with native plants is the first step in restoring balance, and a major component of restoration work. It sounds simple: Remove invasives. Plant natives. Done! However, restoration sites can require years of maintenance and monitoring in order to meet the project objectives.

Monitoring and Maintenance: No Maintain, No Gain.

Project success is measured by monitoring to see if objectives were met. For example, if the objective of a restoration project is to increase the population of a native insect by improving habitat, then the project might focus on planting natives that provide food and shelter for that insect. The project can be monitored by doing insect species counts to see if the numbers of the desired species are increasing. If the goal of a restoration project is to increase the population of a native fish by decreasing stream temperature, one strategy is to plant native plants to increase shade in a riparian area. The results can be monitored by measuring stream temperature as well as monitoring the population of the native fish.

When native plants have been planted, often replanting, pulling invasive plants, and other maintenance is necessary if the plants do not have ideal growing conditions. These challenges are sometimes predictable, and sometimes unforeseen. For example, plants may not get enough rain water, may be eaten by predators, or may be outcompeted by invasives.

Restoration in the Middle Fork Willamette Watershed

The MFWWC has established restoration goals for aquatic, riparian, and upland habitats.

Aquatic Habitat Goals:

- Enhance or restore stream habitat
- Remove fish passage barriers
- Improve water quality

Riparian Habitat Goals:

- Remove non-native species and enhance native species distribution
- Encourage development of mature riparian forests for canopy cover and contribution of large woody debris
- Encourage use of bioengineering for stabilizing stream banks

Upland Habitat Goals:

- Encourage a diversity of upland habitats including early, mid and late-seral stage conifer forests
- Promote oak savanna habitat, natural meadows, and prairies by encouraging the use of prescribed fire and thinning
- Enhance and restore wildlife habitat

Early Detection Rapid Response (EDRR)

Invasive species are a major problem for land managers and homeowners alike. Nearly all the MFWWC restoration projects address invasive plant species. Once they become established they are very difficult to eradicate and the costs of controlling them can be high. The most effective and cost efficient way to manage invasive species is to prevent them from expanding their ranges in the first place. When prevention fails, the next best thing is to find new invaders and aggressively manage infestations when they move into new territory. This type of management is referred to as Early Detection Rapid Response (EDRR).

EDRR focuses on monitoring areas to locate and treat infestations during the earliest stages of the invasion process. If noxious weeds are detected when they first arrive in a new area, they can be managed effectively and efficiently so they don't become established and widespread. EDRR programs rely on volunteers and local professionals to watch out for EDRR-list species where they work, live, and recreate. Locations of target species should be reported to the state invasive species website (http://oregoninvasiveshotline.org/).

We need your help to eradicate new invasive plants in the Middle Fork Willamette Watershed before they get out of control! We have list of priority invasive species that we want to keep out of the watershed. These plants are either new arrivals or they haven't gotten here yet (that we know of).

Here is the MFWWC list of priority species:

Garlic mustard, Old man's beard, Giant hogweed, Yellow archangel, Yellow floating heart, Sulphur cinquefoil, European water chestnut, Flowering rush, Yellow starthistle, Yellow flag iris, Purple loosestrife, Lesser celandine, Knotweeds (Japanese, Giant, Bohemian, and Himalayan), Zebra and Quagga mussels

1.3 Restoration Ecology Discussion:

1. Restoration can be expensive and time consuming. Why do you think humans feel responsible for doing restoration work?

2. What are some of the benefits of restoration work?

3. What are some of the challenges of restoration work?

4. It is said that "An ounce of prevention is worth a pound of cure." How does this apply to habitat threats and restoration?

For instructors...

1.4 Field Guide 1: Site Tour and Site Assessment ~3 hours

The purpose of this field day is to see the project site and conduct a site assessment. At the site, students will have a chance to observe the three zones they've been learning about, stream, riparian, and upland. If questions have come up in class about a particular zone, or there is something students want to learn more about, this is a great chance to see the features and interactions of the three zones first hand. Encourage students to come prepared to ask the specialist questions that have come up in class, and to look for answers themselves as they observe the site. The specialist will show examples of restoration work, and look at areas that are in need of restoration. The specialist will guide students through the Site Assessment process. Students will fill out the site assessment form, in pairs or teams. If time permits, familiarize students with the Site Assessment form ahead of time.

Possible questions to guide observation:

What examples did you see of the interaction between Stream, Riparian, and Upland zones?
Any wildlife sightings? What animals live here?
Most prominent native plants? Invasives?
Observe signs of human and animal traffic through site (footprints, scat, etc.)

The specialist will provide information and be prepared to answer questions regarding:

Site History
Scope of Project
Project partners
Are we adding to restoration work or starting at the beginning?

For ongoing projects:
Are records available that would be a starting-point for restoration efforts? For example, are there maps or prior analyses to help set parameters? What types of monitoring were done in the past?
What are the "lessons learned" so far?
What are some of the challenges that have come up and how were those challenges addressed?
Who is removing invasives and when?
Who is supplying plant materials?
What opportunities are there for students to participate in implementing and monitoring various components of the project?

Site Assessment

Assessor Name(s): Date:
Time of day:
Site Name:

1. Are there known "listed" species of concern? (circle)
western pond turtle, Oregon chub, northern red-legged frog, migratory songbirds, bald eagles, red tree vole, lamprey, salmonids, pileated woodpecker, peregrine falcon, northern spotted owl, gray wolf, other_____

For each species circled above, what is their habitat condition?
Species: Species:
Habitat: Habitat:

2. Signs or knowledge of other native fish and wildlife and their habitats, not listed above
Signs observed: (circle) tracks, nests, scat, predation, other_____

Species: rough-skinned newts, salamanders, elk, fox, coyote, deer, cougar, bobcat, rabbits, grouse, quail, skunk, raccoon, beaver, bear, chipmunk, gray squirrel, flying squirrel, yellow-bellied marmot, porcupine, other
Notes:

3. Signs or knowledge of invasive/ non-native fish & wildlife (tracks, nests, scat, predation, etc.)
Signs observed: (circle) tracks, nests, scat, predation, other_____

Species: (Circle) bullfrog, nutria, turtles (red eared sliders & snapping turtles), crappie, nonnative carp, bass (large- and small-mouth), aquarium fish (such as goldfish), mosquitofish, crayfish (rusty, ringed and virile, red swamp), feral swine (not on the District yet but south of us on the Umpqua NF), other_____
Notes:

4. Native plants (circle)
Upland:
Trees: Douglas-fir, Incense cedar, big leaf maple, cascara buckthorn, Oregon white oak, ponderosa pine, white pine, sugar pine, western hemlock, grand fir, pacific madrone, golden chinkapin

Shrubs: dwarf Oregon grape, salal, rhododendron, baldhip rose, trailing blackberry, vine maple, oceanspray, California hazel, poison oak, snowberry, mock orange, honeysuckle, tall Oregon grape

Herbaceous species: sword fern, bracken fern, Twinflower, wild strawberry, yerba Buena, thimble-berry, huckleberries, gooseberry, red-flowering currant, Bradshaw's lomatium

Riparian:
Trees: Douglas-fir, western hemlock, western red cedar, cascara buckthorn

Shrubs: elderberry, serviceberry, salal, skunk cabbage, red-osier dogwood, alder

Herbaceous species: Oregon oxalis, pacific trillium, queen-cup beadlilly, vanilla leaf, colts foot, wild ginger, lady fern, maidenhair fern, Willamette Valley daisy

Estimated overall native plant density- < 25% / 25-50% / 50-75% / >75%

Notes:

5. Invasive plants (circle)
Scotch broom, non-native blackberries, *Potentilla recta*, rose campion, English ivy, knotweeds (Japanese, giant, Bohemian, and Himalayan), false brome, Eurasian watermilfoil, yellow flag iris, purple loosestrife, garlic mustard, old man's beard, giant hogweed, yellow archangel, yellow floating heart, sulphur cinquefoil, European water chestnut, flowering rush, yellow starthistle, lesser celandine, bittersweet nightshade, hydrilla, Brazilian elodea, reed canarygrass, knapweeds Other_____

Estimated overall invasive plant density: < 25% / 25-50% / 50-75% / >75%

Notes:

6. Health of riparian habitat indicators:
Water table: (high/low)
Trees:_____%conifer _____%deciduous
Shade: open (0-10%)___light (11-40%)_____moderate (41-70%)____heavy (>71%)_____
Vegetation and roots to help protect and stabilize banks: low / med / high
Wildlife habitat diversity: low / med / high

Notes:

7. Considerations for Project Site Selection:
What water sources are available if plantings need to be hand watered?

Is this a high traffic area for humans or predators? (Signs of footprints, scat, garbage/vandalism)

Potential for plantings to be eaten by animals?

Other observations of factors that would be beneficial or pose a challenge to restoration efforts?
(use back of page for any additional notes)

Site Assessment, Addition Notes:

Phase 2: Project Design
Instructor Introduction

Curriculum Overview

In the Classroom:

2.1 Site Assessment Analysis and Project Selection~45 min:
Members from each action team form work groups to discuss their site assessments to find common themes and consider which aspects of the assessment to focus on for the project, and which restoration methods to utilize. Followed by whole class discussion and project selection. Depending on your group dynamics and how the site assessments turned out, a whole class process may be a beneficial alternative to working in groups for this lesson.
Assessment analysis and restoration project selection reviewed and approved by specialist

2.2 Effectiveness Monitoring~30 min:
Purpose of monitoring, overview of various methods
Training in the monitoring method(s) students will use for project
Macroinvertebrates: Built in Water Quality Monitors

2.3 Project Description and Outcome Statement~30 min:
Students synthesize their assessment, restoration methods, and monitoring methods into a succinct project description and outcome statement.

In the Field:

2.4 Field Day 2: Monitoring and Site Prep~4 hours
Guided by a specialist, hands-on monitoring lesson, collect pre project data.
Prepare the site for project implementation

2.1 Site Assessment Analysis

Your site visit and site assessment gave you an overview of the various habitats and the restoration efforts (past, present, and future) at your site. Now that you have a better understanding of the site, it's time to think about how your group can get involved. Hopefully your site tour left you with several ideas for potential restoration projects. An important component of project design
is the ability to look at the feasibility of a project, prioritize the various project components, and break those components down into attainable action steps.

In small groups, analyze the site assessments to determine what some potential projects could be.

List 3 small-scale restoration projects that would benefit the site in the near future.

Project 1:

Project 2:

Project 3:

For each of these 3 projects, consider why each would be a good choice for your group to take on.
Some things to consider include:
What habitat need is addressed by the project?
How does it utilize the diverse set of skills that we have in our group so everyone is involved?
What are some clear action steps that would accomplish the goals of the project?
Is the project able to be implemented over the course of 1-2 days working in the field?
How would we monitor and maintain the project site?

Project 1:

Project 2:

Project 3:

Utilizing the considerations above, for each of the 3 projects, consider what some of the challenges and pitfalls would be if your group were to take them on.

Project 1:

Project 2:

Project 3:

Now that your group has analyzed three options for a restoration project, choose a spokesperson to share your group's top choice with the class. Be prepared to share some of the considerations that lead you to choose this project.

Have someone record each groups top choice on the board.

NGSS Suggestions: ETS-1-2, ETS-1-3, ESS 3-2, ESS 3-4, LS 2-7, LS 4-6

2.1 Project Selection: Group Consensus Techniques

PRES: A Tool for Advocating and Prioritizing Project Ideas

Time: Up to 45 minutes depending on number of participants

The PRES model for Decision-Making is used for

- Advocating for an idea/project in a respectful manner
- Listening to and understanding others ideas
- Gaining a sense of which options the group is leaning towards

The PRES tool allows everyone in the group equal time to be heard and allows the selection process to move forward in a timed, orderly fashion. Each person shares in the following format:

POINT: What I want
REASON: Why I made this decision
EXAMPLE: Describe how it might look
SUMMARY: Restate your point and reason

Facilitator Instructions:

Round 1: Advocacy

- Have participants sit in a circle, and have someone be the timekeeper
- Everyone will have 30 seconds to speak
- Participants will state only the project they support as their top choice, following the PRES model of Point, Reason, Example, and Summary
- This is not a time to answer questions or talk against any ideas
- This is a process that builds listening skills. Listen for what you like about the idea being shared, and what concerns you have.

Round 2: Prioritizing

- Have a volunteer tally weighted votes on a notepad
- 1st choice=3 points, 2nd choice=2 points, 3rd choice=1 point
- Go around the circle again, and have everyone state their first, second, and third choice. No explanations.
- Tally and announce which project had the most support. Share total vote scores as well as number of 1st place votes for the top project to give a sense of how clear the choice was- or not!

FIST TO FIVE- Achieving Consensus on a Project

Time: 10-20 minutes

Fist to Five is a group decision technique that helps the group come to a decision in a timely manner and gives everyone a chance to be heard. Compared to voting "yes" or "no," it allows participants to express their level of support on a continuum- how much they support or don't support the idea and allows others to address concerns that exist. At the end of the activity, the group will have either 1) come to consensus on a class project, or 2) moved on from an unsuccessful consensus vote to a majority decision.

A good way to introduce this technique is to list the Fist to Five definitions (value for each number of fingers, listed below) on the board, and then have the group practice with a simple example first, if necessary. Choose an idea that has obvious concerns, such as...1) Only go to school 3 days per week, and then attend school throughout the summer. 2) Serve only cake and ice cream for school lunch...etc.

FIST: No, I can't live with this
1 Finger: Wait, there are issues to discuss
2 Fingers: I'm close, I have small concerns
3 Fingers: OK, I can live with this decision
4 Fingers: Yes, it's a good decision and I will work for it
5 Fingers: Yes, it's a great decision and I will be a leader in implementing it

Fist to Five Directions:

- State an idea
- Everyone raises the number of fingers to indicate their level of support
- Anyone who has raised 3 or more fingers is considered to be on board
- Anyone who raises 2 or fewer fingers is given the opportunity to share their concerns. The group attempts to address each concern as it is shared. The facilitator asks the person with the concern if they would now be able to change their level of support to a three or more.
- Encourage people to be cautious with using a fist. A fist indicates no degree of project modification or discussion can influence you. Also, it can be viewed by some participants as aggressive.

Tips for managing the Fist to Five Discussion:

- If the group is near consensus, draw out discussion of concerns of participants raising one or two fingers. Have group respond to specific concerns with solutions that help shape project planning
- If there are very few 3,4, or 5's, or if multiple fists are raised, suggest the group may want to propose the next highest priority from the PRES process, rather than discussing the initial idea at length, especially if scores were close during the PRES process.
- If there are many 2 or 1's, then listen to all concerns before responding with comments or solutions.
- If it appears that achieving consensus may be difficult, remind the group that they will work towards gaining consensus for a given time (state the time allotted, between 15-30 minutes). If consensus isn't reached, you can do a traditional majority vote, or use dots to select from the top two (or three) choices in a majority vote. Each person will vote with a single dot. For this process, write the top choices on a flip chart or some place that is not visible to the whole group. Have participants go the list one at a time and place their dot next to their top choice.

2.2 Effectiveness Monitoring

How do you know if your project is successful? Monitoring protocols give scientists a set of data that can be used to evaluate the success of the project. Pre-project data is recorded to give a baseline picture of site conditions before restoration occurs. Once a restoration project is implemented, it is important to continually monitor the site in order to measure the status of the project objectives. Are the trees that were planted surviving, thriving? Is the water quality improving? Measurements and observations are made over the course of several years following the implementation of a restoration project. The data helps to determine what changed over time, whether or not the project objectives were met, and how restoration methods could be improved for future projects. Funders want restoration professionals to provide data that shows that the project goals were achieved.

Effective monitoring requires quantifiable observations taken in a standardized format that is repeated over time.

Some examples of types of monitoring include:

Photopoint Monitoring: Photopoint monitoring is used to document pre-project and post-project site conditions, and monitor changes in habitat. Photopoint monitoring is a vital part of accurately assessing project success over time, while also "telling the story" of the project site in a visual way. The photo point can be a GPS point or simply a physical marker in the ground like a piece of rebar.

Water Quality: Measure water temperature, air temperature, dissolved oxygen, and pH.

Aquatic Macroinvertebrates Survey: Because different macroinvertebrate species have specific sensitivity levels to pollution, the presence of certain species can give clues about water quality.

Riparian and Aquatic Survey: Survey stream for substrate and woody debris, observe vegetation types, and identify plants and wildlife.

Riparian Transect: Stretch a 100 foot transect tape perpendicular from the river's edge into the riparian area. Count conifers, hardwoods, and shrubs in 15-foot diameter circles, at 20 foot intervals, along the transect. (Different lengths can be used than the example given, as long as they are documented and repeated)

Streamflow: Measure the stream depth, width, and velocity using a Flow Sensor

Canopy Cover Survey: Estimate the percent canopy for the site by taking a sample of canopy cover in each cardinal direction, using the spherical densiometer.

Invasive Species Mapping: If the invasives are sparse, take a GPS coordinate of each plant or clump of plants found. For more established invasives, use vegetation plot monitoring grids (described below).

Soil Survey: Use and auger to expose a soil profile, and characterize the soil in each soil horizon contained in the profile

Pebble Count: Pebble counts are an important component of analyzing stream characteristics. The distribution of sediment material on the streambed can inform you about a variety of different stream functions and hydrologic conditions, including erosion potential, woody debris, and aquatic species habitat.

Vegetation plot monitoring: A GPS point or physical marker can be used to mark the plot site. Lay down a PVC square frame to outline a specific small area. In order to make your data collection repeatable, line up a predetermined corner of the square with the point, and face the top of the square in a predetermined direction. Observe and record the vegetation growing in each grid space of the plot. How many of each species? Average height?

These are just some of the types of monitoring that occurs at restoration sites. Your task is to choose the monitoring techniques that will most accurately measure the objectives of your project. Use your knowledge of monitoring to inform your project design process. If your design includes a straightforward monitoring component, it will be easier to measure project objectives.

Monitoring Reports often include a project site description, including a map of the planting area; a description of initial site conditions and treatments; plant material, age, type, and source; method of planting; use of irrigation, mulch, or herbivory protection; and a summary of frequency and type of maintenance activities.

The Design-Implement-Monitor cycle

The goal of restoration ecology is to bring a site closer to ecological equilibrium by restoring components of native habitat. When a system is in balance, it contains diverse populations of native plants and animals that benefit each other. Restoration is challenging because there are so many factors that play into the ecosystem balance. There are many factors that humans cannot control, and human efforts to restore an ecosystem may be challenged by these unforeseen factors. For example, the success rate of planting can be affected by predators eating the plants or lower than average rainfall.

Monitoring data helps determine how design methods can evolve in order to produce more effective implementation results. Just as there are many overlapping cycles occurring simultaneously in an ecosystem, restoration ecology projects can occur in cycles too. The design-implement- monitor cycle becomes more refined as it repeats. An initial project is designed, implemented, and monitored. If the monitoring data show that the objectives were not met, it helps scientists to come up with an improved design, a new implementation strategy, and so on.

Maintain Maintain Maintain!

In addition to measuring project outcomes, a major component of monitoring is maintenance. If you arrive at the project site and discover that the natives you planted have dried up, or have been eaten by predators, you would collect monitoring data that shows what changed over time. And then would you shrug your shoulders and walk away? No, you would replant! You have a great deal of effort into this project, and you want it to succeed. Most projects have a maintenance component, and this must be factored into the project design. Weeding is often necessary to help get native plants established. As you design your project, it is important to anticipate what maintenance will need to occur, and make sure someone has committed to doing it.

2.2 Effectiveness Monitoring Discussion:

Why is it important to collect pre project monitoring data?
How does monitoring help to evaluate a project and determine if objectives were met?
Why is it important to have a monitoring plan in place when you design your project objectives?
How does monitoring a restoration project help to refine the design of future projects?

NGSS Suggestions: ETS1-2, LS4-6, LS2-6, LS2-7, ESS3-2, ESS3-4

2.2 Macroinvertebrates: Built in Water Quality Monitors

Macroinvertebrates can be used as water quality indicators because they are sensitive to changes in the ecosystem and they cannot easily escape changes in the water quality. Many live in an aquatic ecosystem for over a year and they can be collected very easily from most aquatic systems with inexpensive or homemade equipment.

The life cycle of a macroinvertebrate goes from egg to adult form and they can undergo either complete or incomplete metamorphosis. Complete metamorphosis has 4 stages, egg, larvae, pupa and adult. Organisms which undergo complete metamorphosis include true flies, beetles and caddisflies. Many of these organisms are aquatic for the egg and larval stages, but not in the adult stage. Incomplete metamorphosis has 3 stages, egg, nymph and adult. Organisms which undergo incomplete metamorphosis include stoneflies, mayflies, dragonflies and true bugs.
Some of the most important life forms that inhabit a stream are aquatic macroinvertebrates. They help maintain the health of the water ecosystem by eating bacteria and dead, decaying plants and animals. Overall water quality effects which types of organisms can survive in a body of water. "Water quality" may include the amounts of dissolved oxygen and the levels of algal growth, pollutants which may be present and the pH level. Some macroinvertebrates such as stoneflies, mayflies and water pennies require a high level of dissolved oxygen and their abundance is an indication of good water quality.

Other macroinvertebrates can survive at a lower dissolved oxygen level because they can come to the surface to get oxygen through a breathing or "snorkel" tube or carry a bubble of air with them around their bodies or under their wings. Several species of macroinvertebrates are indicative of water systems with lower dissolved oxygen levels and include aquatic worms and leeches. Lower dissolved oxygen levels are often associated with polluted waters while higher levels indicate good quality water.

2.3 Project Description and Outcome Statement

Now that you have prioritized what the main components of the project will be, you can write a project description and outcome statement. The project description is a brief description of what you want to do. An outcome statement captures why you are doing the project, including specific objectives or changes to the project site. It may also highlight benefits to the land surrounding the site, as well as the community. The outcome statement should have a quantitative component, including objectives that can be measured with monitoring data, and can also have a qualitative component.

The quantitative portion of your outcome statement is directly tied to your monitoring methods. Therefore, it is helpful to look at what types of data you will be gathering during monitoring, so that your monitoring methods match your proposed outcomes. Once the project has been implemented, you will gather specific data to measure what is happening on the site, related to your specific project objectives. If you can use your monitoring data to show that the desired objectives were met, the project was successful.

General Example:

Project Description: Our group will improve habitat for native wildlife by removing invasive herbaceous and woody vegetation and planting native trees and shrubs.

Outcome Statement:
No more than 20% of the total ground cover is herbaceous invasive vegetation
No more than 10% of the total ground cover is woody invasive vegetation
A minimum of 12 native trees and shrubs present on the site
(These outcomes are examples from section 4.2: *Student Data Analysis*, on page 84 of the Watershed Stewards manual. It may be helpful to look at the data analysis example to get more ideas for monitoring objectives to include in your outcome statement.)

The project description and outcome statements can be a helpful pieces of information to share with stakeholders, funders, and anyone you want to educate about the project. The project description and outcome statements should be concise, which will help keep the project to a manageable size. By working together as a class to write the project description and outcome statement, it assures that everyone is in agreement about the essence of the project.

In teams, write a 1-2 sentence description of your project.

Now, list up to three outcomes that highlight the most important features of the project.

1.

2.

3.

When you are finished, choose a representative from your group to write you project description on the board. When all the groups have written their description on the board, as a whole group, discuss the project description ideas and draft a unified description that incorporates the most important aspects of the project. Remember to keep it concise, 1-2 sentences.

Now choose one recorder make a class list on the board. Have a representative from each working group share one outcome listed in your outcome statement. Continue to share one outcome per group until all outcomes have been shared. Review the list to see if there are any important outcomes not listed, or any outcomes listed that should be removed.

Choose a pair of volunteers, or work as a whole group, to incorporate this information into a brief outcome statement.

Record the official Project Description here:

Record the official project Outcome Statement here:

For instructors...

2.4 Field Guide 2: Pre-Project Monitoring and Site Prep ~4 hours

During their second field work day, the specialist will provide students a hands-on monitoring lesson, and students will collect pre project data. Students will also do any necessary work to prepare the site for project implementation. Divide students into work teams for monitoring and site prep, if they do not have set teams yet. Coordinate with MFWWC Education Coordinator to acquire the necessary tools and equipment for monitoring and site prep. Review field day overview (page 14) with students to ensure proper clothing and expectations.

Pre-project monitoring:

Each project will have a unique set of monitoring protocols depending on its parameters. There are many monitoring techniques described briefly in the monitoring section of the curriculum. Some general monitoring techniques that can be applied in many situations are photopoints and vegetation plots.

Photopoint monitoring

Equipment:
camera
point marker (GPS point or physical stake) compass

Photopoint monitoring is used to document before and after project site conditions, and monitor changes in habitat. Photopoint monitoring is a vital part of accurately assessing project success over time, while also "telling the story" of your project site in a visual way. The photo point can be a GPS point or simply a physical marker in the ground like a piece of rebar.
Photopoint monitoring can be done in teams of 2, with one person using the camera, and the other person helping to find the point and direction for the photo.

Vegetation plot monitoring

Equipment:
point marker (GPS point or physical stake)
1-meter grid
pocket field guide for plant identification
ruler
Vegetation Plot Monitoring Form

A GPS point or physical marker can be used to mark the plot site. Lay down a PVC square frame to outline a specific small area. In order to make your data collection repeatable, line up a predetermined corner of the square with the point, and face the top of the square in a predetermined direction. Observe and record the vegetation growing in each grid space of the plot. How many of each species? Spacing? Average height? Take a photo of your plot. Vegetation plot monitoring can be done in teams of 2-4. Tasks: Record, photograph, plant identification, plant measurement

Site preparation strategies and techniques:

Again, the specifics will vary depending on the parameters of the project. General information to offer your students in preparation would include:
Tool Safety
Working in teams

Phase 3: Project Implementation Instructor Introduction

Curriculum Overview

In the Classroom:

3.1 Project Review and Preparation~30 min + homework
Review project design
Discuss and Delegate: Order materials, acquire tools, assign field jobs for implementation
(no printed materials provided for section 3.1)

In the Field:

3.2 Field Day 3: Project Implementation~3-4+ hours, depending on project
Project Implementation, guided by specialist

Phase 3: Instructor Notes

Students will prepare for the implementation by reviewing the design and making sure they have all the tools and materials they need. This process will vary depending on the scope of the project, and how much time has passed since the project planning in Phase 2. Students will select and order materials that fit within the project budget, communicate with key stakeholders to seek out in-kind donations, and line up tools to borrow if necessary. They will assign roles to make sure everyone is engaged in the implementation process.

On the day of implementation, all the work students have done to prepare should make for a smooth day of restoration work. The specialist, instructor, and other volunteers as necessary, will be available to guide the students.

For Instructors:

3.2 Field Guide 3: Project Implementation

~3-4+ hours, depending on project

During implementation, the work can be divided up various ways, depending on the project and what would best suit your group of students. For example, tasks to be accomplished may be: dig the holes, transport plants, lay plants out at the proper planting locations, plant them in the ground, and photo documentation of the project. You could have one team do each step, or have each team divide up the steps between the team members. Factors to consider are: size of the area, amount of time available, and how precise the plantings need to be. Planting locations can be marked in advance with colored ribbon or pin flags if necessary. It may be necessary for an adult or team of detail oriented students to manage the project, to monitor the entire implementation process and ensure that each step is done properly.

There has been a great deal of learning and planning leading up to the project implementation. The completion of implementation is a cause to celebrate, as well as a chance for students to reflect on their participation in the program so far. As part of the celebration, take the opportunity to ask a few debrief questions to elicit students reflections. For example:

- How did the work you did today improve native habitat?

- How did the actual implementation process differ from what you initially thought it would be during the project planning phase? What changes were made along the way in order to accomplish the work you did today?

- In what ways have you taken a leadership role in the project?

Field Day 3: Project Implementation Action Team Responsibilities

Project Site:

Implementation Summary: (What will be done at the project site today?)

Action Team Name:

Action Team Members:

Jobs (who is doing what?):

Tools and Materials needed (and how to get them):

Tasks to complete before Field Day 3:

NGSS Suggestions: ETS 1-2

Phase 4: Monitoring, Maintenance, and Project Evaluation

Instructor Introduction

Curriculum Overview

In the Field:

4.1 Field Day 4~2-3 hours
Maintenance and post-project monitoring data collection
Additional maintenance and monitoring field days are recommended. See Phase 4 Instructor Notes.

In the Classroom:

4.2 Data Analysis and Project evaluation~45 min:
Analysis of monitoring data to determine if objectives were met.
Data analysis reviewed and approved by specialist
Project Evaluation Discussion

4.3 Presentation Preparation~45 min + homework:
Each group/ team takes on one aspect of the project to prepare and present.
Whole group decides which key stakeholder to present to. (City Council, MFWWC, Partner Agencies, etc.)

4.4 Project Presentation~30 min

Phase 4: Instructor Notes

Post-project monitoring data can be collected after implementation. Teachers who want to focus on data analysis methods may choose to monitor several times in order to create a more robust data set. Monitoring data can be compiled, and students can analyze the data to determine if the project outcomes were met. Data analysis will be reviewed and approved by specialist or Education Coordinator.

Maintenance is an important, yet often overlooked, component of a successful project. Returning to the project site to maintain the work that has been done is a great lesson for students on the importance of following through on the endeavors they begin!

Students can work in teams to prepare a presentation of their participation in the program.
Presentation options include:
Each team can focus on one key component of the program, and prepare a part of the presentation. The presentation can be offered to key stakeholder groups of the students' choice, including the MFWWC Board and/or Education and Outreach Committee, City Council, or School Board.

Students can create a website detailing the project. If a website has already been created by a previous group, students can add the details of the project to the website to create a collaborative presentation. Examples of student websites from other Oregon high school watershed education programs are listed in the Links and Resources section in the beginning of the MFWS manual.

For Instructors:

4.1 Field Guide 4: Maintenance and post-project monitoring data collection~2-3 hours

The fourth Field Day will focus on post-project monitoring and maintenance. If the schedule allows, there is great benefit from collecting multiple sets of post-project monitoring data over the course of several months. A robust data set will give students an opportunity to analyze their own data and measure more definitively if their project objectives were met. If much time has elapsed since the pre-project monitoring field day in phase 2, you may want to review the monitoring techniques the students will be utilizing in the field.

Maintenance is a very important component of successful restoration work, yet often overlooked and underfunded. For students, it provides an important lesson in seeing their work through to completion. If maintenance motivation dwindles towards the end of the project, it can be helpful to remind students about how excited they were about the project at the beginning, and the importance of following through. Maintenance and post project-monitoring are good opportunities for high school students to mentor the Watershed Rangers in a collaborative field trip. If the site will be utilized for future restoration projects with future Middle Fork Watershed Stewards groups, and those future students are able to attend a field day, this is also a great way to provide mentorship and hand off to the next group.

Since maintenance will be unique for each project, the Program Coordinator will be available to guide the process. Planting maintenance could include replanting any unhealthy plants, watering and pulling invasives, and mulching to help retain moisture and prohibit weeds. Students should fill out the "Field Day 4: *Project Maintenance Action Team Responsibilities*" form similar to the implementation phase action plans from Phase 3.

Debrief:

- How has the project site changed since implementation? Were there any surprises?
- What do you think the site will look like in 6 months? In a year?
- What maintenance will need to occur and when?

Field Day 4: Project Maintenance Action Team Responsibilities

Project Site:

Project Maintenance Summary: (What will be done at the project site today?)

Action Team Name:

Action Team Members:

Jobs (who is doing what?):

Tools and Materials needed (and how to get them):

Tasks to complete before Field Day 4:

4.2 Student Data Analysis

This example of data analysis is from a riparian monitoring project on the McKenzie River, completed by students in the WELL Project. Their surveys focused on the following parameters:

- The amount and type of invasive vegetation present on the site
- The amount of native trees and shrubs present on the site
- The types (species) of native trees and shrubs present on the site
- Growth stage of the native vegetation (measured by size)
- Browse pressure from wildlife or livestock

Use the formulas below to analyze your data in order to answer the following questions:

1. How much herbaceous invasive is present at the site? (measured by percent cover)

2. How much Himalayan blackberry and/or Scotch broom (woody invasive) is present at the site? (measured by percent cover)

3. How much woody native vegetation is present at the site? (measured by stems/acre)

4. What percent of the native vegetation is tree species? (measured by percent)

5. What percent of the native vegetation is shrub species? (measured by percent)

6. What types (species) of native trees and shrubs are present? (total number of species present)

Formulas

1. Percent Cover of invasive herbaceous species

- Determine total area of each survey transect (m2) (Transect Length x Transect width)
- Sum all the transect areas for the total area in m2
- Convert m2 into square feet (m2 * 10.764 = ft2)
- Convert to acres (1 acre = 43,560 ft)
- You now have the total transect area in acres and square meters. You will need both values.
- Calculate percent cover for each ground cover category in each transect (Ave percent cover x total transect area)
- Repeat for each transect
- Determine sum (in area m2) for each ground cover type and total area for all transects
- Calculate percent cover of invasive herbaceous species (total sum of herbaceous invasive cover m2/total transect area m2).

2. Percent Cover of invasive woody species

- Use the total transect areas in square meters from question #1
- Calculate percent cover for each ground cover category in each transect (Ave percent cover x total transect area)
- Repeat for each transect
- Determine sum (in area m2) for each ground cover type and total area for all transects.
- Calculate percent cover of invasive woody species (total sum of invasive woody invasive cover m2/total area m2)

3. Woody Native Vegetation Total Stems per acre

- Determine total number of native plant stems in all survey transects
- Use total transect area in Acres
- Calculate native stems per acre (total stems / total acres)

4. Percent Cover of native tree species

- Organize survey data by species
- Identify tree species and determine total sum of stems
- Divide total tree stem count by total stem count

5. Percent Cover of native shrub species

- Organize survey data by species
- Identify shrub species and determine total sum of stems
- Divide total shrub stem count by total stem count

6. Number of woody species

- Count the number of species present

4.2 Student Data Analysis Discussion

Below are some standards used by the McKenzie Watershed Council for monitoring riparian enhancement projects.

1. No more than 20% of the total ground cover is herbaceous invasive vegetation
2. No more than 10% of the total ground cover is woody invasive vegetation
3. Native stem count: a minimum of 1,600 native woody stems per acre
4. At least 20% of the total native species present are native trees
5. At least 20% of the total native species present are native shrubs
6. A minimum of twelve native trees and shrubs present on the site

Compare your data and calculations to the standards listed above. Based on that comparison list at least three specific recommendations for enhancing riparian conditions at the site.

NGSS Suggestions: LS 2-1, LS 2-2, LS 2-4

4.2 Project Evaluation

Over the course of your participation in the Middle Fork Watershed Stewards program, you used your background in watershed and restoration ecology to design, implement, monitor, and maintain a restoration project. Along the way, you worked cooperatively with your peers, and collaborated with professionals. You have a keen awareness of the project site, through observing what lives there and what is changing as a result of your restoration efforts.

Refer back to your Project Description and Outcome Statement from Phase 2.
Use details from your monitoring data analysis to evaluate if you achieved your proposed outcomes.

If you were able to monitor the project for another year, do you anticipate that the outcomes would be achieved?

What maintenance would need to occur in order to maintain outcomes over the long term?

How have human-caused and natural ecological disturbances affected your site in the past, and what effects do you anticipate in the future?

Zoom out. How does you project affect the habitat surrounding it?

What lessons from your project can you apply to restoration and stewardship in the Middle Fork Willamette Watershed and beyond?

What professional skills did you learn during the Middle Fork Watershed Rangers program that you could see yourself utilizing in the future (internships, classes, training, jobs...)?

What did you observe about yourself during your participation in the project? (How you work in groups, leadership styles, skills you have...)

4.3 Project Presentation:

Tips for creating an effective poster for presentation:

POSTER COMPONENTS INCLUDE

1 Title and Byline
2 Abstract
3 Introduction and/or background
4 Methods and Procedures
5 Observations/Data/Results
6 Discussion/ Conclusions
7 Literature Cited

1. Title and Byline: The title should describe the basis of your study, it should be larger than text print (18-point font or larger). The byline lists your teacher's name and your school. You can also include the names of all student authors who contributed to writing your poster.

2. Abstract: An abstract is a brief summary (50-100 words) of the results and conclusion of a scientific research study. Develop a theme or question for your abstract. To help develop a focus for your abstract, look at your results. Can your results be summarized easily?

3. Introduction/Background: State the nature of the problem to be addressed, the objectives of the study, and hypotheses to be tested. Include a brief background on work which has been done previously and the reason (objective) you are doing this restoration and monitoring.

4. Methods and Procedures: The location and a description of your site(s) should be included in the methods section. A map is an excellent way to illustrate the location of your stream in the watershed as well as the location of your sampling sites. Then a brief description of the stream and each site is in order. This section should contain enough detailed information on the equipment and techniques used so that the reader gets an accurate idea of what you did, and the data used in your study. (remember – you only need to list methods for the data used in your presentation – not all the data you collected)

5. Observations/Data/Results: This section is where you will present the facts and nothing but the facts. Any discussion of your results should be saved for the conclusion section of the presentation. Present your data and explain:

- How your data is displayed, which data is displayed
- Note trends, or significant items that will be discussed in your conclusions
- Consider any factors that may limit the quality of your data.
- Use pictures, charts, graphs, and/or flow charts rather than "raw" data to display your results.
- Always make sure that visuals have units, captions and titles so that people know what they represent.

6. Discussion/Conclusion: Summarize and describe how your results support or reject your project objectives. Discuss your data - what does it mean (refer back to your figures, graphs, illustrations, etc.) State your conclusions clearly and provide evidence in support of these conclusions.

NGSS Suggestions: LS 2-1, LS 2-2, LS 2-4, LS 2-6, LS 2-7, ESS 3-2, ESS 3-4, ETS 1-2, ETS 1-3

Phase 5:
Mentorship and Leadership Development
Instructor Introduction

5.1 Leadership Development:
A set of team-building activities with debrief suggestions

5.2 Facilitation Training:
Facilitator Competencies
Dividing Into Groups
Giving Directions
Learning Theories

5.3 Mentorship Activities:
Sense of Place and Stewardship
Native Plant Cards
Watershed Journals

Phase 5: Mentorship and Leadership Development

Leadership Development consists of team building activities that require communication and creativity. Each activity has debrief questions to elicit students' thinking about group dynamics and leadership styles. **These activities can be utilized throughout the Watershed Stewards program and/or be a focus of the Phase 5 mentorship component.** Consider taking 10 minutes at the beginning of a lesson or a field trip to get students' brains and bodies energized by bringing the group together for a team-building activity. *Facilitation Training* builds awareness of different learning styles and introduces some basic facilitator concepts.

Leadership Development and *Facilitation Training* will prepare students to be effective mentors for their elementary school peers who are participating in the Watershed Rangers Program. In addition to the Mentorship Activities provided, students can create their own activities or provide assistance with Watershed Rangers classroom lessons and field trips. They may also choose to invite Watershed Rangers to their project site to show them their work and mentor the Rangers in helping with monitoring and maintenance. Mentorship opportunities can be coordinated within the community between participating high school and elementary school teachers, with coordination from the MFWWC Education Coordinator as needed.

For Instructors:

5.1 Team Building Activities

Instructors may consider splitting a larger group into two smaller groups for some activities. Most activities will take from 5-15 minutes, depending on group size and length of debrief.

Silent Line-Up:
Objective: For the group to line up in a specific order without talking
Equipment: none
Instructions: The group must line up in a specific order given by the leader (birthdate, height, alphabetical by name, etc). For an added twist and challenge, blindfold one or more of the participants.

Human Knot:
Objective: To morph from one circle into another by untangling held hands
Equipment: none
Instructions: Have the group stand in a circle shoulder to shoulder. Then instruct everyone to outstretch their arms and grab hands with two different individuals. They may not connect to the people directly on either side of them. The purpose of the activity is to get completely untangled and form a new circle without breaking the linkage of hands.

Traffic Jam:
Objective: For the people on the left to get into the same order on the right side (and vice versa)
Equipment: Enough place markers (mats or pieces of paper) for everyone in the group plus one extra. Instructions: Set the markers up like this: >>>>>_<<<<<. The > and < represent people facing each other and the _ is a blank holder. One part of the group stands on the places to the left of the middle square, and the other part of the group stands on the spaces to the right of the middle square. Both groups are facing each other with the blank square in the middle. The goal is to get from ABCDE_12345 to 12345_ABCDE.
The following rules apply:
A person may not move backwards
You may not move around someone who is facing the same direction as you are.
No two people may move at once.
A person may only move to an open space.
A person may move over one player of the other side onto an empty space.

Zen Counting:
Objective: For the entire group to count to a given number without communicating.
Equipment: blindfolds optional
Instructions: Have the group circle up on the ground and close their eyes. Explain that there will be no talking, gesturing, or communication of any kind. Only numbers may be said. Instruct the group that they must count to a designated number in order, without interrupting the other team members. Each person may only say one number. If two people speak at the same time, the count starts over. Have students sit more randomly to make it more challenging.

Group Juggle:
Objective: To see how many objects your group can successfully pass/toss (juggle) at one time (for at least one complete rotation).
Equipment: Soft balls or other objects
Instructions: Everyone in the group must participate in the passing (juggling) of each object. Participants cannot pass an object to a person directly beside them. Works best if group will establish a pattern for passing an object from one person to the next, and maintain that pattern throughout the challenge. Start with one object being tossed/passed around the circle, and gradually add more. The more objects are being passed, the more the activity resembles juggling.
Variation: Group Juggle "Machine" – each player adopts a sound – beep, whoop, whee, yeow, pop, etc. – that they make every time they pass a ball.

Helium Stick:
Objective: To work together as a group to lower the pole from a waist high position to the ground.
Equipment: One lightweight pole (5-10 feet long) per group
Instructions: Students begin facing each other with index fingers extended at waist height. Fingers should be alternated with group members standing opposite (zipper fashion). The pole is laid across the fingers lengthwise. Participants cannot hook their finger over the pole or touch the pole with any other part of their body, and they must maintain the contact between their index finger and the bottom of the pole at all times. As the participants attempt to lower the pole to the ground while maintaining contact with the underside of the pole, the tendency will be for the pole to rise rather than lower.

Debrief Guidelines:

The purpose of the debrief is to help the group process what they have done, look for lessons and transfer those lessons to daily life. Each debrief is unique depending on the experience of the group, and evolves depending on what participants share. Following are a few suggestions for getting the discussion started.

Individual Debrief:

How did you do today?

Participation:

1. I was a leader/ good listener
2. I listened and followed directions together
3. I fooled around until peers spoke up together
4. I fooled around the whole time/difficult today

Responsibility:

1. I did my part to help (leader)
2. I helped to make it work (follower) plan
3. I didn't help until the end
4. I made it difficult for the group

Interaction:

1. I listened and talked about all ideas
2. I talked about my ideas and listened
3. I heard an idea, not a good listener
4. I didn't pay attention

Group Debrief:

Participation:

1. All students took part
2. 3/4 of the group worked
3. 1/2 of the group worked
4. The group didn't work well

Responsibility:

1. Everyone contributed today
2. Most of the group made an effort
3. Less than half of the group worked
4. One or two people worked on the plan

Interaction

1. The group heard everyone's ideas
2. The group only heard 1 or 2 ideas
3. No discussion of ideas
4. Little interaction, disinterested, distracted

Sample Questions for Debriefing

What did you enjoy most about this activity?

What was your first impulse when given the challenge?

How did you feel when . . . ?

What was the biggest challenge?

What were some of the questions that came up?

Did you consider more than one solution?

How did you go about including everyone?

What do you think about some of the other ideas that were tried?

If you were to try this again what might you do differently?

What did you learn about your group? About yourself?

How could you apply what you've learned to other areas of your life?

Team Report Card

How did our team involve everyone in solving the challenge?

Did our team use negative pressure or put-downs during the challenge?

Did we listen to one another and use ideas that we shared?

How many and which team members used praise phrases or positive encouragement?

What were some of the praise phrases used?

Pulju, Mike, Ship Island, OrcaWHALE! Productions, July 2003
Trent, Barry: Cooperative and Adventure Games, Health and Physical Activity Institute, July 26, 2005

5.2 Facilitator Competencies

In your role as mentor for the Watershed Rangers, you will have the opportunity to facilitate discussions and activities. Try to remember what it felt like to be in elementary school. How excited were you to go on field trips and be outside? How did you perceive the high school students in your community? As a mentor, you have the opportunity to work with students who are enthusiastic to participate, and who look up to you with awe and admiration. This sets the stage for you to play a meaningful role in their educational experience. And the good news is, you don't have to be an expert in Watershed Ecology or Restoration, presenting expert knowledge. You do need to understand some of the basic skills that facilitators, mentors, coaches, and teachers use to create meaningful experiences.

Facilitating/mentoring/teaching vs. presenting

Facilitating, Mentoring, and Teaching are...	Presenting is...
Asking and listening	Telling
Promoting greater awareness and discovery	Convincing others to think as I do
Assisting others to learn from their experiences	Transferring my knowledge and experience to others
Empowering, creating maturity	Creating dependency

The following is a facilitator job description. Think of it as a list of competencies to which a skilled facilitator aspires. You can see that a facilitator has a lot of factors to juggle. For a new facilitator, it may seem overwhelming, so start small. As you read the list, put a smiley face next to the competencies that you feel most confident about. Circle the ones you want to learn more about and practice. Start observing your teachers through the lens of facilitator, and observe how they exhibit some of these skills (or not!).

1. Establish a Safe and Comfortable Learning Environment

Show interest and enthusiasm...

- Greet participants personally and smile
- Introduce yourself, wear a name tag

Establish and uphold expectations

- Check with the class teacher about rules and expectations for the participants
- Confirm expectations with your students so they know what you expect
- Lead by example: be sure you are meeting the same expectations (respect, no gum, etc..)

Notice and respond to non-verbal cues

- Be observant and look for behaviors that may be a problem
- If participants look bored or confused, check to see if they're following you

2.Facilitate Participant Understanding

Give clear instructions

- When appropriate, write out specific instructions on the board
- If working in groups, wait to give instructions until participants are settled in their groups
- Provide an example of what is expected, if necessary
- Solicit questions to make sure everyone understands the instructions before starting the activity

Use appropriate language

- Use vocabulary appropriate to participants background
- Avoid slang and inappropriate language
- Encourage participants to share ideas, "Can you tell us more "
- Use polling, "how many of you.?"

3.Demonstrate Effective Delivery Skills

Speak clearly and concisely

- Speak up so everyone can hear you
- Vary your pace and tone
- Speak in complete sentences

Demonstrate active listening skills

- Nod head to show understanding and encourage participants to continue
- Maintain eye contact with participants

4.Foster Group Participation

Provide Positive Feedback

- Use words of encouragement, like, "That's an interesting point," "I'm glad you brought that up."
- Clarify and build on ideas suggested by participants, such as, "As Jane mentioned ealier..."
- Smile!

Utilize a variety of learning and teaching techniques

- Remember visual, auditory, and kinesthetic preferences
- Vary learning activities to engage all participants

Use effective questioning

- Ask open-ended questions beginning with "how, where, when, which."
- After you have asked the questions, wait for an answer. Count to 10

Manage levels of participation

- For over-participation-use a "parking lot"/list on the board for unrelated issues to address later
- For under-participators- call on participants by name, give think time prior to group discussion
- Use small groups, pairs, and trios to actively engage more participants

5.2 Facilitator Competencies Discussion:

1.Which facilitator competencies do you feel familiar with and what has your experience been?

2.Which facilitator competencies do you want to focus on and why?

3.Were there any competencies that surprised you? Things that teachers and facilitators do "behind-the-scenes" that you were unaware of?

4.Why do you think effective questioning is such an important facilitator skill?

5.2 Dividing into Groups

When dividing participants into small groups is done well, it can be done quickly and efficiently, in a way that is fun and energizing. Ensuring each group has the right mix of participants will help set groups up for success. If dividing into groups is not done well, it can be chaotic and time consuming, and groups may have an unbalanced mix of personalities.

Some fun ways to divide into groups:

Keep it Local: Choose a set of native plants or animals, based on the number of groups you need. Tell participants a little about each species if you like, then have them count off. For example, for three groups, you could use salmon, bull trout, black bear; Douglas Fir, Oak, Madrone.

Birthdays: Form subgroups by birth month. For example, everyone born January through April is group 1, May through August is group 2, and September through December is group 3.

Cut It Up: Cut a comic strip or picture into pieces and have participants find their match to find their group.

Treat Time: Hand out different types of snacks and have everyone who got the same thing form a group.

Think of your own creative ways to divide students into groups. The process should be quick, energizing, and create balanced groups.

For Instructors:

5.2 Giving Directions

'How to Tie a Shoelace' Exercise

Instructor Note: have participants do this activity before looking at the tips for giving good instructions

Grab paper and something to write with. Individually, take 5 minutes to write down instructions on how to tie a shoelace. Then, in pairs, one person will read their instructions to the other person. If you are the reader, you must read the instructions exactly as you write them. If you are the listener, pretend you have no idea what you're doing and follow the instructions exactly. (Be sure at least one person in each pair has shoes that tie). When you are finished, switch roles and repeat.

Discussion:

- Does anyone what to share their directions and tell us how it went?
- How would you improve your directions if you had to write them again?
- Did anyone use numbered steps, clear language, or draw a diagram?
- Sometimes it can be challenging to explain something we know really well to someone who is not familiar with it! How do you think this exercise applies to your ability to give directions to young students?
- Empathy can be defined as putting yourself in another person's shoes. In what ways did you feel empathy for your partner trying to tie the shoe?

source: adapted from businessballs.com

5.2 Giving Clear Directions

The basic procedure for giving good directions is summed up in these simple steps:

- Share the purpose of the activity
- Let participants know how much time the activity should take
- Anticipate potential challenges participants may have and address them, when appropriate
- Break down the activity into the smallest, simplest tasks your audience will understand
- Place these tasks in chronological order
- Post instructions so participants can visually see them (on the board, handout, etc...)
- Get the participants attention before you give instructions
- Clearly describe each step, being specific and literal
- Provide examples where appropriate
- Consider asking a participants to repeat the instructions in their own words
- Ask if anyone has questions and be available to answer them

source: adapted from: Rural Development Initiatives, Advanced Facilitation Training, copyright 2013

5.2 Learning Theories

Learning theories group common ways that people prefer to approach new information. Three basic learning styles are visual, auditory, and kinesthetic. Everyone has a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles. Others may find that they use different styles in different circumstances. There is no right mix. Nor are your styles fixed. You can develop ability in less dominant styles, as well as further develop styles that you already use well. Knowing your preferred learning style can help you choose the learning techniques that work best for you. Awareness of learning styles can also help you realize why different people may approach the same situation in different ways. With any theory that categorizes people, the danger is that it labels people in limiting ways. When used appropriately, however, it can be a useful tool to better understand how you and others operate.

Learning Questionnaire

For each question, circle the letter that best characterizes you, answering as honestly as possible with the description that applies to you right now.

1. When I try to concentrate:
    a. I grow distracted by clutter or movement, and I notice things around me other people don't notice
    b. I get distracted by sounds, and I attempt to control the amount and type of noise around me
    c. I become distracted by commotion, and I tend to retreat inside myself.

2. When I visualize:
    a. I see vivid, detailed pictures in my thoughts
    b. I think in voices and sounds
    c. I see images in my thoughts that involve movement

3. When I talk with others:
    a. I find it difficult to listen for very long
    b. I enjoy listening, or I get impatient to talk myself
    c. I gesture and communicate with my hands

4. When I contact people:
    a. I prefer face-to-face meetings
    b. I prefer speaking by telephone for serious conversations
    c. I prefer to interact while walking or participating in some activity

5. When I see an acquaintance:
    a. I forget names but remember faces, and I tend to replay where we met for the first time
    b. I know people's names and I can usually quote what we discussed
    c.I remember what we did together and I may almost "feel" out time together

6. When I relax
    a. I watch TV, see a play, visit an exhibit, or go to a movie
    b. I listen to the radio, play music, read, of talk with a friend
    c. I play sports, make crafts, or build something with my hands

7. When I read:
    a. I like descriptive examples and I may pause to imagine the scene
    b. I enjoy the narrative most and I can almost "hear" the characters talk
    c. I prefer action oriented stories, but I do not often read for pleasure

8. When I spell:
    a. I envision the word in my mind or imagine what the word looks like when written
    b. I sound out the word, sometimes aloud, and tend to recall rules about letter order
    c. I get a feel for the word by writing it out or pretending to type it

9. When I do something new:
    a. I seek out demonstrations, pictures, or diagrams
    b. I want verbal or written instructions, and to talk it over with someone else
    c. I jump right in to try it, keep trying, and try different approaches

10. When I assemble an object:
    a. I look at the picture first and then, maybe, read the directions
    b. I read the directions, or talk aloud as I work
    c. I usually ignore the directions and figure it out as I go along

11. When I interpret someone's mood:
    a. I examine facial expressions
    b. I rely on listening to tone of voice
    c. I focus on body language

12. When I teach other people:
    a. I show them
    b. I tell them, write it out, or ask them a series of questions
    c. I demonstrate how it is done and then ask them to try it

Scoring:

Count the number of a's, b's, and c's you circled and write the total in space provided
The letter with the highest total represents your primary processing style/ how you learn.
The letter with the second-most choices is your secondary style.

TOTALS:

a._____ b._____ c._____

VISUAL AUDITORY KINESTHETIC

My Learning Style

My primary learning style is:_____

My secondary learning style is_____

Now that you know which learning style you rely on, you can boost your learning potential when working to learn more. The following suggestions can help you gain more understanding:

VISUAL: If your primary learning style is visual, draw pictures in the margins, look at the graphics, and read the text that explains the graphics. Envision the topic or play a movie in your thoughts of how you'll act out the subject matter.

AUDITORY: If your primary learning style is auditory, listen to the words you read. Try to develop an internal conversation between you and the text. Don't be embarrassed to read aloud or talk through the information

TACTILE/KINESTHETIC: If your primary learning style is tactile/kinesthetic, use a highlighter to mark passages that are meaningful to you. Take notes, transferring the information you learn to the margins of the book, a notebook, or onto a computer. Doodle whatever comes to mind as you read. Hold the book in your hands instead of placing it on the table. Walk around as you read. Feel the words and ideas.

Another popular theory of learning styles is Howard Gardner's Multiple Intelligence Theory. He defines 7 types of intelligence: linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial-visual, interpersonal, and intrapersonal. For more about Multiple Intelligence Theory and a self-assessment, go to http://www.businessballs.com/howardgardnermultipleintelligences.htm

5.2 Learning Theory Discussion:

- What are your strongest skills and how can you set yourself up for success?

- Why is it important to have diverse teams of people working together on a project?

- How can a better understanding of other people's learning styles allow you to be a more effective leader?

5.3 Mentorship
Sense of Place

Describe an outdoor experience you have had in the Middle Fork Willamette Watershed that left a lasting impression on you.

Where were you?

Who were you with?

What did it look like, feel like?

What was it about that experience that made it memorable?

How do experiences like this one foster a sense of connection with your surroundings?

How does that sense of connection lead to a sense of stewardship?

Why do you think it is important for people, especially youth, to have meaningful outdoor experiences?

Is there anything you can do to protect, maintain, or restore the conditions of the place you visited?

Share your stories in working teams. Choose one or two to share in mentorship teams with Rangers. Then encourage them to share similar experiences. After each story, debrief with a few questions. You can use the prompts above or come up with original ones.

5.3 Native Plant Cards

Native plants play an important role in ecological restoration. Native plants are part of what defines a habitat, and when they are absent, the quality of the habitat is severely affected. Reintroducing native plants into a habitat can help the ecosystem function better. They can provide food and shelter for native animals, improve water quality, and provide better habitat characteristics overall.

Restoration scientists need to be able to easily identify native (and invasive) plants. Vegetation plot and riparian transect monitoring involves observing what plants are present throughout the site. Scientists identify the many different species of plants growing in each plot/transect, measure their characteristics, and quantify how many of each there are.

The goal of this activity is to create a set of beautiful, informative cards that feature pictures and information about the native plants common to your area. The cards will be used in an activity with the Watershed Rangers in your community. Make sure to include the species that are common in your area and growing at your project site. The cards should be made of heavy paper, like card stock or poster board, and laminated when finished. One side of the card should feature a picture of the plant. Get creative. It can be a colorful drawing, a painting, or a simple sketch. You can draw the whole plant, or feature a set of specific parts, like the leaf and blossom. On the other side of the card, name the plant and write a few important facts (identifying features, its role in the ecosystem, etc). It can be in paragraph format or just bullet points.

When the Native Plant Cards are finished, each card will be presented to your group so that everyone can benefit from your expertise.

Native Plants in the Field: Rangers Mentorship Activities

Before the Rangers arrive at the project site, identify some of the native plants that are featured on the cards. Choose 4-6 of the most common native plants to share with the students.

Making teams:

Create work teams so that there is one team for each plant you have chosen. Each team is made up of several high school mentors and a group of elementary students. In order to diversify the teams, use a creative technique for breaking into groups. An easy method is to have them count off, but instead of just saying 1, 2, 3, 4 and then having group 1, group 2, etc, you can have them count off by some set of well-known objects, like "river, salmon, bear, tree." The you have team river, team salmon, team bear, and team tree. (See *Dividing Into Groups, page 98*)

Each team will gather together, and mentors will present some information about the importance of native plants, as well as the chosen native plant. Use the picture on the card as a visual when describing the plant. Then, staying together as a group, allow the Rangers to look for that native plant. It may be useful to have some way to mark the location of the plant, like a ring of stones or sticks, or a flag, so it doesn't get overlooked or trampled. When all the teams have found their plant, you can do a native plant tour, where all teams rotate to each plant site. When everyone is gathered around a plant, have a Ranger use the Native Plant Card to teach their class about the native plant. Tour around the site until all the teams' plants have been featured.

The Native plant cards can also be used like flash cards. Once the students have learned how to identify the plants, they can be shown the picture on the front and see if they can name the plant and some of its distinguishing features. If there are pairs of each plant, the cards can be used like a memory game (which would require covering the writing on the back).

You may also choose to create Invasive Plant Cards. The ability to identify invasive plants is equally important as the ability to identify native ones. The activity centered around invasive plants could include an introduction to the Early Detection Rapid Response (EDRR) program discussed in Phase 1. This gives students a context for the importance of learning to identify invasive plants. They can play an important role in forest health by reporting invasive sitings, helping to stop the spread of invasive plants in our local forests!

5.3 Native Plant Cards Discussion:

What role do native plants play in their native habitat?

Why is it important to be able to identify native plants? Invasive Plants?

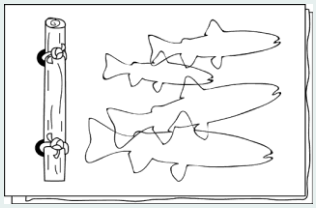
What are some of the characteristics that help you identify a plant?

Watershed Journals

Keeping a journal can be a powerful learning tool to accompany Watershed Rangers activities. Over the school year, students can contribute drawings and writing to the journal, complete in-class assignments of your design, and use the journal for activities on field trips. At the end of the year, a well-utilized journal can be a record of student learning and a source of pride and achievement. This page has some ideas for how to create journals with your students and some suggested journal activities.

Journal Style #1

Use sheets of 8.5"x11" paper cut in half. Punch 2 holes along the short side of the pages. Use a popsicle stick as the binding for now; collect a twig on the first field trip to take its place. Line up all the pages and hold the popsicle stick so that it covers the two holes. Now push the looped end of a rubber band through one hole and loop it around the end of the popsicle stick. Push the other end of the rubber band through the other hole and loop it around the other end of the popsicle stick. You have a quick binding that is easy to undo and add more pages. Your journal will look something like this:



Write your name on the journal and decorate the cover with images from the watershed.

Journal Style #2

Use a slim 3-ring binder as a journal. You can work on new pages anywhere and add them later, leaving the binder at school.

1. Reflect on a field trip. What happened on the trip? What new things did you learn? Favorite and least favorite parts?

2. Reflect on a guest speaker. Who visited the class? What is their job? What did you learn from them?

3. Write down your "watershed address," tracing the route of water from your home to the ocean.

4. Draw a map of our watershed from memory. Start with your house and add any land- marks you remember.

5. Draw a picture of how you imagine your community will look in 50 years. Write a paragraph about the changes that have occurred.

6. Choose an animal that you feel a strong connection with. Draw a picture of your animal and describe why it is special.

7. Name one place in our watershed you've visited and enjoyed. Name one place you haven't been but would like to visit.

8. Draw and label an organism you observed outside.

9. Describe an experience you had recently near a stream, in the mountains, in the forest or by a lake. Use your senses.

10. Make a sound map. Put a dot in the middle of the page to represent yourself. Now listen carefully for several minutes. When you hear a sound mark it on the map approximately where you heard it. Use symbols to represent the sounds.

11. Make a blind contour drawing. Close your eyes and picture a plant or animal. Try to draw it from memory keeping your eyes closed. You might be surprised how accurate it can be.

12. Write about another object or organism as though it was you. What would it be like to be a turtle, frog, or eagle?

13. Use a crayon or soft pencil to make a rubbing of tree bark or a leaf.

14. Write a haiku about an outdoor space. A haiku is 3 lines long with 5 syllables in the first, 7 in the second, and 5 in the third.