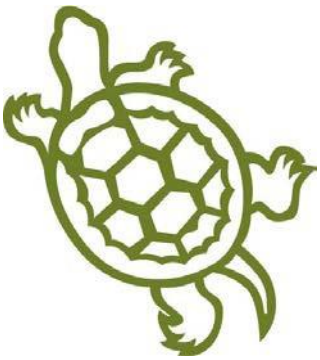
MIDDLE FORK
WILLAMETTE
WATERSHED COUNCIL

A Teacher's
Guide to

# WaterShed Rangers

A Place-based Curriculum &
Field Study Program
For 3rd-6th Grades

Compiled by Cristina Watson, Watershed Education Program Coordinator.
February, 2011



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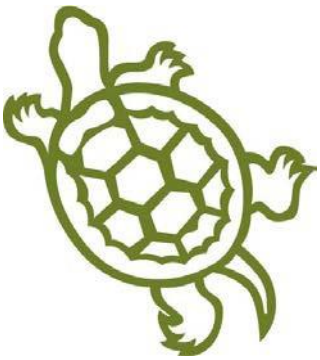


# Acknowledgements

Watershed Rangers 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. Watershed Rangers would not be possible without the generous contributions of the following project partners.

- US Forest Service, Middle Fork Willamette Ranger District
- US Army Corps of Engineers, Willamette Valley Project
- US Bureau of Land Management, Eugene District
- US Environmental Protection Agency
- Oregon Parks and Recreation Department
- Oregon Department of Fish and Wildlife
- Oregon Watershed Enhancement Board
- Springfield Utility Board
- Lane Educational Service District
- School Districts of Springfield, Pleasant Hill, Lowell, and Oakridge
- Cities of Lowell and Oakridge
- Oregon State University, OSU Extension Service and Sea Grant
- University of Oregon Environmental Leadership Program
- Oregon Community Foundation
- Oregon Forest Resources Institute
- Camas Educational Network
- SOLV Organization

This Teacher's Guide owes itself to the efforts of the MFWWC Watershed Education Program staff and the Education and Outreach Committee. Special acknowledgement goes to Ernie and Marcia Ledbetter for their ongoing support of the stream simulator program; to teacher Sid Rosen, whose inspiring work with his 4th grade class became the pilot for Watershed Rangers; and to all the teachers whose enthusiasm for watershed education continues to make this project a success.

# Foreword

Welcome to the Watershed Rangers education project! This document is a guide for teachers who are interested in participating in an inquiry-based, outdoor-focused approach to science education. A project of the Middle Fork Willamette Watershed Council, Watershed Rangers is a way for students, teachers, and community members alike to get to know more about the amazing and unique natural resources in our local area.

This guide gives a general description of Watershed Rangers, its core philosophy and the various aspects of the program. It also offers guidelines for teachers to assist in planning watershed education activities - everything from classroom lessons to field trips to service projects. Finally, this guide provides lesson plans, a field guide of background information about the Middle Fork Willamette watershed, and other resources to point teachers in helpful directions.

The material included in the pages that follow should give the reader a comprehensive look at how watershed education can be incorporated into the existing curriculum. We believe that outdoor, hands-on experiences enable students to come to know and love their home watershed - and, with this new understanding, become stewards of our precious natural resources. We are confident that you'll agree, and we look forward to collaborating with you!

## 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

# What is Watershed Rangers?

Watershed Rangers is the elementary education project of the Middle Fork Willamette Watershed Council. It is a main focus of the MFWWC Watershed Education Program (WEP), and it is implemented by the WEP Coordinator, a staff member of the MFWWC. The goal of Watershed Rangers is to get students outside the classroom making connections with the ecosystems in their home watershed. To achieve this goal, the project draws upon the instructional approach of hands-on, inquiry-based learning, incorporating the fundamentals of the scientific method and other valuable forms of analysis and expression.

### Watershed Education Program Goals

1. To develop a positive connection between youth and the environment in which they live

2. To foster appreciation for the resources, assets, and challenges of the watershed

3. To acquire new knowledge, skills, and capacity to enhance awareness and stewardship of the environment

4. To involve community organizations and agencies in the provision of educational opportunities for area schools

5. To develop an environmentally literate citizenry

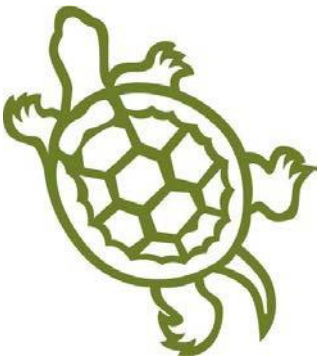
Watershed Rangers is designed to meet the needs of several groups. For the Watershed Council, this project works towards the goal of developing a sense of place and spirit of stewardship among residents of the Middle Fork Willamette Watershed. As a part of the WEP, Watershed Rangers provides education and outreach on the most pressing challenges facing the natural resources in our area. For our partner organizations, Watershed Rangers provides the bridge between natural resource managers and schools. Our partner groups and agencies may have differing roles and interests, but they all have a stake in the education of our youth and initiatives toward natural resource education and outreach. Watershed Rangers provides the coordination necessary to effectively unite the resources of our partners with the teachers and students who can benefit from them.

Lastly, for the small rural school districts along the Middle Fork Willamette, Watershed Rangers provides a hands-on science program complete with field experiences and opportunities for service learning at no additional cost to the schools. Teachers work closely with the WEP Coordinator to develop a unique program

to fit the needs of each class, and all lessons and activities are aligned with Oregon education benchmarks.

Partnerships play a key role in the WEP. It is important for local students to be exposed to the organizations that manage the land and water in our area - both to introduce them to possible careers in natural resources and to educate them on the issues they will be faced with and called upon to address as adults. Our partners are committed to providing support for watershed education activities, offering teachers and students their expertise and available resources, and providing opportunities for students to participate in service learning projects. Wildlife and fisheries biologists, water quality managers, habitat restoration specialists, park rangers, and public servants are just a few of the folks who support Watershed Rangers by giving classroom presentations, guiding during field trips, providing leadership during service projects, and serving on the watershed council's Education and Outreach Committee.

The outdoor classroom is a place where students can explore science concepts firsthand, gaining a real-world understanding of our local ecology. It is also a setting for inspiration and wonder, offering students the space and opportunity to make meaningful connections with the special places in our watershed.



# Program Structure

Watershed Rangers consists of five components: 1) Teacher Preparation & Planning, 2) Classroom Lessons, 3) Guest Speakers & Special Presentations, 4) Field Trips, and 5) Service Learning Projects. This section provides participating teachers with a description and guidelines for each program component.

Feel free to contact Watershed Council's education program at any time at

Program Manager:
Emma@middleforkwillamete.org

Project Coordinater
Dassy@middleforkwillamete.org

or call the MFWWC office at **(458) 215 8200**.

## Teacher Preparation

Teacher participation is vital to the success of this project. The effectiveness of field trips and guest speakers is greatly increased when teachers pre-teach concepts and vocabulary beforehand and review what was learned afterward. Our eventual goal is that teachers feel that they have the time, tools, and support to adopt as many watershed lessons as they would like. To this end, the WEP provides periodic teacher training events, and the WEP Coordinator is available to provide lesson plans and work with teachers or teams of teachers in a workshop-style setting anytime during the school year. Resource kits and education materials are available for check-out as well (see page 15).

Sample Calendar

Fall
Introductory class visit
Field trip #1

Winter
Class Lessons
Guest speaker

April
Class lessons
Service learning project

May
Class Lessons
Field trip #2
Final wrap-up

## Planning the Year

Working closely with the WEP Coordinator, each teacher plans out the theme and activities for the school year. Often, all classes in a grade level will opt to participate and planning will be a collaborative process involving a team of teachers and the WEP Coordinator. It is also common for several grade levels at one school to participate, and meetings with the WEP Coordinator can help to ensure that activities and themes are differentiated by grade level. This helps to avoid having students repeat activities and makes the most of our ability to build upon the knowledge of students who participate in Watershed Rangers for multiple years.

The planning process typically starts at the beginning of the school year, and dates for class visits, field trips, and service projects are set for Fall and Spring. Setting dates far in advance is helpful to partner agencies and the WEP Coordinator to ensure that guest instructors are available and to allow time for coordination and planning. It also helps teachers to chart the year and plan their own calendars. Once a general plan is developed and dates chosen, periodic planning meetings with the WEP Coordinator occur throughout the year as needed to plan details.

*Thematic Approach*
The plan for the year is customized by each teacher or team of teachers working with the WEP Coordinator. Though this plan can take on whatever form the teachers choose, some themes have tended to work well for certain grades. These can serve as a good starting point in developing the plan for the year.

Examples of Grade Level Themes

3rd: What is a Watershed; Local Plants & Animals; Ponds as Habitat
4th: Oregon Natural Resources: Forests, Streams, Salmon
5th: Land Use; Dams & Wastewater Treatment; Ecosystems
6th: Outdoor School Prep; Fire Ecology; Groundwater Protection

## Classroom Lessons

Classroom lessons help set the stage for learning in the outdoors, and follow-up activities ensure that students apply what they learn beyond the field trip. The WEP Coordinator is available to guest teach watershed lessons and may teach several lessons during the year for newly participating classes. This helps the WEP Coordinator get to know new classes as well as model lessons for new teachers. Over time, teachers gradually take on more responsibility for teaching watershed lessons in the classroom, allowing the WEP Coordinator to expand the program to more classes and focus on coordinating field experiences.

*Watershed Rangers Lesson Plans*
The Watershed Rangers curriculum draws upon a number of excellent existing curriculum guides in environmental education, including Project WET, Project WILD, Project Learning Tree, Wolftree Watershed Science Program, and Alien Invasion: Plants on the Move. The WEP Coordinator is familiar with these resources and selects lessons that fit with the class theme. Because these lessons are designed to be general and, thus, easily adopted in any location, part of the role of the WEP Coordinator is to adapt these and create innovative lessons that are specifically relevant to the Middle Fork Willamette watershed. Several of these place-specific lessons are included as part of this Teacher Guide.

*Watershed Rangers Resource Kits*
Many teachers report that they would love to teach more watershed lessons, but the time and funds needed to develop the necessary materials can be scarce. To address this challenge, the

WEP provides resource kits for checkout. These kits contain the specialized pieces and parts needed to teach each lesson - a set of flashcards, laminated charts, or special dice, for instance. The kit may also be customized with other helpful materials on the lesson theme, such as maps, posters, storybooks, or field guides. Resource kits can be delivered to the school through the Lane ESD courier service or picked up at the MFWWC office if convenient for the teacher. The length of checkout time can be negotiated between the teacher and the WEP Coordinator to coordinate with the schedules of other teachers in the program.

*The Stream Simulator*

An amazing hands-on teaching tool is available for any teacher to use at any time through the WEP. Pleasant Hill, Lundy, and Oakridge Elementary schools each house a small 4-foot version of the stream simulator, and a larger 6-foot model can be made available with advance planning. The stream simulator is essentially a portable model stream, and it has an accompanying curriculum entitled *Streams of Thought*. There are many applications for the stream simulator, but the setup and maintenance of it can seem daunting. The WEP Coordinator provides training on how to use the simulator and is available to teach lessons as well. Detailed instructions are also included in *Streams of Thought*, which can be found in the resource kit included with each simulator. This is a great tool to familiarize students with a variety of stream concepts before a field trip.

Creating a salmon habitat with the stream simulator.

## Guest Speakers & Special Presentations

The collaborative, partner-based structure of the WEP puts us in contact with many experts in the field of resource management. These people are wonderful resources, often serving as guest instructors and guides during field trips. They are also available to provide presentations in the classroom. The WEP Coordinator can suggest ideas for speakers, make the initial connection between the teacher and the speaker, and assist with logistical details as needed. If the guest speaker will be giving a presentation to more than one class in a school day, it can work out well to have the WEP Coordinator or teachers present a lesson on the same topic to one class while the presenter is with the other class - then switch.

Periodically, unexpected opportunities arise - perhaps environmental education students from the University of Oregon guest teaching a lesson, or a special grant through the Forest Service bringing in a traveling biologist. The WEP Coordinator works to stay connected with current happenings in the environmental education world in order to inform teachers about these opportunities. Likewise, feel free to share news that may be of interest to other teachers with the Coordinator.

## Field Trips

The foundation of Watershed Rangers is connecting students with their local community and environment through field experience. Field trips help students make discoveries and get to know the special places in our watershed in a personal, meaningful way. In the outdoors, students learn firsthand ideas that may seem abstract or conceptual in the classroom. Repeated visits to the same outdoor site can be particularly powerful. Students become scientists-in-training, honing their observation skills and tracking the changes in a habitat over time. Building connections with a place also helps students develop a sense of pride and stewardship for their watershed.

*Planning Field Trips*

Teachers and the WEP Coordinator select field trip sites together to best fit the program of study. The Coordinator is familiar with many field trip sites in the watershed and can suggest locations based on desired theme and the size and needs of the individual class or classes. In choosing locations for field trips, the Coordinator considers availability of restrooms, school bus turn-around space, and accessibility. Depending on the plans for the day, other considerations might be access to a picnic area or covered shelter larger enough to accommodate the entire group. The WEP Coordinator takes the lead in planning logistical details, including contacting and scheduling guest instructors, planning education activities and a schedule for the day, and reserving shelters or picnic areas as needed.

Depending on the type of field trip and the size of the group, it often makes sense to divide the students into smaller groups and rotate through several different activities. These activity stations may be led by the WEP Coordinator, a guest instructor or tour guide, and/or the participating teacher. A handy form entitled Field Notes can be found on pages 11-12 and includes a checklist of guidelines for before and after field trips, as well as brief profiles of sample trips in the watershed.

## Service Learning Projects

The final component of Watershed Rangers is service learning - turning knowledge into action. Often when students learn about threats to water quality or native wildlife, they ask the natural question: “What can we do about it?” Service learning projects help students to take meaningful action toward the stewardship of our watershed, building upon their new knowledge of watershed science concepts and empowering them to become engaged members of the watershed community. Students learn that they, regardless of age, can play an important role in caring for our natural resources. Service learning projects are hands-on, active, and provide students with real-life skills and training, as well as the satisfaction of knowing they are making a difference.

*Planning Projects*

The WEP Coordinator works closely with representatives from partner agencies like the Forest Service, Oregon Parks, the Army Corps of Engineers, and Springfield Utility Board to generate ideas for service learning projects. A good project will strike a balance between three factors. It should address a real need for the host agency, be a high priority project for the MFWWC, and provide an activity that is age-appropriate and enjoyable for students. The WEP Coordinator takes these factors into account to ensure that the project is meaningful and successful for all parties. It is our goal for students to leave a project site feeling a sense of accomplishment and having had a positive experience. We intentionally plan projects in areas that are highly visible and visited by the public, bringing exposure to Watershed Rangers and increasing the likelihood that students will revisit project sites and share their accomplishment with family and friends.

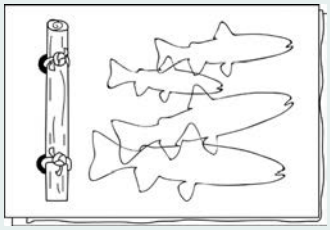
Using weed wrenches to pull the invasive shrub Scotch broom is a favorite activity among students.

# 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 landmarks 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 a favorite 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.

## Examples of Field Trips

Theme: **Ecosystems and Food Webs**
Possible Locations: Elijah Bristow State Park, Buckhead Wildlife Area
Activity 1: Wildlife or bird walk
Activity 2: Native species scavenger hunt
Activity 3: Pond invertebrate collection
Lunch
Activity 4: Web of Life wrap-up activity

Theme: **Managing Our Water**
Possible Locations: Lookout Point Dam, Oakridge Sewage Treatment Plant, SUB Wellfield in Springfield
Activity 1: Facility tour
Activity 2: Water quality testing
Activity 3: Stream simulator or groundwater model demo

Theme: **Forests and Fire Ecology**
Possible Locations: Clark Creek Organizational Camp, Giustina Land and Timber managed forest
Activity 1: Visit to Giustina timber forest
Travel to Clark Creek, lunch
Activity 2: Hike to Clark Fire burn area
Activity 3: Plant and tree ID

Theme: **Streams and Salmon**
Possible Locations: Elijah Bristow State Park, Willamette Fish Hatchery
Activity 1: Stream invertebrate ID
Activity 2: Water quality testing
Lunch
Activity 3: Stream survey journal activity
Activity 4: Salmon talk

## Examples of Service Learning Projects

Project: **Invasive Plant Removal** Target Species: Scotch broom, English ivy, mullein, teasel, blackberry
Possible Locations: Elijah Bristow State Park, Jasper Park, Pengra Greenway Park, Red Cedar Trail, Willamette Fish Hatchery, Buckhead Wildlife Area

Project: **Restoring Native Habitat**
Planting natives: Oregon white oak, black cottonwood, white alder, bigleaf maple, western redcedar, other native shrubs
Possible Locations: Elijah Bristow State Park, Logjam Landing, Buckhead Wildlife Area

# Resource Kits Available for Checkout

At the time of publication, 9 lesson plans with accompanying teaching materials are available for checkout from the WEP. The WEP Coordinator can assemble thematic resource kits around each lesson, drawing from the WEP library to provide related books, posters, videos, maps, field guides, etc. to help round out a unit.

| |
|---|
| What's A Watershed? Creating a model drainage basin<br>*Introduction to watersheds, mapping, water cycle* |
| Aquifer in A Cup: Building miniature groundwater models<br>*Water quality, pollution, land use, water cycle, earth science* |
| The Water Cycle Game: Following a water molecule through the water cycle<br>*Water cycle, watersheds, states of matter* |
| Sum of the Parts: Planning a stream-side community<br>*Watersheds, land use, water quality, pollution, managing resources* |
| Microhabitat Survey: Taking a look at wildlife on a small scale<br>*Plants, habitat, biodiversity, adaptations, ecosystems, life cycles* |
| Adopt A Native Tree: Schoolyard as habitat<br>*Native plants, habitat, biodiversity, ecosystems, life cycles, seasons* |
| Mind Your Macros: Stream macroinvertebrate sorting activity<br>*Salmon, streams, food chain, food web, habitat, insects, life cycles* |
| The Great Middle Fork Race: Learning how invasive species take over<br>*Plants, habitat, biodiversity, adaptations, ecosystems, life cycles* |
| Forests and Fire: Model matchstick forests demonstrate fire scenarios<br>*Forests, fire ecology, fire cycle, old growth habitat, biodiversity* |

# Contacts & Links

**Middle Fork Willamette Watershed Council**
655 A Street Suite A/B
Springfield, OR 97477
(458) 215 8200. | www.mfwwc.org

**U.S. Forest Service**
Willamette National Forest Supervisor's Office
3106 Pierce Pkwy Ste D, Springfield OR 97477
(541) 225-6300
Middle Fork District Office
46375 Highway 58, Westfir OR 97492
(541) 782-2283 | www.fs.usda.gov/willamette

**BLM District Office**
3106 Pierce Pkwy Ste E, Springfield OR 97477
(541) 683-6600| www.blm.gov/office/northwest-oregon-district-office

**U.S. Army Corps of Engineers**
Willamette Valley Project Office
40386 W. Boundary Road, Lowell OR 97452
(541) 937-2131
https://www.nwp.usace.army.mil/Locations/Willamette-Valley/

**Oregon Parks and Recreation Department**
Southern Willamette Management Unit
45 S. Moss Street, Lowell OR 97452
(541)937-1173|www.oregon.gov/OPRD /

**Springfield Utility Board Water Division**
202 S. 18th St. Springfield OR 97477
(541) 744-3745 | www.subutil.com/

**Oregon Department of Forestry**
2600 State Street, Salem OR 97310
(503) 945-7424 | www.odf.state.or.us

**Oregon Department of Fish and Wildlife**
Raise salmon in the classroom through the STEP Program | www.dfw.state.or.us/STEP/resources-education.asp

**Oregon Forest Resources Institute (OFRI)**
(503) 229-6718 | www.oregonforests.org

**Oregon Natural Resources Education Program (ONREP)**
051 Peavy Hall, Corvallis, OR 97331-5713
(541) 737-2128 | onrep.forestry.oregonstate.edu

**Forests Today and Forever**
www.foreststodayandforever.org

**Oregon State Extension Service**
http://extension.oregonstate.edu/

**Oregon Trout Salmon Watch Program**
Water quality survey, macroinvertebrates
230 SW 3rd St. Corvallis OR 97333
(541) 753-4280 | www.oregontrout.org

**Talk About Trees Program**
https://oregonforests.org/talk-about-trees
Free interactive science presentation for K-6

**Walama Restoration Project**
(541) 484-3939 | www.walamarestoration.org
A local non-profit dedicated to restoring ecosystems in the Willamette Valley.

**Lane Audubon Society**
(541) 4852475 | www.laneaudubon.org/audubon-in-schools.htm Bird related classroom presentations

**Nearby Nature, Alton Baker Park**
(541) 687-9699 | www.nearbynature.org
Nature programs for youth in Eugene.

**Mt. Pisgah Arboretum**
(541) 747-3817
www.mountpisgaharboretum.org

# What's A Watershed?

## Description

Students visualize how a watershed works by creating a simple model using paper and markers. They then use a map to describe their "watershed address."

### Grade Level

3rd-4th

### NGSS:

5-ESS2-1,2
5-LS2-1

### Materials

- Blue washable markers
- Maps of the Middle Fork Willamette watershed
- Spray bottle

***From classroom***

- Large piece of butcher paper

### Setting

Classroom; schoolyard

### Concepts

Watershed
River
Stream
Lake
Pond
Tributary
Runoff
Ridge Line
Divide
Drainage basin
Floodplain

## Goal

Students will understand the concept of watershed and how the land within a watershed is connected by water.

## Objectives

As a result of this lesson, students will...

- Gain an introduction to the term "watershed"
- Observe how water moves through a landscape
- Identify important landscape features, such as mountains, valleys, rivers, streams, and ponds
- Hypothesize which direction water will move through a watershed model
- Identify watershed boundaries by pointing out ridges and divides
- Trace the path of water from the Middle Fork Willamette watershed to the Pacific Ocean.

## Background *Adapted from Project WET: Branching Out!*

When the ground is saturated or impermeable to water during heavy rains or snowmelt, excess water flows over the surface of land as runoff. Eventually, this water collects in channels such as streams. The land area that drains water into the channels is called the watershed or drainage basin.

Watersheds are separated from each other by areas of higher elevation called ridge lines or divides. Near the divide of a watershed, water channels are narrow and can contain fast-moving water. At lower elevations, the slope of the land decreases, causing water to flow more slowly. As smaller streams merge together, the width of the channel increases. Eventually, water collects in a wide river that empties into a body of water such as a lake or ocean.

From an aerial view, drainage patterns in watersheds resemble a network similar to the branching pattern of a tree. Tributaries, similar to twigs and small branches, flow into streams, the main branches of the tree. Streams eventually empty into a large river, comparable to the tree trunk. Like other branching patterns (road maps, veins in a leaf, the human nervous system) the drainage patter consists of smaller channels merging into larger ones.

Watersheds are either closed or open systems. In closed systems, such as Crater Lake or the Great Salt Lake in Utah, water collects at a low point that lacks an outlet. The only way water naturally leaves the system is through evaporation or seeping into the ground. Most watersheds are open: water that collects in smaller drainage basins overflows into outlet rivers and eventually empties into the sea.

## Procedure

*Preparation*

In advance, prepare sheets of white butcher paper approximately 4 feet long. It works well to divide the class into small groups of 3-4 students, and there should be one sheet of butcher paper per group. Fill the spray bottle with water.

*Activity*

1. Tell students they will be creating a model of a watershed. Ask them: What is a watershed? Students may have trouble explaining the concept of watershed at first. It may be helpful to break the word down into its root words, water and shed. A shed can be a structure that provides storage, and it can also mean to release, eliminate, cast off, or prevent from being absorbed. Any of these synonyms can be used in comparison to the function of a watershed. A good working definition of watershed might be: An area of land that drains into a specific body of water. Tell students that they will now create a model of a watershed to help demonstrate the concept.

2. Hold up one piece of butcher paper and tell students that this will become the watershed model. However, the surface of the earth is not flat like the paper. What features should the paper have to better resemble the landscape around us? Students may mention mountains, valleys, etc. Create a varied landscape by crumpling the paper into a ball, then pulling it slightly back apart to reveal "mountains" and "valleys."

3. Instruct students that they will help create a visual model of the path of runoff in a watershed by coloring with blue marker on the tops of the ridge lines. You may choose to demonstrate this for the class in order to emphasize what is meant by ridge line. The demonstration is most effective if students color only on the peaks and thoroughly saturate these areas with the blue marker.

4. Crumple each sheet of butcher paper and distribute one to each group. Distribute the blue markers and instruct students to begin coloring. Circulate around to each group to monitor progress and guide the coloring process as needed. Remind them to avoid flattening out the "mountains" as they color. This may be a good time to ask students where they think rivers and streams might be located in the model.

5. After about 10 minutes, bring the class back together and tell them that the next step is to spray water on the ridge tops. Ask them to look at their model and hypothesize where small streams, large rivers, ponds, and lakes may form once water is added. *Recommendation: Lead the class to an outdoor area to spray the water.*

6. Spray each model with a generous amount of water, focusing on the ridge tops. Ask the group if the runoff went where they expected it to. For the first group, point out watershed boundaries – divides – that become obvious when the marker runs. Ask students to point out watershed divides with each successive group.

## Assessment and Extension

1. Ask students if they have a better understanding of what a watershed is. As a class, develop a unified definition of the word watershed. Emphasize that a watershed is not only made up of water, but includes all of the land that drains into a particular body of water. A watershed includes the forests, landforms, cities, roads, homes, schools, etc. in a certain drainage basin. Explain that the paper models illustrate surface runoff, but that groundwater is part of a watershed too.

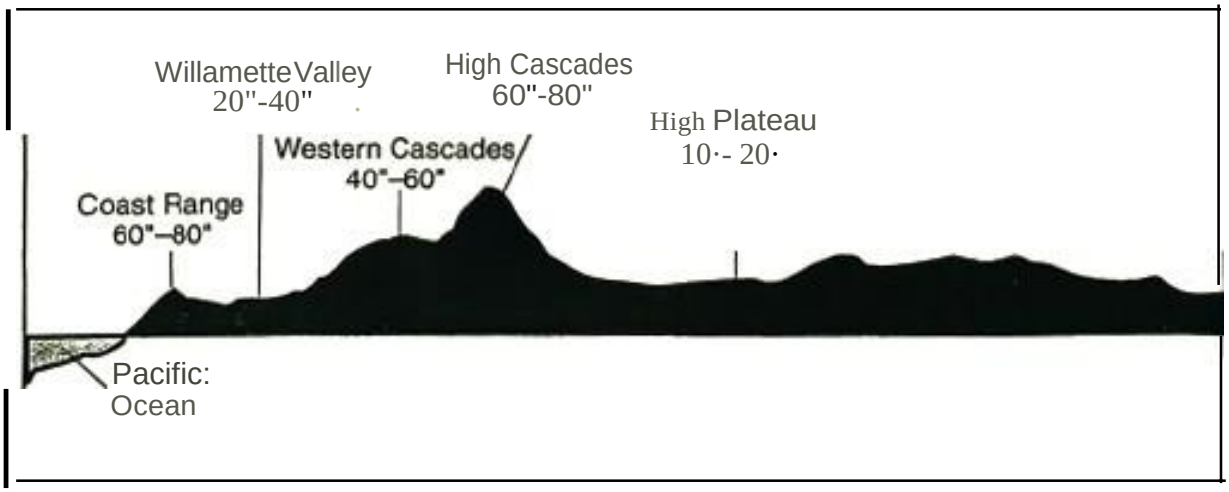
2. Provide each student with a map of Oregon including the Middle Fork Willamette watershed. Place a copy of the map on an overhead projector or SMART Board. Ask students to identify where their school is on the map. Point out the Middle Fork Willamette River and ask students where it begins and where it flows into the Willamette. Trace the path from the source of the Middle Fork to the Pacific Ocean. What cities are downstream of us? (Eugene, Albany, Salem, Portland). Identify other important landmarks and bodies of water that students may have heard of or visited, such as Dexter Reservoir, Hills Creek Reservoir, the Coast Fork Willamette River, the McKenzie River, Mt. Pisgah, Waldo Lake, and Diamond Peak.

3. Have students describe their "watershed address" by writing down the path from the school to the Pacific Ocean. The watershed address might look something like this:

Lost Creek (varies) →Middle Fork Willamette R. →Willamette River →Columbia River →Pacific Ocean

4. Ask students if they can locate the boundary of the Middle Fork Willamette watershed on the map. Have them work with a partner to locate and trace along the divides that separate the Middle Fork drainage from the McKenzie, Deschutes, and Coast Fork watersheds.

**Oregon A-age Annual Rainfall**



# Aquifer in a Cup

## Description

Students create their own miniature model of an aquifer and use it to demonstrate how groundwater can become polluted.

### Grade Level

3rd-6th

### NGSS:

5-ESS2-1,2
5-LS2-1
3-ESS3-1

### Materials

- Clear plastic cups, one per student
- Drinking straws, one per student
- Rice or other small grain
- Larger beans
- Two dish tubs
- Food coloring
- Water can with "rain" spout

*For optional demo*

- Modeling clay

### Setting

Classroom

### Concepts

Watershed
Aquifer
Bedrock
Groundwater
Well
Drinking water
Water Table
Filtration
Pollution
Contamination

## Goal

Students will understand that groundwater is an important resource and that human actions on the surface can contaminate the aquifer.

## Objectives

As a result of this lesson, students will...

- Create and identify the layers beneath ground level
- Learn how rain water travels through those layers
- Describe how soil helps filter water
- Understand that the aquifer is an underground layer of permeable rock that holds water
- Learn that an aquifer is an important source of drinking water
- Observer how groundwater becomes polluted

## Background

According to the US Geological Survey, 3% of water on earth is freshwater, but only about 1% is usable by humans. Most freshwater exists in ice and glaciers. Of all the freshwater on earth, only .3% exists as visible water in lakes and streams. By comparison, groundwater makes up 30% of the freshwater supply on the planet. Groundwater is an important source of drinking water and one of the most important resources on earth.

In the Middle Fork Willamette watershed, the underlying rock is mainly basalt, formed by volcanic eruptions from the Cascade Mountains. Diamond Peak is an example in our watershed of a mountain with a volcanic past – one of many such volcanoes in the Cascades. Basalt is quite porous, containing holes caused by air bubbles in the lava as it hardens. This allows basalt to hold water like a sponge. Groundwater passes through layers of rock, sand, and silt, all of which act to filter impurities from the water. At the headwaters of the Middle Fork Willamette, Waldo Lake exists as one of the purest lakes in the world. That is because it is fed entirely by groundwater, which has been filtered through the porous surrounding rock. In fact, Waldo Lake has no surface streams feeding it at all.

The communities in our watershed get drinking water either from the ground through wells or from surface water. Since not all rock layers hold water, wells must be drilled deeply enough to tap into a rock layer containing water, or an aquifer. Wells can be either owned by private citizens or communally owned and operated by a utility company. Springfield Utility Board manages a system of seven wellfields near the confluence of the Middle Fork and the Coast Fork, tapping into a large aquifer beneath the

city of Springfield. This groundwater supplies thousands of residents with water, including many people living in our watershed. Water can also be collected and purified from rivers and streams. SUB takes a portion of its water from the Middle Fork Willamette, and the city of Lowell draws water directly from the Middle Fork at Dexter Reservoir. The supply of water in our watershed, and the world in general, is finite, and the small portion available for human use must be protected and managed carefully.

It is easy to imagine how pollutants such as oil, gasoline, and antifreeze can be carried from parking lots and roads into the Middle Fork and its tributaries through storm water runoff. However, hazardous materials can just as easily contaminate our groundwater. Gravity pulls water downward, and as it soaks into the ground pollutants come with it. This can contaminate the drinking water in wells, and it can also pollute rivers and streams from underground as they are fed by groundwater. Examples of potential groundwater contaminants are motor vehicles, septic tanks, agricultural chemicals like pesticides and fertilizer, manure from livestock, leaking industrial waste storage, landfills, and wastewater treatment facilities.

## Procedure

*Preparation*

The different sized "gravel" – rice and beans – should be put into dish tubs and placed where students can access them. Each tub should have a scoop in it – ¼ cup for the rice and ¼ cup for the beans. Fill the watering can with water.

*Activity*

1. Tell students they will be creating a model of an aquifer. You may ask them: What is an aquifer? and Do you know where the water you drink comes from? Depending on your area and the individual students, they may have a well, get their water from groundwater via the city or SUB, or in Lowell, get water from surface water out of the Middle Fork. You may choose to take some time teaching background material on groundwater and introducing students to relevant vocabulary. The diagram included at the end of this lesson is a useful depiction of an aquifer.

2. Pass out a clear plastic cup and a straw to each student. Each student will take 1 scoop of large gravel and put it in the cup. On top, they will add 1 scoop of small gravel / sand. Have them create a sloped surface with the surface gravel so that there is an obvious high point and low point. You may create a demo model to help illustrate this.

3. After everyone has the layers of gravel in their cups, circulate around the room adding water to each model. Add enough water to saturate the bottom half of the model, but not so much that the water rises above the highest point. Instruct the students to look at their model. Where is the water table? Tell them that the area above the water table is called the unsaturated zone. There is water present, but it does not completely fill the spaces between the gravel. The area below the water table is called the saturated zone. This is where groundwater fills all the spaces between the rocks with no air bubbles. This layer can provide groundwater for a well; this is the aquifer.

4. Have the students "drill a well" into the aquifer by pushing the straw down into the cup. This step should be done fairly soon after the water is added before the beans expand. Note: For the teacher's demo model, you may choose to use a liquid hand soap style pump instead of a straw.

5. Now share a pollution scenario with the students. Perhaps a home is located on the hillside near the well, and a car parked there is leaking oil onto the ground. This pollutant will be represented

by food coloring. You may ask the students to name other sources of surface pollution that the food coloring could represent. Circulate around the classroom and add 1 drop of food coloring to the highest point in each aquifer model.

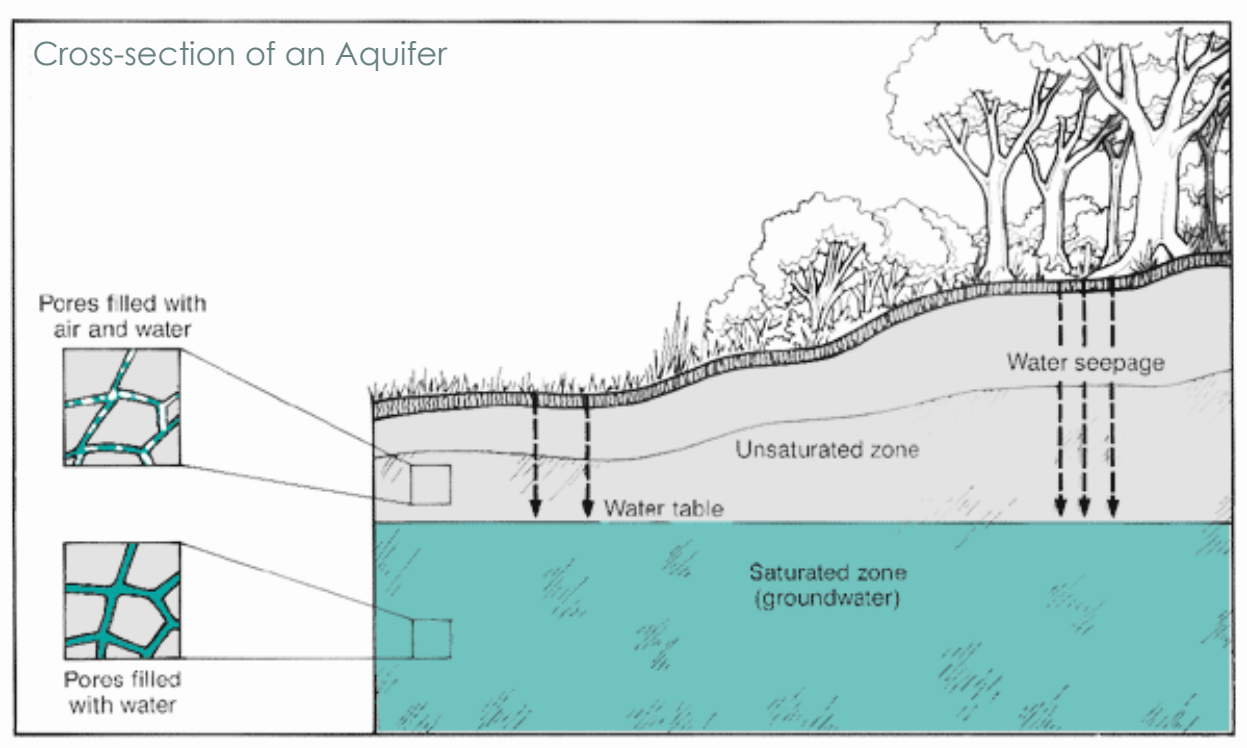
6. Before long, the food coloring will be drawn downward toward the aquifer. Tell students to carefully observe their model. How long before the well is contaminated? If using a hand soap pump, pump a few times and observe if the water has been tainted by the food coloring.

*Optional*
Give each student a piece of modeling clay about the size of a walnut. Instruct them to flatten the clay and place it on top of the rice. What could this impermeable layer represent? Some types of rock are not porous and cannot hold water. The clay could also represent a parking lot or road. Add 1 drop of a different color of food coloring to the surface of the clay. What would happen if it rained? Sprinkle a little water on each model and ask students to describe where the pollutant ended up. Will this second pollutant contaminate the well too? Ask students to watch and see if the colors combine. It most effective to use two primary colors, such as blue and yellow, with this demonstration.

## Assessment and Extension

1. Ask students to explain what an aquifer is and how we obtain water for drinking and other uses. Why is it important to protect the aquifer? What can we do to prevent our water sources from becoming polluted?

2. The lesson 'Sum of the Parts,' also available as a Watershed Rangers resource kit, is a great next activity to take a closer look at pollution sources and the concepts of point and non-point source pollution.




**The Middle Fork Willamette**

# The Water Cycle Game

*Adapted from Project WET and Water Wonders*

## Description

Students learn about the complex path a water molecule can take through the water cycle, then write about their unique journey as a water molecule in the Middle Fork Willamette watershed.

### Grade Level

4th-6th

### NGSS:

5-PS1-1

### Materials

- Water cycle dice (7)
- Color-coded sign for each station (7)
- Colored beads (7 sets)
- Cups to hold beads
- Pipe cleaners
- Water Cycle Score Card worksheet
- Maps of the Middle Fork Willamette area

### Setting

Classroom

### Concepts

Watershed
Condensation
Evaporation
Percolation or infiltration
Precipitation
Transpiration
Respiration
Water table
Groundwater
States of matter: solid, liquid, gas

## Goal

Students will understand the complex ways water moves through the water cycle, connecting landforms, plants and wildlife, and communities in the Middle Fork Willamette watershed.

## Objectives

As a result of this lesson, students will...

- Describe the movement of water within the water cycle
- Identify the states of water as it moves through the water cycle
- Consider the complex and unique journey of a single water molecule
- Write about their journey as a water molecule in the Middle Fork Willamette watershed
- Be able to name key places, animals, and plants in the Middle Fork Willamette watershed

## Background

In describing the water cycle, we often simplify the process to a circle of water flowing from a stream to an ocean, evaporating to the clouds, raining down on a mountaintop, and flowing back into the stream. Role-playing a water molecule helps students to conceptualize the water cycle as more than a predictable two-dimensional path.

Many forces impact the path water can take through the cycle.
The force of gravity influences the ability of water to travel over, under, and above the Earth's surface. Porous surfaces, like the layers of volcanic rock that cover much of the land area of the Middle Fork Willamette watershed, allow water to percolate into the ground. This groundwater is also moving downhill due to gravity, like an underground river.
Heat energy affects the rate of motion of water molecules. Heat causes water to change from solid to liquid to gas, and along with these state changes usually comes physical movement of water from one place to another. The processes of evaporation and condensation move water through the cycle.

Living organisms also help move water. Humans and other animals carry water in their bodies. Water is excreted as a liquid or leaves as a gas, usually through respiration. Water in the form of perspiration can evaporate from the skin of an animal. Plants move the most water of all living organisms. Roots absorb liquid water, some of which is used by the plant. Much of the water travels upwards to the surface of the leaves, where it evaporates through the process of transpiration.

These forces all influence the pathways of water. In turn, the pathways water takes influence the lives of living organisms. Plants and animals are differently adapted to survive in certain habitats. Streams, lakes, rivers, oceans and seas, deserts and rainforests, ponds and wetlands – the various ways in which water moves through the water cycle are in large part responsible for the diversity of habitats on Earth.

## Procedure

*Preparation*

1. Using the materials provided in the Water Cycle Game resource kit, set up seven stations around the classroom as follows. Each station should have a numbered sign with color-coded marking: 1. Cloud=white, 2. Mountain=light green, 3. Ocean=dark blue, 4. Stream=light blue, 5. Groundwater=gray, 6. Animal=brown, 7. Plant=dark green

2. Place a cup of colored beads at each station, matching beads to color on sign. Recommend taping cup down to prevent spilling of beads. Place a die at each station, taking special care to match number on die to station number (each die is specific to its station). Give each student a copy of the Water Cycle Score Card and one pipe cleaner.

*Activity*

1. Tell students that they are going to become water molecules moving through the water cycle. What are some of the different routes water can take through the water cycle? You may want to ask students to describe how the water cycle works as you draw it on the board. Explain that the water cycle can seem simple in the drawing, but is actually more complex than we might think.

2. Briefly describe what students will do in the game. Introduce the seven stations, pointing out where they are around the room. Instruct students how to proceed at each station. Upon reaching each station, students first take a colored bead and place it on the pipe cleaner. Then, students will take turns rolling the die to see where they will go next. Students should use the Score Card to record their journey.

3. Divide the class into 7 equal groups and assign each group to a station. Begin game. You may wish to have groups rotate on a command, such as "Cycle," rather than moving freely, perhaps completing the first few rounds together until they get the hang of it.

4. After 10 rounds, the molecule's journey is complete. Each student should have a unique "bracelet" symbolizing his or her journey. *Note: Students who finish first may stay busy drawing a "new and improved" water cycle diagram of their unique journey.*

## Assessment and Extension

1. Ask students to describe their journey. Did any students visit a station more than once? Or stay at the same station twice in a row? What does this tell us about the path of water in the water cycle?

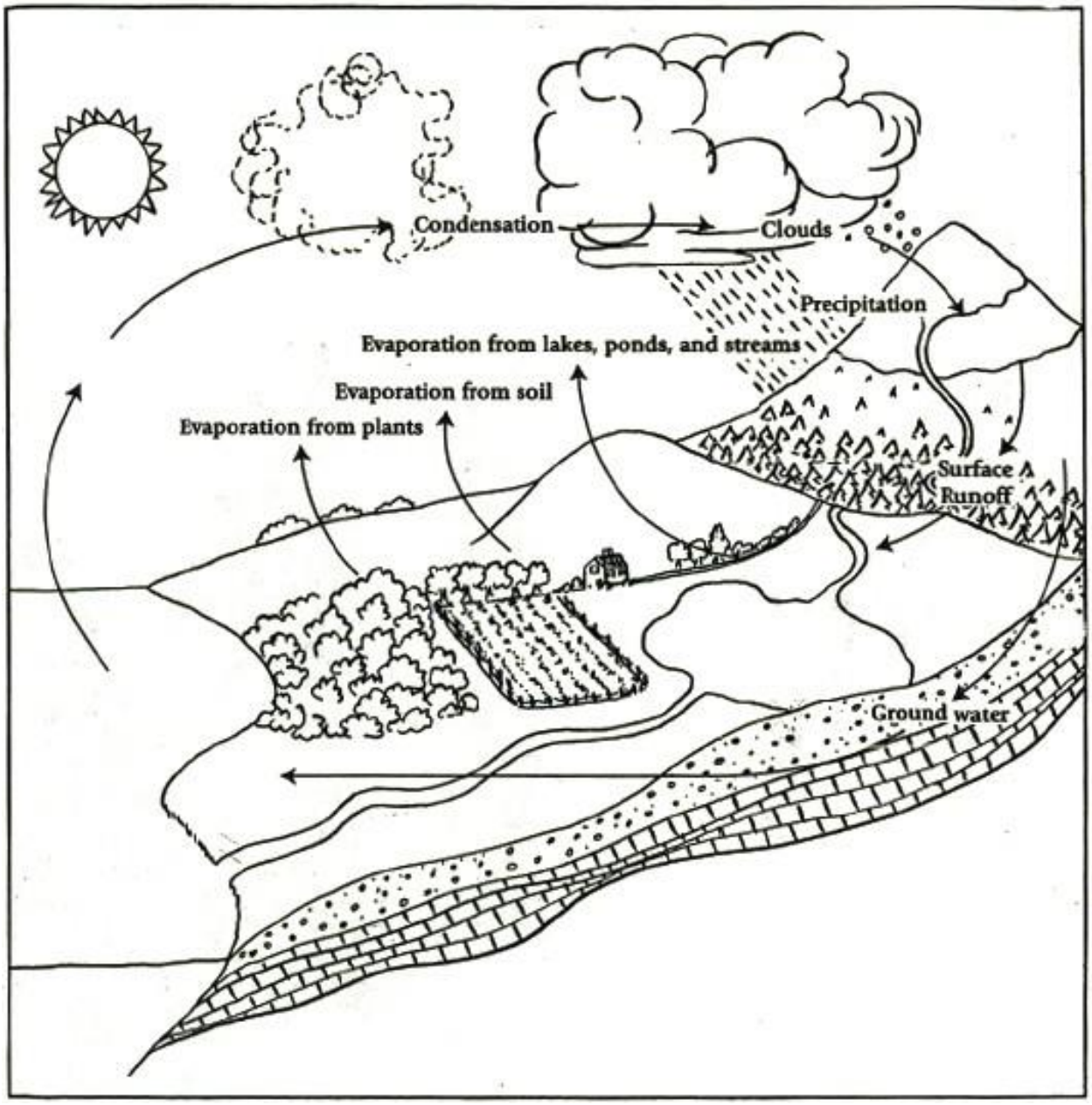
2. Have students write a paragraph describing their journey. Challenge them to make the paragraph specific to the Middle Fork Willamette watershed by using the names of actual landforms, bodies of water, and native plants and animals in the watershed. Have students brainstorm names and/or research using a map or the internet. (Area map included in Water Cycle Game kit).

3. Have students draw and label a water cycle diagram for their unique journey to accompany the paragraph.

4. Have students investigate how water becomes polluted and is cleaned as it moves through the water cycle. For instance, it might pick up contaminants as it travels through the ground, which are then left behind as water evaporates at the surface. What does the water cycle game show us about water pollution, and how might we work to prevent water pollution in our home watershed?

5. Global extension: Read "A Drop Around the World" by Barbara McKinney (book and teacher's guide included in Water Cycle Game kit). How do our actions in our own watershed affect others around the world? How might their actions affect us? Consider having older students read the book to younger students.

6. Consider teaching related lessons available from the WEP: Sum of the Parts and Aquifer in a Cup.



STUDENT PAGE

**WATER CYCLE SCORE CARD**

Bead Color Key:

CLOUD - white
ANIMAL - brown
MOUNTAIN - light green
STREAM - light blue
PLANT – dark green
OCEAN - dark blue
GROUNDWATER - gray

# WATER CYCLE SCORE CARD

**STUDENT'S NAME:**

| STATION STOP | WHAT HAPPENS | DESTINATION |
|---|---|---|
| EXAMPLE | | |
| Cloud | Fall as rain | Mountain |

Describe your entire journey on the back of the card

# Sum of the Parts

*Adapted from Project WET, Discover a Watershed Guide*

## Description

Students demonstrate how everyone contributes to the water quality and habitat health of a river as it flows through a watershed and recognize that the impacts of our actions affect the people and landscapes downstream.

### Grade Level
5th-6th

### NGSS:
5-ESS2-1,2
5-LS2-1
3,5-ESS3-1

### Materials
- Stream side property templates
- Maps showing Middle Fork Willamette area
- Set of poker chips

*From classroom*
- Large piece of butcher paper, or
- Sheets of 8.5"x11" paper (one for each student)
- Crayons, markers, and/or pencils
- Items from students' desks

### Setting
Classroom

### Concepts
Watershed
Point source pollution
Nonpoint source pollution
Riparian zone
Habitat fragmentation
Best management practices

## Goal
Students will understand why it is important to avoid polluting our rivers and streams

## Objectives
As a result of this lesson, students will...
- Distinguish between point source and nonpoint source pollution
- Understand that communities in the Middle Fork Willamette watershed are connected by rivers and streams
- Recognize that everyone contributes to and is responsible for a river or lake's water quality
- Describe how developing the land near rivers and lakes can affect the quality of riparian habitat and drinking water
- Identify Best Management Practices to reduce pollution

## Background
The quality of water in a river (or lake) is, to a large extent, a reflection of land uses and natural factors found in its watershed. If soil near a river or lake naturally erodes, chances are the river has sediment and turbidity problems. If the land has stable vegetative cover, erosion is kept in check. When humans settle and develop land, water quality is affected. Breaking sod, cutting forests, building cities, mining, and other land uses make an impact on water quality.

Everyone bears responsibility for the health of a watershed and the water systems – rivers, lakes, wetlands – within a drainage basin. Individual actions, both positive and negative, add up. Understanding a river or lake's water quality and quantity involves investigating the condition of the contributing watershed. If the watershed is polluted, the river will likely be polluted. The greatest effects of accumulating water pollution are felt by downstream communities. When watershed managers investigate land use practices that might affect the quality of water, they are concerned with two general sources of pollutants: point and nonpoint.

Point source pollution involves pollutants that are discharged from and can be traced back to an identifiable point or source – such as a factory's discharge pipe or a sewage ditch. Nonpoint source pollution (NPS) occurs when the source of the contaminant is unidentifiable – that is, the pollutant can come from many places and cannot be traced back directly to the source. Examples of

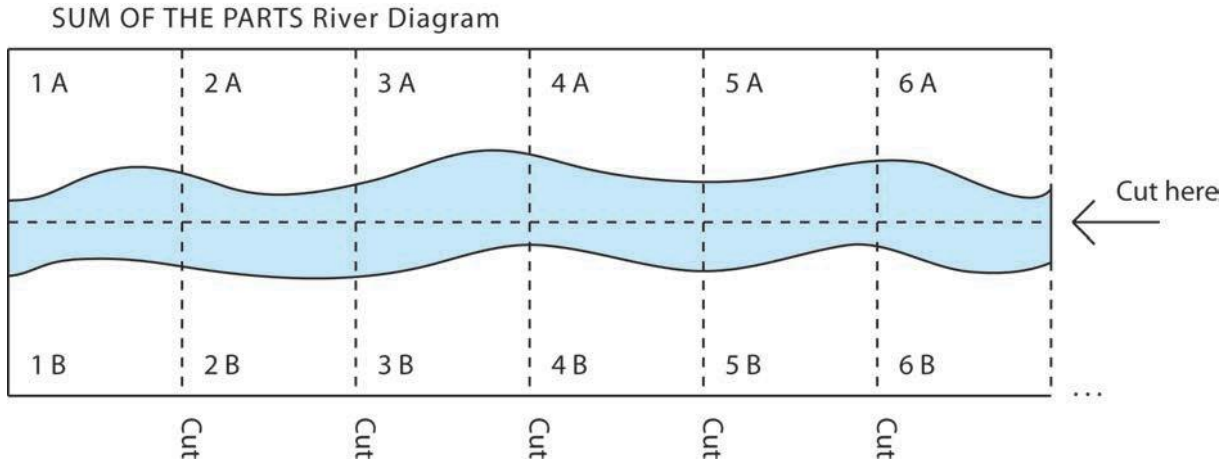
nonpoint source pollution include runoff from agricultural fields containing fertilizer and pesticides, motor oil filtering from urban areas, and sediments from eroded stream banks. A list of nonpoint source pollution sources and suggested Best Management Practices can be found in the attached table.

Nonpoint source pollution from anywhere in the watershed can affect the health of a river, but development along the riverfront has additional impacts. The riparian zone of vegetative cover along waterways is important for keeping erosion at a minimum and providing a safe corridor for wildlife. In the Middle Fork Willamette watershed, alders and cottonwoods along creeks provide shady pools for spring Chinook salmon, steelhead, bull trout, and other native cold-water fish. Lowland ponds provide essential habitat for Oregon chub, Western pond turtles, and red-legged frogs. Riverfront development can have negative impacts on these ecosystems. In order to build close to the water, the natural flood regime must be altered to protect property. This separates ponds and side channels from the floodplain, reducing quality habitat. Poor land use planning, removal of native vegetation, and invasion of exotic plants can break up the corridors of habitat used by wildlife, resulting in habitat fragmentation. Loss of shade from riparian deforestation results in warmer water temperatures and reduced water quality. Using ecologically minded development practices and restoring degraded riparian areas can help enhance riverside habitats and protect clean drinking water.

## Procedure

*Preparation*

In advance of the lesson, create a "stream side property" page for each student. If using butcher paper, use a blue marker to draw and color a river down the center of the butcher paper, as shown in the diagram below. Divide the stream in half down the middle and crosswise into sections. Number each section as illustrated in the diagram. Each section should include a bit of river and blank space to allow room for students' drawings. Make enough sections to have one for each student. Cut out the sections of stream. If using pieces of 8.5"x11" paper, use the templates included in the Watershed Rangers resource kit. Trace the river outline from Template A on half the sheets and Template B on the other half. Number each section as illustrated in the diagram.




*Activity*

Determine students' knowledge of the Middle Fork Willamette watershed by asking them to name towns and other places along the river. Is the named place upstream or downstream? What streams or creeks flow into the Middle Fork? What are some names of lakes in our watershed, and where does their water come from? What river does the Middle Fork flow into, and where? It will be helpful to have students look at a map (included in resource kit).

Discuss some of the predominant types of land use along the Middle Fork Willamette river. Some examples are: residential, agriculture (pasture, orchard, farm), dams and reservoirs, recreation / trails, protected land / state parks, national forest, timber industry, urban structures (roads, bridges, buildings, wells, water treatment facilities) in south Springfield, Jasper, Pleasant Hill, Lowell, Dexter, and Oakridge/ Westfir. Do students think these practices could affect the river? What do students think the attitude of downstream residents might be about the water received from their upstream neighbors?

Tell students that they have just inherited a piece of riverfront property and enough money to do whatever they want with the land. Pass out a "piece of property" to each student. Explain that the blue on their property is the Middle Fork Willamette river and the blank space is the land they own. They can develop their land as they wish – a home, farm or ranch, factory, park, plant forest, log, etc.

When students have completed their drawings, ask them to find the number on their property. Explain that each piece is actually a part of a puzzle. Starting with the number ones, have students assemble the "puzzle." Note: You many want to have the students attach the pieces to a large bulletin board or tape the sections together as they go and hang on the wall for display.

Have students describe how they developed their land and how they used water. Challenge them to think of ways their development could pollute the water and change the natural habitat. For each way a student's property impacts the river, have the student find an item from their desk – preferably one with their name on it or that they can easily identify later (symbolizing point source pollution). Alternatively, you could use identical classroom items like index cards or blocks – items that would be difficult or impossible to trace back to the source (nonpoint source pollution). A set of poker chips is included in the Watershed Rangers resource kit for this purpose.

Tell students to take the items from their desk and then to line up in the order of their riverfront property, with one line of A's and a second line of B's. Starting with the Ones, have the students pass the "pollution" from their property to the next person in the line. The last student in each line will eventually end up with all the "pollution." To finish the activity, have the students at the end of each line count the "pollutants" in their hands. Then have them return each item to its owner.

## Assessment and Extension

1. Discuss what happened in the activity. Where did all the pollution end up? Does that seem fair to the people living downstream? How do the actions of upstream residents affect the lives of downstream residents?

2. Ask students to answer the following questions:
What is "point source pollution?" What might be some causes of point source pollution and how might we work to prevent it? How is point source pollution different than nonpoint source pollution? Which type of pollution do you think would be more difficult to address? Why?

3. Have students do the following:
Redesign their riverfront property to reduce pollution and protect habitat
Write a paragraph expressing their opinions about individual contributions to total water quality
Come up with ideas for things they personally can do to protect water quality
Describe things that landowners can do to protect wildlife habitat and water quality on their property

4. Teach a related lesson, such as Aquifer in a Cup or the Stream Simulator pollution lesson.

## Major Sources of NPS Pollution and BMPs

| Source | Best Management Practices: |
|---|---|
| **Roads and Streets** | • dispose of paints, solvents, and petroleum products at approved disposal sites, not in storm drains or street gutters<br>• fix automobile oil and fuel leaks<br>• stop oil dumping on rural roads<br>• use nonchemical deicers (sand and ash) on roads, sidewalks, and driveways<br>• construct a sediment catch basin to collect storm water runoff<br>• reduce road construction runoff by building terraces and catch basins, and by planting cover crops |
| **Agriculture** | • read and follow all labels and ask for application directions before using chemicals, fertilizers, and pesticides<br>• use conservation tillage<br>• use contour farming<br>• use strip cropping<br>• leave filter strips and field borders along wetlands and streams<br>• use a cover crop to protect exposed soil<br>• rotate crops<br>• plant shelter belts and windbreaks<br>• institute pasture management<br>• terrace areas prone to erosion<br>• construct livestock waste collection and treatment ponds for confined livestock<br>• use grassed waterways<br>• seal abandoned or waste disposal wells<br>• fence waterways to reduce riparian zone impact by livestock |
| **Logging** | • monitor water entering and leaving cut areas<br>• prevent sediments from reaching streams and lakes by building terraces, catch basins, and natural filters<br>• leave a vegetative buffer zone in riparian areas<br>• maintain and restore effective watersheds<br>• implement a plan to reduce erosion from roads |
| **Mining** | • monitor all water entering and leaving mine sites<br>• intercept and reroute uncontaminated water away from contaminated areas (keep clean water clean!)<br>• construct catch basins and terraces, and plant cover crops, to catch sediment and prevent erosion<br>• catch and treat contaminated water (clean contaminated water!)<br>• stabilize stream channels<br>• stabilize mining waste areas to prevent release of materials to streams<br>• maintain buffer strips along streams |
| **Construction** | • implement a sediment control plan<br>• plant ground cover to reduce erosion<br>• dispose of solvent, paint, and other wastes at approved disposal sites<br>• build temporary, small dikes to slow and catch runoff<br>• build sediment catch basins to collect construction runoff<br>• build earth berms and filter runoff before water enters stream |
| **Residential** | • use nonchemical deicers (sand and ash) on residential driveways and sidewalks<br>• read labels prior to using pesticides and fertilizers<br>• consider xeriscaping<br>• use nonchemical fertilizers (compost) on gardens<br>• dispose of household hazardous waste at approved disposal sites<br>• maintain septic tanks if sewers are not available |

*From Project WET*

# Microhabitat Survey

*Adapted from Project Learning Tree*

## Description

Students explore habitat on a small scale by taking a close look at the animals living in the schoolyard.

### Grade Level
3rd-6th

### NGSS:
3-LS4-3
5-LS2-1

### Materials
- Pieces of string
- Hand lenses
- Bug bottles
- Plastic containers with lids
- Student worksheets (2 options)
- Field guides

*From classroom*
- Clipboards
- Pencils

### Setting
Schoolyard

### Concepts
Habitat
Ecosystem
Living and nonliving
Life Cycle
Classification of organisms
Invertebrate
Vertebrate
Biodiversity
Survey
Inventory

## Goal
Students will understand what a habitat is and gain an appreciation for the diverse types of habitats in our watershed.

## Objectives
As a result of this lesson, students will...
- Identify animals and plants living in a small-scale ecosystem
- Observe signs of animals living in the schoolyard
- Describe ways the school environment provides suitable habitat for animals living there
- Understand that habitats can take many forms and are all around us
- Describe what we can learn by surveying a habitat

## Background
Habitat refers to the place where an organism lives. The habitat provides an organism with everything it needs to survive, including its specific needs for food, water, shelter, space, and reproduction. Habitats vary tremendously in terms of size and appearance. Even in the most sterile-looking environment, you can usually find some signs of animal life. Most of the animals and animals signs your students find will likely be insects and other small invertebrates. All animals, large and small, need food, water, shelter, and space to survive.

Some habitats have the ability to support many types of organisms. The degree of variety among life forms present in a given ecosystem is known as “biodiversity.” Biodiversity in an ecosystem generally implies that the ecosystem is healthy; this is because biodiversity supports many ecological services that are beneficial to humans and other organisms. Water quality, air quality, erosion prevention, pollination, limiting the spread of disease, and carbon dioxide sequestration are all enhanced by biodiversity.

Ecologists conduct field surveys to inventory the species present in an area. Determining the number and type of organisms in a habitat helps ecologists determine the biodiversity of an area, but it is not reasonable to count every plant in the forest. To make a good estimate, an ecologist might use a transect, or a path along which the occurrence of certain species is recorded. Recording the species living along several transects in a given area can give scientists an estimate of biodiversity. Surveying the same transect over time can indicate changes in the biodiversity of an area. Ecologists working for the Middle Fork Willamette Watershed Council and partner agencies like the Forest Service and Bureau of Land Management conduct field surveys. Gathering and analyzing data on the number and type of species in a habitat helps resource managers determine if habitats are healthy or degraded, if restoration projects have been successful, and if invasive species are moving into an area (to name a few examples).

## Procedure

*Preparation*

In advance, find a site on the school grounds, preferably with some grass or other plants present, where students have space to spread out and locate their own microhabitat to study. Check for any safety hazards. You may want to do this activity in spring or fall when animals and animal signs are most likely to be seen. Make copies of the worksheet of your choice. A worksheet from Project Learning Tree and journal-sized activity pages are both included. Or, devise your own worksheet.

*Activity*

1. Tell students they are going to explore a habitat on the school grounds. They will first search for animals and animal signs moving in a large group with you as the leader. They will look carefully for signs of animals living or visiting there. When students discover animals or animal signs, they should tell the group so all can observe. Tell students that they will need to search carefully for the animals and that they will be more likely to find them if they are quiet. This is a good preparation activity for a field trip.

2. Lead the group to the area you selected for the microhabitat study. Tell students they will use a piece of string to encircle a small area of habitat – or, microhabitat. Ask students for ideas about where they might position their string. What might be a good place to find an animal here? What types of animals might they find? Pass out the pieces of string, plastic containers, hand lenses, and bug bottles. You may choose to have students work in pairs or groups of three. Materials can be divided in advance and placed in the plastic container for ease of distribution to the groups.

3. Give students time to select a microhabitat and complete the worksheet. Encourage them to carefully collect insects and other invertebrates they find and place them in the bug bottle or plastic container for a closer look.

## Assessment and Extension

1. Back in the classroom, have students share their findings. Ask the following questions: What animals did you observe? What evidence did you find of other animals? What do these animals need to live? What kinds of food might animals find around the schoolyard? Where might animals get water? What kind of shelter might animals find on the school grounds? Did you see any damage to habitats or unhealthy conditions for plants, animals, and people? Were those conditions natural?

2. Help students look for patterns in the data they collected. What organisms occurred the most among all groups? What organisms were the rarest? Where were these rare organisms found? Encourage students to be as specific as possible.

3. Extend the survey to a larger outdoor setting, such as a student's backyard. Students might focus their investigations by (1) looking for birds and tallying the number of different kinds, (2) looking for evidence of animals eating or being eaten by something else, (3) looking for evidence of animals using water, or (4) sketching trees and looking for evidence of how trees help animals and people. Consider returning to the schoolyard site to observe seasonal changes.

4. Help students learn more about the animals they found in the schoolyard. For example, they could research different animals found and create a class chart showing a picture of each animal and information about what it needs to survive. Compare the school grounds habitat with a local forest or

woodland. Do these two habitats have any animals, trees, or other plants in common? Make a guess: which one has a greater degree of biodiversity?

5. Ask students what kinds of animals they would like to see more of on school grounds. Have them do some research to find out what could be done to enhance the schoolyard habitat. Help students make a proposal, get permission from administrators, and put the plan into action. Ask the WEP Coordinator for assistance in coordinating a project.

*The following field trip activity can be adapted for use on school grounds:*

Transect Habitat Study (Instructor guide)

Animals and plants have adapted to live in certain habitats. They survive within limits of temperature, moisture, shelter, and any number of other factors making up their environment. Some plants and animals can adapt to a wide variation of factors. Other species have a very narrow range in which they can survive. A whale clearly cannot survive in a desert, but it is just as impossible for a bluebird to survive in a dense forest.

In this study we will work with the four forest layers: subfloor, forest floor, understory and canopy. The different forest layers provide habitat needs for a variety of wildlife species. Some animals use only one forest layer, while others use all four layers to get the things they need to live. (food, shelter, and water)

When a forester or wildlife biologist wants to study a forest, it isn't always practical to study the entire forest. Instead, they choose and study a series of plots that represent the surrounding forest. You are going to take the part of a forester or wildlife biologist and choose a survey plot to study.

Without going too far into the forest, choose a spot you would like to survey. Two people in your group will mark a transect (a straight line) using your 20' length of string: one person stands still, holding onto one end of the string, while the other person holds the other end of the string and walks in a straight line, keeping the string tight. Your study plot will include the area approximately two feet on each side of the string, from the subfloor to the canopy. Alternate method: the trail can serve as a transect, and students can survey habitat 2-3 feet on each side of the path.

On a blank sheet of paper or in your journal, write down or draw pictures of your observations of the forest layers (not all study sites will have all four layers).

When studying your site, look for the following:

plants * trees * moss * lichen * bugs/spiders

animals or signs of animals * rotting logs or stumps * roots

## Microhabitat Activity

Instructions

Working in pairs, choose a small area you would like to study. Use a piece of string to make a circle around the area. This is your **microhabitat**. Answer the questions below.

**1.** Think of words and phrases that describe your microhabitat. Tell about the location, condition, and appearance of the site. (Examples: Is it moist or dry? In the sun or shade? Near a stream? On a hill? At the base of a tree? On a dead log?)

_____

_____

_____

_____

**2.** What animals live in your microhabitat? You may lift up leaves and branches to see what lives beneath them. Record them below.

Draw one here:

_____

_____

_____

_____

_____

**3.** Estimate the number of different types of plants growing in your microhabitat. Circle the closest estimate.

Less than 5 5 to 10 10 to 20 Greater than 20

Choose 1 plant and draw a picture of it below. If you know the name of the plant, write it here: _____

Plants provide habitat for animals. Which of the following does your plant provide? (Hint: You may circle more than 1)

Food Water Shelter Oxygen

Below, write 3 animals that may use this plant for food or shelter. Circle if the animal uses it for Food or Shelter. (You may circle both)

_____ _____ _____

Food Shelter Food Shelter Food Shelter

**4.** Lastly, circle any of the following you see in the microhabitat.

Rotting wood Dead Leaves Animal Homes, Scat, or Tracks

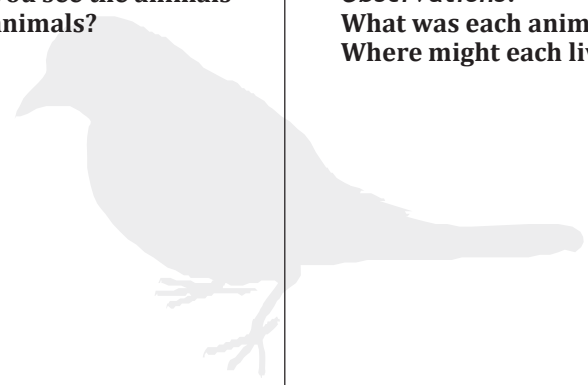
Soil Rock Moss Mushroom Lichen Other fungus

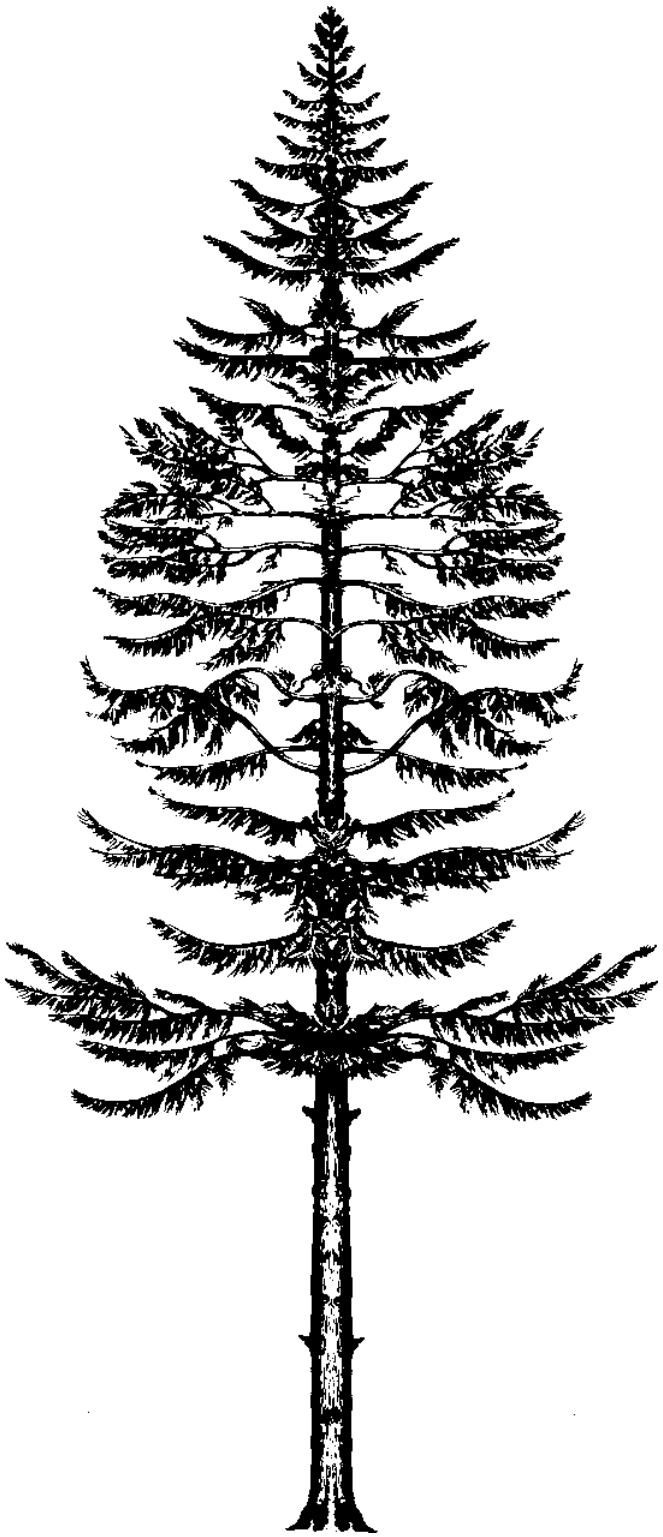
# Schoolyard Safari Survey

Name(s) _____ Weather _____

Date _____ Time _____

| ***What*** **animals or signs of animals did you see? Write or draw a picture of them.** | ***Where*** **did you see the animals or signs of animals?** | ***Observations:*** **What was each animal doing? Where might each live? etc.** |
|---|---|---|
| | | |





# Adopt a Native Tree

*Adapted from Project Learning Tree*

## Description

Students "adopt" a tree on the school grounds, observe changes in it over time, and learn more about the tree species native to the Middle Fork Willamette watershed.

### Grade Level
3rd-4th

### NGSS:
5,4-ESS3-1,2
3-LS3-1,2
3-LS4-2
4-LS1-1

### Materials
- Adopt a tree worksheet
- Field guides
- Hand lenses
- Bug bottles

*From classroom*
- Clipboards
- Pencils, colored pencils

### Setting
Classroom; schoolyard

### Concepts
Habitat
Organism
Native
Snag
Ecosystem
Life Cycle
Biodiversity
Seasons

## Goal
Students will understand the importance of native trees to other plants, animals, and people in our watershed.

## Objectives
As a result of this lesson, students will….
- Learn more about the native trees in the area
- Observe changes in a given tree over time
- Identify relationships between trees and other organisms
- Describe ways in which organisms depend on trees for survival

## Background
A habitat is the place where a plant or animal gets all the things it needs to survive, such as food, water, shelter, and space for having and raising offspring. A habitat may be 200 square miles for a mountain lion or a single plant for an insect. A tree may serve as part of an organism's habitat, or it may be the organism's entire habitat. For example, an Oregon white oak tree may provide food for western gray squirrels and nesting sites for a wide array of songbirds. Lichens and moss get everything they need to live by growing on the tree. Even snags, or standing dead trees, provide habitat for a number of different species. Tree frogs and beetles live under a snag's bark. Woodpeckers and other birds feed on the insects that live in snags. Nuthatches nest in natural cavities or cavities created by woodpeckers. Squirrels store food in them. Trees provide habitat when they are alive and when dead and rotting.

The different types of forests in our watershed provide habitats for native wildlife. Oregon white oak savanna and woodland habitats can support an amazing array of songbirds and other wildlife species. (If tree cover shades less than 50% of the understory and grasses are predominant, the ecosystem is considered a savanna. If trees grow more densely and shade over 50% of the understory, the ecosystem is considered a woodland).

The ability of a habitat to support many different types of organisms is known as "biodiversity." Oregon white oak habitats are being lost due to deforestation and fire suppression. White oak is a seral, or early successional tree – meaning that if an area goes undisturbed, white oak will naturally be overtaken by other tree species such as Douglas-fir. Historically, the Kalapuya tribe burned fields to start the cycle of succession over, keeping Oregon white oak savannas and woodlands intact to provide the habitat that their plant and animal food sources needed to remain plentiful. Oregon white oak savanna of the Willamette Valley is now considered one of the most endangered ecosystems in North America. In our watershed, Mount Pisgah Arboretum is home to a large-scale oak savanna conservation project.

In another forest ecosystem, Douglas-fir is the seral tree. Though a Douglas-fir tree can live to be 1000 years old or more, they seldom live over 500 in our watershed. The old growth forests in our area are prone to wildfire, and after several hundred years enough woody debris has built up to create a hot, stand-replacing fire. If not for wildfire, Douglas-fir forest would eventually be replaced by shade-tolerant Western hemlock. Western hemlock shades the understory, preventing sun-loving Douglas-fir seedlings from becoming established. Fire, strong windstorms, and logging created openings in the canopy and allow new Douglas-fir trees to grow. Old growth forest is a vital ecosystem in our watershed, providing habitat for many species including spotted owl, red tree vole, flying squirrel, and myriad migratory birds.

## Procedure

*Preparation*

1. Locate an area at the school with several trees that students can visit throughout the year. If at all possible, locate native trees such as Oregon white oak, Western redcedar, bigleaf maple, or Douglas-fir. The WEP Coordinator can assist you if needed.

2. Prepare worksheets for students. This activity can be done in an existing nature journal or as a separate project. There are two worksheet versions included with this lesson, and one is designed to fit in a half-sheet sized journal. Or, create your own customized journal pages.

*Activity*

1. Explain that each person will choose his or her own tree to adopt. You may choose to have students work in teams, particularly if there is a shortage of trees nearby. Students will observe their trees throughout the school year, or for however long you decide to conduct the activity.

2. Take students outside and pass out hand lenses and bug bottles. Instruct them to observe the tree closely as they complete the worksheet activities. Encourage them to use their sense of smell, touch, and hearing in addition to sight. Circulate to each student or group of students to help as needed. Have field guides available so that students can try to identify their tree species and any organisms they find living on or in the tree.

3. Back in the classroom, have students research more about their tree and the organisms they observed. Is the tree native to our watershed? Was it planted by people or growing here naturally? Ask students to identify how each plant and animal they found benefits from the tree, and any ways in which these organisms affect or benefit the tree in turn.

4. Return to the site one or more times. Have students record any changes they observe and complete additional activities related to their adopted tree. If you have access to a digital camera, have students take photos of their trees over time.

## Assessment and Extension

1. Review the concept of habitat with the class. Ask them to explain how their tree provides habitat. Direct the students to share the data they collected by completing the worksheet. Did they find anything in their observations of the tree that surprised them?

2. Have students make a poster of their drawings, photos, and the data from one or more of their worksheet activities. Direct students to make presentations to the class and post their work in the school.

3. Develop an idea for a service-project that will help benefit native trees in the watershed.

Adopt a Tree

What kind of tree is it? _____

Where is your tree? _____

Is your tree alive? Circle YES or NO. How can you tell?

_____

Write 3 words that describe your tree:

1.

2.

3.

Are any animals on or near your tree? Don't forget to look for insects, spiders, and other small animals. Write them below:

Are there any signs that animals have used your tree in the past? Look for holes, nests, and other signs. Write them below:

Can you fit your arms all the way around your tree? Circle YES or NO

# Adopt a Tree

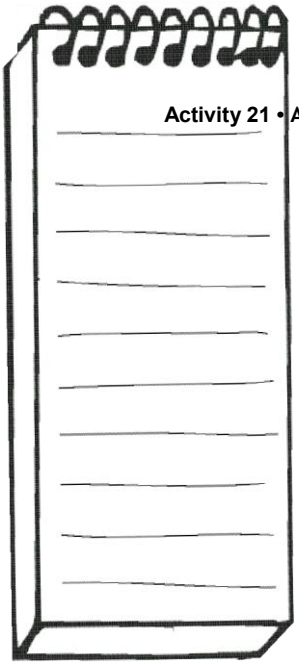
Give your tree a nickname. _____

Find a leaf from your tree and make a drawing of it below.

Use a crayon to make a rubbing of your tree's bark below.

On the back of this page, make a drawing of the entire tree.

**1.**



# Mind Your Macros

## Description

Students learn how to identify common aquatic macroinvertebrates and learn how finding certain critters can tell us about the quality of a stream.

### Grade Level

3rd-6th

### NGSS:

3-LS4-3

4-ESS2-1

### Materials

- Paper cut-outs of common macros, sorted into envelopes
- Sorting charts
- Stream life identification books

### Setting

Classroom

### Concepts

Indicator Species
Macroinvertebrate
Water Quality
Food chain
Food web
Salmon & Trout
Insect stages of development: Larva, Nymph, Adult
Biodiversity

## Goal

Students will understand the importance of healthy stream habitat in the Middle Fork Willamette watershed

## Objectives

As a result of this lesson, students will...

- Be able to identify several aquatic macroinvertebrates commonly found in the Middle Fork Willamette watershed
- Understand that the number and type of macros present in a stream can tell us about habitat health
- Know what an "indicator species" is and be able to name several stream indicator species
- Describe the vital role macros play in a stream ecosystem
- Be prepared for collecting and sorting macros in an actual stream in the watershed

## Background Info

There is more life in a stream than meets the eye. Aside from commonly known vertebrates that rely on streams – like fish, amphibians, reptiles, and birds – there is a world of organisms known as aquatic macroinvertebrates. A macroinvertebrate is a critter that lacks an internal spine and is large enough to be seen with the unassisted eye. Aquatic or benthic (bottom-dwelling) macroinvertebrates are an important part of the stream ecosystem for many reasons. They make up a vital link in the food web, moving nutrients from detritus (organic matter from decomposing organisms) and aquatic plants up the food chain to trout, salmon and eventually to the mammals, birds, and other animals that feed on them.

Some aquatic macroinvertebrates also have a story to tell. Certain species are sensitive to environmental stressors, such as high water temperatures and pollutants. These macros are known as indicator species because their presence signals to us the health of a stream. By analyzing the types and numbers of indicator species found in a stream, we can make a judgment about the stream's ability to support other sensitive species. In the Middle Fork Willamette watershed, these include spring Chinook salmon, fall and winter steelhead, and bull trout.

"Macroinvertebrates" is a general title for these organisms. What types of critters, specifically, might we expect to find in the Middle Fork and its tributaries? Different types of insects, snails, worms are common residents. The insects we find living underwater are in their juvenile, or larval, stage – living under, on and around rocks on the stream bottom. At first glance, these insect "nymphs" do not look like adult flies at all. They have no wings, and everything about them is adapted to life in a fast

moving stream. Though most of these critters have the word “fly” in their names, they actually live longer underneath the water, wingless and breathing through gills. Stoneflies, mayflies, and caddisflies are the three primary indicator species we look for.

Some macros (stoneflies, mayflies, caddisflies) are very sensitive to pollution while others are only somewhat sensitive. For this reason, macros are often classified into three separate groups: Group 1 = Pollution Sensitive, Group 2 = Somewhat Pollution Tolerant, and Group 3 = Pollution Tolerant. Finding a single individual of one species from Group 1 does not tell us as much about the stream’s health as finding several individuals from different species. The variety of species in an ecosystem is biodiversity. Biodiversity among aquatic macroinvertebrates – particularly among indicator species – is a good sign that the stream can support many other types of organisms further up on the food chain as well.

## Procedure

*Preparation*

1. Using the Watershed Rangers Mind Your Macros Kit, set up “stream stations” around the room. Each station, or cluster of desks, will have a group of 4-6 students. At each station, place an envelope of macroinvertebrates (the “stream sample”) and one copy of each identification chart (Group 1, Group 2, Group 3). On the board or projector, create a diagram similar to the one that follows to record results. Note: If preparing the envelopes of cut-out macros, yourself, make sure each envelope has a different ratio of macros from each group, i.e. one stream should be the “best,” with the most from Group 1 and a few from Groups 2 and 3, while the “worst” stream has only a few from Group 1 and many from Groups 2 and 3.

*Activity*

1. Tell students they will be learning how to identify and sort aquatic macroinvertebrates. Review background information by asking them: Why would we want to identify and sort macros in a stream? What does this tell us about the stream habitat? What is an indicator species? Ask them to look at the charts in front of them and name a species that could indicate a healthy stream. (It is important to note that, while Group 1 species tell us a stream is healthy, finding Group 3 species does not necessary mean the stream is unhealthy. Group 3 macros can survive in any stream conditions, so they are not indicators like those in Group 1). To prepare students for the identification process, you may wish to project one or two sample images of macros and go through identifying it as a large group. Ask students what physical traits to look for when trying to ID a macro. Does it have legs? How many? How can you tell the difference between legs and gills? Remind them that insects might be in the larval stage and look more like worms or caterpillars at first glance.

2. Instruct students that the envelope in front of them represents a stream sample of macros, and that each “stream” is of a different level of health. Their goal is to determine how healthy their stream is based on the sample. When told to begin, they will open the envelope and begin to identify and sort the macros they find. You may wish to have students each take several macros and then work in pairs to identify them, trading the ID charts among pairs as needed. One student in the group should act as a recorder to write down how many of each Group their “stream sample” contains.

3. When all the groups have finished sorting, record results on the board or projector. Each stream should have a slightly different distribution of macros from the three groups.

*Assessment and Extension*

1. Ask students which stream appears to be the healthiest. How can you tell? Which stream had the fewest Group 1 macros? What might that mean about the quality of that stream? Rank the

MIND YOUR MACROS Recording Chart

| NUMBER OF MACROS | Stream 1 | Stream 2 | Stream 3 | Stream 4 | …etc |
|---|---|---|---|---|---|
| GROUP 1 Pollution Sensitive | | | | | |
| GROUP 2 Somewhat Pollution Tolerant | | | | | |
| GROUP 3 Pollution Tolerant | | | | | |

"streams" in the class in order from Healthiest to Least Healthy. Have students explain their choices, giving special attention to any rankings that students may disagree upon. Explain to students that each stream had many different macros for the sake of the sorting exercise, but in real streams with high temperatures and pollution levels, they might only find a few different species, all from Group 3.

2. Ask students to explain what an "indicator species" is. Why aren't the macros in Group 2 and 3 useful as indicators?

3. Ask students if they think the water quality of a stream might vary at different points along the stream. When they go out in the field, how should they conduct the sample to account for any variations? (Take samples from areas with different flow and depth). Where might they be most likely to find macros from Group 1? (fast moving water, "riffles" – shallow areas where water moves quickly over gravel, creating air bubbles, cold water, gravel bottom rather than sand, etc.).

4. Sampling for macroinvertebrates can signal to us that a stream is degraded, but it cannot tell us the source of the degradation. How might we discover the source of the degradation? (Testing pH, temperature, dissolved oxygen, testing for contaminants like nitrates, bacteria, visual observations of the habitat, looking for signs of healthy stream habitat such as riffles, logjams, and stream side vegetation).

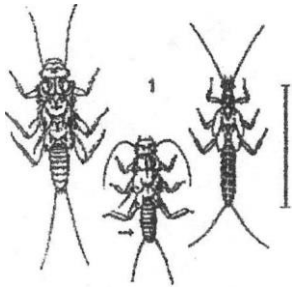
5. Ask students if they had difficulty identifying any of the macros in the envelope. If appropriate, walk through some identification tips to help students when they are in the field.

# Stream Invertebrates

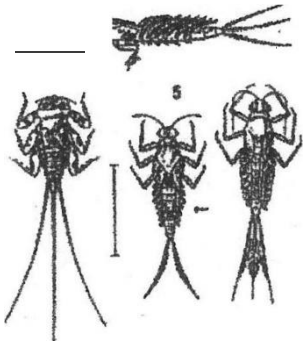
## Group1

*Pollution sensitive organisms*

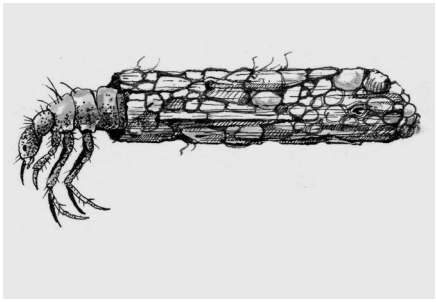
### Stonefly



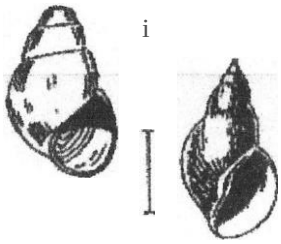
### Mayfly



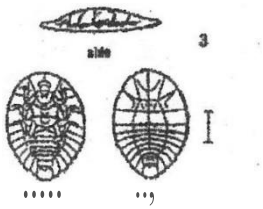
### Caddisfly



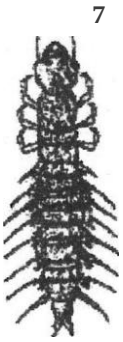
### Gilled Snail



### Water Penny



### Dobsonfly (Hellgrammite)



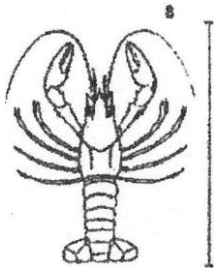
### Riffle Beetle

# Stream Invertebrates

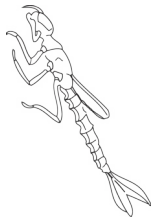
## Group 2

*Somewhat pollution tolerant organisms*

**Crayfish**

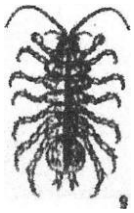


**Damselfly**

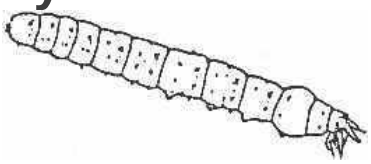


**Water snipe Fly Larva**

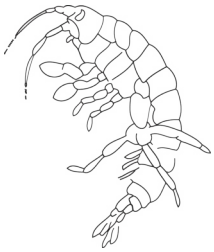
**Sow bug**



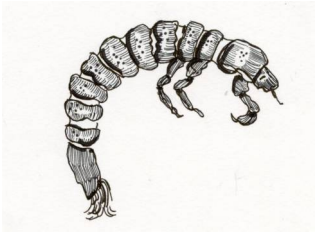
**Crane Fly**



**Scud**

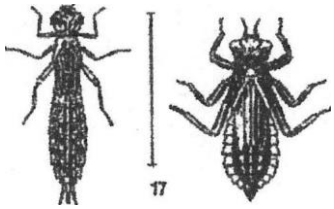


**Beetle Larva**

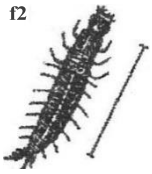


**Alderfly Larva**

**Dragonfly Larva**



Fish fly Larva



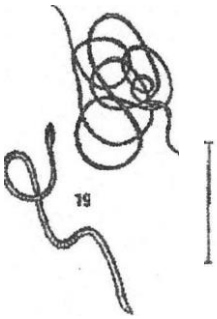
## Clam

# Stream Invertebrates

## Group 3

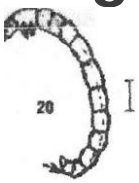
*Pollution tolerant organisms*

### Aquatic Worm

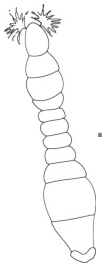



### Snails

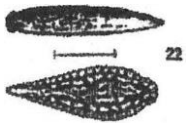

### Midge Fly Larva




### Blackfly Larva



### Leech



# The Great Middle Fork Race for Survival

*Adapted from Alien Invasion: Plants on the Move curriculum*

## Description

Students become plants in a race between native and invasive species.

### Grade Level

3rd-5th

### NGSS:

5,4-ESS3-1,2
3-LS3-1,2
3-LS4-2
4,5-LS1-1

### Materials

- Set of plant species cards
- Rope to mark off playing field
- Weed movement scenarios

### Setting

Classroom; gym or playing field

### Concepts

Native
Invasive
Exotic
Noxious
Adaptations
Competition
Propagate
Inhibit
Allelopathy

## Goal

Students will understand that many species of invasive plants threaten the health of habitats in the Middle Fork Watershed.

## Objectives

As a result of this lesson, students will….

- Learn that plants must compete for available resources, such as sunlight, water, and minerals and that these resources are finite.
- Understand how a wide range of adaptations enable invasive plants to establish themselves and out-compete native plants
- Understand some of the ecological, economic, and aesthetic consequences that occur when invasive plants dominate
- Become inspired to help restore native plants in the Middle Fork Willamette watershed

## Background

Many non-native plants grow in our watershed, and the same is true of most areas of the world. While native plants originally developed in a given region, non-native (exotic) plants have been transported either by natural forces - carried by animals, water, or wind - or introduced by humans. People introduce exotics either by accident or purposefully for ornamental or agricultural reasons. When a plant has the ability to out-compete natives and take over the landscape, it is considered "invasive." Invasive plants are able to do substantial harm to the ecosystem and economy of an area may be classified as "noxious" by management agencies. The adaptations of invasive plants enable them to out-compete native and crop species where soils have been disturbed. Some invasive plants have developed characteristics that provide them with reproductive and other advantages. These adaptive characteristics enable invasive to out-compete native plants, establish themselves, and persist in disturbed environments.

Not all invasive plants have developed all adaptive characteristics; however, all invasive plants are opportunistic, and invasive plants have a broad tolerance to a wide range of climate and soil conditions.

*Reproductive advantages*

The seeds of many weed species can germinate in a variety of environments. Invasive plants often grow and produce seeds rapidly, and invasive plants continue to produce seeds as long as the growing season permits. Consequently, invasive plants produce a large number of seeds. For example, a single purple loosestrife plant – a weed that occurs in the lower Middle Fork Willamette watershed – can produce millions of seeds in a single summer. Seeds from invasive plants often survive for many years, have a high rate of germination, have high seedling survival rates, and possess highly effective adaptations for dispersal.

Many invasive plants in the Middle Fork watershed have developed effective adaptations for seed dispersal. Himalayan blackberry produces many seeds, which are ingested by birds and other wildlife and carried long distances. Scotch broom seeds can remain viable in the ground for 50-100 years. False-brome produces a great quantity of seeds, and their size and structure allows them to be easily carried by the wind. Reed canary grass, another invasive grass in our watershed, produces a great number of seeds that are able to germinate immediately upon dispersal and have a high germination rate.

Many invasive plants have the ability to self-fertilize and cross-fertilize. Unspecialized visitors (pollinators that are not limited a certain type of plant) and the wind often pollinate weed flowers. Many invasive plants are annuals that complete their life cycles quickly. Some invasive plants can readily propagate without or in addition to producing seeds. Perennial weed species like English ivy and Japanese knotweed are capable of vigorous vegetative reproduction. English ivy can regenerate from a small piece of root or stem, and Japanese knotweed plants snap apart into small pieces that can be carried long distances via streams and begin
to grow wherever they land. Often, invasives that reproduce in this way have vegetative reproductive structures that can survive extreme conditions such as winter weather and flooding.

*Other advantages*
Many invasive plants grow rapidly and take hold early on in the season, accessing resources before native plants. This enables invasive plants to form a dense mat and disallow other plants from becoming reestablished. In our watershed, shining geranium, false-brome, reed canary grass, and English ivy are key examples. English ivy has creeping vegetative structures – roots and stems – that exude a sticky material and easily spread to new sources of water, nutrients, and sunlight. English ivy grows up tree trunks and can eventually kill individual trees by blocking the sun and weakening tree structure.

Some invasive plants species have extra-long roots, which enable them to easily access water and minerals, particularly in periods of drought. Scotch broom is an example of a local weed with a long taproot.

Other invasive plants are parasitic, deriving nutrients directly from host plants at the expense of the host plant. Still other invasive plants actually inhibit the growth of their competitors by releasing chemicals that effectively poison the soil. These chemicals prevent the normal growth of other plants. This phenomenon is known allelopathy. Scotch broom is an example of an allelopathic weed in our watershed.

As though icing on the invasive cake, the most noxious invasive plants have several of these hardy adaptations and are incredibly difficult to eradicate. Early detection is the key to stopping weed invasions before they become widely established.

## Procedure

*Preparation*
1. Select a location, such as a gym or playing field, to conduct the race. If needed, use cones or rope to set up a starting line and a finishing line that is about 50 feet from the starting line.

2. Tell students they are going to become plants in a race for survival. Give one plant species card to each student (card set included in Watershed Ranger resource kit). The kit includes 36 cards; if the group is substantially smaller than that, make sure that all the invasive plants named in the weed movement scenarios get passed out.

3. Ask students to line up at the designated starting line and explain the race. Show students the finish line. Tell them they must listen carefully to your directions to know how and when to move.

The race will end when you call it. More than one plant might reach the finish line, but all plants will not survive.

4. Begin reading the movement directions and proceed with the race. According to your instructions, students will stay where they are, step forward, or step backward.
*Note: Stress to them that when they take a step, it must be one normal-sized pace – no running or giant steps. If this becomes an issue and students are taking exaggerated steps to get ahead, you might try having them hop instead.*

5. After one or more students have reached the finish line, help students identify which are weed species. Read the names of the invasive plants aloud and ask students to raise their hand if they hear their weed name called. Most or all of the students across the finish line will be invasive plants. All students whose names are not called are native plants.

6. To play again, have the students line back up on the start line and pass their card to the student next to them. Make sure each student gets a new card. Read another scenario, or if you wish, the same scenario again.
*Note: After a couple of rounds, some students may catch on and intentionally try to get weed species cards so they can "win" the race. You may throw in a twist by reading an alternate scenario where Invasive plants are removed and the area is restored.*

## Assessment and Extension

Conclude the lesson by discussing the race with students and asking the following questions:

- Who won the race? Was it a fair race? Why or why not?
- Which plants were most successful, the non-native invasives or native species?
- Why were some species more successful than others?
- What are some of the characteristics that enabled invasive plants to succeed?
- When invasive plants win, what happens to other plants?
- What might be the consequences to animals and humans of a weed invasion?
- How was the race similar to and different from real life?
- What are some economic, ecological, and aesthetic consequences when invasive plants take over?

*Back in the Classroom*
1. The Weedy Word Match worksheet (attached) can be used as a quiz or extra exercise.

2. Ask students to draw an imaginary weed that possesses as many adaptive characteristics as possible. Students can name their weed and share their drawings in cooperative groups or in front of the entire class.

3. For a longer project, have each student choose a plant from the Middle Fork plant card set. Students can write journal entries or longer reports on their plants. Activities could include: a sketch of the plant, a description of the plant and where it is found, a statement of its importance to wildlife and/or people if native, and, if invasive, a statement of adaptive characteristics, how it was introduced, and how it can be controlled. Students' plant profiles can be compiled into a larger report or guide to plants of the Middle Fork Willamette watershed and presented at the school or shared with the watershed council.

| | | | |
|---|---|---|---|
| | survival | A | to stop something from continuing or developing to grow |
| 2 | inhibit | B | the release of chemicals by a plant to prevent other plants from growing nearby |
| 3 | native plants | C | a substance used in or produced by the process of chemistry that has a unique structure |
| 4 | parasitic | D | substances found in nature that are not plants or animals |
| 5 | propagate | | plants that originally grew, lived, or evolved in a particular place over time |
| 6 | allelopathy | F | staying alive; continuation of life or existence |
| 7 | chemical | G | living in or on another plant or animal, usually causing it harm |
| 8 | nutrients | H | part of a plant, such as a root, that enables the plant to reproduce without producing seeds |
| 9 | minerals | I | to reproduce |
| 10 | vegetative reproductive structure | J | substances that provide nourishment, such as the minerals a plant takes from the soil that keep it healthy and help it grow |

# Weed Movement Scenarios

Select an open area, such as a gym or field, in which to conduct the race. If needed, use cones or rope to designate a starting and finishing line. The playing field should be about 50 feet long and as wide as the line of students standing shoulder to shoulder at the starting line.

## Roadside Race Scenario

Make sure to pass out at least one of each of the following invasive species cards: false-brome, Himalayan blackberry, teasel, shining geranium, English ivy, garlic mustard, scotch broom, butterfly bush.

Read aloud the following scenario.

1. Each one of you has been transformed into a tiny plant seed. You are many different kinds of seeds from different kinds of plants. You are all lying along the same stretch of road in the Willamette National Forest. Some of you have been carried here by wind, some by animals, and some by people on their clothing, cars, or equipment. You have been lying dormant all winter. When this road was built last year, bulldozers disturbed the soil, making it ideal for invasive plants to get established here. The events I am about to describe represent one year in a plant's life. All of you will not survive the year. Listen carefully to the instructions and when I tell you to step forward or backward, take normal walking steps.

**2.** It is early spring. Rain, snowmelt, warm temperatures, and long days result in rapid plant growth. Seeds that have lain dormant all winter start to sprout. **Everyone step forward 4 steps.**

**3.** The soil along this new roadbed contains many more seeds from some types of plants than others. **False-brome, Himalayan blackberry, and teasel, step forward 4 steps.**

**4.** The growing season continues to be favorable. **All plants step forward 6 steps.** Some plants grow more quickly than other species. **Shining geranium, English ivy, and garlic mustard, step forward 3 steps.**

**5.** A few species are capable of producing chemicals that they release into the soil. These chemicals inhibit the growth of nearby plants. **Any plant within four steps of Scotch broom and garlic mustard, step backward 2 steps.**

**6.** As the growing season continues, drought hits this area and plant growth slows. Drought-tolerant plants and plants with long taproots do best. **Butterfly bush, teasel, and Scotch broom step forward 2 steps.**

**7.** Summer storms and slightly cooler temperatures improve growing conditions for all plants. **All plants step forward 4 steps.**

**9.** English ivy, raise your hand. This plant sends out long, creeping stems that climb trees and form a dense mat of vegetation, choking out other plants. **All plants within two steps of English ivy, step backward 3 steps.**

**10.** Plants continue to grow, but shorter days slow growth. Much plant energy is now devoted to food storage and seed production. **All plants step forward 2 steps.**

**11.** Some plants release seeds. Those that are able to send their seeds long distances help ensure their success by finding new areas in which to grow. Himalayan blackberry, your berries are eaten by birds who later deposit the seeds far away. False-brome, your seeds are carried long distances by the wind. **Both of these plants take 5 steps forward.**

12. End the game after one or more students have crossed the finish line.

## Riparian Race Scenario

Use at least one of the following invasive species cards: Japanese knotweed, false-brome, Himalayan blackberry, reed canary grass, purple loosestrife, garlic mustard, shining geranium, scotch broom, English ivy

1. Each one of you has been transformed into a tiny plant seed. You are many different kinds of seeds from different kinds of plants. You are all lying along the same stream bank on a tributary of the Middle Fork Willamette River. Some of you have been carried here by wind and some by animals, but most of you have been carried here by the stream. The stream flooded its banks this winter, and the powerful current brought you and many other seeds and parts of plants with it. As the water level went back down, you were deposited on the land next to the stream. This area is called the "riparian zone." The events I am about to describe represent one year in a riparian plant's life. All of you will not survive the year. Listen carefully to the instructions and when I tell you to step forward or backward, take normal walking steps.

**2.** It is early spring. Rain, snowmelt, warm temperatures, and long days result in rapid plant growth. Seeds that have lain dormant all winter start to sprout. **Everyone step forward 4 steps.** Japanese knotweed, your stems and roots can snap into small pieces and are carried downstream, where they take root in new locations. **Japanese knotweed, take 2 more steps forward.**

**3.** The soil along this stream contains many more seeds from some types of plants than others. **False-brome, Himalayan blackberry, and reed canary grass, step forward 4 steps. Purple loosestrife, step forward 6 steps.**

**4.** The growing season continues to be favorable. **All plants step forward 6 steps.** Some plants grow more quickly than other species. **Reed canary grass, Japanese knotweed, garlic mustard, shining geranium: step forward 3 steps.**

5. A few species are capable of producing chemicals that they release into the soil. These chemicals inhibit the growth of nearby plants. **Any plant within four steps of Scotch broom and garlic mustard, step backward 2 steps.**

**6.** As the growing season continues, drought hits this area and plant growth slows. Well-established plants out-compete others for water and nutrients. **Japanese knotweed and reed canary grass, and step forward 2 steps.**

**7.** Summer storms and slightly cooler temperatures improve growing conditions for all plants. **All plants step forward 4 steps.**

**9.** English ivy, raise your hand. This plant sends out long, creeping stems that can climb trees and form a dense mat of vegetation, choking out other plants. **All plants within two steps of English ivy, step backward 3 steps.**

**10.** Plants continue to grow, but shorter days slow growth. Much plant energy is now devoted to food storage and seed production. **All plants step forward 2 steps.**

**11.** Some plants release seeds. Those that are able to send their seeds long distances help ensure their success by finding new areas in which to grow. Himalayan blackberry, your berries are eaten by birds who later deposit the seeds far away. False-brome, your seeds are carried long distances by the wind. **Both of these plants take 5 steps forward.**

12. End the game after one or more students have crossed the finish line.

# Forests and Fir

## Description

Students learn about the role of fire in Middle Fork Willamette watershed forests then create matchstick forests and observe how they burn.

### Grade Level

5th-6th

### NGSS:

5,4-ESS3-1,2

3-LS3-1,2

3-LS4-2

5,4-LS1-1

### Materials

- Playdough
- Cake pans
- Matches
- Butane lighter
- Fire scenario cards

*From classroom*

- Container of water for safety

*Optional*

- Grass, paper, other dry tinder

### Setting

Classroom, schoolyard

### Concepts

Forest
Old growth
Fire Ecology
Succession
Climax Forest
Shade-tolerant
Disturbance
Windthrow

## Goal

Students will understand that naturally occurring fire is crucial to the ecology of our old growth forests.

## Objectives

As a result of this lesson, students will…

- Learn that fire is a natural occurrence
- Understand the importance of wildfire in the old growth forests of our watershed
- Describe the effects of fire suppression on forest composition
- Learn what is meant by the terms "succession" and "climax forest"
- Create and burn a model forest based on a realistic scenario for our watershed

## Background

Fire is a natural occurrence. From an ecological standpoint, fire is neither "good" nor "bad." Some forests depend on fire to recycle nutrients back into the soil in the form of ash. Fire is an essential component in the life cycle of several tree species. Some, such as the Lodge pole pine, depend on the heat of fire to open their cones and release the seeds, while others like Douglas-fir simply need fire to open the forest canopy to provide light. Fires also help control disease by lowering the insect population.

Fires need heat, fuel, and oxygen to burn—these three elements are known as the "fire triangle." Remove any one of these three elements and the fire will not burn. Initially, the heat is provided by the source of ignition. Fire occurs naturally through lightning strikes in the presence of dry fuel. Fuels include dry trees, dead trees and limbs, leaf litter, and dry grass. Fires also occur when humans start them intentionally or accidentally. Weather conditions have a great influence on when fires occur and how they spread. Hot temperatures and dry winds can dry out trees and grasses in a forest, making them available as fuel for a fire to consume. The stronger the winds, the more quickly moisture evaporates from the vegetation and the faster the fire can spread.

Even in the largest forest fires, not everything burns. Patterns of burned areas across the landscape can help keep the ecosystems healthy. Areas that have recently burned do not have much fuel or dry dead litter, and they are less likely to burn again soon. *Adapted from Project Learning Tree*

Fire is a natural and necessary event in the old growth forest of the Middle Fork Willamette watershed. Many may think that old growth forests contain trees of all ages, from venerable giants in excess of 1000 years old to seedlings several years old. This sort of stand structure is not common in the

fire-prone Douglas-fir forests of the Cascade Mountains. In a typical 400-year-old Douglas-fir forest there may be many young understory tree seedlings, such as Western hemlock, and there may be some larger Western hemlock and Western redcedar from one to several hundred years old that grew up in canopy openings created by wind throw (trees uprooted in storm events). The occasional ground fires that occur would typically remove this understory tree component. The overstory Douglas-fir are usually all around the same age, or if the area reforested gradually due to a severe disturbance or lack of adequate seed sources, they may vary in age by about 50 years. Due to the relatively frequent occurrence of fire in the Douglas-fir ecosystem in our region, stands of trees seldom get to be more than 500 years of age. As these forests age, individual trees die or are blown over, and large amounts of fuel accumulate on the forest floor. When wildfire comes to that particular forest stand, it burns so hot that the whole stand of trees is killed.

This may seem violent, yet fires and other major disturbances maintain Douglas-fir as the dominant species and cultivate old growth forest. In our watershed, a mature Douglas-fir old growth stand may have many Western hemlock and some Western redcedar seedlings in the understory – yet almost no Douglas-fir seedlings. This is because Douglas-fir is a sun-loving tree and its seedlings cannot survive the deep shade of the old growth understory. When a mature tree dies or is blow over, an opening is created in the canopy. Hemlock and redcedar seedlings have a head start over Douglas-fir, and the increased sunlight allows them to grow up into the canopy. If no major disturbance occurs, Douglas-fir will eventually die out and Western hemlock will become the dominant tree. This process is known as "forest succession," and the forest type that succeeds all others is the "climax forest." A stand-replacing wildfire essentially allows the forest to start over. Faster growing Douglas-fir seedlings gain access to sun and are able to become reestablished. The cycle begins anew.

In addition to the aesthetic and spiritual values they hold for us humans, Douglas-fir old growth forests in particular provide habitat for a number of plant and animal species that either tend not to occur in younger forests or occur less abundantly elsewhere. This habitat is provided by the protection from sunshine and wind that the deep and dense tree canopies provide, as well as the physical structures for nesting, hiding, and plant growth provided by standing and down dead trees, thick bark, complex crown structures and heavy branches, and undisturbed duff and litter layers. Old growth trees also may provide a record of past climate and fire occurrence in their many annual growth rings. Older forests provide for stream protection and input of large down wood to the stream system that creates more complex aquatic habitat, shading of stream waters to keep them cool, and filters for sediments. Old growth Douglas-fir forests contain some of the highest amounts of stored biomass of any ecosystem on earth.

## Procedure

*Preparation*

Introduce students to the concepts in the Background section above. Describe the relationship between Douglas-fir old growth forest and fire. Students should have an understanding of what succession means, why Western hemlock and Western redcedar are climax trees, and how fire affects old growth forest succession.

*Activity*

1. Divide students into 4 groups. (There are 4 fire scenarios. If you have a large class you can create more groups and assign the same scenario to two groups. It is ideal to have no more than 4 students in a group). Give each group a cake pan and a container of playdough.

2. Give each group a Forest Scenario card. Instruct the teams read the scenario aloud to each other and begin to build a forest floor by shaping the playdough. The terrain could be flat, sloped,

disconnected, etc. While students work on this, circulate around the room and pass out 20-30 matches to each group. Students will push the matches into the clay to create the forest in their scenario. Instruct each group to read the scenario closely; they may break matches in half or use the excess tinder if appropriate to the scenario. Emphasize that students are not to light the matches themselves.

3. Give the teams time to design their forests. Circulate to each group and have students describe to you what is going on in their forest. Offer guidance as needed.

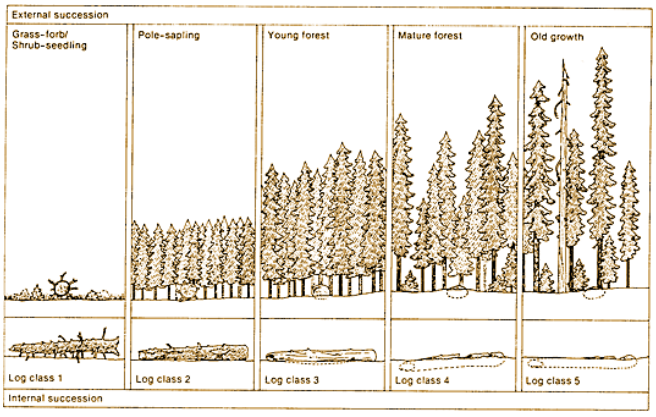
4. When the teams are done, take the class outside to a location far from vegetation and anything flammable. Ask the first team to come forward. Ask them to describe how they think the forest will burn. Why? Ask the rest of the class if they agree. With the butane lighter, light one match, as though a random lightning strike. Observe and discuss. Repeat until all the forests are burned.

## Assessment and Extension

1. Back in the classroom, spark a discussion. Ask students to analyze the results of the experiment. What conditions affected the way the forests burned? Were they surprised at the results? Why or why not? Were the hypotheses about how forests would burn correct?

2. Ask students any of the following: How does fire suppression affect Douglas-fir old growth forest? What other disturbances occur in old growth forest? (windthrow, logging) Why do you think fires might occur more frequently in our watershed than in areas further north? (climate, drier summers) What natural conditions might affect wildfire intensity and speed of spreading? (wind, hot temperatures, dry fuel, excess fuel, slopes)

3. Ask students to give pros and cons of fire suppression. Have students imagine they were responsible for making the decision to let a forest burn or put a fire out, and ask what they would decide. Stress the importance of striking a balance between human needs and the needs of nature.



Instructor Guide

1. Create a stand of an old growth Douglas-fir forest that has not burned for over 500 years. There are smaller shade-tolerant trees (Western hemlock) and many fallen dead trees (snags) in this type of forest.
*How might the hemlock grow around the Douglas-fir? Will there be more hemlock trees or Douglas-fir trees? Which ones are larger?*

2. Create a stand of old growth Douglas-fir forest on a steep hillside. There are smaller shade-tolerant trees (Western hemlock) and many fallen dead trees (snags) in this type of forest.
*How might the hemlock grow around the Douglas-fir? Will there be more hemlock trees or Douglas-fir trees? Which ones are larger?*

3. Create a young forest growing back after a stand-replacing fire in an old growth forest. The plants and trees in this forest are densely established and competing for water, nutrients, and light. They grow in and around snags, the dead remains of trees that burned.
*With exposure to full sun, what types of plants and trees may be growing here?*

4. Create a stand of forest on its way to becoming an old growth forest. The Douglas-fir trees here are young – about 100 years old. They compete with each other and the other trees for space and resources (water, nutrients, light).
*Do they grow close together, or far apart? Have shade-tolerant trees had a chance to get established?*

Follow up Questions:

How does hillslope affect fire? What other factors can affect the size and strength of a fire? *Heat, wind, dryness, amount of fuel, type of fire (crown, ground, etc)*
What would happen if there was no fire in the Doug-fir old growth? *hemlock climax*
How does fire help Doug-fir get reestablished? *Allows sun, clears out competitors*
Why is old growth forest important? *Habitat, biodiversity*
What are some other positive impacts of fire? *Controls pests – disease, bugs, returns nutrients to the soil*

**GROUP 1**
Create a stand of an old growth Douglas-fir forest that has not burned for over 500 years. There are smaller shade-tolerant trees (Western hemlock) and many fallen dead trees (snags) in this type of forest.

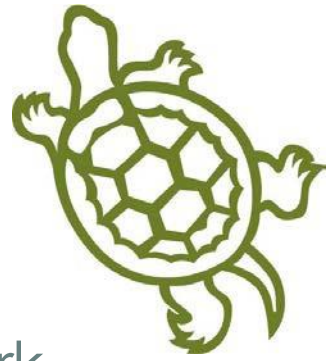
**GROUP 2**
Create a stand of old growth Douglas-fir forest on a steep hillside. There are smaller shade-tolerant trees (Western hemlock) and many fallen dead trees (snags) in this type of forest.

**GROUP 3**
Create a young forest growing back after a stand-replacing fire in an old growth forest. The plants and trees in this forest are densely established and competing for water, nutrients, and light. They grow in and around snags, the dead remains of trees that burned.

**GROUP 4**
Create a stand of forest on its way to becoming an old growth forest. The Douglas-fir trees here are young – about 100 years old. They compete with each other and the other trees for space and resources (water, nutrients, light)

# Field Guide to the Middle Fork Willamette Watershed


An in-depth look at the unique environments & natural resource challenges in our watershed



# Field Guide to the Middle Fork

## What is a Watershed?

A watershed is an area of land that collects and runs off or holds water, then passes that water on through the water cycle, typically through groundwater, streams and rivers, to a larger body of water. We concentrate on watersheds as a physical reference area so we may effectively create a potential 'boundary of responsibility' for citizens and government agencies to focus on their local water quality, water quantity, population pressures, natural resource management, wildlife and habitat issues. In our region, the 'upper watershed' is the area of land in the high elevations, where fewer people, industry and infrastructure typically exist. The Middle Fork Willamette upper watershed is characterized 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 'lower watershed' is typically along the valley floor, where roads, communities, infrastructure and larger order rivers and creeks exist. Our lower watershed is characterized as the *Willamette Valley Ecoregion*.

### What is a Watershed Council?

Watershed councils are locally organized, voluntary, non-regulatory groups established to improve the conditions of watersheds in their local area. Watershed councils create a forum that brings local property owners and residents, concerned citizens, and private land managers together with local, state, and federal land management agencies to form a common vision for the ecological and economic sustainability and livability of their watershed.

## Getting to Know the Middle Fork Willamette Watershed Council

Our purpose is to serve as a volunteer-based partnership of diverse watershed stakeholders that focuses on promoting sustainability and making the Middle Fork Willamette Watershed a better place to live, work, and visit for now and future generations. We work together as a community to restore and sustain the ecological integrity and economic viability of the Middle Fork Willamette Watershed and to promote local control of our future by providing effective voluntary solutions to watershed issues. Our origins date back to early 1998. A council operating charter was developed during the summer and fall of 2000, and the Lane County Board of Commissioners formally recognized the Middle Fork Willamette Watershed Council on November 21, 2000. Some of our key partners and projects are profiled in this Field Guide

Goals of the Middle Fork Willamette Watershed Council include:

- Maintain and enhance overall water quality.
- Gather, verify, and share information on present and historical watershed conditions.
- Protect and advocate for healthy riparian habitat.
- Conserve and restore native fish, wildlife, and vegetation throughout the watershed.
- Promote awareness, communication, education, learning, and participation among all people and interests within the watershed.
- Serve as a technical, financial, and educational resource for individuals and groups who wish to get involved in restoration and enhancement of the watershed.
- Develop an integrated and comprehensive watershed management program, which includes biennial Work Plans focused on maintaining, enhancing, and monitoring watershed health.
- Advocate for the social and economic stability of the communities within the Middle Fork Willamette watershed.
- Promote the mission, purpose, and goals of the Middle Fork Willamette Watershed Council to regional, state, and national officials.

*MFWWC Identification and Prioritization of Key Issues*

Human activities and impacts upon the watershed are dynamic. We constantly learn more about how to best build, live and coexist with our unique environment. We are also always learning more about the impacts of our human activities, so research, education and outreach are foremost critical activities of a watershed council. In its 2002 assessment of the lower watershed, the MFWWC evaluated watershed conditions and identified key issues. The MFWWC used the assessment results to develop a prioritized, five-year action plan for restoration, water quality, and education in the lower watershed, where most of the private land in the watershed occurs.

The MFWWC has recently launched a second prioritization process: the fish passage database and prioritization project. While the project focuses on prioritizing fish passage improvement projects, the data and GIS maps will be used to prioritize sites for other habitat restoration efforts as well. The MFWWC keeps track of new data and insights from other sources of information and assessments from the upper watershed, monitoring data, etc. As pressing resource management issues arise, such as increases in illegal dumping or the new discovery of a Japanese knotweed epicenter, the MFWWC adjusts its priorities accordingly.

Restoration Priorities and Goals of the MFWWC (in order of priority)

1. Increase stream side shading along high priority riparian areas; connect and extend the intact areas of floodplain forest; and promote large wood recruitment potential.
2. Restore fish passage and access to high quality aquatic habitat throughout the watershed.
3. Control and eradicate invasive plants in high priority sites throughout the watershed.
4. Maintain and restore the habitats of endangered, threatened, and sensitive species.
5. Promote efforts to restore the Middle Fork Willamette River's connection to the floodplain.
6. Restore oak savanna habitat at high priority sites.

# Overview of the Middle Fork Willamette Watershed

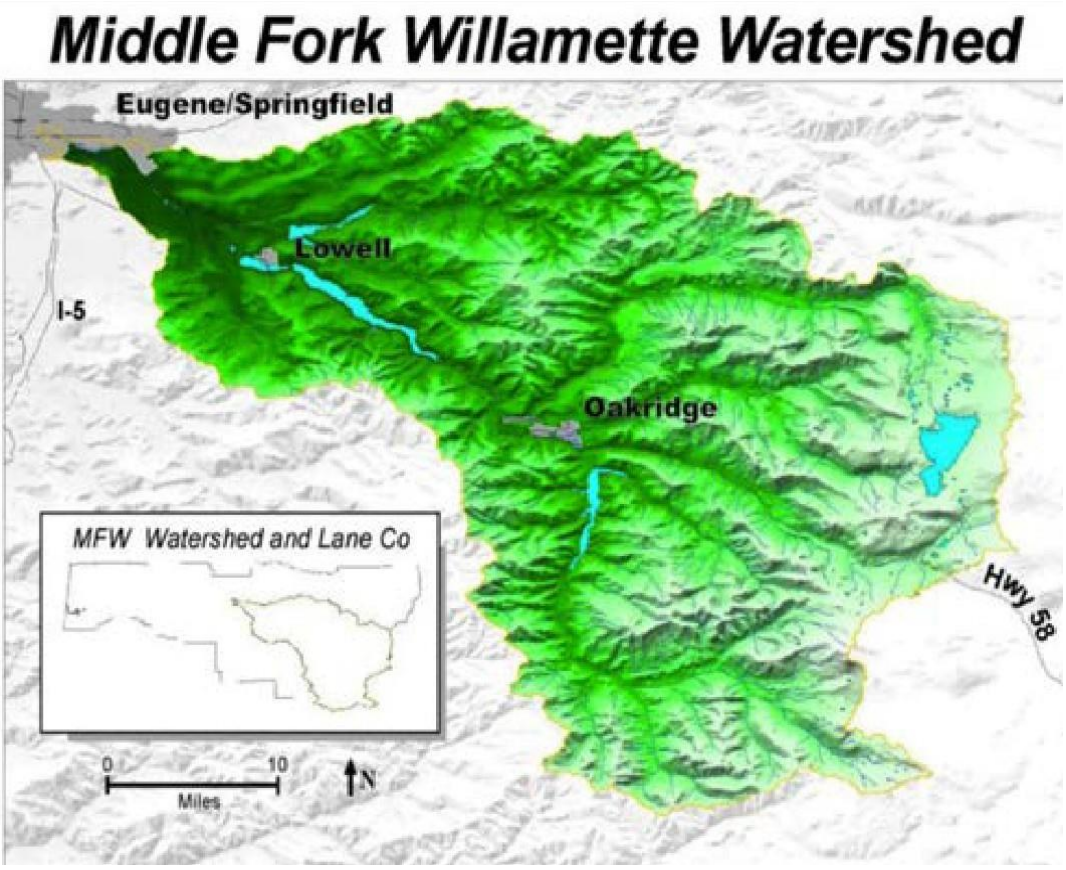
## OUR LAND ACKNOWLEDGMENT

*The area we know as the Middle Fork Willamette Watershed covers land and water that is honored and stewarded by the Winefelly, Molalla, Yoncalla, Tenino, and Klamath nations. The US Government forcefully removed them from this land following treaty negotiations between 1851-1855, culminating with the signing of the Willamette Valley Treaty in 1855. Now, many descendants of these nations are citizens of the Confederated Tribes of Grand Ronde Community of Oregon, Confederated Tribes of Warm Springs, Confederated Tribes of the Siletz Indians, and Klamath Tribes and continue to make important contributions in their communities and across the land we now refer to as Oregon. This acknowledgement demonstrates our commitment to a process of dismantling ongoing colonialism. We strive to uplift Indigenous voices and honor Indigenous values and history through our evolving work in habitat restoration, youth education, and community engagement.*

The Middle Fork Willamette Watershed (MFWW) covers an area of approximately 1,363 square miles on the western slope of the Cascade Mountains to the floor of the Willamette Valley. The watershed is located in the older, deeply eroded Western Cascades portion of the Cascade Mountain complex. The region's boundaries are marked by the snow-covered peaks of the High Cascades to the East, and the Willamette River valley on the west. The headwaters of the Middle Fork Willamette River (MFWR) originate in the Diamond Peak and Waldo Lake Wilderness areas on the Willamette National Forest. The Middle Fork Willamette watershed covers 865,920 acres southeast of Springfield, Oregon, and includes 1,342 stream miles. Characteristics throughout much of the area include the steep ridges, narrow valleys and volcanic soils, which typify the western slope of the Cascades. The area shows effects of glacial scouring and erosion from Ice Age activity that followed earlier volcanic activity. Some volcanic cones and lava flows are covered by forest. Past glaciation and active stream erosion created a dramatic landscape of steep stream reaches in the higher elevations and flatter, wide floodplains in the lower elevations.

The Middle Fork Willamette River is located in the southeastern portion of the larger Willamette Basin complex and drains the Cascade Range. The dynamic physical environment, including climate and weather, flooding, erosion, and deposition create habitat and provide the foundation for complex biological systems and interactions. Our unique ecosystems and habitats are adapted to and supported by the physical processes of the west Cascades and the Middle Fork Willamette River and its tributaries, terrain, temperature, soils, hydrology.

The MFWW is dominated by forestry land use in the uplands; however, land uses change to other industry, residential, agriculture, and public services in the lower elevations and on the wide, more fertile floodplains. Towns are oriented to the main stem of the Middle Fork of the Willamette River valley, along Highway 58 from Eugene/Springfield to Oakridge. Flat land is



hard to come by in our mountainous watershed, so agriculture is not widely seen. The Lower Middle Fork Willamette, just east of Springfield, has the highest concentration of both agriculture and population. The political jurisdiction of the watershed is within Lane and Douglas Counties. The communities of Westfir and Oakridge are in the upper watershed (upper elevations), and the lower watershed includes the communities of Dexter, Lowell, Jasper, Fall Creek and portions of Pleasant Hill and Springfield. The population of the watershed is approximately 24,000 people.

Approximately 70% of the land within our watershed is public and 30% private. The watershed basin is dominated by forested land use with some agriculture and residential land use in the lower basin. Of the public lands, ownership is about 85% federal, most of that managed by the Willamette National Forest (USFS), United States Army Corps of Engineers (USACE), and the Eugene Bureau of Land Management (BLM). Small, private landholders and industrial timber companies operate throughout the remainder of the basin. Virtually all private land is concentrated in the lower watershed in the communities of Fall Creek, Little Fall Creek, Jasper, Lowell, Dexter, Lost Creek and Pleasant Hill.

## Lakes and Streams

The Middle Fork Willamette River flows into the Willamette River at its mouth at RM 186. The Middle Fork Willamette watershed includes the following smaller creeks: Fall Creek, Winberry Creek, Hills Creek, Swift Creek, Little Fall Creek, Lower Middle Fork Willamette River, Middle Fork Willamette/Lookout Point, North Fork of Middle Fork Willamette, Salmon Creek, Salt Creek / Willamette River, Upper Middle Fork Willamette River, and Lost Creek. The wild and scenic North Fork of the Middle Fork Willamette and pristine Waldo Lake lie within the Middle Fork Willamette watershed. The MFWW basin also has four man-made reservoirs: Fall Creek, Dexter, Lookout Point, and Hills Creek.

Waldo Lake, the headwaters of the wild and scenic North Fork Middle Fork Willamette River. This pristine lake is fed only by groundwater, which is purified as it filters through the surrounding lava rock.

Creeks, streams and rivers in the higher elevations experience different causes of peak instream flows than the ones in the lower elevations. Rainstorms are the dominant cause of runoff in areas below 2300 feet elevation. Above 2300 feet, a significant amount of snow accumulates in winter. When warmer rains land on snowpack and rapidly melt snow, this creates the highest stream levels - or 'peak flows' - in the region. This phenomenon is known as rain-on-snow. Highest elevations collect massive amounts of snow and store it until spring. When temperatures warm up in spring, snow melt also increases stream flow and runoff in the high elevations, but this does not create the highest 'peak flows' we see in winter from rain-on-snow.

*Dams and Reservoirs*

The operation of four large dams in the Middle Fork Watershed brings a social benefit to people, as it significantly diminishes the risk of catastrophic flooding. When first completed, flood protection from dams and reservoirs across the West helped our region grow economically, protecting the highways and railroads from the west Cascades to the interior of the United States which served as "lifelines" for isolated Oregon.


Lookout Point Dam near Lowell.

From an ecological standpoint, dams and reservoirs greatly alter the historical function of the river. The impacts of altered natural river flow regimes by dams and reservoirs are examined extensively in the watershed, and improving instream and floodplain habitat is a major focus of ecological restoration activities. The dams are designed for flood mitigation, and as such they are very effective at reducing peak flows and the amount of time floodplains are underwater. Since the dams were built, peak flow volumes of the Middle Fork Willamette River have been reduced to 25-30% of historical volumes. Through regulation, dramatic flood discharge that may have naturally occurred is now regulated to 'bankfull flow,' or the maximum amount of water a stream channel can hold without overflowing.

Changes in the timing and magnitude of floods have affected the establishment of pioneer plant species such as cottonwoods and reduced the formation of side channel habitat, which provides fish with foraging areas and refuge from high flow events. The dams have altered the links between the upper and lower watersheds, reducing the transport and delivery of large wood and substrate to downstream reaches. Dams and reservoir operations also affect stream temperatures. The release of water from reservoirs may increase downstream temperatures as the heat held by the impounded water is also released. This can be a threat to the survival of native fish species, which require cold-water habitat. Relative to the lower watershed, the area above the dams have aquatic habitat that is closer to the historic baseline, with the highest proportion of functioning riparian areas, largest amounts of large wood in the river and tributary channels, and the highest-quality fish spawning areas. For migratory fish species, dams restrict access to these areas and limit spawning and rearing ability. More about salmon, steelhead, and bull trout can be found in the section entitled 'Endangered and Threatened Species' on page 11.

## Forests

There are four basic forest types in the watershed: Douglas-fir dominated (with some western hemlock and western redcedar), mixed conifer (which contains Douglas-fir, grand fir, sugar pine, incense cedar, and ponderosa pine), Pacific silver fir, and mountain hemlock. These are general categories; all tree species often occur as minor components in other types. Douglas-fir is an especially long-lived tree and can grow to be as old as 1000 years. If a Douglas-fir forest is not disturbed by fire, windthrow, or insects and diseases over its life, Douglas-fir trees will eventually be replaced by species such as western hemlock and western redcedar since the seedlings of these species are tolerant of the shade produced by mature trees. This forest of shade tolerant species is called a climax forest, since these species can theoretically regenerate themselves in

perpetuity. Douglas-fir seedlings and saplings cannot survive to maturity underneath an intact canopy of their parent trees; they need a rather large opening in the forest, typically as wide as the dominant trees are tall, to get enough sun to grow vigorously in height.

*Old Growth Forests*

Many may think that old growth forest contains trees of all ages, from venerable giants in excess of 1000 years old to seedlings several years old. This sort of stand structure is not common in the fire-prone Douglas-fir forests of the Cascade Mountains. In a typical 400-year-old Douglas-fir forest there may be many young understory tree seedlings, such as western hemlock, and there may be some larger western hemlock and redcedar from one to several hundred years old that came into canopy openings created by past windthrow. The occasional ground fires that may occur would typically remove this understory tree component. The overstory Douglas-fir are usually all around the same age, or if the area reforested gradually due to a severe disturbance or lack of adequate seed sources, they may vary in age by about 50 years. Due to the relatively frequent occurrence of fire in the Douglas-fir ecosystem in our region, stands of trees seldom get to be more than 500 years of age. As these forests age, individual trees die or are blown over, and large amounts of fuel accumulate on the forest floor. When wildfire comes to that particular forest stand, it burns so hot that the whole stand of trees is killed.

Fungi serve a crucial role in the old growth forest, converting nitrogen from decaying matter into a form trees can use to grow.

In addition to the aesthetic and spiritual values they hold for us humans, Douglas-fir old growth forests in particular provide habitat for a number of plant and animal species that either tend not to occur in younger forests or occur less abundantly elsewhere. This habitat is provided by the protection from sunshine and wind that the deep and dense tree canopies provide, as well as the physical structures for nesting, hiding, and plant growth provided by standing and down dead trees, thick bark, complex crown structures and heavy branches, and undisturbed duff and litter layers. Old growth trees also may provide a record of past climate and fire occurrence in their many annual growth rings. Older forests provide for stream protection and input of large down wood to the stream system that creates more complex aquatic habitat, shading of stream waters to keep them cool, and filters for sediments. Old growth Douglas-fir forests contain some of the highest amounts of stored biomass of any ecosystem on earth.

*Riparian Forests*

Riparian forests are the forests along the river valley floor and in the floodplain zones. Prior to regulation of flood regimes by dams in our area, the Middle Fork Willamette River lower elevation riparian valley areas were dominated by black cottonwood, red alder and willow forests. These hardy pioneer species are adapted to the extreme conditions of frequent floods. They are sun-loving, shade intolerant, grow rapidly on infertile mineral substrates deposited by

river flooding, and maintain direct access to the water table through rigorous root development. Without freshly formed bars and islands available for these pioneers to colonize, it is likely their areas will decrease over time. They will lose territory to species such as bigleaf maple and Oregon ash.

*Our Logging History*

Western Oregon has provided the U.S. with timber since the 1920's, and especially in the 1950's and 1960's during the height of American urbanization and suburbanization. Oregon and the Middle Fork region in particular continue to be major timber producers today.

The first settlers in the area in the 1840's used timber to build their homes, fences and barns. Tracts were cleared for homesteads and farming. At first, logs were considered adequate, but eventually milled lumber was preferred and marketed. In the 1920's and 30's 'splash dams' were common on our area rivers. These dams enabled loggers to drive logs downstream to mills. The dams held water and all the collected logs behind it. Then the dams were blasted, sending the water rushing out and flushing the logs downstream to the mill. One can imagine the environmental consequences of these disturbances to wildlife populations and riparian habitat. Logging increased in the 1960's when railroad construction began. Lumber was used to create railroad ties, and timber was the main fuel for the steam engines. The railroads allowed Oregon lumber to be marketed to other U.S. markets. Huge sawmills began to be built and loggers from all over the world came to work in Oregon. Local families set up log drives, floating logs down the Middle Fork Willamette to the Springfield mills. Later, in the 1920's, the Southern Pacific railroad announced plans to build a railroad up the Middle Fork route. Several major timber sales and allocations for commercial logging were established at this time. The USDA Forest Service began to administer forest management and timber sales. Western Lumber Company secured a timber harvest and sale in 1923 of 13,300 acres, promising a harvest of 50 million board feet per year. The operation was run out of Westfir and a mill and logging camps sprang up quickly. A route to the Middle Fork railroad, now dismantled, was built. This is now Forest Road 19, or "Aufderheide Drive", a scenic by-way. Other mills in the area include Hines Lumber Company and the Pope and Talbot mill. *Willamette National Forest archeologist summary, 2004*

Northern spotted owl, unwitting source of decades of controversy.

Logging began in earnest on Pacific Northwest Federal lands shortly after World War II aided by the invention of the gas-powered chain saw and improvements in transportation. European methods of forest management were gradually adopted on most Federal and private lands, including techniques such as clearcutting, removal of logs and snags, slash burning, thinning, and planting of single species stands on cutover areas. As a result of over a century of logging and fire control, the forests of the Pacific Northwest presently consist of a highly fragmented mosaic of recent clear-cuts, thinned stands, and young plantations interspersed with uncut natural stands.

As studies on the ecology of late-successional forest began to proliferate in the 1970's and 1980's, it gradually became apparent that a simplistic approach to forest management based on high-yield, short-rotation forestry was not going to adequately protect the considerable biodiversity that was present in late-successional forests and their associated aquatic ecosystems. Listed as endangered under the Endangered Species Act in 1990, the northern spotted owl was the first species to receive recognition in this regard followed closely by the Marbled Murrelet, anadromous fish, and the recognition that a wide variety of species are closely associated with old forest. More recently, ecologist, foresters, and the public have begun to recognize that the old forests that remain in
the Pacific Northwest may be unique ecosystems that developed under climatic and disturbance regimes that may never be duplicated.

Changes in public perceptions and expectations concerning management of Federal lands in the Pacific Northwest and elsewhere have led to a gradual increase in protection of unique ecosystems and species, increased concern with riparian areas, and experimentation with methods of "new forestry" designed to retain some of the structural features found in old forests and thereby more closely imitate natural disturbance regimes. As these changes have occurred, harvest rates of timber on Federal lands have declined, and considerable controversy has ensued.

By 1992, there were over a dozen lawsuits and three court injunctions in the Pacific Northwest (total gridlock) involving the Northern Spotted Owl, Marbled Murrelet, and future timber harvesting in old-growth forests. The adoption of the Northwest Forest Plan (NWFP) in 1994 culminated a nearly decade-long series of processes and policy prescriptions to address an array of increasingly complex issues concerning management of late-successional and old-growth forests in the Pacific Northwest and northern California. The NWFP is a management strategy designed to address both societal and environmental needs by sustaining timber harvest while also protecting habitat for species protected under the Endangered Species Act. The NWFP represents the first time that the Bureau of Land Management and the Forest Service, in conjunction with other Federal agencies, have developed a common management approach for an entire ecological region. *Regional Ecosystem Office, www.reo.gov*

Today, logging on the Middle Fork District of the Willamette National Forest continues in accordance with the 1990 Forest Plan as amended by the 1994 Northwest Forest Plan. Clearcutting of old growth on the Middle Fork has effectively ceased, with most timber sales taking place in the form of commercial thinning.

Students from Lowell visit an active timber operation run by Giustina Land and Timber in the Lost Creek drainage.

*Commercial Forests in the Watershed Today*

Industrial foresters are the largest private landowners in the watershed, concentrated in the Lower Middle Fork area below the Willamette National Forest boundary. In Little Fall Creek sub-watershed, 70% of the land is under industrial forest management; in Lost Creek, 42% is privately owned forest and 33% is managed by the Bureau of Land Management. Weyer-

haeuser and Giustina Land and Timber are primary timber companies operating in the Middle Fork Watershed.

## Weed Control & Management

Oregon has over 1,300,000 acres of invasive plants. If left unchecked, many exotic plants have the potential to transform entire ecosystems by out-competing native species and, consequently, degrading native fish and wildlife habitat. Invasive plants are typically brought to the area from somewhere else for decoration, food, or by accident, often long ago before effects were known. Introduced species become invasive when they are able to 'take over' and turn the diverse, native, natural landscape into a monoculture of one dominant species. They are adapted to thrive in disturbed areas, such as construction sites, roadside ditches, and stream side areas prone to flooding. Invasive plants are prevalent throughout the watershed, particularly below Dexter Dam. In the MFWW, we focus on removing invasive plants with an aim to restore native habitats and ecology. Once we remove invasive plants, we replant the area with native plants that will restore the natural ecology of the habitat.

An invasion of false-brome, the light-colored grass overpowering the prairie floor.

## Priority Habitats in Our Watershed

*Wetland/Oxbow/Beaver Pond*

Populations of western pond turtles are present in the historic side channels and backwater sloughs of the main stem Middle Fork Willamette River. Habitat can be created and enhanced by placing large wood in backwater sloughs to provide shelter, shade, and basking areas. Removing invasive plant species, such as, Armenian blackberry, will greatly improve habitat conditions.

Focal species: Oregon chub, red-legged frog, western pond turtle, green heron, American dipper, wood duck, American beaver, river otter.

Western pond turtle hatchlings at Elijah Bristow State Park.

*Wetland/Prairie Habitat*

Much of this habitat has been eliminated due to the change in flood regime. Restoring and preserving this habitat is a priority for plant and wildlife species present.
Focal species: Bradshaw's lomatium, Willamette Valley Daisy, and northern red-legged frog.

*Riparian Forest*

Between the Middle Fork dams and the confluence of the Coast Fork and Middle Fork of the Willamette, remnants of a once greater and contiguous cottonwood gallery forest remain.

Riparian forests also occur along numerous waterways and streams. These forests provide important habitat for neo-tropical migrant birds.
Focal species: willow flycatcher, yellow warbler, red-eyed vireo, American beaver, and river otter.

*Savanna*
White oak savanna is characterized by a grassland where trees (primarily white oaks) are a component but their density is low enough to allow grasses and understory plants to be dominant in the landscape. This habitat supports many focal species, including some that are now extirpated from the valley (Lewis's woodpecker). Restoring and protecting oak savanna habitat would enhance the abundance and distribution of wildlife species in the watershed including, Pacific tree frog, American kestrel, western bluebird, and western meadowlark.
Focal species: northwestern pond turtle, western rattlesnake, southern alligator lizard, American kestrel, western bluebird, chipping sparrow.

Oregon white oak.

*Oregon White Oak Woodland*
White oak woodland habitat differs from savanna in the density of trees. When tree cover shades over 50% of understory, the habitat is considered a woodland. This habitat supports so many

species, it should be considered a priority everywhere it occurs in the watershed.
Focal species: sharp-tailed snake, acorn woodpecker, white-breasted nuthatch, house wren, western bluebird, western gray squirrel.

*Old Growth Forest*
The attributes of this important habitat are detailed in the previous section.
Focal species: spotted owl, olive-sided flycatcher, Vaux's swift, great gray owl, Oregon slender salamander, American marten, Townsend's big-eared bat, red-tree vole.

## Endangered & Threatened Species

Endangered Species Act (ESA) listed species for the watershed include the bald eagle, Bradshaw's lomatium, bull trout (Columbia river population), Chinook salmon (Upper Willamette river ESU, spring run), northern spotted owl, Oregon chub, and Willamette Valley daisy. In addition to the ESA species listed, the watershed contains key populations of western pond turtles, which are designated as "sensitive" in the state of Oregon. Sensitive species are those listed by the State of Oregon, listed under the ESA, or under consideration to be listed under the ESA. These species are generally of concern because they are reported to be declining in populations and therefore thought to be in some level of danger of becoming extinct. In some cases, the species are listed as sensitive because little information is known about their exact status.

*Fish and Other Aquatic Species*
There are populations of the western pond turtle, Oregon chub and northern Red-legged frog at **the confluence of Lost Creek and the Middle Fork Willamette River located in Elijah Bristow Page of**

State Park. Red-legged frogs are suspected to be present upstream and downstream of the confluence area as well.


Bull trout, a member of the salmonid family and native to our watershed.

Spring Chinook, bull trout, Oregon chub and cutthroat trout are present in the Middle Fork Willamette Watershed. Spring Chinook spawn in the lower reaches of the main stem and its tributaries Little Fall Creek and Lost Creek. Spring Chinook are transported above Fall Creek, Dexter-Lookout Point and Hills Creek dams, providing access to otherwise unavailable habitat. Spawning occurs in the upper reaches of Fall Creek and lower reaches of Winberry Creek, the North Fork of the Middle Fork Willamette River and the Middle Fork Willamette River above Hills Creek Reservoir. Spring Chinook also use Wallace, Anthony, Middle, and Rattlesnake Creek for rearing and migration. Resident bull trout are present above Hills Creek dam in the upper watershed and rear in the upper reach tributaries and springs, including Swift and Bear creeks, and Chuckle, Indigo and Iko springs. Oregon chub are present in the side channels and tributaries to the lower reaches of the main stem. Dense populations exist at the confluence of Lost Creek and the Middle Fork of the Willamette River. These are some of the most viable chub populations in the Willamette Valley. There are also resident populations of cutthroat trout throughout the tributaries in the watershed.

*The Needs of Our Native Fishes*

Oregon's native fish species need cold, clean water. The overall water quality of the watershed is some of the highest quality of the entire Willamette River Basin. With the exception of some lower reaches of tributaries entering the Middle Fork below Dexter Dam and main-stem reaches of streams influenced by dam operations, water quality in the watershed is generally favorable for the production of salmon and their kin. However, altered hydrologic processes, changes in
water temperature regimes, modified riparian and aquatic habitat, and limited access to historic spawning and rearing areas have impacted population productivity, capacity, and diversity for Chinook salmon, cutthroat trout, and bull trout.

*Water Quantity*

Adequate flow in tributaries to the main-stem is needed to sustain viable fish populations during summer months. Maintaining a minimum flow would lower the water temperature, providing suitable habitat. Best management practices should be identified and implemented in these sub-watersheds to retain adequate flow.

*Water Temperature*

Temperature is the greatest water quality concern in the watershed. The alteration of riparian areas has reduced riparian shading along tributaries of the lower watershed and, to a smaller degree, of the upper watershed. Riparian vegetation, stream morphology, hydrology (including groundwater interactions), climate, and geographic location influence stream temperature.

While climate and geographic location are outside of human control, riparian condition, channel morphology and hydrology are affected by land use activities. Disturbance or removal of vegetation near a stream reduces stream surface shading because of decreased vegetation height, width and density. This results in greater amount of solar radiation reaching the stream surface. Along the main-stem Middle Fork, release of water from the dams reverses natural seasonal trends by decreasing water temperatures in late summer and increasing them in the fall and winter, which impacts the upstream movement of spring Chinook salmon adults, alters the timing of spawning, and affects the survival of eggs.

*Passage and Connectivity*

The dams on the Middle Fork and fish passage barriers at road crossings on tributary streams prevent access into historical spring Chinook salmon and cutthroat trout spawning areas, block the interchange between the upper and lower watershed cutthroat trout populations, and limit juvenile access into rearing and refuge habitat. The most common man-made fish migration barrier in the watershed, however, is the poorly functioning road culvert.

A helicopter places logs in Little Fall Creek.

*Management of Riparian Areas*

Riparian vegetation also influences channel structure. Vegetation supports streambanks during erosive, high stream flow events by slowing floodwaters, and it promotes sediment deposition when floodwaters exceed the banks. Loss or disturbance of riparian vegetation may lead to stream bank erosion and channel widening. This decreases the ability of remaining vegetation to shade the stream and increases the stream surface area exposed to the sun. Timber harvest has limited the future input of large woody material to the stream channel. Woody materials and large logs provide shelter and habitat to fish and other wildlife, adding complexity and diversity to the stream character. Past management of riparian areas and stream cleaning practices in the lower watershed have led to reduced large wood loads in the aquatic system. Reduced in-channel wood has modified gravel deposition patterns, reduced the frequency and depth of pools, and minimized hiding cover for adult and juvenile fish. In addition, the 1964 flood removed riparian vegetation, and subsequent salvage of wood within the stream contributed to the reduction in channel complexity. In pristine conditions riparian vegetation would be readily available and frequently fall into the stream; however, much of the riparian condition has been altered so that large riparian trees are no longer as dominant.

## Restoring Water Resources in the MFWW

*Watershed Process and Function*

Improving watershed process and function is key to achieving a viable ecological system that supports the residents and focal aquatic species in the watershed. For habitat enhancement, riparian and instream projects that benefit anadromous and resident fish species, including spring Chinook, cutthroat trout, and bull trout, are a major focus. For the communities of the watershed, groundwater recharge areas that provide drinking water to local municipalities should

be the highest priority wherever in conjunction with projects that address hydrologic process, wetland and channel habitat.

*Restore Riparian Area Function*
Riparian restoration includes planting native trees and shrubs, which will improve stream shading, large wood recruitment into the stream, and wildlife habitat. The goal is to increase shade along selected high priority streams to lower water temperature and to provide food and cover to aquatic species. Riparian enhancement projects include removal of exotic plant species and establishment of native vegetation.

*Channel Complexity and Hydrologic Processes*
Channel complexity and re-connectivity with the floodplain are two key factors to improving the ecological processes in the watershed. Complex channels, a result of large wood in the stream and other geomorphic factors, provide protected habitat and cool, deep pools for cover and food for fish and wildlife during the summer. Much of the wood in the high priority sub-watersheds has been removed, so the major source for natural recruitment of wood into streams has been reduced. Placing wood in the streams will provide and/or enhance habitat for spring Chinook, Oregon chub and bull trout. Reconnecting the channel to its floodplain in the lower watershed will enhance wetland habitat and off-channel habitat for spring Chinook.

*Water Quality*
Reducing high water temperatures in the lower reaches of the main stem and its tributaries is a high priority for the Council. Reestablishing floodplain forest and riparian canopy would lower water temperatures. Temperature control on Lookout Point Dam affects water temperature in the lower watershed. Working with the U.S. Army Corps of Engineers on a project for temperature control at this reservoir would positively impact spring Chinook in the lower reaches of the main stem Middle Fork of the Willamette River. Reducing input of toxic chemicals will improve drinking water supply for residents of the watershed.

*Water Quantity*
Though water quantity is not a primary concern in the MFWW, summertime water withdrawals through both valid water rights and unauthorized uses from tributary streams of the lower watershed reduce stream flows. Such reductions can increase water temperatures and the concentrations of bacteria and other contaminants.

## Join the Watershed Council Community

Citizen involvement is critical to the success of restoration projects. The MFWWC emphasizes community and citizen participation in all of its projects and plans. Council meetings are open to the public and welcome citizen participation. General Council meetings are held every other month. Learn more about the concerns, highlights and projects in your area and find out ways to become involved.

For an updated calendar of meetings and events, visit **www.mfwwc.org**

# Project Profiles

## Lost Creek Confluence Project

One of the highest priority areas for restoration in the Middle Fork Willamette Watershed lies at the confluence of Lost Creek and the Middle Fork Willamette River in Elijah Bristow State Park. This 30-acre deforested area is part of a historical floodplain forest. In December of 2007, the MFWWC began the final phase of a multi-phased project to restore the area. The project involved extensive weed removal, planting of 4,500 native trees, the installation of an innovative solar-powered irrigation system, and western pond turtle and red-legged frog monitoring. The project also has served as a publicly accessible demonstration project: since January of 2004, over 300 volunteers and community members have visited the site and learned about on-the-ground watershed restoration. Our Watershed Education Program works with elementary, middle, and high schools in the watershed to teach science and environmental concepts while providing opportunities for students, teachers and parents to get involved in community service projects. Students have salvaged native plants from the site, planted trees, removed invasive plants, and conducted water quality monitoring on site.

New plantings at the Lost Creek Confluence site are mulched and protected by 'blue tubes.'

## False-brome Survey & Removal

The blades of false-brome are covered with tiny hairs.

Slender false-brome (Brachypodium sylvaticus) is a perennial, non-rhizomatous bunchgrass native to Europe, Asia, and northern Africa. It was first officially collected in Oregon in 1939 near Eugene. By 1966 there were at least two large populations established near the Corvallis-Albany area, and it has since expanded into many other areas of western Oregon. False-brome is a very aggressive invader, able to quickly form dense, monospecific stands in a wide variety of habitats ranging from 200' to 3500' in elevation. It has great shade and drought tolerance and is a strong competitor for early season moisture. A large established population of false-brome reduces the biological diversity of an area by suppressing native plants and reducing habitat quality and resource availability for wildlife.

The Middle Fork Willamette Invasive Species Working Group was formed in May 2007 to work to contain and treat false-brome and other invasive weed species. Members of the partnership are: Bureau of Land Management, US Forest Service, US Army Corps of Engineers, Walama Restoration Project, Weyerhaeuser, Giustina Land and Timber, Springfield Utility Board, Oregon Department of Agriculture, Willamalane, Oregon Parks and Recreation Department, Lane County, and the MFWWC.

The project aims to: determine the extent of species distribution and the severity of the infestation in the lower MFW watershed; prevent further spread of false-brome from population centers; identify vector corridors and set priorities for containment and treatment activities; educate private landowners and general public on false-brome and its ecological impact; and restore habitat by controlling false-brome and engaging private landowners in riparian and forestland restoration projects.

By the end of December 2008, 1200 landowners had been contacted, 140 private landowners had participated, 2000 acres of private property surveyed and 300 acres of false-brome mapped. Willing landowners and partners continue the commitment to work together to treat false-brome on their properties.

## Oregon Chub Habitat Restoration

The Oregon chub (Oregonichthys crameri) is a small minnow found only in the Willamette River Basin of Oregon. This little speckled fish reaches a maximum length of 3 inches. At one time the Oregon chub thrived throughout lowland areas of the Willamette Valley in shallow, slow moving waters, such as sloughs, beaver ponds, oxbows and side channels. Historically, floods that created and destroyed Oregon chub habitat occurred on a regular basis in the Willamette Valley. Rivers overflowed their banks, scouring new side channels and back water areas while filling in other areas. Of all Oregon native fish species, the Oregon chub was ideally suited to making these areas home.

Flood control altered this dynamic process. Dams were built to reduce peak flows causing river channels to become more stationary. Habitat loss also resulted from dike construction, channelization of streams and draining and filling of wetlands. Additionally, non-native species, like bass, bluegill and mosquitofish were introduced. These species are well suited to the habitat preferred by the Oregon chub and compete for limited habitat or prey on chub. The Oregon chub was listed as a federally endangered species in 1993. Prior to listing, several state and federal agencies created a Conservation Agreement to protect this species. This was one of the first Conservation Agreements developed before federal listing of an endangered species. Oregon chub monitoring and reintroduction is ongoing throughout the Willamette Valley.

In early 2006, Eric and Gail Haws discovered fish in a pond on their property in Westfir. A survey by ODFW revealed a healthy population of 126 adult Oregon chub. To enhance this habitat, the MFWWC secured funding from the Oregon Watershed Enhancement Board in September 2006 and a chub pond was created on August 15, 2007.

# Partner Profiles

## The United States Forest Service

The Forest Service manages 193 million acres of public land in the United States. The entire area of Willamette National Forest is approximately 1.7 million acres and is about the size of New Jersey. The forest stretches for 110 miles along the western slope of the Cascade Mountains and includes the Middle Fork of the Willamette River, the McKenzie River, Calapooia River, North Santiam River, South Santiam River and countless tributaries. The Middle Fork Ranger District manages approximately 85% of the land area of the Middle Fork Willamette watershed. There are several federally designated protected areas within the Middle Fork Watershed, including the Waldo Lake Wilderness, the Three Sisters Wilderness, the Diamond Peak Wilderness, and the Fall Creek National Recreation Area.

The Willamette National Forest is home to amazing fisheries. Through its "Homes for Lost Natives" program, the Middle Fork Ranger District and its partners have teamed to restore habitat for threatened spring Chinook salmon and bull trout and the endangered Oregon chub. This program has also benefited native trout as well as other aquatic species. Large wood has been added to streams to create hiding cover, scour deep pools, collect spawning gravel, and slow the water during floods so that fish have an area of refuge. Culverts once impassible to fish have been replaced to allow native species to reach critical upstream habitat. Many roads have been improved or closed to help keep streams clean and clear of sediment. Invasive plants that out-compete native vegetation have been and continue to be removed. In addition, ponds have been improved and created to benefit Oregon chub, pond turtles and other pond-dwelling species.

One particularly exciting project has been the restoration of bull trout to the Middle Fork Watershed. Bull trout, once extirpated from this watershed, have been reintroduced in one of the first successful efforts of its kind anywhere in the United States. Bull trout fry were moved from a population in the McKenzie River into springs in the Upper Middle Fork Willamette River. These fry have survived and are now spawning. Efforts to improve fish passage and spawning habitat continue to aid in bull trout survival.

Willamette National Forest
Supervisor's Office
3106 Pierce Parkway Suite D
Springfield, OR 97477
(541) 225-6300

Middle Fork District Office
46375 Highway 58
Westfir, OR97492
(541) 782-2283

## The U.S. Bureau of Land Management

The mission of the BLM is to sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations. The BLM is responsible for some of the most beautiful landscapes in the West, including forests and rangelands, beaches, and mountains across more than 15 million acres in Oregon. The Eugene District of the BLM extends from the Pacific Coast into the western slopes of the Cascade Range, encompassing about 316,000 acres. The Eugene District manages several ecosystems ranging from coastal inlands to dense Douglas-fir, hemlock, and cedar forests, including approximately 18,600 acres in the Middle Fork Willamette watershed. Many of the BLM's management decisions are mandated by the 1937 O&C Act to manage timber resources in the watershed to provide a steady flow of revenue to western Oregon counties. The BLM seeks to manage ecosystems in the watershed to improve both aquatic and upland habitat conditions, both in concert with timber projects and as stand-alone restoration projects.

As a member of the Middle Fork Willamette Watershed Council Invasive Plant Partnership, the BLM implemented a non-herbicide control study for false-brome, an invasive perennial grass species. The Partnership has developed a methodology to evaluate the effectiveness of mowing, mulching, and seeding with native species to fight the spread of this noxious weed species. The BLM will share results and implement the project on a larger scale if it is determined to be feasible.

For over a decade, the BLM has worked in partnership with the Oregon Department of Fish and Wildlife to conduct stream surveys on high priority streams in order to plan and conduct aquatic restoration.

"BLM's fragmented land ownership pattern in the watershed could be viewed as a blessing or a curse. The positive aspect of managing a patchy land base is that it affords us great opportunity to partner with a host of landowners, agencies, and organizations to achieve healthy ecosystems throughout the watershed."
Bill O'Sullivan, BLM Upper Willamette Field Manager.

Bureau of Land Management
Eugene District
3106 Pierce Parkway Suite E
Springfield, OR 97477
(541) 683-6600

## The U.S. Army Corps of Engineers

The United States Army Corps of Engineers (USACE) operates 13 dams and reservoirs in the Willamette Valley for the primary purpose of flood damage reduction. Other products of the reservoir system are hydropower generation, irrigation, navigation, industrial and municipal water supply, and recreation. The Corps operates the Willamette Valley dams and reservoirs as a single system operating in balance.

Four dams are within the Middle Fork Willamette watershed, and together they regulate 87% of the water runoff in the watershed. Lookout Point Dam and Dexter Dam, which began operation in 1954, are located near the town of Lowell. Dexter Dam re-regulates flows from Lookout Point Dam to allow for hydropower generation during peak power needs. Hills Creek Dam, completed in 1962, regulates the Upper Middle Fork and the Hills Creek tributary. Fall Creek Dam, completed in 1966, regulates Fall Creek, a major tributary to the Middle Fork. As part of the Willamette Basin Project, the Corps also performed bank stabilization, built levees and cleared channels downstream of the dams.

Today, the Corps conducts numerous environmental stewardship projects in the Willamette River watershed including habitat enhancement, removal of invasive species, and the protection of listed species. The Corps also conducts education and outreach activities in local schools and communities.

Willamette Valley Project Office
(541)-684-4300
Park Ranger Office
(541) 942-5631

## Oregon Parks and Recreation Department

The mission of the Oregon Parks and Recreation Department is to provide and protect outstanding natural, scenic, cultural, historic and recreational sites for the enjoyment and education of present and future generations. OPRD operates Oregon's state parks through a headquarters staff in Salem and field regions. It is also responsible for Oregon's Recreation Trails, the Ocean Shores Recreation Area, Scenic Waterways and the Willamette River Greenway. The department was created as a branch of the Highway Department in 1921. The 1989 Legislature created a separate Parks and Recreation Department, effective in 1990. Oregon's state parks are among the most popular in the U.S.: their combined day-use and camping attendance of 39.6 million visitors (2001) consistently ranks the system among the ten most visited in the nation.

OPRD's Heritage Programs Division, which includes the State Historic Preservation Office, Heritage Commission and the Oregon Commission on Historic Cemeteries, operates a number of cultural and historic preservation programs. Department activities are funded primarily by state park user fees, Oregon Lottery dollars, and recreation vehicle license fees.

OPRD manages several parks and recreation sites along the Lower Middle Fork Willamette River, including Fall Creek State Recreation Area, Jasper Park, Elijah Bristow State Park, Pengra Greenway Access Park, Dexter State Recreation Site, and Lowell State Recreation Site. OPRD lands provide ideal sites for field trips and service learning projects for the Watershed Rangers Project. Elijah Bristow State Park is a popular field trip site, offering river, stream, and pond habitat, as well as opportunities for students to take part in native planting and invasive species removal projects. Elijah Bristow also includes a stretch of Lost Creek that is perfect for wading and collecting aquatic macroinvertebrates and the MFWWC Lost Creek Confluence Project, an ongoing long-term restoration project for students to visit and observe.

Southern Willamette
Management Unit
(541) 937-1173

## Springfield Utility Board

The Springfield Utility Board (SUB) is a customer-owned utility founded in 1950. Approximately 70% of SUB's water comes from a system of six wellfields that tap groundwater from a vast aquifer that lies underneath Springfield. SUB draws the remaining 30% from the Middle Fork Willamette River and Willamette Wellfield at its filtration plant in south Springfield just above the confluence with the Coast Fork Willamette River. From these sources, the water is pumped through 240 miles of distribution lines to the homes and businesses of SUB's 56,000-plus water consumers.

Because the Middle Fork Willamette River provides a surface water source and maintains a hydrologic connection to Springfield's aquifer, protection of the Middle Fork Willamette Watershed is vital to keeping SUB's drinking water safe and healthy. The importance of this resource will only increase with time. As the City of Springfield continues to grow, SUB will draw more and more water from the Middle Fork Willamette River. Surface water from the Middle Fork will become an increasingly greater percentage of Springfield's total drinking water supply.

Some of the greatest potential upstream threats to SUB's water supply include hazardous material and chemical spills, runoff from highways and railways, failures of wastewater treatment and septic systems, and leaking underground storage tanks. SUB partners with upstream communities and land managers to reduce the risks to our drinking water through education, emergency response planning, best management practices, hazardous waste and materials management, and riparian restoration. Education is the first priority in Springfield's Drinking Water Protection Plan. The Watershed Rangers Project contributes to SUB's efforts by building awareness and understanding of how people's actions can either adversely or positively affect those living downstream. The hands-on approach emphasizes not only why we should protect a drinking water source but how.

"Stewardship of the Middle Fork Willamette Watershed benefits thousands of people who depend on the watershed for their drinking water." Chuck Davis, retired SUB Water Quality Program Manager.

Springfield Utility Board
(541) 746-8451
250 A Street
Springfield, OR 97477