

An Educator's Resource Guide for Hatching Salmon and Trout in the Classroom

Background Information, Activities, and Class-
room Resources to Make It Happen!



Oregon Department of Fish and Wildlife
Salmon-Trout Enhancement Program

An Educator's Resource Guide for Hatching Salmon and Trout in the Classroom

Background Information, Activities, and
Classroom Resources to Make It Happen!

by Patrick Griffiths



An Oregon Department of Fish & Wildlife
Salmon-Trout Enhancement Program Publication

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About the Author

Patrick Griffiths has been teaching, using, and writing watershed education curriculum since 1994. In 1998, he was chosen "The Oregon Conservation Education Teacher of the Year." He holds a Master of Science Degree in Environmental Education from Southern Oregon University. A former public middle school science teacher, he is currently the Water Conservation Specialist for the City of Bend and spends his free time watching his two boys perfect their catch and release technique with crayfish from the Deschutes River.

About this Guide

This guide is based on the author's actual teaching experience. He created the guide as part of his Masters thesis in Environmental Education at Southern Oregon University located in Ashland, Oregon. His intent was to create a one-stop guide for locating the best resources available for hatching fish eggs in the classroom and teaching about salmon and trout.



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Chapter 1

Introduction



Hatching salmon and trout in your classroom is a special, hands-on activity that grabs children's imaginations and helps connect them to real fish and wildlife management issues, problems, and possibilities for solutions. The cross-curricular nature of hatching fish eggs provides a shared experience and starting point for creating powerful new thematic units. This project can bridge to other materials and topics and provide fresh ideas to incorporate within existing programs — no matter how diverse your student population.

quickly locate many of the best materials available for teaching about fish and their aquatic habitats.

Finding Your Way

To begin your search for the answers and resources you desire most, based on your chosen level of involvement, see **Chapter 2, Finding Your Way**. Regardless of the grade level you teach and your background in science, this chapter shows you where to begin.

About This Guide

Oregonians recognize the importance of the state's fisheries resources and the need for good fisheries education. Use this guide to

Resources

For resources you can use to develop a program for hatching salmon and trout in your classroom and to teach related lessons,

Here's the teaching philosophy behind this guide:

- Hands-on is the best way to teach and learn.
- Quality background information combined with the best available activities and resources is the key to success.
- The more comfortable a teacher is about a topic, the more confident he or she will be while teaching.
- These philosophies translate to a high-quality learning experience for everyone involved!

see **Chapter 3, Resources**. This chapter includes lists of curricula and reference materials; programs; World Wide Web sites; videotapes; computer programs; posters; miscellaneous props; games; plays; maps; equipment; water quality test kits; D-frame nets; temperature data loggers; field trips; classroom speakers; traveling trunks; and children's literature.

Salmon-Trout Enhancement Program (STEP)

For information about the Oregon Department of Fish and Wildlife's (ODFW) STEP program, see **Chapter 4, Salmon-Trout Enhancement Program (STEP)**. This chapter describes volunteer opportunities and includes contact information for your local STEP biologist or the nearest ODFW office.

Applying Oregon's Education Standards

To learn how resources mentioned in this guide can contribute to successful lesson development in meeting Oregon's Education Standards, see **Chapter 5, Applying Oregon's Education Standards**.

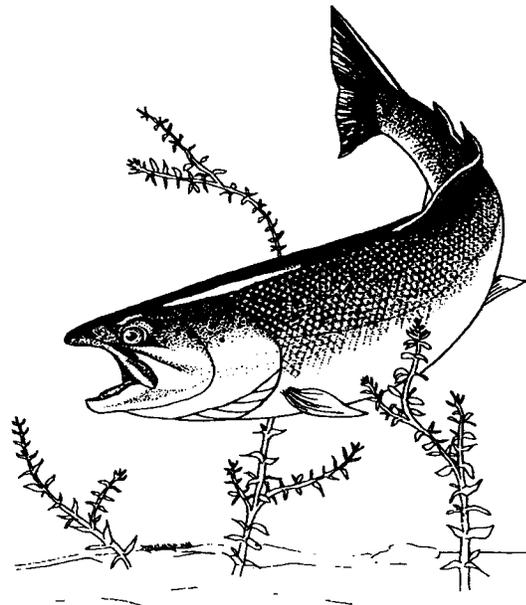
Fisheries Education Activities

For examples of hands-on, ready-to-go activities you can use in your classroom to teach about fish, see **Chapter 6, Fisheries Education Activities**.

Applying For Fish Eggs

To apply for fish eggs for your classroom incubator, see the Egg Request Application and Transport Permit at the end of Chapter 6. Using the list on page 41, call your local STEP Biologist to inquire about fish stocks available in your area, when you can expect egg delivery, and any other related questions. Then, complete and return the form to your nearest STEP Biologist by June 1 to qualify for fish eggs during the upcoming school year.

ODFW reserves the right to designate fish species, numbers of eggs received, and release sites within policy guidelines.



Chapter 2

Finding Your Way



This chapter helps you get started, regardless of your background and experience. Use the tables in this chapter to begin your search for resources about fish and their aquatic habitats. Resources listed in the tables direct you to additional information on these topics:

- How to begin a salmon and trout egg-hatching program in your classroom.
- The amount of time and effort involved with this type of project.
- How to make the project a success!

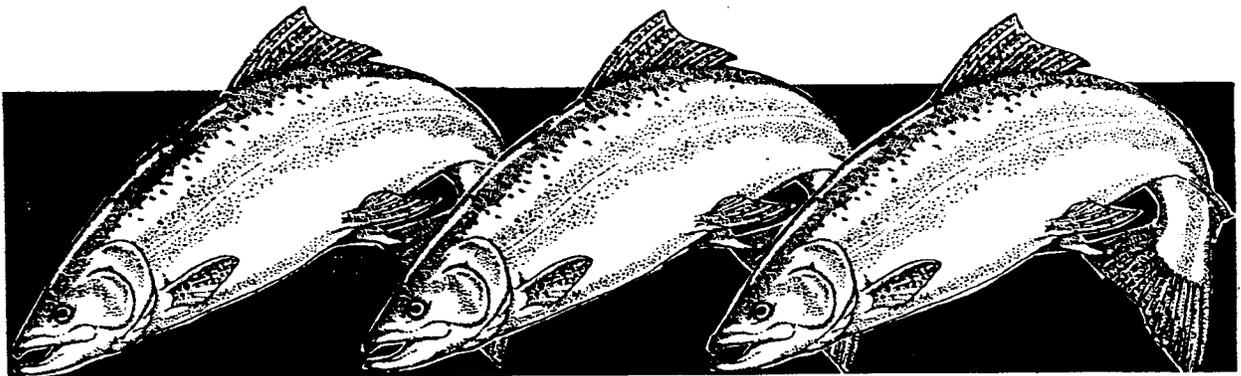
About This chapter

If you already have experience with a classroom fish egg incubation project, see **Going Deeper** on the next page. If you need more information before undertaking this

type of project, continue reading to determine how to proceed.

If you teach kindergarten through eighth grade and have a limited science background, see **Getting Started** on page 5. Use Table 1 if you are **thinking** about hatching fish eggs in your classroom. The table contains suggestions on how to begin and where to find information about the amount of time and effort required for this type of project.

If you teach kindergarten through eighth grade, and you are **committed** to hatching fish eggs in your classroom, but you have no experience with this type of project, see **Hatching Fish Eggs in Your Classroom** on page 6. Regardless of your science background, use the resources listed in Table 2 to find the information you need to develop a program.



If you teach middle or high school science, you are a watershed council educator, or a museum, agency, or outreach specialist who is comfortable with science, see **Creating Your Own Program** on page 7. Use Table 3 to locate detailed and complete information that you can adapt to your specific needs.

Going Deeper

If you already have a classroom fish egg incubation project, and you are serious about expanding your knowledge, modifying existing lessons, creating new lessons, or

undertaking a community project, see **Chapter 3, Resources**. This chapter includes many resources related to hatching fish eggs in the classroom — curricula and reference materials; programs; World Wide Web sites; videotapes; computer programs; posters; miscellaneous props; games; plays; temperature data loggers; maps; D - frame nets; equipment; water quality test kits; field trips; classroom speakers; traveling trunks; and children's literature.



Adapted from original artwork by Gary Bloomfield, *Salmon and Trout Go To School, An Instruction Manual For Hatching Salmon and Trout Eggs In Classroom Aquarium-Incubators* by Diane Higgins, California Department of Fish and Game and American Fisheries Society, Humboldt Chapter, 1996.

Getting Started

If you teach kindergarten through eighth grade, have a limited science background, and you are **thinking** about hatching fish eggs in your classroom, see Table 1. Use the resources listed in this table to locate information on how to begin and the amount of time and effort required for this type of project.

Table 1. Getting Started

Type of Information	Resource to Use	Page #
Who To Contact	<ul style="list-style-type: none"> Your local ODFW STEP Biologist for more information on what you need to start hatching fish eggs in your classroom. 	41
	<ul style="list-style-type: none"> A local teacher who operates a classroom fish-egg incubation project in your area and who will arrange for you to visit. The local STEP Biologist can suggest names and schools in your area. 	41
Background Information, Equipment, and Curricula	<ul style="list-style-type: none"> Fish Eggs to Fry is a "how-to" manual that provides all the information an Oregon teacher needs to hatch salmon or trout eggs in a classroom incubator. 	11
	<ul style="list-style-type: none"> Salmonids in the Classroom is a fisheries education curriculum from British Columbia. Several others are also available. 	16
Activities and Field Trip Ideas	<ul style="list-style-type: none"> The Fish Hatchery Next Door is a resource that will help you create a successful visit to a fish hatchery with students of all ages. 	11
	<ul style="list-style-type: none"> Traveling Trunks 	32
	<ul style="list-style-type: none"> Classroom Speakers 	31
	<ul style="list-style-type: none"> Example Fisheries Education Activities 	51
Programs, Literature, and Other Resources	<ul style="list-style-type: none"> Children's Literature 	33
	<ul style="list-style-type: none"> Posters 	27
	<ul style="list-style-type: none"> Hands-on training programs that provide guides and networking opportunities 	18
Multimedia	<ul style="list-style-type: none"> Videotapes 	24
	<ul style="list-style-type: none"> Computer Programs 	27
	<ul style="list-style-type: none"> World Wide Web Sites 	21

Find a parent volunteer to run the project for you or team with another teacher and share!

Hatching Fish Eggs In Your Classroom

If you teach kindergarten through eighth grade, and you are **committed** to hatching fish eggs in your classroom, but you have no experience with this type of project, see Table 2. Regardless of your science background, use the resources listed in this table to find the information you need to develop a program.

Table 2. Hatching Fish Eggs in Your Classroom

Type of Information	Resource to Use	Page #
Who To Contact	<ul style="list-style-type: none"> Your local ODFW STEP Biologist for more information on what you need to start hatching fish eggs in your classroom. 	41
	<ul style="list-style-type: none"> A local teacher who operates a classroom fish-egg incubation project in your area and who will arrange for you to visit. The local STEP Biologist can suggest names and schools in your area. 	41
Background Information, Equipment, and Curricula	<ul style="list-style-type: none"> Fish Eggs to Fry is a "how-to" manual that provides all the information an Oregon teacher needs to hatch salmon or trout eggs in a classroom incubator. 	11
	<ul style="list-style-type: none"> Salmonids in the Classroom is a fisheries education curriculum from British Columbia. Several others are also available. 	16
	<ul style="list-style-type: none"> The Stream Scene is a watershed education publication that targets students in grades 6–12. 	16
	<ul style="list-style-type: none"> Reference Materials 	10
Activities and Field Trip Ideas	<ul style="list-style-type: none"> The Fish Hatchery Next Door is a resource that will help you create a successful visit to a fish hatchery with students of all ages. 	11
	<ul style="list-style-type: none"> Field Trips 	31
	<ul style="list-style-type: none"> Traveling Trunks 	32
	<ul style="list-style-type: none"> Example Fisheries Education Activities 	51
Programs, Literature, and Other Resources	<ul style="list-style-type: none"> Children's Literature 	33
	<ul style="list-style-type: none"> Curricula 	10
Multimedia	<ul style="list-style-type: none"> Videotapes 	24
	<ul style="list-style-type: none"> Computer Programs 	27
	<ul style="list-style-type: none"> World Wide Web Sites 	21
Training	<ul style="list-style-type: none"> Trout in the Classroom Online 	23
	<ul style="list-style-type: none"> Hands-on training programs that provide guides and networking opportunities 	18

Creating Your Own Program

If you teach middle or high school science, you are a watershed council educator, or a museum, agency, or outreach specialist who is comfortable with science, see Table 3. Use this table to locate detailed and complete information that you can adapt to your specific needs.

Table 3. Creating Your Own Program

Type of Information	Resource to Use	Page #
Who To Contact	<ul style="list-style-type: none"> Your local ODFW STEP Biologist for more information on what you need to start hatching fish eggs in your classroom. 	41
Background Information, Equipment, and Curricula	<ul style="list-style-type: none"> Fish Eggs to Fry is a "how-to" manual that provides all the information an Oregon teacher needs to hatch salmon or trout eggs in a classroom incubator. 	11
	<ul style="list-style-type: none"> The Stream Scene is a watershed education publication that targets students in grades 6–12. 	16
	<ul style="list-style-type: none"> Project WET is an interdisciplinary water education program to supplement a school's existing curriculum. 	14
	<ul style="list-style-type: none"> Watershed Uplands Scene is a package that provides a model for students to learn about their local watershed. 	17
Activities and Field Trip Ideas	<ul style="list-style-type: none"> Field Trips 	31
	<ul style="list-style-type: none"> Equipment 	30
	<ul style="list-style-type: none"> Maps 	29
	<ul style="list-style-type: none"> Classroom Speakers 	31
	<ul style="list-style-type: none"> Example Fisheries Education Activities 	51
Programs, Literature, and Other Resources	<ul style="list-style-type: none"> Reference Materials 	10
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Multimedia	<ul style="list-style-type: none"> Videotapes 	24
	<ul style="list-style-type: none"> Computer Programs 	27
Training	<ul style="list-style-type: none"> Hands-on training programs that provide guides and networking opportunities 	18

Chapter 3

Resources



This chapter lists many of the best resources available for hatching salmon and trout eggs in the classroom. These resources will help you create a program focused on fish, expand your knowledge, modify existing lessons, create new lessons, and involve the community. This list of resources was compiled from teacher recommendations and experiences. Information included in the lists is current, as of this printing.

Curricula And Reference Materials

includes lesson-based curricula for specific grades and topics and a number of fisheries and watershed-related references.

Programs lists training programs available for teachers and students.

World Wide Web Sites lists Web sites that can expand your resources.

Videotapes lists multimedia you can purchase for classroom use.

Computer Programs lists interactive computer programs that help students explore ecology, watersheds, science, and other topics.

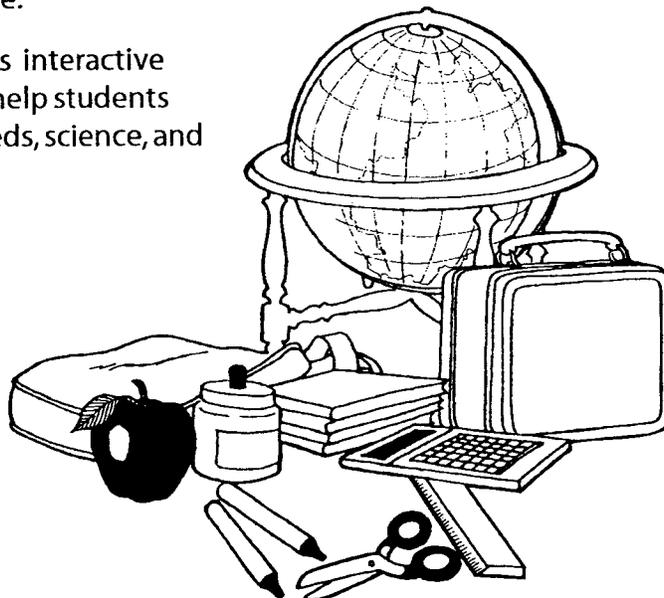
Posters lists examples of colorful informative posters that illustrate fish species, their habitats, and watershed concepts.

Miscellaneous Props, Games, and Plays lists puppets, games, and plays you can use to teach about fish and their life cycles.

Temperature Data Loggers, Maps, D-Frame Nets, Equipment, and Water Quality Test Kits includes lists of additional resources to expand fisheries and watershed education lessons.

Field Trips, Classroom Speakers, and Traveling Trunks includes suggestions for field trips, classroom speakers, and preassembled classroom materials.

Children's Literature lists elementary-level children's literature related to water, watersheds, fish, and wildlife. Contact your local Education Service District or public library for more titles and information.



Curricula And Reference Materials

Adopting A Stream: A Northwest Primer

Steve Yates, \$9.95

University of Washington Press

PO Box 50096

Seattle, WA 98145-5096

Filled with information about aquatic habitat, water quality, and salmonids, this book tells how school, community, or sports groups can restore a nearby creek and, in the process, learn much about biology, ecology, economics, and the effects of watershed activities on our streams.

Adopting A Wetland: A Northwest Guide

Steve Yates, \$5

Adopt-A-Stream Foundation

PO Box 5558

Everett, WA 98206

This guide is an ideal resource for schools, community groups, and individuals interested in restoring and protecting their neighborhood wetland areas. It provides an introduction to wetland plants, information on marsh life, wetland types and identification, values and benefits of wetlands, mitigation and legislative issues, and developing an action plan. Technical appendices on wetland plants and wildlife, scientific classification, and a basic observation checklist are included.

Aquatic Project WILD

Aquatic Project WILD is available only through workshops. For an update on Oregon availability, contact the national office at Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org or Oregon Forestry Education Program, College of Forestry, Oregon State University, 146 Forest Research Laboratory, Corvallis, OR 97331-7404, (800) 554-6987, ofep@cof.orst.edu

This package contains many interdisciplinary water-related activities for grades K–12.

Aquatic Resources Education Curriculum

C. Boyd Pfeiffer and Mark Sosin, \$25 + \$4 s/h

Future Fisherman Foundation

1033 N. Fairfax St., Suite 200

Alexandria, VA 22314

(703) 519-9691 for order form

(847) 364-1222 for credit card/purchase order

Units include A Fishing Primer, Becoming A Better Angler, Understanding Fish and Their Environment, Water Resources For Our Future, and Careers. Water safety and aquatic life are also discussed.

California's Salmon and Trout: Our Valuable Natural Heritage

Diane Higgins, \$20

4649 Aster Avenue

McKinleyville, CA 95521

(707) 839-4987

This material for grades K–6 is divided into sections dealing with biological aspects of salmon and trout and habitat needs of the various species.

Clean Water, Streams, and Fish: A Holistic View of Watersheds

Wendy Borton, et. al., \$12 + \$3 s/h

Washington State Office of Environmental Education

2800 NE 200th

Seattle, WA 98155-1418

(206) 365-3893

<http://cifl.ospi.wednet.edu>.

Focusing on human dependence and human impact on water quality of the Northwest, this book covers water quality, life cycle of salmon, stream ecology, and environmental and economic tradeoffs. It is specific to Washington State, but most is applicable elsewhere.

Curricula And Reference Materials (continued)

The Creek Book

UBC Press, \$10.95 + s/h
Raincoast Book Distribution
8680 Cambie St.
Vancouver, BC V6P 6M9
(800) 663-5714

This book contains drawings and descriptions of plants and animals found in this ecosystem. Student worksheets are included.

Discovering Salmon: A Learning and Activity Book

Nancy Field and Sally Machlis, \$4.95 +s/h
Dog-Eared Publications
PO Box 620863
Middleton, WI 53562-0863
(608) 831-1410 (phone and fax)
(888) DOG-EARS
<http://www.dog-eared.com>

This primary-level activity book covers life cycle, different species of salmon, river geography, predators, and hatcheries.

Earth: The Water Planet

Jack Gartrell, et. al., \$18.50 + \$4.25 s/h
Special Publications
National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 22201-3000
(703) 243-7100 or (800) 722-6782
<http://www.nsta.org>

This collection of elementary and middle school water activities has five sections: Ground-water; Reshaping the Surface of the Earth; Raindrops Keep Falling On My Head; Water Water Everywhere; and Investigating the Physical Properties of Water. Each section includes readings and hands-on activities.

Field Identification of Coastal Juvenile Salmonids

WR Pollard, et. al., \$12.95 + s/h
Harbour Publishing
PO Box 219
Madeira Park, BC Canada V0N 2H0
(604) 883-2730

This guidebook is designed primarily for juvenile salmonid identification in Canadian waters, but applies throughout the Northwest.

Fish Eggs to Fry: Helping Kids Hatch Fish

Bowers, Patty, et. al.
Oregon Department of Fish and Wildlife
PO Box 59
Portland, OR 97207
(503) 872-5252

Call local STEP Biologist to obtain a copy.

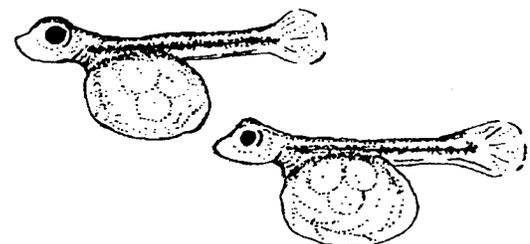
This manual provides all the information an Oregon teacher would need to hatch salmon or trout eggs in a classroom incubator.

The Fish Hatchery Next Door

Hastie, Bill and Bowers, Patty
Oregon Department of Fish and Wildlife
PO Box 59
Portland, OR 97207
(503) 872-5264

Or, contact your local Oregon hatchery.

This package helps you create a successful visit to a fish hatchery with students of all ages. Fish hatcheries play an important role in maintaining the balance between human demands and the needs of Oregon's diverse wildlife.



Curricula And Reference Materials (continued)

Fish in the Floodlights

BCTF Lesson Aids
#100-550 W.6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181

This package contains nine short dramas; ideal for theme units and integrated activities.

From Ridges to Rivers – 4-H Watershed Project

Contact any Oregon State University Extension Service county office for a copy.

This interactive curriculum is based on creek tables using diatomaceous earth. Additional support activities, such as Mud Milk Shakes and Aquifer In A Cup, encourage scientific inquiry.

Groundwater: A Vital Resource

Cedar Creek Learning Center (free)
Citizen Action Office
Tennessee Valley Authority
400 W. Summit Hill Drive
Knoxville, TN 37902

This collection of groundwater-related activities for grades 3-12 includes The Water Cycle, Water Distribution in Soils, Water Quality, and Community Impacts.

How to Catch and Identify the Gamefish of Oregon

E. A. Lusch
Frank Amato Publications
PO Box 02112
Portland, OR 97202

This is a practical guide to fish identification for all interested individuals.

Investigating Aquatic Ecosystems

William A. Andrews
Prentice-Hall Canada, Inc.
Scarborough, Ontario, 1987

This textbook introduces the basic principles of freshwater ecology. It includes field and laboratory studies and thought-provoking questions.

Leapfrogging Through Wetlands

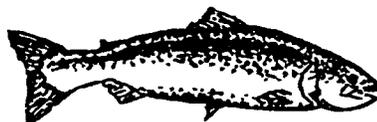
Margaret Anderson, Nancy Field and Karen Stephenson, \$7.95 + s/h
Dog-Eared Publications
PO Box 620863
Middleton, WI 53562-0863
(608) 831-1410 (phone and fax)
or (888) DOG-EARS
<http://www.dog-eared.com>

This book helps young people understand the significance of wetlands in ecosystems throughout North America. Readers learn about the vast array of plant and animal life associated with wetlands. Educators will find this book a valuable companion for **WOW! The Wonders Of Wetlands** and **Project WET**.

Learning to Love Streams

Izaak Walton League of America
1401 Wilson Boulevard, Level B
Arlington, Virginia 22209

This package is a collection of water quality and pollution materials.



Curricula And Reference Materials (continued)

Living in Water – An Aquatic Science Curriculum (3rd edition)

Kendall Hunt, \$23.95 + \$4 s/h
4050 West Mark Drive
PO Box 1840
Dubuque, IA 52004-1840
(800) 228-0810

This is a basic hands-on aquatic science curriculum for grades 4–6. The material provides extensive background on the basic principles and concepts of aquatic ecology: the solubility of water and its effects on the distribution of aquatic life, adaptations to aquatic environments, food web interactions, and the importance of aquatic research.

The Magnificent Journey

Bonneville Power Administration
Public Involvement Office
PO Box 12999
Portland, OR 97212
(800) 425-8429
www.bpa.gov/corporate/kr/ed/reslist/reslistx.shtml

This life story of Onco, a chinook salmon from Idaho, contains information about habitat and threats. A poster of salmon and steelhead is included. You may download the publication from the Web site.

Make It Work! Rivers: The Hands-On Approach To Geography

Andrew Haslam
Two-Can Publishing Ltd
Chicago, IL 60661

One of a four-part "Make-It-Work" series of books that use colorful, realistic models and exercises to engage children, age 8 and older, in interactive hands-on projects.

OBIS Ponds and Lakes

Delta Education, Inc., \$18.95
Box M
Nashua, NH 03061-6102
(603) 889-8899

The eight activities in this module explore aquatic sites, the plants and animals that live there, and their behaviors.

OBIS Streams and Rivers

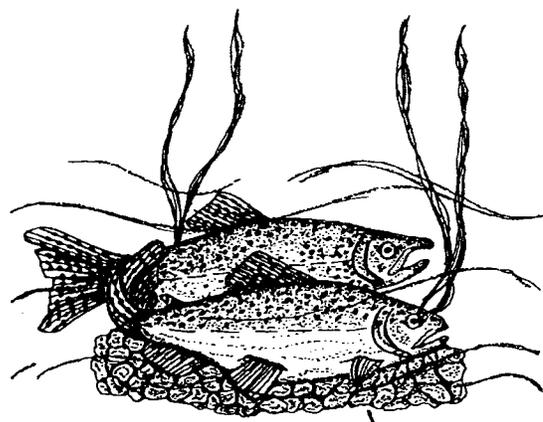
Delta Education, Inc., \$18.95
Box M
Nashua, NH 03061-6102
(603) 889-8899

The eight activities in this module investigate aquatic life in streams and rivers. Specialized activities include feeding behaviors of crawdads and water striders, and the impact of a simulated oil spill on the environment.

Oregon Environmental Atlas

Carolyn Young, \$10
Portland State University, Media Publications
PO Box 1394
Portland, OR 97207

The atlas includes valuable statewide information about Oregon landforms, surface water, ground water, hydrologic cycle, uses of water, water quality, water pollutants, and related issues, as well as air quality, solid and hazardous wastes, toxic issues, nuclear wastes, and noise pollution.



Curricula And Reference Materials (continued)

Our Water World - 4-H Marine Science Discovery Project

Contact any Oregon State University Extension Service county office for a copy.

Developed by the staff of Hatfield Marine Science Center and the 4-H Youth Development Program, this curriculum is designed for grades 4-5. It includes activities about watersheds and ocean conditions that can affect salmon. The lessons are keyed to grade 5 science benchmarks.

The Pacific Salmon and Steelhead Coloring Book

U.S. Fish & Wildlife Service
Outreach Specialist, Fisheries
911 NE 11th Ave.
Portland, OR 97232
(503) 231-6874

www.r1.fws.gov/publications/

Download this children's coloring book from the Web site and help students identify Pacific salmon and learn about a salmon's life cycle. It discusses hazards and problems encountered by salmon during their life history.

The Pond Book

UBC Press, \$10.95 + s/h
Raincoast Book Distribution
8680 Cambie St.
Vancouver, BC V6P 6M9
(800) 663-5714

This book contains drawings and descriptions of plants and animals found in this ecosystem. Student worksheets are included.

Project Learning Tree

Project Learning Tree (PLT) materials are available only through workshops. Contact the PLT office, Oregon Forestry Education Program, College of Forestry, Oregon State University, 146 Forest Research Laboratory, Corvallis, OR 97331-7404, (800) 554-6987,

<http://www/cof.orst.edu/cof/extended/ofep>

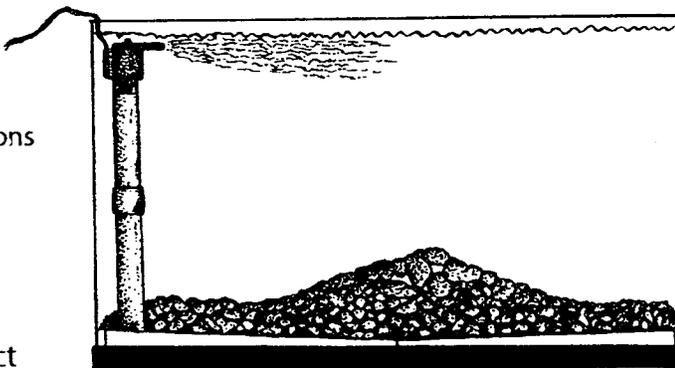
PLT is an interdisciplinary, comprehensive environmental education program that uses the forest as a "window" into the natural world. The pre K-8 activity guide is arranged into five major themes: diversity, interrelationships, systems, management and technology, and society and culture.

Project WET

The Watercourse
201 Culbertson Hall
Montana State University
Bozeman, MT 59717-0057
(406) 994-5392

Or, contact Project WET coordinator for Oregon at The High Desert Museum, (541) 382-4754.

Project WET is an interdisciplinary water education program intended to supplement a school's existing curriculum. The program facilitates and promotes the awareness, appreciation, knowledge, and stewardship of water resources through the development and dissemination of classroom-ready teaching aids.



Curricula And Reference Materials (continued)

Project WILD

Project WILD is available only through workshops. For an update on Oregon availability, contact the national office at Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org or Oregon Forestry Education Program, College of Forestry, Oregon State University, 146 Forest Research Laboratory, Corvallis, OR 97331-7404, (800) 554-6987, ofep@cof.orst.edu

This package contains a broad range of interdisciplinary activities focused on conservation and wildlife education.

Responsible Angling: The Oregon Angler Education Manual

Oregon Department of Fish and Wildlife
Aquatic and Angler Education Program
PO Box 59
Portland, OR 97207
(503) 872-5264

The ODFW Aquatic and Angler Education course provides an awareness and understanding of the aquatic ecosystems that fish inhabit and the relationships these systems have to the sport of angling. Primary areas of instruction include conservation and stewardship, ethical conduct and responsibilities, water safety, and basic angling skills.

Rivers and Streams, Habitat Pac

National Institute for Urban Wildlife, \$5
10921 Trotting Ridge Way
Columbia, MD 21044

The package includes teacher overviews, lesson plans, student worksheets, and a poster.

Rivers Curriculum Guide

Rivers Project, \$23.95 each + s/h
Southern Illinois University
PO Box 2222
Edwardsville, IL 62026-2222
(618) 650-2000

This series of six rivers-based units was written by teachers participating in the Rivers Curriculum Project funded by the National Science Foundation. Units include biology, chemistry, earth science, geography, language arts, and mathematics.

Salmon A La Arte: An Arts-Based Science Curriculum

Roxallanne Medley, \$30 + s/h
701 NW Madrona Way
Coupeville, WA 98239
(360) 678-3720
rmedley@whidbey.net

This curriculum is designed for students in grades 1-5. It teaches about salmon through a variety of arts-based activities.

Salmon Below The Surface

BCTF Lesson Aids
#100-550-W. 6th Avenue
Vancouver, BC, V5Z 4P2
(604) 871-2181

These seven new, intermediate, science activities are used with **Salmonids in the Classroom** and are suitable for grades 8-10.

Salmon Kit

Pacific Science Center, \$200
200 2nd Avenue N.
Seattle, WA 98109

This package includes ten activities, three computer diskettes, filmstrips, slides, magnifying lenses, thermometers, laminated salmon cards, activity outlines, and worksheets.

Curricula And Reference Materials (continued)

Salmonids in the Classroom

BCTF Lesson Aids
#100-550-W.6th Avenue
Vancouver, BC, V5Z 4P2
(604) 871-2181

Primary Package (K-3) includes video cassette and eight life cycle posters, \$60 + 20% surcharge for non-BCTF members

Intermediate Package (4-7) includes video cassette, \$70.00 + 20% surcharge for non-BCTF members

The primary package is a study of salmonids taught through an illustrated story of Chucky Chum. The intermediate package is divided into three units on life cycle, harvesting, and enhancement. Units cover biological aspects, salmonid habitat, the fishing experience, and salmonids in today's world. Ideas integrate in all subject areas. It is specific to British Columbia, but basic concepts are easily adaptable to any area.

Save Our Streams

Izaak Walton League of America
1401 Wilson Boulevard, Level B
Arlington, VA 22209

This packet of materials on stream care and water quality includes background information, activities, a teaching guide, and guidelines for how to adopt and monitor a stream.

Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods

Murdoch, Tom, et. al., \$29.95 + \$4.00 s/h
Adopt-A-Stream Foundation
600-128th St SE
Everett, WA 98208
(425) 316-8592

This guide provides background information on how streams and their surrounding watersheds function, detailed methods on watershed inventory and stream monitoring for volunteers, tips on presenting data, and stories about Streamkeepers putting watershed inventory and

stream monitoring information to use in the protection and restoration of our nation's streams.

The Stream Scene: Watersheds, Wildlife, and People, Second Edition

Bowers, Patty, et al., 1999, \$32
Oregon Department of Fish & Wildlife
PO Box 59
Portland, OR 97207
(503) 872-5264

This watershed education curriculum package targets students in grades 6–12. Units include The Water Cycle, Watersheds, Uplands, Riparian Areas, Hydrology, Water Quality, and Aquatic Organisms. The package contains background information, student worksheets, field data sheets, correlations with state education standards, ideas for younger students, scientific inquiry experiences, and other resources.

Streamwalk Manual

US-EPA, Krista Rave
Eco-081, 1200 6th Ave
Seattle, WA 98101
(206) 553-6686

This standardized, easy-to-use screening tool for monitoring stream corridor health is designed for use by lay people who are interested in learning more about their streams and rivers.

Update!

BCTF Lesson Aids
#100-550 W.6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181

Contained in this package are new and revised activities, handouts, and cooperative learning strategies for use with **Salmonids in the Classroom, Primary**.

Curricula And Reference Materials (continued)

Water Education

Distributed by the International Office for
Water Education
Utah Water Research Laboratory
Utah State University
Logan, UT 84322-3200
(435) 797-3232

Geared to grades K–6, the activities in this manual help students develop a scientific attitude about water.

Watershed Uplands Scene: Catching the Rain

Ferschweiler, K., Horn, K., and Hughes, A.
Environmental Education Association of
Oregon, \$15
Oregon Watershed Enhancement Board
775 Summer St. N.E., Ste. 360
Salem, OR 97301-1290
(503) 986-0178

This package provides a model for students to learn fundamental concepts about their local watershed while developing information-gathering, problem-solving, group interaction, and public presentation skills. Unit 1 explores the biophysical aspects of a watershed – weather and climate, soils vegetation, and wildlife. Unit 2 introduces the human uses – urban, forestry, recreation, and agriculture. Unit 3 provides an opportunity for students to apply knowledge and skills learned in the previous sections to local land-use management issues.

Wetland Walk Manual

US-EPA, Krista Rave
Eco-081, 1200 6th Avenue
Seattle, WA 98101
(206) 553-6686

This standardized, easy-to-use screening tool for monitoring wetland health gives citizens the opportunity to become partners in learning about wetlands and at the same time collect information and data that help identify trends in wetland health and location.

Oregon Department of Fish and Wildlife

4-H Wetland Wonders

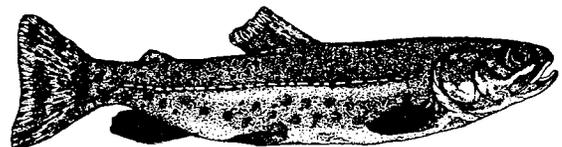
Virginia Thompson, Dave Price, Connie Reid
Oregon State University Extension Service
5390 4-H Road NW
Salem, OR 97304
(503) 371-7920

This curriculum guide for grades 4-5 focuses on wetlands and water quality issues. Lessons begin with the water cycle and extend through watersheds, ground water, home water uses, and wetland plants, soils, and animals.

WOW! The Wonders of Wetlands

Kesselheim, Alan, et. al.
Environmental Concern, Inc., \$15.95 + s/h
The Watercourse
201 Culbertson Hall
Montana State University
Bozeman, MT 59717-0057
(406) 994-5392

This curriculum contains background material for all educators preparing wetland study units. It also contains material on organizing a wetlands field trip, making inexpensive sampling equipment, and getting involved in wetland enhancement and stewardship.



Programs

A number of the training programs listed below include guides. Other programs may be available in local areas. Check with the local Oregon Department of Fish and Wildlife office, other natural resource agency offices, extension service, or the local watershed council for programs in your area.

4-H Youth Development

Oregon State University Extension
4-H Natural Science Specialist
Oregon 4-H Education Center
5390 4-H Rd. NW
Salem, OR 97304
(503) 371-7920

The 4-H Youth Development Department of Oregon State University's Extension Service offers training workshops on all of their curriculum and travel kits.

Creeks and Kids Watershed Education Workshops

Oregon Watershed Enhancement Board
775 Summer Street NE, Suite 360
Salem, OR 97301-1290
(503) 986-0178

Creeks and Kids watershed education workshops give educators the skills and confidence to use their local streams as learning sites. Participants learn about stream surveying and monitoring through field experiences and classroom activities. Teachers leave this workshop with armloads of resource materials and are prepared to use their local watershed and stream as a focus for learning. Contact the number above for information about availability and dates.

Kokanee Karnival

Eastern Oregon STEP Biologist
Oregon Department of Fish and Wildlife
61374 Parrell Road
Bend, OR 97702
(541) 388-6363

Kokanee Karnival is loosely patterned after Oregon Trout's Salmon Watch program. It is offered on a limited basis for Central Oregon schools. Fall field trips include touring a fish hatchery and viewing naturally spawning kokanee salmon. Students learn about fish life cycles, habitat needs, food chains, and water quality at rotating stations. Students then hatch kokanee or rainbow trout eggs in a classroom incubator. Angler education instruction followed by an angling clinic and a community stewardship project round out the experience in the spring.

This program, which is supported wholly by grants and volunteer donations of time and dollars, is coordinated and implemented by volunteers from the Central Oregon Flyfishers, the Sunriver Anglers, and the Central Oregon Llama Association.

Oregon Forestry Education Program

Oregon PLT office
Oregon Forestry Education Program
College of Forestry, Oregon State University
146 Forest Research Laboratory
Corvallis, OR 97331-7404
(800) 554-6987
<http://www/cof.orst.edu/cof/extended/ofep/>

The Oregon Forestry Education Program (OFEP) provides interactive workshops in environmental education focusing on forest issues. Each year the OFEP provides dozens of Project Learning Tree workshops for teachers, as well as other forestry-related workshops and forest field trips. The OFEP is part of Oregon State University's College of Forestry.

Programs (continued)

Project Learning Tree

Project Learning Tree (PLT) materials are available only through workshops. Contact the Oregon PLT office, Oregon Forestry Education Program, College of Forestry, Oregon State University, 146 Forest Research Laboratory, Corvallis, OR 97331-7404, (800) 554-6987, <http://www/cof.orst.edu/cof/extended/ofep/> or contact the national office at Project Learning Tree, 1111 19th St., Washington, D.C. 20036, (202) 463-2462, www.plt.org.

PLT is an interdisciplinary environmental education program that uses the forest as a "window" into the natural world. The pre-K-8 activity guide is arranged into five major themes: diversity, interrelationships, systems, management and technology, and society and culture. The PLT curriculum also includes modules for secondary level teachers and students. Each secondary module challenges students to explore the complexity of real-life environmental decisions and incorporate key social science and humanities concepts as well as science and math.

Project WET

The Watercourse
201 Culbertson Hall
Montana State University
Bozeman, MT 59717-0057
(406) 994-5392

Or, contact Project WET coordinator for Oregon at The High Desert Museum, (541) 382-4754.

Project WET is an interdisciplinary water education program intended to supplement a school's existing curriculum. The program facilitates and promotes the awareness, appreciation, knowledge, and stewardship of water resources through the development and dissemination of classroom-ready teaching aids.

Project WILD

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Project WILD and Aquatic Project WILD contain a broad range of interdisciplinary activities focused around environmental and conservation education emphasizing wildlife and water.



Programs (continued)

Salmon and Watershed Education Programs

Education Coordinator
Hatfield Marine Science Center
Oregon Sea Grant
2030 Marine Science Drive
Newport, OR 97365
(541) 867-0257
www.hmsc.orst.edu/

The Sea Grant Marine Education Program at the Hatfield Marine Science Center (HMSC) offers a number of programs that focus on salmon and watersheds. The Hands-On Salmon Laboratory for school children visiting the center allows students to key out salmon fry hatched in the HMSC demonstration salmon hatchery. Northwest RIVERNET works with teachers and students to monitor local streams.

Salmon Watch

Oregon Trout
117 SW Naito Parkway
Portland, OR 97204-3512
(503) 222-9091
www.ortrout.org/

Salmon Watch provides teacher and volunteer training, a comprehensive curriculum, streamside field trips, facilitation and coordination of service learning projects, and funding for transportation and teacher subsidies.

Storm Drain Marking

Contact your local STEP Biologist or Public Works Agency for information.

Kids are making their mark to point out that what goes on the ground flows into the water. By stenciling messages on storm drains and parking lots, children raise community awareness and educate citizens about the ecological hazards of dumping household chemicals into storm drains. Kids paint a fish near storm drains to remind people that everything that goes into a storm drain flows directly, untreated into a freshwater stream or groundwater reserves. They also distribute a brochure, which explains how to properly dispose of materials that pose a potential hazard to fish and water quality, to homes in the area where drains have been marked.

The storm drain marking program is supported by the American Public Works Association. To get involved in a storm drain marking project, contact your local public works jurisdiction. They will loan or help you find sources of the stencils and may be able to provide other materials and instructions needed to complete the project. They can also tell you locations of storm drains in your area and into which streams they drain.



World Wide Web Sites

The addresses of some Web sites included below might not be accurate because of the ever-changing nature of the Internet. If you have trouble accessing a site, try using one of the many search engines that are available on the World Wide Web.

Alaska Aquatic Education Resources

www.state.ak.us/local/akpages/FISH.GAME/sportf/geninfo/aq_ed/aeindex.htm

Contains ideas and activities from Alaska's classroom fish egg incubation program.

Aquatic Invertebrates

education.lanl.gov/resources/ntep95/Aquatic_Insects/Waterbugs.html

Includes Web pages for insect identification and classroom insect activities.

Bonneville Power Administration Resources

www.bpa.gov/corporate/kr/ed/reslist/reslistx.shtml

Try the salmon life cycle hexaflexagon.

British Columbia Salmon Page

www.canfisco.com/bc-salm2.html

Tells the story of salmon in British Columbia.

Central California

www.fix.net/surf/salmon/

Includes classroom fish egg incubation ideas.

Environmental Education Link

eelink.net/classroomresources-directories.html

www.nceet.snre.umich.edu

Includes environmental education Web sites with many links.

Environmental Studies

www.monticello.avenue.gen.va.us/Community/Environ/EnvironEdCenter/habitat

For the Sake of the Salmon

www.4sos.org

For the Sake of the Salmon provides support and expands the work of local watershed groups through grant information for restoration and protection projects and available landowner incentive programs.

The High Desert Museum

www.highdesert.org/

Check this Web site for classes, other resources for teachers, and tours.

Hach Water Test Kits For Educators

www.hach.com/Prod/paeduc.htm

Source of full-range test kits for pH, dissolved oxygen, ammonia, and others.

Hatfield Marine Science Center

www.hmsc.orst.edu/

Includes resources and links to other Web sites.

National Marine Fisheries Service

www.nmfs.noaa.gov/

www.nwr.noaa.gov/

This group administers the endangered species fish listings for the USA.

Oregon Coast Aquarium

www.aquarium.org/

Includes many pictures, resources, and links to other Web sites.

Oregon Department of Environmental Quality

www.deq.state.or.us/

waterquality.deq.state.or.us/wq/

World Wide Web Sites (continued)

Oregon Department of Fish and Wildlife

www.dfw.state.or.us/

This Web site contains much information about the state's fish and wildlife resources. See the Salmon-Trout Enhancement Program and aquatic and angler education links.

Oregon Department of Forestry

www.odf.state.or.us/

Are salmon connected to forests? Check it out.

Oregon Department of Water Resources

www.wrd.state.or.us/

Learn more about water rights in Oregon.

Oregon Museum of Science and Industry

<http://www.oms.edu/>

Update your science curriculum, gain new ideas to excite your students about science and technology, or recharge your own interest in science through OMSI.

The Oregon Plan For Salmon And Watersheds

www.oregon-plan.org/

The Oregon Plan is the State of Oregon's effort to restore salmon, trout, and other aquatic resources to productive and sustainable levels.

Oregon Sea Grant

www.seagrant.orst.edu/links/salmsites.html

This program, which operates out of the Hatfield Marine Science Center in Newport, Oregon, contains many links about salmon.

Oregon Trout

www.ortrout.org/

Oregon Trout's award-winning education programs teach the importance of wild fish conservation and watershed management. Programs include Salmon Watch and Stream Adventure.

Oregon Zoo

www.zooregon.org/

Formerly known as the Washington Park Zoo.

Portland Metro

www.metro.dst.or.us/

Includes information about the Portland area METRO regional government.

Salmon Challenge

<http://dnr.metrokc.gov/wlr/waterres/salmonch.htm>

This Web site is an interactive online voyage.

Science and Mathematics Consortium for Northwest Schools

www.col-ed.org/smcnws

The consortium is one of ten regional consortia across the country. Its purpose is to provide catalytic support that will broaden the effect, accelerate the pace, and increase the effectiveness of improvements in the region's science and mathematics education. Web site includes information about all SMCNWS project activities and ensures access to project resources and services.

The Salmon Page

www.riverdale.k12.or.us/salmon.htm#k-12

A comprehensive salmon resource with many additional links.

"A Snapshot of Salmon in Oregon"

<http://eesc.orst.edu/salmon/>

One of the most balanced publications about the salmon issue.

Seattle Public Utilities

<http://www.ci.seattle.wa.us/util/RESCONS/default.htm>

This is the Conservation and Environment Web page from Seattle Public Utilities. It includes many salmon-friendly hints.

World Wide Web Sites (continued)

Stream Studies Page

www.wsrv.xlas.Virginia.EDU/~sos-iwla/StreamStudy/StreamStudyHomePage/StreamStudy.HTML

Provides many resources about stream studies.

Trout In The Classroom Online

www.newberg.k12.or.us/ey/html/trout.html

This Oregon Web site is designed for educators and students involved in the classroom fish egg incubation program. It provides educators and students with quick access to resources designed to enrich the egg hatching experience.

Trout Unlimited

<http://www.tu.org/>

Trout Unlimited's mission is to conserve, protect and restore North America's trout and salmon fisheries and their watersheds. They accomplish this mission on local, state and national levels with an extensive and dedicated volunteer network.

U.S. Bureau of Land Management

www.or.blm.gov/

U.S. Bureau of Land Management for Oregon and Washington offices. Includes links to other Web sites.

U.S. Environmental Protection Agency

www.epa.gov/r10earth

Features many links to items of environmental concern, including www.yahoo.com/Government/Agencies/Independent/Environmental Protection Agency EPA and www.epa.gov/OWOW/305b for reports about water quality.

U.S. Fish and Wildlife Service

<http://www.fws.gov/>

Includes many valuable links to other Web sites and access to education materials you may download.

U.S. Forest Service

<http://www.fs.fed.us/>

National Web page for the U. S. Forest Service, which is under the Department of Agriculture (USDA). Search for the National Forest nearest you for more local connections. Each local office has experts on fish to fungus.

U.S. Geological Survey, Oregon Water Studies, Teacher Page

<http://www.usgs.gov/education/>

This group monitors water resources throughout the country.

Water Department

Use your favorite search engine to locate the Web site for your municipal water department. Not all municipalities maintain a Web site.

Water Education Site

<http://www.uwex.edu/erc/ywc/sumlist.htm>

Includes a list of 100 curricula for educating youth about water.

Water Education Related Web Sites

<http://www.dnr.state.oh.us/odnr/water/educate/edulinks.html>

Contains links to many water education related Web sites.

Watershed Councils

Use your favorite search engine to locate the Web site of your local watershed council. Not all watershed councils maintain a Web site.

World Forestry Center

<http://www.worldforest.org/>

Includes more Internet connections to forest-related Web sites.

Videotapes

A Good and Careful Harvest (Commercial Fishing)

Department of Fisheries and Oceans
Communications Branch
Suite 400-555 West Hastings St.
Vancouver, BC V6B5G3
(604) 666-1847

12 minutes, 1987, videotape, e-j-s

This videotape is part one of a trilogy narrated by children. A young girl and boy discuss the gear and operations of commercial salmon boats (gillnetter, seiner, troller).

Part 2: Fishing is Fun

Part 3: Silver Swimmers

Birth of a Salmon

Department of Fisheries and Oceans
Communications Branch
Suite 400-555 West Hastings St.
Vancouver, BC V6B5G3
(604) 666-1847

6 minutes, 1976, e-j-s

The complex workings of salmon embryology are simplified and beautifully photographed in this short presentation.

Cascade Watershed: The Sandy River Basin

Northwest Film and Video Center
1219 SW Park Avenue
Portland, OR 97205
(503) 221-1156
21 minutes, 1987, video, j-s-c-a
Rental: \$20.00

The Sandy River, a major tributary of the Columbia River, springs from Sandy and Reid Glaciers on Oregon's Mt. Hood and travels its 57-mile channel from wilderness to urban development. Advanced students in Experiential Biology at Cleveland High School investigated the varied wildlife and habitats of the river and consulted with professional biologists and representatives from environmental organizations to produce this visual introduction to the study of watersheds.

The Coho Salmon Puzzle

Washington Dept. of Natural Resources
9701 Blomberg Street SW
Olympia, WA 98504
(360) 902-1609

20 minutes, 1989, videotape, s-c-a
nominal fee for duplication

This well-produced videotape explores the history and habitats of coho salmon throughout a large river basin. It focuses on the interrelationships of spawning and rearing habitats and on the importance of floodplains, wetlands, and tributaries as winter habitats.

Fishing is Fun

Department of Fisheries and Oceans
Communications Branch
Suite 400-555 West Hastings St.
Vancouver, BC V6B5G3
(604) 666-1847

12 minutes, 1987, videotape, e-j-s

This videotape is the second part of a trilogy narrated by children. The intrinsic as well as the extrinsic aspects of sport fishing are examined through a young boy's experience.

Part 1: A Good and Careful Harvest

Part 3: Silver Swimmers



Videotapes (continued)

Healthy Watersheds

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration Building
Corvallis, OR 97331-2119
(541) 737-2513

20 minutes, 1994, color videotape, e-j-s-c-a
\$20.00 (includes s/h); Order #VTP 019

This videotape takes viewers to the Cascade Mountains of Central Oregon where students from nearby towns learn to analyze their local watersheds. It examines all parts of a watershed, including streams, stream life, soils, vegetation, wildlife, and humans. It emphasizes the interdependence of a watershed's individual elements and the consequences of removing or damaging even one of the elements. The video demonstrates a variety of watershed survey techniques and discusses their importance in managing various resources.

Life Cycle of the Anadromous Salmonid

Jeff Self
Washington Elementary School
3322 Dolbeer Street
Eureka, CA 95503
(707) 441-2547
(707) 441-3323 (FAX)
20 minutes, 1988, j-s-c-a
\$20.00

This videotape highlights the salmon's life cycle with beautiful photography and an easy-to-follow narrative.

Macroinvertebrates and the River Continuum

Oregon Department of Fish and Wildlife
PO Box 59
Portland, OR 97207
(503) 872-5264
20 minutes, 1990, j-s-c-a
\$8.00 + \$2.50 s/h; Call for order form.

This videotape includes instructions for sampling aquatic invertebrates, discusses the river continuum, and the relationship of aquatic invertebrates to fish populations. It is designed for use with **The Stream Scene: Watersheds, Wildlife, and People**.

Return of the Salmon

Videotape Orders
Oregon Sea Grant Communications
ADS 402, Oregon State University
Corvallis, OR 97331
(800) 375-9360 or (541) 737-2716
30 minutes, 1995, videotape, j-s-c-a
\$25.00 purchase, \$5.00 rental
Order # ORESU-V-95-001

Knowledgeable observers from the Northwest give their views on the effects and meaning of the salmon decline. The complex factors contributing to the salmon decline are shown, including habitat loss and damage, overfishing, the inadequacy of hatcheries, and unfavorable ocean conditions. The video concludes with coastal residents describing how they are taking action to restore the salmon.

Silver Swimmers

Department of Fisheries and Oceans
Communications Branch
Suite 400-555 West Hastings St.
Vancouver, BC V6B5G3
(604) 666-1847

12 minutes, 1987, videotape, e-j-s

Third in a trilogy of videotapes narrated by children; a young native Indian boy observes and comments on the traditional and modern day fishing and preserving methods.

Part 1: A Good and Careful Harvest

Part 2: Fishing is Fun

Videotapes (continued)

Strangers in Our Waterways

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration Building
Corvallis, OR 97331-2119
(541) 737-2513
28 minutes, 1994, videotape, j-s-c-a
\$30.00

Goldfish, carp, largemouth bass, brown trout, zebra mussels, mysis shrimp, and aquarium plants — What do all these seemingly unrelated organisms have in common? In their native waters, these organisms are benign. But when transplanted to other waters, they may cause problems for native organisms. These problems may lead to an unbalanced ecosystem, affecting many other organisms and species, including humans. This video reveals how the introduction of nonnative organisms, such as fish, shellfish, and even aquarium plants, have affected native organisms in and around our waterways. While there are no easy solutions to the problem, there are ways to avoid making it worse. This video explores research to help reduce or prevent negative impacts of nonnative species.

Way of a Trout

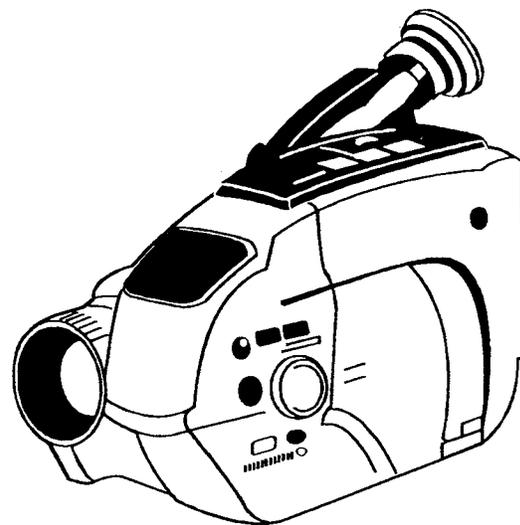
Trout Unlimited
1500 Wilson Blvd., #310
Arlington, VA 22209
(703) 284-9421
30 minutes, color videotape, j-s-c-a
\$30.00 plus shipping

This videotape covers a year in the life of a trout and the many pitfalls a fish must face throughout its life.

We All Live Downstream

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration Building
Corvallis, OR 97331-2119
(541) 737-2513
29 minutes, 1996, color videotape, j-s-c-a
\$30.00; Order # VTP 021

This educational videotape examines Oregon's Tualatin River, a waterway that struggles to survive under pressure from nonpoint source pollution. Its subject matter has implications for most every watershed in the country. Like many fresh water surface and groundwater supplies across our nation, the Tualatin absorbs pollution from a variety of sources. The video covers how local residents and government officials are trying to reduce nonpoint source pollution. It also offers tips to help each of us play an active role in cleaning up our nation's drinking water supplies.



Computer Programs

Exploring the Nardoo River

The Learning Team
(800) 793-TEAM

This interactive compact disc was developed with National Science Education Standards in mind. Students explore the ecology of an imaginary river, as well as its biology, chemistry, and physical science.

Salmon Odyssey

School Edition \$79.95

Ingenuity Works

(800) 665-0667

www.ingenuityworks.com

This interactive simulation is designed to teach higher-level thinking skills. As the salmon travels down the river, out to the ocean, and back up the river, there are many possible problems to solve. Designed for grades 4 and up, this cross-curricular program covers science, social studies, and language arts. Macintosh only. Call for PC availability.

Tom Snyder Productions

(800) 342-0236

www.teachtsp.com/index.html

This company has many compact disc and computer-based interactive activities on a wide range of subjects. Many are environmental based, involve critical thinking skills, and can be used with one computer in a classroom. Call for a catalog.

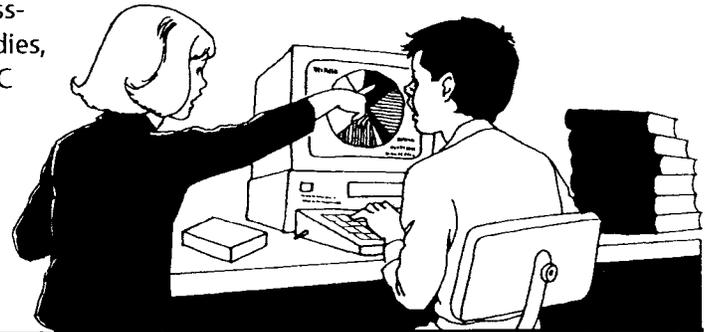
Water You Doing

Seattle Public Utilities

Order from the Seattle Aquarium.

(206) 386-4353

The material applies to the Puget sound area, but can be transferred to other watersheds. It includes many video clips, information, and activities. Under \$10 for educators.



Posters

Check visitor's centers, U.S. Forest Service offices, museum gift shops, and other natural resource offices as additional sources of posters for your classroom.

Acid Rain Posters

Clearing

Environmental Learning Center

19600 S. Molalla Avenue

Oregon City, OR 97045

(503) 657-8400

\$2.75 + s/h

Pacific Salmon Life Cycle

Education Coordinator

Alaska Department of Fish and Game

333 Raspberry Road

Anchorage, AK 99518

(907) 267-2265

nominal fee for s/h

Posters (continued)

Pacific Salmon Of North America Poster

Timothy Colman, Publisher
Good Nature Publishing Company
1904 Third Avenue #415
Seattle, WA 98101
(800) 631-3086
www.goodnaturepublishing.com
two sizes; \$16.00 or \$14.99 + \$5.00 s/h
Features color illustrations of all five Pacific salmon and the steelhead.

Salmon Alphabet Poster

BCTF Lesson Aids
#100 – 550 W. 6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181
full color, 48 x 80 cm, \$10.00 + 20% surcharge
for non-BCTF members
Includes illustrated salmon words from A to Z.

Salmon Come Back

Adopt-A-Stream Foundation
600 128th Street SE
Everett, WA 98208
18" x 24," \$12.00
Features full color migrating salmon design
with black border. Created for Adopt-A-Stream by
artist Sandra Noel.

Salmon Life Cycle Posters

BCTF Lesson Aids
#100 – 550 W. 6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181
\$18.00 + 20% surcharge for non-BCTF
members
Eight posters showing the life stages of a
salmon. Catalog available.

A Stream Continuum

Oregon Chapter American Fisheries Society
PO Box 722
Corvallis, OR 97339
(541) 753-0442
educators: \$4.00 s/h
others: \$10.00 + s/h

Trout, Salmon, and Char of North America

Ed Lusch
Windsor/Nature Discovery LLC
1000 S. Bertelson #14
Eugene, OR 97402
(800) 635-4194
\$10.95 + s/h
Call for catalog.

Miscellaneous Props

Puppets

BCTF Lesson Aids
#100 – 550 W. 6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181
\$45.00 + 20% surcharge for non-BCTF
members
Five, well-made stylized sock puppets of the
salmon life cycle stages (egg, alevin, fry, adult,
spawner).

Stuffed Dissection Fish

Pacific Seam Works
3731 Winston Cr.
Victoria, BC V8X 1S2
(250) 388-3730
corrine@pinc.com
\$275 Canadian + s/h
Fabric likeness of a coho salmon is an excel-
lent resource for fish dissections with any salmo-
nid species. You can easily remove all internal
parts, which attach with velcro.

Games

Upstream Racers – An Educational Board Game

BCTF Lesson Aids
#100 – 550 W. 6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181
\$18.00 + 20% surcharge for non-BCTF members

Includes a colorful game board, rules, die, pawns and predator capture canisters, plus 20 pages of related learning activities.

Plays

Fish in the Floodlights

BCTF Lesson Aids
#100 – 550 W. 6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181

Includes nine short dramas that are ideal for theme units and integrated activities.

Temperature Data Loggers

Onset Computer Corporation

PO Box 3450
Pocasset, MA 02559-3450
(508) 759-9500
<http://www.onsetcomp.com/>

Onset makes data loggers, electronic instruments that record measurements (temperature, relative humidity, light intensity, on/off, open/closed, voltage, pressure and events) over time, and software for analysis.

Maps

Pacific Northwest Watersheds Map

Timothy Colman, Publisher
Good Nature Publishing Company
1904 Third Avenue #415
Seattle, WA 98101
(800) 631-3086
www.goodnaturepublishing.com

Oregon Drainage Basin Maps

Oregon Water Resources Department
Commerce Building
158 12th St. NE
Salem, OR 97310
(800) 624-3199
www.wrd.state.or.us/publication/pdfs/publist99.pdf

See pages 6–8 for map choices; see page 9 for order form.

D-Frame Nets

Wards Natural Science Establishment

5100 West Henrietta Rd.
PO Box 92912
Rochester, NY 14692-9012
(800) 962-2660



Equipment

Discovery Scope

Carolina Biological Supply
(800) 334-5551
\$32.00 each, part #D8-95-3735

Discovery Scope® is an ideal tool for observing the microworlds of life that surround us. It's a small, hand-held, micro-macro viewing system — a type of portable microscope that is sturdy and easy to use anywhere.

Aquariums

Contact your local STEP Biologist (See page 41.) for a copy of the **Fish Eggs To Fry** manual. Page 17 of this manual describes all the equipment you need to complete a classroom incubator project. Some items may vary depending on the type of air circulation and cooling systems chosen. Consult with an aquarium supply store about availability and cost. (Check local Yellow Page listings.) In some areas, local conservation organizations sponsor costs of a classroom incubator system. Check with your local STEP Biologist for a list of organizations who may be willing to sponsor your project. Here are the minimum items you need:

- 10 or 20 gallon aquarium
- gravel
- undergravel filter
- riser tubes
- powerhead or air pump
- refrigerator or other cooling unit (See pages 54-56 in **Fish Eggs To Fry**.)
- 5 gallon buckets

Water Quality Test Kits

Hach Co., Inc.

PO Box 389
Loveland, CO 80539-9986
(800) 227-4424

Cole-Palmer

72245 North Oak Park Avenue
Chicago, IL 60648
(800) 323-4340

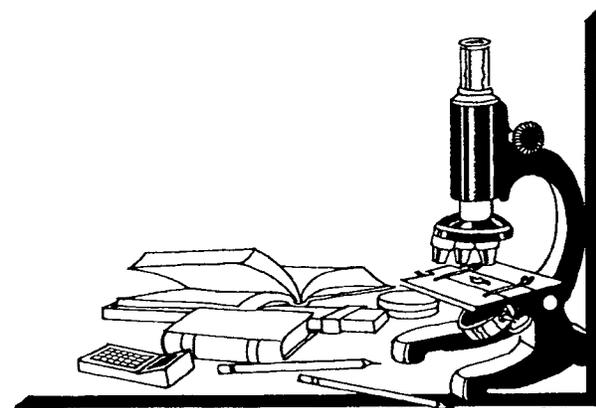
CHEMetrics, Inc.

Route 28
Calverton, VA 22106
(800) 356-3072

LaMotte Chemical Products Co.

PO Box 329
Chestertown, MD 21620
(800) 344-3100

Check your local Yellow Page listings for aquarium supply stores in your area. Most carry a variety of inexpensive water quality test kits suitable for a classroom fish egg incubation project.



Field Trips

Oregon is rich with potential field trip sites that are too numerous to mention in this guide. Contact your local STEP Biologist or ODFW office to find the most suitable local field trip locations to see fish hatcheries, fish ladders, rearing ponds, spawning areas, and other appropriate sites.

For information about other field trip possibilities and programs related to fish and watersheds, contact Oregon Coast Aquarium (541) 867-3474, Hatfield Marine Science Center (541) 867-0100, and The High Desert Museum (541) 382-4754.

Classroom Speakers

Every local community has at least one member who is knowledgeable about fish. These people are often willing to visit a classroom and share their knowledge. Begin with your own students. Ask if any of their parents work in fish-related industries or for related government agencies. Check with local fishing shops, conservation organizations, or others to find local experts.

Want something special? Contact
your local STEP Biologist for ideas!



Traveling Trunks

Many museums, agencies, and other institutions have created "trunks" filled with books, props, activities, lesson plans, children's literature, and other items related to various topics. Most trunks require a nominal fee plus return shipping costs. Check with your local sources, or use these ideas:

- In some areas, the Oregon Department of Fish and Wildlife loans fish eggs to fry sample displays, a trunk filled with pelt kits, and various animal displays. Contact your local ODFW office for more information.
- See the Oregon Museum of Science and Industry Web site for ideas. www.oms.edu/
- Contact The High Desert Museum for trunks related to insects, water history, and other topics. (541) 382-4754
- See the World Forestry Center Web site for ideas. www.worldforest.org/
- See the Oregon Zoo Web site for ideas. www.zooregon.org/
- Contact the U.S. Fish and Wildlife Service for information about endangered species kits. (541) 867-0100 or www.fws.gov/
- See the Oregon Sea Grant Web site for ideas. <http://seagrants.orst.edu/links/salmsites.html>

Of People and Fish - A 4-H Natural Resources and Culture Discovery Program

For coastal areas contact:

Sea Grant Education Coordinator
Hatfield Marine Science Center
2030 Marine Science Drive
Newport, OR 97365
(541) 867-0100

For Willamette Valley corridor or other statewide areas contact:

4-H Natural Science Specialist
Oregon State University Extension
Oregon 4-H Education Center
5390 4-H Rd. NW
Salem, OR 97304
(503) 371-7920

Five loaner kits are based at both the Hatfield Marine Science Center in Newport and the Oregon 4-H Education Center in Salem. The tool kit includes videos, books, reusable materials, a teacher's guide and learner copy pages to engage students in lessons about the interactions of people and fish in the Pacific Northwest. Beginning with the time of Lewis and Clark, students explore both the Native American and Euro-American philosophies of resource management, culminating in a discussion of how fishery management decisions are made today. Lessons are keyed to the Oregon grade 5 benchmarks for science, social science, and English.



Children's Literature

Adventures of Tom Sawyer

Mark Twain, Scholastic, Inc

The American classic adventure of a boy growing up in a 19th century Mississippi River town. Gr. 4-7

Alejandro's Gift

Richard E. Albert

Lonely in his house beside a road in the desert, Alejandro builds an oasis to attract the many animals around him.

Amazing Fish

Mary Ling, Alfred A. Knopf

Introduces memorable members of the fish world, explains what makes them unique, and describes important characteristics of the entire group.

Amazing Water Big Book

Melvin Berger, Newbridge Communications

Animal Encyclopedia for Children

Roger Few, Scholastic Inc.

An encyclopedia of animals, arranged according to their habitats.

Argyle Turkey Goes to Sea

James E. Davis, DLM Teaching Resources

On the way to see a whale in the ocean, Argyle Turkey sees a pond, a stream, a swamp, a lake, a river, a waterfall, and finally, a whale in the bay. Preschool-Gr. 3

At the Pond

David M. Schwartz, Creative Teaching Press, Inc.

Examines the life in and around a pond, including bullfrogs, crayfish, and snapping turtles.

Beavers

Theresa Desmond, Scholastic Inc.

Based on the IMAX/OMNIMAX motion picture.

Beavers Beware!

Barbara Brenner, Bantam Books

A family with a house on the river finds two beavers cutting down trees and building a lodge on their dock. A Bank Street Ready-to-Read book. Preschool-Gr. 3

Chemistry Experiments for Children

Virginia L. Mullin, Dover Publications

Gives directions for many simple chemistry experiments, including descriptions of necessary equipment, principles, techniques, and safety precautions.

Come Back Salmon

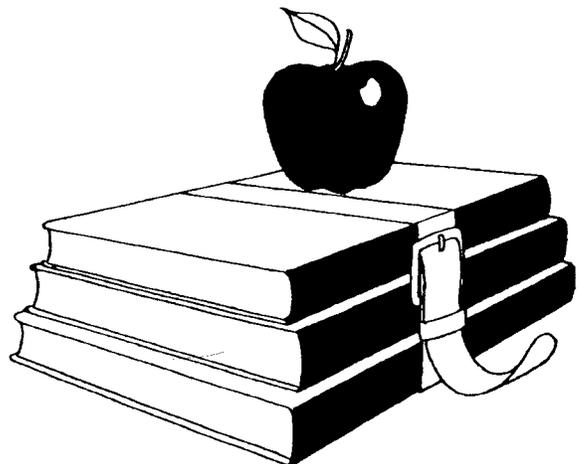
Molly Cone, Little Brown and Co.

True story of a group of students that helped reclaim a local stream so that salmon could once again spawn there. Gr. 3-6

Danger on Midnight River

Gary Paulson, Dell Publishers

World of adventure story.



Children's Literature (continued)

Davy Crockett and the King of the River

A.L. Singer, Disney Press

Based on the Walt Disney television show.

A Drop of Water

Walter Wick, Scholastic Inc.

Describes the origins, characteristics, and uses of water.

Earth

Patricia Daniels, National Geographic Society

Examines the composition and surface characteristics of the Earth, describing such features as rivers, mountains and other land formations, and various vegetation regions.

Experiment With Water

Bryan Murphy, Scholastic Inc.

Presents simple experiments demonstrating the basic scientific principles of water.

Fish

Gallimard Jeunesse, Scholastic Inc.

Introduces the physical characteristics, behavior, and habitat of various fish.

Fish

Jane P. Resnick, Kidsbooks, Inc.

28 pages, color illustrations

Fish

Elizabeth Schleichert, National Geographic Society

Discusses the physical characteristics of fish and examines different kinds, including sharks, eels, and catfish.

Fish and How They Reproduce

Dorothy Hinshaw Patent, Holiday House

Describes the general characteristics of different kinds of fish, with emphasis on their varied reproductive processes.

Fish Eyes

Lois Ehlert, Scholastic Inc.

A counting book. Depicts the colorful fish a child might see if he turned into a fish.

Preschool–Gr. 3

A Fish Hatches

Joanna Cole and Jerome Wexler, William

Morrow and Co., NY

1978

A Fish in His Pocket

Denys Cazet, Scholastic Inc.

Fish Is Fish

Leo Lionni, Scholastic Inc.

A minnow wants to follow his tadpole friend, who becomes a frog, onto land. Preschool–Gr. 3



Children's Literature (continued)

Freshwater Alphabet Book

Jerry Pallotta, The Trumpet Club

A colorful alphabet book introducing some familiar and some unusual aquatic animals.

Preschool–Gr. 3

Going Fishing: A Story Set in Bangladesh

Rachel Warner, Scholastic Inc.

Hang on Hopper!

Marcus Pfister, Scholastic Inc.

Hopper the Arctic hare attempts a shortcut across a river even though he cannot swim.

The Hole in the Dike

Norma Green, Scholastic Inc.

When a young boy in Holland sees a small trickle of water leaking through the dike, he bravely spends the night with his finger in the hole in order to save his country from a flood.

Preschool–Gr. 3

How Many Fish?

Rachel Gosset, Scholastic Inc.

Beginning readers count the fish in ponds, lakes, and streams. Preschool–Gr. 1

In a Small, Small Pond

Denise Fleming, Scholastic Inc.

A rhyming text describes the seasonal changes in a frog's little pond. Preschool–Gr. 2

In the Footsteps of Lewis and Clark

Gerald S. Snyder, National Geographic

215 pages, illustrations, maps

Jump, Frog, Jump!

Robert Kalan, Scholastic, Inc.

Life in the Water

Time-Life Editors, Time-Life Books, Inc.

Questions and answers present information about aquatic animals such as sharks, crabs, fish, frogs, and barnacles. Includes an activities section.

Little Beaver and the Echo

Amy MacDonald, The Trumpet Club

Unaware that the voice from across the pond telling him he's lonely is his echo, a little beaver sets out to make a friend of that voice, encountering real animal friends on the way.

Loon at Northwood Lake

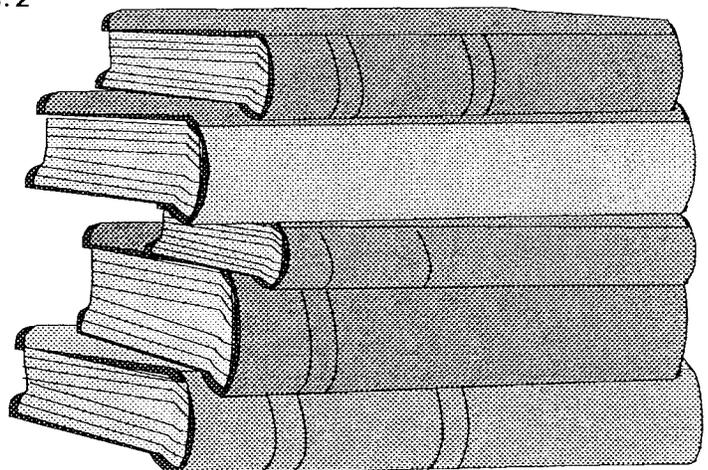
Elizabeth Ring, Soundprints

Loon and his mate protect their chicks from curious people, egg-hunting eagles and hawks, and ferocious pike throughout a summer at Northwood Lake.

The Lost Lake

Allen Say, Houghton Mifflin Co.

A young boy and his father become closer friends during a camping trip in the mountains.



Children's Literature (continued)

Magic School Bus at the Waterworks

Joanna Cole, Scholastic Inc.

When Ms. Frizzle, the strangest teacher in school, takes her class on a field trip to the waterworks, everyone ends up experiencing the water purification system from the inside.

McElligot's Pool

Dr. Seuss, Random House

A young boy fishes in McElligot's pool with high hopes. Gr. K-3

Mike Fink

Steven Kellog, Scholastic Inc.

Relates the extraordinary deeds of the frontiersman who became King of the Keelboatmen on the Mississippi River.

The Missouri River Country of Montana and North Dakota

Tom Thayer, "Montana Speaks"

One Duck Stuck

Phyllis Root, Scholastic Inc.

In this counting book, increasingly larger groups of animals try to help a duck that is stuck in the sleepy, slimy marsh.

175 Science Experiments to Amuse and Amaze Your Friends

Brenda Walpole, Random House

Instructions for 175 experiments, tricks, and creations that illustrate the principles of light, water, movement, and air.

Over the Steamy Swamp

Paul Geraghty, Harcourt Brace Jovanovich

A hungry mosquito starts a food chain in a steamy swamp as each hungry animal both preys and is preyed upon. Preschool-Gr. 3

Paddle to the Sea

Holling Clancy Holling, Houghton Mifflin Company

The journey of an Indian boy in a small canoe traveling from Lake Superior to the Atlantic Ocean. Gr. 3-6



Children's Literature (continued)

Rain Drop Splash

Alvin Tresselt, Scholastic Inc.

Rain becomes a puddle, then a lake, and grows larger and larger until it reaches the sea. Preschool–Gr. 3

The River

Gallimard Jeunesse, Scholastic Inc.

River Life

Barbara Taylor, Dorling Kindersley Inc.

Examines, in text and photographs, the various animals and plants that live in and along a river.

A River Ran Wild: An Environmental History

Lynne Cherry, Harcourt Brace Jovanovich Publishers

An environmental history of the Nashua River, from its discovery by Indians through the polluting years of the Industrial Revolution to the ambitious cleanup that revitalized it. A Reading Rainbow book. Gr. 1–4

Rivers and Oceans

Barbara Taylor, Kingfisher Books

Introduces the different forms of water in our world; the water cycle; stages in the life of a river; ocean currents, waves, and tides; lakes; and water pollution.

A Salmon for Simon

Betty Waterton, Groundwood Books

Simon, a young Native boy, has been trying to catch a salmon all summer but when the opportunity finally arrives he must decide whether to take it home or let it go. Gr. K–4

Snake River Country

Bill Gulick, Caxton Printers

195 p. col. illus.

Squishy, Misty, Damp and Muddy, The In-Between World of Wetlands

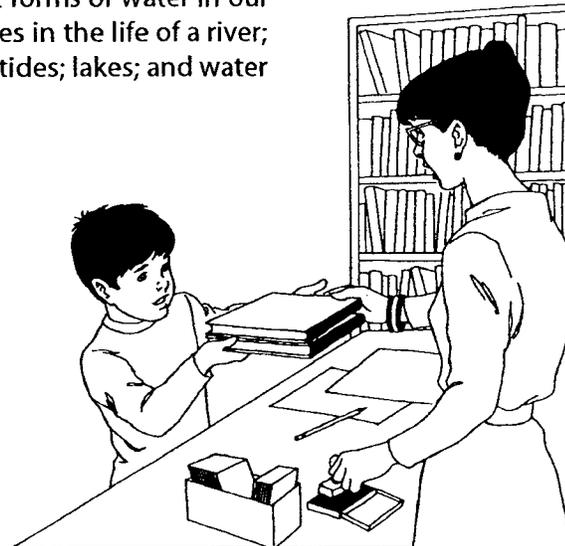
Molly Cone, Sierra Club Books

An introduction to the many kinds of wetlands, their importance in our lives, the plants and animals that live there, and why we must work to preserve these habitats. Gr. K–6

Swimmer

Shelley Gill, PAWS IV Publishing

The story of the Chinook salmon. Swimmer's journey over 10,000 miles illustrates the cycles of life for the salmon and the girl Katya, who is coming of age. Gr. K–6



Children's Literature (continued)

Three Days on a River in a Red Canoe

Vera B. Williams, Scholastic Inc.

Mother, Aunt Rosie, and two children make a three-day camping trip by canoe.

Water Dance

Thomas Locker, Harcourt, Brace and Company

An innovative and beautiful picture book that follows water's constant dance—a poetic text and complementary paintings contain hundreds of fascinating facts about water. Gr. K-6

Water, Precious Water

Judith Hillen, AIMS Education Foundation

Water, The Source of Life

Diane Costa De Beauregard, Scholastic Inc.

Water's Way

Lisa Westberg Peters, Scholastic Inc.

Tony watches water change from clouds to rain to frost, until it finally becomes snow, and he can try his new sled. Preschool-Gr. 3

Water, Water Everywhere

Joan Wade Cole, The Economy Co.

What Makes it Rain? The Story of a Raindrop

Keith Brandt, Troll Associates

Gr. K-3

Where the River Begins

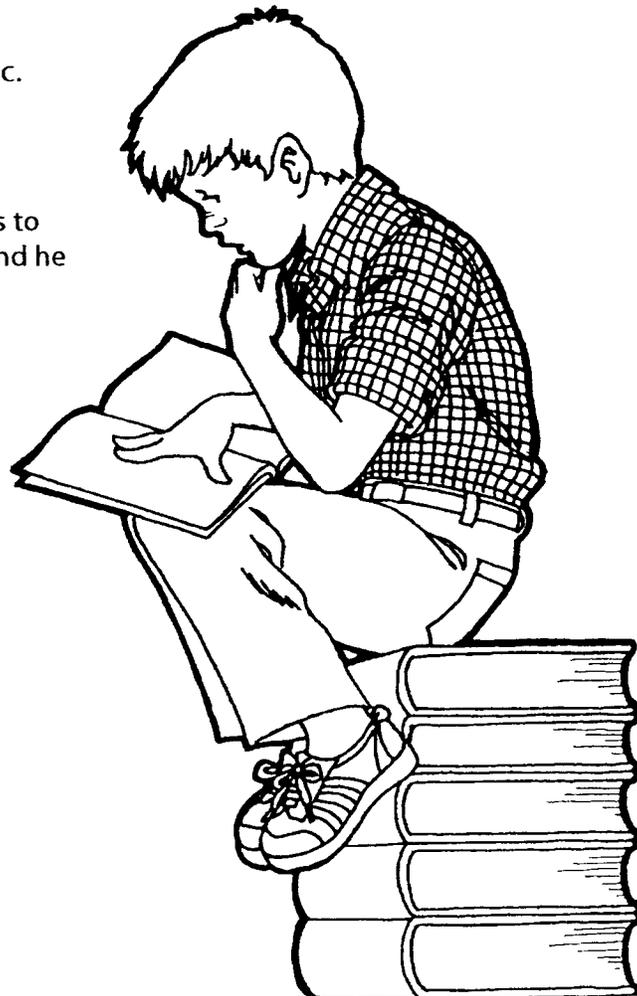
Thomas Locker, Puffin Books

Two boys and their grandfather camp and hike to follow the river to its source. Gr. K-3

Wind in the Willows

Kenneth Grahame, Puffin Books

The escapades of four animal friends who live along a river in the English countryside—Toad, Mole, Rat, and Badger.



Chapter 4

Salmon-Trout Enhancement Program



What Is STEP?

Recognizing that volunteers could play an important role in the restoration of native stocks of salmon, steelhead and trout, the Oregon Legislature created the Oregon Department of Fish and Wildlife's (ODFW) Salmon-Trout Enhancement Program (STEP) in 1981.

Since that time thousands of volunteers have assisted Oregon's fisheries through their involvement in STEP. They have donated money, materials, equipment, and countless hours of time and labor. STEP volunteers have completed stream habitat restoration work, conducted surveys, helped with education projects, and hatched and reared several million salmon and trout eggs — all because they care about fish and fish habitat.

What Can A STEP Volunteer Do?

Interested citizens can help in many ways, from data collection and management to habitat restoration or education. Volunteer projects and opportunities are defined by the diversity of fish resource management needs found throughout Oregon.

Each of Oregon's watersheds has its own fish management priorities. Local biologists determine what must be done and identify ways volunteers can help.

Many fish projects simply could not happen without volunteers. Volunteers provide the extra effort needed to get the job done. Volunteer participation also frees up ODFW staff time and dollars for other important work.

Surveys

Volunteers help determine the status of fish populations and the condition of stream and lake habitats through a variety of survey projects. **Aquatic Habitat Inventories** provide information about the quality of fish habitat in streams. **Fish Population Surveys** determine the species present, their abundance, and distribution within a given stream. **Spawning Surveys** document the amount of spawning activity in a stream system. Some surveys are part of annual efforts to track a population trend within a basin. Others determine the potential impacts of proposed land use activities.

Another survey might document migration barriers caused by poorly functioning culverts. Others measure streamflows or monitor water temperatures to develop stream temperature profiles, and photographic surveys follow habitat changes over time.

Habitat Restoration

Biologists use the information gathered during surveys to identify factors that may limit fish production. For example, a stream

survey might show few pools or a lack of spawning gravel, barriers to fish passage, or summer monitoring might reveal extreme water temperatures. Once needs are identified, habitat restoration projects can be designed to address those needs. Volunteers can assist with all phases of habitat restoration. These include help with funding, site selection, project design, construction and placement, equipment donation and operation, photo monitoring, and report writing.

Fish Culture

In those waters where natural production does not meet fish management needs, STEP volunteers may be asked to help with fish culture efforts. Volunteers can assist ODFW personnel with broodstock collection, egg incubation, and fish rearing activities. The work may take place at an ODFW facility or at a volunteer-operated site that complements public hatcheries.

Education

The STEP program distributes a number of publications to promote public awareness and understanding of fish and wildlife habitat needs and to show how citizen volunteers can participate in STEP activities. Publications include **The Stream Scene**, a curriculum package about watersheds, upland and riparian areas, streams, and aquatic organisms. **Storm Drain Marking** is a program to educate citizens about the ecological hazards of dumping household chemicals into storm drains. **Fish Eggs To Fry** is a tool for setting up and maintaining a classroom aquarium to hatch fish eggs. **An Educator's Resource Guide for Hatching Salmon and Trout in the Classroom** directs teachers to sources of fisheries lessons and other support material. **Why Wild?** is a supplement to help students understand how fish are adapted to their

native streams. **Stream Care** is a landowner's guide for protecting and enhancing stream habitat.

Other Projects

Many fish management tasks provide opportunities for volunteer involvement. Some volunteers may snorkel a clear mountain stream in search of an endangered native trout or perhaps others enjoy entering data at a computer terminal. Still other volunteers might try fish salvage, fin clipping, fish stocking, or equipment maintenance. Volunteers also suggest projects like streamside plantings, identifying fish passage barriers, and acquiring access for anglers.

What's In It For Me?

STEP is a growing program and Oregonians are eager to contribute time, muscle, money, and perseverance. The combined effort of all STEP volunteers has made an important and measurable impact toward conservation of Oregon's valuable fish resources. Participants also benefit. Volunteers come away with a better understanding of fish and the systems upon which they depend. And, they achieve a strong sense of personal accomplishment through their hard work. Do you want the satisfaction of knowing your stewardship helps fish? Come join us. You'll be glad you did.

How Can I Get Involved?

Contact the nearest STEP Biologist or ODFW office to learn more about the needs in your area. Sign up today as a STEP volunteer — Oregon's fish need your help now!

STEP Biologists

**Lower Columbia
STEP Biologist**
17330 SE Evelyn Street
Clackamas, OR 97015
(503) 657-2000 ext. 235

**Coos-Coquille
STEP Biologist**
PO Box 5430
Charleston, OR 97420
(541) 888-5515

**Eastern Oregon
STEP Biologist**
61374 Parrell Road
Bend, OR 97702
(541) 388-6363

**South Coast
STEP Biologist**
PO Box 642
Gold Beach, OR 97444
(541) 247-7605

**Mid-Willamette
STEP Biologist**
7118 NE Vandenberg Ave.
Corvallis, OR 97330
(541) 757-4186

**North Coast
STEP Biologist**
4909 Third Street
Tillamook, OR 97141
(503) 842-2741

**Umpqua
STEP Biologist**
4192 N. Umpqua Highway
Roseburg, OR 97470
(541) 440-3353

**Mid-Coast
STEP Biologist**
2040 SE Marine Science Drive
Newport, OR 97365
(541) 867-4741

**Upper Willamette
STEP Biologist**
3150 E. Main Street
Springfield, OR 97478
(541) 726-2539

**Upper Rogue
STEP Biologist**
1495 E. Gregory Road
Central Point, OR 97502
(541) 826-8774

STEP Coordinator
PO Box 59
Portland, OR 97207
(503) 872-5252



Oregon Department of Fish & Wildlife Regional and Watershed District Offices

**NW REGIONAL OFFICE
North Willamette
Watershed District Office**
17330 SE Evelyn Street
Clackamas, OR 97015
(503) 657-2000

**South Willamette
Watershed District Office**
7118 NE Vandenberg
Avenue
Corvallis, OR 97330
(541) 757-4186

**North Coast Watershed
District Office**
4909 Third Street
Tillamook, OR 97141
(503) 842-2741

Astoria Field Office
2021 Marine Drive, Rm. 101
Astoria, OR 97103
(503) 338-0106

Newport Field Office
2040 Marine Science Center
Drive
Newport, OR 97365
(541) 867-4741

Salem Field Office
4412 Silverton Road NE
Salem, OR 97305
(503) 378-6925

Sauvie Island Field Office
18330 NW Sauvie Island
Road
Portland, OR 97231
(503) 621-3488

Oregon Department of Fish and Wildlife

Springfield Field Office
3150 East Main
Springfield, OR 97478
(541) 726-3515

Corvallis Research Lab
28655 Highway 34
Corvallis, OR 97333
(541) 757-4263

**SW REGIONAL OFFICE
Umpqua Watershed
District Office**
4192 N. Umpqua Highway
Roseburg, OR 97470
(541) 440-3353

**Rogue Watershed District
Office**
1495 E. Gregory Rd.
Central Point, OR 97502
(541) 826-8774

Charleston Field Office
PO Box 5430
63538 Boat Basin Drive
Charleston, OR 97420
(541) 888-5515

Gold Beach Field Office
PO Box 642
29907 Airport Way
Gold Beach, OR 97444
(541) 247-7605

**NE REGIONAL OFFICE
Grand Ronde Watershed
District Office**
107 - 20th Street
LaGrande, OR 97850
(541) 963-2138

**John Day Watershed
District Office**
73471 Mytinger Lane
Pendleton, OR 97801
(541) 276-2344

Baker City Field Office
2995 Hughes Lane
Baker City, OR 97814
(541) 523-5832

Enterprise Field Office
65495 Alder Slope Rd.
Enterprise, OR 97828
(541) 426-3279

Heppner Field Office
PO Box 363
430 Heppner-Lexington
Hwy.
Heppner, OR 97836
(541) 676-5230

John Day Field Office
PO Box 9
John Day, OR 97845
(541) 575-1167

**HIGH DESERT REGIONAL
OFFICE
Deschutes Watershed
District Office**
61374 Parrell Road
Bend, OR 97702
(541) 388-6363

**Klamath Watershed
District Office**
1850 Miller Island Road W.
Klamath Falls, OR 97603
(541) 883-5732

**Malheur Watershed
District Office**
PO Box 8
237 S. Hines Blvd.
Hines, OR 97738
(541) 573-6582

Lakeview Field Office
PO Box 1214
101 N. "D" St.
Lakeview, OR 97630
(541) 947-2950

Ontario Field Office
3814 Clark Blvd.
Ontario, OR 97914
(541) 889-6975

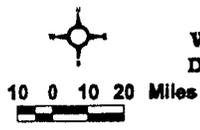
Prineville Field Office
2042 SE Paulina Hwy.
Prineville, OR 97754
(541) 447-5111

The Dalles Field Office
3701 West 13th
The Dalles, OR 97058
(541) 296-4628

**HEADQUARTERS
OFFICE**
2501 SW 1st Avenue
Portland, OR 97201
(503) 872-5310

Oregon Department of Fish & Wildlife Watershed District Structure

Offices



- ★ Headquarters
- △ Regional Office
- Watershed District Office
- Field Office
- Watershed District Bdy.
- Region Bdy.



Chapter 5

Applying Oregon's Education Standards



The Oregon Department of Education has revised its educational standards to better prepare students for life in the 21st century. Teachers today need resources that can help connect their teaching to the latest educational standards.

There are many ways to infuse fisheries education lessons into a student's overall learning experience. (See Chapter 6, Fisheries Education Activities.) A classroom fish egg incubation project combined with a study of fish habitat requirements within a watershed extends across all disciplines and grade levels. Students hatch their own fish eggs and become personally involved in what is happening in their local streams, rivers, and lakes.

This guide lists resources educators can use to develop lessons that help students achieve success with state standards in English, mathematics, science, social sciences, arts,

and career-related learning. You must decide which resources are best suited for you, your students, and your school environment.

To obtain the most current listing of benchmarks for each of the content areas, contact the Oregon Department of Education at <http://www.ode.state.or.us>.

About this chapter

This chapter includes tables with representative selections of Curricula; Programs; World Wide Web Sites; Multimedia; Maps, Posters, Equipment, Miscellaneous Props, Games, and Reference Materials; Field Trips, Classroom Speakers, and Traveling Trunks; and Fisheries Education Activities. Each table shows the academic content areas that can be supported with the resources mentioned in this guide.



The left column of each table lists the resources. The column headings show the page number where you can find the resource **in this guide** and Oregon's Education Standards content areas. A check "✓" under the content area indicates the resource can assist you in addressing standards in this content area.

Use these tables as a starting point when planning lessons around the project, then adapt the materials to meet your specific needs.

For a representative list of curricula you can use to develop lessons that address state standards across all content areas, see **Table 4. Curricula That Help Students Achieve Oregon's Education Standards With Fisheries Education.**

For a representative list of teacher training and student programs, see **Table 5. Programs That Help Students Achieve Oregon's Education Standards With Fisheries Education.**

For a list of several relevant World Wide Web sites appropriate for most content areas, see **Table 6. World Wide Web Sites That help Students Achieve Oregon's Education Standards With Fisheries Education.**

Depending on your search skills, you may locate simulations, calculations, pictures, references, and more. The status of many Web sites changes rapidly. The sites referenced in this table focus on agencies, museums, and nonprofit groups that have a role in water, fish, and other habitat connections.

For a partial list of videotapes, plays, and computer programs you can apply to several content areas, see **Table 7. Multimedia That Help Students Achieve Oregon's Education Standards With Fisheries Education.** Use these resources to support or enhance other curricula or activities. These resources may help visual learners and students with limited English-speaking ability. Some resources are available with closed captioning for the hearing impaired.

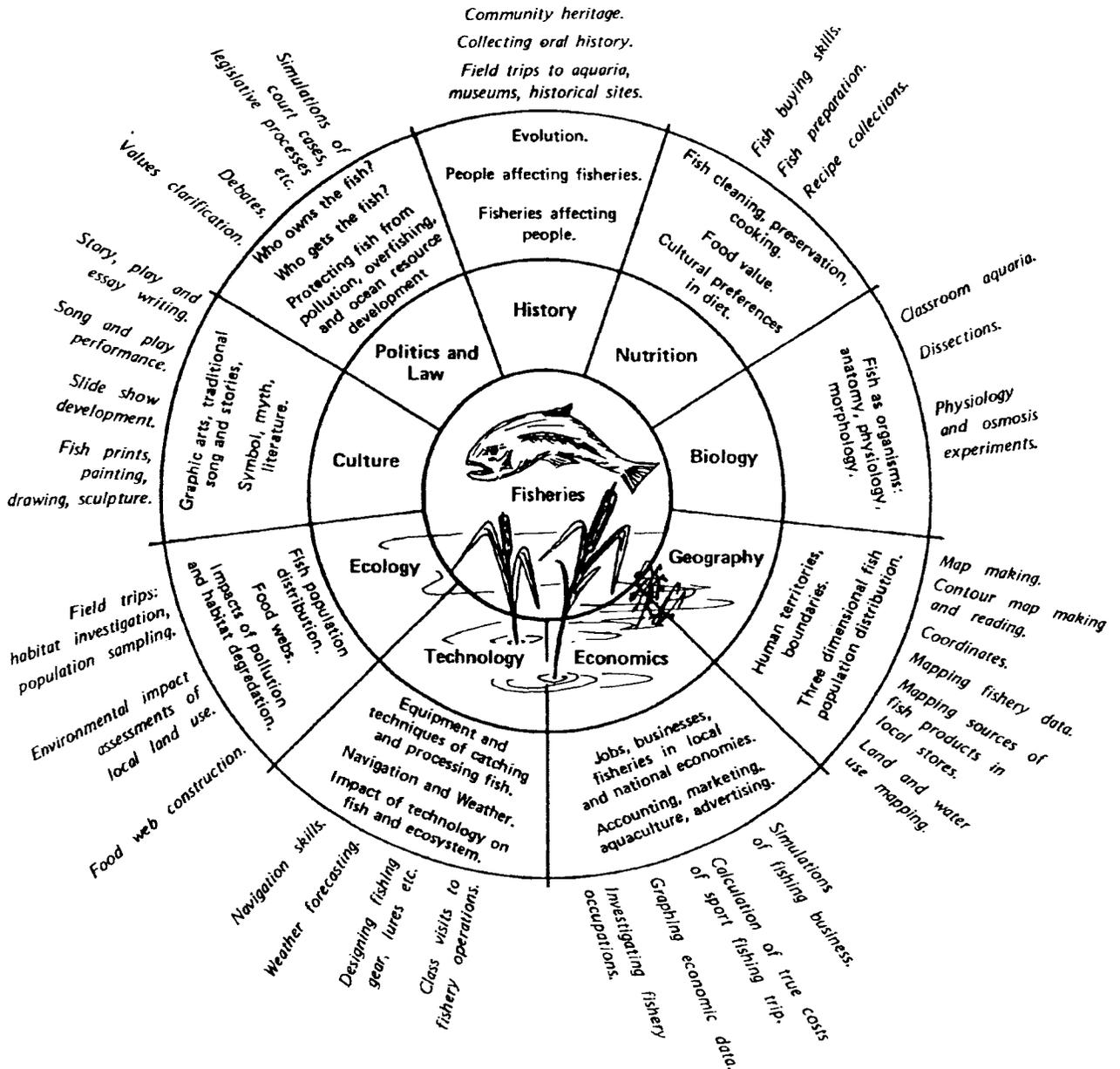
For a representative list of maps, posters, equipment, miscellaneous props, games, and books you can use to enhance lessons, see **Table 8. Maps, Posters, Equipment, Miscellaneous Props, Games, and Reference Materials That Help Students Achieve Oregon's Education Standards With Fisheries Education.**

For more suggestions that can make an academic content area come alive, see **Table 9. Field Trips, Classroom Speakers, and Traveling Trunks That Help Students Achieve Oregon's Education Standards With Fisheries Education.** The choices are limited only by your time constraints.

For a list of hands-on example fisheries education activities, see **Table 10. Fisheries Education Activities That Help Students Achieve Oregon's Education Standards.**

Dimensions of Fisheries Education

Suggested Activities for Integrating Fisheries Education Into Any Classroom



From "An Expanded Perspective of Fisheries Education," *Current, The Journal of Marine Education*, by Leslie Y. Lin, Augusto Q. Medina, and Wilfrid J. Rollman, with the Michigan Sea Grant Program, Fall 1980.

Table 4. Curricula That Help Students Achieve Oregon's Education Standards With Fisheries Education

Resource From	Page # *	English				Science	Math	Social		Career Related Learning
		Reading	Literature	Writing	Speaking			Science	Arts	
Aquatic Project Wild **	10	✓	✓	✓	✓	✓	✓	✓	✓	✓
California's Salmon and Trout	10	✓		✓		✓	✓	✓	✓	✓
Clean Water Streams and Fish	10	✓		✓		✓	✓	✓		
Discovering Salmon	11	✓		✓		✓	✓	✓		
Earth: The Water Planet	11	✓				✓				
Fish Eggs to Fry	11	✓	✓	✓	✓	✓	✓	✓	✓	✓
The Fish Hatchery Next Door	11	✓	✓	✓		✓		✓		✓
Fish In The Floodlights	12	✓	✓			✓			✓	✓
Living in Water	13					✓	✓			
The Magnificent Journey	13	✓	✓	✓		✓		✓		
Make It Work! Rivers	13					✓				
OBIS Ponds & Lakes	13	✓		✓		✓	✓	✓	✓	
OBIS Streams & Rivers	13	✓		✓		✓	✓	✓	✓	
Project Learning Tree **	14					✓	✓	✓	✓	
Project WET Guide **	14	✓	✓	✓	✓	✓	✓	✓	✓	✓
Project WILD **	15	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rivers Curriculum Guide **	15	✓	✓	✓		✓	✓	✓		
Salmon Below the Surface	15					✓		✓		
Salmon Kit	15					✓				
Salmonids in the Classroom **	16	✓	✓	✓	✓	✓	✓	✓	✓	✓
The Stream Scene	16	✓	✓	✓	✓	✓	✓	✓	✓	✓
Update!	16	✓	✓	✓	✓	✓	✓	✓	✓	
Watershed Uplands Scene	17	✓		✓	✓	✓	✓	✓		✓

* See page number in this guide.

** This guide has a complete index for subjects, grade levels, topics, and time needed for lessons.

Table 5. Programs That Help Students Achieve Oregon's Education Standards With Fisheries Education

Resource	Page # *	English				Science	Math	Social Science	Arts	Career Related Learning
		Reading	Literature	Writing	Speaking					
Creeks & Kids	18	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kokanee Karnival **	18	✓	✓	✓	✓	✓	✓	✓	✓	✓
Oregon Forestry Education Project	18					✓	✓	✓		✓
Salmon and Watershed Education	20					✓		✓		✓
Salmon Watch	20	✓		✓	✓	✓	✓	✓		✓
Storm Drain Marking	20					✓		✓		✓

* See page number in this guide.

** This program is currently offered only in Central Oregon on a limited basis.

Table 6. World Wide Web Sites That Help Students Achieve Oregon's Education Standards With Fisheries Education

Resource	Page # *	English				Science	Math	Social Science	Arts	Career Related Learning
		Reading	Literature	Writing	Speaking					
World Wide Web Sites **	21	✓	✓	✓	✓	✓	✓	✓	✓	✓

* See page number in this guide.

** It is possible to meet the standards in many areas, depending on which Web sites are used and how.



Table 7. Multimedia That Help Students Achieve Oregon's Education Standards With Fisheries Education

Resource	Page #*	English				Science	Math	Social Science	Arts	Career Related Learning
		Reading	Literature	Writing	Speaking					
Videotapes										
A Good & Careful Harvest	24					✓		✓		✓
Birth of a Salmon	24					✓				
Cascade Watershed	24					✓		✓		
Healthy Watersheds	25					✓		✓		✓
Life Cycle of the Anadromous Salmon	25					✓	✓	✓		
Macroinvertebrates & the River Continuum	25					✓	✓			
Return of the Salmon	25					✓	✓	✓		
Way of a Trout	26					✓				
We All Live Downstream	26					✓		✓		
Plays										
Fish in the Floodlights	29	✓			✓	✓		✓	✓	
Computer Programs										
Exploring the Nardoo R.	27	✓		✓		✓				✓
Salmon Odyssey	27	✓		✓		✓		✓		✓
Tom Snyder Productions	27	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water YOU Doing	27	✓	✓	✓	✓	✓	✓	✓	✓	✓

* See page number in this guide.

Table 8. Maps, Posters, Equipment, Miscellaneous Props, Games, and Reference Materials That Help Students Achieve Oregon's Education Standards With Fisheries Education

Resource	Page # *	English				Science	Math	Social Science	Arts	Career Related Learning
		Reading	Literature	Writing	Speaking					
Maps										
Pacific Northwest Watersheds	29					✓		✓		
Oregon Drainage Basin	29					✓		✓		
Posters										
Pacific Salmon Life Cycle	27					✓		✓		
Pacific Salmon of North America	28					✓		✓		
Salmon Alphabet Poster	28	✓		✓		✓			✓	
Salmon Come Back	28					✓		✓	✓	
Salmon Life Cycle	28					✓		✓	✓	
A Stream Continuum	28					✓				
Trout, Salmon & Char of North America	28					✓		✓	✓	
Equipment										
Temp. Data Loggers	29					✓	✓			
D - Frame Nets	29					✓				
Discovery Scope	30					✓				
Water Quality Test Kits	30					✓	✓			
Miscellaneous Props	28				✓	✓			✓	
Games	29					✓		✓	✓	
Reference Materials										
Reference Books	10	✓				✓		✓		✓
Children's Literature **	33	✓	✓	✓	✓	✓	✓	✓	✓	✓

* See page number in this guide.

** It is possible to meet the standards in many areas, depending on which books are used and how.

Table 9. Field Trips, Classroom Speakers, and Traveling Trunks That Help Students Achieve Oregon's Education Standards With Fisheries Education

Resource	Page #**	English				Science	Math	Social Science	Arts	Career Related Learning
		Reading	Literature	Writing	Speaking					
Field Trips**	31	✓	✓	✓	✓	✓	✓	✓	✓	✓
Classroom Speakers**	31	✓	✓	✓	✓	✓	✓	✓	✓	✓
Traveling Trunks**	32	✓	✓	✓	✓	✓	✓	✓	✓	✓

* See page number in this guide.

** It is possible to meet the standards in many areas, depending on which resources are used and how.

Table 10. Fisheries Education Activities That Help Students Achieve Oregon's Education Standards

Resource	Page #*	English				Science	Math	Social Science	Arts	Career Related Learning
		Reading	Literature	Writing	Speaking					
Hooks & Ladders	52					✓	✓	✓		
Fashion a Fish	52				✓	✓			✓	
Macroinvertebrate Mayhem	52					✓	✓			
Scales & Tales	52	✓		✓	✓	✓	✓	✓	✓	✓
Salmon Language Crossword Puzzle	52	✓				✓				
Coming Home!	52	✓		✓	✓	✓		✓	✓	
Natural Survival Pyramid	53					✓	✓			
What Can a Curve Say?	53					✓	✓			
First Nations People: A Trilogy	53	✓	✓			✓			✓	
Life Cycle of the Salmon Fish Banner	53				✓	✓			✓	

* See page number in this guide.

Chapter 6

Fisheries Education Activities



The Oregon Department of Fish and Wildlife's Salmon-Trout Enhancement Program (STEP) offers the classroom fish egg incubation project as an unique interactive classroom experience to help students observe and participate in the development of fish and to understand fish habitat needs.

Some form of lesson development focused on fish or fish habitat is required to participate in the project. See the Dimensions of Fisheries Education wheel on page 45 to develop a theme for integrating fisheries education in your classroom. It suggests activities for most disciplines.

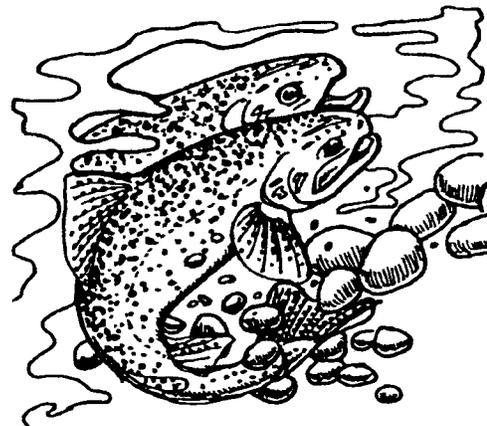
Getting Started In Fisheries Education

To help you get started, several examples of hands-on, ready-to-go classroom activities are included in this chapter. The source of each activity and contact information is listed at the beginning of each activity. For additional curricula, reference materials, video-tapes, posters, props, and equipment, see **Chapter 3, Resources**.

Applying for Fish Eggs

To apply for fish eggs for your classroom incubator, see the Egg Request Application and Transport Permit at the end of Chapter 6. Using the list on page 41, call your local STEP Biologist to inquire about fish stocks available in your area, when you can expect egg delivery, and any other related questions. Then, complete and return the form to your nearest STEP Biologist by June 1 to qualify for fish eggs during the upcoming school year.

ODFW reserves the right to designate fish species, numbers of eggs received, and release sites within policy guidelines.



Adapted from original artwork by Gary Bloomfield, **Salmon and Trout Go To School, An Instruction Manual For Hatching Salmon and Trout Eggs In Classroom Aquarium-Incubators** by Diane Higgins, California Department of Fish and Game and American Fisheries Society, Humboldt Chapter, 1996.

Sample Activities

The classroom activities in this chapter represent the content found in the curricula listed below. Each package is full of exciting ideas and lessons to round out your students' fisheries education experience. For additional curricula, reference materials, videotapes, posters, props, and equipment, see **Chapter 3, Resources**.

Hooks and Ladders

Fashion A Fish

SOURCE: Aquatic Project WILD

Aquatic Project WILD is available only through workshops. For an update on Oregon availability, contact the national office at Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org or Oregon Forestry Education Program, College of Forestry, Oregon State University, 146 Forest Research Laboratory, Corvallis, OR 97331-7404, (800) 554-6987, ofep@cof.orst.edu.

Hooks and Ladders

Students simulate Pacific salmon and the hazards they face in an interactive activity that illustrates three important concepts — life cycle, migration, and limiting factors.

Theme: life cycle

No. pages: 6

Fashion a Fish

Students design a variety of fish adapted for various aquatic habitats.

Theme: structure & function

No. pages: 4

Macroinvertebrate Mayhem

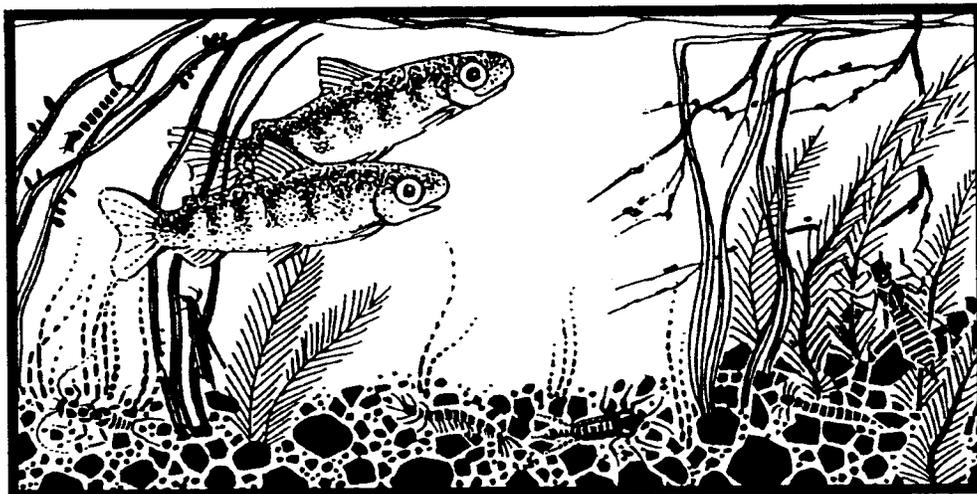
SOURCE: Project WET

Available only through a workshop. Contact Project WET coordinator for Oregon at The High Desert Museum, (541) 382-4754.

Students play a game of tag to simulate the effects of environmental stressors on macroinvertebrate populations, a major source of food for fish.

Theme: habitat, food chain

No. pages: 6



Adapted from original artwork by Jennifer Stone, Black Cat Graphics, from **Scales and Tales**, by Linda Bermbach and Jennifer Stone, Department of Fisheries and Oceans, Vancouver, BC, Canada.

Sample Activities (continued)

Scales and Tales

SOURCE: Department Of Fisheries and Oceans, British Columbia, Canada

Department of Fisheries and Oceans
Community Involvement Division
555 West Hastings Street,
Vancouver, B.C., Canada V6B 5G3
Permission to copy for educational, noncommercial purposes only.

Each of the fact/fun sheets illustrates some aspect of the life cycle of the Pacific salmon.
Theme: life cycle No. pages: 18

Salmon Language Coming Home

SOURCE: The Stream Scene: Watersheds, Wildlife, and People, Second Edition

Bowers, Patty, et al., 1999, \$32
Oregon Department of Fish & Wildlife
PO Box 59
Portland, OR 97207
(503) 872-5264

Salmon Language

Students demonstrate understanding of the basic terminology and concepts of the salmon life cycle by completing the crossword puzzle.
Theme: vocabulary No. pages: 3

Coming Home

Students identify a diversity of issues affecting watersheds and salmonid populations within those watersheds by creating an advertising campaign to encourage salmonids to return to a new home stream.
Theme: watershed, habitat, life cycle No. pages: 6

Natural Survival Pyramid

What Can A Curve Say?

SOURCE: California's Salmon and Trout: Our Valuable Natural Heritage

Diane Higgins, \$20
4649 Aster Avenue
McKinleyville, CA 95521
(707) 839-4987

Natural Survival Pyramid

Students create and illustrate a large pyramid that shows the number of salmon surviving at each life stage.
Theme: life cycle No. pages: 3

What Can A Curve Say?

Students analyze graphs for information about how trout production is affected by environmental conditions.
Theme: habitat, mathematics No. pages: 3

First Nation People: A Trilogy

SOURCE: Fish in the Floodlights

BCTF Lesson Aids
#100-550 W. 6th Avenue
Vancouver, BC V5Z 4P2
(604) 871-2181

Students enact a play which demonstrates children's experiences with salmon in 1790, 1990, and 2190.
Theme: drama, arts No. pages: 11

Sample Activities (continued)

Life Cycle Of The Salmon Banner

SOURCE: Theme Series — Fish, Integrated
Activities for Whole Language and Thematic
Teaching

Creative Teaching Press Inc., 1990
Cypress, CA 90630

Students create and display a series of
banners illustrating the life stages of a salmon as
if they were in a stream. Currently out of print.

Theme: arts, life cycle No. pages: 2

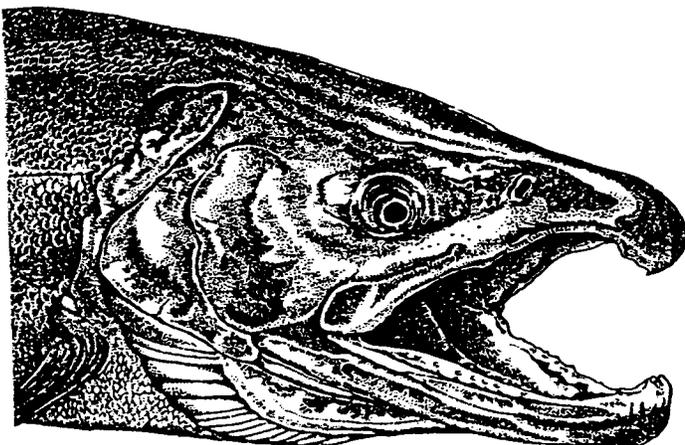
Application For Classroom Fish Egg Incubation Project

SOURCE: Oregon Department of Fish and
Wildlife STEP Biologist

See page 41 for contact information.

To apply for fish eggs for your classroom
incubator, see the Egg Request Application and
Transport Permit at the end of this chapter.
Complete and return the form to your nearest
STEP Biologist by June 1 to qualify for fish eggs
during the upcoming school year.

Theme: life cycle No. pages: 1



SOURCE: AQUATIC PROJECT WILD

Contact Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org.

HOOKS AND LADDERS

OBJECTIVES

Students will be able to: 1) recognize that some fish migrate as part of their life cycle; 2) identify the stages of the life cycle of one kind of fish; 3) describe limiting factors affecting Pacific salmon as they complete their life cycle; and 4) generalize that limiting factors affect all populations of animals.

METHOD

Students simulate Pacific salmon and the hazards faced by salmon in an activity portraying the life cycle of these aquatic creatures.

BACKGROUND

Many fish live part of their lives in one habitat and then migrate to another habitat. Some make their migratory journeys to mature and reproduce. Both the Atlantic and Pacific salmon are spectacular examples of migrating fish. (See this activity's "Variation" section for adapting "Hooks and Ladders" to Atlantic Salmon.)

Pacific salmon are destined to spawn only once in their lifetime. Within their genetic fiber is an encoded instinct that drives them from the time of hatching along a monumental journey from their freshwater spawning beds downstream into the sea. Once in the sea they spend several years reaching the maturity needed for their single return journey to their original hatching ground. Once there, the salmon spawn and die.

Salmon must face a myriad of hazards that serve as limiting factors in the completion of their life cycle. Limiting factors are factors that reduce the populations of living organisms. Sometimes the limiting factors are natural and sometimes they result from human intervention with natural systems.

The female Pacific salmon deposits 1,500 to 7,000 eggs in her freshwater spawn. The eggs are deposited in a shallow gravel depression scooped out by the female. Once deposited, the eggs are fertilized by the male and then both fish nudge the gravel back over the eggs to offer as much protection as possible. Within a few days both the male and female salmon have completed their reproduction and soon die.

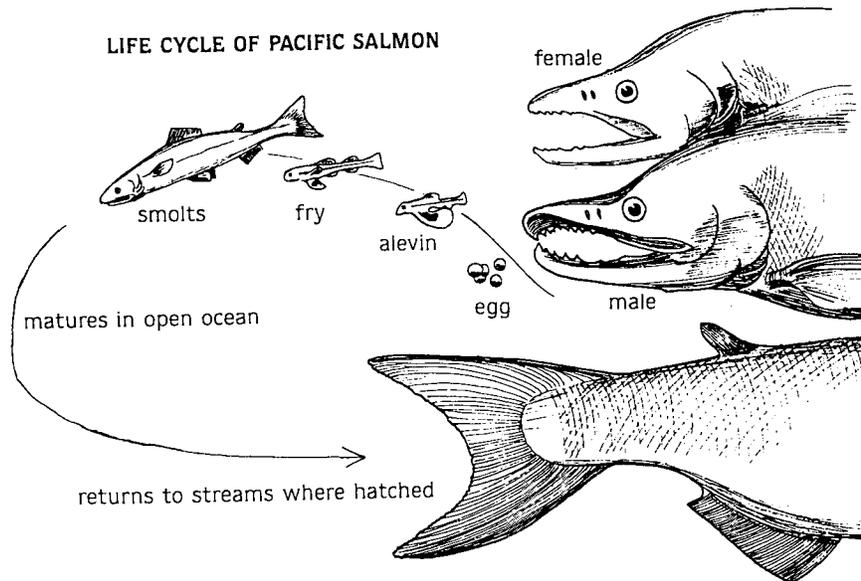
The eggs, before and after hatching, are susceptible to many limiting factors. Smothering silt can be washed in suddenly from watersheds damaged by a variety of land-use practices and events—including erosion following some road building, logging and fires. Predators can eat some of the eggs and damage hatching populations. Dropping water levels can isolate salmon offspring in streamside depressions to remain isolated and die. After hatching, the small fish—called "alevins"—spend their first two weeks hiding in the gravel. Gradually they absorb their yolk sac and become known as "fry." If they survive the first two weeks, they then begin their journeys. Some head directly to the sea. Depending on the species, young salmon may spend several months to as much as a year or more in the river before migrating to the estuary and then to the open ocean.

The small ocean-bound salmon, now called "smolts," are at once confronted by hazards on their downstream journey. Dams slow salmon migration. Because salmon cannot find the current behind dams they become disoriented in reservoirs. When disoriented, salmon are extremely vulnerable to predators. Low water in streams, predatory birds, mammals, and larger fish pose additional hazards. Up to 90% of the salmon that hatch never reach the sea.

When in the ocean, the salmon grow rapidly by feeding on the ocean's rich food supply. Predators such as sharks, killer whales and other marine mammals take their toll. In addition, humans fish for salmon commercially and for personal reasons, including food and recreation.

SOURCE: AQUATIC PROJECT WILD

Contact Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org.



In two to five years, the Pacific salmon start the journey that will guide them back to the rivers and streams leading to their own hatching site. The upstream migration from the ocean is also a series of hazards. For example, dams hinder their journey and would block it completely if fish ladders were not installed. Fish ladders are water-filled staircases that allow the migrating fish to swim upstream around the dam. Humans who fish, eagles, bears, and other predatory mammals also reduce the numbers along the way to the spawning ground. Sometimes landslides and logjams provide unexpected new barriers. So too do the natural waterfalls and rapids that the now weighty salmon must overcome. Once back at the spawning ground the life cycle of the Pacific salmon begins anew. To maintain the Pacific salmon population, some biologists believe that only one pair of fish from each spawn must return to deposit and fertilize eggs.

All possible conditions are not covered by the design of this activity. However, the activity does serve simply and effectively to illustrate three important concepts—life cycle, migration, and limiting factors.

The major purpose of this activity is for students to gain an understanding of some of the complex characteristics of the life cycle of one representative aquatic species, the Pacific salmon.

MATERIALS

large playing area (100 feet x 50 feet); about 500 feet of rope, string, or six traffic cones for marking boundaries (masking tape may be used if area is indoors); two cardboard boxes; 100 tokens (3 x 5 cards, poker chips, etc.); jump rope

SOURCE: AQUATIC PROJECT WILD

Contact Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org.

PROCEDURE

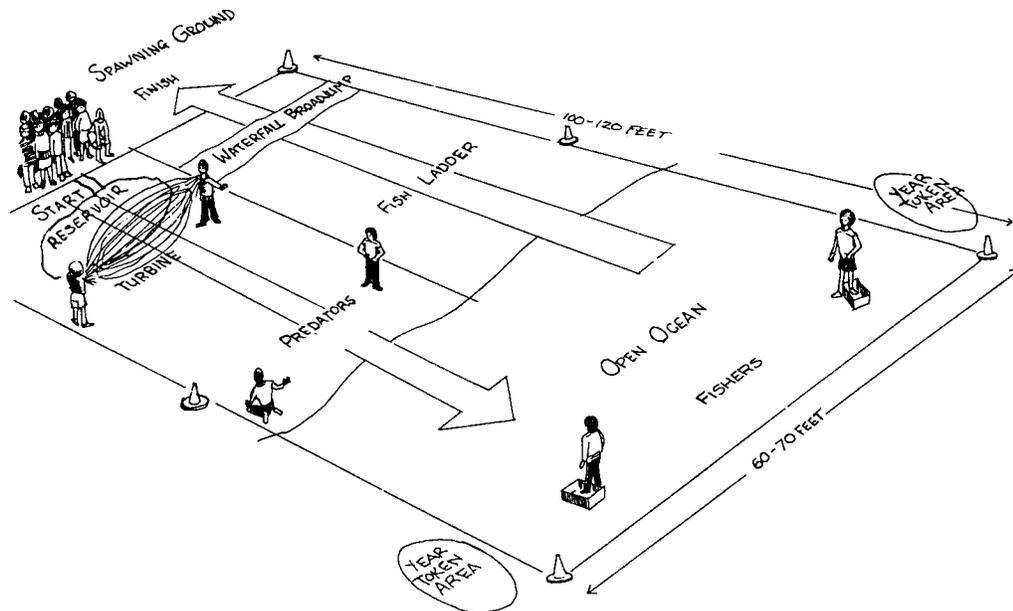
1. Begin by asking the students what they know about the life cycle of fish that live in their area. Do any local fish migrate to spawn? If yes, which ones? (Mullet, shad, lake trout, striped bass, suckers, carp and salmon are examples of fish that migrate to spawn.) In this activity, students will learn about some of the characteristics of one species of fish that migrates as a part of its life cycle—the Pacific salmon.

2. This is a physically involving activity! Set up a playing field as shown in the diagram, including spawning grounds, reservoir, downstream, upstream, and ocean. The area must be about 100 feet by 50 feet. Assign roles to each of the students. Some will be salmon, others will be potential hazards to the salmon. Assign the students roles as follows:

- Choose two students to be the turbine team. These are the ones who operate the jump rope which represents the turbines in hydroelectric dams. Later in the simulation, when all the salmon have passed the turbine going downstream, these students move to the upstream side to become the waterfall-broad jump monitors. (See diagram.)

- Choose two students to be predatory wildlife. At the start of the simulation, the predators will be stationed in the reservoir above the turbines to catch the salmon fry as they try to find their way out of the reservoir and downstream. Then, they will move to below the turbines where they catch salmon headed downstream. Later in the activity when all the salmon are in the sea, these same two predators will patrol the area above the "broadjump" waterfalls. There they will feed on salmon just before they enter the spawning ground. (See diagram.)
- Choose two students to be humans in fishing boats catching salmon in the open ocean. These students in the fishing boats must keep one foot in a cardboard box to reduce their speed and maneuverability.
- All remaining students are salmon.

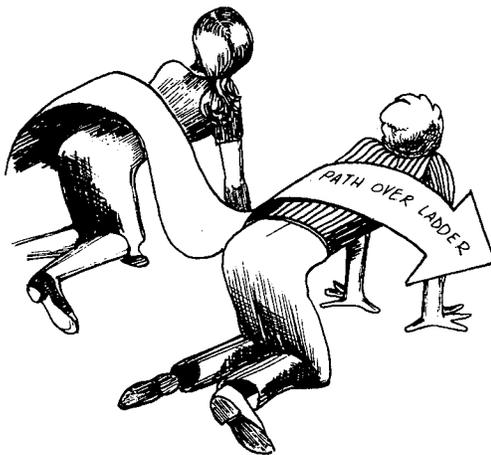
NOTE: These figures are based on a class size of 25 to 30. If the group is larger or smaller, adjust the number of people who are fishing and predatory wild animals accordingly.



SOURCE: AQUATIC PROJECT WILD

Contact Council for Environmental Education, 5555 Morningside Drive, Ste. 212, Houston, TX 77005, (713) 520-1936, www.projectwild.org.

3. Begin the activity with all the salmon in the spawning ground. The salmon first move into the reservoir above the dam. They must stay in the reservoir while they count to 30. This simulates the disorientation that salmon face due to a lack of current in the lake to direct them on their journey. During this time, the predators may catch the salmon and escort them one at a time to become part of the fish ladder. The salmon then start their journey downstream. A major hazard is the turbines at the dam. At most dams there are escape weirs to guide migrating salmon past the turbines. The student salmon cannot go around the jump rope swingers, but they can slip under the swingers' arms if they do not get touched while doing so. A salmon dies if it is hit by the turbine (jump rope). The turbine operators may change the speed at which they swing the jump rope. NOTE: Any salmon that "dies" at any time in this activity must immediately become part of the fish ladder. The student is no longer a fish, but becomes part of the physical structure of the human-made ladders now used by migrating salmon to get past barriers such as dams. The students who are the fish ladder kneel on the ground as shown below, a body-wide space between them.



4. Once past the turbines, the salmon must get past some predatory wildlife. The predators, who have moved from the reservoir area to the area below the turbine, must catch the salmon with both hands—tagging isn't enough. Dead salmon are escorted by the predator to become part of the fish ladder. Later, the salmon who survive life in the open ocean will use the structure of the fish ladder—by passing through it—to return to the spawning ground. NOTE: Both the predatory wildlife in the last downstream area and the people fishing in the open ocean must take dead salmon to the fish ladder site. This gets the predators and fishing boats off the field regularly, helping to provide a more realistic survival ratio.

5. Once in the open ocean, the salmon can be caught by fishing boats. The salmon must move back and forth across the ocean area in order to gather four tokens. Each token represents one year of growth. Once each fish has four tokens (four years' growth), that fish can begin migration upstream. The year tokens can only be picked up one token at a time on each crossing. Remember, the salmon must cross the entire open ocean area to get a token. The "four years" these trips take make the salmon more vulnerable and thus they are more readily caught by the fishing boats. For purposes of this simulation, the impact of this limiting factor creates a more realistic survival ratio on the population before the salmon begin the return migration upstream.

6. Once four of the year tokens are gathered, the salmon can begin upstream. The salmon must walk through the entire pattern of the fish ladder. This enforced trip through the fish ladder gives the students a hint of how restricting and tedious the upstream journey can be. In the fish ladder, predators may not harm the salmon.

7. Once through the ladder, the salmon faces the broad jump waterfall. The waterfall represents one of the natural barriers the salmon must face going upstream. Be sure the jumping distance is challenging but realistic. The two former turbine students will monitor the jump. The salmon must jump the entire breadth of the waterfall to be able to continue. If the salmon fails to make the jump, then it must return to the bottom of the fish ladder and come through again.

NOTE: When playing indoors, the broad jump waterfall may be changed into a stepping stone jump defined by masking tape squares for safety on hard floors.

SOURCE: AQUATIC PROJECT WILD

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8. Above the falls, the two predators who started the simulation as the predators below the turbines are now the last set of limiting factors faced by the salmon. They represent bears—one example of predatory wildlife. Again, remember that the predators must catch the salmon with both hands. If they do catch a salmon, they must then take the students they caught to become part of the structure of the fish ladder.
9. The activity ends when all the salmon are gone before the spawning ground is reached—or when all surviving salmon reach the spawning ground.
10. Next engage the students in a discussion. Explore topics such as:
 - the apparent survival-mortality ratio of salmon
 - the students' feelings throughout the activity
 - the role of the barriers
 - the role of the predatory wildlife and the people fishing
 - where the losses were greatest
 - where the losses were least
 - what the consequences would be if all the eggs deposited made the journey successfully
 - what seemed realistic about this simulation and what did not
11. Ask the students to summarize what they have learned about the life cycle of salmon, the salmon's migration and limiting factors that affect salmon. Make sure the students have a clear working definition of limiting factors. Encourage the students to make the generalization that all animals—not just Pacific salmon—are affected by limiting factors. Ask the students to give examples. They might mention availability of suitable food, water, shelter and space; disease; weather; predation; and changes in land use as well as other human activities.

VARIATION: ATLANTIC SALMON

This activity can easily be adapted to feature Atlantic, rather than Pacific, salmon. The most significant difference between Pacific and Atlantic salmon is that the Atlantic salmon can spawn more than once. Many Atlantic salmon make their complete migratory journey and spawn two or more times. All Pacific salmon die after spawning only once. To adapt this activity for Atlantic salmon, students are to make as many complete migratory trips as possible. After the activity is finished, ask students to report how many times they successfully completed the migratory cycle. Graph the data. Have the students explain how age influences mortality rates and susceptibility to limiting factors.

SOURCE: AQUATIC PROJECT WILD

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EXTENSIONS

1. Write a report on the life history of one of the species of salmon (e.g., chinook or king, chum or dog, pink or humpback, coho or silver, sockeye or red, Atlantic). Create a mural showing the life cycle of this salmon.
2. Research and illustrate the life cycle of any local fish. If possible, look for one that migrates.
3. Compare how the life cycle of a Pacific salmon is similar and different to the life cycle of one or more local fish.
4. Investigate similarities and differences in the migration and life cycles of Atlantic and Pacific salmon. Investigate the life cycle of salmon in the Great Lakes ecosystem.
5. Visit fish hatcheries that work with migratory species and investigate how they function.
6. Explore ways that dams can be modified to let fish safely pass downstream and upstream. Design the "perfect" fish ladder.
7. Investigate and discuss **commercial** fishing for salmon. Investigate and discuss **personal**, including recreational, fishing for salmon.
8. Find out about laws protecting migratory species, including fish.
9. Consider this and try the activity again:

In the last 100 years, salmon have experienced many new, human-caused limiting factors. Dams, commercial fishing, timber harvest and road construction have had tremendous impact on salmon populations. In 1991, the Snake River sockeye salmon was placed on the federal endangered species list. In the past, tens of thousands of sockeyes would make the 900-mile return trip from the sea to Idaho's mountain streams and lakes. There they would spawn and die. Their offspring would hatch and begin their early development in freshwater. The actual migration to the Pacific Ocean could be completed in as few as nine days. Today that trip takes over 60 days. In 1991, only four Snake River sockeye salmon returned to their spawning grounds.

To simulate these increases in salmon limiting factors, play several rounds of "Hooks and Ladders." Allow each round to represent the passage of 25 years. Start in 1850. In that year do not include dams or commercial fishing operations in the scenario. As time passes, add the human commercial fishing operations. Build dams (jump ropes) as the scenario progresses into the 20th century.

Describe some of the possible effects on salmon from increased limiting factors as a result of human activities. Discuss possible positive and negative effects on both people and salmon from these increases in limiting factors affecting salmon. When the activity reaches "the present," predict what might happen to salmon in the future. Approaching this as a complex dilemma, discuss possible actions, if any, that might be taken to benefit both people and salmon.

10. Substitute striped bass for salmon. The striped bass is more widely distributed along the United States' coastlines than either the Atlantic or Pacific Salmon. Like the salmon, striped bass reproduce in freshwater and migrate to and mature in saltwater. They also must face the limiting factors outlined in this activity.

11. Find out if salmon exist in your state. If so are they native or were they introduced?

EVALUATION

1. List, describe, and illustrate the major stages in a Pacific salmon's life cycle.
2. Identify and describe some of the factors that affect salmon as they complete their life cycle.
3. Identify and describe some limiting factors that might affect other animal populations.

Age: Grades 3-9

Subjects: Social Studies, Geography

Skills: analysis, description, discussion, generalization, inference, interpretation, kinesthetic concept development, observation, psychomotor development, recognition, synthesis, using time and space

Duration: 30 to 60 minutes

Group Size: 20 to 30 students or more

Setting: outdoors or large indoor area

Conceptual Framework Reference: III.E., III.E.1., III.E.2., III.A., III.A.1., III.A.2., III.A.3., III.B., III.B.1., III.B.2., III.B.3., III.B.4., III.B.5., III.B.6., III.C., III.C.1., III.C.2., III.D., III.D.1., III.D.2., III.D.3., III.D.4., III.D.5., III.F., III.F.1., III.F.2., III.F.3., III.F.4., III.F.5., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5., VI.B., VI.C., VI.D., VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.7.

Key Vocabulary: life cycle, limiting factors, population, migration

Appendices: Simulations, Ecosystem

SOURCE: AQUATIC PROJECT WILD

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FASHION A FISH

OBJECTIVES

For Younger Students

Students will be able to classify fish according to body shape and coloration.

For Older Students

Students will be able to: 1) describe adaptations of fish to their environments; 2) describe how adaptations can help fish survive in their habitat; and 3) interpret the importance of adaptations in animals.

METHOD

Students design a variety of fish adapted for various aquatic habitats.

BACKGROUND

Aquatic animals are the product of countless adaptations over long periods of time. These adaptations, for the most part, are features that increase the animals' likelihood of surviving in their habitat.

When a habitat changes, either slowly or catastrophically, the species of animals with adaptations that allow them many options are the ones most likely to survive. Some species have adapted to such a narrow range of habitat conditions that they are extremely vulnerable to change. They are over-specialized and are usually more susceptible than other animals to death or extinction.

In this activity, the students design a kind of fish. They choose the adaptations that their fish will have. Each choice they make would actually take countless years to develop. As these adaptations become part of the fish's design, the fish becomes better suited to the habitat in which it lives. Because of the variety of conditions within each habitat, many different fish can live together and flourish. Some adaptations of fish are shown in the table that follows.

The major purpose of this activity is for students to investigate the concept of adaptation in fish.

MATERIALS

five cards for each adaptation from the masters provided: mouth, body shape, coloration, reproduction; art materials; paper

NOTE: Body shape and coloration are the only cards needed for younger students.

PROCEDURE

1. Assign students to find a picture or make a drawing of a kind of animal that has a special adaptation—for example, long necks on giraffes for reaching high vegetation to eat, large eyes set into feathered cones in the heads of owls to gather light for night hunting.
2. Conduct a class discussion on the value of different kinds of adaptations to animals. As a part of the discussion, ask the students to identify different kinds of adaptations in humans.
3. Pool all of the students' pictures or drawings of adaptations. Categorize them into the following groups:
 - protective coloration and camouflage
 - body shape/form
 - mouth type/feeding behavior
 - reproduction/behavior
 - other (one or more categories the students establish, in addition to the four above that will be needed for the rest of the activity)

NOTE: *For Younger Students:* The first three steps in the Procedure are optional for younger students. The remaining steps need only include the adaptation cards for body shape and coloration; reproduction and mouth cards are optional for younger students.

4. Divide the adaptation cards into five groups of four cards each, one each of coloration, mouth type, body shape and reproduction.
5. Pass one complete set of cards to each group of students. There might be five groups with four to six students in each group. If the class size is larger than about 30 students, make additional sets of adaptation cards.
6. Ask the students to "fashion a fish" from the characteristics of the cards in the set they receive. Each group should:
 - create an artform that represents their fish
 - name the fish
 - describe and draw the habitat for their fish
7. Ask each group to report to the rest of the class about the attributes of the fish they have designed, including identifying and describing its adaptations. Ask the students to describe how this kind of fish is adapted for survival.
8. *For Older Students:* Ask the students to make inferences about the importance of adaptations in fish and other animals.

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EXTENSIONS

1. Take an adaptation card from any category and find real fish with that adaptation! NOTE: A collection of books about fish is useful. Do not be as concerned about reading level as much as profuse illustrations.
2. Look at examples of actual fish. Describe the fish's "lifestyle" and speculate on its habitat by examining its coloration, body shape and mouth.

For Older Students

1. Name two fish adaptations in each of the following categories: mouth, shape, coloration, reproduction. Then describe the advantages of each of these adaptations to the survival of the fish in their habitats.
2. Invent an animal that would be adapted to live on your school grounds. Consider mouth, shape, coloration, reproduction, food, shelter and other characteristics. Draw and describe your animal.

EVALUATION

For Younger Students

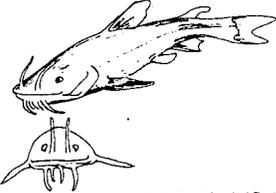
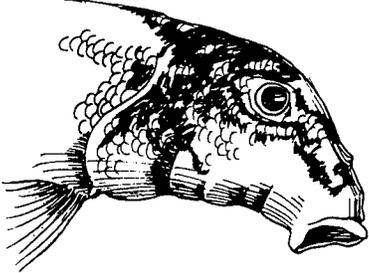
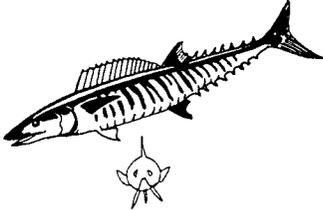
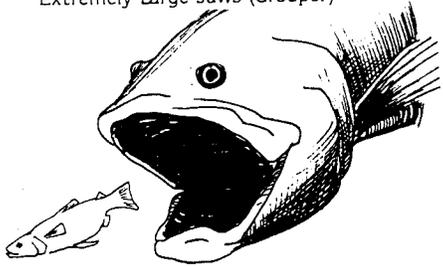
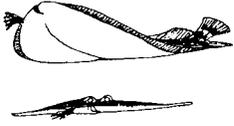
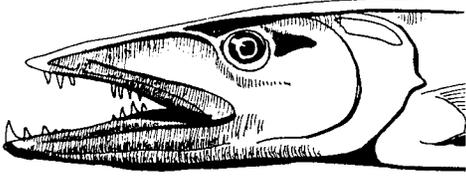
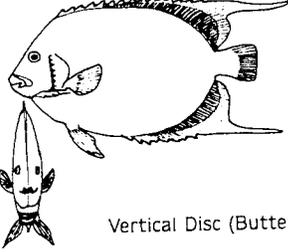
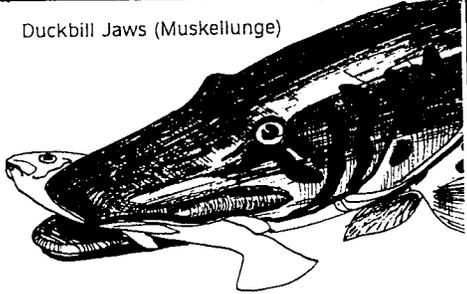
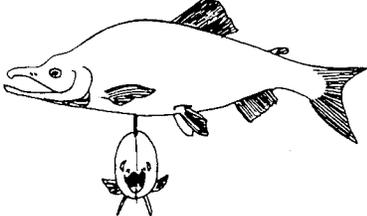
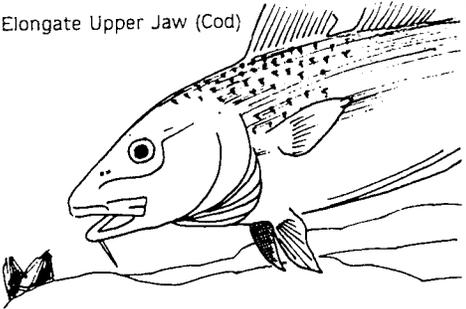
Circle the fish with vertical stripes, the one that can best hide in plants. Circle the fish with the horizontal, flat shape. Circle the fish that would be difficult to see from above. (Use the masters provided to give the students drawings of fish.)

Age: Grades K-12
Subjects: Science, Art
Skills: analysis, application, classification, communication, description, discussion, drawing, identification, inference, invention, media construction, public speaking, reporting, small group work
Duration: two 30 to 45-minute periods for older students; one or two 20-minute periods for younger students
Group Size: any; groups of four students each
Setting: indoors or outdoors
Conceptual Framework Reference: III.A.3., III.D., III.D.1., III.D.2., III.D.3.
Key Vocabulary: adaptation, coloration, camouflage, habitat
Appendices: Local Resources

ADAPTATION	ADVANTAGE	EXAMPLES
Mouth		
sucker shaped mouth	feeds on very small plants and animals	sucker, carp
elongate upper jaw	feeds on prey it looks down on	spoonbill, sturgeon
elongate lower jaw	feeds on prey it sees above	barracuda, snook
duckbill jaws	grasps prey	muskellunge, pike
extremely large jaws	surrounds prey	bass, grouper
Body Shape		
torpedo shape	fast moving	trout, salmon, tuna
flat bellied	bottom feeder	catfish, sucker
vertical disk	feeds above or below	butterfish, bluegill
horizontal disk	bottom dweller	flounder, halibut
hump backed	stable in fast moving water	sockeye salmon, chub, razorback
Coloration		
light colored belly	predators have difficulty seeing it from below	most minnows, perch, tuna, mackerel
dark upperside	predators have difficulty seeing it from above	bluegill, crappie, barracuda, flounder
vertical stripes	can hide in vegetation	muskellunge, pickerel, bluegill
horizontal stripes	can hide in vegetation	yellow and white bass, snook
mottled coloration	can hide in rocks and on bottom	trout, grouper, rockbass, hogsucker
Reproduction		
eggs deposited in bottom	hidden from predators	trout, salmon, most minnows
eggs deposited in nests	protected by adults	bass, stickleback
floating eggs	dispersed in high numbers	striped bass
eggs attached to vegetation	stable until hatching	perch, northern pike, carp
live bearers	high survival rate	guppies

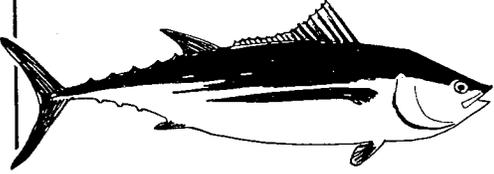
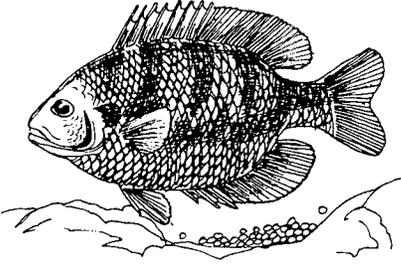
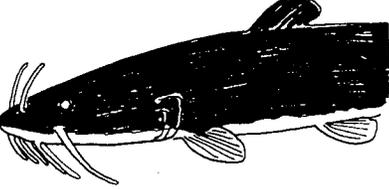
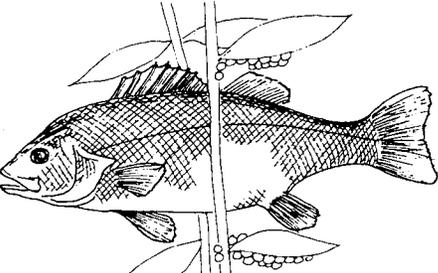
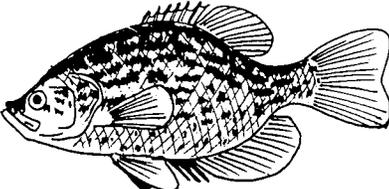
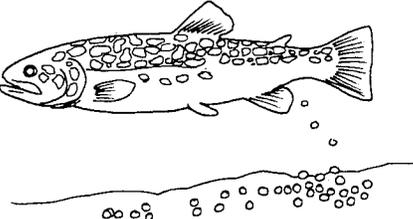
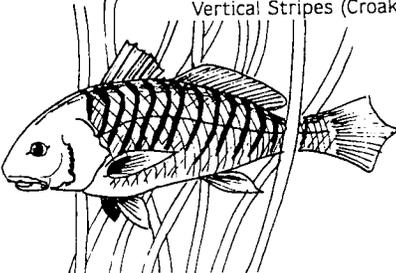
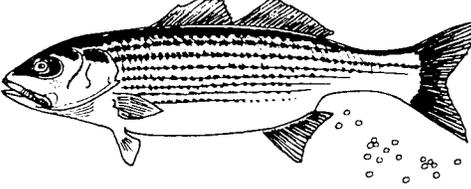
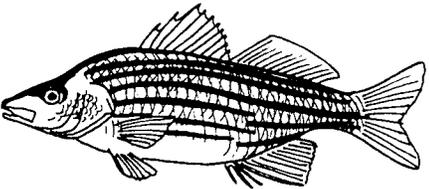
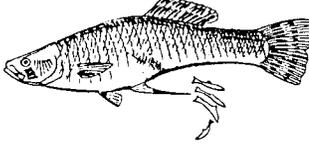
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<p>Shape</p>  <p>Flat Bellied (Catfish)</p>	<p>Mouth/Feeding</p>  <p>Sucker Shaped Jaw (Sucker)</p>
<p>Shape</p>  <p>Torpedo Shape (Wahoo)</p>	<p>Mouth/Feeding</p>  <p>Extremely Large Jaws (Grouper)</p>
<p>Shape</p>  <p>Horizontal Disc (Halibut)</p>	<p>Mouth/Feeding</p>  <p>Elongate Lower Jaw (Barracuda)</p>
<p>Shape</p>  <p>Vertical Disc (Butterfish)</p>	<p>Mouth/Feeding</p>  <p>Duckbill Jaws (Muskellunge)</p>
<p>Shape</p>  <p>Humpbacked (Sockeye)</p>	<p>Mouth/Feeding</p>  <p>Elongate Upper Jaw (Cod)</p>

SOURCE: AQUATIC PROJECT WILD

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 <p>Light Colored Belly (Albacore)</p>	<p>Eggs Deposited in Nests (Blue Gill)</p> 
<p>Dark Upperside (Catfish)</p> 	 <p>Eggs Deposited on Vegetation (Yellow Perch)</p>
 <p>Mottled (Crappie)</p>	 <p>Eggs Deposited on Bottom (Trout)</p>
<p>Vertical Stripes (Croaker)</p> 	<p>Free Floating Eggs (Striped Bass)</p> 
<p>Horizontal Stripes (Yellow Bass)</p> 	 <p>Live Birth (Gambusia)</p>

SOURCE: PROJECT WET

Available only through a workshop. Contact Oregon's Project WET Coordinator, The High Desert Museum, (541) 382-4754.

Macroinvertebrate Mayhem



■ **Grade Level:**
Upper Elementary, Middle School

■ **Subject Areas:**
Ecology, Environmental Science, Mathematics

■ **Duration:**
Preparation time:
Part I: 20 minutes
Part II: 50 minutes

Activity time:
Part I: 50 minutes
Part II: 50 minutes

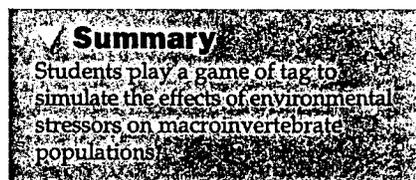
■ **Setting:**
Large playing field

■ **Skills:**
Gathering information (researching); Organizing (categorizing); Interpreting (relating, drawing conclusions)

■ **Charting the Course**
Orient students to stream ecology prior to this activity. The **Extension** of "Stream Sense" provides a variety of streamside investigations. Students can learn how nonpoint source pollutants accumulate in a stream in "Sum of the Parts." Treating polluted water is addressed in "Sparkling Water" and "Reaching Your Limits."

■ **Vocabulary**
macroinvertebrate, biodiversity

How does the phrase "appearances can be deceiving" apply to the water quality of a sparkling, crystal-blue stream?



Objectives

Students will:

- illustrate how tolerance to water quality conditions varies among macroinvertebrate organisms.
- explain how population diversity provides insight into the health of an ecosystem.

Materials

- *Samples of macroinvertebrate organisms* (optional)
- *Resources* (texts, field guides, encyclopedia)
- *Identification labels for macroinvertebrate groups, one per student* (Divide the number of students by 7 and make that number of copies of each macroinvertebrate picture. One side of each label should have a picture of one of the seven macroinvertebrates. The other side of each label [except those for midge larvae and rat-tailed maggots] should have a picture of either the midge larva or rat-tailed maggot. For durability, the cards may be laminated. Use clothespins or paper clips to attach labels to students' clothing.)
- *Pillowcases or burlap bags*
- *Chart paper or a chalkboard*

NOTE: To adapt this activity for your area, call the state Department of Land and Natural Resources or Fish and Wildlife Service for information.

Making Connections

People may be able to assess the water quality of a stream by its appearance and smell. Sometimes, however, a polluted stream looks and smells clean. Students may have already learned certain ways to test water quality and may have conducted macroinvertebrate stream studies. Simulating how environmental stressors affect macroinvertebrate populations helps students relate the concept of biodiversity to the health of aquatic ecosystems.

Background

Macroinvertebrates (organisms that lack an internal skeleton and are large enough to be seen with the naked eye) are an integral part of wetland and stream ecosystems. Examples of macroinvertebrates include mayflies, stoneflies, dragonflies, rat-tailed maggot, scuds, snails, and leeches. These organisms may spend all or part of their lives in water; usually their immature phases (larvae and nymphs) are spent entirely in water. Larvae do not show wing buds and are usually very different in appearance from the adult versions of the insects. (Maggot is the term used for the larva of some flies.) Nymphs generally resemble adults, but have no wings and are usually smaller.

A variety of environmental stressors can impact macroinvertebrate populations. Urban and/or agricultural runoff can produce conditions that some macroinvertebrates cannot tolerate. Sewage and fertilizers added to streams induce the growth of algae and bacteria that consume oxygen and make it unavailable for macroinvertebrates. Changes in land use from natural vegetation to a construction site or to poorly protected cropland may add sediment to the water. Sedimentation destroys habitats by smothering the

SOURCE: PROJECT WET

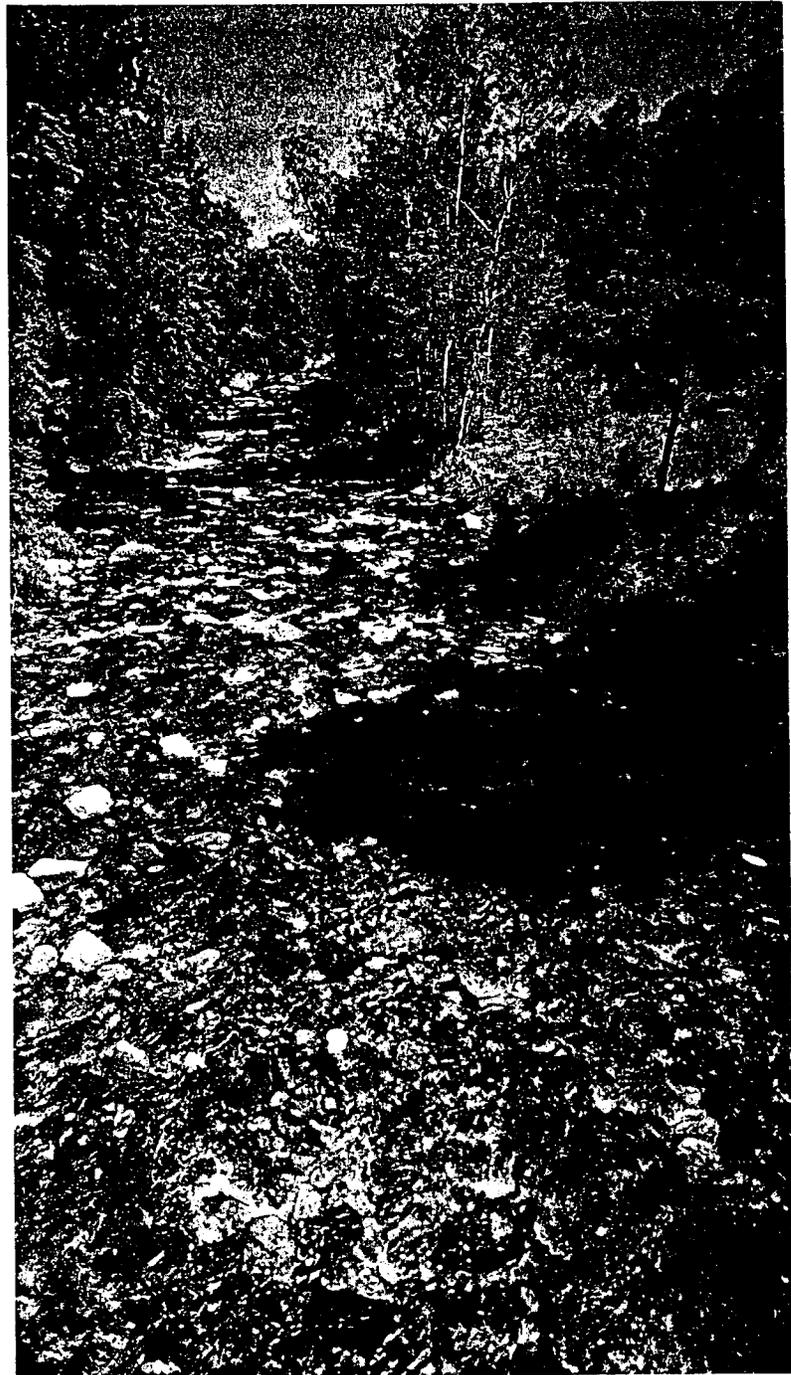
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...ky areas of the stream where macroinvertebrates live. The removal of trees along the banks of a river and alteration of stream velocity can both alter normal water temperature patterns in the stream. Some organisms depend on certain temperature patterns to regulate changes in their life cycles. Other stressors include the introduction of alien species and stream channelization.

Some macroinvertebrates, such as the mayfly, stonefly, and caddis fly larvae, are sensitive (intolerant) to changes in stream conditions brought about by pollutants. Some of these organisms will leave to find more favorable habitats, but others will be killed or will be unable to reproduce. Macroinvertebrates (e.g., rat-tailed maggots and midge larvae) that may thrive in polluted conditions are called tolerant organisms. Other organisms, called facultative organisms (e.g., dragonflies, damselflies, nymphs) prefer good stream quality but can survive polluted conditions.

Water quality researchers often sample macroinvertebrate populations to monitor changes in stream conditions over time and to assess the cumulative effects of environmental stressors. Environmental degradation will likely decrease the diversity of a community by eliminating intolerant organisms and increasing the number of tolerant organisms. If the environmental stress is severe enough, species of intolerant macroinvertebrates may disappear altogether. For example, if a sample of macroinvertebrates in a stream consists of rat-tailed maggots, snails, and dragonfly nymphs, the water-quality conditions of that stream are probably poor (i.e., low oxygen level, increased sediment, contaminants). If, on the other hand, a sample contains a diversity of organisms, the stream conditions are



HOWARD KARGER, N E STOCK PHOTO

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likely good. However, baseline data is essential because some healthy streams may contain only a few macroinvertebrate species. A variety of food sources, adequate oxygen levels, and temperatures conducive to growth all characterize a healthy stream.

Procedure

▼ **Warm Up**

Review the conditions that are necessary for a healthy ecosystem. Ask students to describe what could happen to an ecosystem if these conditions were altered or eliminated. What clues would students look for to determine if an ecosystem was healthy or not?

Remind students that a stream is a type of ecosystem. Ask them how they would assess the health of a stream. Students may suggest conducting a visual survey of the surrounding area and answering the following questions: What land use practices are visible in the area? How might these practices affect the stream? Is there plant cover on the banks of the stream or are the banks eroded? What color is the water? What is living in the stream?

Identify several environmental stressors (e.g., urban and agricultural runoff, sedimentation, introduction of alien species) and discuss how they can affect the health of a stream. Review the many types of plants and animals, including insects, that live in streams. How might environmental stressors affect these organisms? Would all organisms be impacted in the same way? Why or why not?

▼ **The Activity**

Part I

1. **Introduce the practice of sampling macroinvertebrate populations to monitor stream quality.** Show students pictures or samples of

macroinvertebrates used to monitor stream quality.

2. **Divide the class into seven groups and assign one macroinvertebrate (from *Macroinvertebrate Groups*) to each group. Have group members conduct library research to prepare a report for the class about their organism. The report should include the conditions (e.g., clean water, abundant oxygen supplies, cool water) the organism must have to survive.**

Macroinvertebrate Groups
Caddis fly larva
Mayfly larva
Stonefly larva
Dragonfly nymph
Damselfly nymph
Midge larva
Rat-tailed maggot

3. **Have students present their reports to the class and compare each organism's tolerance of different stream conditions.**

Part II

1. **Tell students they are going to play a game that simulates changes in a stream when an environmental stressor, such as a pollutant, is introduced. Show students the playing field and indicate the boundaries.**

2. **Have one student volunteer to be an environmental stressor (e.g., sedimentation, sewage, or fertilizer). Discuss the ways that a stream can become polluted and how this can alter stream conditions. With a large class or playing field, more students will need to be stressors.**

3. **Divide the rest of the class into seven groups to play the game. Each group represents one type of macroinvertebrate species listed in *Macroinvertebrate Groups*. Record the number of members in each group, using a table similar to *A Sample of Data From Macroinvertebrate Mayhem*.**

NOTE: Try to have at least four students in each group. For smaller classes, reduce the number of groups. For example, eliminate the

Intolerant Macroinvertebrates and Hindrances		
ORGANISM	HINDRANCE	RATIONAL FOR HINDRANCE
Caddis fly	Must place both feet in a bag* and hop across field, stopping to gasp for breath every five hops.	Caddis flies are intolerant of low oxygen levels.
Stonefly	Must do a push-up every ten steps.	When oxygen levels drop, stoneflies undulate their abdomens to increase the flow of water over their bodies.
Mayfly	Must flap arms and spin in circles when crossing field.	Mayflies often increase oxygen absorption by moving gills.

*CADDIS FLY LARVAE BUILD CASES AND ATTACH THEMSELVES TO ROCKS FOR PROTECTION AND STABILIZATION.

SOURCE: PROJECT WET

Available only through a workshop. Contact Oregon's Project WET Coordinator, The High Desert Museum, (541) 382-4754.



A Sample of Data From Macroinvertebrate Mayhem:

ORGANISM	TOLERANCE	NUMBERS (AT START AND AFTER EACH ROUND)			
		START	ROUND ONE	ROUND TWO	ROUND THREE
Caddis fly larva	Intolerant	5	2	2	2
Mayfly larva	Intolerant	5	4	1	0
Stonefly larva	Intolerant	4	4	4	2
Dragonfly larva	Facultative	5	5	4	4
Damselfly larva	Facultative	4	4	4	3
Midge larva	Tolerant	4	6	7	9
Rat-tailed maggot	Tolerant	4	6	9	11
TOTAL		31	31	31	31

stonefly larva and the damselfly nymph groups.

Distribute appropriate identification labels to all group members. The picture of each group's macroinvertebrate should face outward when labels are attached.

5. Inform students that some macroinvertebrates have hindrances to crossing the field. (See *Intolerant Macroinvertebrates and Hindrances*, below.) These obstacles symbolize sensitive organisms' intolerance to pollutants. Have students practice their motions.

6. Assemble the macroinvertebrate groups at one end of the playing field and the environmental stressor(s) at midfield. When a round starts, macroinvertebrates will move toward the opposite end of the field and the stressor will try to tag them. To "survive," the macroinvertebrates must reach the opposite end of the field without being tagged by the environmental stressor. The environmental stressor can try to tag any of the macroinvertebrates, but will find it

easier to catch those with hindered movements.

7. Begin the first round of the game. Tagged macroinvertebrates must go to the sideline and flip their identification labels to display the more tolerant species (i.e., rat-tailed maggot or midge larva). Tagged players who are already in a tolerant species group do not flip their labels.

8. The round ends when all of the macroinvertebrates have either been tagged or have reached the opposite end of the playing field. Record the new number of members in each species.

9. Complete two more rounds, with all tagged players rejoining the macroinvertebrates who successfully survived the previous round. Record the number of members in each species of macroinvertebrates at the conclusion of each round. Because some players will have flipped their identification labels, there will be a larger number of

tolerant species in each successive round.

▼ Wrap Up and Action

The game is completed after three rounds. Discuss the outcome with students. Emphasize the changes in the distribution of organisms among groups. Have students compare population sizes of groups at the beginning and end of the game and provide reasons for the changes. Review why some organisms are more tolerant of poor environmental conditions than others. Have students compare the stream environment at the beginning of the game to the environment at the end.

Have students investigate a nearby stream. What types of macroinvertebrates live there? How would students describe the diversity of organisms? Do students' findings provide insight into the quality of the stream? What other observations can students make to determine stream quality? They may want to report their findings to local watershed managers or water quality inspectors.

SOURCE: PROJECT WET

Available only through a workshop. Contact Oregon's Project WET Coordinator, The High Desert Museum, (541) 382-4754.

Assessment

Have students:

- analyze a stream based on a visual assessment (*Warm Up*).
- describe macroinvertebrate organisms and identify what stream conditions they need to survive (*Part I*, steps 2 and 3, and *Wrap Up*).
- explain how some organisms indicate stream quality (*Wrap Up*).
- interpret stream quality based on the diversity and types of organisms found there (*Wrap Up*).

Upon completing the activity, for further assessment have students:

- develop a matching game in which pictures of streams in varying conditions are matched with organisms that might live there.

Extensions

Supplement the students' macroinvertebrate survey of a stream with chemical tests and analyses. (See **Resources**.)

Have students design their own caddis fly case.

Have students study aspects of biodiversity by adding another round to the game. For example, add a fourth round in which all organisms are caddisflies. This round will demonstrate how a few intolerant species or a single species can be quickly eliminated.

Resources

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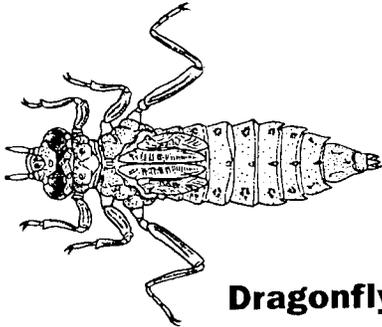


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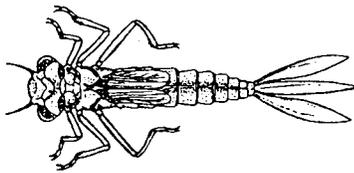
Identification Labels



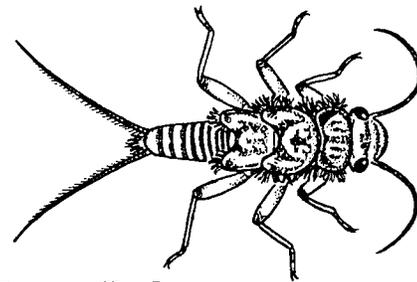
Dragonfly Nymph



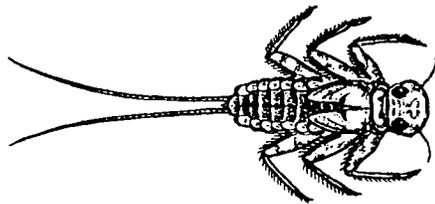
Caddis fly Larva



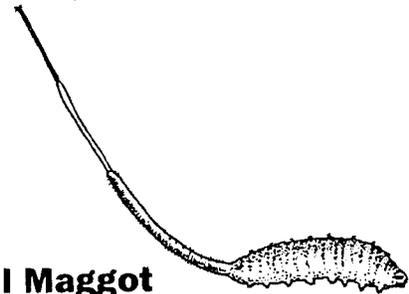
Damselfly Nymph



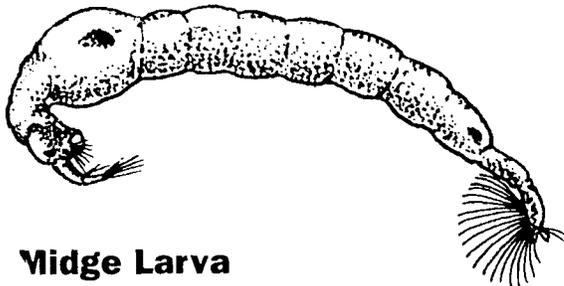
Stonefly Larva



Mayfly Larva



Rat-tail Maggot



Midge Larva

Environmental Stressor

ILLUSTRATION OF MACROINVERTEBRATES USED WITH PERMISSION OF THE ARTIST, TAMARA SAYRE.



SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street,
Vancouver, B.C., Canada V6B 5G3.



Introduction

This series of Scales & Tales is intended to be used sequentially. The fact/fun sheets are written for kids ages 8 — 12 and may be photocopied and distributed separately or as a set. Each sheet illustrates some aspect of the life cycle of the Pacific salmon with information on one side and an activity on the other.

There are also suggestions for extension projects which can be done at school, at home, at the library, or in the community.

- Not Eggsactly Exciting** pros and cons of life as an embryo
- Lunch Bags for Little Fish** all about alevins
- A Free-Swimming Fry** salmon fry, their predators, and their prey
- Pacific Salmon Species** characteristics of the 5 species
- Growing and Changing Fast!** the maturing smolt or juvenile
- Cruising the Ocean** adults and migration
- Salmon Anatomy** body parts of a salmon
- The Last Lap** the journey home to spawn

If you would like further information, please contact

Department of Fisheries and Oceans
Community Involvement Division
555 West Hastings Street, Vancouver, B.C., V6B 5G3

or your local Department of Fisheries and Oceans/
Salmonid Enhancement Program, in the blue
Government of Canada pages of your telephone book.

Acknowledgements

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Bev Bowler, Education Coordinator, Lower Mainland
Cathy Cardinal, Education Coordinator, N. Vancouver Island
Produced by: Don Lawseth



SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

For The Teacher or Leader: Summing Up Salmon Their Natural Life Cycle

Salmon begin their life in freshwater streams, rivers and lakes. They grow and mature in the ocean and return to spawn and die in the same stream in which they were born.

Their life cycle begins in gravel streambeds. Mature females returning to spawn dig a nest, called a redd, in the gravel. Here they deposit up to 6,000 eggs, depending on their species. The average is between 2,500 - 3,000. The eggs are immediately fertilized by the male salmon. Then they are covered with gravel by the female for protection.

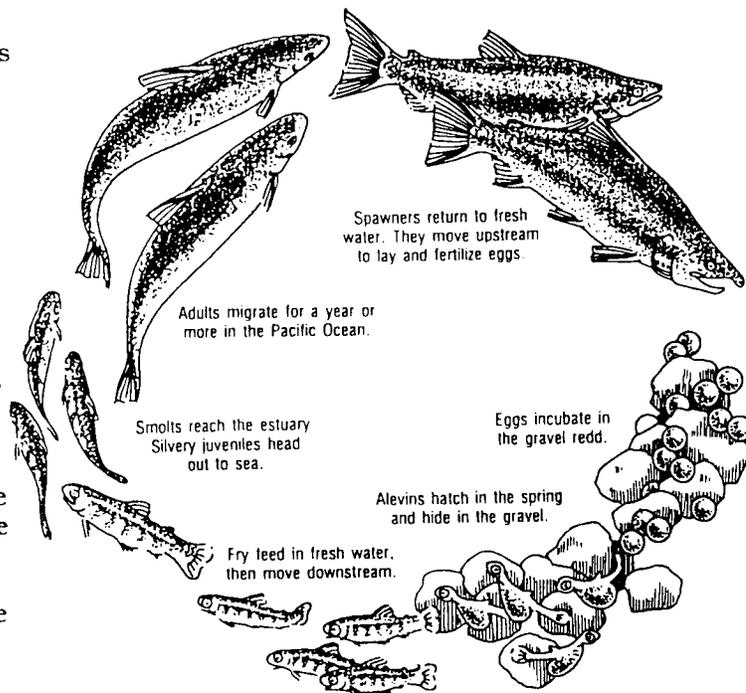
The eggs incubate under the gravel over the winter months. When the salmon hatch they are called alevins. Alevins have a yolk sac attached to the underside of their bodies from which they receive nourishment. In the spring, when the yolk sac has been absorbed, the miniature salmon emerge from the gravel as swim-up fry.

Coho, chinook and sockeye salmon will remain in freshwater for a time. Chum and pink salmon migrate to the sea soon after emerging from the gravel as free-swimming fry. The amount of time spent in freshwater depends on the species and sometimes the location. Salmon fry eat constantly and grow quickly. When they reach what is called the smolt stage, they move downstream and linger in the estuary as their bodies get used to saltwater. Smolts will then migrate to the ocean.

Ocean migration patterns vary in distance and direction. Many salmon travel along with ocean currents in circular routes. Some wander as far as 3,200 kilometres from their stream. Others stay closer to home. The salmon grow to adulthood on rich seafood diets, including small fish such as herring and anchovies.

When they are ready to spawn, the salmon return to the stream where they were hatched. During the difficult journey, their bodies change in colour and shape. Once the eggs are laid and fertilized, their life cycle is complete and the salmon die.

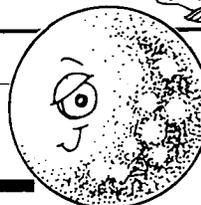
The Life Cycle in Nature



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 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.



Not Eggsactly Eggciting



Some animals are born ready for action. Many animals are born looking like miniature copies of their parents. Most animals are born with at least one parent still alive. Me, I'm a salmon egg and I have to fill in 'none of the above' to all of the above.

I'm not exactly complaining. But life so far, as a salmon egg, has all kinds of downsides and, quite frankly, not too many advantages.

The biggest drawback is that, although 2500 of us were laid in this underwater gravel nest (redd), only one in ten of us will ever see the light of day. That's because we are so sensitive. The least disturbance of the streambed means death to most of us. Changes in water level will kill hundreds of us. Add predators, flooding, pollution and disease to the list and that leaves very few survivors. Those of us who do live do so

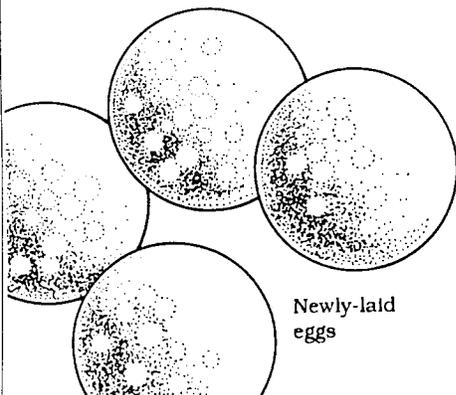
in the dark. We salmon eggs are not high profile creatures until later in our lives.

Enough of doom and gloom. On the positive side, I am orange. I am about 7 millimetres in diameter, and I weigh almost 220 milligrams. My shell is soft and transparent. It's made up of two layers - the outer casing and a membrane on the inside.

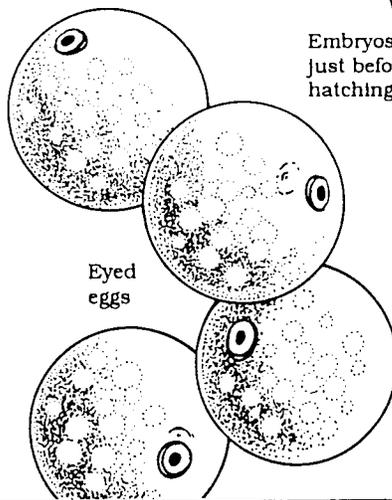
I would like to say that I have some control over my own development. But, like most young critters, I don't. Technically I'm known as an embryo. That doesn't mean much to me down here in the dark. Soon I will have eyes but I don't think that will make much difference either. I know I am growing inside

this shell. I also know that my rate of development depends on the temperature of the surrounding water. The warmer the water the faster I grow. Of course, being a cold water kind of fish, I can't tolerate temperatures below freezing or above 20 degrees Celsius.

I've just about eggshasted the pros and cons of life as a salmon embryo. I can hardly wait until I hatch, which will happen in about 3 months. I bet you can hardly wait either because that means you will get to read another chapter in my continuing story!

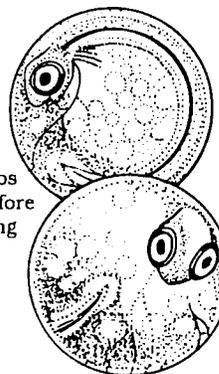


Newly-laid eggs

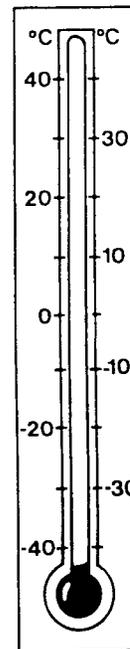


Eyed eggs

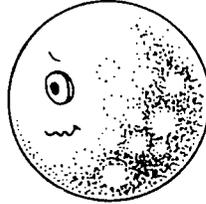
Embryos just before hatching



What do you think the water temperature is today? Indicate the temperature on the thermometer.



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 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

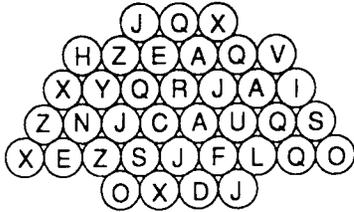


Eggsposed to Danger!

Being a salmon egg is risky business. Some of the conditions that kill salmon eggs are:

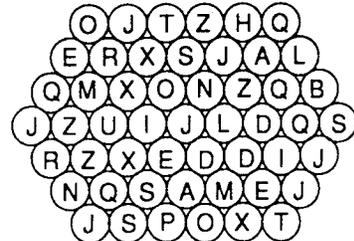
- 1) pollution
- 2) movement
- 3) silt clouding the water
- 4) extreme temperatures
- 5) a change in the water level

Hidden in each of these groups of eggs is a situation that may cause **one or more** of these conditions. To find out what's happening to put these salmon eggs at risk, decode the message by crossing out eggs marked J, Q, X, or Z. Then circle the condition(s) (1, 2, 3, 4, and/or 5) that might be caused by that situation.



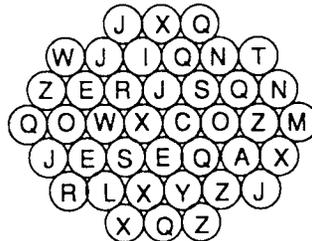
Decoded message:

This can cause 1 2 3 4 5



Decoded message:

This can cause 1 2 3 4 5



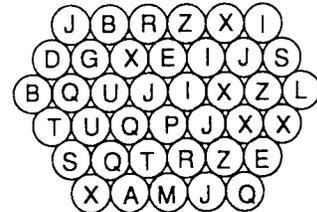
Decoded message:

This can cause 1 2 3 4 5



Decoded message:

This can cause 1 2 3 4 5



Decoded message:

This can cause 1 2 3 4 5

Other things to do:

Can you think of other natural and human-made stresses that might put salmon eggs at risk? Can you think of ways to prevent these things from happening?

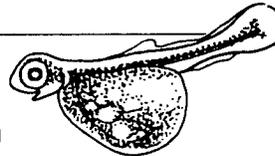
How many eggs are on this page? Colour every tenth egg, to show the 10% that will survive to hatch.

Build a model of a salmon redd (a frisbee or paper plate makes a good base for a stream bed).

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Lunch Bags for Little Fish



Bet you don't recognize me. I'm still down here in my under-gravel redd. I'm still pinkish orange and fragile but I'm not round anymore and I'm no longer a salmon egg. I'm still me but now I'm an alevin!

Let me explain. When salmon eggs hatch they are called alevins. Two days ago I hatched so that makes me an alevin.

Don't worry. I'm not going to fill you in on every little detail of my life, but I would like to share some things with you. First of all, I have a very weird shape.

That bulge on my underside is my yolk sac. It's a little bulky-looking but I may as well get used to it. For the next 30 — 50 days it's going to be my food cupboard.

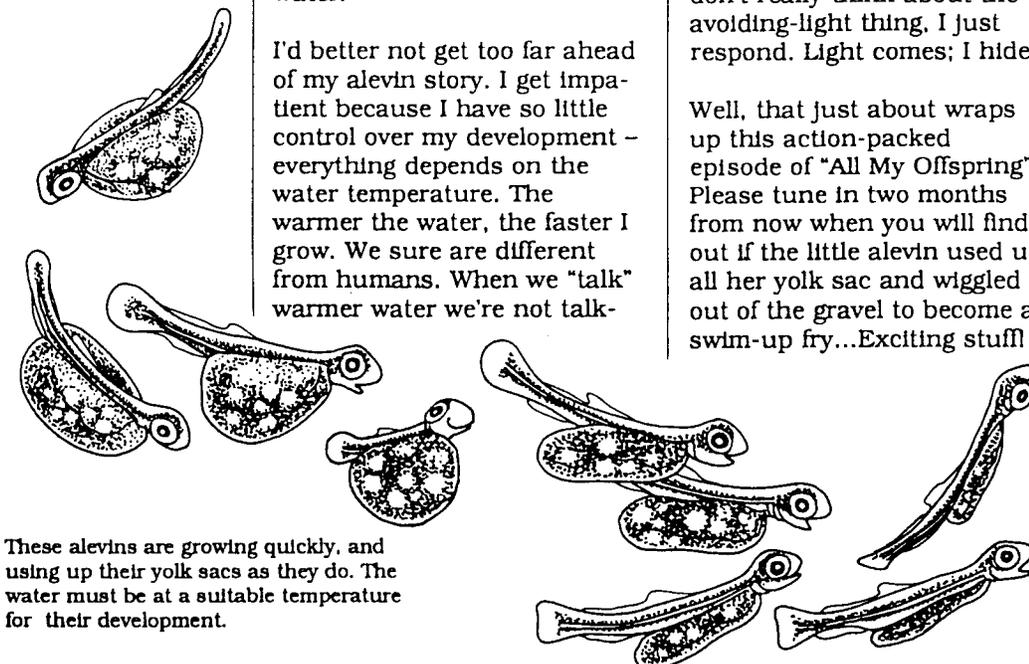
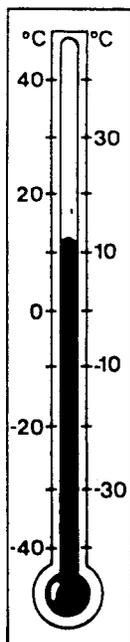
This yolk sac of mine contains all the protein, minerals and salts that I will need for my living and growing. All those goodies (but no junk food) are packed in my own little attached lunch bag. As my body grows bigger my yolk sac gets smaller. By the time I am ready for real food, I will be slim enough to wiggle my way up and out of my gravel nest. Then it will be goodbye, redd; hello, swimming around in the water.

I'd better not get too far ahead of my alevin story. I get impatient because I have so little control over my development — everything depends on the water temperature. The warmer the water, the faster I grow. We sure are different from humans. When we "talk" warmer water we're not talk-

ing bathtub warm. (Remember we salmon are cold-water fish.) When the temperature gets above 14° C we get very uncomfortable.

Speaking of differences. Are you afraid of the light? I didn't think you were but I sure avoid it. No night light for me. The darker the better. I'm not absolutely sure why I wiggle away as quickly as I can if any light penetrates down here. It probably has something to do with the fact that alevins are fragile and defenceless. We don't exactly blend in with the gravel or did you forget that we are orange? Anyway, I don't really think about the avoiding-light thing, I just respond. Light comes; I hide.

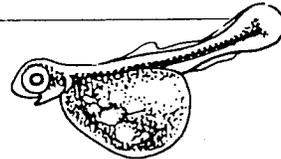
Well, that just about wraps up this action-packed episode of "All My Offspring". Please tune in two months from now when you will find out if the little alevin used up all her yolk sac and wiggled out of the gravel to become a swim-up fry... Exciting stuff!



These alevins are growing quickly, and using up their yolk sacs as they do. The water must be at a suitable temperature for their development.

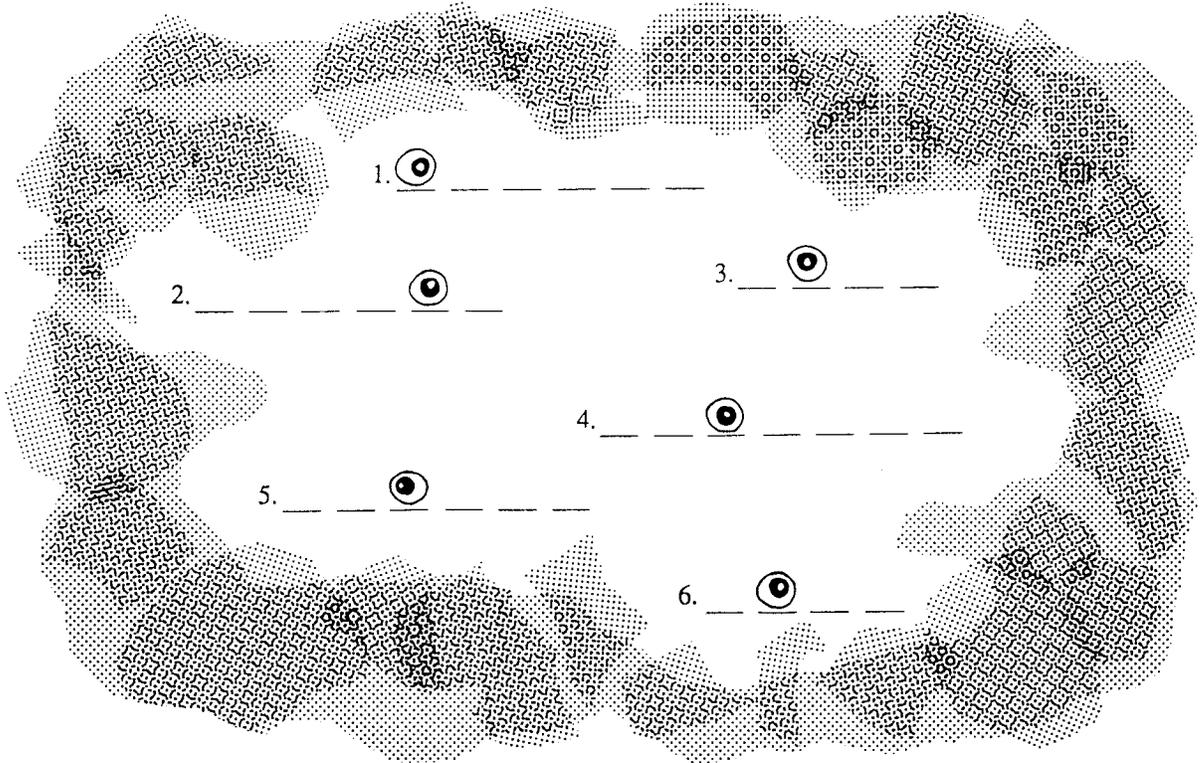
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Down in the Dark



These alevins are hiding in the gravel. It's so dark down there, all you can see is their eyes! Solve the word clues and fill in the blanks, using the eyes for the letter "O".

1. Eggs and yolk sacs are coloured _ _ _ _ _
2. When an alevin grows up, it becomes an adult _ _ _ _ _
3. The mixture in an alevin's "lunch bag" is called the _ _ _ _ _
4. Alevins need _ _ _ _ _ , minerals, and salts to grow.
5. Alevins grow more _ _ _ _ _ if the water is too cold.
6. Salmon are _ _ _ _ _ -water fish.



Other things to do:

Imagine you are a research scientist. Design an experiment to test the hypothesis that alevins instinctively avoid light.

Alevins' "lunch bags" contain all the protein, minerals and salts they need. How about *your* lunch bag? Draw yourself a big, fat sandwich containing at least one thing from each of the Canada Food Guide food groups: dairy, meat, vegetable, grain and fruit.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA

Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.



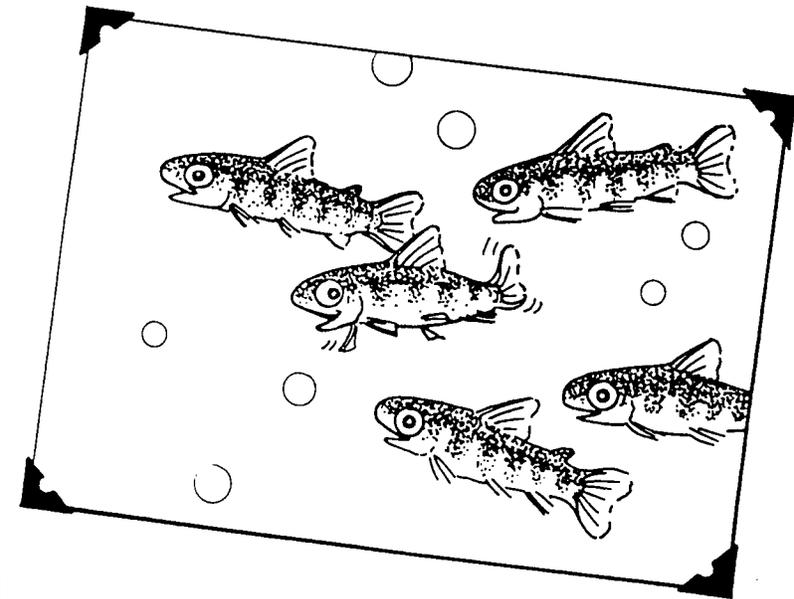
A Free-Swimming Fry

Boy oh boy, or should I say girl oh girl. Life is sure different for me these days. I want to let you in on all the exciting changes that I've been experiencing. I don't know quite where to begin. If you believe that a picture is worth a thousand words then take a peek at this photo taken of yours truly just last week.

Can you pick me out? Just look at me. No more yolk sac. No more living in an under-gravel redd. No more avoiding light. I'm a free-swimming salmon fry these days. (My rate of development is still controlled by water temperature. I realize that you know this rule by now but it's important enough to repeat: **THE WARMER THE WATER, THE FASTER I GROW.** Of course, the water must be between 4°-14°C. Fussy little critter, aren't I?).

There is one other **BIG RULE** for salmon fry: **EAT OR BE EATEN.** I can assure you the eating and growing stuff is becoming more and more important every day. My neighbourhood - this gently flowing little piece of river - is really not such a gentle place in which to live.

Most rivers and streams (creeks too) are actually divided into desirable and less



desirable areas. The dividing lines are invisible but we know the difference. In the "good" areas there are plenty of insects and plankton to eat. There is also more streamside cover in the "better" neighbourhoods, such as bushes and trees for shade.

The trick to becoming a successful fry, which is a living fry, is to establish a territory and then defend that area from other fry. The real trick, though, is to be big enough to have the energy to do the establishing, the defending and the hunting. Oh,

and then there's the darting. Just a minor point. It almost slipped my mind. The Darting Thing. If you forget the darting part there won't be any worries tomorrow or the next day about defending the territory and snacking on insects - because something will be snacking on you.

To sum up what life is all about as a salmon fry, it's easy as 1,2,3!

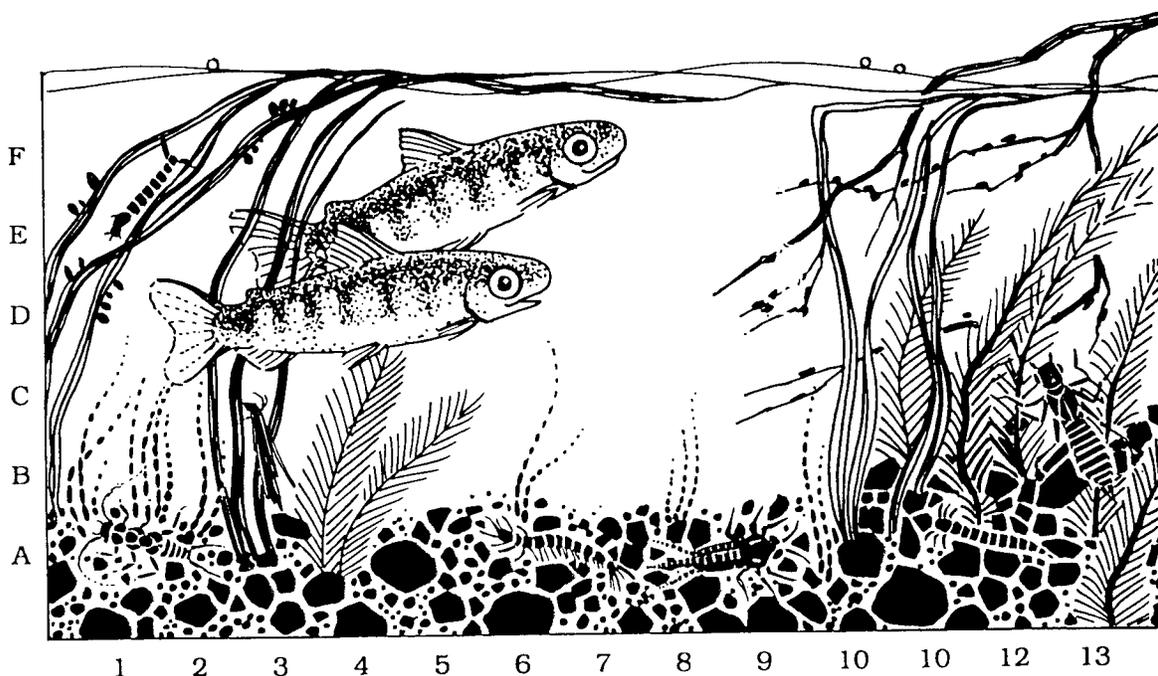
1. Eat lots
2. Grow bigger.
3. Avoid predators.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

Eat... or Be Eaten!



All insects hatch from eggs. Then they go through other stages of development before they become adult insects. Some live for a while as nymphs or larvae in ponds and streams, providing a source of food for salmon fry. Help these fry find a good dinner. Circle seven insects hidden in the stream.



Salmon fry eat adult insects, too. Check your library to see what some of these insects look like when they grow up.

- Answers**
- A1 — Stonely nymph
 - E1 — Mosquito larva
 - B3 — Caddisfly larva
 - A6 — Whirligig beetle larva
 - A8 — Mayfly nymph
 - A12 — Crane fly larva
 - B13 — Dragonfly nymph

Other things to do:

There are many birds, reptiles, mammals, and fish that might enjoy having a salmon fry for lunch. Draw some of them, from a "fry's eye" point of view.

Imagine you are a newspaper reporter for the *Wildlife Times*. Visit a nearby stream and spend some time observing exactly what is going on in and near the water. Conduct an interview with a) an animal that might be eaten by a salmon fry, b) an animal that might eat a salmon fry.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.



Pacific Salmon Species

Five futures for a fast-growing fry!



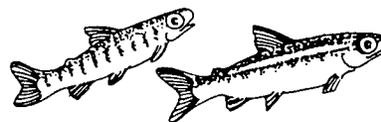
Now that I am a free-swimming fry, I really must pause in my fish tale and explain the BIG PICTURE to you.

Up until now it has not really mattered what kind of salmon I was. All types of salmon look and behave pretty much the same when they are eggs and alevins. Now, however, it's a different story.

In a nutshell it works like this. There are five species of Pacific salmon. Each one spends a different amount of time in fresh water growing and developing. This is called the rearing phase.

When we reach just the right size for our kind of salmon we begin a journey towards the sea. During our trip

downstream we continue to change (inside and out) until we are ready to live in salt water.



Fry

Smolt

We change from being called fry to being called smolts or juveniles.

Once in the ocean, each species spends a different amount (2, 3, 4, or 5 years) of time travelling out into the big, blue Pacific.

When we are adults we return to fresh water and make our way up the same river we journeyed down as young fish.

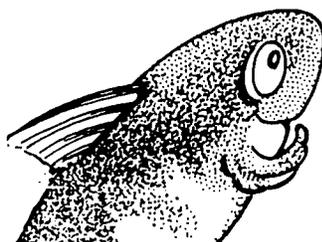
How heavy do adult salmon usually get?

Pink	1.5 - 3 kg.
Chum	4 - 9 kg.
Coho	3 - 6 kg.
Sockeye	3 - 5 kg.
Chinook	4 - 16 kg.

Once we have reached our home stream we spawn and die.

So much for the BIG PICTURE. Now back to my own personal story. When I am ready, I will make my way downstream to the ocean. Before I go I will know all the sights and sounds and especially the smells of the water. Everything about this stream - the rocks, the roots, the other animals - will be *imprinted* in my brain. I don't even realize this imprinting is taking place. After I have lived in the ocean, and it is time for me to return here to spawn, I will be guided upstream by the smell of this good old stream.

How long and where do salmon fry rear?



- Pink - in a stream, from a few days to a few weeks
- Chum - in a stream, from a few days to a few weeks
- Coho - in a stream or a lake, for a year
- Sockeye - in a lake, for 1 to 3 years
- Chinook - in a stream, for 90 days (or sometimes a year)

How long do salmon live?

Pink	2 years
Chum	3 - 4 years
Coho	3 - 4 years
Sockeye	4 - 5 years
Chinook	2 - 7 years

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

Identifry Me!



- 1) Here's a "salmon speak" code. Each letter has a matching number. Look for a pattern in the number/letter pairs provided, and complete the code.
- 2) Now, using the salmon-speak code, fill in the blanks. When you've finished, the details of my life will reveal which species of salmon I belong to!

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s
2	__	4	3	__	__	__	__	10	9	__	__	__	__	__	15	__	__	20
t	u	v	w	x	y	z												
__	__	21	24	23	__	__												

I will spend _____ rearing in this _____. During
 16 13 6 26 6 2 17 4 16 2 20 19 2 11 20 19 17 6 2 14

that time I will have to _____ for _____ and be alert for _____!
 11 16 16 12 5 16 16 3 15 17 6 3 2 19 16 17 20

While I'm _____, everything about the _____ - the _____, the
 8 17 16 24 10 13 8 20 19 17 6 2 14 17 16 4 12 20

_____, the _____ - will be _____ in my
 17 16 16 19 20 16 19 7 6 17 2 13 10 14 2 11 20 10 14 15 17 10 13 19 6 3

brain. After _____ years of travelling in the _____ I may weigh as much
 19 24 16 16 4 6 2 13

as _____ kg. Then, probably in late _____, I will come back here to
 20 10 23 13 16 21 6 14 1 6 17

_____, guided by the smell of this good old _____!
 20 15 2 24 13 20 19 17 6 2 14

What species of salmon am I? _____

Other things to do:

Many salmon in British Columbia do not develop in streams - they live the freshwater part of their lives in a hatchery. Find out if there is a hatchery in your community. All hatcheries welcome visitors at certain times of the day or week, so take along your notebook and sketch pad and do some research.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA

Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.



Growing and Changing Fast!

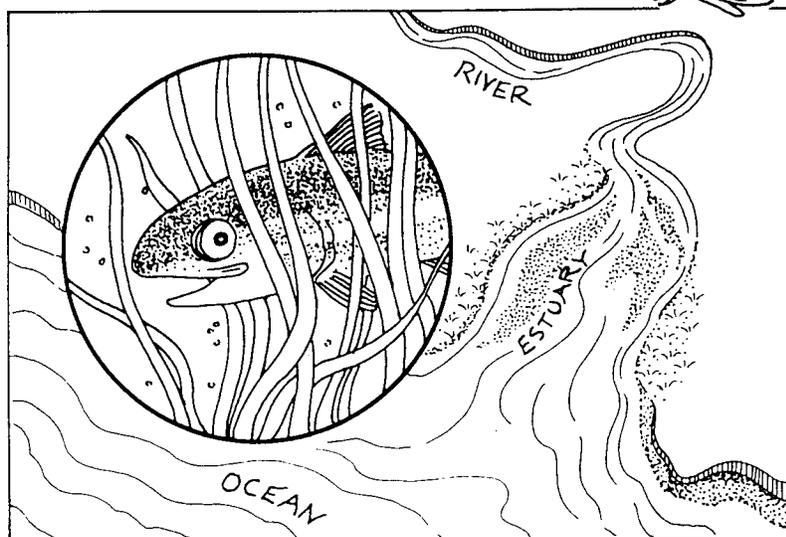
DeFINITION of a smolt: A young salmon undergoing changes in preparation for entering saltwater. Also known as a juvenile.

That's me all right — a smolt. Those changes that the definition says I'm undergoing are pretty weird. (I think I know how human teenagers must feel.)

First of all, I'm losing the parr marks on the side of my body. I'm also becoming silvery all over. Guess I won't be needing the same kind of camouflage in the ocean as I need here in the stream. I'm also becoming restless. At first I thought it was just spring fever but now I realize all the young coho are gathering together and moving toward the sea. Good thing I'm changing on the inside as well as the outside because I have a feeling that life in saltwater will take some getting used to...

DeFINITION for migration: To move seasonally from one place to another.

That's me again - a migrating smolt. Not only is my body (both inside and out) changing, but I'm on the move. I've travelled many kilometres in the past few days. Yesterday I got a chance to try out some of my new changes. A bunch of us were just migrating along



when, "Yuck." I got a whole gill full of not too great tasting water. My first reaction was to turn back. Then I thought, "call the pollution control hotline." I took another taste and the light went on upstairs — the water wasn't polluted, just salty. This area of the river we're in now is different from our home stream. The water is brackish — partly fresh and partly salt. It must be nature's way of gradually getting us used to life in the ocean. I sure don't want to miss that part of my life.

DeFINITION of an estuary: A place where fresh water mixes with salt water from the sea.

Aren't dictionaries great? Now I know what to call this place. That's where I am right now - an estuary. I think the definition

should also say: "a place where a young coho smolt meets lots of food and also lots of critters looking for food". Wow, this place is both exciting and scary. In human terms, the experience would be similar to suddenly finding yourself, a small town type, dropped off in the middle of a freeway at rush hour.

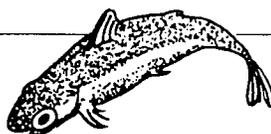
I'm not sure how long I'll be in the estuary — as long as it takes, I guess, to get a little bigger, a little more used to salt water, and a little readier for the big adventure ahead of me.

DeFINITION of an adventurer: One who seeks the risky, the new and the unknown.

That's definitely me. See you in the Pacific.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

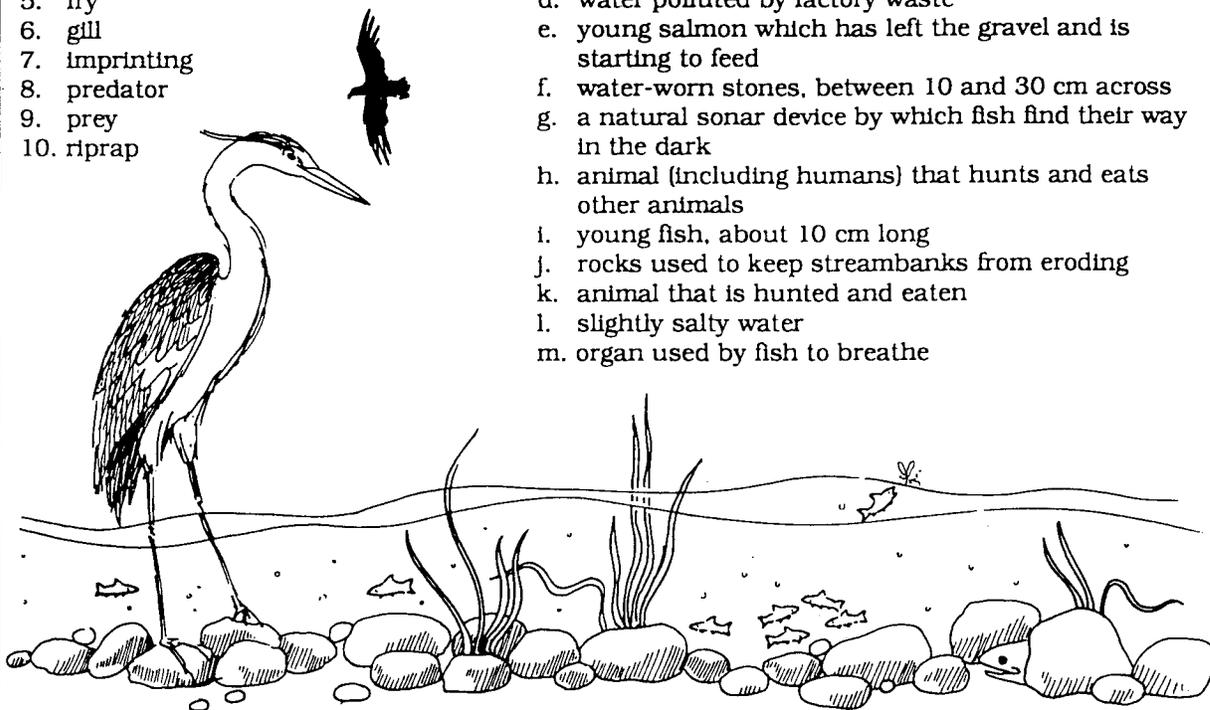
Fishy DeFINitions



Here are a few more salmon words. Match them with the definitions at right. There are more definitions than there are words, so watch out for fishy definitions! Answers are upside-down at the bottom of the page.

1. brackish water
2. cobble
3. ecosystem
4. fingerling
5. fry
6. gill
7. imprinting
8. predator
9. prey
10. riprap

- a. interaction of living creatures with each other and the world around them
- b. a salmon with a damaged tail fin
- c. word describing how a salmon stores up information about its home stream
- d. water polluted by factory waste
- e. young salmon which has left the gravel and is starting to feed
- f. water-worn stones, between 10 and 30 cm across
- g. a natural sonar device by which fish find their way in the dark
- h. animal (including humans) that hunts and eats other animals
- i. young fish, about 10 cm long
- j. rocks used to keep streambanks from eroding
- k. animal that is hunted and eaten
- l. slightly salty water
- m. organ used by fish to breathe



Other things to do:

Write a story about the picture, using some of the words listed above. If you chose incorrect definitions for any of them, make sure you use them in the story. That's a good way to fix them in your memory.

Find someone who has lived in your area a long time, and ask them how your nearest stream has changed over the years. For example, are there culverts to allow the water to flow under the road? Have the banks been cemented? Are there any dams or other obstructions? Ask the person if the stream was ever home to salmon or if there are fish in it now.

Answers: 1. l 2. f 3. a 4. i 5. e 6. m 7. c 8. h 9. k 10. j

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA

Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.



Cruising the Ocean

Hello again. It's me, your friendly, no name, journal-writing, coho salmon. I'm an adult now. In human terms I'm only two and a half years old. I have a great life. There's only one thing I'd like to change: I wish I could fly! I don't want to be a bird, but I wish I could get a bird's eye view of the Pacific Ocean.

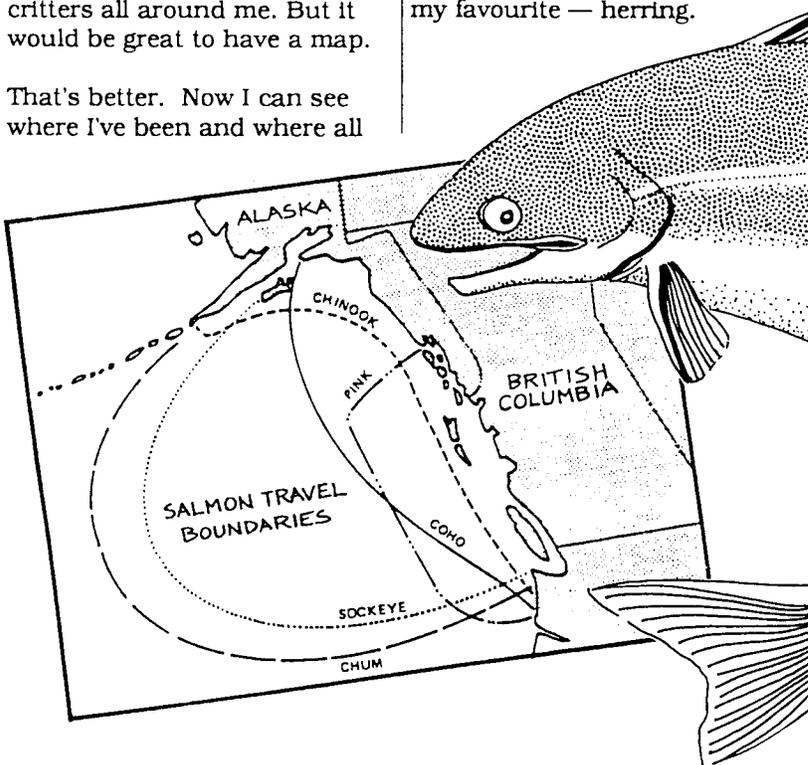
It seems like I've travelled hundreds of kilometres, but I can't picture where I've been on my ocean migration. I keep swimming. I can see water and critters all around me. But it would be great to have a map.

That's better. Now I can see where I've been and where all

the other species of salmon are hanging out.

Remember when I was a young salmon and I said I wanted an adventure? Well, I've certainly had a few thrills and near spills out here in the salt chuck. I barely escaped being caught in a huge seine net and I came *this* close to touching a whale's tongue.

The food in the good old Pacific is abundant and tastes terrific. I usually go with the "catch of the day", which today happens to be my favourite — herring.



I keep wondering if I'm being guided by ocean currents or a compass in my head. Maybe we are following the same route our parents took. Maybe our migration is affected by all kinds of things, like the earth's magnetic field. Maybe it's all about water temperature.

What a mystery. Where are Nancy Drew and The Hardy Boys when you really need them? I guess this amateur sleuth better stop trying to solve the who am I, where am I going type mysteries or I'll be the hero in a new "whodunit": "The Mystery of the Inquisitive Coho".

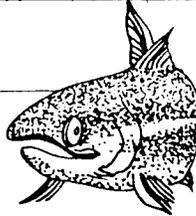
I think you get the general idea of what ocean life is like. Lots of swimming, lots of eating, lots of growing, lots of avoiding predators. Of course, I'm not travelling alone. There are about 200 of us coho in this one school.

What I haven't really talked about is what I look like. At the peak of my development (and maybe I should whisper this part in case any anglers are in the vicinity), *I look terrific*. You've probably seen pictures of some of my friends. They are usually posed with a smiling angler. You know the shot and the caption - Fisherman weighs in THE BIG ONE.

Fortunately there's no happy, smiling angler in this portrait of yours truly and my Cruise Chart.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

Let's Go Fishing!



Lots of you humans want to catch a handsome adult salmon like me! There are three types of salmon fisheries competing for the pleasure of scooping me out of the water – work out what they are by finding the letter in each clue. The first one is done for you.

The first is in OCEAN but not in LOCATE
 The second is in BOAT but not in BOTTOM
 The third is in TAIL but not in SAIL
 The fourth is in SHIP but not in SHAPE
 The fifth is in WAVE but not in WHALE
 The sixth is in SEA but not in SALT

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The first is in COHO but not in HOOK
 The second is in HOOK but not in HAKE
 The third is in SWAM but not in SEAWEED
 The fourth is in CHUM but not in LUNCH
 The fifth is in NET but not in TON
 The sixth is in DART but not in DATA
 The seventh is in SCALE but not in SEAL
 The eighth is in GILL but not in GULL
 The ninth is in CATCH but not in TOUCH
 The tenth is in EEL but not in FEED

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The first is in SEINE but not in DINE
 The second is in PINK but not in TAKING
 The third is in GROW but not in GREW
 The fourth is in HERRING but not in WEIGHT
 The fifth is in DIET but not in HIDE

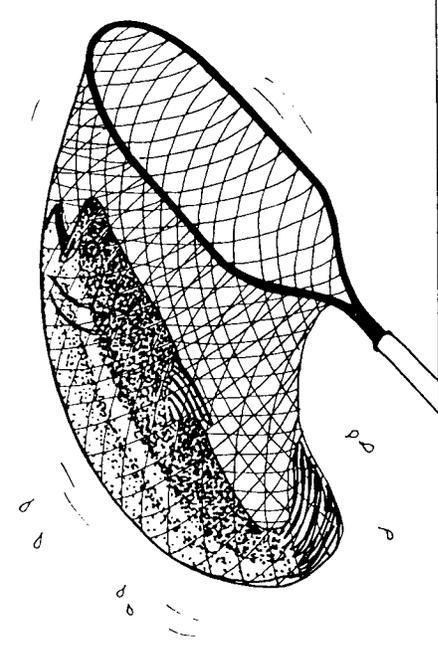
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The three kinds of salmon fishery are: _____, _____, and _____ . If you are not sure how they are different, make a trip to the library and do some research. What boats or gear are used in each? Do all three fisheries happen in the same places, at the same time of year?

Other things to do:

Have you ever taken part in any or all of the three types of salmon fishing? Describe or make up a Whopper Story about the time you caught THE BIG ONE!

Find out about the Head Recovery Program, salmon tagging, and the Catch and Release Program by calling your local Fisheries office.

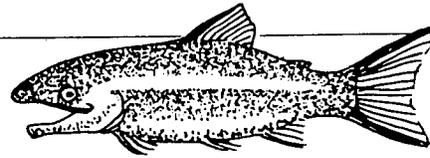
Do a market survey. Make up a short list of questions to ask your family and friends. Remember, the more people you ask, the more accurate your resulting data! Some sample questions: Which species of salmon do you prefer to eat: pink, chum, coho, chinook, or sockeye? What is your favourite method of preparing salmon? What vegetable tastes best with a salmon dinner?

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA

Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

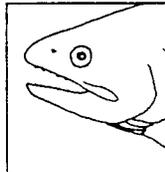


Salmon Anatomy



You have a body. I have a body. So far we're even! But you live in the air, while I live in the water, and that means a lot of differences between us. I've checked a great book on Salmon Anatomy out of our school library. While you're reading about *my* body, think about how salmon and humans are the same and how they are different.

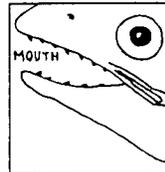
Head: The salmon's head contains the eyes, teeth, nostrils, mouth and gills. The area in front of the eyes above the mouth is the snout.



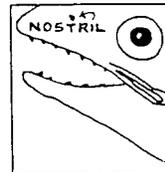
Eyes: Fish can see to the front and back at the same time because each eye works by itself. Eyelids and tear glands are not needed. Water keeps the eyes wet and clean.



Mouth: The mouth is used to catch and hold food. Fish do not chew before swallowing. The mouth is important for breathing, too.



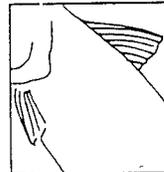
Nostrils: Salmon have an excellent sense of smell. They can detect very faint odors in a stream. Salmon use this ability to find their home stream for spawning.



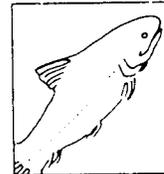
Gills: Like people, fish need oxygen to breathe. They gulp water into their mouths and force it out over the gills. The gills are full of blood vessels, like human lungs. They take oxygen (a part of air) out of the water.



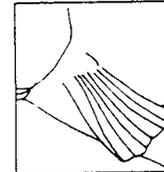
Body: The area just behind the gill coverings is called the pectoral or chest region. The belly extends from the pectoral fins to the anus.



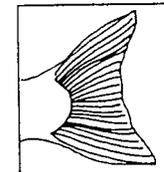
Lateral Line: Most fish have a line running along each side of their body. The little holes in the line help the fish sense movements of other animals and objects in the water.



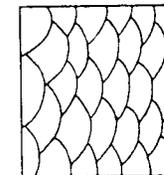
Fins: Fish swim by body movement and by sculling with their tail fins. Fins on their backs and sides are mainly used as rudders, brakes and devices to keep them upright in the water.



Tail: The tail is the part of salmon behind the anus. The slender section between the base of the tail fin and the dorsal fin is called the wrist. Another name for tail fin is caudal fin.



Scales: The bodies of most fish, salmon included, are covered with scales. These are small, hard plates that overlap like shingles on a roof. They are covered with mucus or slime. This protects the fish from disease and helps it slide through the water.



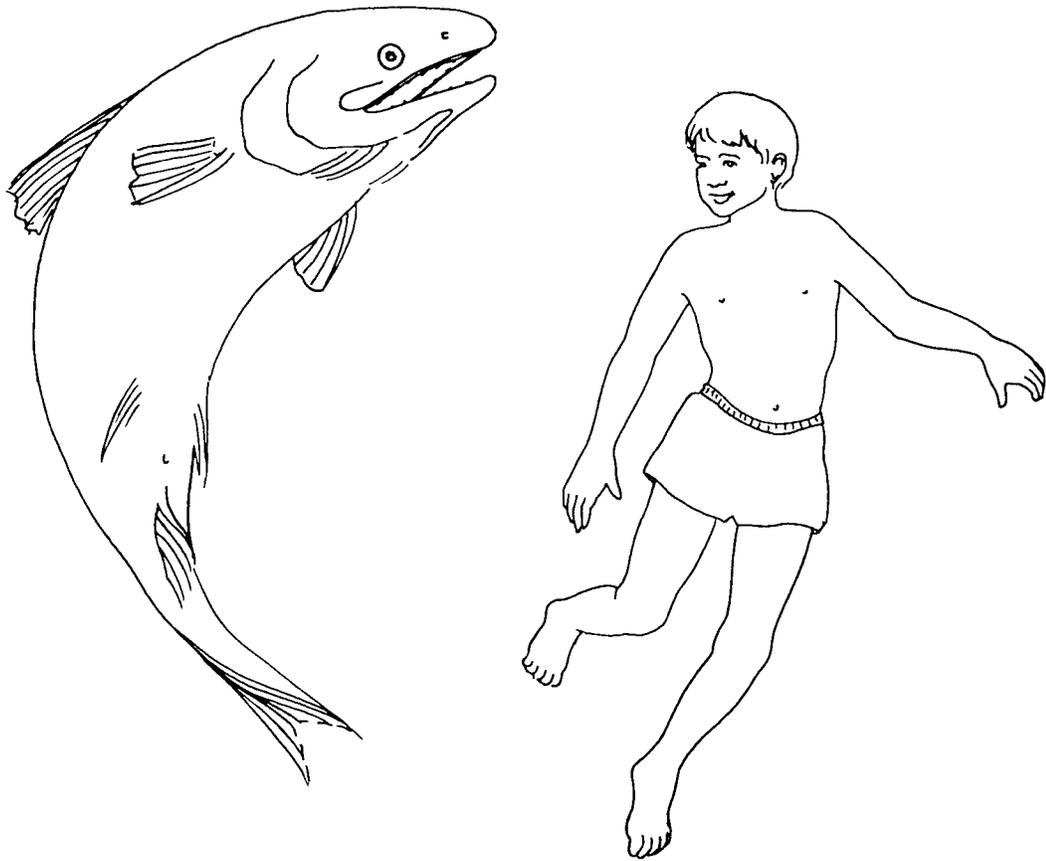
SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street,
Vancouver, B.C., Canada V6B 5G3.

Trading Places



If a human and a salmon could trade places for a week, they could learn a lot about each other!

What would the fish need to help him get along on land? Add body parts to the fish that would let it walk, breathe, and eat in our world. Do the same for the boy. Remember, he'll be under water; so he'll have to watch for predators, find food, and do all the things that salmon do.



Other things to do:

Read up on SCUBA divers in the library. What does SCUBA stand for? What equipment does a diver use that makes him or her more like a fish?

Write a story about your week as a fish. What do you look like? What happens to you?

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA

Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.



The Last Lap

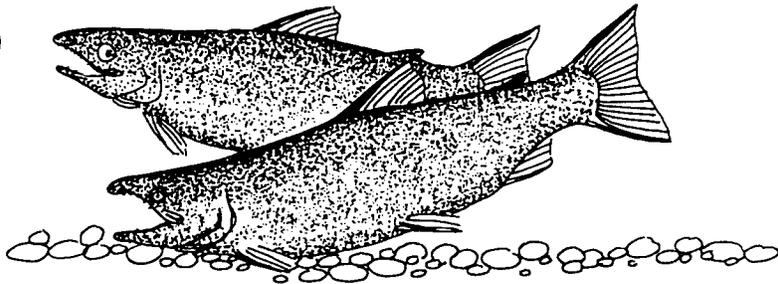
Whew! Am I tired! Am I battered! I've only got a few more kilometres to go before I reach my spawning grounds. It may get pretty hectic with all the redd digging that I'm going to be doing so I thought I'd rest a minute and bring you up to date on the latest in my life history.

Remember: When I started this story I was a tiny orange egg with a slim chance of survival. Back then I was always complaining about how dull life was. What did I know? I was just an egg tucked in a redd. Well, life certainly hasn't been dull these past few years. Especially these past few days. Maybe I'll just list a few of my close encounters of the dangerous kind:

- nipped by a harbour seal - good thing I'm a strong critter;
- scooped up by a bear - good thing I'm a slippery critter;
- delayed for a few days as I tried and tried to leap over a waterfall - good thing I'm a determined critter.

Not only has this old body had to work hard, it has really changed in appearance. The changes started once I left the ocean and began to swim in freshwater again. All of a sudden I stopped eating.

My only source of energy came from my stored body fat. I'll



have just enough energy to get me through all the spawning activity ahead.

I have begun to lose the slimy mucus that covered my scales. My skin has become thick. My scales have been *resorbed* — that means disappeared into my skin. I have lost my silvery colour and instead have become quite dark. My teeth are long and fang-like and my jaw is hooked. Actually, I'm quite fierce looking.

That's only half the story.

My insides have changed too. My kidneys and gills have adapted to freshwater. The most exciting change is that my ovaries are full of eggs. (It seems like only yesterday I was an egg myself). In just a few years salmon go from being teenagers (smolts) to old folks (spawners). In people the change takes 60 to 70 years.

Tomorrow or the next day, I will reach the spawning grounds. I will rest for awhile in a quiet pool. When I'm ready to spawn I'll find a mate. Then the hard redd-digging work will begin. I can just imagine what my caudal fin will look like when I'm

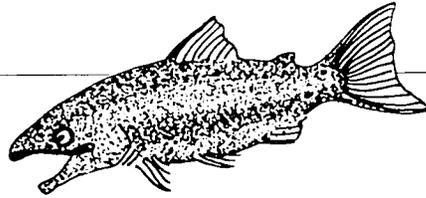
finished. But I bet I dig some fine looking redds.

I'm not exactly sure how all the actual spawning stuff will work. I know I'll try and lay all my eggs. I hope most of them will be fertilized by my mate so they'll at least have a chance to start developing. After the spawning part comes the guarding of the redd part. Then in a few days comes the dying part. All Pacific salmon die after they spawn - it's all part of our natural cycle. Our bodies will be eaten by other critters that live in and near the water. The parts of my body that aren't eaten will decay and decompose and become part of the natural food chain of this stream.

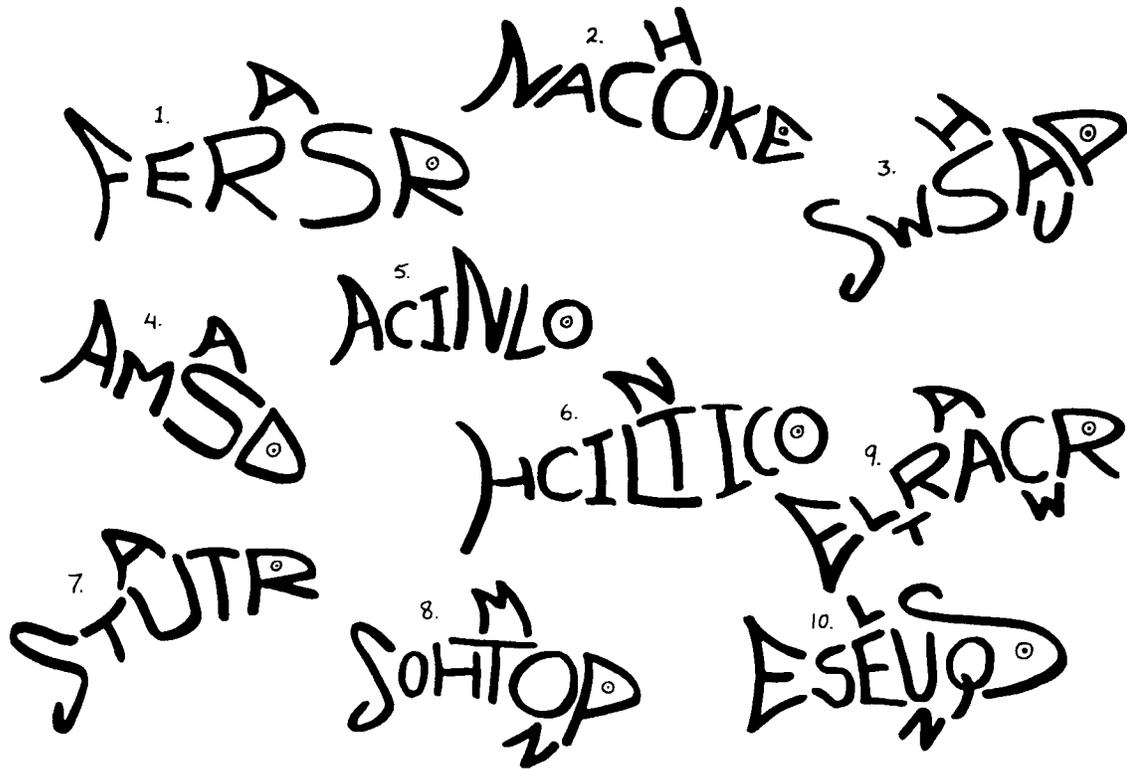
If I don't get a chance to write once I get to the spawning grounds I know you'll understand. Got to go now — and forever. It was terrific talking to you. You were all fine listeners and I'm sure you'll think of me whenever you think of clear, cool, unpolluted water. Remember, each and every one of you can make a difference to us salmon and to our environment.

SOURCE: DEPARTMENT OF FISHERIES AND OCEANS, BRITISH COLUMBIA, CANADA
 Contact Department of Fisheries and Oceans, Community Involvement Division, 555 West Hastings Street, Vancouver, B.C., Canada V6B 5G3.

Leaping Letters



Many spawning salmon, especially sockeye, head up the Fraser River. They are returning to spawning grounds in the many streams that flow into the Fraser. The leaping fish below are made of letters which spell out the names of some of the lakes and streams on their route. Use a map to help you with the long ones! You will see that the Fraser River and its tributaries cover almost half the province!



Other things to do:

Make up some leaping fish using letters that spell out the names of spawning streams in your area. See if your friends can figure them out.

Most salmon return to spawn in the same stream in which they were laid. After they hatched, and as they grew and began to swim about, they were imprinted with the smells and tastes of their home stream. These "memories" guide them on their return. Think about a salmon stream you know about. What smells in the water might make it different from another stream? What happens if there is a change in the stream due to siltation, pollution, or an obstruction?

Answers: 1. Fraser 2. Nechako 3. Shuswap 4. Adams 5. Nicola 6. Chilcote 7. Stuart
 8. Thompson 9. Clearwater 10. Guesnel

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION
Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

_____ Name

Salmon language crossword puzzle

Do you know . . .

All Pacific salmon are **anadromous**. They begin their lives in freshwater, migrate to the ocean, and return to freshwater to spawn and die. Salmon are important to Oregon's commercial and recreational fisheries.

The salmon life cycle begins when eggs are deposited and fertilized in the gravel of cool, clean rivers and streams.

In late winter or spring, the eggs hatch. The young fish, called **alevins**, are less than one inch long. During this time they are fed from a **yolk sac** that protrudes from their bellies. As the yolk sacs are used up, the fish, now called **fry**, emerge from the gravel in late spring or summer, approximately one to three months after hatching.

The fry of some species head directly for the sea, but others might stay in freshwater for a few months to a few years. Aquatic invertebrates provide most of the food for salmon fry.

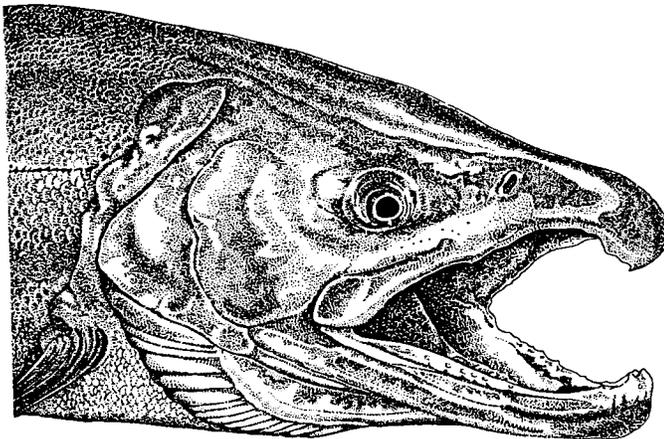
When they are ready to migrate to the sea, they go through a physiological change and are known as **smolts**. Once in the sea some spend up

to five years feeding and growing before they are ready to return to fresh water.

Salmon return to spawn in the same stream where they hatched. Weeks or months after they have reached the gravel beds, the female digs a nest, or **redd**. Here she deposits up to 5,000 eggs. The male fertilizes the eggs by covering them with **milt**, a milky substance that contains the sperm. The female finishes the spawning process by covering the eggs with gravel. After spawning, the salmon's life is finished. Within a short time, it dies and the carcass drifts downstream, decaying and contributing its nutrients to the stream from which it originally came.

Now it's your turn . . .

Do you understand how the salmon life cycle fits into the "watershed" picture? Can you name and describe the major steps of the salmon life cycle? Use the following crossword puzzle to test your knowledge about the salmon life cycle and to practice the new words you have learned.



Student sheet

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION
Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

Salmon Language Crossword Clues

Across

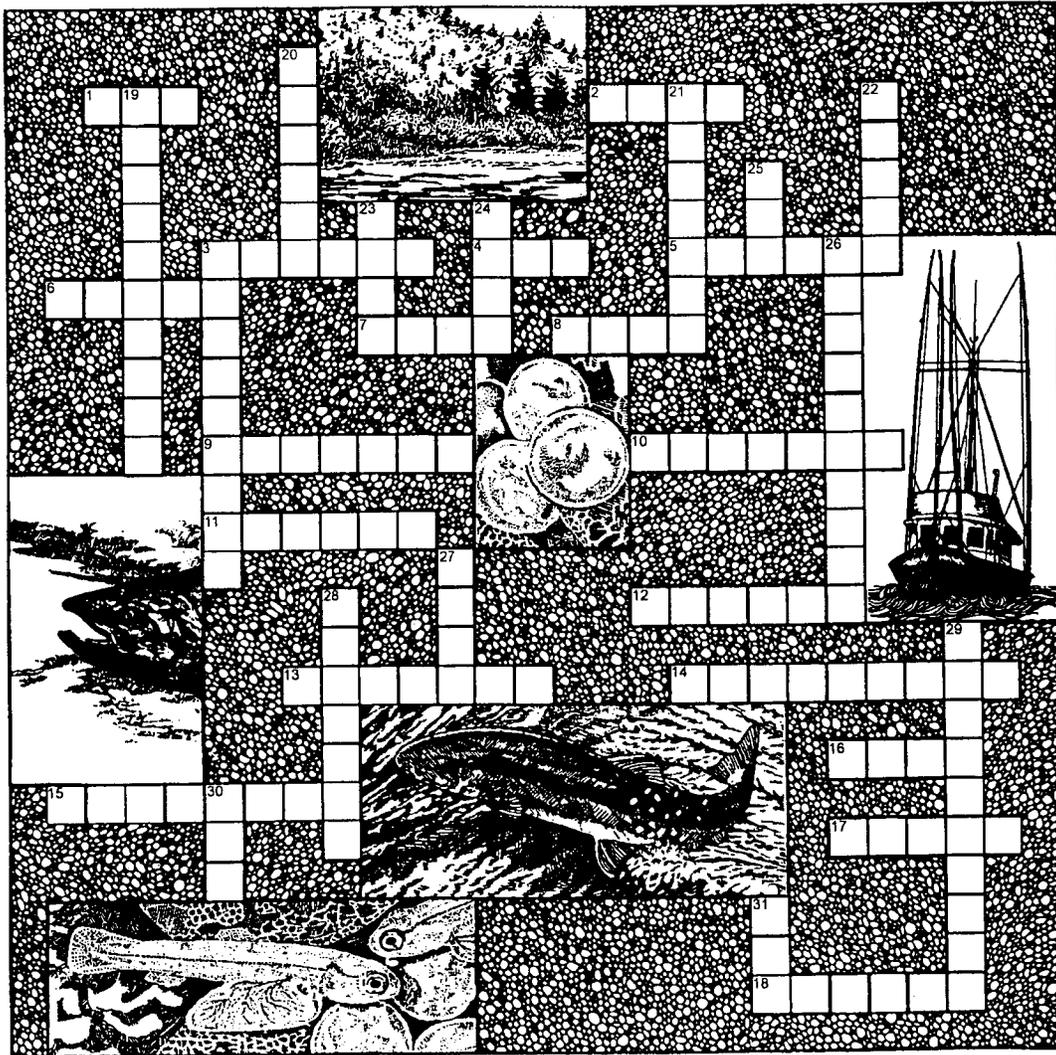
1. A major barrier to the migration of salmon and steelhead.
2. Early maturing, two-year-old coho (silver) salmon that return to spawn a year earlier than normal.
3. A healthy _____ is required to produce healthy juvenile chinook and coho salmon.
4. Abbreviation for Oregon Production Index, a mathematical model used to predict the size of runs of coho salmon (based on the return of two-year-old jack salmon).
5. Salmon eggs, juveniles, and adults must have _____ dissolved in the water to survive.
6. A juvenile salmon that is ready to migrate to sea is called a _____.
7. A salmon nest where eggs are deposited.
8. The shortest-lived and smallest of the Pacific salmon. The males develop a large humpback during spawning.
9. For salmon, cold water, plenty of food and good cover is excellent _____.
10. The term for commercial fishing boats and fishermen that fish for ocean salmon.
11. A newly hatched salmon with the unabsorbed yolk sac still attached.
12. Upper Columbia and Snake River fall spawning chinook salmon stocks which enter the river in excellent condition.
13. Species of salmon that usually spawn in streams having lakes in their watershed and are related to kokanee.
14. The _____ of the salmon has puzzled humans for centuries.
15. Healthy streambanks, called _____ zones, are essential for good natural salmon production.
16. Another name for dog salmon.
17. When salmon are caught for recreation and personal use, it is called _____ fishing.
18. Good spawning sites always have _____ for salmon to build redds in.

Down

3. A rainbow trout that spends much of its life in the ocean.
19. Fish that migrate from the sea to spawn in fresh water are called _____ fishes.
20. Another name for the coho salmon.
21. The largest salmon, also called a "king."
22. Term used to describe the laying of eggs by the female salmon and their fertilization by the male.
23. An older juvenile salmon with dark, oblong bars along each side is called a _____.
24. Water in which salmon live must be fairly _____.
25. Salmon that have absorbed their yolk sacs, emerged from the gravel, and are ready to feed.
26. Those salmon that are *not* caught by commercial or sport fisheries and escape to spawn in streams or hatcheries.
27. A stock of chinook salmon used in many lower Columbia River hatcheries.
28. _____ water is required around salmon eggs to deliver oxygen and carry away waste products.
29. When fish are caught and sold for profit, it is called _____ fishing.
30. The salmon entering a river system during a specific time of year are called that river's _____.
31. The _____ to fry stage in the salmon's life cycle is the period of greatest mortality.

Student sheet

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION
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Word list

- | | | | | | | |
|---------|------------|------------|-----------|-----------|------------|------|
| gravel | cold | run | stream | redd | bright | jack |
| sockeye | anadromous | escapement | migration | smolt | commercial | dam |
| alevin | OPI | habitat | egg | spawn | fry | |
| flowing | sport | parr | tule | steelhead | chinook | |
| pink | riparian | oxygen | troller | chum | silver | |

Student sheet

SOURCE: **THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION**
Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION

Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

_____ Name

Coming home!

Do you know . . .

Most clean, healthy streams, no matter how small, can contribute to salmonid (salmon and trout) habitat. All salmonids—salmon, steelhead, and trout—spend at least a part of their life cycle in small streams. Some, like chum or pink salmon, may only spend a few weeks in the stream or the estuary before moving to the ocean, while others may spend three or more years before migrating. Young sockeye salmon move from small streams to rear in freshwater lakes for one or more years while still other species are permanent residents of large and small streams.

A single stream may appear insignificant as a producer of wild fish. But together, thousands of small streams throughout the Northwest account for a lot of fish production. Healthy streams are valuable, but they are fragile. They are easily damaged by poor agriculture and forestry practices, pollution, mining, and urban development.

Wild salmonids need certain stream conditions to survive. Salmonids need clean water for every stage of their life cycle. A healthy stream usually runs cool and clear over a clean gravel bottom. The silt present in cloudy water can coat incubating eggs and surrounding gravel, preventing oxygen from reaching the eggs. Without oxygen the eggs will die. In a healthy, natural stream, the flow of clean water usually remains steady. The land on both sides of a healthy

stream acts as a giant sponge to soak up heavy rains. This water is then released slowly into the stream. Slow release of groundwater also prevents small streams from drying up during the warm summer months.

Aquatic organisms, including fish, have a relatively narrow temperature range for survival. Shade provided by trees and other plants that grow beside the stream helps keep the water cool and within that acceptable range. Insects that feed on the leaves and branches of these stream-side plants sometimes fall into the water providing food for the fish. Mayflies and other insects that land on the water's surface to lay their eggs are also eaten by fish. Some insect eggs hatch and become part of the stream food chain. These aquatic forms of insects live on, around, and among the rocks of the streambed. These insect forms are often carried along by the water current where they become part of the menu for a fish waiting downstream.

Small streams often contain natural debris such as root wads, fallen trees, and boulders. Fish use these structures to hide from their enemies which include larger fish, birds, and small animals.

Adult migratory salmonids, like salmon and steelhead, need a barrier-free route to their spawning areas. They also need cover, both in the stream and alongside it, for protection from predators and for shaded resting areas. Salmon usually return to spawn in the same stream where they hatched. No one knows for certain how they find their way back to the same stream, although one theory is that they can smell or actually taste the water chemistry of their home stream. When they enter fresh water, salmon stop feeding. Their journey upriver is made on the energy stored while living in the ocean. Within days of spawning, adult salmon die, contributing the nutrients in their bodies to the stream from which it originally came.

This activity is adapted from "Salmon Stream Advertisement" created by Patrick Griffiths, Pilot Butte Middle School, 1500 NE Penn, Bend, Oregon 97701, and used with permission. Portions of the activity content are adapted from *Small Streams*, a Salmonid Enhancement Program fact sheet, Department of Fisheries and Oceans, BC Ministry of Environment, 555 West Hastings Street, Vancouver, B.C. Canada V6B5G3.

Student sheet

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION

Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

Once young fish hatch they also need barrier-free access as they distribute themselves both upstream and downstream where food and cover is available.

Now it's your turn . . .

You are an employee of an advertising firm that has been hired by the local watershed council. A local client has approached the watershed council for help in getting salmon to come back to the stream on his property. The stream begins in a wilderness headwater area, flows through farmland and finally through urban areas on its way to the Pacific Ocean. This stream needs salmon! You are going to break with tradition and see if you can get salmon to come back to this stream even though they did not originally grow up there. Your job is to create an advertisement that will attract salmon to this stream! The advertisement will tell salmon how great the stream is and why it is suitable place for salmon to live.

The ultimate goal of the advertisement is to communicate what salmon need to live and reproduce, impacts human activities have had on watersheds in the past, and how we can improve streams to attract salmon in the future.

1. Work in groups of three students.
2. As a group, look at examples of advertising campaigns in newspapers, a variety of magazines, and junk mail. Look for the common themes in all of the advertisements. Note how the advertisers have used color,

headlines, text, pictures, charts, art work, and other features to convey the message.

3. Name your stream. Use this name to distinguish your stream from that of other groups.
4. Create a map of the stream and its watershed based on the description above. Determine where in the watershed the client wants salmon to spawn? Center your work in that area.
5. Organize your thoughts around the question "Why should salmon come and live in this stream?"
6. Create a planning guide around the main topics noted below. Use the questions following each topic to prepare for the advertising campaign and guide your research. Then, choose the points you want to emphasize in the advertisement.
 - **pH:** what is it, why is it important, how have humans altered the pH of streams, what range do salmon like best, how can humans keep pH within acceptable ranges.
 - **Temperature:** why are cool temperatures important to fish, how have human actions changed water temperatures in rivers and streams, what is the best temperature range for salmon, how can you protect a stream against drastic changes in temperature.
 - **Dissolved oxygen:** what is dissolved oxygen, why is it important to fish and



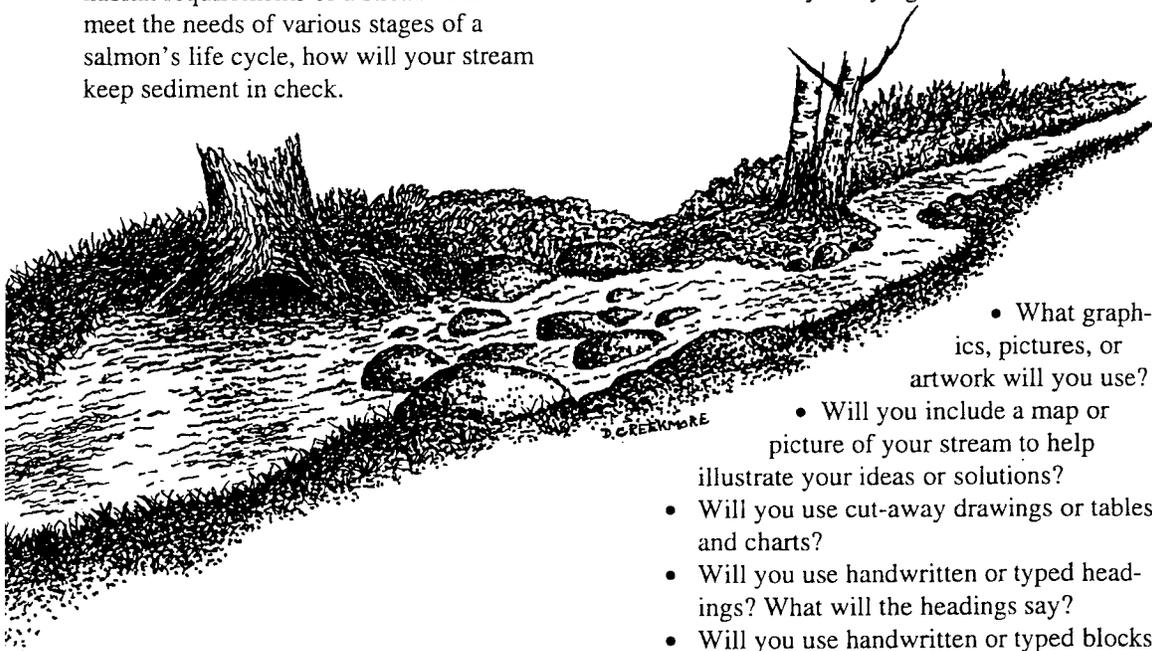
Student sheet

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION

Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

other organisms, how do dissolved oxygen concentrations change naturally, how do human activities change dissolved oxygen concentrations (for worse or better) in streams, how is dissolved oxygen related to temperature, what are the best levels for salmon, and do salmon need different amounts of dissolved oxygen during different parts of their life cycle.

- **Sediment:** what is sediment, what is its source, what is its effect on a stream (good and bad), how are excessive sediment accumulations controlled.
- **Food:** what are the food needs for salmonids, how does the stream provide for these needs.
- **Stream habitat:** what are the physical habitat requirements of a stream that will meet the needs of various stages of a salmon's life cycle, how will your stream keep sediment in check.



- **Pollutants:** how might fertilizers, pesticides, or other pollutants get into a stream and how might they harm a river or stream, how are pollutant problems solved.
- **Watershed land use activities:** how might watershed activities like mining, forestry, ranching, and farming practices,

commercial and recreational fishing, dams, and urban development affect rivers and streams and salmon (good and bad), what are some alternatives, how can watershed management activities be designed to be salmon-friendly

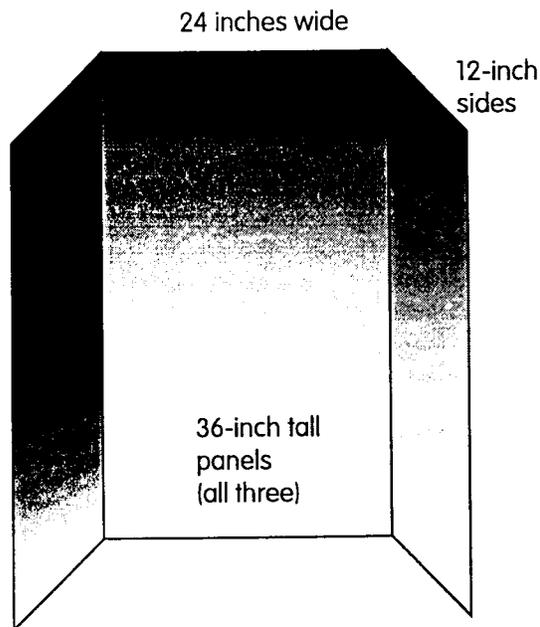
- **What does a healthy stream look like:** in the forest, passing through a farm, passing through a city?
7. Use butcher paper or other large pieces of paper to prepare a rough draft of the advertisement. Consider the following as you plan the display.
 - What key information will you include?
 - Where will you place the key information on the poster?
 - What colors will you use?
 - Who is your audience?
 - What are you trying to sell?

- What graphics, pictures, or artwork will you use?
 - Will you include a map or picture of your stream to help illustrate your ideas or solutions?
8. Prepare the final advertisement as a tri-fold poster made from two pieces of 24"×36" poster board or ¼" foam core board. See diagram.

SOURCE: THE STREAM SCENE: WATERSHEDS, WILDLIFE, AND PEOPLE, SECOND EDITION

Contact Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 872-5264.

9. A successful project will include:
 - The stream name in a prominent location.
 - Appropriate stream, fish and watershed words.
 - Effective layout and promotional features, (quotes from visitors, headlines, etc.).
 - Pictures, diagrams, artwork, and photographs to help tell the story.
 - Well-organized information so that the message and the effect is clear and attractive.
 - Specific methods used to improve past stream habitat problems.
10. Set up your advertisement for display. Obtain a copy of the grading sheet. Write the name of your stream in the box provided. List group member's names on the back of the grading sheet. Place the grading sheet in a location close to your advertisement. Move around the room viewing the advertisements produced by other groups. Choose two, other than your own, to score. As a group complete the grading sheet for each advertisement you have chosen. When four different groups have scored your advertisement, turn in the grading sheet to the teacher.
11. Answer the following questions.



Student sheet

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Questions

1. What did you like most about this activity? What did you like least? Why?
2. How did this activity help you complete your study of watersheds and fish habitat?
3. What would you change if you were to do this activity again? Why?
4. What were the main sources of information used to complete your research?
5. What was the most interesting thing you learned about advertising as a means of persuasion?

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Stream Name _____

Grading Sheet: Coming Home

Points Possible: 20 out of 20 or 10 out of 10 is a perfect score. There are very few perfect projects

Category Description	Points possible: Group # >	Grader Group #	Grader Group #	Grader Group #	Grader Group #	Teacher Grade
Followed directions: see instructions: size, shape, format.	20					
Appropriate words: examples connected to lessons	20					
Is the advertisement easy to read? Does it help "sell" the stream. Does it make you want to go there?	20					
Is the advertisement clear and attractive?	20					
Do pictures, diagrams or other graphics help the advertisement without confusing the message?	10					
Are improvement methods shown? (for making or keeping the stream in good shape?)	10					
Is specific information included about watershed activities? Is the information accurate?	10					
Is specific information included about physical habitat requirements? Is it accurate?	10					
Total	120					
Grader's Group #	What did you like best about this advertisement?		Were any items missing from this advertisement? Any other suggestions?			

SOURCE: CALIFORNIA'S SALMON AND TROUT: OUR VALUABLE NATURAL HERITAGE
Contact Diane Higgins, 4649 Aster Avenue, McKinleyville, CA 95521

NATURAL SURVIVAL PYRAMID

Students make a large pyramid that shows number of salmon surviving at each life stage.

OBJECTIVES

Younger students will be able to: Explain that most salmon eggs will not survive to adulthood and name two natural threats to salmon.

Older students will also be able to: Calculate the percentage of fish that do and do not survive each life stage.

BACKGROUND

Even under ideal conditions, most salmon or steelhead eggs will never survive to maturity. Some things that can cause eggs to die are: eggs were not fertilized, water temperatures may get too cold, they're eaten by predators, they surcome to disease or fungus, flooding causes gravel to shift and eggs are crushed or alevin are buried to deeply to swim up. Flooding may also scour gravel and the eggs wash away. If water levels drop eggs may dry up.

Predators claim many of the fry. Young fish also must compete for food and space, which may act as limiting factors. As streams flows diminish in the summer, so does available habitat. Water temperature may rise to lethal levels. The fry stage is the toughest, only five percent will survive.

Smolts face the same hazards as fry. Adult fish in the ocean also face predators, and the occasional El Nino.

PREPARATION

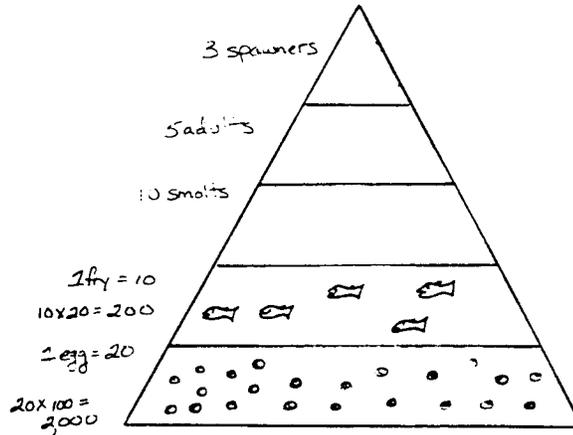
Materials: large sheet of butcher paper, construction paper (5 colors), yard stick, scissors, glue, colored pens, pencils, and a paper punch.

1. Draw a triangle on the butcher paper with sides of 40 inches. Draw in four lines, dividing the triangle into five sections, as shown.

2. To make the eggs, you may use a hole punch on colored paper (pink or orange is best) that has been folded over several times. Save the punched out circles to use as eggs.

PROCEDURE

1. Explain to students that they will begin with 2,000 eggs and will make a picture that shows how the number of surviving fish will get smaller at each life stage.



2. It would be hard to cut out all those eggs and to fit them into the space on the pyramid, so one egg will represent 20 eggs. For the same reason, one fry will represent 10 fry. Help students calculate how many eggs they must use to represent 2,000 eggs. How many fry to represent 200 fry?

3. Decide on your color coding, ie. orange eggs, green fry, blue smolts, silver adults, red spawners. Have children count out the eggs, then draw and cut out the other fish forms.

4. Glue the eggs and fish onto the pyramid. Make a key that shows the relationship between color and stage. Also, indicate that 1 egg = 20 eggs and 1 fry = 10 fry. Write the number of fish at each stage next to each section, as shown.

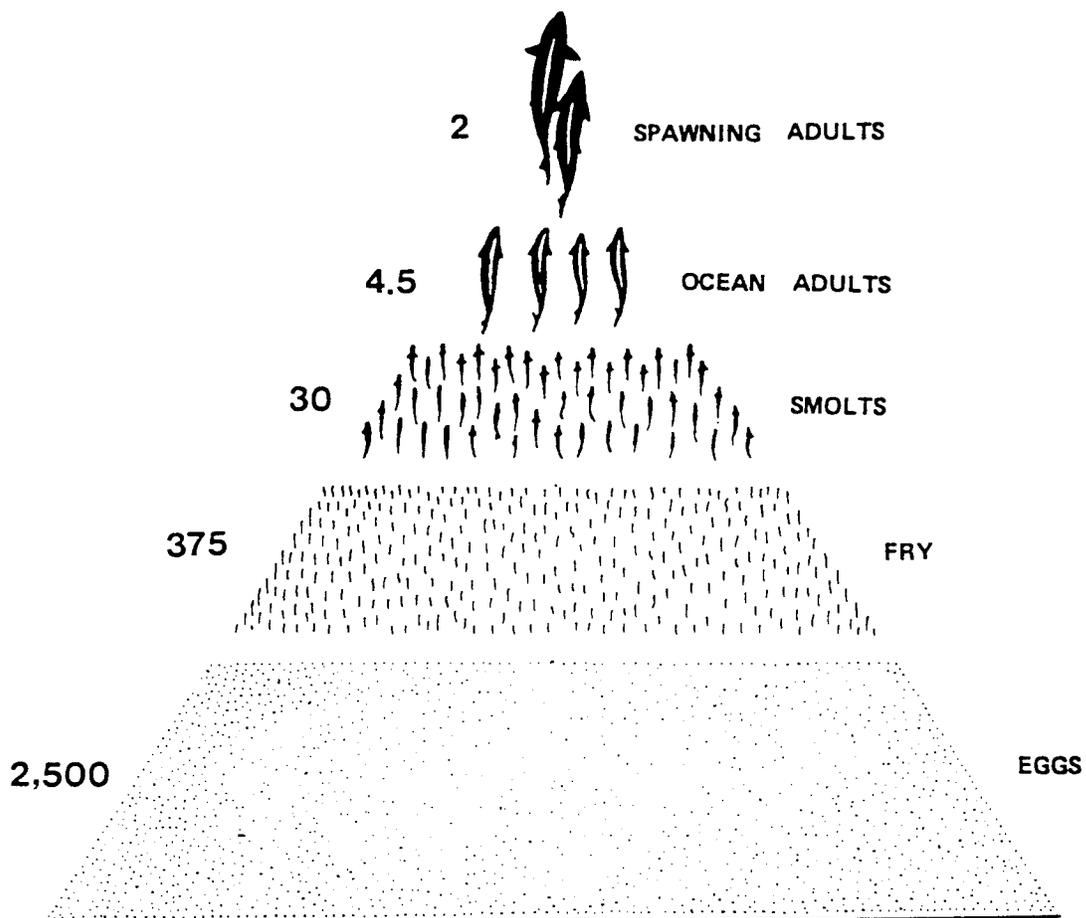
5. As you put the pyramid together, discuss why so many of the fish die. What kills them? What would happen if they all lived and returned to spawn? Why does the female fish lay so many eggs? How would survival be affected if the parents were around to somehow protect the young fish?

6. Have older students calculate what percentage of the fish survive through each life stage. What percentage die at each life stage? (90% die as eggs or alevin, 95% of the fry will die before smolting, 50% of the smolts will not reach adulthood, and 40% of the adults will not survive to spawn).

7. A very large salmon may lay as many as 10,000 eggs. Have students figure out how many will remain at each life stage, using the same percentages as before.

SOURCE: CALIFORNIA'S SALMON AND TROUT: OUR VALUABLE NATURAL HERITAGE
Contact Diane Higgins, 4649 Aster Avenue, McKinleyville, CA 95521

Natural Survival



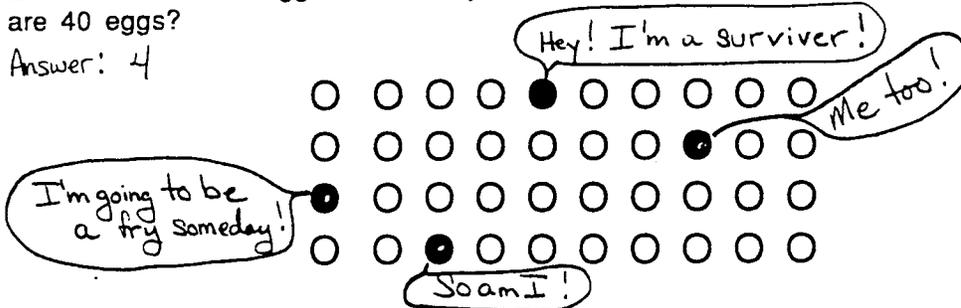
SOURCE: CALIFORNIA'S SALMON AND TROUT: OUR VALUABLE NATURAL HERITAGE
Contact Diane Higgins, 4649 Aster Avenue, McKinleyville, CA 95521

HOW MANY RETURN? NAME _____

DIRECTIONS: Look at the Natural Survival Chart. It shows that out of every 2,500 eggs, only 2 fish survive to spawn. Not very good odds. Aren't you glad you're human? Please answer the following questions about salmon survival.

EXAMPLE: If one egg out of every ten survives, how many will survive if there are 40 eggs?

Answer: 4



1. Only about 1 egg out of 10 lives to become a fry.
 - a. If there are 100 eggs, how many will become fry? _____
 - b. What about if there are 1,000 eggs? _____
 - c. 10,000 eggs? _____
 - d. 50,000 eggs? _____
2. If 1 in every 200 fry survive to spawn, how many fish would return to spawn if there were 800 fry? _____
3. If 1 in 15 smolts return as adults, how many adults would return to spawn if there were 75 smolts? _____
4. If only 1/2 of the returning fish survive the journey upstream, how many would make it if 40 fish started out? _____
5. 2,000 eggs are hatched in a hatchbox and all of them live to be fry. How many will live to spawn if 1 in 200 survive? _____

SOURCE: CALIFORNIA'S SALMON AND TROUT: OUR VALUABLE NATURAL HERITAGE
Contact Diane Higgins, 4649 Aster Avenue, McKinleyville, CA 95521

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WHAT CAN A CURVE SAY?

Analyze graphs for information about how environmental conditions affect potential trout production.

Skills: interpretation of graphs, analysis, inference

BACKGROUND

Graphical interpretation is an important skill that has applications in almost every discipline. Graphs can give us precise, quantitative information about how two (or more) variables are related at any given values, or they can be interpreted qualitatively. Most of the questions in this lesson are qualitative in nature. By looking at the general shape of the curve, students should be able to make general statements about how changes in the various stream conditions (shown on the x-axis) can change the number of trout that can live in that stream. The habitat requirements of salmon are very similar to those of trout.

Curve A tells us that as fine sediment (mud and silt) increases, trout production decreases. Fewer trout fry emerge from the gravel successfully when the sedimentation increases because they smother or they become buried and can not swim out.

Trout production increases as the amount of shade along the stream increases (up to a point). Trout like cold water, and the trees or shrubs that shade the water also contribute nutrients to the stream. Note that the curve falls off when shade approaches one hundred percent. This is because the plants that grow in the stream need some light to thrive. These plants are the base of the food chain.

Curve D is related to curve B. It shows that the temperature range in which trout will survive is rather small.

Curve C shows us that trout do best in streams that have stable banks. This is

because unstable banks contribute extra sediment to the stream. Also, fish use the root wads at the stream's edge and the under cut banks for cover. When these are removed, the fish are more vulnerable to being preyed upon.

Curve E would apply to controlled flows below dams. Not surprisingly, more water released leads to an increase in habitat and an increase in trout production.

PREPARATION

Make copies of the two worksheets. You may also want to review graphing concepts and what students have learned about habitat needs of salmonids.

PROCEDURE

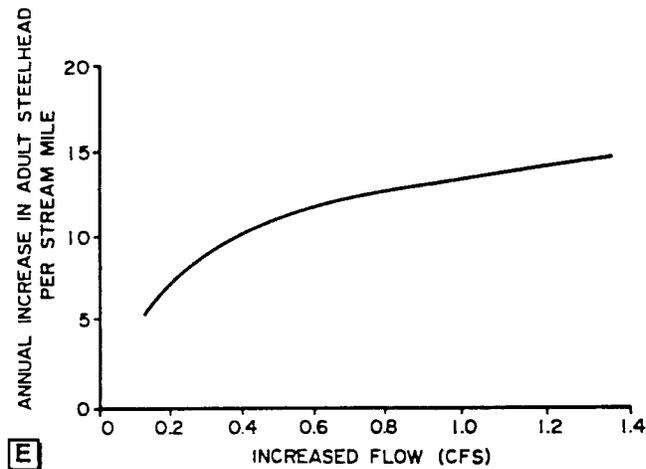
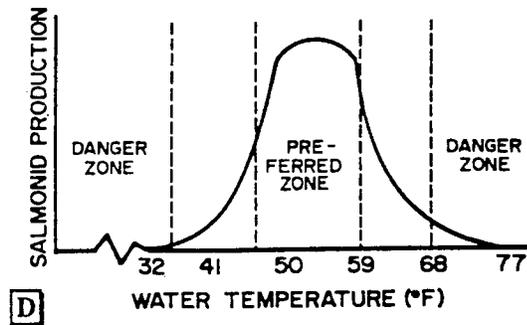
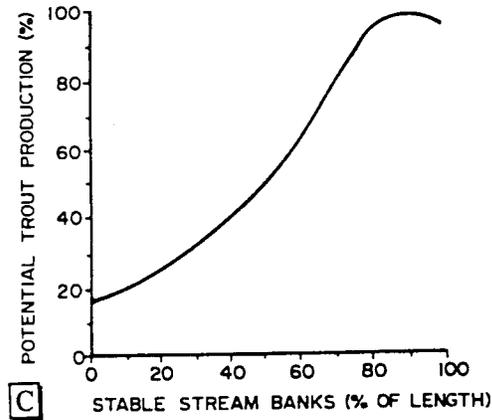
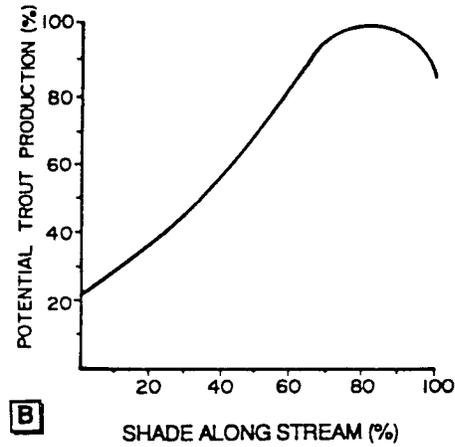
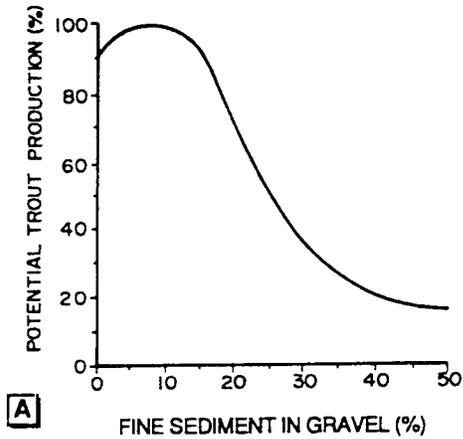
You might begin this lesson by drawing a few curved lines on the chalk board. Ask student if the lines mean anything. Now add the x and y axes, positioning them so that the curve falls within their boundaries. Put numbers on the axes, and then labels. For instance, you could show the relationship between temperature and amount of ice cream bought. Ask the students if the curved line means anything now. They should agree that a curve can indeed say a lot .

Have the students use the graphical information to answer the question.

Answers: 1. decreases 2. trees and/or shrubs were removed 3. increases 4. about 80% 5. stream plants don't grow as well - plants are basis of food chain for trout 6. About 15% 7. decreases 8. as the percent of stable banks increases, so does trout production 9. About 46° to 59° 10. 68° 11. Graph E says that as flows increase, so does trout production 12. Accept all reasonable answers.

SOURCE: CALIFORNIA'S SALMON AND TROUT: OUR VALUABLE NATURAL HERITAGE
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WHAT CAN A CURVE SAY?



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WHAT CAN A CURVE SAY?

Name _____

A curve can say a lot, when it is part of a graph! Use the information shown by the five graphs to answer the following questions.

1. According to graph B, what happens to potential trout production as the percent of shade along the stream decreases? _____
2. What might cause the percent of shade to decrease? _____

3. What happens to potential trout production as the amount of shade increases? _____
4. At what percent shade does potential trout production peak out? _____
5. Why do you think trout production decreases as the stream gets close to being 100% shaded? _____
6. According to graph A, what is the ideal percentage of fine sediment in spawning gravel for trout production _____
7. What happens to potential trout production as the percent of fine sediment in the spawning gravel increases? _____
8. Look at graph C. Describe how the amount of stable stream banks affects potential trout production. _____
9. According to graph D, what is the preferred temperature range for salmonid production? _____
10. At what temperature does water get dangerously warm for salmonids? _____
10. Explain what graph E says. _____
11. On another sheet of paper, describe what ideal trout and salmon habitat is like, using the information from the five graphs.

SOURCE: CALIFORNIA'S SALMON AND TROUT: OUR VALUABLE NATURAL HERITAGE
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SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

First Nations People: A Trilogy

Part One: 1790 Part Two: 1990 Part Three: 2190



Indians possess values which were once fundamental to all humans: respect for the environment, a caretaker's role in relationship to the land, and a recognition that other human beings will follow us to reap the benefits or consequences of our actions. Such concepts are old and reflect a humankind attuned to the world - an awareness now largely engulfed by and subservient to today's technologies.

*Lyle Wilson
From "When Worlds Collide"
1979 UBC Museum of Anthropology Note No. 28*



SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

First Nations People: A Trilogy - Pre-Post Activities

Synopsis

Three short vignettes involving two children. The first takes place in 1790 as two young First Nations children are awaiting the arrival of the first salmon on the spawning grounds. The second (1990) involves two children, also streamside, who are throwing rocks at spawning salmon. The concluding segment takes place in the future (2190) as two children are visiting a Natural Resources Museum.

Vocabulary:

trilogy	extinct
ceremony	aquarium
defenceless	conscience
exhibit	decline

Suggested Cooperative Learning Strategies

The Fish Bone, located after the play.

Integration with "The Arts"

Music

- Create the sounds of the background using body percussion, voices and found instruments or tape recorder.
- Explore the importance of music in First Nations culture (chants, dancing).

Art

- Illustrate the playbill
- Make a story map.
- Study the work of First Nations artists.
- Recreate the play using shadow puppets or masks.
- Salmon gyotaku.

Drama

- Readers' Theatre
- The Trilogy could be read/staged using the following special effects:
 - Shadow Puppets for Scene I (historical effect)
 - Modern lighting/urban setting for Scene II
 - High tech (robot-like movements and costumes or puppets) for Scene III.

Integration with Other Subject Areas

Language Arts

- Read the "Ceremony of the First Salmon" page*. (Teacher read or jigsaw reading by students.)
- A new NFB film "The Salt Water People" gives an updated perspective on the First Nations involvement in managing the fishery.

Social Studies

- The involvement of First Nations people in fishing in B.C. is very controversial. There are several "landmark" decisions still before the courts. Students should collect newspaper articles and editorials, interview politicians and then prepare a class debate: Should First Nations people be allowed to sell the salmon they catch?
- Invite someone from the local First Nations Band to come and speak to the class.

For other salmon related information and activities (all subject areas) check with Salmonids in the Classroom (Primary and Intermediate). Available through BCTF Lesson Aids.

SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

First Nations People: A Trilogy

Part One

Setting:

It is the year 1790. In a wooded area near a river two First Nations children are on the banks of a river. Person II is older than the other child.

Person I: What are you doing?

Person II: I'm watching for the first salmon to come up the river.

Person I: Why?

Person II: The first salmon is important.

Person I: Why is the first salmon so important?

Person II: Because every year we must watch for the first salmon that swims upstream to our village.

Person I: Why?

Person II: Because we must treat the first salmon especially well.

Person I: Do you catch the first salmon?

Person II: Yes, but before we catch him we offer him a prayer. We say to him:

"O Supernatural one. O swimmer. We thank you that you are willing to come to us. Don't let your coming be bad, for you come to be food for us."

Person I: Why do you do this?

Person II: Because every animal has a spirit. We must show respect for the animal and his spirit. We have a ceremony to show our respect. If we treat the first salmon with respect he will tell the other salmon that this is a good village and the other salmon will come. We want many salmon to come to our river. We need them for our Ceremony.

Person I: What ceremony?

Person II: The Ceremony of the First Salmon.

Person I: What's that?

Person II: It's an important feast. We depend on the salmon. We do not want to take the salmon's coming for granted.

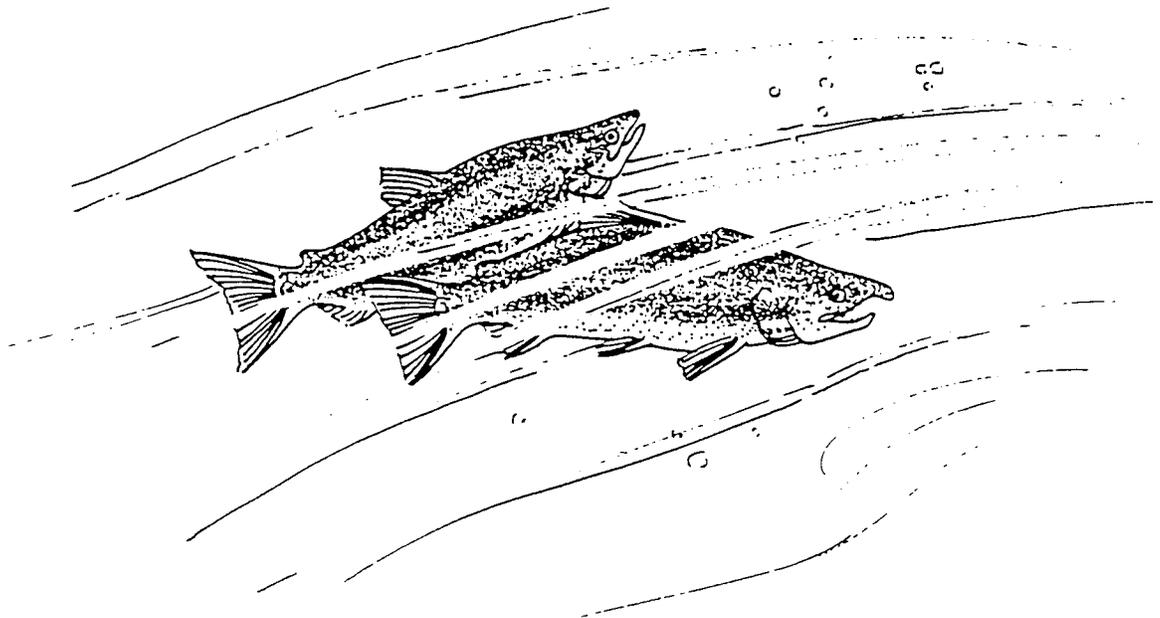
Person I: Why?

Person II: Because if many salmon come we will have much food for the winter. If few salmon come, many of our people will be hungry.

SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

- Person I:** Will you catch all the salmon that come to our river?
- Person II:** No. We will catch what our villagers need. We will smoke many salmon. They will keep us full all winter. We will not catch all the salmon.
- Person I:** Why not?
- Person II:** If we catch all the salmon this year there will be no salmon the next year. We must let many salmon lay their eggs. We must keep our rivers clean so that the salmon will want to return to us for many years.
- Person I:** Who do the salmon belong to?
- Person II:** The salmon do not belong to anyone. We belong to the salmon. All things in nature are connected. Whatever happens to the salmon, happens to us all. We are all part of the web of life. If we destroy the salmon, we destroy ourselves.
- Person I:** May I help you watch for the first salmon?
- Person II:** Will you treat the salmon with respect? Will you teach your children to respect the salmon and the water and the earth?
- Person I:** I am young now but I will remember this day. I will remember to teach my children about the first salmon.



SOURCE: FISH IN THE FLOODLIGHTS

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Part Two

Setting: *It is the year 1990. Two pre-teenage children are standing on the banks of a river.*

Person I: Hey, I hit a big one.

Person II: What are you doing?

Person I: What does it look like?

Person II: It looks like you're throwing rocks at some old, tired salmon that are just minding their own business.

Person I: So what - it's fun!

Person II: They are only a few defenseless fish. It doesn't look like much fun.

Person I: Well, it used to be more fun 'cause there used to be lots more fish in here. I wonder how come there are only a few this year. See if you can hit one. *(Pause)* Come on, or are you one of those animal rights types? Or maybe you just can't throw straight. Maybe you're afraid some fish cops will arrest you.

Person II: *(Picking up a rock).* There, I hit one too.

From Offstage - through a megaphone, long paper tube or cupped hands.

Deep Voice: THERE USED TO BE HUNDREDS.

Person II: What'd you say?

Person I: I didn't say anything. Hey, I hit another one - that big one over there. Why don't you try again.

Person II: *(Picks up a rock - but hesitates to throw)*

Person I: Well, are you just going to hold that precious rock? Maybe you just lucked out the first time.

Person II: *(Throwing the rock)* There, I hit another one of your stupid fish.

From Offstage:

Deep Voice: THERE USED TO BE HUNDREDS.

Person I: Yeah, yeah, I know.

Person II: Know what?

Person I: That there used to be hundreds. I wish there were hundreds now, it'd be more fun. What I'd like to know is where did they all go?

Person II: Don't ask me. I guess somebody caught them all.

From Offstage:

Deep Voice: HUNDREDS AND HUNDREDS OF SALMON USED TO SPAWN HERE.

SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

Person II: Hey, who's there.

Person I: Yeah, come on out whoever you are.

From Offstage:

Deep Voice: SO MANY SALMON. ENOUGH FOR EVERYONE. NOW ONLY A FEW.

Person I: This place is giving me the creeps.

Person II: (Looking around) I'm going to find out who's trying to scare us. Hey you, come out here.

From Offstage:

Deep Voice: USED TO BE LOTS FOR EVERYONE. NOW THERE ARE ONLY A FEW.

Person I: Maybe we'd better get out of here. There's plenty of weirdos around.

Person II: It sounds like it's coming from the water.

From Offstage:

Deep Voice: HELP THE SALMON. LET THEM SPAWN SO THERE WILL BE HUNDREDS AGAIN.

Person I: What'd you say?

Person II: I didn't say anything.

From Offstage:

Deep Voice: USED TO BE HUNDREDS. NOW ONLY A FEW.

Person I: Huh, What'd he say?

From Offstage:

Deep Voice: TREAT THE SALMON WITH RESPECT AND THEN MORE WILL COME.

Person I: Hey, you know it's time to go do your homework when the water starts talking to you. I'm outa here. Are you coming?

Person II: Yeah, in a minute. I just want to see if the Phantom of the Stream has anything more to say. Maybe we disturbed some kind of fish god when we killed those salmon. I bet lots of kids chuck rocks at these salmon. That's why there are hardly any salmon in this stream.

Person I: Maybe. Maybe. Maybe you shouldn't be listening to strange voices.

Person II: Or maybe I should have listened to a familiar voice a while ago.

Person I: What familiar voice?

Person II: This one. *(Points to own head)*

SOURCE: FISH IN THE FLOODLIGHTS

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Part Three

Setting: *It is the year 2190. Two young people are looking at exhibits in a museum.*

Person I: What's that?

Person II: It's a salmon. Well, I should say, it's a model of a salmon.

Person I: What's a salmon?

Person II: A salmon is an extinct species of fish. Hundreds of years ago they used to be very plentiful. In the late part of the last century their numbers started to decline. My father told me he once saw three in an aquarium, and my dad's brother swears he even saw one in a river. But now there are only models.

Person I: Looks kinda neat. I wish I could have seen a real one. I wonder why they became extinct?

Person II: Oh, probably some natural disaster wiped them out.

Person I: Too bad. *(Moving to next exhibit)* What's that?

Person II: It's a tree. Well, it's a model of a tree.

SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

Cooperative Learning Strategy

The Fish Bone

Adapted from *The Cooperative Think Tank*, by James Bellanca, Skylight Publishing Inc., 1990, Palatine, Illinois

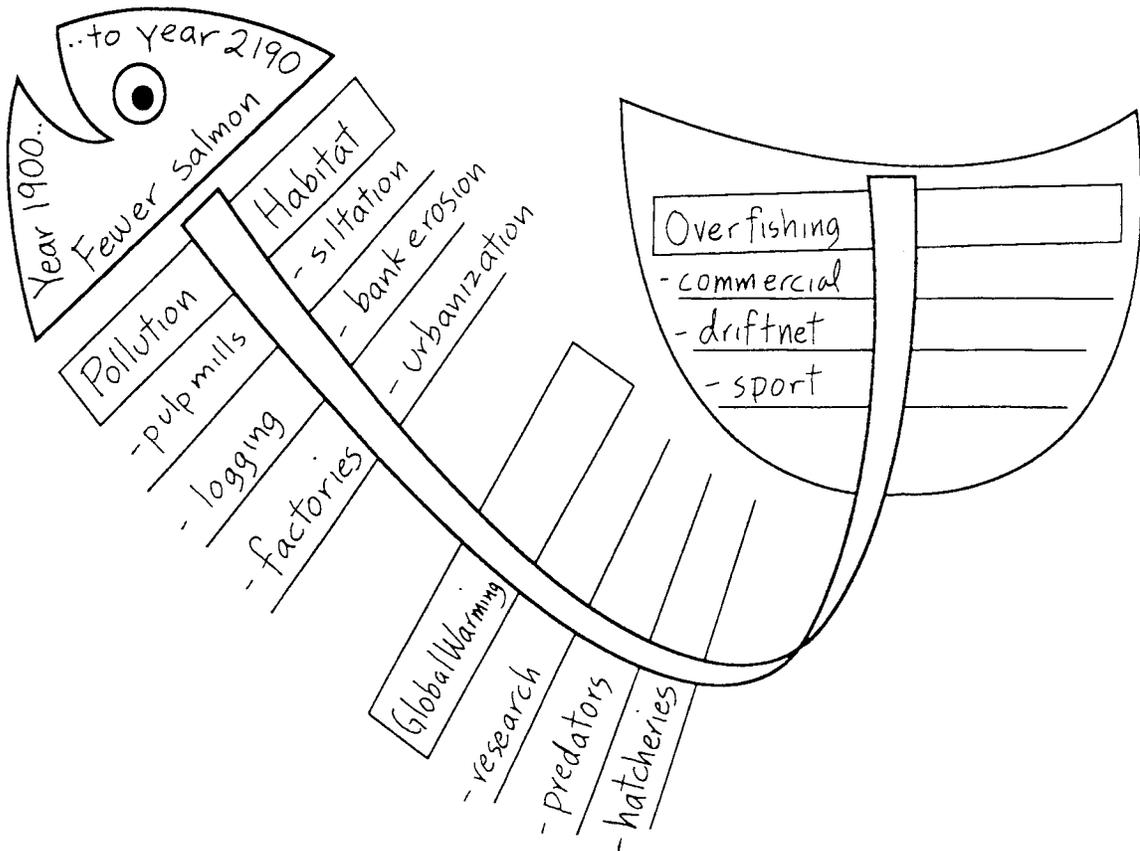
Explain to the students that the Fish Bone is used in problem solving situations.

Suggestions for using the Fish Bone:

1. After reading the play(s) identify the effect/ problem.

2. Establish the main categories.
3. Brainstorm for causes under each category.
4. Rank the causes (individuals or pairs).
5. As a class establish the final rank order of causes.

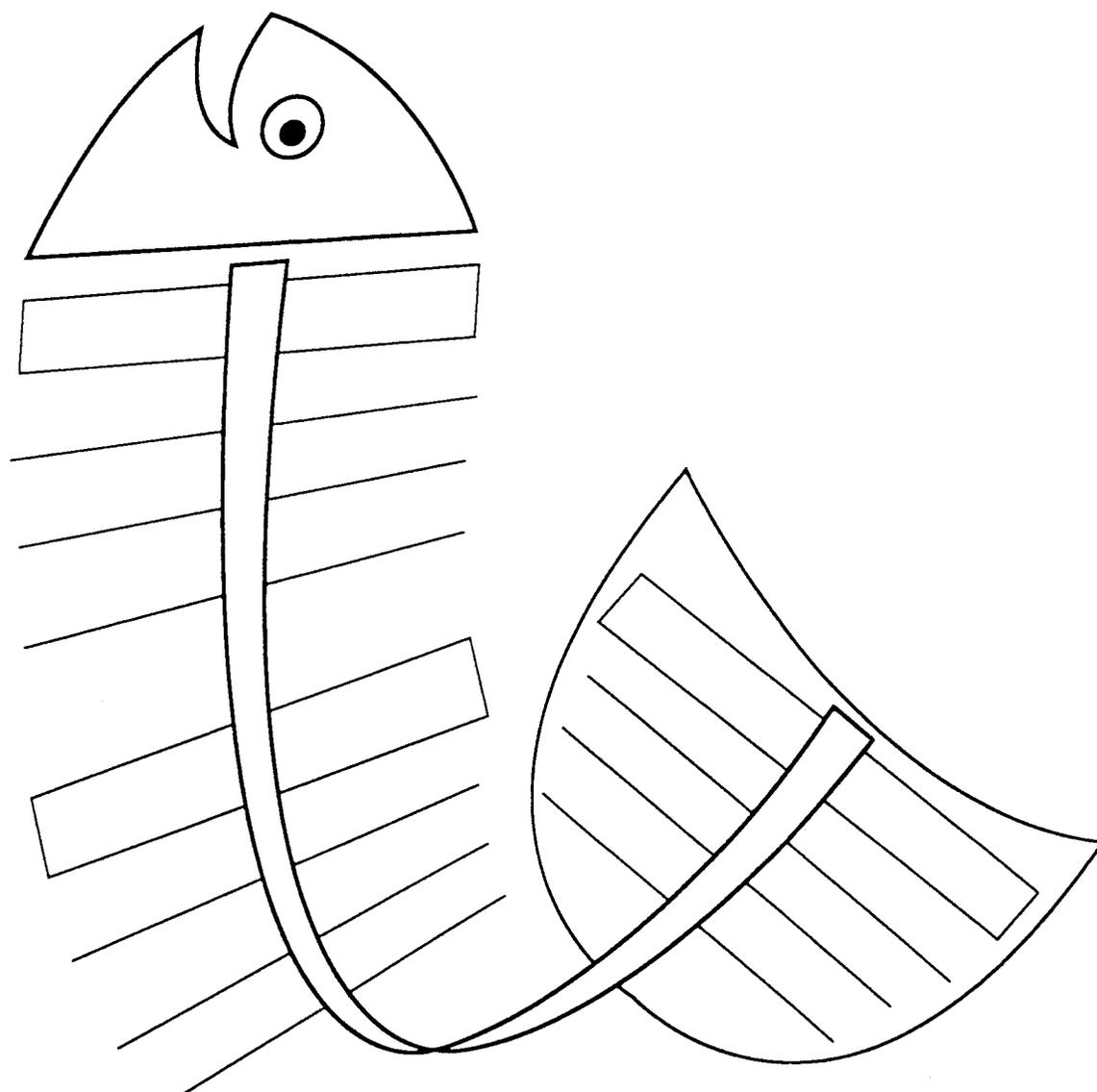
The following is only a sample. There should be no "correct" structuring.



SOURCE: FISH IN THE FLOODLIGHTS

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The Fish Bone



SOURCE: FISH IN THE FLOODLIGHTS

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The Ceremony of the First Salmon

On a wooden platform, suspended from the canyon walls the fisherman stood with his net. Ice still floated on the river, but an early sun was shining. It was time for the salmon people to come.

The fisherman had made the hoop of his net from vine maple sapling, steam-bent to an oval. His wife had woven the mesh from spun nettle fibres. Now he dipped the net into the water, patient and intent. Nearby a small boy watched and waited.

Today the fisherman thought it might happen. But if not today, certainly soon. The salmon came each year, making their journey from Salmon Country at the unknown edge of the sea, swimming upstream in the narrow inlet, through the river along which the villagers lived.

All through the winter they lived on last year's catch of dried smoked fish. Now there was little left. When the salmon returned there would again be abundance. There would be feasting in the villages, followed by weeks of work to preserve supplies for the next winter.

The salmon would arrive, but this year as always, powerful forces had been invoked to make their coming even surer. Twins, born with the power to summon the fish, had come to the river to call them. The shamans, men endowed with supernatural powers, had seen, in visions, the salmon making their journey. The shamans said they would arrive soon.

The right to take the fish from this place on the river belonged to these villagers. It had been their birthright since the very beginning of things; since Raven created the earth, stole the sun, moon and stars from a chief's wooden chest and flying into the sky, brought light to the world. It was the same Raven who had put the salmon into the sea.

The boy came down to the river's edge. He had been eating the sweet tissue from under the hemlock bark and he wanted to share it with the salmon who must surely like it too. The boy rolled pieces of the inner bark into balls, stuck feathers in them and let them float down the river.

Suddenly the fisherman's net jerked. Shivers ran up the wooden shaft as he swung the net upward from the water. Leaping and twisting in the mesh was the chief of the

Spring Salmon - leader of all others - but, silver-wet and shining.

The spring salmon were here!

The boy raced back to the village with the news, and immediately preparations began for the Ceremony of the First Salmon. For until the Ceremony had been completed, no more salmon could be taken.

Four shamans came to the fisherman's platform, carrying with them the paraphernalia of the Ceremony: a new cedar-bark mat, the down of white birds, red ochre, and an eagle's tail.

The chief shaman performed a mystic rite over the writhing salmon. Using an intricately-carved club, he killed it with a single blow. Now the face of the fisherman who had caught the first salmon was painted with red ochre.

It was time to bring the salmon to the village. Reverently it was lifted and laid on the mat, its head pointing upstream so that the other salmon would follow the same way. The white down, a symbol of friendship and welcome, was sprinkled on the river.

The mat was lifted by its four corners and carried slowly back to the village, the chief shaman leading the way, shaking his rattle with his right hand, swinging the eagle tail with his left.

The news had flashed through the village and people rushed forward to meet the procession, as it moved toward the house of the chief. This was the place of welcome for all honoured guests. It was a large and sturdy house, built of thick cedar planks. A tall pole stood in front, carved with crests showing the Chief's noble lineage and power. At the top a carved wolf surmounted the winged image of an eagle. At the bottom, the figure of a bear formed an entry way into the house.

Before the salmon could be taken into the house, it had to be purified. Anyone who had been closely connected with birth, death, and puberty, had to leave. Such people, considered unclean, might offend the fish and thus cause the run to stop.

SOURCE: FISH IN THE FLOODLIGHTS

Contact BCTF Lesson Aids, #100-550 W. 6th Avenue, Vancouver, B.C., Canada V5Z 4P2, (604) 871-2181.

The procession entered the darkened hall in a single file, the shamans leading the way, the fishermen following. Smoke rose lazily from a fire on the floor, passing upward through a smokehole in the roof, through which a single shaft of spring sunlight slanted to the ground.

The salmon was transferred to a large cedar plank. Now all the shamans of the village assembled in the house, dressed in a variety of ceremonial regalia: leggings, decorated dance aprons, necklaces of pendant bones and headdresses of bear's claws.

Next came the procession of the village people with the very old leading the way. Finally the salmon was encircled.

The singers began their hymn of welcome. Four times the shamans marched around the salmon. Drums throbbed, rattles of shells and deer hooves were shaken and the celebrants danced to the beat. The music ended. Everyone sat down behind the fire, each person taking his or her place according to rank.

It was now very quiet in the house. The sightless round eyes of bears carved into the massive corner posts of the house stared down at the ceremony. The flicker of the flames illuminated the curved image of the killer whale painted across a great wooden screen that set the chief's quarters apart from the rest of the house. Around the celebrants, rich furs, carved painted storage chests and spruce-root baskets of the chief lined the walls.

The voice of the highest ranking guest broke the silence. "Oh Supernatural one! O Swimmer! I thank you that you are willing to come to us. Don't let your coming be bad, for you come to be food for us. Go home and tell your friends that you had good luck on account of coming here, O Friend, O Swimmer."

There was a pause. Time now to cut the salmon. Two very old women shamans came forward - these tasks were always done by women.

The naming was a form of high compliment to the honoured guests. The names carried high social privilege and prestige.

So one of the women shamans spoke: "My dear Chief Spring Salmon, named Quartz Nose, named Two Gill on Back, named Lightening Follow One Another, named Three Jumps."

The names were well-chosen. Each was a tribute in itself. Great honour was bestowed on the salmon. The women took up their knives, special instruments made of mussel, shell - for to use the usual knives of stone for this purpose would be an insult to the guest, bringing thunderstorms and disaster. With great care, and in the prescribed manner, they cut the fish open and it was roasted slowly over the fire.

When it was done, fresh new mats were laid. The salmon was placed on them and each guest ate a portion. Afterwards, they drank fresh water and wiped their hands on finely shredded cedar-bark.

The fisherman's wife brought forward a new, unused mat. She gathered up all the bones of the salmon, and its intestines, and took them to the river's bank and threw them into the water. The villagers knew that this would cause the salmon to instantly return to life and that he would swim back to his people in the Spring Salmon Country.

The Ceremony of the First Salmon was over. Now the men of the village could fish, filling their nets. But while they fished, they took care to respect the many taboos pertaining to the salmon; doing nothing that might offend the salmon and cause them not to return.

For they knew the Salmon to be a creature of value and the means of the sustenance. To assure its continued abundance and its yearly return, respect was necessary.

SOURCE: FISH IN THE FLOODLIGHTS

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SOURCE: ADAPTED FROM THEME SERIES FISH: INTEGRATED ACTIVITIES FOR WHOLE LANGUAGE AND THEMATIC TEACHING
by Rozanne Williams, Creative Teaching Press, Inc., 1990.

Life Cycle of the Salmon Banner *

Materials:

- ✓ wax paper, 12" x 36," two pieces for each banner
- ✓ spray starch
- ✓ blue food coloring (optional)
- ✓ assorted colors of tissue paper
- ✓ brightly colored construction paper, 12" x 6," two for each banner
- ✓ white construction paper, 2" x 4," one for each banner
- ✓ black permanent marking pens with a heavy tip, such as Sharpie
- ✓ stapler
- ✓ glue
- ✓ dowel, 1/8" x 14," one for each banner
- ✓ yarn or cord, 20," one for each banner

Procedure:

To fully illustrate the life cycle of the salmon, plan for six to eight banners, one for each life cycle stage (green eggs, eyed eggs, alevins, fry, fingerlings, smolts, adults, and spawning adults). Assign groups of students to complete each stage of the life cycle.

Locate a sketch** for each life cycle stage. Copy the sketches onto white paper. If necessary, enlarge the sketch. Lay tissue paper over the white paper and trace the sketch onto the tissue paper with a black permanent marking pen.

Cut tissue paper into the shapes of the life cycle stage by cutting outside the black lines. Use orange tissue paper for the green eggs and eyed eggs. Use various other colors for the other stages. Use gray and green for plants and rocks. Overlay different colors for a blended effect.

Arrange the tissue paper pieces on one piece of the wax paper. If desired, place a few drops of blue food coloring between the shapes and spread carefully with a brush. Lay the other piece of wax paper on newspaper to catch the over spray. Lightly coat the wax paper with the spray starch. (If you over spray, it will run.) Quickly lay the starched wax paper piece, spray side down, on top of the tissue paper pieces. Press lightly to seal.

Fold the construction paper in half lengthwise and place over the bottom end of the wax paper banner. Staple or glue in place. Repeat with the top end of the banner. Carefully run the dowel through the top end of the banner, leaving about one inch extending on each end. Attach the yarn or cord to each end of the dowel.

Print the name of the life stage on the piece of white construction paper. Staple or glue the name near the bottom of the banner. (You can also place the life stage label at the top of the banner and write a description of the life stage at the bottom of the banner.)

Hang the banners from the ceiling of the classroom or the hallway. Ask students to describe the life cycle of the salmon as they accompany parents or other classroom visitors on a walk down the "stream."

Hint: Before constructing banners with students, construct your own banner and use it as an example for students. You can complete this activity in one 50-minute class period.

* Adapted by Helen Boedecker, Elizabeth Ann Seton School, Anchorage, Alaska and Cheryl Butler, Cascade Middle School, Bend, Oregon from *Theme Series Fish: Integrated Activities For Whole Language and Thematic Teaching*, by Rozanne Williams, Creative Teaching Press, Inc., 1990.

** A good source of sketches is the *Pacific Salmon and Steelhead Coloring Book*, which you can download from the U.S. Fish and Wildlife Service Web site at <http://www.fws.gov/publications/>

SOURCE: ADAPTED FROM THEME SERIES FISH: INTEGRATED ACTIVITIES FOR WHOLE LANGUAGE AND THEMATIC TEACHING by Rozanne Williams, Creative Teaching Press, Inc., 1990.

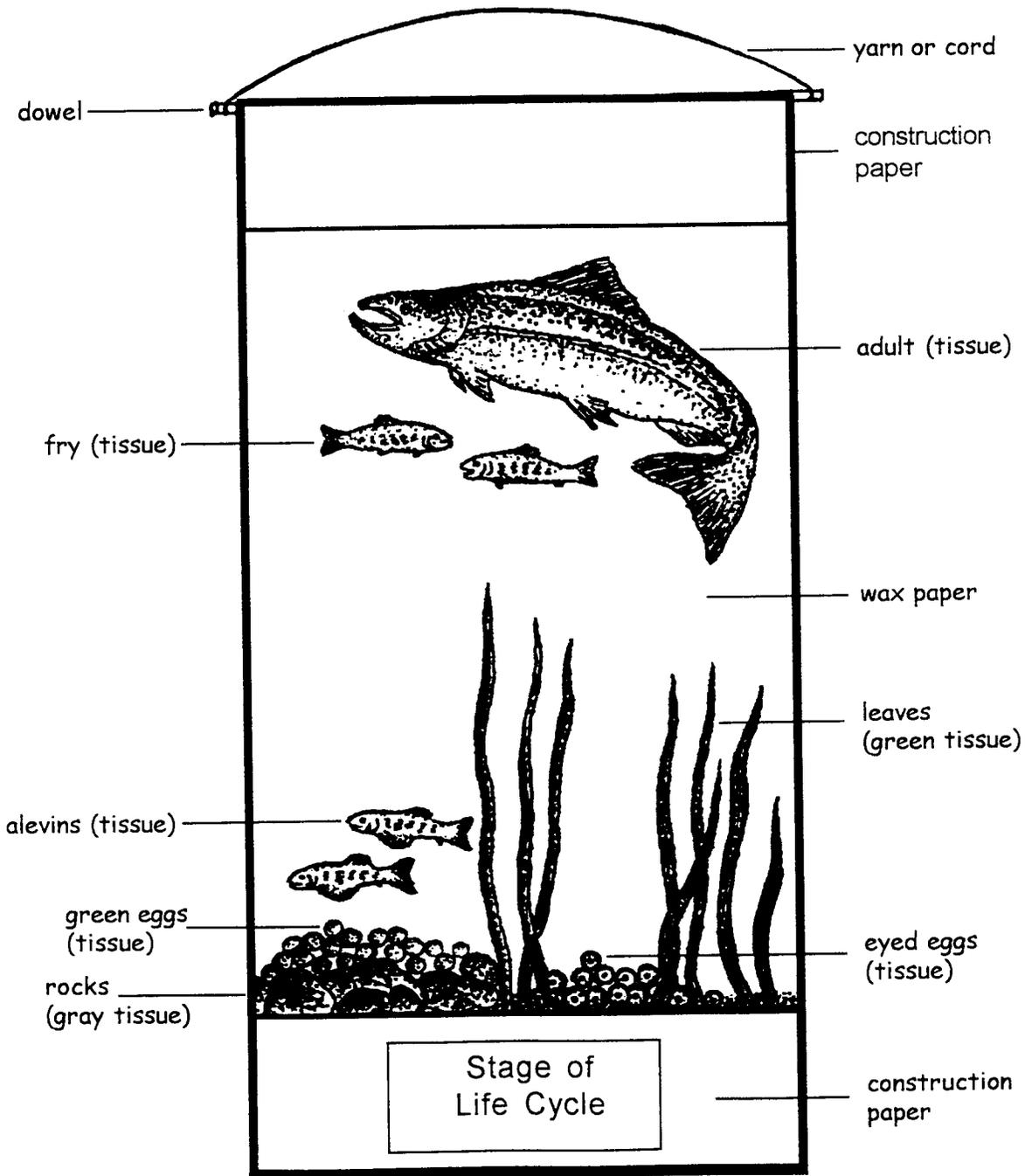


Illustration by David Creekmore, adapted from sketch provided by Helen Boedecker, Elizabeth Ann Seton School, Anchorage, Alaska.

SOURCE: CONTACT YOUR NEAREST OREGON DEPARTMENT OF FISH AND WILDLIFE STEP BIOLOGIST, SEE PAGE 41 Ask about fish stocks available in your area, when you can expect egg delivery, and any other related questions.



OREGON DEPARTMENT OF FISH AND WILDLIFE Salmon-Trout Enhancement Program



Classroom Egg Incubation Project

Egg Request Application And Transport Permit

For ODFW Use Only: Stock # Year

NEW RENEWAL

PLEASE PRINT CLEARLY

Name VO# Name of School Address City State Zip Work Phone Home Phone Fax Email

(ODFW representative uses information above to coordinate egg delivery.)

Species/Stock Requested: (Complete one application/stock.)

RETURN TO: Nearest ODFW-STEP Biologist or ODFW District/Regional Office.

I agree to comply with the following permit conditions:

- 1. Related fisheries lessons must focus on the project. Please describe on back of this form. 2. Fish shall be hatched only at the location shown on the permit. 3. All fish from classroom incubator projects will be released as unfed fry. 4. The local ODFW-STEP or project biologist or District Fish Biologist must approve all release sites. 5. Fish shall be released only at the location(s) shown on the permit. 6. A written report of activities is required within 15 days following release of the fish.

Signature of Applicant Date

NOTE: This is a request to receive eggs as available. The Oregon Department of Fish and Wildlife reserves the right to designate stock, numbers received and release site within policy guidelines. This form also serves as a fish transportation permit and must be in possession when eggs or fish are held or transported from the authorized source to the incubation or release site. You will receive an approved copy of this permit.

TRANSPORTATION/RELEASE SITE PERMIT: (ODFW will complete after approval.)

The above participant is authorized to transport and release fish from a STEP egg incubation project only at the following location(s):

Species: Location (s):

Authorized ODFW Representative Date

It is unlawful to transport and/or release fish in other than above designated location(s) (OAR 635-09-140).

SOURCE: CONTACT YOUR NEAREST OREGON DEPARTMENT OF FISH AND WILDLIFE STEP BIOLOGIST, SEE PAGE 41
Ask about fish stocks available in your area, when you can expect egg delivery, and any other related questions.



Our mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations.

