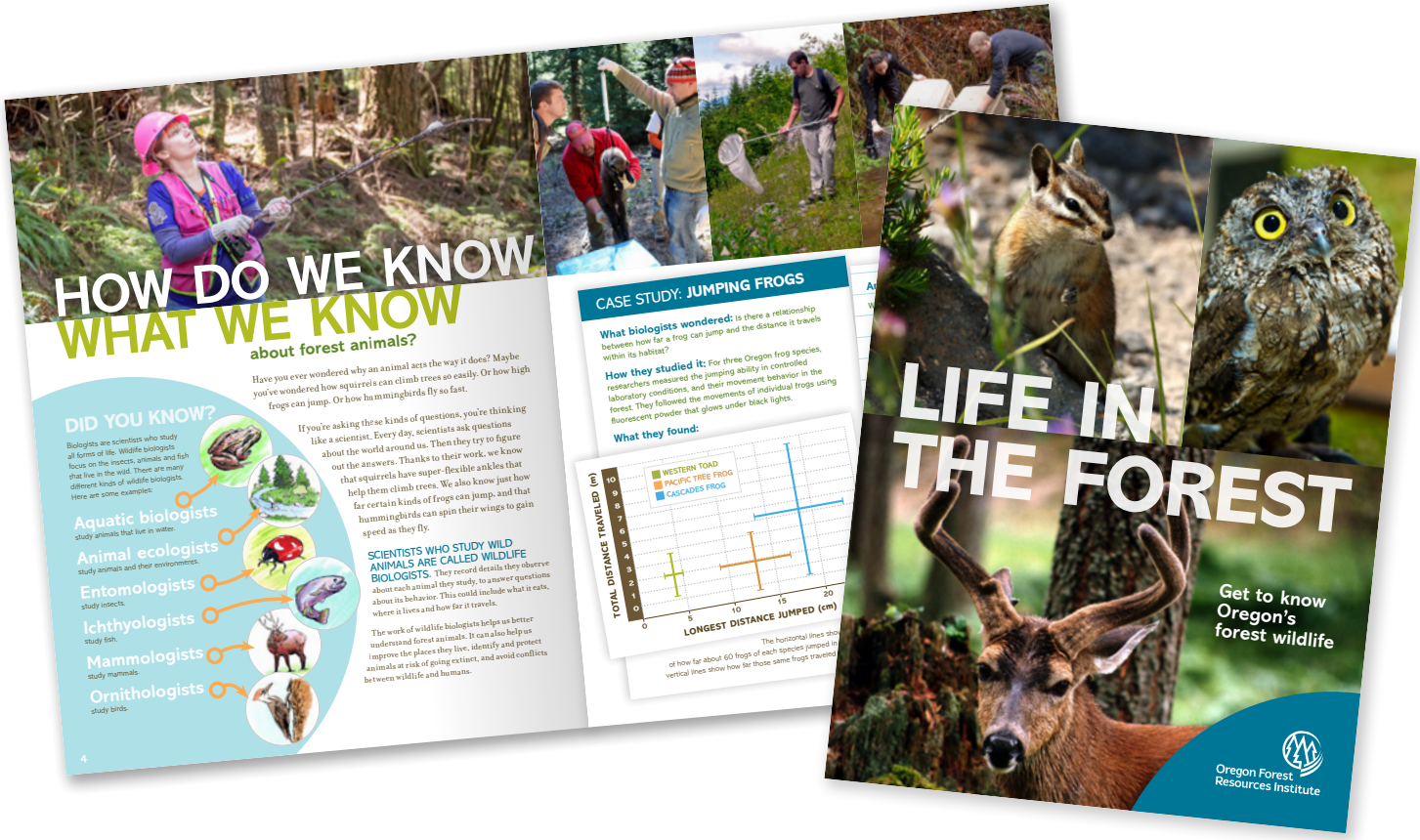
LIFE IN THE FOREST:

Get to know Oregon's forest wildlife

Instruction Guide

Grades 6-8



When most people think of forests, they visualize trees. But a forest wouldn't be a forest without wildlife. Forest wildlife are essential components of the nutrient, energy and water cycles that fuel the forest ecosystem. They also contribute to the rich biodiversity that enables forests to thrive. By monitoring wildlife and promoting wildlife habitat, forest managers can ensure the health of Oregon's forests, now and into the future.

This guide is designed to help middle school teachers use *Life in the Forest: Get to know Oregon's forest wildlife* with students to investigate the wildlife inhabiting our state's forests. Using actual data collected by researchers, students will explore how scientists learn about Oregon's forest wildlife and how they monitor their health, populations, range and distribution.

This guide suggests student activities for examining and analyzing data on Oregon's forest wildlife, using accompanying resources available online. In addition, the student book includes case studies, with "Analyzing the evidence" student activities that students may do on their own or as assigned by the teacher.

Through these activities, students will practice analyzing data and drawing conclusions from evidence – skills that are key to meeting Oregon's science education standards. They will also gain an appreciation for how scientists know what they know about Oregon's forest wildlife.

BACKGROUND

No matter where you live in Oregon, you depend on forests to survive. Oregon's forests obviously provide wood and wood products, but they also supply clean water and air, provide food, prevent soil erosion and help mitigate climate change. Thriving forests are not just good for people; they're also good for wildlife. Healthy forest habitats contain the food, water, protection, nesting sites and migratory corridors a wide array of wildlife need to survive.

Oregon's forests support hundreds of wildlife species that are part of a complex web of life. For example, tiny insects pollinate the flowers of trees and other plants; birds and elk disperse the flowers' seeds; and slugs break down the dead leaves and plant material. This rich biodiversity ensures a healthy, functioning and sustainable forest ecosystem.

For forest managers in Oregon, the presence of wildlife is an important indicator of forest health. Forest managers might enhance wildlife habitat by creating snags (standing dead trees) and down logs, installing nest boxes or planting pollinator-supporting hedgerows. To make informed decisions about wildlife, they rely on monitoring data that tells them what species are present and how an action may impact those populations.

Since forest wildlife tend to be elusive, researchers use a variety of high- and low-tech methods to monitor and study them. For example, the researchers use computers to analyze audio recordings, set up motion-sensing cameras to take pictures, attach radio collars to animals to map their movements, and train dogs to sniff out the feces of particular species. In the eDNA sequencing activity (right), students learn how wildlife biologists use environmental DNA (eDNA) to determine the presence of wildlife species.

Activity – eDNA sequencing

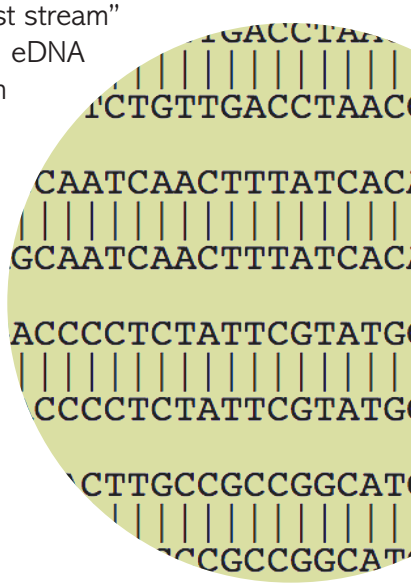
In this activity, students use eDNA to assess whether an invasive fish species, the Japanese weatherfish, is present in an Oregon stream. Through a publicly available online tool called BLAST (Basic Local Alignment Search Tool) that scientists actually use, students compare nucleotide sequences to a database of known sequences and identify which species they are likely from.

Wildlife biologists use genetic information known as environmental DNA (eDNA) to detect the presence of organisms in the field, without ever seeing or handling them. All living animals leave traces of deoxyribonucleic acid (DNA) sequences in their environment; this may come from feces, urine, sloughed skin or reproductive cells, or from the decomposition of dead organisms. To use eDNA, researchers collect water, air or soil samples; separate out the eDNA; and compare the eDNA sequences to a database of known nucleotide sequences. This method allows them to detect which species are present, and to determine the distribution of species over large geographic areas.

Materials: Copies of the "Monitoring a forest stream" student page (on back page), *Find Your Path: Fish Biologist* video (optional) at youtube.com/user/oregonforests, and online access to the "Assessing eDNA sequences" student instructions are available at bit.ly/LITFguide

Procedure:

1. (Optional) Share *Find Your Path: Fish Biologist* with students. In this 2.5-minute video, an Oregon fish biologist describes her job.
2. Present the scenario that students are wildlife biologists charged with monitoring Oregon streams. Their task is to use eDNA to determine whether an invasive species, the Japanese weatherfish, is present in a stream in the central Coast Range.
3. Give students copies of the "Monitoring a forest stream" student page. Help them link to the "Assessing eDNA sequences" student instructions and walk them through how to use the BLAST database.
4. Direct students to compare their BLAST results to the possible different species shown on the "Monitoring a forest stream" student page.
5. Discuss: What conclusions can you draw from your findings?



Questions for discussion

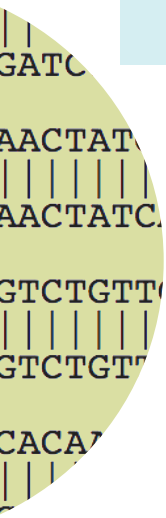
After students read all or portions of *Life in the Forest: Get to know Oregon's forest wildlife*, lead a discussion on the value of learning about Oregon's forest wildlife:

What different techniques do wildlife biologists use to study wildlife?

What questions do you have about Oregon's forest wildlife? How might you go about answering them? (Encourage students to be creative.)

What challenges do Oregon's forest wildlife face?

What can we do to ensure forest wildlife continue to thrive?



More activity suggestions

The following activities will deepen your exploration of Oregon's wildlife. The first three use actual data sets collected by wildlife biologists.

- **Mapping mammals.** Direct students to map locations where fishers, gray foxes and ringtails were detected, using real coordinate data collected by wildlife biologists and summarized on page 8 of *Life in the Forest*. (Note that the spreadsheet data were collected across the border in northern California but represent similar mammal populations in Oregon.) Students can input the data into Google Earth or other mapping programs to locate the monitoring sites and identify where the mammals were detected. Challenge students to see what patterns or other conclusions emerge when they compare detections by year or by species. Access the data at bit.ly/LITFguide.
- **Monitoring nesting in snags.** Encourage students to graph bird-nesting data collected by wildlife biologists from created snags (dead upright trees) in logged forest areas. Researchers were interested in whether birds nest in created snags to successfully produce fledglings. The graphs on pages 16-17 of *Life in the Forest: Get to know Oregon's forest wildlife* show summaries of the data. Students can analyze the biologists' data, which looked at four different species over three years, and count the number of successful and failed nests. Access the data at bit.ly/LITFguide.
- **Analyzing aquatic species.** Invite students to analyze data that fish biologists collected on fish and other aquatic forest wildlife in different locations of Fall Creek. For their analysis, students might create pivot tables using the built-in pivot table tool found in many spreadsheet programs. Pivot tables allow users to quickly and easily summarize selected columns or rows of a data table. Students might use a pivot table to compare the aquatic wildlife data by species, location, abundance or size. Access the data at bit.ly/LITFguide.
- **Exploring careers.** Show students the two-minute video *Find Your Path: Wildlife Biologist*, describing the work of a wildlife biologist, and then introduce them to other forest career ideas using Oregon Forest Resources Institute's *Find Your Path* publication (see Resources).
- **Researching forest wildlife.** Challenge students to research and write about a wildlife species that lives in Oregon's forests. To start, have them look at *Wildlife of Oregon's Forests* and the Oregon Zoo's Animal Fact Sheets (see Resources).
- **Viewing wildlife.** Give students opportunities to see forest wildlife in your area, including black-tailed and mule deer, bald eagles, Rocky Mountain and Roosevelt elk, and more. For

best success, use the Wildlife Viewing Map and the weekly Recreation Report from the Oregon Department of Fish and Wildlife (see Resources) to find good locations for viewing.

- **Creating a wildlife habitat.** Involve students in creating or restoring wildlife habitat on school grounds or other sites. The National Wildlife Federation provides information on how to attract wildlife, and steps to certify an outdoor space as a wildlife habitat (see Resources).
- **Contributing to community science.** Engage your students in a participatory science project that helps researchers collect data about wildlife in Oregon. Possibilities include:
  - Audubon Christmas Bird Count, www.audubon.org/conservation/science/christmas-bird-count
  - Bumblebee Watch, www.bumblebeewatch.org
  - Butterflies and Moths of North America, www.butterfliesandmoths.org
  - Great Sunflower Project, www.greatsunflower.org
  - Project FeederWatch, feederwatch.org
  - Western Monarch Milkweed Watcher, www.monarchmilkweedmapper.org/citizenscience

ANSWER KEY TO CASE STUDY ANALYSIS

The following are possible responses to the "Analyzing the evidence" case studies in *Life in the Forest: Get to know Oregon's forest wildlife.*

Case study: Jumping frogs

1. Longest jump: Pacific tree frog
2. Shortest jump: Western toad
3. Farthest distance: Pacific tree frog
4. Shortest distance: Cascades frog
5. Tells us: Different frog species travel different distances in the forest. The distance they travel is related to how far they can jump.

Case study: Wolf tracking

1. OR-7 traveled from northeastern Oregon through central Oregon, to northern California and back into southern Oregon, about 1,000 miles.
2. Tells us: Wolves require a vast range (to find food and mates).

Case study: Bees and fire

1. Heavily burned areas had more bees.
2. The more intense a forest fire, the more flowering plants can grow, attracting more bee species.
3. Tells us: Fire is beneficial for bees, because it provides them with more food sources.

Case study: Detecting fishers

1. Differences: The fisher range has significantly diminished. They used to live all over western Oregon and in northeastern Oregon, but currently only live in pockets of southwestern Oregon.
2. Tells us: One or more factors are reducing the fisher range in Oregon.
3. Possibilities: Competition from other species, lack of food, changing forests, human disturbance, climate change or other factors.

Case study: Created snags

1. Most nests: Chestnut-backed chickadee. It had at least twice as many nests as the other species.
2. Differences: Chestnut-backed chickadees, house wrens and northern flickers had their highest number of nests in 2009. Purple martins had few nests every year, with their most in 2008.
3. Tells us: Chestnut-backed chickadees and house wrens can quite successfully nest in human-made snags. Northern flickers and purple martins also nest there, but do so less frequently.

ANSWER KEY TO "MONITORING A FOREST STREAM" STUDENT PAGE

- *Acipenser transmontanus* (white sturgeon) – 7
- *Cottus asper* (sculpin) – 1
- *Misgurnus anguillicaudatus* (Japanese weatherfish) – none found
- *Dicamptodon tenebrosus* (coastal giant salamander) – 9
- *Lampetra sp.* (lamprey) – 3
- *Nitzschia sp.* (diatom) – 5
- *Oncorhynchus clarkii* (cutthroat trout) – 2
- *Oncorhynchus tshawytscha* (Chinook salmon) – 4 (*Note that only the top hit gets tshawytscha specifically)
- *Pacifastacus leniusculus* (signal crayfish) – 8
- *Phytopthera sp.* (oomycete) – 6

RESOURCES

Oregon Forest Resources Institute, LearnForests.org

- *Wildlife of Oregon's Forests.* Online guide to common species found in Oregon's forest habitats. oregonforests.org/content/wildlife-variety.
- *Find Your Path.* Student publication and more than 20 two-minute online videos exploring different forest careers, including *Find Your Path: Wildlife Biologist* and *Find Your Path: Fish Biologist.* youtube.com/user/oregonforests.
- *Forest Fact Breaks.* A series of 90-second videos that introduce key forest concepts, including *"Forest Fact Break: Wildlife"* and *"Forest Fact Break: Ecosystems."* youtube.com/user/oregonforests.

Oregon Department of Fish and Wildlife, www.dfw.state.or.us

- Wildlife Viewing Map. Interactive map showing where and when you can see Oregon's fish and wildlife. myodfw.com/articles/oregon-wildlife-viewing-map.
- Recreation Report. Weekly update on best places for wildlife viewing and other recreation opportunities in different regions of Oregon. myodfw.com/recreation-report.

Oregon Zoo, www.oregonzoo.org

- Animal Fact Sheets. Profiles of many animals at the zoo, including Oregon forest species such as bobcat, rainbow trout and red-tailed hawk, with facts about animal behavior, life history and conservation. www.oregonzoo.org/discover/animals.
- Endangered Species and Conservation. Information about the zoo's conservation projects in the Pacific Northwest. www.oregonzoo.org/conserve/fighting-extinction-pacific-northwest.

National Wildlife Federation (NWF), www.nwf.org

- Attracting Wildlife. Suggestions for encouraging wildlife to visit gardens. www.nwf.org/Home/Garden-for-Wildlife/Wildlife.
- National Wildlife Federation – Oregon. Information on the NWF Oregon Education Coordinator's activities. www.facebook.com/NWFOregon.
- Schoolyard Habitats. Resources for creating wildlife habitats at school. www.nwf.org/Garden-for-Wildlife/Create/Schoolyards.
- Other Educator Tools. www.nwf.org/Educational-Resources/Educator-Tools.

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CURRICULUM WRITER

Leslie Comnes, Writing for Education

ABOUT THE OREGON FOREST RESOURCES INSTITUTE

The Oregon Legislature created the Oregon Forest Resources Institute (OFRI) in 1991 to advance public understanding of how forest stewardship meets the social, environmental and economic needs of both present and future generations. OFRI works closely with the scientific, academic and educational communities at Oregon State University, the Oregon Department of Forestry and other agencies to ensure its K-12 resources are accurate and objective.

OREGON FOREST LITERACY PLAN CONCEPTS

- Theme 2, B.2. Forests provide habitat for fish and wildlife.
- Theme 3, B.5. As human populations and global demand for forest resources increase, forest management and advances in research and technological systems can help ensure forest resources are maintained or improved to produce the desired values and products.

EDUCATION STANDARDS CONNECTIONS

NEXT GENERATION SCIENCE STANDARDS

- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (Grade 6)
- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (Grade 7)
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (Grade 7)
- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. (Grade 8)

COMMON CORE STATE STANDARDS – ENGLISH LANGUAGE ARTS

- WHST.6-8.9. Draw evidence from informational texts to support analysis, reflection, and research.

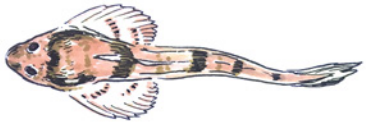
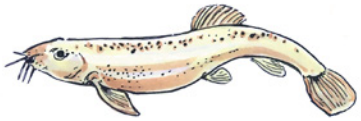
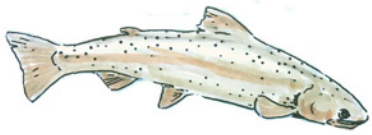
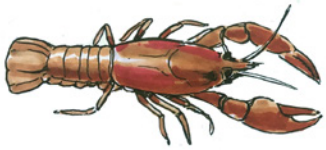
COMMON CORE STATE STANDARDS – MATHEMATICS

- 6.SP.2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
- 6.SP.5. Summarize numerical data sets in relation to their context.
- 7.SP.1. Understand that statistics can be used to gain information about a population by examining a sample of the population.

Oregon Forest Resources Institute

STUDENT PAGE

NAME _____

Species Latin name / Common Name	Image*	Matching eDNA sequence (1-9)†
Acipenser transmontanus white sturgeon		
Cottus asper sculpin		
Misgurnus anguillicaudatus Japanese weatherfish		
Dicamptodon tenebrosus coastal giant salamander		
Lampetra sp. lamprey		
Nitzschia sp. *(various species)* diatom		
Oncorhynchus clarkii cutthroat trout		
Oncorhynchus tshawytscha Chinook salmon		
Pacifastacus leniusculus signal crayfish		
Phytopthera sp. *(various species)* oomycete		

* Images are not to scale. Diatoms and oomycetes are microscopic organisms.
† from "Assessing eDNA sequences" student instructions.

Monitoring a forest stream

You are a wildlife biologist who monitors forest streams for invasive species such as the Japanese weatherfish. This small fish is originally from Asia, where it is relatively harmless. In Oregon, however, it eats native species, carries diseases and competes with young trout and salmon for habitat and food. It has been seen in some Oregon forest streams.

You want to learn whether this invasive species is present in Trout Creek. To find out, you use deoxyribonucleic acid (DNA), which carries genetic code. You filter five liters of water from the creek, collecting strands of environmental DNA (eDNA) that comes from the feces, urine, dead skin or eggs of living animals, or from decaying dead ones. Back in the laboratory you use a sequencing machine to identify the eDNA sequences contained in your sample.

You then compare the eDNA sequences to a database of known sequences, called the BLAST database. By doing this, you can identify the species present in Trout Creek.

To complete your task, use the data and BLAST link found on the "Assessing eDNA sequences" student instructions at bit.ly/LITFguide. Record the sequence number on the right for any species matches you find.

Explain your findings:

_____

_____

_____

_____

_____