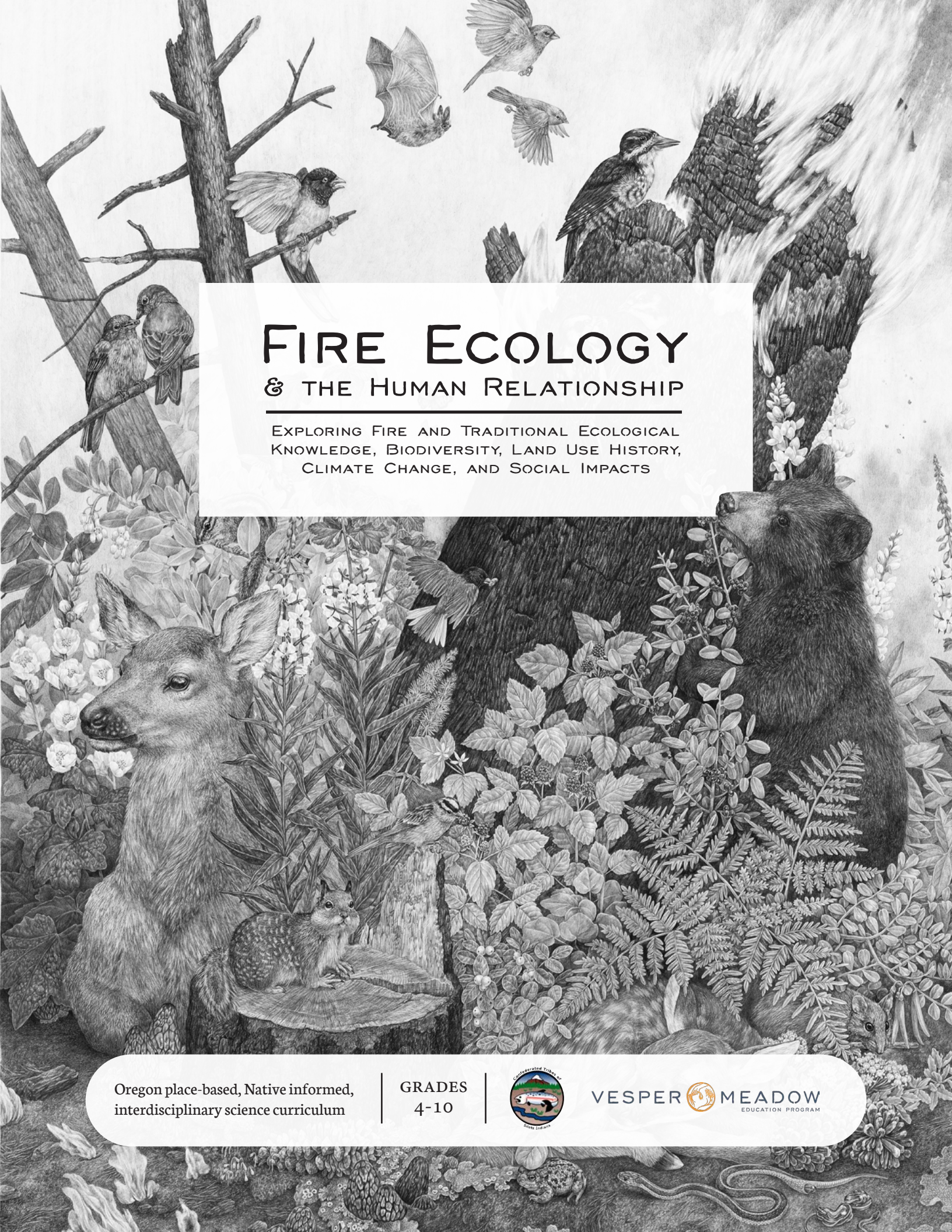

Fire Ecology
& the Human Relationship

Exploring Fire and Traditional Ecological Knowledge, Biodiversity, Land Use History, Climate Change, and Social Impacts

Oregon place-based, Native informed, interdisciplinary science curriculum

GRADES 4-10

Confederated Tribes of Siletz Indians

VESPER MEADOW EDUCATION PROGRAM

Fire Ecology and the Human Relationship:

Exploring Traditional Ecological Knowledge, Biodiversity, Land Use History, Climate Change, and Social Impacts

A Place-based, Native informed, interdisciplinary Science Curriculum
For Oregon students in grades 4th - 10th

Many thanks to the people who have provided support, research, time, and care for the creation of this curriculum

- Funding provided by the Confederated Tribes of Siletz Indians
- Written by the Vesper Meadow Education Program: Jeanine Moy and Brian Geier
- Edited by: Joseph Scott, Debra Agnew, Katie Boehnlein, Chris Adlam, Robert Kentta, Tara Laidlaw, Stasie Maxwell, Nancy Austin.
- Art: Zoe Keller, Sarah F. Burns
- Layout and design: Casey House
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The Vesper Meadow Vision

Vesper Meadow Education Program is building a culture of land stewardship and nature connection. We demonstrate biocultural restoration through Tribal partnership, diverse partnerships for land stewardship, community involvement in scientific monitoring, and sharing our work through nature-inspired art and creation of educational materials. Our work provides an integrated approach to cultivating and sustaining the human-nature relationship.

Acknowledging Land and Relationship

Core to our vision is the belief that ecological restoration is synonymous with cultural revival. It is important to recognize that every part of what is now known as the U.S. is someone's traditional territory. We honor the people of the land on which we work: Latgawa, Takelma, Shasta, and Klamath, and recognize the legacy of federally-sponsored genocide and forced removal. Many of these people, now members of the Confederated Tribes of Siletz Indians and Confederated Tribes of Grand Ronde, await the fulfillment of rights reserved under ratified treaties. We work to reduce the adverse effects of colonization on the land, and support self-identified goals through partnership with Indigenous leaders and local Tribes.

All lessons and associated materials can be found online via the Vesper Meadow Education Program at VesperMeadow.org and at the Confederated Tribes of Siletz Indians at ctsi.nsn.us

VESPER MEADOW
EDUCATION PROGRAM

Confederated Tribes of Siletz Indians

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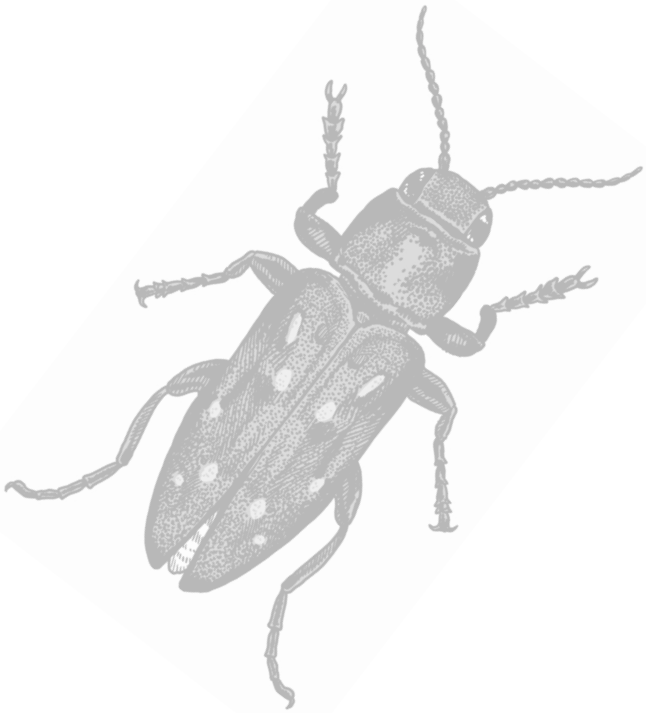


Preface

Fires Past and Future, for Our People and Our Lands

For thousands of years our ancestral Tribal peoples of Western Oregon have lived not just on the land, but with the land, coaxing it into peak production for diverse resources, habitat types and the species that thrive in those diverse environs. Fire can be a destructive force when it is exposed to heavy fuel loads, extreme dry conditions, or habitats that are not adapted and resilient to a healthy fire cycle.

These interactions with our landscapes did not happen by chance. They were taught through generations of practice and observation: which fire or other treatments were beneficial, what times and conditions produced safe renewal and abundance. Always there were specific targeted goals: to enhance traditional food plants, to maintain hunting grounds, to tend basket materials, etc. Fires had many uses and different effects at different times of the year. Useful burns could fire-proof village areas in the event of wildfire, or drive deer and elk to harvest. For some of our ancestors, ceremonial burning was believed to signal the salmon that it was time for them to leave the ocean and return up the rivers to spawn.

Fire acts differently based on fuel types and the moisture content, whether it is on flat ground or steep slopes, whether it first contacts fuels at the top of a ridge and then creeps down toward the bottom, or starts at the bottom and races to the top. Our people knew these things and employed that knowledge in appropriate application.

We live in a zone unique for its biodiversity with diverse fire-adapted habitats such as oak savannah and subalpine meadows that are home to a variety of low-growing forbs (bunchgrasses) and bulb plants. Many of these plants thrive with frequent, low intensity burning practices which keep their surroundings open and prevents shrubs and trees from outcompeting them with shade or the development of a thick layer of leaf litter.

We also live in times where our landscapes have experienced lots of rapid changes, and now our climate itself is also experiencing fluctuations and extremes that are not typical for our region. Our landscapes have been dependent on us, and they remain so. We must have a healthy respect for the destructive potential of fire, while not being so fearful that we think all fire is bad for the landscape.

This curriculum is meant to introduce students to the subject and develop understandings, but is not meant for anything other than collaborative, planned and approved uses of the concepts and information contained herein.

The dire emergencies that we and our landscapes face in this century cry out for considered, collaborative, devoted action, and for lessons born of long experience. We have ancestral knowledge (both passed down through the generations to today, and from interviews with elders of generations past). We have modern sciences to assist us. We have historic resources, such as careful work of the early General Land Office (GLO) surveyors, which sometimes give us startling glimpses of the texture of our landscapes from before fire suppression became the new, and ultimately disastrous, law of the land.

If there is a way out of our current, undesired, and dangerous predicament it begins with education. For that, I am thankful to the Vesper Meadow Education Program for doing the slow hard work of collaboration to bring these lessons to you. Please read, ask questions, and think about how we can sow a better future for our lands and for all peoples.

Thank you.

Robert Kentta
Cultural Resources Director
Confederated Tribes of Siletz Indians

Texture of Our Landscape

Rapid Changes Over two centuries

Survey Plot Map of Vesper Meadow region,
General Land Office records online

Google Sattellite Image

The outlines of Vesper Meadow stand out clearly in the north half of both maps. Looking at a broader area, shows how unique and precious Vesper Meadow is, since it was once part of a much larger group of prairies, meadows, and diverse habitats at the cusp of the Rogue and Klamath watersheds. Other prairies that once stood nearby have been converted to reservoirs or encroached on by trees in the absence of fire. In many places, dense monocultures of fir for commercial timber replace the open stands of "Fir, Pine, Cedar, Yew, c. with Undergrowth of Manzanita, Sage, etc." that surveyors first described.

Foreword:

Indigenous Fire Science: Cultural Burning Traditions in Western Oregon

Since time immemorial, Native American people have been tending the land with fire. Here in what is now Western Oregon, our ancestors carefully burned to maintain oak groves for acorns, used mindful fire in meadows for camas and other foods, and pruned and burned hazel patches for basketry materials. These practices, among many others, require the use of fire as a transformational element: fire to clear grassland, maintain forest health, and encourage new growth. Our Tribal languages describe a land full of good fire — place names that locate fire-crafted basketry materials, broad savannah hunting grounds, and mountain woodlands tended for berries. All that we have been and all we will be is fire dependent.

Tribal seasonal rounds — the ongoing cycle of tending and gathering — depend on the use of fire. Tending, gathering, and eating traditional foods supports the health and well being of Tribal communities. In this way, we recognize that the use of prescribed fire in tending our traditional food producing places has a direct and tangible impact on our overall health as a people. For many, this fire-dependent food is playing an increasingly important role in our lives.

When settlers reached our homelands nearly two hundred years ago, they failed to recognize the critical role Native people played in shaping the landscape they came to occupy. The open savannah park-like paradise they first saw was far from pristine. It was the result of fire-dependent Indigenous land management and agricultural practices refined over countless generations.

> *The first whites in the Willamette Valley did not tame a wilderness; they inherited a park.*
> — Esther Stutzman, Siletz Tribal Member, storyteller, and Kalapuya descendent

The newcomers and strangers to our traditional ways of knowing brought devastating changes. From disease and warfare to forced removal and boarding schools, they attempted to dispossess us of our places and erase our cultural identity. Our people were often removed far away from the homes we tended and cherished. The settlers' extractive approaches to resource management left little room for our traditional fires, and the land fell to disrepair. As the new map of the West filled with railroads, towns, and non-native croplands, the meadows became choked with invasive grasses, undergrowth and litter built on the forest floor, and our traditional foods went ungathered. The untended landscape became a compromised landscape.

A legacy of fire suppression caused by settler-society has led us to a time of collective reckoning — a time of reflecting on failed practice, re-thinking ties to place, and recognizing the insight of Indigenous ways of knowing. These ways of knowing and understanding a place have come to us from generations of careful exploration, experimentation, and observation. The importance of centering Indigenous approaches to land management cannot be overstated. Native American ecological practice — "Traditional Ecological Knowledge" (TEK) — will emerge to serve Tribal communities as well as to address challenges faced by the larger world. In this context of TEK, fire becomes Traditional Fire Knowledge.

In some places, fire practitioners are returning to the land. In some places, they never left. In spite of policies designed to trivialize and vilify our ecological practice, strip us of our places and identities, and erase our histories, our fire remains. Ongoing global climate change will call on science — Indigenous and otherwise — to explore new ways to address the impacts of wildfire and drought in a rapidly changing world.

This curriculum recognizes that "Indigenous Fire Science" is the science of engaging with fire as a practice and as a tool of Indigenous agriculture. Background information and lesson activities in this curriculum integrate and elevate critical understandings of Indigenous fire practice and how it has shaped the land. It identifies and supports a path forward as we all confront the complex web of changes we now face. As traditional fire knowledge and Western fire science converge, our TEK increasingly shapes and guides the ways in which we talk about and tend to fire.

All of the lessons provide opportunities to recognize and honor the wisdom and insight of Native Americans. There are opportunities to integrate Western science with Indigenous science and provide insight into how the two will increasingly converge in the future. The lessons allow place-based learning opportunities, a chance to explore fire through the eyes of the land you are on. With this in mind, educators are encouraged to contact local Tribes, who often provide direction to those seeking to center Native voices in their classrooms, and can offer guidance when teaching and learning about local Tribal histories and cultures.

Teaching and learning about fire in a cultural context can be challenging in unfamiliar ways. To many Native American people, fire — like the land itself — is honored as sacred. Fire brings the stories, songs, ceremonies, and protocols associated with sacred things. For some, spiritual ties to places are made stronger with fire. Seeking to know this truth can lead to critical reflection on our individual and shared values, and foster a deeper understanding of our connections to our places.

The incredible diversity and intertwined nature of the languages, cultures, and practices found in the place now known as Western Oregon (see this map: https://www.ctsi.nsn.us/reservation-maps/) is reflected in traditional burning practices. Our people often worked and are still working with fire to produce different outcomes in different places at different times. We collaborate to reach mutually beneficial results. Teaching to know these things while working to explore our shared ties to a place will make learning that much more meaningful. This recognition of cultural fire diversity also helps students better understand the overall human and geographic diversity of the region.

Fire is universal. Fire is to be revered as a power of creation, and a force of destruction. The lessons found here serve a common cause: the understanding of fire as a transformational element of the landscape, and the recognition of Tribal peoples' intergenerational relationship with good fire and the places where fires are tended.

Joe Scott
Traditional Fire Practitioner
Siletz Tribal Member

Introduction

Welcome to the Fire Ecology and the Human Relationship Curriculum

The Vesper Meadow Education Program is honored to put forth the *Fire Ecology and the Human Relationship* curriculum with the support of the Confederated Tribes of Siletz Indians. This curriculum is the fulfillment of a multi-year vision to provide teachers with tools to address some of the most critical and misunderstood issues facing Oregon today. The curriculum reflects our principles of encouraging hands-on, joyous experiences for diverse learners, promoting equity and justice for all beings, and embracing multiple ways of understanding our world. Though the curriculum is primarily science-based, you will find that the lessons fulfill other subject areas and are infused with art, historical references, creative writing, geography, and even social media.

The curriculum is intended to expand upon existing wildfire curricula that are more general to lands of the American West and emphasize settler / industrial perspectives. This Oregon-based curriculum covers fire's connections with biodiversity, Indigenous culture, land management history, climate change, and social impacts today. Many of the lessons contain several classroom activities, and provide opportunities for educators to break the lesson into multiple learning sessions or choose the parts that are best suited to their students. We hope to provide a foundation to effectively teach about the role of fire in Oregon's ecosystems, how humans have interacted with fire past and present, and engage students to think critically about solutions for a fire-adapted future.

Recognizing that the ecological roles, multicultural relationships, and perceptions of fire are extremely complex, we have intentionally created a flow of lessons that build on concepts over successive grade levels. The lessons for older students draw on basic ecological concepts introduced in earlier lessons and integrate additional scientific and societal frameworks. Further acknowledging that some students may have negative perceptions of fire and/or have been personally influenced by wildfire in their lives, we provide moments for classroom discussion and additional resources to address students' emotional wellbeing. The lessons are meant to strike a balance of candid information without adding to prior perceptions of fear, and ultimately allow students to think clearly about the material, participate in the activities, and feel empowered to take actions in their lives beyond the classroom.

Building Understanding, Empathy, and Applicable Skills

The lessons in this curriculum are designed to support multiple styles of learning, encourage students to think critically, and provide opportunities for creative, collaborative problem-solving, nourishing the whole student and promoting empathy for other living beings.

Throughout these lessons, auditory, visual, literary, oral, artistic, and technological approaches invite students to engage deeply with Vesper Meadow's Education Program themes:

- Understanding and celebrating biodiversity
- Rekindling the human-land relationship
- Promoting healthy ecosystems
- Solving problems creatively and collaboratively

Considerations for Teaching Native American Perspectives

When teaching about Native American issues, it is very important to understand both historical and contemporary issues that affect Native peoples. Inextricably, the histories of colonization, land management, and environmental policy shape the fire-adapted landscapes we experience today. The current settler colonial society has created many changes to the environment, family structures, culture, and food sources of Native people. Removal of Native people to reservations caused a loss in their connection to traditional lands. While Native families struggled in new environments, many of their ancestral lands also suffered from the loss of traditional tending practices and the introduction of extractive land-use practices. Native people maintained their Indigenous land management practices through relationships with new lands, rivers, and native plants. Today, Tribes work to regain land access in places that were taken from them. At the same time, many practices used by public land agencies, such as prescribed burning, are based on Native American land management practices. A critical look at these issues is essential to teaching the curriculum.

Prior to the use of this curriculum, students should have an introduction to the original peoples of the lands they inhabit and about who (Native and non-Native) inhabits these lands today. (See Native Land Map for reference: www.ctsi.nsn.us/reservation-maps/) The curriculum invites older students to seek articles and web-based resources that will help them realize the many Native people's land science and management practices currently happening in Oregon and throughout the United States. We encourage educators to continue learning about Native goals and efforts for land management as time progresses.

Concurrent to the development of this curriculum is the development of a shared curriculum for Oregon under Senate Bill 13 Tribal History, Shared History. See the Confederated Tribes of Siletz Indians website, Confederated Tribes of Siletz Indians | Siletz Tribe located in Oregon (ctsi.nsn.us) for more information and resources regarding the 9 Federally recognized Tribes of Oregon. See Oregon Department of Education's website for more information and classroom lessons.

A Note on Honoring Tribal Knowledge, Foods and Medicines

Native plants such as the First Foods mentioned in these lessons, are important to the lifeways of Siletz Tribal members and other Native American people. They are foods that keep people nourished, active, and healthy, but also important for staying connected to their families, ancestry, and culture. Many traditional food systems were diminished by colonization and replaced with the introduction of Western diets and processed foods, often with health consequences for Native people. With concurrent changes in land use and degradation of habitats, many First Food plants are now rare or endangered on the landscape.

Many Siletz Tribal members and other Native American people work to restore and reconnect with food, health, community, tribal identity, spirituality, and their ancestral natural world. Traditional Ecological Knowledge of First Foods includes understandings of not only plant biology and ecology, but also about complex human-plant interactions such as cultivation strategies and harvesting ethics. With the rarity of many native plants today, it is most ethical to approach First Foods plants with 'principles of caution,' e.g. taking extra time to learn about the plants throughout the seasons, conservative harvesting, harvesting after plants have gone to seed, doing the least harm, engaging in practices that promote future growth of a population, being aware of invasive species, etc. With these understandings combined, we encourage non-Native learners to study and appreciate native plants as First Foods and learn principles of respectful harvest or to refrain from harvesting them.

Why Native-Centric Curriculum for All?

We hope this curriculum will bring Native issues to light for all students, and moreover empower Native students to take action and be leaders in their communities. Historically, education was used as a weapon of forced assimilation. Hundreds of thousands of Native American children were abducted from their families, communities, and Tribes by US government agents and sent to boarding schools where they were forced to refrain from practicing their culture, and were subject to severe physical and emotional abuse, and often death. The forced removal of Native people and cultural genocide of the last two centuries has had lasting effects, including systemic barriers, intergenerational trauma, and huge educational disparities for Native students today. Students continue to learn and celebrate historical events that were notoriously violent toward Native people, such as actions taken by Christopher Columbus and other colonizers, the Gold Rush, and settlement of the American West. This curriculum seeks equity and justice in education, attempting to keep all students engaged by honoring Native wisdom and providing perspectives for Native students to see themselves reflected in the curriculum.

By creating an educational curriculum that looks at fire and land management, we hope to encourage all Oregonians to understand related issues and engage in meaningful ways as community members. We hope this work will inspire further place-based and statewide environmental education that incorporates the knowledge and perspectives of Native peoples. We hope to reverse the trend of underrepresentation of Black, Indigenous, and People of Color in classroom topics and discussions and make steps toward addressing racism both in schools and beyond.

Lesson Summaries and Teaching Standards

All lessons include alignments with Next Generation Science Standards (NGSS); some include alignments with Common Core State Standards (CCSS), Oregon Social Sciences Standards, Oregon Ethnic Studies Standards, and/or Oregon SB 13 Tribal History / Shared History expectations.

1) Reading the Fire-Influenced Landscape | Topography and Fire

Recommended for 4th – 5th grades

The most significant influences on fire behavior are weather patterns, vegetation, and topography, also known as the "wildland fire triangle." The geographic region of southern Oregon provides unique case studies of fire behavior due to its geologic diversity and varied terrain.

Students will look at historic photos and modern aerial photos and satellite imagery to learn about how some people have studied fire in the last 100 years and to explore how fire interacts with the landscape. Utilizing interactive satellite imagery from NASA, students will formulate a hypothesis about fire behavior and create a model of their hypothesis.

NGSS: 5-ESS2-1, 4-ESS2-2, 4-ESS3-2

2) Fire Biodiversity Puzzle | Biodiversity and Fire, part one

Recommended for 4th – 5th grades

Plants, fungi, wildlife, humans, and other living things throughout the Western United States have adapted to coexist with fire for millions of years. In the Oregon Cascades and Siskiyou mountains, a region renowned for biodiversity, there are both common and rare species that find homes amongst blacked and regrowing conifer forests, oak savannah, chaparral, and meadows.

Students will learn about local species' adaptations to their fire-affected habitats by constructing the Fire Biodiversity Puzzle art image. Studying species adaptations is not only fascinating, but may also provide inspiration for how to thrive in a world with fire.

NGSS: 4-LS1-1, 5-LS2-1, 5-ESS2-1
CCSS: ELA-L.W.4.1, ELA-L.W.4.2.B, ELA-L.W.4.3B, ELA-L.W.5.1, ELA-L.W.5.2.B, ELA-L.W.5.3.B

3) Fire Nourishes the Land, the Land Nourishes Us | Fire as an Agricultural Tool, part one

Recommended for 4th – 5th grades

Since time immemorial, Siletz Tribal members and Indigenous peoples have applied fire to the lands of Oregon, using traditional knowledge and skills passed down over many generations. This traditional use of fire can be referred to as a "cultural burning." Cultural burns are used by Indigenous people to ensure the quantity and quality of First Foods and Materials plants (plants that provide traditional foods and materials for cultural practices). In this way, fire can be understood as an agricultural tool used to nourish the land and plants. In turn, this fire-enhanced landscape nourishes the people and provides materials necessary for basketry, cordage, and other tools.

Students will learn about First Foods and Materials plant ecology, identification, and cultural significance. An understanding of First Foods and Materials plants and understanding cultural burns can provide key insights into sustainable forest and landscape management in Oregon.

Note: This activity is not meant to guide students to harvest and use plants for food or materials without the guidance of an adult with knowledge of plant identification, safe use, plant care, and permissions to use.

NGSS: 4-LS1-1, 5-LS2-1

4) Black to Green Creature Collage | Biodiversity and Fire, part two

Recommended for 6th – 8th grades

Fire is so important to the biodiversity of ecosystems throughout the Western United States that it is recognized as the keystone ecological process. Various intensities of burns, especially in southern Oregon forests, can be characterized as low severity, mixed severity, and high severity.

Students will learn about the interconnections between the fire-affected landscape and biodiversity. Utilizing the southwest Oregon region as a case study, students will think critically about ecological relationships between the fire regimes and wildlife habitat by collaboratively creating a collage.

NGSS MS-LS1-5, MS-LS2-1, MS-LS2-4

5) Burning for Basketry: Engineering Ecosystems with Fire | Fire as an Agricultural Tool, part two

Recommended for 6th – 8th grades

Fire is a naturally occurring part of the dry summers of Oregon, and a dependable fire cycle has created fire-adapted native plant species. Closely linked to natural fire regimes, cultural burns have been used in southwestern Oregon for thousands of years and have also shaped the land and plants within it. Fire suppression policies of the early 20th century deprived landscapes and plants of this critical ecosystem-engineering process in some areas of Oregon. While prescribed burns are now recognized as important by federal land agencies, the reintroduction of fire where it has been suppressed has faced many challenges

In this lesson, students will study cultural burning of hazel and look at the interrelated effects of cultural burning, wildfire, and fire suppression. Students' evaluations will highlight opportunities that cultural burning and Indigenous cultural practice offer to forest management and fire policy and planning today.

NGSS: MS-LS2-1, MS-L2-4, MS-LS-5

6) Leading the Way with TEK: Understanding Land Use Changes in Oregon | Fire and Land Use History, part one

Recommended for 6th – 8th grades

Traditional Ecological Knowledge (TEK) includes knowledge and practices that have been passed down from generation to generation in Indigenous communities, and has been shaped by the close relationship between Indigenous people and their land. Since the displacement of Indigenous people from traditional homelands in Oregon in the mid 1800's, the land has suffered from the loss of its original stewards' tending practices like cultural burning. In recent decades there has been an increased advocacy for returning fire where it has been suppressed, and for centering TEK in land restoration.

Students will study the historical shift in Oregon land use from the Long Indigenous Existence to the era of colonization, compare and contrast land management of the two eras, and utilize TEK concepts to design and present solutions for environmental issues influencing fire today.

NGSS: MS-LS2-5
Oregon Social Sciences Standards: 8.23, 8.24

7) When to Burn? Climate Change and Oregon's Fire Season | Climate Change and Fire, part one

Recommended for 6th – 8th grades

Climate change is affecting fire season and fire intensity across Oregon landscapes. Longer fire seasons and larger, hotter fires pose increasing risks to human, animal, and plant communities. While prescribed burns can help make and maintain fire-adapted landscapes, their ability to be implemented is complicated by factors of climate change, land use history, and an increase in population living in the wildland-urban interface (WUI).

Students will look at patterns of climate change in Oregon, and learn how these affect fire season and the use of prescribed burns. Students will understand the compounding factors associated with prescribed fire and think critically about how to mitigate risks.

NGSS: MS-ESS3-3, MS-ESS3-5, MS-LS2-4, MS-LS2-5

8) Community Preparation and Resilience | Forest Fire and Social Issues Today, part one

Recommended for 6th – 8th grades

By analyzing demographics and natural disasters, it is clear that certain people experience the effects of wildfire and smoke differently than others. Tribal communities, communities of color, immigrants, and low-income families are more vulnerable to climate disasters such as extreme wildfire due to homes located in proximity to areas of risk and exposure to weather through outdoor jobs. Some communities also experience disparities in relief efforts following climate disasters.

Students will examine four case studies of diverse communities in Oregon affected by wildfire, and discuss and present solutions for community preparedness and resilience.

NGSS: MS-ESS3-2
Oregon Ethnic Studies Standards: 6.26

9) Fire Policy and Practices of the Last 200 Years | Fire and Land Use History, part two

Recommended for 9th – 10th grades

Land management is a term that describes how people make decisions and take action with ecosystems and resources. The way in which land is managed has a direct effect on the health of humans and the environment. Students will take a look at land use policy over the last two centuries and how it has shaped forest land management in Oregon.

Students will gain historical perspective for fire behavior today and think critically about how land management decisions can affect the resiliency of landscapes and human communities moving into the future.

NGSS: HS-LS2-6, HS-LS2-7, HS-ESS 3-1
Oregon Tribal History, Shared History SB13 connections:
Natural Resource Management: Historical and Contemporary

10) Climate Change: Mitigating, Adapting, and Taking Action | Climate Change and Fire, part two

Recommended for 9th – 10th grades

Climate change is the paramount context for considering how wildfire impacts ecosystems and human communities. We must continue learning about climate change as research develops, as

well as think critically about our beliefs around climate change, so we may develop a sense of moral responsibility. We have potential to be agents of positive change as community members, parts of ecosystems, and citizens of Earth as a whole.
Students will discuss ways that society can mitigate and adapt to the impacts of climate change on the fire-adapted landscape.

NGSS: HS-ETS1-1
CCSS: RST.11-12.2, ELA-LITERACY.RH.11-12.1, ELA-LITERACY.RH.11-12.6, ELA-LITERACY.RH.11-12.7, ELA-LITERACY.RH.11-12.8, ELA-LITERACY.RH.11-12.9

11) Wildfire Vulnerability and Climate Justice, What Do You Meme? | Forest Fire and Social Issues Today, part two

Recommended for 9th – 10th grades

Historically marginalized communities are at most risk from the effects of climate change and wildfire. Recent studies across the American West are looking at the effects of wildfire on health, housing, psychology and other basic needs. The results of these studies illustrate the need for large scale changes to social systems in order to address climate change and wildfire effects into the future.

Students will learn about disparities in the relative impacts of wildfire on human communities, and research information presented in news media. Students will utilize "memes," a popular social phenomenon, to reflect on social issues and as a creative outlet and for comic relief.

NGSS: HS-LS2-7
CCSS: 9-10.RH.1, 9-10.RH.6, 9-10.RH.7, HS-ESS2-4
Oregon HS Ethnic Studies Standards HS.2, HS.7, HS.8

4TH - 5TH

Lesson 1
Reading the Fire-Influenced Landscape
Topography and Fire

NGSS: 5-ESS2-1, 4-ESS2-2, 4-ESS3-2

Summary

60 min.

The most significant influences on fire behavior are weather patterns, vegetation, and topography, also known as the "wildland fire triangle." The geographic region of southern Oregon provides unique case studies of fire behavior due to its geologic diversity and varied terrain. Students will look at historic photos and modern aerial photos and satellite imagery to learn about how some people have studied fire in the last 100 years, and to explore how fire interacts with the landscape. Utilizing interactive satellite imagery from NASA, students will formulate a hypothesis about fire behavior and create a model of their hypothesis.

Goals

- Students will learn about the interactions between topography, vegetation type, and fire behavior through a slideshow and class discussion.
- Students will observe historic photographs and modern imagery to explore concepts of fire behavior and how it has been measured/recorded by experts.
- Students will gather evidence to generate and create a model of their own hypothesis about fire behavior.

Classroom Procedure

1. Introduction discussion (alternatively, you may incorporate this into Activity One)
2. Activity One: Reading the Burned Landscape presentation
3. Conclusion

Preparation

***Note: the full worksheet will require students to be able to understand how to create basic line graphs.**

- Print one copy of the Fire on the Landscape: Satellite View Worksheet for each student
- Become familiar with the content presented in the discussion section below, also found in the PowerPoint presenter notes at the bottom of each slide.
- Open up NASA's Worldview website and use the directions at the top of the worksheet to become familiar with the website. https://worldview.earthdata.nasa.gov/
- Prepare to have an overhead projection of the Worldview website for the class and/or a set of classroom computers for the students.

Associated Lesson Materials

- PowerPoint presentation: Fire on the Landscape
- Website: NASA's Worldview Map: Satellite Detections of Fires https://worldview.earthdata.nasa.gov
- Fire on the Landscape: Satellite View Worksheet

VOCABULARY AND TERMS

Aerial imagery: photos or models that illustrate the landscape from above, a 'birds-eye view"

Aspect: the direction the slope of a hill faces

Klamath Knot: the mountainous region of Southwest Oregon and Northern California

Topography: the shape/configuration of the landscape and its features (landforms). Topography comes from the Greek "topos" meaning place and "graphein" meaning to carve/write

Pyrodiversity: characterizes the many different ways fire can burn and the resulting variety of habitats and landscapes influenced by fire

Ravines: depressions in the landscape, less severe than a canyon

Mixed-severity fire: describes how forest fires will show a wide range of burn effects on the trees, shrubs, and understory

Saddles: dips that are found along a ridge, or depressions in a mountain range resulting from being between two mountains

Slope: the degree of steepness of the land

Introduction

What influences the way a fire will burn on a landscape? Fire behavior is influenced by three main factors: weather conditions, type of vegetation or plants (also referred to as "fuels"), and topography. These three factors combined are sometimes referred to as the "wildland fire triangle." All of these factors interact with each other to create very complex fire behaviors across the landscape.

Topography is the most "static" or unchanging factor in the fire triangle since the shape of a landscape and its features are much slower to change than weather patterns or the condition of plants. Topographic features like ridges, gullies, meadows, and wetlands influence fire in different ways. Certain features may help fires to speed up, such as steeper slopes. Fire barriers on the landscape such as wetlands, rocky outcrops, or roads may slow down or stop fires.

Fire scientists study fire behavior to understand the way fire moves on the landscape. There is still much to learn about the ways in which fire will heat up or cool down and why it may change its direction or speed. One of the key ways to gather information about fire behavior is to look at images. The progress of technology in the last 80 years has allowed scientists to gather more accurate imagery more quickly.

Discussion Points

It is important to keep in mind that topography's influence on fire is always combined with other important factors like weather and condition of vegetation. As we look at different landscape features that influence fire, consider how weather and vegetation might interact with topography.

1. What topographic factors influence fire behavior?

SLOPE

Slope steepness: The steeper the hill, the faster fire will generally spread. This is in part due to the fact that steeper slopes can encourage higher winds.

Fire moving upslope: Fire moves more quickly upslope than downhill. Daytime conditions tend to contribute to fire moving upslope because heat will tend to rise and the sun warming the earth can contribute to an upward air draft. Also with heat and flames rising, they preheat fuels on the uphill side of the fire and make them easier to burn.

Fire moving downslope: During nighttime when the slope becomes shaded, the surface loses heat rapidly and becomes cool. The air next to the surface also cools and becomes more dense and heavier and it will begin to flow downslope, encouraging downslope movement of fire.

ASPECT

South facing slopes: Slopes facing south to southwest will receive the most sun exposure. As a result, these slopes are warmer than slopes facing a northerly direction. The warmer slope results in higher temperatures and drier conditions. The fuels/vegetation on south-facing slopes will tend to be drier and may ignite and burn readily. Fires on south-facing aspects may last longer, and may occur more often over the years. This sort of fire regime can help to maintain grasslands or shrublands.

North facing slopes: Slopes that are north facing receive less sun exposure and tend to be cooler and have more forested/wet vegetation. Fires may be less severe on north facing slopes, or slopes with this aspect may be the point at which a fire will slow down as it moves.

LANDFORM FEATURES

Ridges and mountains: Mountains and ridges may act as barriers to the horizontal movement of air. The wind is deflected over them and may increase upward air drafts or convective winds. When these winds reach the top of ridges and meet with updrafts from the other side, flames may bend back.

Ravines and gullies: Depressions in the landscape like ravines and gullies will form pathways for the flow of air and may change the direction of the fire. In narrow ravines, heat will dry out fuels on the uphill side and they will readily ignite.

Saddles and gaps: Dips that are found along a ridge will funnel the wind and increase its speed. Winds will also be gusty in these features and can spread embers that ignite smaller "spot" fires nearby.

Barriers: Various features on the landscape may act as barriers to stop or slow down the spread of fire. These include:

- Fields
- Roads
- Streams, lakes, swamps
- Rocky outcrops
- Old burned areas

2. How might the varying topography across the Western United States have varying effects on wildfire behavior?

The characteristics of different mountain ranges (elevation, mountain shape) and the weather patterns of different regions can vary greatly across the US. This means that the degree to which different factors influence fire behavior also varies greatly; for example, a study found that weather and vegetation were the most important factors in the Northern Rockies, whereas vegetation and topography were dominant in the Southwest. The study found that: (1) temperature was the most influential weather variable in the Northern Rockies; (2) previous burns (particularly those that were 65 years old) were moderately to highly influential in all study areas; and (3) valley bottoms and ridgetops were significantly associated with slowing or stopping fires. (Holsinger 2016)

3. What are some tools that we have to observe fire and its interaction with the landscape?

LOOKOUT TOWERS

The US Forest Service had built over 5,000 fire lookout towers by the mid 1930's. Fire spotters, the people who staffed the lookout towers, could detect fires up to about 20 miles away and used a device known as the Osborne Firefinder to determine the direction of fires. Most lookout towers are no longer in use because aerial photography, satellite imagery, and infrared technology are more effective.

HELICOPTER AERIAL PHOTOGRAPHS

Not long after fire lookout tower construction became common, planes and helicopters were used to take photographs of wildfires from above (aerial photography). These images were used to detect locations of wildfires, and study the impacts of fire on the landscape. Today, small remote-controlled drones are also used to gain aerial photos with less danger to a pilot.

SATELLITE AERIAL PHOTOGRAPHS

Satellites are launched into Earth's orbit and regularly collect data, often in the form of photographs. The first satellites were launched into space by Russia in 1957. Today, there are over 2,500 satellites orbiting the Earth. Images taken from space of the Earth's surface can provide information about wildfires, along with many other things like weather patterns, landscape conditions, and human activity. Satellite photography is used to detect new fires, map the edges of fires, and detect the movement of fires over time.

SATELLITE INFRARED IMAGERY

NASA's Jet Propulsion Laboratory created a tool nicknamed ECOSTRESS (ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station) to gather high-resolution temperature data across the earth. The ECOSTRESS instrument uses infrared technology that can "read" the temperature on earth. This could, for example, show how plants are stressed when they don't have enough water.

ECOSTRESS is special because it is set up on the International Space Station, which takes a different orbit than other Earth observation satellites. The advantages over normal photographs are (1) being able to more effectively track the edges of forest fires and detect new, smaller "spot fires"; (2) collecting more data and more often than could be done with a helicopter; and (3) reducing the safety risks for helicopter pilots and firefighters.

Activity

READING THE BURNED LANDSCAPE PRESENTATION

- Use the PowerPoint slide presentation and corresponding presenter notes to introduce background information about fire interacting with the landscape and past and present ways of observing fire.
- Lead a classroom discussion based on prompts in the second half of the slide show. Encourage students to observe the photographs and maps closely, considering when and how photos were taken. It may be helpful to toggle back and forth between slides.
- The final slide introduces NASA's interactive satellite map interface, Worldview. Explore the Worldview website together on an overhead screen before handing out worksheets.
- Students will orient themselves to the Worldview website with the directions on the worksheet and then create hypotheses* about fire behavior. They can work individually or in small groups.

*suggested for older students

Take it Outside

Prepare in advance or debrief after a class field trip by utilizing NASA's World View. Students may compare their activities on their field trip, sights they saw, or take pictures to compare with aerial imagery from the website.

Conclusion

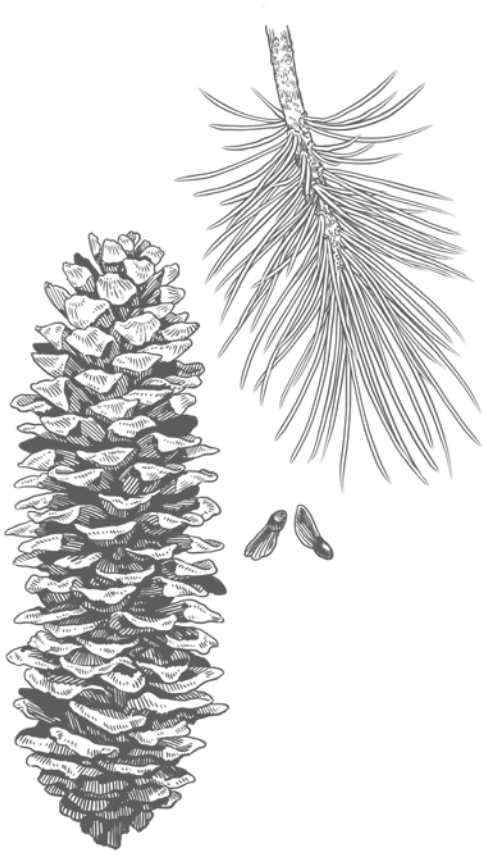
Encourage students to share their hypothesis with the class and draw their graph on the board. Remind students to be kind to each other and support each other's thought process, for it is possible that we may never know if a hypothesis is true or not. However, we can research it and see how much evidence there is to support it.

Choose two or three different student hypotheses to consider together as a class. Ask students to brainstorm ways in which they would look further into and/or test the hypothesis.

- Are there experts or other research that they would explore first?
- Do they have examples of ways they could do some direct observation?
- Can they use mapping and aerial imagery to look further?
- How would they design an experiment?

Take-Away Concepts

- Features on the landscape and overall topography have a significant impact on how fires burn on the land.
- There are complicated interactions between weather, vegetation, and the landscape which influence fire behavior.
- Developments in technology over time have increased our ability to safely and efficiently observe fire behavior across the landscape, and researchers continue to study fire.



NAME _____ DATE _____

4TH - 5TH

Lesson 1: Reading the Fire-Influenced Landscape

WORLDVIEW WORKSHEET

Using NASA's Worldview Website

1. Orient on the map: Go to the NASA Worldview website: worldview.earthdata.nasa.gov Scroll or use the search bar in the upper-right toolbar, zoom in to the region where you live. (Click on "Place Labels" and "Coastlines/Borders/Roads" if you need help orienting the map. Try different base layers if needed)

2. Explore layers: Click "+ Add Layers" at the bottom of the menu on the left side of the page. In the pop-up window, select the "Hazards and Disasters" tab, then click "Fire and Thermal Anomalies." Click the check boxes to add layers to the map. Next, click on the "Science Disciplines" tab and try adding layers from "Biosphere," "Human Dimensions," or other categories: Settlements,Vegetation, Air Quality, Drought Hazard, and Precipitation. Observe different combinations of layers displayed together.

3. Discuss possible correlations: Do you notice any patterns or relationships between the different layers you explored? What additional information might you need to explore these patterns further? Sometimes patterns that seem to correlate might not be directly related—and in order to know if they are related we would need to further study the relationship.

4. Compare seasons and years: Use the timeline slider at the bottom of the page to see satellite images from earlier dates. First, look at the changes that occur over the course of one year (seasonal changes). Then look at earlier years. What trends do you notice?

5. Use the distance measuring tool: The distance measuring tool appears in the bottom right of the screen as a button that looks like a small ruler. Turn on one of the measuring tools (note the popup instructions) and use it to measure distances between points on the map. For example, you may measure the distance between fires, between fires and the coast line, etc...

Create a model of a hypothesis about fire behavior

Your hypothesis: *Example: the farther away from the coast, the more fires occur*

How would you test to see if your hypothesis is true?

Lesson 1: Presenter Notes

Fire on the Landscape

Slide 2

Fire behavior is influenced by three main factors: weather conditions, type of vegetation (also referred to as "fuels"), and topography. This is sometimes referred to as the "fire triangle." All of these factors interact with each other in different ways under different conditions and can create very complex fire behaviors across the landscape.

Slide 3

Landscape is the most "static" or unchanging factor in the fire triangle since the landscape is slower to change than weather patterns or the conditions of plants. Patterns of the landscape that influence fire depend on the shape and amount of features like ridges, gullies, meadows etc. Certain characteristics may help fires to speed up, such as steeper slopes. Fire barriers on the landscape such as wetlands, rocky outcrops, or roads may slow down or stop fires.

It is important to keep in mind that topography's influence on fire is always combined with other important factors like weather and condition of vegetation. As we look at different landscape features that affect fire, consider how weather and vegetation might interact with topography.

Slide 4

Slope steepness: The steeper the hill, the faster fire will generally spread. This is in part due to the fact that steeper hills can encourage higher winds.

Fire moving upslope: Fire moves more quickly upslope than downhill. Daytime conditions tend to contribute to fire moving upslope. This is because heat will tend to rise and the sun warming the earth can contribute to an upward draft. Also with heat and flame rising, they pre-heat fuels on the uphill side and make them easier to burn.

Fire moving downslope: During night when the slope becomes shaded, the surface loses heat rapidly and becomes cool. The air adjacent to the surface also cools and becomes more dense, thus heavier, and it will begin to flow down slope.

Slide 5

South-facing slopes: Slopes facing south to southwest will receive the most solar radiation. As a result, this slope is warmer than slopes facing a northerly direction. The warmer slope results in higher temperatures and drier conditions. The fuel will tend to be dryer and may ignite and burn readily. Fires on south-facing aspects may last longer and may occur more often over the years. This sort of fire regime can help to maintain grasslands or shrublands.

North-facing slopes: Slopes that are north facing receive less solar radiation and tend to be cooler and have more forested/wet vegetation. Fires may be less severe on north-facing slopes and may be a significant place where fire will slow its movement on the lanscape.

Slide 6

Ridges and mountains: Mountains and ridges may act as barriers to the horizontal movement of air. The wind is deflected over them and may add to the upslope convective winds. When the ridge tops are reached, updrafts from the other side may bend the flames back.

Ravines and gullies: Depressions in the landscape like ravines and gullies will form paths for the flow of air and may change the direction of the fire. In narrow ravines, heat will dry out fuels on the opposite side and they will readily ignite.

Saddles and gaps: Dips that are found along a ridge will funnel the wind and increase its speed. Winds will also be gusty and can spread embers that create smaller "spot" fires igniting nearby.

Barriers: Various features on the landscape may stop or slow down the spread of fire.

- Fields
- Roads
- Streams, lakes, swamps
- Rocky outcrops
- Old burned areas

Slide 7

Example of natural fire breaks: *Beavers promoting fire resilient landscapes*

The Bootleg Fire in southern Oregon in 2021 burned through thousands of acres of open forest and timber plantations. This photo was taken along Dillon Creek where beavers had been tending the creek. Notice the beaver dams in the right two photographs, and the amount of lush green along the waterway that remained unburned. This oasis habitat will help neighboring areas of the forest to regenerate in the following years.

Slide 8

The characteristics of different mountain ranges (elevation, mountain shape) and the weather patterns of different regions can vary greatly across the US. This means that the degree to which different factors influence fire behavior also varies greatly; in some regions topography and weather may be the biggest influence, in some regions topography and vegetation may be the biggest influence.

A study found that weather and vegetation were the most important factors in the Northern Rockies, whereas vegetation and topography were dominant in the Southwest. The study found that: (1) temperature was the most influential weather variable in the Northern Rockies; (2) previous burns (particularly those that were 65 years old) were moderately to highly influential in all study areas; and (3) valley bottoms and ridgetops were significantly associated with slowing or stopping fires. (Holsinger 2016)

Slide 9

Fire scientists continue to study fire behavior to understand the way fire moves on the landscape. There is still much to learn about the ways in which fire will heat up or cool down and the things that may change its direction or speed. One of the key ways to gather information about fire behavior is to look at images. The progress of technology in the last 80 years has allowed scientists to gather better imagery more accurately and more quickly.

Slide 10

The US Forest Service had built over 5,000 fire lookout towers by the mid 1930's. Fire spotters, the people who staffed the lookout towers, could detect fires up to about 20 miles away and used a device known as the Osborne Firefinder to locate the direction of fires. Most lookout towers are no longer in use because aerial photography, satellite imagery, and infrared technology are more effective.

LEFT: Fire Control Officer and Lookout with the Fire Finder
Cinnabar Lookout Tower
Rogue River National Forest 1964

RIGHT: Abbot Butte Lookout Tower
Rogue River National Forest

Slide 11

LEFT: Panoramic photograph from the Bald Mountain Lookout
Rogue River National Forest, Prospect Ranger District 1933

RIGHT: Photo of a fire near Yellowjacket Lookout
Rogue River National Forest 1917

Slide 12

Not long after fire lookout tower construction, planes and helicopters were used to take photographs of wildfires from above (aerial photography). These images were used to detect locations of wildfires and study the impacts of fire on the landscape. Today, small remote-controlled drones are also used to gain aerial photos with less danger to a pilot.

Pictured: Moon Prairie Fire, aerial view 1962

Slide 14

Satellites are launched into Earth's orbit and regularly collect data, often in the form of photographs. The first satellites were launched into space by Russia in 1957. Today, there are over 2,500 satellites orbiting the Earth. Images taken from space of the Earth's surface can provide information about wildfires, along with many other things like weather patterns, landscape conditions, and human activity. Satellite imagery is used to detect new fires, map the edges of fires, and detect the movement of fires over time.

Slide 15

NASA's Jet Propulsion Laboratory created a tool nicknamed ECOSTRESS (ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station) to gather high-resolution temperature data across the earth. The ECOSTRESS instrument utilizes infrared technology that can "read" the temperature on earth. This could, for example, show how plants are stressed when they don't have enough water.

It is special because it is set up on the International Space Station, which takes a different orbit than other Earth observation satellites. The advantages over normal photographs are (1) being able to more effectively track the edges of forest fires and detect new, smaller "spot fires" (2) collecting more data and more often than could be done with a helicopter; (3) reducing the safety risks for helicopter pilots and firefighters.

PICTURED: Scientists use satellites to help map wildfire perimeters and hotspots (indicated in red), as in this image of the Jack Fire 2021 in Oregon. Courtesy of Pacific Northwest National Laboratory
Slide 17

Question: What do you observe in this lookout tower photo?
Possible answers and further discussion:

- Trees have been cut in proximity to lookout tower
- Probe further: Why might this have been done? To increase visibility from the tower, to protect the tower from potential forest fires
- You can see about 25 miles from the lookout tower, it seems slightly hazy in the distance
- There are fewer, smaller trees growing alomg the ridge (pictured right)
- There are open areas on the forested hills in the distance.
- Probe further: What do you think that these openings are? What caused them? Possible answers: open meadows maintained by fire, rock outcrops and lava fields, areas that have been logged

Photo: Blue Rock Lookout, Butte Falls Ranger District, 1936
from the RRNF Historical Records Collection in Hannon Library Special Collections.
This photograph is part of the Historical Records Collection of the Rogue River National Forest, and made available courtesy of Southern Oregon University Hannon Library."

Slide 18

Question: What do you notice about the landscape that could influence fire behavior?
Possible answers and further discussion:

- The south-facing aspect of the hillside (foreground) of the photo doesn't have many trees. Together with the road, they may serve as a barrier, or fire break
- Probe further: Why might the hillside have fewer trees on the south slope? South-facing aspects tend to be naturally drier and lack tree growth
- Mt. McLoughlin has very little snow, this picture must have been taken late in the summer/ early fall.
- Open rocky lava fields on Mt. McLoughlin's slopes may act as barriers, or fire breaks

Photo: Blue Rock Lookout, Butte Falls Ranger District, 1936

Slide 19

Question: What can you observe from a lookout tower that you can't observe from an aerial photo?
Possible answers:

- Individual trees, size, height, growth form/shape
- Getting more detail about ground cover: rock versus small plants
- Weather conditions

Photo LEFT: Blue Rock Lookout, Butte Falls Ranger District, 1936
from the RRNF Historical Records Collection in Hannon Library Special Collections
This photograph is part of the Historical Records Collection of the Rogue River National Forest, and made available courtesy of Southern Oregon University Hannon Library.

Photo RIGHT: Google Earth image 1994

Slide 20

Question: What can you observe from an aerial photo better than from a lookout tower?
Possible answers:

- Landscape level features
- Road networks
- Logging, Clearcuts
- Different stands/ patches of trees regrowing
- Burned areas

Slide 21

Buck Rock Lookout location 2005

Question: What has changed in this image 11 years later?
Possible answers:

- Logging (see the patches of open ground within the orange circle)
- Regrowth of plantation stands (see the rows of trees within the green circle)
- New road (see the blue circle)

Slide 22 (Optional slide)

Slide 23

Question: How might changes across the landscape 1994-2019 (over 25 years) affect changes in fire behavior?
Possible answers:

- Plantation stands grow in thick, with trees close together burn hotter and faster
- Fires are often started by people who access this area by roads

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Slide 25

Question: What do you observe in this satellite image?
Possible answers:

- Smoke is blowing to the west
- Fires are generally in the Cascade mountains
- Most smoke is blowing for a long distance

Follow up question: How do you think this image was created? What type of technology would illustrate the smoke, but also the outlines of the fires?
Answers: Read description below

Satellite imagery may include cameras but also additional technology that can detect fires. For example, infrared sensors can detect the boundaries of fire. Infrared sensors "read" temperatures on the landscape to provide detailed information about where fires are, since smoke makes it hard to see what is happening below. (See outlined red boundaries on the map image)

This image of the widespread "Labor Day Fires" in 2020 from a satellite shows smoke and fire boundaries in red outline. NASA's Aqua captured this image of the large number of fires that were burning by the first week of September 2020. Some of the fires started in August, but the majority started after an unprecedented and historically rare windstorm that swept through the region Monday Sep. 7 – Tuesday Sep. 8. Wind gusts up to 65 mph were clocked during the event. The timing of the windstorm was unusual because those strong east winds usually occur in in the dead of winter—not in early September. In addition to the heat, it is another example of the changing weather patterns that are being seen.

The smoke from fires is seen cascading off the coast into the Pacific Ocean traveling more than 600 miles just in this image. It is striking how thick and concentrated the smoke is in this image, and many cities and towns up and down the entire West Coast reported almost "nightlike" conditions and red-orange skies created by particles in the air blocking out all other colors.

Map Image of the widespread "Labor Day Fires" in 2020 from satellite

Slide 26

Bootleg Fire 2021

During the summer of 2021, the Bootleg Fire in southern Oregon burned more than 410,000 acres, making it one of the largest fires in Oregon's history. Images shown here from the ECOSTRESS tool, were used to measure surface temperature from the vantage point of the International Space Station, twice per day at a high spatial resolution (around 70 meters). Other satellites only can provide data every week or two. This provides new types of data that can be used by first responders like the US Forest Service.

Areas in red represent the hottest pixels ECOSTRESS detected. The extreme heat in those areas indicates the fire front, or where the fire is hottest and spreading.

Slide 27

Online exploration: explore data on NASA's Worldview website (https://worldview.earthdata.nasa.gov/)

1) Read the background information below to the class.
2) Hand out the Worldview Worksheet to students
3) Explore the Worldview website together as a class. Have students then follow the directions on the worksheet to guide them through the website and creating a model for their hypothesis.

US Satellites from NASA: Scientific instruments attached to satellites are often the first to detect wildfires burning in remote regions, and the locations of new fires are sent directly to land managers worldwide within hours of the satellite overpass. These instruments detect actively burning fires, track the transport of smoke from fires, provide information for fire management, and map the extent of changes to ecosystems based on the extent and severity of burn scars.

Constantly updated imagery: Check out NASA's Worldview application (https://worldview.earthdata.nasa.gov/), which allows you to interactively browse over 700 global, full-resolution satellite imagery layers and then download the data. Many of the imagery layers are updated within three hours of observation — actively burning fires are shown as red points.

Orbiting every day and taking pictures: Terra passes over the equator at approximately 10:30am (day) and 10:30pm (night) local time, NOAA-20 passes over the equator at approximately 12:40pm (day) and 12:40am (night) local time, and Aqua and Suomi NPP passes over the equator at approximately 1:30pm (day) and 1:30am (night) local time. The fire information is available within Worldview approximately 3 hours after satellite overpass.

4TH - 5TH

Lesson 2
Fire Biodiversity Puzzle

Fire and Biodiversity, part one

NGSS: 4-LS1-1. , 5-LS2-1. , 5-ESS2-1.
CCSS: ELA-LITERACY.W.4.1, W.4.2.B, 4.3.B, W.5.1, W.5.2.B, W.5.3.B

Summary

60 mins

Plants, fungi, wildlife, humans, and other living things throughout the Western United States have adapted to coexist with fire for millions of years. In the Oregon Cascades and Siskiyou Mountains, a region renowned for biodiversity, there are both common and rare species that find home amongst blacked and regrowing conifer forests, oak savannah, chaparral, and meadows. Students will learn about local species' adaptations to their fire-affected habitats by constructing the Fire Biodiversity Puzzle art image. Studying species' adaptations is not only fascinating, but may also provide inspiration for how to thrive in a world with fire.

GOALS

- Students will discuss with peers how biodiversity is important to ecosystem health.
- Students will demonstrate in writing their understanding of how different species in Oregon are adapted to fire-affected landscapes.
- Students will work collaboratively to describe how biodiversity, fire, and habitat are related.

CLASSROOM PROCEDURE

1. Introduction discussion: concepts of fire and biodiversity
2. Activity One: Fire Biodiversity Puzzle
3. Activity Two: Write a Species Story
4. Conclusion

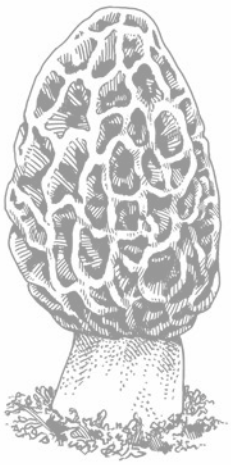
Preparation

- Become familiar with Introduction and Discussion Points
- Print one copy of the Fire Adaptations Strategies handout per group of 2-3 students
- Print one copy of the Biodiversity Fire Puzzle pages for each group of 2-3 students
- Print one copy of the Species Story Worksheet per student
- Suggested prerequisite lesson topics: food webs, ecosystem interactions, simple chemical reactions (heat/light)

materials

Per group of 2-3 students:

- Masking tape OR posterboard plus glue
- Colored pencils (optional)
- Fire Biodiversity Puzzle Pieces
- Fire Adaptations Strategies handout
- Species Survival Story Worksheet
- Artist's Statement



Vocabulary and Terms:

Biodiversity: variety of life in a particular habitat or ecosystem

Blacked forest: the stage in which a forest has recently burned, before it has started to regrow into a green forest

Burl: a growth on a tree formed from unsprouted bud tissue. The burl forms large, knobby looking growths on the base and trunk of the tree where stems may grow back after disturbance

Forest structure: layers of the forest including the canopy, understory, shrubs, forest floor, and soil

Mycelium: the vegetative part of a fungus (whereas the mushroom is the fruiting part of the fungus). Mycelium grows in soil or wood and is made up of a network of fine rootlike filaments that are often white.

Organism: a single living being

Serotinous: an adaptation of plants with seeds that require fire to release and germinate

Snag: a tree that is dead but still standing; snags serve as important wildlife habitat for insects, birds, rodents, fungi and other organisms.

Habitat: the environment in which an organism survives that provides all the things that it needs to live

Introduction

Southwest Oregon is recognized globally as an incredible hotspot for biodiversity. A complex web of relationships exists among the many species native to Southwest Oregon where the Cascade and Siskiyou Mountains converge. This complex web is central to Native ancestral relationships (food, medicine, fibers, tools, and intricate cultural understandings and practices).

The individual species that make up the web are able to thrive in habitats that have been affected by fire for millions of years. Some wildlife species survive with fire because they find food or shelter within the burned features of a blacked forest. Some plant species rely on fire to survive because their seeds need fire to germinate. Other understory plants may only be triggered to grow after fire when they are no longer shaded out by bigger shrubs or trees. We will explore some specific Southwest Oregon species and their adaptations to living with fire and how their interconnected existence contributes to biodiversity.

Discussion Points

1. What is biodiversity?

Biodiversity is the sum of all the different types of life on this earth. It includes life at all levels from groups of animals to individual species and even the genes within a single organism.

2. Why is biodiversity important?

The strength of interconnections
Biodiversity is important because it creates healthy ecosystems. All living things are connected by their relationship to water, air, fire, earth, and especially by their connections with each other. Connections to each other include being food for each other, helping each other to grow by sharing nutrients, and helping create rich soil when their bodies die and decompose. When there are many different types of life on this earth, all helping each other to live and grow over time, the earth and interconnected web of life is stronger.

When all species benefit, humans benefit
Humans depend on healthy ecosystems and biodiversity. For example, when bees and butterflies are healthy, they pollinate the plant crops that we eat. Genetic diversity amongst wild populations of all types of animals helps to ensure healthy populations for hunting and to protect against disease that can spread to domestic livestock.

3. How do Organisms Survive with Fire?

Give a copy of the Fire Adaptations Strategies handout to each group of 2-3 students. Explain that in a minute, you're going to put together a puzzle that illustrates how fire, plants, and animals interact in an ecosystem, but first, you need to learn about how organisms can survive (and thrive) with fire individually. Have each student read the information about one strategy/species to their small group, or to the whole class.

Activity

FIRE BIODIVERSITY PUZZLE

- **Complete the puzzle**

  Hand out a complete set of puzzle pieces to each small group. Direct students to work in their small groups to assemble the puzzle pieces into the complete art image using tape on the back of the pieces OR by gluing them to a posterboard. Optional: students may color the puzzle pieces after assembling.

- **Reflect on the completed puzzle**

  Once student groups have completed the puzzle, summarize the total image by reading the artist's statement aloud to students. Students may also read the artist's statement to themselves or in their groups if using the Species Story Worksheet.

Then, lead a discussion around the question: How does fire benefit wildlife habitat and support biodiversity? Remind students to look back at the Fire Adaptations Strategies handout for clues.

Fire supports habitat diversity: Landscapes burn unevenly; different patches of land respond differently to fire, stimulating suitable habitat and usable nutrients for a variety of organisms.

Fire creates shelter and food: Tall snags, fallen logs and downed wood, ground hollows, and tree cavities create habitat for nesting birds and other organisms; they shelter insect life that provides forage for animals like birds, reptiles, and small mammals; they support decomposers like fungi and bacteria, which in turn further break down the wood into soil nutrients.

Fire supports productivity: Fire opens space and increases available light for new life at all levels of the forest structure, especially in the mid and understory; it stimulates new plant growth from seeds stored in the soil and fungal networks are stimulated to produce mushrooms, like morels, to bloom; it changes nutrients in the soil, helping stimulate the growth of decomposers such as insects, bacteria, and fungi as they break down organic matter used by new life.

Fire recycles and redistributes nutrients: In the forest ecosystem, the flow of essential nutrients is "jump started" through heat, ash additions, and changes to vegetation dynamics which allow for soil restoration and new plant growth.

Write a Species Story

After groups have finished assembling their Fire Biodiversity Puzzle, ask them to choose one species from the puzzle and write a short story from their (first person) point of view about how that species came to be in the post-fire burned area.

For writing, students may use the Species Story Worksheet or, if you write story prompts on the board, students may write in their journals:

- What was your habitat like before the fire, and what changed?
- Did changes in the air and water affect your ability to find food or shelter?
- What parts of your body (internal or external) helped you to survive the fire, or to grow?
- Were you able to resprout (plants) or have offspring (animals) after the fire?
- How are you interacting with other plants and animals around you after the fire?

Optional: If students need more time, the Species Story may be assigned as homework with a target word/paragraph count. Finish conclusion (below) in the classroom before students turn in their stories.

Conclusion

- Have students share their stories with their group.
- Ask student groups to reflect on their puzzle experience and have students take turns sharing species adaptations they learned about.
- Further prompts for wrap-up discussion: What was something new to you? Had you realized all the different species that are adapted to fire?

Take-Away Concepts

- Many different species thrive or even rely on fire for habitat. Fire may create shelter or trigger growth of their foods, and support biodiversity across the landscape.
- Species have adapted to living with fire for millions of years. The diversity of strategies they have adapted to live with fire are intricate and complex, and humans are just starting to understand some of these relationships.
- What are some adaptations of animals and plants that we discussed today that could apply to humans living with fire adapted landscapes?

NAME _____ DATE _____

4TH - 5TH

Lesson 2

Fire Biodiversity Puzzle

Statement from Artist Zoe Keller

What is a complex early seral forest?

As a mixed or high-severity fire sweeps across a forested landscape, it leaves behind the vital ingredients for the life of a new forest. Tree crowns burn, and some living trees are killed or damaged severely enough to die slowly in the following years. As these mature trees wane, the canopy is pulled open. Light rains down on the forest floor, nutrients and moisture once monopolized by trees becomes available for new forms of plant life, and the ground is made rich with woody debris. Grasses, wildflowers, shrubs, and hardwood and coniferous tree seedlings take hold in this landscape, weaving together complex and diverse plant communities. This burst of vegetation creates habitats for a diverse group of species. Grasses, flower nectar, seeds and berries touch off a tangled food web, twisting through insects to rodents, birds, and bats, and finally to raptors like northern goshawks and northern spotted owls that hunt from adjacent unburned forests. Larger mammals — Roosevelt elk, Columbian black-tailed deer, and black bears in the Klamath–Siskiyou region - browse on foliage and berries. Equally as important as this lush new burst of greenery are the blackened ghosts of fires past, elements of the forest that are called "biological legacies." Standing dead trees called snags, downed trees and woody debris provide unique habitats. Birds perch on the branches of snags, flying out across the opened landscape to feast on the flush of moths, butterflies and other insects. Bats dart across the sky, sharing in the six-legged buffet. Woodpeckers dig grubs out of blackened trees and excavate nesting holes that are used by succeeding cohorts of birds and small mammals. This vibrant stage in the life of a forest is called a "complex early seral forest," a name applied to forests recovering from any type of disturbance, including not only fire but also wind, severe flood or volcanic eruption. This stage lasts until tree seedlings grow tall and the canopy closes once again, a process that can take decades or even a century. Because of their high levels of biodiversity and relative rarity across forested landscapes of the Pacific Northwest, complex early seral forests are considered just as precious as old growth forests.

Write a Species Story

Choose one species from the puzzle and to write a first-person short story about how it came to be in the post-fire burned area. Use the backside of this paper and answer the prompts below to guide your story:

- What was your habitat like before the fire, and what changed?
- Did changes in the air and water affect your ability to find food or shelter?
- What parts of your body (internal or external) helped you to survive the fire, or to grow? Were you able to resprout (plants) or have offspring (animals) after the fire?
- How are you interacting with other plants and animals around you after the fire?

Case Studies Species Descriptions
Lesson 2: Fire Biodiversity Puzzle

Oregon Cascades and Siskiyou fire-adapted species, corresponding with Fire Biodiversity Puzzle pieces:

1. Bluebirds and oregon junco

Insectivorous (insect-eating) birds like Western **Bluebirds** will feast in post-burned forests. Insects will be some of the first life to colonize the burned forest. They help to decompose burned wood, rejuvenate the soil, pollinate new plants, and feed other creatures. **Oregon juncos** find seeds and make nests on the open ground found in recently burned forests.

2. Long-eared myotis bat, lazuli bunting, townsend's solitaire

Bats can benefit from fire because it creates a variety of habitat conditions. When fire clears patches of forest, it creates openings in the forest that enable bats to hunt more easily with echolocation, find an abundance of insects, and some roost (take shelter) in dead snags and rotting wood. (Steel 2019) **Lazuli bunting** have been shown to increase in population in areas in the years immediately following mid- and high-severity fires. (Leidolf 2007)

3. Black-backed woodpecker, hairy woodpeckers, butterflies

The black-backed woodpecker relies on dead wood and large burned snags that are created by mid- to high-severity fire. Other woodpeckers, like the **hairy woodpecker** also benefit from big dead "legacy trees" that provide holes for nesting cavities and a place to forage for the insects they prefer. In the several years after wildfire, an abundance of flowers and flowering shrubs will often regrow and become alive with pollinators. Some **butterflies**, like those in the "blue" family of butterflies, rely on the lupine and other flowers that grow after wildfire to continue their life cycle.

4. Ponderosa pine old growth snag, common false lupine

Old trees are extremely important to the burned forest because they can withstand hotter fires, and will provide seeds for forest regrowth. The ponderosa pines' fire adaptations include thick fire-resistant bark, shedding of lower limbs (self-pruning), and having open crowns and a branching pattern that can dampen fire. **Lupines** and other pea-family plants work together with bacteria in the soil to absorb nitrogen from the air. This nitrogen helps pea-family plants to be some of the first plants to spring up after a fire when they will bloom in large quantities.

5. Black bear, buffaloberry, and fireweed

Black bears find a diversity of foods such as plant sprouts, berries, insects, and rodents when the burnt forest flushes with regrowth. **Fireweed,** named for its growth after a fire, will grow in large fields of burned forests and along waterways. **Buffaloberry** has roots that will survive fires to resprout in the following years. The open canopy of burned forests allows it access to more light which can increase berry production.

6. Bracken ferns, broad-leaved lotus, pine cones

Some seed cones like those of the **knobcone pine** are serotinous, meaning they require the heat of fire to open up and release their seeds for germination. **Bracken ferns** have hearty roots that survive in sandy soils and readily resprout after fire.

7. **Columbian black-tailed deer, valley garter snake, boreal toad, prostrate ceanothus**

Columbian black-tailed deer like to browse the fresh grass and plants that resprout a year after fire. **Prostrate ceanothus** works together with bacteria to bring nitrogen from the air into the soil soon after fire has gone through the forest. Some related ceanothus species have seeds that require high-intensity fire to help them germinate. To aid this strategy, they have a flammable resin in their leaves along with seeds that remain dormant in the soil for long periods of time waiting for high-intensity fire.

8. Black morel mushroom, northern alligator lizard, umbrella liverwort (Marchantia polymorpha)

Morels will often sprout in the few years after a fire because theirunderground mycelium are stimulated to grow a mushroom. The common and widespread **umbrella liverwort** is commonly associated with postfire shrub regrowth. Umbrella liverwort likes the exposed mineral soil and high lime concentrations present after a severe fire and can sometimes cover entire burned areas. It helps prevent soil erosion that frequently occurs after severe fires, and renews the humus (topsoil layer) in the burned soil.

The northern alligator lizard is sensitive to fire and will avoid it by finding protective habitat like rocks or drainages.

9. Ground squirrels

These rodents can thrive in areas post-fire, as they like to burrow in the soil in open pine forests with some rock features. Fire and other disturbances that remove the forest canopy improve the habitat for these animals. (Shick 2006)

10. Roosevelt elk, california globe mallow

California globe mallow is a fire-following mallow endemic to the Modoc Plateau of northeast California and southern Oregon. It has recently been designated a sensitive species (Arneson 2004).

Roosevelt elk like to forage at forest edges and clearings that are regrowing during the years after fire where they find fresh shoots, berries, and other foods. Traditionally, Native people of southern Oregon and other areas would use fire to manage hunting grounds. These cultural burns benefit larger, landscape-scale fire processes over time.

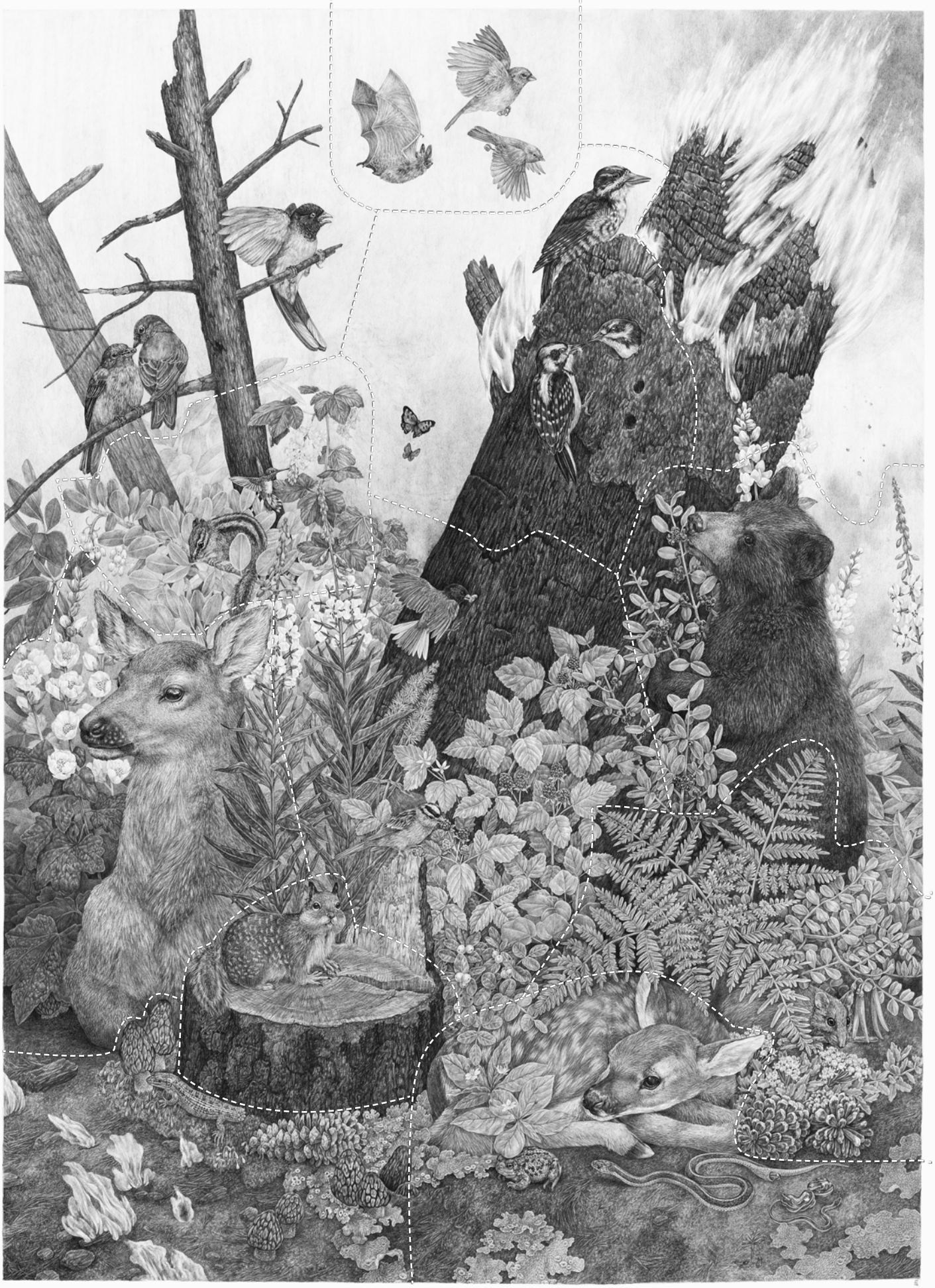
11. Chipmunk, manzanita, red flowering currant, hummingbird

Some species of **manzanita** are evolved to resprout from the base of their stump, or burl, and will do so just weeks after fire. Similarly, other berry shrubs like the **red-flowering currant** will thrive after fire, and their red color attracts **hummingbirds** to their nectar. **Chipmunks** forage on serotinous seeds that are released and other seeds that are produced in the first few years after fire.

12. Snowberry, white-crowned sparrow, pacific blackberry

Snowberry has a root crown and rhizomes that sprout after fire. Snowberry serves as pollinator habitat later in the summer when it blooms. **Pacific blackberry** will sprout from “suckers” after fire and is also capable of spreading rapidly from trailing stems. (Tirmenstein 1989)

The **white-crown sparrow** is migratory and eats insects and seeds. It does best in “hybrid” habitats where fire has increased shrub diversity and the growth following a fire is still young. (Bent 1968)



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Species Strategies

How might different plants, animals, and all living creatures including humans, be adapted to living with fire? Explore the many ways that species have evolved and interacted with fire over millennia:

Species' fire adaptation strategies	Definition	Example Oregon species
Invader species	Species that prefer disturbance to the landscape and are some of the first ones to regrow. Also known as pioneer species.	Fireweed, deerbrush, buckbrush, willow
Evader species	Species that have long-lived seeds that survive on trees or in the soil during fire. Sometimes those seeds require fire to be released and grow (serotinous).	Knobcone pine, lodgepole pine
Avoider species	Species that grow in the understory and are generally shade tolerant. These species are less resistant to fire and tend to grow in late-successional (old growth) forests where they can avoid frequent fire.	Bigleaf maple, pacific yew, Brewer's spruce, mountain hemlock
Resister species	Species that evolved closely with fire and can survive low to mid-intensity fire. Species adaptations may include thick bark, high water content in leaves/trunk, and shedding of dead branches.	Ponderosa pine, sugar pine, douglas fir, red fir
Endurer species	Species that withstand being burned above ground, but have vigorous roots that resprout after fire. These species regrow readily after high-intensity fires.	Manzanita, madrone, hazel, oak, ocean spray

4TH - 5TH

Lesson 3
Fire Nourishes the Land, the Land Nourishes Us

Fire as an Agricultural Tool, part one

NGSS: 4-LS1-1, 5-LS2-1

Summary

60+ mins

Since time immemorial, Siletz Tribal members and other Indigenous peoples have applied fire to the lands of Oregon using traditional knowledge and skills passed down over many generations. This traditional use of fire can be referred to as "cultural burning."

Cultural burns are used by Indigenous people for many purposes, including to ensure the quantity and quality of First Food and Materials plants, plants that provide traditional foods and cultural materials. In this way, fire is an agricultural tool used to nourish the land and plants. The fire-enhanced landscape nourishes the people and provides materials necessary for basketry, cordage, and other tools.

In this activity, students will learn about First Food and Materials plant ecology, identification, and cultural significance in relation to cultural burning. **Note**: Students should not harvest or use plants without the guidance of an adult who can guide plant identification safe use, plant care, and permissions to use.

An understanding of First Foods and Materials plants and understanding cultural burns can provide key insights into sustainable forest and landscape management in Oregon.

GOALS:

- Students will identify examples of First Food plants by biological and ecological clues.
- Students will identify different ways that fire can benefit plants and be used as an "agricultural tool."
- Students will develop and draw a model that describes fire as a catalyst in the movement of matter among organisms.

CLASSROOM PROCEDURE

1. Introduction discussion: First Foods and Cultural Burning
2. Activity One: First Foods and Materials Plants Card Game
3. Activity Two: My Fire-Adapted Plant Worksheets
4. Conclusion

Preparation

- Familiarize yourself with the Summary and Plant Card activity
- Prepare to divide students into groups of 3 or 4
- Print off one set of Plant Cards (9 per set) for each group of students. Use cardstock, if available, so names of plants are not visible from the other side
- Print off one set of Hint Cards (9 per set) for each group of students, use cardstock if available
- Print one Note Sheet and Worksheet for each student
- Cut Plant Cards and arrange in stacks with image-sides down, with manzanita card on top
- Cut Hint Cards and arrange in stacks with name-sides facing down
- Optional: have students work in groups to cut and arrange Plant Cards and Hint Cards

Materials

- White board, chalkboard, or screen-share for making lists
- First Food Plant Cards
- Hint Cards
- Note Sheets
- Plant Worksheets
- Vocabulary List

Vocabulary and Terms

Agricultural tool: any method, practice, or physical tool used by people to affect food production or collection in a tended ecosystem

Annual: a plant that germinates, flowers, and sets seed in one year

Burl: a growth on a tree formed from unsprouted bud tissue. The burl forms large, knobby-looking growths on the base and trunk of the tree where stems may grow back after disturbance.

Canopy: the branches and leaves at the top of a group of trees that form the "roof" of the forest

Catkin: a long, thin cluster of tiny flowers that do not have petals; found on willows, oaks and other trees

Cultural burn: traditional use of fire to maintain and manage landscapes for foods and materials, to cook food, or to hold ceremonies

Deciduous: trees or shrubs that shed leaves seasonally, usually in fall

Endemic: describes a species that lives in only one specific place

Fire suppression: a land management practice that focuses on fighting and stopping wildfires

First Foods: traditional native foods (plant or animal) that provide sustenance and promote health

Geophyte: a plant with underground storage parts, like starchy roots or bulbs, that can survive when conditions above ground are too harsh. Camas is an example of a geophyte.

Material culture: objects of traditional use that require plants and animals to provide materials

Material plants: plants that grow materials for traditional food collection and storage equipment, such as baskets and nets

Mid-story tree: a tree whose canopy exists between the heights of the tallest trees and the understory plants

Perennial: a plant that lives more than two years

Seed bank: all viable seeds of a species present in the soil

Shrub: a small or medium-sized, woody, perennial plant with multiple stems growing from ground level

Time immemorial: a very long time, before written history

Understory: the layer of plants and shrubs growing closest to the forest floor

Introduction Discussion

First Foods and Cultural Burning Discussion
Classroom time: 20 minutes
Materials used: screen or board for making lists

1. **Make a list of "Agricultural Acts."** Ask students to imagine being a farmer, and ask, "What does a farmer do to help plants grow on their farm?" Record the responses and label this as a list of "agricultural acts," and guide the discussion to include answers like planting seeds, watering, fertilizing, removing pests, pruning, or weeding.

2. **Make a list of "First Food Plants."** Ask students if they can identify sources of food for humans that come from native plants. Some hints you may consider giving are:"Think about things that grow and fall from trees in the forests," or "Are there any fruits you have seen growing in the wild? (acorns and berries)." Record a list and label it as "First Food plants," and define First Foods.

3. **Make a list of "Materials Plants."** Ask students if they can identify plants that people use to make items or tools. Some hints you may offer: "Is there anything in your home that came from a plant?" Define Material Plants and give examples like wood from trees for various uses, and plants used for hats and basketry. Point out that material culture is an important part of traditional gathering, storing, and processing of First Foods.

4. **Discuss the agriculture of First Foods and Materials:** Next, ask students to think of taking care of a First Food such as oak trees and their acorns, like a farmer: "If you depended on acorns for food,

what might you do to have a good acorn crop?" Ask students to think about taking care of Materials plants: "If you want plants to grow a certain way, how might you work with them?" Discuss how some plants can provide both food and materials.

5. **Fire as an agricultural tool/defining a cultural burn:** Ask, "Do you think fire can be used to take care of First Food and Materials plants?" "How do you think fire is used to care for plants?"

   Gather some student responses, then explain: "Fire is a primary agricultural tool used by Indigenous people. Cultural burns are applied widely on the land, and are important to the Indigenous way of life and to the land. The traditions associated with cultural burns are handed down from generation to generation. They are often accompanied by ceremonies and are done very carefully at specific times, in specific places. Fire helps ensure the landscape will provide enough foods and materials that people need to sustain a rich, traditional life."

   Discuss some examples of fire as an agricultural tool:
   - Fire is a traditional way that some Indigenous people control acorn weevils, the wormy pest of acorns. Fire disrupts their lifecycle, as acorns infected with weevils fall to the ground. The weevils overwinter inside fallen acorns, but are killed by fire if it moves across the land.

   - Fire can return nutrients from burned material to the soil. Decomposers in the soil use those nutrients to fertilize further growth of nearby plants. Fire helps nutrients cycling through the land, and to fertilize First Foods.

6. **Indigenous removal and fire suppression:** Lastly, say: "Cultural burning has been on the decline in recent history. Populations of Indigenous people declined very sharply when nonnative traders brought new diseases into Indigenous communities (Wilkinson, 2010). With a decline in the number of Indigenous people on the land, the number of cultural burns also declined. Later, when Indigenous people were forcibly removed to Reservations in the mid 1800's, the number of people practicing cultural burning further declined. By the 1900's, fire suppression became a policy of federal and state agencies, with some Tribal weaver families being the last to practice burning around their hazel patches and close to their homes in Tribal communities (Kentta, Robert, personal communication, 2021). Fires were suppressed wherever possible for many many years. It was only recently that state and federal agencies started to acknowledge what Indigenous people knew all along: that fire plays a necessary role in ecosystem health in this region. Now fires are sometimes set intentionally on landscapes to achieve the benefits of fire. Today, Indigenous knowledge of cultural burning is beginning to be incorporated more widely in forest management by government agencies and landowners."

Activity One

First Foods and Materials Plants Card Game
Classroom time: 30 minutes
Materials used: First Food Plants and Materials Cards, Hint Cards, Note Sheets

In this activity, small groups of students will work together to identify First Foods and Materials plants using hints about plant identification, cultural uses, and relationships to cultural burning. After the group activity, each student will complete a worksheet to reflect what they learned.

1. Divide students into groups of 3-4.

2. Hand out one set of Plant Cards to each group in a stack, picture-sides facing down, with manzanita on top.

3. Hand out a Note Sheet to each student. Explain that the information they will record on their note sheets is what will help them be successful in this game.

4. Explain that students will first read through the Plant Cards while taking notes on the Note Sheets about each plant. Read through the manzanita Plant Card as an example, and discuss the example notes for manzanita on the Note Sheets. You may want to write the four categories of notes on a board: Plant Name, Identification, Uses, and Fire.

5. Instruct groups to now take the manzanita Plant Card and place it in the middle of the group, image-side up, so none of the information that was just read can be seen. Explain that they will now work through the rest of the Plant Cards in their groups until all 9 Plant Cards are placed image-side up in the middle of the groups. Instruct students to take turns reading one of the plant cards while the rest of the team takes notes, until the group has worked through all 9 Plant Cards and each student's Note Sheet is complete.

6. Point out that after Plant Cards are read, they are placed image-side up and that the information is no longer visible. This is why it is important for students to fill in notes on the Note Sheets as the Plant Cards are read aloud.

7. Allow the groups to read through the rest of the Plant Cards in their groups and monitor students to ensure they are filling out Note Sheets thoroughly for each Plant Card as they work. Note: You may use the Plant Card file to display and read the Plant Cards as a class or have the students take turns read through them in their groups. Use the method that works best for your classroom.

8. When students have read through all 9 Plant Cards, pass out one set of Hint Cards to each group, explain:

    - Students will shuffle the Hint Cards, with the "Hint" side facing up and the "Name" side facing down, and place the stack in front of one student.

    - One student then reads through the top Hint Card out loud, keeping the cards in the stack, so that the "Name" side is not revealed.

    - After a "Hint" side of a Hint Card is read, the group uses their notes to discuss, name, and point to which Plant Card the "Hint" side referred to. The students can discuss their notes until there is a consensus or a majority agree.

    - The Plant Card identified during the discussion is now turned over to confirm the accuracy of the groups' identification. The Hint Card may also now be turned over to confirm. Note: If one group finishes the Hint Cards early, they may continue to play the game by re-shuffling the Hint Cards and seeing how quickly they can go through them a second time.

Activity Two

Worksheets
Classroom time: 15 minutes
Materials used: Plant Worksheets, Note Sheets, Vocab List

1. Ensure students have access to the internet.

2. Hand out a worksheet to each student.

3. Display vocabulary list for students to reference.

4. Have students pick and use one plant from the activity to complete the worksheet. Students may also use the Plant Cards or their Note Sheets for reference. For more references, write out the following webpage for students to look up their plant:
    - OregonFlora Home
    - Wildflowers of the Pacific Northwest (pnwflowers.com)

5. After students have completed the Plant Worksheet, present and discuss the take away concepts

Conclusion / Take-Away Concepts

- **Defining cultural burns:** Cultural burns are intentionally set fires practiced with the knowledge and traditions passed down for thousands of years by Indigenous people.
- **Understanding fire as an agricultural tool:** Cultural burns can have many different, beneficial effects like fertilizing plants by recycling nutrients, "weeding" out plants that might compete with a target species, or helping to control insects or diseases.
- **First Food Plants:** First Food plants have many different uses including seeds, edible roots, as a sweetener.
- **Material Culture Plants:** Plants that provide materials for traditional food, textiles, tools, and other cultural uses. For example, hazel provides food and sticks for baskets and iris supplies fiber for nets.
- **Ethical and safe use:** Although this lesson introduces food and materials plants to students, along with their uses, this is not meant to guide students to harvest and use plants without the guidance and supervision of a knowledgeable adult.
- **Importance:** All of us can benefit from knowledge of First Foods plants, plants used in Material Culture, and cultural burns that are used to tend them. By understanding how cultural burns benefit plants and animals, we may learn to become better stewards of fire-shaped landscapes in the future.

Take it Outside

Students can use the plant cards to try to identify the plants (or find similar, related plants) in parks or forested areas.

NAME _____ DATE _____

4TH - 5TH

Lesson 3: Fire Nourishes the Land, the Land Nourishes Us

My Fire-Adapted Plant

Name of plant chosen

Search for other names for this plant, and if you find them, list them here.

Is it an annual or perennial?

- ☐ Annual
- ☐ Perennial

Is it a First Food plant, a Materials plant, or both?

- ☐ First Food plant
- ☐ Materials plant

Find photos of your plant, and draw your plant here.

Think about using fire as an agricultural tool, to help your plant grow well. What is one way that fire might help your plant grow well?

Think about a cultural burn of this plant. Some parts of the plant might burn and turn to soil. Others will survive. Circle the plant parts that will survive:

ROOTS BRANCHES LEAVES SEEDS

Now, imagine your plant one year later, following a fire. Draw it below. What has changed about your plant after the fire? Label these changes on the left and connect them to your picture.

NAME _____ DATE _____

4TH - 5TH

Lesson 3: Fire Nourishes the Land, the Land Nourishes Us

Note Sheet

	Plant Name	Identification	Uses (Food, Materials)	Fire
	*Manzanita*	*tree, chocolate-covered bark, bell-shaped flower*	*berries for sugar cold drinks*	*seeds need fire, burls*
				
				
				
				
				
				
				
				

This endemic plant is not eaten by humans. It has a single, central, strong fiber found in the leaf that has been used to make nets, ropes, or in baskets	This plant is a geophite with edible bulbs that were once the most widely traded food (after salmon) in the Pacific Northwest.	After a forest fire, some of these shrubs can resprout from a burl, a swelling at the junction of the roots and stem that can survive fires. This shrub makes sweet berries that have often been collected and used to make sweet beverages.
This fruit is made of many juicy druplets around a central core. Its large leaves have been used for teas and as drying mats to preserve the fruits.	This tree is grown by farmers for use in cough syrups, and has hollow stems that people can make tools and musical instruments out of.	Plants with flower structures that look like upside down umbrellas are known as “umbels.” This native umbel has delicate white flowers and a root that can be eaten raw or cooked.
The flower of this plant is called a catkin, and the shoots are used in Indigenous, Siletz basketry.	This plant has a large, perennial taproot that can grow to be decades old and has traditional and current uses as a powerful medicine for flus, pneumonia and other illnesses.	The only part of this plant not covered in oils is the flower, and to preserve moisture, this plant closes the flower most of the day.

Manzanita	Camas	Siskiyou Iris
Yampah	Elderberry	Thimbleberry
Madia	Fernleaf Biscuitroot	Hazel

Manzanita

Identification

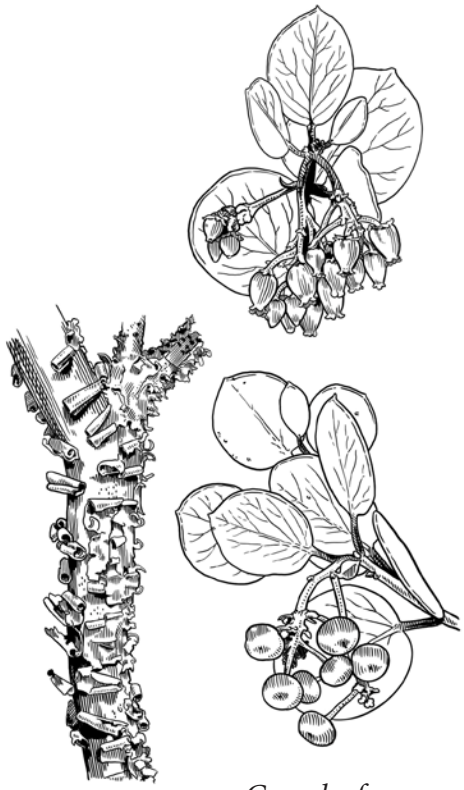
Manzanitas are evergreen shrubs with smooth, chocolate-colored bark and round leaves. They bloom in late winter or early spring, providing some of the first pollen and nectar of the season to pollinators. The flower petals are fused together into cups that hang upside down. These petals protect the pollen and nectar from spring rains. Pollinators have adapted to these bell-shaped flowers, some simply chew through the flowers, leaving holes, and certain bees can buzz at the perfect pitch to cause pollen to drop from the flowers!

Food

Manzanita fruits are often gathered when they are dry, used as a sweetener in a variety of foods, and to make refreshing, sweet drinks.

Fire

After fire, some resprout from a swelling at their base (called a "burl"). Branches atop burls may only be as old as the period since the last fire, but the burl and underground parts can be hundreds of years old.



Greenleaf manzanita
Arctostaphylos patula
art by Zoe Keller

Camas

Identification

Camas is a perennial plant with edible underground bulbs. Its flowers have 6 purple petals and bright, yellow anthers (the part of the flower that contains pollen and is at the end of a stalk). Camas often grows in wet meadows.

Food

Camas is a very special food plant. At one time, camas was the most widely-traded food in southwest Oregon, after salmon. Many places where Europeans first settled, built farms, and established cities in Oregon were ancient gardens of camas, tended to by Indigenous people for thousands of years.

Fire

Camas is a geophyte: a plant with underground parts that survive when conditions above ground are too harsh. Camas bulbs can survive in soils for years without flowering...even decades! When fires burn plant materials that have built up on the soil surface, that matter is released into the soil, where it can be used by camas bulbs. The removal of material on the soil surface can also help sun warm the soil, which can help dormant bulbs flower.

Camas plant and seed head
Camassia quamash
art by Zoe Keller

Tarweed

Identification

Few plants are better than tarweeds at preserving water, a precious resource in our dry summers. Every part of a tarweed plant is covered with oils that help keep moisture from evaporating through the plant. The only part of the plant not covered with oils is the flower. To keep moisture from escaping there, the plant closes its flowers each day as the sun rises, then opens them again at night.

Food

Tarweed seeds, like the rest of the plant, are high in oils and have been collected and used in high-energy foods or for cooking oil. Traditional harvests utilize special sticks to knock the seeds loose and tightly woven baskets to collect and carry the seeds. Reports say that traditional harvests are a community affair involving many people and that the "swish, swish" sounds of many sticks and baskets were a familiar summer sound of the grasslands.

Fire

Traditional harvests often include the use of fire before harvests. Fire removes the stickiness of tarweed's stems and leaves, making seed collection easier. Fire can also slightly roast seeds and enhance flavor.

Tarweed
Madia spp.
art by Zoe Keller

Yampah

Identification

Yampah is a perennial plant with an underground edible root. It has delicate white flowers that bloom in midsummer. Yampah's flower stalks radiate in all directions from the main stem in the shape of an upside-down umbrella. This umbrella-shaped flower structure is shared by all members of its plant family, the "umbels." Many spices and food plants are in this plant family, including cumin, dill, fennel, caraway, and carrots. Other members of this plant family are highly poisonous (like poison hemlock). Proper plant identification is essential to utilize umbels safely!

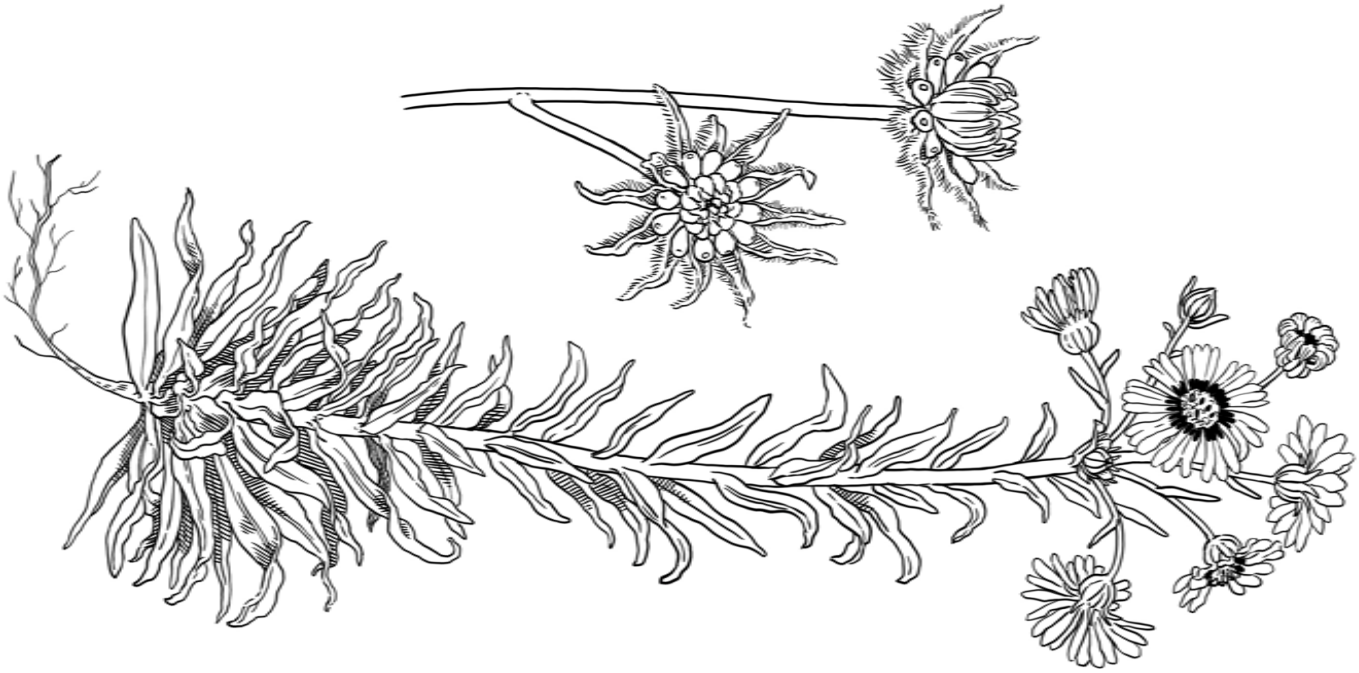
Food

Yampah is a special food plant in many Indigenous cultures. Its roots are edible raw or cooked and provide a powerful source of energy.

Fire

Yampah's edible root survives extreme conditions above ground, including frozen winters, dry summers, and even fire. Plants with underground storage parts that can survive these harsh conditions even as the above-ground parts die are called "geophytes." Cultural burning can help maintain open prairies, where yampah and other geophytes thrive. The fires can recycle nutrients to underground parts and help keep areas clear for sun-loving prairie plants like yampah.

Yampah
Perideridia spp.
art by Zoe Keller



Blue Elderberry

Identification

Elderberry is a mid-sized tree with large compound leaves, clusters of white flowers, and blue or purple berries.

Food (and music)

People use elderberry's large clusters of flowers for teas and drinks, the sweet berries for foods and medicines, and their hollow stems to make musical instruments and tools. Blue elderberries are typically cooked before eating. They are commercially grown by farmers across the northern hemisphere for use in cough syrups.

Fire

Elderberry trees send up new stems and sprouts each year. Over time a single tree can crowd itself, and its branches may rub against one another and slowly weaken. Fires can burn weakened branches, allowing a tree to more efficiently use its energy on production of healthy leaves, flowers, and berries.

Elderberry
Sambucus cerulea
art by Zoe Keller

Bisquitroot

Identification

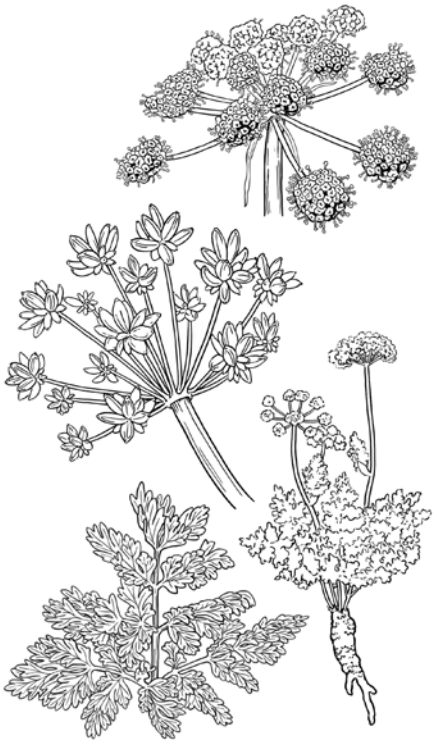
Biscuitroots are wildflower plants with large perennial taproots. Flowers emerge in mid summer, from a central stalk that sends out a set of smaller stalks at one point, like an upside down umbrella. (Flowers with this structure are called "umbels." Another umbel is the plant "yampah".)

Food

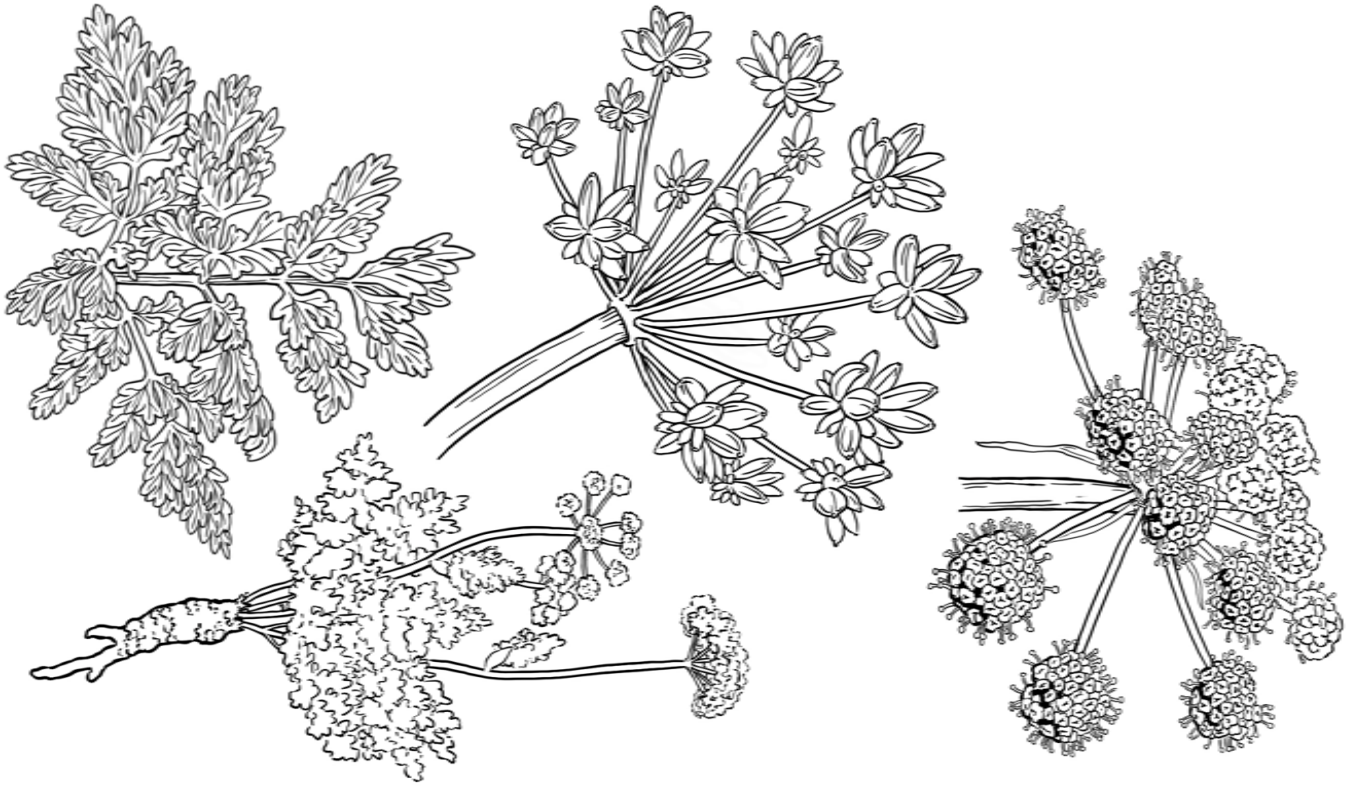
Roots have traditionally been dug, pounded, and preserved into biscuit-type foods. Some Biscuitroots' taproots can grow several feet deep and live to be decades old. Fernleaf Biscuitroot is not only eaten, but it also has traditional and current uses as a medicine. More than one Indigenous name for this plant has been translated to "big medicine." The plant is a powerful treatment for many sicknesses, and is wild-collected to create medicines available in stores.

Fire

Fire can return nutrients from stalks to the soil where they can be absorbed by the perennial roots in the future. Fire can also keep areas clear so they receive the ample sunlight that biscuitroots thrive in.



Fernleaf Biscuitroot
Lomatium dissectum
art by Zoe Keller



Siskiyou Iris

Identification

The Siskiyou iris is a small wildflower that grows only in southern Oregon and northern California. Plants that only grow in one certain area are said to be "endemic" to the area. Siskiyou iris is rare and endangered. It is estimated that there are only a few thousand individual plants of this species, all within a fairly small area in the Cascade–Siskiyou region. Many other species of iris grow in southwestern Oregon. Some are common and widespread, while several are endemic to certain areas.

Food (and music)

Iris has traditionally been used in making bags and nets. A single strong fiber found in the center of the leaf can be used to make sturdy thread, string, rope, and cordage. Although Iris and other plants used for materials may not be eaten, the nets, cordage, and baskets are essential parts of traditional ways of capturing, storing, and processing foods.

Fire

In areas where iris was gathered for cordage by Indigenous people, fire was often used to ensure a good supply of plant material. iris roots survive through the winters and form patches. Burning around iris patches clears the area for the iris to grow well, and recycles nutrients from leaves, sticks, and pine needles on the ground into the soil, making them available to the Iris.

Siskiyou Iris
Iris bracteata
art by Zoe Keller

Hazel

Identification

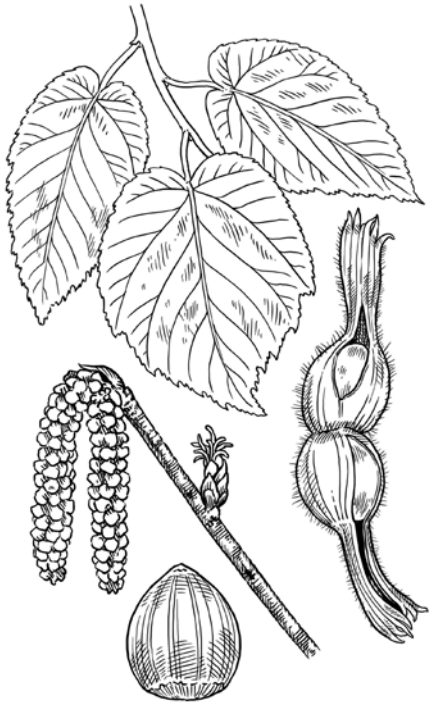
Hazel is a deciduous shrub that often grows under the partial shade of larger trees like pine and fir. In winter long, slim, cylindrical flower clusters called catkins appear and dangle downward, tinseling the branches. Wind carries the pollen from the catkins to tiny reddish florets along the stem, and from there, hazelnuts form.

Food

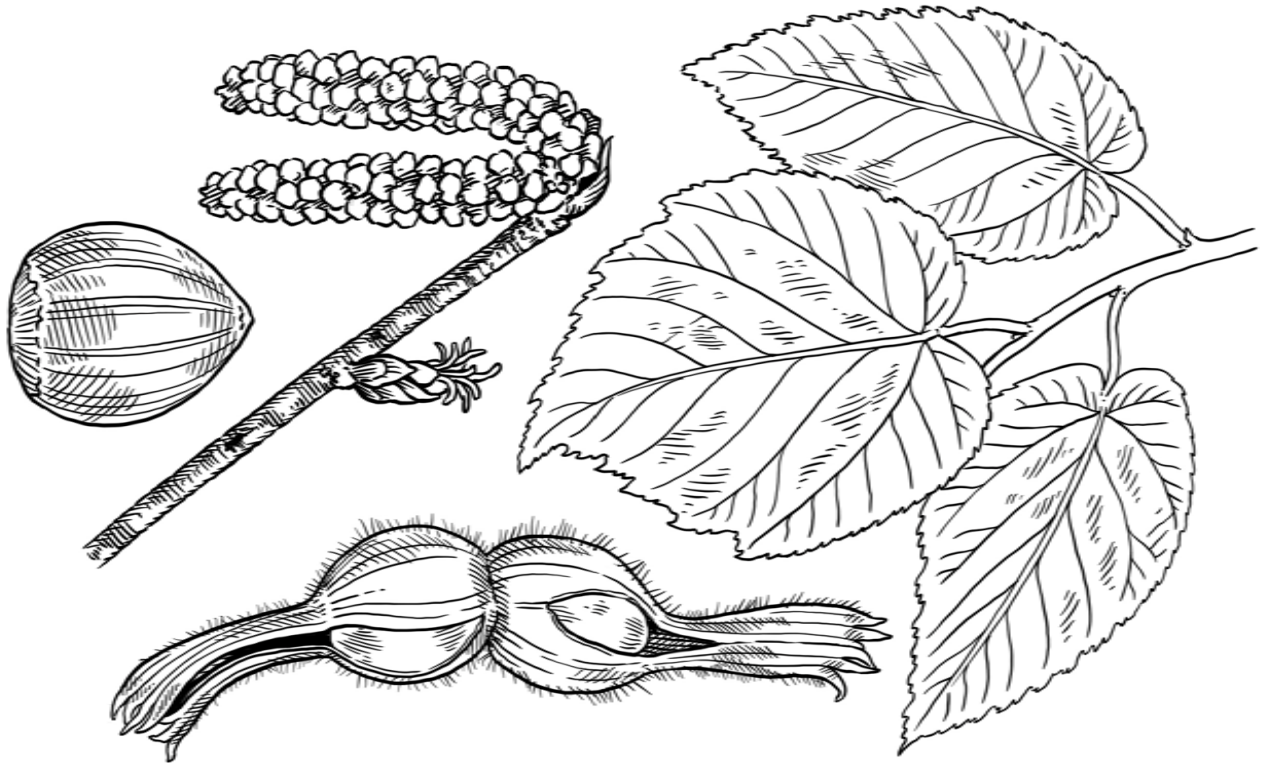
Hazelnuts are an important food plant for Indigenous people, often harvested by the basketful, hulled by hand at leisure, and dried in shell for winter/spring. They are also grown commercially by farmers.

Fire

Hazel shoots (the young, new growth) are important for Indigenous basketry and in making other cultural materials. Basket makers prefer hazel shoots that are long, straight, and healthy. The roots of the shrub survive low-intensity fire and send up new straight sprouts the following year. In areas where fire is not or cannot be used, basket makers may prune the plants to stimulate this growth.



Hazel
Corylus cornuta
art by Zoe Keller



Thimbleberry

Identification

Thimbleberries are made of tiny, juicy drupelets around a central core, like a raspberry. When the fruits are removed, a thimble-looking core remains on the plant, hence the name. Once removed from the plant (a process that easily damages fruit flesh), thimbleberries decay quickly. Since they damage so easily you most likely will not find thimbleberries in the grocery store.

Food (and music)

Food uses of thimbleberry include fruit preserves and beverages, food from roots, and medicinal uses of leaves for stomach aches and issues involving blood. The leaves of thimbleberry can grow to be 8 inches or wider, and some people have used them to make a drying mat to dry the berries.

Fire

Thimbleberries have perennial root systems that can form thickets of plants that spread out over time. Dense thickets have root systems that help hold soil in place and retain soil moisture. Thimbleberry plants often grow successfully when planted in disturbed areas or after fires.

Thimbleberry
Rubus parviflorus
art by Zoe Keller

6th - 8th

Lesson 4
Black to Green Creature Collage
Fire and Biodiversity, part two

NGSS: MS-LS1-5, MS-LS2-1, MS-LS2-4

Summary

60-80 min

Fire is so important to the biodiversity of ecosystems throughout the Western United States that it is recognized as the keystone ecological process. Various intensities of burns, especially in southern Oregon forests, can be characterized as low severity, mixed severity, and high severity. Students will learn about the interconnections between the fire-affected landscape and biodiversity. Utilizing the southwest Oregon region as a case study, students will think critically about ecological relationships between the fire regimes and wildlife habitat by collaboratively creating a collage.

Goals

- Students will hear about, view images of, and discuss the roles that fire plays in supporting biodiversity within an ecosystem.
- Students will apply prior understandings of biodiversity, species adaptations, and habitat to the relationships of various fire regimes in two classroom activities.
- Students will work collaboratively to create a model of species that live in the post-burn habitat created by mixed-severity fire.

Classroom Procedure

1. Introduction and discussion of fire and biodiversity relationships
2. Activity 1: Fire Severity Pictures, What do you think? (interactive presentation)
3. Activity 2: Black to Green Forest Collage
4. Discussion and conclusion

Preparation

- Print and prepare for each group of 3-4 students:
- Black to Green Landscape Drawing (collage background)
- Creature Cards
- Scissors
- Glue or tape
- Color pencils or markers
- Optional: have students work in groups to cut and arrange Plant Cards and Hint Cards

MATERIALS

- Student notebook and pencil for taking notes
- Fire Severity Pictures Powerpoint presentation
- Black to Green Landscape Drawing (2 pages) for each group of 3-4 students
- Creature Collage card pages for each group of 3-4 students
- Scissors, coloring pencils, crayons, or markers for each student
- Glue or tape for each group of 3-4 students

Vocabulary and Terms

Chaparral: a habitat dominated by shrubs and maintained by high-severity fire. Chaparral is important to many birds, deer, elk and other wildlife and is considered an endangered habitat type in southern Oregon.

Early-seral forest: forest ecosystem that regrows after a high-intensity fire, before re-establishment of a mature, closed forest canopy.

Fire regime: the generalized pattern, frequency, and intensity of wildfires that occur over long periods of time (e.g. hundreds and thousands of years).

Keystone process: an ecological event that significantly influences the ecosystem and helps to initiate further evolution of the ecosystem.

Klamath–Siskiyou: ecological region of southern Oregon and northern California; includes the Siskiyou Mountains, Rogue and Klamath River watersheds. This area is renowned for extremely high biodiversity.

Mixed-severity fire: the pattern of fire in mountain forests in which the burned landscape is a combination of unburned areas, medium burns, and heavily burned areas.

Stand: a patch of forest that is in one given area and has fairly related characteristics in tree species, age, size, arrangement, and other forest conditions.

Tree plantation: stands of same-sized trees in rows, often of the same species, that are planted for timber. Tree plantations are low in biodiversity and are less resilient to forest fires and other disturbances.

Introduction

Fire has sculpted the landscape over countless millennia by creating a cycle of growth, cleansing by flame, and regrowth once again. Fire is considered a keystone ecological process since it greatly influences all components of the ecosystem including wildlife habitat, human activity, soil nutrients, plant species that regrow after fire, and features like downed wood and snags (standing dead trees) that serve as shelter.

Various fire regimes, or ways in which fire can burn, create different types of post-fire habitat and affect the biodiversity across the landscape. Fire regimes are characterized by patterns of how hot fires burn and how often they burn in a particular place. We will explore some specific Southwest Oregon species, particularly how their adaptations to living with fire and their interconnected existence contributes to biodiversity.

Discussion Points

1. Review Concepts of Fire and Biodiversity from Lesson 2 (page 11)
2. Read the passage below to introduce students to different types of fire regimes and how they can interact with different habitats.

Fires wash across the lands like many other weather processes, greatly affecting some areas and barely touching others. This can be described as mixed-severity fire, meaning some places burn really hot and some places burn less hot. In places with low fire severity, there is little burning of the overstory vegetation, or the tops of the trees. In areas with moderate fire severity there is considerable but not total overstory burning. In areas with high severity, there is complete burning of the overstory. When looking at the diversity of fire types across the land, we can describe the landscape as a fire-created mosaic — like an interwoven patchwork quilt of various stages of post-burned habitats.

Defining low-, mixed-, and high-severity fire
Fires affect the landscape in a diversified, or heterogeneous (not uniform) way. Factors like topography, elevation, human activity, and landforms can influence fires to burn at different temperatures, and return at different intervals over time (discussed in Lesson 1). Indigenous or cultural burns have had a significant influence on historic fire regimes in this region (discussed in Lessons 3 and 5), affecting different places depending on the native foods being managed.

Low-severity fires are common in places with limited fuels (for example, where there is mostly short vegetation as in a pine or oak savannah) and have limited flammability (for example, where there is a lot of bare ground or rock). In fuel-limited ecosystems, fires generally have low severity, cover large areas, and are fairly frequent.

High-severity fires are typical in Oregon's Coast Range and western Cascade Range. These wet, cool forests may experience infrequent and large fires facilitated by extremely dry and warm springs and summers or high winds. Some shrublands and grasslands in central, eastern, and southwest Oregon also burn at high severity, but more frequently than forests. East of the Cascade Range, most wildfires are ignited by lightning, whereas west of the Cascade Range, most are ignited by human activity. (Dalton 2021)

Mixed-severity fires are complex and are the least understood across the western United States because many of the ways scientists reconstruct fire history were developed for low- or high-severity fires. Characterized by variability in burn intensity and plant mortality, they are influenced by life histories of the plants and vary with water availability and topography. (Dalton 2021)

Fire Severity Characteristics and Effects
(also provided in the fire severity pictures slide show for activity 1)

Fire Regimes*	Characteristics and Landscape influence	Habitat Benefits
Low severity	Lightning and Indigenous cultural burns can be low severity, estimated to occur every 3-30 years. Low-severity burns of valley bottom and low foothills tend to create open forests with oaks and pines, growth in grove clusters and grassy clearings, and scattered shrubs across the landscape.	Opens up forest canopy, creates mineral ash and increase soil nutrients, invigorates understory and groundcover species, triggers new pine, hazel, and oak growth.
Mixed severity	Lightning and localized Indigenous cultural burns can be mixed severity, estimated to occur every 30-100 years. Mixed-severity fires are diverse, patchy and irregular in pattern at the stand and landscape scale. The range of fire intensity will create mixed forest types across the landscape that are also patchy, ranging from dense conifer forests to open, regenerating shrub stands. Mixed-severity fire occurs at high mountain elevations, and is limited by snow pack, moist springs and meadows, and rocky outcrops.	Creates a diversity in forest type and forest structures across the landscape, and thus, a diversity of species take advantage of the varied habitat types.
High severity	These fires may occur every 50-100 years depending on vegetation type, topography, past fire history, soil type, and other factors. High-severity fire will often reburn the same areas. They are typical in brush fields and pine stands at both high and low elevations. High-severity fires may burn in patches across open shrublands, or in uphill strips on steep mountain slopes.	Helps maintain chaparral and early-seral forest habitats. Creates ongoing regrowth and sprouts that provide forage for rodents, deer, and elk. Depending on the geology, it may even break down rock or create various features in the soil.

***Note for students:** Keep in mind that generalizations which humans use to describe patterns in nature may not always hold true. Patterns in nature, such as fire regimes, are always changing and do not follow hard and fast rules. Fire ecology is complex and something that scientists continue to study.

Activity One

What do you think? Interactive presentation

1. Utilize the Fire Severity Pictures slide show to illustrate different fire regimes and what they look like on the landscape as the forest grows back.

2. As you move through the slides, ask students to do a quick chat with a buddy (30 seconds), then ask for a raise of hands: "Who thinks this slide shows a low-severity fire? Mixed-severity? High-severity?"

3. Have students discuss evidence in the photo that led them to their opinion.

4. Read the notes on the bottom of the slide to reveal the answer and more information about the pictured landscape.

Discuss

Prompt students to think, pair, share:
What are some examples of plant conditions and habitat features on the landscape that might affect how hot a fire burns? Remind students of the wildland fire triangle (see Lesson 1).

Ask students to take a few minutes to think and/or write down a couple of ideas before discussing with a partner. Have partners then share their ideas with the class to start a discussion. Examples below:

- Fires may grow hotter from having lots of dry plant material in a specific area. An example of when this happens is in areas that have been heavily logged and then replanted with dense timber plantations, or when large piles of branches and other logging debris are left behind.

- Fires may burn less hot when they move to places that are more moist such as north-facing slopes, river's edges, valley bottoms, lower thirds of mountains, and ravines.

- Fires may stop burning when they come up to a rocky hill slope, bare ground, a river, or a wetland. An interesting example is seen in beaver habitat where the beaver's pond habitat creates a fire break because it is a flooded area in a creek.

Activity Two

1. Break students into groups of 3-4 and provide them with group materials: Black to Green Landscape Drawing by Sarah Burns (which will serve as the collage background for the Creature Cards), colored pencils or markers

2. Ask students to each take 4-5 Creature Cards, then read and share the information on their cards with their group members. Optional: students may color in each of their cards.

3. Ask students to work together to decide where to place the Creature Cards on the Black to Green Landscape drawing. They may consider factors like where the species prefers to live, how long ago a fire burned, and/or how intense a fire burned.

Class discussion

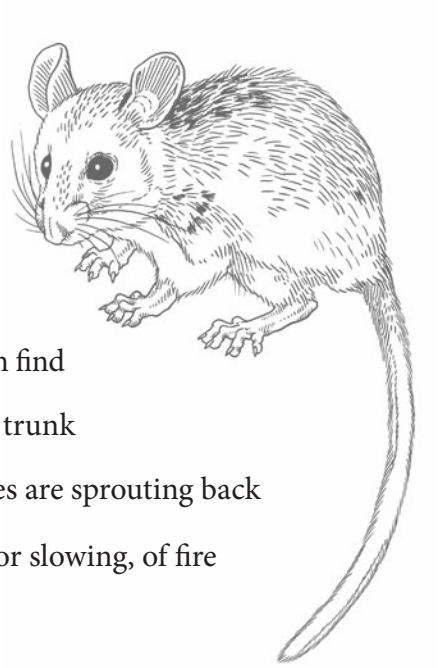
Hang each group's complete collage up on the walls around the classroom.

1. Ask students to reflect on the arrangement of creatures across the landscape.
2. Have students share with the class why they chose the placements for different animals in theirhabitat. Acknowledge that multiple answers are possible because there is variation in the landscape, as well as animals' habitat needs.
3. Ask students to compare and contrast the arrangement of creatures and think about why there may be differences between collages.

   Further example prompts:

   - How do different creatures react to the post-burned landscape?
   - Which species utilize features in forests that have experienced high-severity burns?

Take it Outside



Bring your students to a nearby forested area for a field trip and make observations about how fire has influenced the forest. Ask students to consider concepts from the classroom discussion, and search for clues such as:

- Fire scars at the base of old trees or inside old stumps
- The diversity of size of trees versus the number of fire scars they can find
- Lightning-struck trees that have fire scars that spiral around the trunk
- Recently burned areas and which trees have survived, which ones are sprouting back
- Features on the landscape that may have influenced the spread, or slowing, of fire

Take-Away Concepts and Further Connections

- The way in which forest fires burn is influenced by vegetation, weather conditions, human activity, and features on the landscape.
- Fire is an important ecological process, contributing to the diversity of species in Oregon.
- A diversity of plants and wildlife are adapted to survive or thrive in the post-fire landscape.
- Fires burn at variable severities across the landscape and affect future growth of the forest and the habitat for a diversity of species.
- Landscape features, soil, and water affect the post-fire regrowth of plants and wildlife habitat.

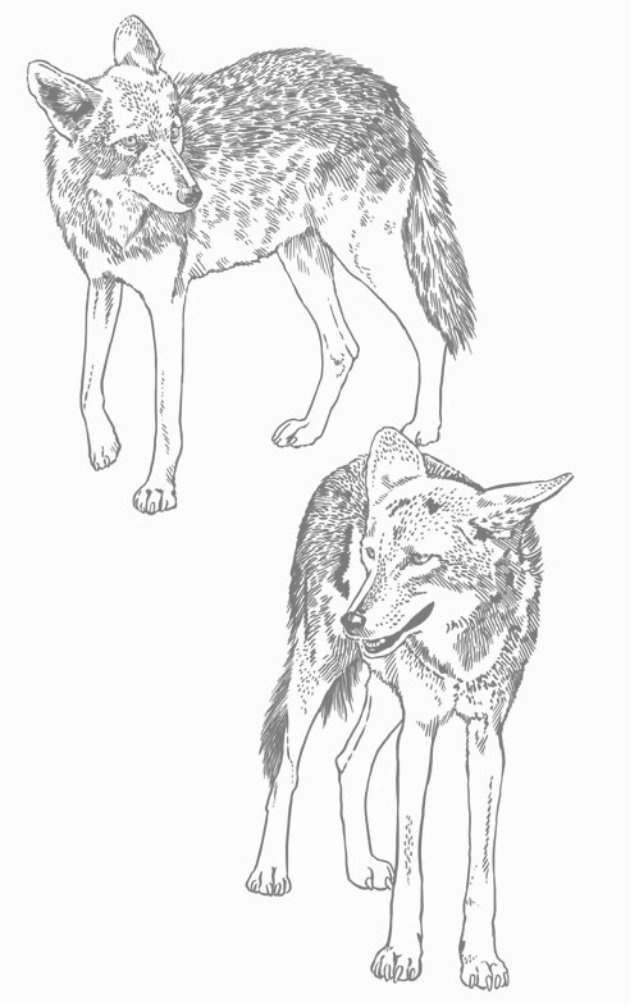
Conclusion

Fire is essential to Oregon's ecosystem in many ways: it recycles nutrients, helps to break apart rocks and form new soil, forms wildlife habitat, and triggers new plant growth. A mix of fire severities over past millennia have shaped the current landscape as we know it today. Because fire burns in a diversity of ways and is variable across the landscape it can further the diversity of living things in an ecosystem. The sum total of mixed-severity fire across the landscape can be described as a fire-created mosaic.

Online Video Resources

Disturbance
19 minute film
https://vimeo.com/groups/future/videos/8627070

Exploring with Dick Hutto Episode 15
Bird diversity and habitat after Wildfire
9:46 minute film
https://www.youtube.com/watch?v=iTl-naywNyY&list=PL7F70F134E853F520&index=16



Lesson 4: Black to Green Creature Collage













Beaver: greatly affect their wetland habitats by building dams and lodges. As they improve wetlands, they are also creating natural fire breaks on the landscape that remain green after a fire has gone through.

Black-backed woodpecker: depend on burned trees for their homes and insect foods.

Black bears: area able to roam great distances and enjoy the black-green edges of the post-fire landscape. In the years following fire they feast on the regrowth of berries, shrubs, and small wildlife.

Black-tailed deer: like to forage for grasses and shrub shoots that grow on the edges of meadows and resprout after burns.

Coyote: are some of the most adaptable creatures in North America. They will hunt for rodents that proliferate in burned areas.

Deer Mouse: due to increase in seeds and insects, mice populations can increase after fire.

Coho Salmon: are endangered in part because of habitat loss due to pollution, dams and loss of gravel in rivers to lay their eggs under. The powerful disturbances of wildfire, postfire landslides, and debris flows over time can enrich in-stream habitats (eg with gravel for spawning and logs for cover), enhancing long-term fish survival and productivity. (Kirkland 2017)

Clark's nutcracker: Post-burned forests can provide habitat for the Clark's nutcracker to store its pine seeds. In return to support the forests, the Clark's nutcracker initiates forest regrowth after large fires by moving pine seeds from long distances (Coop and Schoettle, 2009)

Morel mushrooms: will sprout in large numbers for several years after fire because the heat and soil disturbance trigger them to grow.

Melanophila beetle: commonly known as fire chaser beetles, are attracted to forest fires because they use freshly burnt (and sometimes still-smoldering) wood to lay their eggs. They detect fires with specially developed infrared receptors and will flock to a fire while it is still burning.

Spotted Owl: are adapted to take advantage of patches of moderate-severity fire. They use standing dead snags for perches to hunt rodents from, especially if there is nesting habitat nearby. Some studies suggest that they can live in forests regrowing after mixed-severity fires with up to 70% being high-severity burn. (Lee 2020)

Red tailed hawk: are an extremely adaptable species that can live in many different environments. They prefer open areas and open forests, and will hunt for rodents and small birds - all things that fire can help to promote. The have been reported to be attracted to fire and smoke and even feed on grasshoppers fleeing from fires. (Tesky 1994)

Western bluebirds: are insectivorous (insect-eating) birds that find opportunities to feast in post-burned forests. The insects are some of the first life to recolonize the post-burned forest.

1. CUT ON DOTTED LINE
2. GLUE OTHER PAGE TO THIS SECTION TO COMPLETE THE PICTURE

Lesson 4: Presenter Notes

Fire-Severity Pictures

Slides 1 - 5

Present to students about the differences between low-, mixed-, and high-severity fire definitions

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Slide 6

The Grizzly Creek Fire was a small fire of less than 400 acres in southwest Oregon, September 2020. It burned mostly in homogenous timber plantation stands, and some in second-growth Bureau of Land Management forests. The second-growth forest shown here was likely logged in the 1960's, and the largest trees standing are between 60-100 years old, here showing a mixed-severity burn.

Slide 7

The Grizzly Creek Fire was a small fire of less than 400 acres in southwest Oregon, September 2020. It burned mostly in timber plantation stands like this one, and some in second growth BLM forests — here showing a high-severity burn. This timber plantation can be described as homogenous since all of the trees are the same age, size, and species — approximately 20-30 year old lodgepole pine.

Slide 8

This shot from the Kalmiopsis rim in the high-country depicts a mixed-severity burn from the 2017 Chetco Bar fire. Notice the burn came up the hillside in the photo but burned only certain portions of the rim (right side of picture). Picture by Vesper Meadow Education Program 2021

Slide 9

This photo is just over the rim from the previous picture, a few hundred yards away. The mixed-severity burn of the Chetco Bar fire that occurred here in the wilderness burned hot on the rim, but less so in this area near to a spring, and on the northerly aspect.

Slide 10

This high-elevation forest burned in the 2020 Slater Fire at a mixed severity as the shrubs and small trees in the foreground burned at a low to moderate severity (they still have smaller twigs). In the distance patches of hotter fires are black, moderate fire in orange, and low to no fire in the green areas.

Slide 11

This stand of old pine trees ranging from 200-600+ years old near Cedar Basin in the Red Butte Wilderness easily withstand low- and mixed-severity burns, as evident by the recent fire scars or "cat faces" on their trunks.

Slide 12

This huckleberry patch remains below a mixed-conifer overstory in the southern Cascades in southwest Oregon. Patches like these have been maintained with low/mid-intensity fire by Indigenous people for a very long time — this agricultural practice is part of a deep and extensive web of understanding called Traditional Ecological Knowledge — and in this case, the cultural burning can enhance the quality of the patch by encouraging new shrub growth, canopy gaps and other benefits.
Learn more about cultural burning in subsequent lessons.

6th - 8th

Lesson 5
Burning for Basketry:
Engineering Ecosystems with Fire
Fire as an Agricultural Tool, part two

NGSS: MS-LS2-1, MS-L2-4, MS-LS-5

Summary

60 min

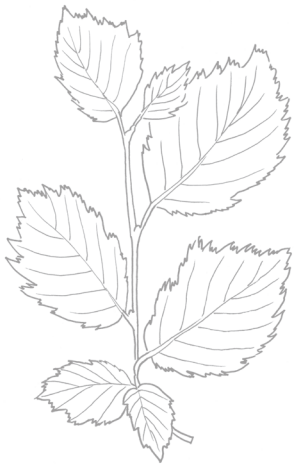
Fire is a naturally occurring part of the dry summers of Oregon, and a dependable fire cycle has created fire-adapted native plant species. Closely linked to natural fire regimes, cultural burns have been used in southwestern Oregon for thousands of years and have also shaped the land and plants within it.

Fire suppression policies of the early 20th century deprived landscapes and plants of this critical ecosystem-engineering process in some areas of Oregon. While prescribed burns are now recognized as important by federal land agencies, there are many challenges to reintroducing fire where it has previously been suppressed.

In this lesson, students will study cultural burning of hazel, an understory shrub species used by Siletz and other Indigenous basket makers. Comparisons will be drawn between effects of cultural burning, wildfire, and fire suppression on a certain culturally important species. Students' evaluations will highlight opportunities that cultural burning and Indigenous cultural practice offer to forest management and fire policy and planning today.

GOALS

- Students will understand the long-term effects of fire regimes and fire as a natural part of the climate in southwestern Oregon.
- Students understand how Indigenous cultural burning can affect resource availability for humans, browse for grazing animals, and the mitigation of future wildfires.
- Students will understand the opportunities and risks associated with reintroducing fire (via prescribed and cultural burns) following a period of fire suppression.
- In a worksheet, students will use empirical evidence to explain how fire suppression, prescribed fire, and cultural burning affect populations of hazel plants.
- In a worksheet, students will interpret data and explain how overstory tree competition affects the productivity of hazel (and understory shrubs).



CLASSROOM PROCEDURE

1. **Activity One:** Burning for Basketry (Slideshow)
2. **Activity Two:** Cultural Burning to Enhance Hazel for Basket Weaving (Worksheet)
3. **Activity Three:** Two short videos about cultural burning

Preparation

- This lesson pairs well with Lesson 6: Leading the Way with TEK, and you may consider teaching Lesson 6 first

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- Familiarize yourself with the Burning for Basketry (slideshow)
- Familiarize yourself with the Revitalized Karuk and Yurok cultural burning study
- Print Worksheets, one copy per student

MATERIALS

- Discussion Points Slideshow
- Projector and screen
- Student Worksheets
- Worksheet with answers
- Coloring pages (optional)

Vocabulary and Terms

Basketry: the creation and use of baskets by Indigenous people for purposes such as food harvesting, processing, cooking, and storage, for child-rearing (baby baskets), in everyday clothing, and in ceremonies

Cultural burn: traditional use of fire to maintain and manage landscapes for foods and materials, to cook food, or to hold ceremonies

Fire-dependent environment: where species have adapted to fire cycles and depend on the effects of fire for growth, reproduction, health, or survival

Fire regime: the particular frequency and intensity of fires over time in a certain area

Fire suppression: a land management practice that focuses on fighting and stopping wildfires

Hazel: a deciduous, perennial shrub that often grows under the shade of larger trees. It is an important plant for Indigenous basketry and an important agricultural crop for Oregon farmers.

Mediterranean-type climate: includes cold, wet winters and hot, dry summers with a dependable fire cycle

Overstory: the uppermost canopy layer in a forest

Prescribed burn: a fire set intentionally for land management

Understory shrub: a shrub that thrives in the forest layer below the overstory canopy

Activity One

Burning for Basketry (slideshow)
Classroom time: 20 minutes

Present the Burning for Basketry slideshow, using the information in the speaker notes section of each slide or print out the Burning for Basketry: Presenter Notes sheet.

Activity Two

Cultural Burning to Enhance Hazel for Basket Weaving Worksheets
Classroom time: 20 minutes

Students will look at data figures from a recent study, analyze and interpret the data, and describe the physical changes that cultural burns can have on plant growth in hazel populations.The activity is built using data from the following research paper, included here for reference:

> Revitalized Karuk and Yurok Burning to enhance California hazelnut for basketweaving in northwestern California. Authors: Tony Marks-Block, Frank K. Lake, Rebecca Bliege Bird, Lisa M. Curran. 2021

Instructions:

1. Pass out one worksheet to each student.

2. Instruct students to read through the worksheets and answer the questions. Students may work together for additional support. Students may benefit from using rulers or other straight edges to help interpret the graphs.

3. Collect the worksheets for grading and return to the students, or go over answers as a class.

Activity Three

Videos
Classroom time: 20 Minutes

Cultural Burning Today video
Watch this 2 minute video to give students a visual of what a cultural burn looks like today for the Yurok and other Tribes in northern California. Video includes a short discussion of hazel and hazel baskets.

Question for discussion following "Cultural Burning Today" video:
In what ways do cultural burns like those in the video change the way things grow on the land? Fire helps spur the growth of plants and animals used for food, and fire creates fresh growth of hazel for good basketry materials.

Siletz Tribal Elder presents Hazel Basketry materials video
Watch this 4 minute excerpt from a presentation by Agnes Baker Pilgrim, Siletz Tribal Elder. This video includes a show-and-tell with baskets and hats made with hazel.
Begin video at 4:16 and play until 7:43 for a short presentation of baskets. Play until 20:51 for a longer presentation of baskets, hats, cradleboards, and more.

Conclusion

Review and discuss the answers to the questions on the worksheets.

Take-Away Concepts and Further Connections

- Fire is a natural part of the Mediterranean-type climate and fire plays a positive role in forest ecology.
- Natural and cultural burns were suppressed in Oregon for many decades until recently.
- Fire suppression has disrupted important activities associated with material culture among Native American people.
- Regular cultural burning can have positive effects on plant populations that surpass the effects of one-time prescribed burns.
- Revitalizing Indigenous cultural practices including fire and harvesting can enhance forest management.

Take it Outside

Go to a nearby natural area and observe the plant community there. Ask students to look for plant materials that they think might work well for making baskets, clothing, or other tools or objects. (Refrain from collecting materials.) In a nature journal, students sketch and take notes about the plant materials and their ideas about what to make.

Discuss student ideas in a group. How abundant are these plant materials? How much time and area would students need to forage enough material to create their items? Remind them that Indigenous peoples use cultural burns to help make sure they could gather enough materials to make important items. How could fire help enhance the amount or the quality of plant materials for human use?

NAME _____ DATE _____

6th - 8th

Lesson 5: Engineering Ecosystems with Fire

Science of Basketry

Read the following excerpts from a study (Marks-Block 2021), then answer the questions below.

"Karuk and Yurok tribes in northwestern California, USA, are revitalizing the practice of cultural burning, which is the use of prescribed burns to enhance culturally important species. These cultural burns are critical to the livelihoods of Indigenous peoples, and were widespread prior to the establishment of fire exclusion policies. One of the major objectives of cultural burning is to enhance California hazelnut basketry stem production for Karuk and Yurok basket weavers.

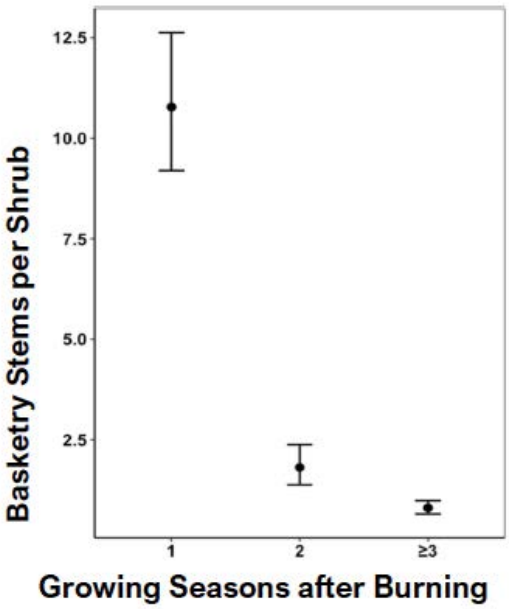
To evaluate cultural burning as a form of human ecosystem engineering, we monitored hazelnut basketry stem production (stems per shrub), qualities (stem length and diameter), and shrub density (shrubs per 400 square meters) in 48 plots within prescribed and cultural burn sites. Socioecological variables that were analyzed included burn frequency (fires from 1989-1019), burn season (winter, spring, summer, fall), and overstory tree area (area of all tree trunks per plot >10 cm).

We also observed basketry stem gathering to compare travel distances, gathering rates (stems per minute), and basket weaver preferences across sites with different fire histories and land tenure."

What things are being measured in the hazel plants?

What are some socio-ecological variables being analyzed?

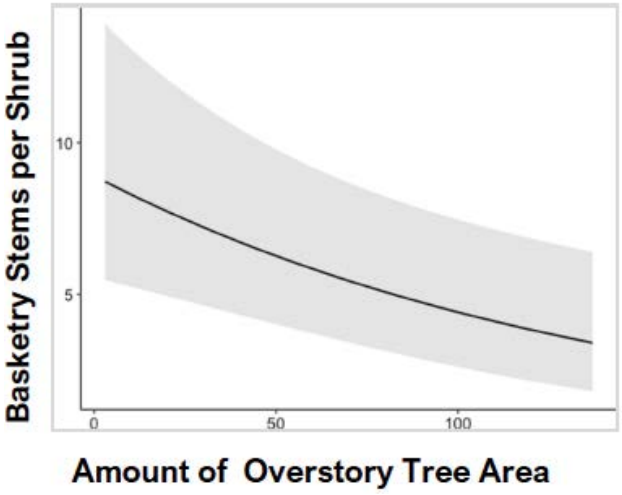
What is being measured when observing basket makers as they gather hazel?



This figure shows how many basketry stems were found per hazel shrub 1, 2, and 3 growth seasons after fire was used.

What is the average number of basketry stems found on an average hazel shrub, in the first growing season after burning? _____

What is the average number of stems per shrub found in the second growing season after fire? _____



This figure shows how the number of good shoots relates to competition with nearby trees.

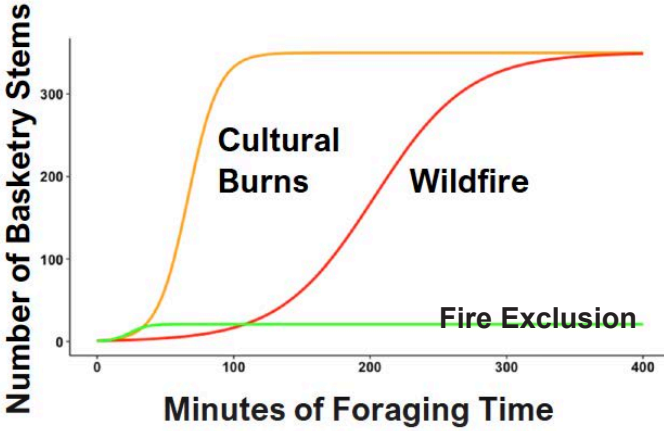
Did the hazel produce more or fewer basketry stems in crowded areas? _____

How might thinning trees to reduce overstory affect stem production?

_____

_____

_____



The last figure shows how long it took to find 300 good stems in areas following: cultural fires, a wildfire, and fire exclusion (or no fire).

How many minutes did it take to collect 300 stems of Hazel...

... after a wildfire? _____

... after a cultural burn? _____

... in an area where fire was excluded? _____

Lesson 5: Presenter Notes

Burning for Basketry

Slide 2

Southwestern Oregon's climate is known as a Mediterranean-type climate, a type of climate that occurs in only about 5% of the areas around the world (Kauffmann, 2021). These places share several characteristics, including cool, wet winters, long dry summers, and a naturally-occuring, dependable fire cycle. Many species of plants and animals have evolved to thrive in the Mediterranean climate, in what can be called a fire-dependent landscape.

In this landscape, fires change the land, and the frequency and intensity of fires over a certain time on a certain part of the land is known as the fire regime.

Slide 3

Indigenous people in this fire-dependent landscape learned how fire affects the land, and learned how to use fire to provide the food and materials needed for subsistence. The knowledge of how and when to burn lands to produce certain foods or materials is passed down from generation to generation. Fire was used very widely, and was perhaps the most utilized land management tool in many parts of Oregon before the arrival of American settlers (Anderson 2013).

The intentional use of fire by Indigenous people to enhance (or affect) cultural materials can be called "cultural burning." Cultural burns were once responsible for a large part of the fire regime of southwest Oregon, and were responsible for the type, quantity, and quality of plants on the land that sustained Indigenous populations as well as a diversity of animals. Cultural burns may be applied to large areas, to patches of certain trees or plants, or to individual trees or shrubs, like this small cultural burn of a hazel bush. Seasonality, or the time of burn, is very important, and might vary from place to place, from year to year, or from practitioner to practitioner. This photo shows a hazel plant being burned in early winter, but other cultural burns of hazel are done in early spring.

Slide 4

Fires, both wildfires and cultural burning, have been removed or suppressed in recent history. There are three ways that fire has been removed or excluded.

First, when germs from afar and abroad reached Indigenous communities (through trade routes), epidemics like smallpox and malaria killed many Indigenous people and reduced the number of people practicing cultural burns.

Second, shortly after early American settlers declared Oregon a new state, Indigenous people were forcibly removed from traditional homelands to Reservations. In the image in the middle of the slide, you can see the traditional territory of the Siletz Indians, marked in dark grey, and the Coast Reservation they were removed to. (The Coast Reservation was also taken from the Siletz Indians later in Oregon's history.) When Indigenous people were forcibly removed, their land practices, including cultural burns, were also removed. Early American and Oregon governments did not recognize fires and fire regimes as natural, necessary, and beneficial, but rather as destructive and dangerous (NRDC 2003).

Third, the United States Department of Agriculture Forest Service initiated fire suppression policies to protect timber resources and newly-built structures. It was declared that any fire, including wildfires started by natural causes like lightning, be extinguished as quickly as possible. Fire was suppressed by this policy for over 100 years in many areas of Oregon.

Discussion Question:
What do you think happens to an area that evolved with regular fire, when fire is suppressed?
When fires are suppressed, there can be a build up of burnable material. Risks of future fires can increase with buildup of burnable materials. Populations of plants may also shift, if those plants require fire for seed germination or other parts of their life cyle.

Slide 5

Let's look at what happens when fire is excluded from lands where it is a natural part of the ecosystem.

Beginning at the left side of this image, we see tall trees, and under them many small trees and shrubs. We also see low, dead branches of the taller trees. These are examples of what can happen when fire is suppressed and a buildup of burnable materials happens. "Surface fuels" are burnable materials on the soil surface, and the low branches and low-growing shrubs are sometimes called "ladder fuels." When a fire moves through the area, it burns the surface fuels (1 on the slide), then quickly spreads to the ladder fuels (2), and the ladder fuels then pass the fire up to the upper canopy, or the tree crowns. The crowns of trees are where new growth happens, and trees lack thick bark that can protect them from fires, so fire that reaches the crowns of trees is more likely to damage or kill a tree.

Slide 6

After years of fire suppression, many land managers and agencies that manage lands are beginning to recognize something that Indigenous cultures of Oregon understood all along: that fire is a beneficial, necessary process for landscapes that ought to be applied to the land where and when it would most benefit. Instead of suppressing all fires, managers and agencies are beginning to return fire to the land. Prescribed fires are where land managers intentionally set fires to accomplish certain goals. Prescribed fire can be beneficial in many ways. It can be an effective tool for reducing the fuels we just learned about. Prescribed fire can also be used to:

- Minimize the spread of pest insects and disease;
- Remove unwanted species that threaten species native to an ecosystem;
- Provide forage for game;
- Improve habitat for threatened and endangered species;
- Recycle nutrients back to the soil; and
- Promote the growth of trees, wildflowers, and other plants.

Slide 7

What happens when prescribed burns are led by Indigenous people, groups or Tribes that practice cultural burning? Different Indigenous practitioners of cultural burning bring particular practices, such as starting or spreading a fire using plant materials, as shown in this photo from northern California. Cultural burning practices can differ in:

- How the fire is started, spread, or controlled
- Seasonality
- Location (for example, in a forest or in a meadow)
- What plant(s) are being burned

Let's learn more about cultural burning as it relates to the hazel plant, a plant used for food and in basketry.

Slide 8

The hazel plant is deciduous, meaning it is a plant that sheds its leaves in the fall. It is a perennial plant. Hazel plants are shrubs that survive year after year. They are a native shrub that often grows under the shade of larger trees. They are an important plant for Indigenous basketry, and they are an important agricultural crop for Oregon farmers, too.

Slide 9

Here is a look at the hazel plant through the seasons.

Clockwise from top left:

1. Early spring: hazel plants have both male and female flowers, and the male flowers are long and cylinder-shaped (a flower part called a "catkin"). Flowers are wind pollinated.
2. (Top) Spring and summer: pollinated flowers begin to develop into seeds, underneath a protective, beaked-shaped layer
3. (Right) Mature hazel seeds, hazelnuts, are an important food source and agricultural crop
4. (Bottom right) Fall: leaves turning yellow
5. (Bottom left) Winter: buds at the growth tips of stems are dormant

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Slide 10

Baskets are a very important tool to traditional Siletz and other Tribes' lifeways in Oregon. Indigenous people have used baskets for many purposes: food harvesting, processing, cooking, and storage, for child-rearing (baby baskets), in everyday clothing, and in ceremonies.

These three pictures show a ceremonial Siletz basket cap (hat) made from hazel and other materials. In the first picture, the close up, you can see the fine weaving and different materials used. In the second, middle picture, you can see the entire basket cap. The patterns, also called "overlays," used by the basket weaver are named—this one is called the "dance knife." The white is beargrass, the black is maidenhair fern, and the twine (brown color) is split spruce root. In the third picture, you can see the inside of the the cap. As the base, this basket cap contains hundreds of individual hazel sticks radiating from the center like spokes on a wheel. Spruce root "weavers" are used to hold the hazel stick spokes together by a technique called "twining," and in an overlay (pattern). (Joseph Scott, personal communication, 2021)

Basketry requires not only the knowledge of weaving, but also the knowledge of tending to and gathering the plant materials. In order to ensure enough materials are ready and accessible for making baskets, Indigenous basket makers have learned that regular tending practices like pruning and burning increase the production of certain usable plant materials, like hazel. Let's look at how this works.

Slide 11

Basket makers prefer to use shoots of hazel that are long, straight, unbranched, young and healthy. Tending practices like burning or coppicing (pruning old growth to the ground) can result in more shoots of usable quality to emerge in future years.
Let's look at an illustration of how this works.

Side 12

On the left, we have a hazel bush. Notice that some of its branches are older and thicker, while some are young.

Discussion Question:
If you were a basket maker, how many usable hazel sticks do you see in this first hazel plant?
Most of these hazel branches are at least a few years old, and fairly thick...too thick for making a basket

Basket makers depend on large amounts of hazel sprouts for materials. One way to induce hazel plants to produce many sprouts is to cut back the branches (when the plant is dormant, in winter or early spring). When branches are cut back to induce sprouts, it is called coppicing. A coppiced hazel plant is shown in the picture on the right. Basket makers and people using plants for materials have been coppicing plants all over the world for thousands of years.

In addition to coppicing, Indigenous basket makers tending to hazel plants may lay the cut branches down in place, add dead, dry, burnable branches from nearby, and set them all on fire. This practice removes weak growth, fertilizes the hazel plant by adding the charcoal to the soil, and, if there are any insects or diseases that affect hazel plants, fire may disrupt their life cycle.

Slide 13

Now let's look at what happens to a burnt, coppiced hazel plant the following spring. Several young shoots have emerged. They have the qualities that basket makers prefer to use. They are long, straight, unbranched, young, and healthy. They are long and straight because the area was cleared by the coppicing. They are unbranched and straight because they are first-year sprouts. And they are healthy because the fire helped fertilize the plant and removed any insects or diseases that may have been present on the hazel plant.

Slide 14

Now that we know about hazel, about its importance for making baskets, and how Indigenous people in Oregon and California traditionally care for hazel plants, including cultural burns, we are going to learn how scientists are looking at cultural burning today. Next we will look at some studies where people are beginning to be able to look at and measure the benefits of prescribed fires and cultural burning on the land.

6th - 8th

Lesson 6
Leading the Way with TEK:
Understanding Land Use Changes in Oregon
Fire and Land Use History, part one

NGSS: MS-LS2-5 OSSS: 8.23, 8.24

Summary:

120 minutes
(can be two 60-minute blocks)

Traditional Ecological Knowledge (TEK) is knowledge and practice that has been passed down from generation to generation in Indigenous communities and has been shaped by the close relationship between Indigenous people and their land. Since the displacement of Indigenous people from traditional homelands in Oregon in the mid 1800's, the land has suffered from the loss of its original stewards' tending practices, like cultural burning. In recent decades there has been an increased advocacy for returning fire where it has been suppressed, and for centering TEK in land restoration.

Students will study the historical shift in Oregon land use from the Long Indigenous Existence to the era of colonization, compare and contrast land management of the two eras, and utilize TEK concepts to design and present solutions for environmental issues influencing fire today.

Goals

- Students will watch a video to gain understanding of a major historical shift in Oregon land use.
- Students will complete a worksheet to demonstrate understanding of ecological, social, and economical effects of shifts in land use.
- Students will study and utilize themes of Traditional Ecological Knowledge to propose modern design solutions for maintaining an ecosystem.

Classroom Procedure

1. Activity One: Changing Places, Warm Up (introduction)
2. Activity Two: Understanding Land Use Changes in Oregon (presentation)
3. Activity Three: Supplemental video
4. Activity Four: Being a Land Steward Worksheet

Preparation

- Review the introductory Activity One: Changing Places Warm-Up.
- Review the Activity Two: Understanding Land Use Changes in Oregon presentation.
- Prepare to present the supplemental video (Activity Three).
- Review Activity Four and print one copy per student of the Being a Land Steward Worksheet
- Since these four activities may take 2 hours to complete, consider separating them into two 1-hour periods:

  Period One:
  - Activity One: Discussion
  - Activity Two: Presentation (Part One only, slides 1-17)
  - Activity Three: Video

  Period Two:
  - Activity Two: Presentation (Part Two, slides 18-29)
  - Activity Four: Worksheets
  - Conclusion

Optional Preparation and Further Resources

- Review or use the 8th Grade Tribal History Plans developed through Senate Bill 13, and check for other lesson plans that have since been developed through SB 13 for your grade.
- More about Siletz Tribal history, the Tribe featured in the supplemental video, can be found at the Tribe's webpage and in the book *The People are Dancing Again: The History of the Siletz Tribe of Western Oregon* by Charles Wilkinson.

Materials

1. Powerpoint Presentation Leading The Way with TEK: Understanding Land Use Changes in Oregon
2. Presenter Notes for Leading The Way with TEK: Understanding Land Use Changes in Oregon
3. Computer and projector
4. Being a Land Steward Worksheet, one copy per student
5. Writing or drawing utensils for students
6. Blank paper for Warm-Up Activity

Vocabulary and terms

Colonization: the act of sending people to live in and govern another area, where the newcoming population retains strong links to their original country and gain significant privileges over original inhabitants of the area

Commodification: when something is made into a product that can be bought and sold

Donation Land Claim Act: the federal policy, enacted in 1850 during early colonization of Oregon by the US, that allowed white, male citizens to be given land in the Oregon Territory

Exportation: the removal, transport, and sale of resources from one area or country to another

Fire suppression: a land management practice that focuses on fighting and stopping wildfires

Kincentric: a view of the world where all parts of the natural world (land, plants, animals, water, etc) are viewed as kin, or family

Land stewardship: caring for a piece of land while taking into consideration ecological, economical, and social dimensions

Ladder fuels: burnable material that builds up in a forest which can ignite and pass a low-burning fire to the tops of trees

Legacy trees: large, old trees that are resistant to disturbances (like fire) and have the capacity to produce and spread large amounts of seed

Long Indigenous Existence: the thousands of years before colonization that Indigenous peoples lived closely with the land and passed on knowledge to the next generations

Low-intensity burn: a fire that moves slowly and burns at lower temperatures

Renewal capacity: the ability of a species to renew itself

Traditional Ecological Knowledge (TEK): the knowledge base acquired by Indigenous people and passed down from generation to generation

Introduction

The "Long Indigenous Existence" is a term adapted from *The People are Dancing Again: The History of the Siletz Tribe of Western Oregon* by Charles Wilkinson, and refers to the time before the Euro-settler colonization of Oregon. Wilkinson begins this book with: "By far, the greatest part of western Oregon Indian history took place over the course of thousands of years before the arrival of Europeans." During this period, one of the most widespread TEK practices across Oregon was the use of fire (Anderson, 2013). The use of fire is an important part of Indigenous culture and identity, as well as a keystone ecological process that shaped ecosystems throughout thousands of years of the Long Indigenous Existence.

Early colonization of Oregon brought many major changes, including population shifts and new land management practices and strategies. The removal of Indigenous people and cultural burning, combined with federal fire suppression policies led to a period of fire deficit that led to significant ecosystem shifts. There is a growing understanding that use of prescribed fire and cultural burning has a positive and necessary part to play in forest management today. However, reintegration of TEK and cultural burning into fire-suppressed, human-altered, and climate-change-affected landscapes, owned and managed by a variety of individuals, businesses, and agencies, is a complex task. This activity provides an understanding of changes in land use during the shift from the Long Indigenous Existence to early colonization (roughly the mid 1800's), and provides students a framework for approaching land stewardship that reflects this complexity.

Activity One

Changing Places, Warm-up
Classroom time: 15 minutes

Students will begin to think about changes in land use and discuss who enacts changes, why changes happen, and how different people are affected.

Begin by saying, "I'd like you each to think about a place you have been that has experienced a change due to human use. Perhaps there was a shift in who was using the place, for example a field you once visited became a site for a new building. Or maybe someone changed the way they used a place, like a restaurant closing or turning into a different business. Or perhaps an area around your home went through some kind change. As you think about the place, think about what you saw, heard, felt, or even what you smelled or tasted there."

Give students some time to think or journal about their place then ask/write these questions on the board:

1) Who or what caused the place to change?
2) How did that change affect how you could use that place?
3) How did the change make you feel?
4) How did the change affect how other people or wildlife could use that place?"

In pairs or small groups, have students share the place they were thinking about, and their answers to the four questions.

Conclude by asking students:

5) How do you think the change could have happened to have a different impact on people and wildlife?

After giving the students time to develop and write down their answers, have a few students share their answers to the five questions with the class.

Activity Two

Understanding Land Use Changes In Oregon (presentation)
Classroom time: 60 minutes

Present the slideshow to the class, using the information in the presenter notes. Many slides also include recommended discussion questions. If dividing the presentation over two class periods, go through slides 1-17 in the first class period, and slides 19-29 in the second.

Activity Three

Supplemental Video
Classroom time: 15 minutes

This 13-minute video provides historical context of TEK and the removal of Indigenous people from their homelands in Oregon. Skookum Tillicum: The Strong People Of Siletz - YouTube

Activity Four

Being a Land Steward Worksheet
Classroom time: 15 minutes

Display the final slide of the presentation as a visual reference for students to look at while working through the worksheets. Pass out worksheets and read through the instructions.
You may wish to allow students to work in small groups or to discuss decisions aloud with their neighbors. As they work, help students as they have questions about specific themes or practices.

Conclusion

Classroom time: 15 minutes

- Lead a discussion about the practices/themes on the worksheets. TEK practices and themes on the worksheet include Kincentric Thinking, Renewal Capacity, Seed Sowing, Keystone Species, Pruning, Digging/Tilling, Use of Fire, Transplanting, and Legacy Trees.
- Choose a few TEK practices/themes, and have students share how and why they chose to use them in their landscapes. Discuss what economical services or goods the students sought to provide, why they chose specific TEK practices, and how the practices affect the ecology (animals and plants) of their land.

Take-Away Concepts

- TEK themes are learned from direct relationships with the land over thousands of years.
- TEK has been passed from generation to generation through oral tradition since time immemorial.
- TEK practices continue today, though they were disrupted by introduced diseases that devastated populations of Indigenous people.
- TEK practices were further disrupted when many Indigenous people were removed at the beginning of the colonization of Oregon.
- A very widely utilized TEK practice is the use of fire in cultural burns, and as an agricultural act.
- TEK themes can be utilized so that the needs of people are being met while biodiversity and health of the land are not compromised.

NAME _____ DATE _____

6th - 8th

Lesson 6: Leading the Way with TEK

Being a Land Steward

You have been asked to become a land steward, to care for a hillside that was recently logged. Think about which TEK themes and practices from the list below you might use to care for the land. Circle the ones you would use. Draw what the hillside might look like in the future, and answer the questions on the back of the page.

Land Stewardship

Caring for the land while considering:

Ecology (plants, animals, water, soil, air)
Economy (what might be produced)
Social Impacts (who in a community benefits)

Circle what you will choose

Concentric Thinking Renewal Capacity Seed Sowing Keystone Species Pruning

Legacy Trees Tilling/Digging Use of Fire Transplanting

Draw what the land could look like in the future

TEK Themes: Choose two TEK themes that you circled on the front of the page,
and explain how they helped the ecology, economy, or social impacts of your land-steward project.

1) TEK theme: _____

How did this theme help the ecology, economy, or social aspects?

_____

_____

_____

2) TEK theme: _____

How did this theme help the ecology, economy, or social aspects?

_____

_____

_____

Lesson 6: Presenter Notes

Leading the Way with TEK

Slide 1

Today we are going to learn that humans can use their environments differently, for different reasons and with different practices. We will learn that changes in who is using land, what they are using it for, and their practices produce different outcomes.

In this lesson, called "Leading the way with TEK," we are going to learn about TEK, or traditional ecological knowledge. TEK is knowledge that Indigenous people have gained by living closely with the land and passing knowledge on from one generation to another, over very long periods of time.

We will also learn about a time in history when Oregon first became a state, when TEK practitioners (the Indigenous people) were removed from their lands, and newcomers arrived and began using the land with different practices and for different reasons. We will learn from what has happened in the past so that we can become better land stewards in the future.

Slide 2

Let's look at changes that have happened over time, in the area that we now call Oregon. In this slide, we see a timeline that includes today and reaches back in time over 10,000 years! The green star at the right side of the line marks the present. Moving to the left, there is a blue star, marking 1,000 years ago.

Discussion questions:

1. What year was it 1,000 years ago?
2. Was your grandmother alive 1,000 years ago? How about your great-grandmother? (If the average age of a mother is 25 years old when they give birth, it would mean that you would have to go back about 40 generations to find your family's generation that was alive 1,000 years ago.)
3. Can you think of something that you or your family learned from your great-grandmother?

This timeline goes back even further. This time, from 10,000+ years ago, is a time before written history, is sometimes called "time immemorial." You might hear that Indigenous people have been living in a place "since time immemorial" or "for time immemorial".

The middle blue star marks 5,000 years ago. If you traced your family tree back to this star, 5,000 years ago is about 200 generations ago! And the blue star on the left side of the timeline marks 10,000 years ago, or 400 generations in the past. And notice that the timeline goes back in time to the left (the blue arrow points left). That is because Indigenous people have been in Oregon for even longer than 10,000 years.

Indigenous people were living here in Oregon, interacting with the land, ocean, rivers, native species of animals and plants, and learning how to live with the land, passing that knowledge to the next generation. This period of thousands of thousands of years, where Indigenous people lived closely with the land and passed that knowledge onto the next generation, has been called "The Long Indigenous Existence". (Wilkinson 2010)

Discussion questions:

1. Can you say the word "immemorial" with me? It has 5 syllables: "em-meh-more-ee-al"

2. What, besides Indigenous people, have been in Oregon since time immemorial?
   Rivers, rocks, mountains, soil, native species of plants and animals, native species of trees, wildfire, the seasons, winter rains are all examples of things that have been in the area since time immemorial.

Slide 3

This is a map of Oregon during the long Indigenous existence, just before a period of great change when gold was discovered by foreign miners, settlers arrived, and Indigenous people were removed from homelands to reservations. The lands in Oregon were tended to by many different Indigenous people, including many more than these 16 Tribes speaking at least 9 different languages on this map.

Discussion questions:

1. Which Tribe's ancestral lands are we on right now?

2. What language was spoken here?

3. Have any of you visited another language area on this map? Have any of you been to three language areas? Four?

Slide 4

During the long Indigenous existence, people gained intimate knowledge about their environments, including plants, animals, waters, and climate. They learned how to obtain everything they needed from the environment around them including food, clothing, and shelter (although many things were obtained from regional trading networks as well). They also learned how to ensure that there would be plenty for future generations. Each generation learned from the past, and added to this knowledge.
This knowledge, where the ways of working with the land are passed from generation to generation, is called Traditional Ecological Knowledge or TEK. As you might imagine, Traditional Ecological Knowledge is very local knowledge. TEK in one area may be very different than TEK in another area, and TEK is something that has been developed and passed down all over the world, wherever Indigenous people lived for very long periods of time, since time immemorial.

This is a picture of a person Indigenous to Oregon, wearing and holding materials obtained from the land and utilizing TEK. The basket in this picture, for example, was made with many different types of plant materials and with an immense amount of TEK.

Discussion question:
What might a person need to know in order to make a basket like this?
A person would need to know which plants could be used to make a good basket, how to harvest them, when to harvest them, where to harvest them, how to properly store or prepare them for making baskets, how to weave them, how to care for the plants so they would continue to provide basketry materials into the future, and how to teach the next generation.

Slide 5

TEK continues today!
Even though, as we will learn, changes in land use in Oregon resulted in the loss of TEK, Indigenous communities keep TEK alive by practicing and revitalizing the knowledge. Here, salmon is being cooked around a large pit fire at a recent gathering of Indigenous people in Oregon.

Discussion question:
What types of TEK might have been utilized and passed on during the cooking and preparation of this salmon?
Knowledge may include where and how to catch the fish, how to leave enough fish so there will be enough in the future, and what trees or shrubs can be used to splay and hold the fish for cooking.

Slide 6

The way that TEK is practiced is different from place to place, and Oregon has many different types of places and environments. Some TEK practitioners are reluctant to share specific knowledge with people who are not Indigenous to their area (because there is a history of outsiders utilizing the knowledge to exploit resources or claim land). Still, even if we do not know specific aspects of TEK, we can learn from the shared themes of TEK.

Discussion Question:
The first theme listed here is "kincentric," what do you think that means?
A kincentric view of the world means looking at all things in nature as kin, or family. By seeing all animals, waters, and lands as kin, they are allowed the rights to exist and thrive. By holding a kincentric view of the world, TEK practices value and enhance biodiversity.

The second theme is "renewal capacity."

Second discussion question:
What do you think renewal capacity means?
Renewal capacity is the ability of a species to renew themselves. By ensuring a species retains its renewal capacity, TEK practices maintain landscapes that provide for future generations. One example of this is that when harvesting the roots of trees for making basketry materials, people knew how and how much to gather so the tree remained living and healthy.

A third theme of TEK is seasonality. Food and plant materials change with the seasons, and as a result, Indigenous people moved to different areas at different times of the year following patterns of hunting, fishing, tending, and harvesting. Tribal leaders studied weather patterns and wildlife conditions to determine the best time to move. These seasonal movements, sometimes called seasonal rounds, are still practiced today by many Tribes.

Another theme of TEK is the use of fire, and the use of low-intensity, controlled burns.

Lastly, a theme within TEK is that many things, including water, are sacred, and are to be shown respect. TEK practitioners often have traditional songs, prayers, dances, or ceremonies that acknowledge that water and other things are sacred and reinforce other themes and practices.

Now that we have learned a little about TEK, let's think about what people might do on the land when they are utilizing TEK. What are some practices that people did and do when working with TEK?

Slide 7

During the long Indigenous existence, fire was a widely used land management practice in Oregon and the Pacific Northwest. Using TEK and fire to enhance a landscape can be called a cultural burn.

Cultural burning can have many effects and ecological benefits: fire recycles nutrients from old growth into the soil, fire can keep areas clear and open for species of plants or grazing animals, fire burns off old and weak plant parts so that new growth come back stronger, and fire can help control pests, such as worms that infest acorns.

Discussion question:
How can regular, controlled burns benefit human communities?

Wherever large amounts of burnable materials are built up, the chances of larger and hotter fires increase. Cultural burning has also been used to simply protect sites, like villages, from catastrophic fires.

Slide 8

Pruning is another practice. Plants utilized for baskets, like this hazel shrub, are pruned so that they will grow many small, straight shoots the following year, which can then be gathered by basket makers.

Photo Credit: Kathy Kentta-Robinson

Slide 9

Weeding. TEK practitioners may weed nearby species so that a plant thrives. The flowers in the picture are Klamath fawn lilies, a plant that has been used for making cordage and nets used for gathering foods. Cultural burning is one way that TEK practitioners have kept areas clear of weeds.

Discussion question:
Do you see any weeds growing with these lilies? Why or why not?

(Allow a discussion to take place that explores the definition of a weed and different ways that people weed gardens.)

A weed is simply a type of plant that is growing in the wrong place, according to the people utilizing plants in that place.

Few other plants are growing with these lilies, but students may observe that a single yarrow plant, a feathery leafed plant, can be seen. The yarrow may be seen as a weed or as another valuable plant that isn't threatening the lilies since there is only one small one.

There are few weeds in this area, possibly because people removed them in the past by hand, or the use of fire burned away other plants.

Slide 10

Traditional tools, like this digging stick, are used for digging root foods from the ground and have a "tilling" effect on soil.

The sticks are often made from strong trees like yew trees, and are hardened on one end by the application of fire (see the burned tip in the photo). Handles are often made from deer or elk antlers. The strongest, hardest, healthier antlers coming from healthy elk and deer, who thrive on post-fire grasses (Scott, personal communication).

Digging sticks are tools used for lifting root foods and medicines from the ground. When groups of people harvest hundreds or thousands of roots with sticks like this one, they can influence the health of the soil in an area. The digging sticks make small holes in the ground, and the holes introduces air into the top few inches of soil and can contribute to soil health. Root harvesters dig, gather, divide, and replant root foods. By doing so, the roots/bulbs remain closer to the surface and easier to dig.

Discussion question:
What is tilling? Do farmers till the soil on farms today? What does that look like?
Tilling is preparing soil. Farmers do this today in many ways including using a plow to turn soil over, a disc or "roto-tiller" to incorporate old plant matter or fertilizer into the soil. Gardeners till soil with small rototillers, or hand tools like shovels and rakes.

Slide 11

Spreading seed. TEK practitioners might spread seeds of plants to increase the size or density of food plots, or carry seeds to new areas to sow a new garden. Plants can be harvested at certain times of the year so that seeds have time to develop and fall, or harvesting baskets can be designed so that even while harvesting seed, some falls to the earth to grow in the future. Yampah, the plant in the picture, has a sweet and crispy edible root and edible, fragrant seeds.

Slide 12

Many root plants, like the camas bulbs that you see in the picture on the left, are replanted during harvests or can be carried to new areas for planting. Camas roots often have many bulbs, so harvesters can collect some, and divide and re-plant the others. By replanting bulbs, the renewal capacity of the patch of camas is maintained and can even be improved. On the right, you can see the purple flowers of the camas plant growing across a large meadow.

Slide 13

Lastly, TEK practices for water-loving plants, like this Brodiaea, include irrigating by digging small channels to divert water from one place to another.

Slide 14

What did thousands of years of TEK mean for the land, animals and plants?

Since TEK is kincentric and it values the renewal capacity of all the plants and animals, the landscape can remain abundant with the resources that the people need to live.

When certain species are so abundant that their presence begins to shape the land themselves, they become a keystone species. Salmon are one example. After salmon spawn, swimming miles and miles upstream from the ocean to lay eggs so the young can breed in cool freshwater, the many adult salmon die. The carcasses are then used by many other species.

Discussion question:
What species might use the adult salmon after they die?

Bear are one example of animals that feast on salmon (before or after they die). Birds are others. Small insects are also important because they decompose the adult salmon and carry the nutrients into the forest where they can be consumed by birds or other animals that eat the insects. Ultimately the nutrients fall to the ground and are taken up by plants and trees. Scientists recently looked at nutrients in old-growth trees, and were able to detect that nutrients from the ocean had been brought far inland by salmon and were ultimately taken up by old growth trees where salmon are still spawning. In other areas without salmon spawns, these nutrients are not found in the trees. In this way, salmon are a keystone species that feed all the other species on the land.

Slide 15

After thousands of years of TEK on the landscape, vast areas of what is now Oregon were large gardens, tended to with fire and other TEK practices.

"The first whites in the Willamette Valley did not tame a wilderness; they inherited a park." Esther Stutzman, Kalapuya, CTSI elder. (Joseph Scott, personal communication, 2021)

When non-Native people arrived, they not only noted the abundance of salmon, but they were impressed by the abundance of plant species as well. Large fields of camas, like this one in the photo, were described as "seas of purple." Along with the accounts of the abundance of salmon and camas fields, many non-Native people noted seeing Indigenous people burning landscapes often. Remember that fire was very widely used during the long Indigenous existence, and that it can be thought of as helping to maintain these abundant ecosystems.

Slide 16

TEK in practice not only leads to abundance, but it also allows for perennial species like trees to grow very old. Some species of trees in Oregon can grow to be hundreds or thousands of years old. Older trees are able to withstand disturbances like fire more easily than younger trees, and they are also able to produce large amounts of seed that ensure new trees for the future. We call these trees legacy trees. TEK practitioners may utilize legacy trees, but the renewal capacity of the tree is maintained. Not only is the renewal capacity maintained during use, families or villages of TEK practitioners may inherit specific legacy trees to care for and use, and pass that responsibility onto younger generations. (Scott, 2021)

Discussion questions:

1. Would gathering acorns from this oak tree maintain the renewal capacity of the tree?
   Gathering acorns would not affect the ability of this particular tree to survive. Gathering all the acorns might prevent this tree's acorns from producing any new trees that year.

2. Would cutting this tree for firewood maintain the renewal capacity of the tree?
   If the tree was cut down entirely, it would not grow back and it would not have any capacity to renew itself. However, if you waited until a branch died, and cut only the dead branch, the capacity of the tree to live would not be affected.

Slide 17

We just learned about the land use practices that Indigenous people used in Oregon for a long, long time. Now we are going to learn about a change in who used the lands in Oregon. We will learn about changes in what the land was used for, and changes in the practices used on the land, including if and how people worked with fire.

(**Note:** now is a good time to take a break from the presentation, if needed, to watch the first 3:30 of the video.)

Slide 18

About 200 years ago, non-Native people began coming into Oregon. In the early 1800's, many non-Native people were fur trappers and traders. When gold was discovered in California and near Jacksonville, Oregon, more and more non-Native people came at a quickening pace. Many of the migrants were from other countries, including US citizens that came west on the Oregon Trail.

We can call this time the beginning of the "colonization" of Oregon. Colonization is the act of sending people to live in and govern another area, where the newcoming population retains strong links to their original country, and where those links provide newcomers with privileges over original inhabitants of the area.

The time of early colonization, marked on the timeline in red, is referred to differently by different people. Some people call this time the time of "contact" between Indigenous and non-Native people. Some people might call it a time of "invasion" of the area by non-Natives. Some may say it was a time of "settlement" by US citizens.

Now we will look at some of the changes in land use that happened during this time, during the shift from the long Indigenous existence to the colonization of Oregon by the United States.

Slide 19

Colonization brought about many changes in land use.

One change that can be seen here is that newcomers used new and different maps. Compare this map to the first one we saw. The newcomers made maps that claimed ownership of vast areas of lands that were occupied by many different Indigenous people speaking many different languages.

A second change is that as Oregon became a state, land became private property, something that could be bought and sold. As more Americans came to what was then called The Oregon Territory, the US passed the Donation Land Claim Act. Through this act, title to land was given, for free, to newly-arrived, non-Native people. Each individual was given 320 acres if they were single or 640 acres if they were married. However, the individual had to be white, male, and a US citizen.

Slide 20

Colonization brought many changes to the people who lived in the area. Indigenous populations were heavily affected in two ways during early colonization: 1) by epidemics and 2) by forced removal.
Even before the arrival of settlers, populations of Indigenous people were heavily affected by epidemics of diseases that killed many and reduced the number of people caring for the land with TEK. Germs came from trade ships along the coast or trade routes through North America, and greatly affected populations of people who had no immunity built up to foreign germs.

Second, at the arrival of migrants, during early colonization, there was much conflict between the Indigenous populations who had lived here for thousands of years and the newcomers. Eventually, Indigenous people were forcibly removed from the lands, marched long distances, and kept in certain areas of the state, far from where the newcomers were settling or setting up industries to remove resources like gold, salmon, and timber.

(**Optional discussion:** Examine the routes and dates of removal of people from western Oregon, including overland marches and removal by boat from coastal communities up the Columbia to the Siletz/Coast Reservation area.)

Just as the newcomers brought changes like new maps and the privatization of land, the removal of Indigenous people and practices brought change as well. This removal of Indigenous people also removed the regular use of TEK practices like cultural burning.

Discussion question:
What changes do you think happened on the land when it was no longer regularly burned by Indigenous people? Fire suppression can lead to the build-up of burnable materials and increase the risk of catastrophic fires.

Slide 21

Another change that took place during this period is the changing of place names. With the removal of Indigenous people from homelands, and the claims to lands by English-speaking people and governments, changes in place names were enacted and are still in use today.

Mt McLoughlin, pictured here, is a major landmark in southwestern Oregon, being the tallest mountain of the Cascade Range between Mt Shasta in California and South Sister near Bend, Oregon. It was named in the late 1800's after John McLoughlin, a French-Canadian who worked with a fur-trapping and trading company to help establish US settlement in Oregon. The name was accepted by the Oregon Legislative Assembly in 1907 and remains in popular use today.

Before this name change, the mountain was known by many different names by Indigenous people of the area. Ma'l-si is a name for this mountain from Takelma people (Scott, personal communication). Shasta, Klamath, and Modoc people all have different names for this mountain, too. These names may have been used for thousands of years before being renamed by explorers and settlers, and may still be used today.

Slide 22

Remember that TEK practices had themes, like being kincentric and focused on renewal. This new period of colonization has themes, too. One of these we have already mentioned is private property, or the ownership of land, where individual US citizens could buy and sell lands. The map on the left shows the traditional homelands of of the Confederated Tribes of the Siletz Indians as the grey, shaded area of western Oregon. The red area along the coast is the Coast Reservation where many people living in the shaded area were forcibly removed to. Over time, more and more lands were taken from Indigenous peoples for US citizens to claim, including the coast reservation in this map. Notice the flier on the right, from 1910, offering land for sale in Oregon and other states.

Discussion question:
How does ownership, where one person can buy and sell land, differ from the TEK theme of being kincentric?

If one person can buy and sell land, the rights of the plants and animals that use that land may be interfered with. If land, water, soil, animals and plants are seen as kin, or family members, they have the inherent right to exist and this right cannot be bought or sold.

Slide 23

A second theme of colonization is exportation, which is the removal of resources from an area so they can be sold and used in another area. Here we see pictures of the removal of legacy trees, first from the land, then on roads and bridges, then on railroads, and finally to a massive, floating barge that is taking trees from Oregon to San Francisco and even as far as China.

Discussion question:
How does removing legacy trees for export differ from the TEK theme of renewal capacity?
If people focus on exporting as much as possible, and making as much money as possible, the renewal capacity of certain species on lands can be disrupted, causing changes in overall ecosystems.

Slide 24

A third theme of colonization is commodification, where something is taken made into a product that can be bought and sold. Here, we see pictures from the early days of colonization when salmon canneries started exporting the fish from Oregon to other areas. It was not uncommon for salmon to weigh over 100 pounds!

Discussion questions:

1. Let's remember the TEK theme of "providing for all the needs of people" from the land, and compare that with the commodification of salmon. What is being produced when salmon is being commodified?
Food for people in other places, jobs, money, and towns. Many towns created during early colonization were set up at traditional fishing spots where salmon could easily be taken from rivers.

2. Do you think the renewal capacity of salmon is being considered in these pictures?
(Allow for an open discussion where students utilize, compare, contrast, and begin to blend themes of land use. Lead students to consider overlaying themes, where salmon or other natural resources can be commodified and shared WHILE renewal capacity is given priority.)

Slide 25

Changes can also be seen in how people view and use water.

Remember the TEK theme that water is sacred, and that to acknowledge the sacred traditions of songs, dances, and ceremonies often accompany TEK. Just as a TEK practitioner looks at plants and animals as kin, with rights to exist, water and rivers have an inherent right to exist. While TEK practitioners might set up camps in the summer next to rivers, winter villages might be in a different, higher location, out of the flood zone, since rivers often swell and flood during winter rains. On the left, you can see Tribal people fishing salmon at Celilo Falls, on the Columbia River, in the 1950's. Native villages and trading sites were located at and near Celilo Falls for at least 15,000 years.

Colonization brought about a time of water control, including dams, diversions, storage lakes and hydroelectric power stations. Water control practices brought power, large reservoirs of water for towns and farms, and controlled floods so that permanent settlements next to waterways were less likely to flood in winter. On the right, the Dalles Dam, constructed in 1957, submerged Celilo Falls.

Slide 26

Remember that fire, or cultural burning, was a very widely used TEK practice in Oregon.
Shortly after the colonization of Oregon, all burning, including naturally-occurring wildfires, was suppressed, or stopped. Fire was seen as a threat to towns, farms, and the timber resources being exported.

Discussion question:
During the long Indigenous existence, cultural burns were applied regularly to many areas of Oregon. Do you think that suppressing fires for long periods after colonization led to any changes on the land? Can you describe the changes that may occur when fire is suppressed?

Suppressing fire can lead to a build up of burnable materials. Burnable materials can increase the intensity of a fire, and can become ladder fuels which are materials that can burn and pass a low-burning fire to the forest canopy, causing more damage to trees.

Plants and animals that depend on regular fire cycles may also be affected. For instance, some seeds need fire to germinate.

Slide 27

Fires that move through the land today are moving through lands that are shaped by who has used the lands, what they used the lands for, and how they care for, or steward the land. Fire suppression can lead to a buildup of burnable materials. In the picture on the left, we see an example of ladder fuels passing a ground fire toward the canopy. The ladder fuels increase the risks of fire.

In the picture on the right, we see a landscape that has been managed with prescribed fire in the recent past. Notice the absence of large burnable materials on the ground and the absence of low, dead branches on the trees. Also notice how the fire is low to the ground and not passing to the canopy. Ground fires generally burn cooler and cause less damage to trees than fires in the canopies.

Slide 28

We have just learned a lot about traditional ecological knowledge, including its themes: of seeing other species as kin, seasonality, protecting renewal capacity, using fire, and regarding water as sacred.

We also learned about the colonization of Oregon, and how new themes of land use were enacted on the land, including land ownership, commodifying and exporting goods, fire suppression, and water control.

Slide 29

The changes we have been learning about happened in the last 200 years, which is a small piece of the timeline. Although the portion of the timeline is small, the changes brought about are large, and affect the land that we now call home today.

Slide 30

Now we are going to think about how we might use land, and how to use some of the land use themes we have been learning about.

(Display this slide as a visual reference for when students are working through the "Land Stewardship" worksheet and you conclude the activity)

As you pass out the worksheets, discuss what being a land steward means:
A land steward is a person who takes care of land while taking into consideration different things including ecology (the plants and animals that live there or use the area), economics (what people may get from the land), and social or cultural dimensions, who or what has access or has their access changed as in the scenarios we talked about in the warm-up activity.

Read through the instructions on the worksheet, and give students 15 minutes to work.

Conclusion:
Ask students about utilizing the themes and practices on the worksheets. Choose a few TEK practices/ themes, and have students share how and why they chose to use them in their landscapes.

6th - 8th

Lesson 7
When to Burn?
Climate Change and Oregon's Fire Season
Climate Change and Fire, part one

NGSS: MS-ESS3-3 , MS-ESS3-5, MS-LS2-4 , MS-LS2-5

Summary

75 minutes
Optional: Additional 30 min. Listening and Art Activity

Climate change is affecting fire season and fire intensity across Oregon landscapes. Longer fire seasons and larger, hotter fires pose increasing risks to human, animal, and plant communities. While prescribed burns can help make and maintain fire-adapted landscapes, their ability to be implemented is complicated by factors of climate change, land use history, and an increase in population living in the Wildland–Urban Interface (WUI). Students will look at patterns of climate change in Oregon and learn how these affect fire season and the use of prescribed burns. Students will understand the compounding factors associated with prescribed fire and think critically about how to mitigate risks.

GOALS

- Students will view a slideshow and participate in a classroom discussion to develop understanding of how climate change contributes to fire season and severity.
- Students will complete a worksheet to demonstrate understanding of how landscapes affected by climate change pose risks to communities and may complicate management plans for prescribed fire.
- Students will participate in an activity that considers the risks of climate change and benefits of prescribed burns.

CLASSROOM PROCEDURE

1. Warm Up: Think-Pair-Share-Feel
2. Activity One: Climate Change and Oregon's Fire Season (slideshow)
3. Activity Two: When to Burn? Worksheet

PREPARATION & MATERIALS:

1. Review Climate Change and Oregon's Fire Season presentation
2. Print one copy per student of When to Burn? Worksheets (print single-sided)
3. Review worksheet answers
4. If completing the optional podcast activity: print Fire Mandala Coloring Pages (enough for one per student) and set up a computer with speaker that can play audio to the entire class
5. Gather coloring utensils, pencils, scissors, and glue/tape for worksheets and mandalas

VOCABULARY AND TERMS

Climate: long-term patterns of weather over time including temperature, precipitation, and humidity

Fire intensity: how hot a fire burns

Fire season: the period of the year when wildfires are most likely to occur and a legally-enacted time when restrictions and prohibitions are in effect

High-severity fires: burn hotter and faster, are more difficult to predict and contain, and have the potential to cause damage in the areas they burn

Mediterranean-type climate: characterized by cool, wet winters and hot, dry summers

Prescribed burn: an intentional fire set on a particular area with a particular purpose and plan

Wildland–Urban Interface (WUI): the area where human development and wildlands meet

BACKGROUND INFORMATION

For this activity, students should be familiar with cultural burning.
(See Lesson 5: Fire as an Agricultural Tool)

Fire season is the period of the year when wildfires are most likely to occur. It is also a legally enacted time when activities are regulated by the Oregon Department of Forestry, Tribal governments, federal agencies, or at the county/city level.

Areas where there are dry, hot summers (a Mediterranean-type climate) experience natural and dependable fire seasons, including areas of Oregon and California, parts of Australia, much of the Mediterranean, parts of the west coast of South America, and in South Africa. Fire, both natural and intentional, is a keystone process that is essential to these landscapes.

While there have been other periods of climate change, current patterns are happening more quickly than during any other known periods in Earth's history (IPCC 2018). Climate change includes human-induced global warming as well as its impacts on weather systems, and poses compounding risks to humans, animals and plants forced to adapt. The main cause of human-induced global warming is the emission of greenhouse gases from burning fossil fuels for energy. Climate change is responsible for warmer temperatures, declining snowpacks, reduced summer rains, and earlier springs, all of which contribute to longer fire seasons and increases in fire size and severity (Littell et al. 2018).

The previous lesson (Lesson 6: Land Use History) shows how changes in land use can contribute to an increase in the risks associated with fire. The shifts associated with climate change can compound these risks.

Fire is a natural phenomenon in many areas of Oregon that has many benefits to biodiversity and natural resource management (see Lesson 5: Fire as an Agricultural Tool). Returning prescribed fires, and their ecosystem-engineering effects, to landscapes (particularly those that have experienced fire suppression) can be complex. Though traditional resource managers may have favored a certain season for burning (i.e. late fall), climate change, land use history, and fire season regulations mean adjusting these practices to a changing world.

Prescribed fire and cultural burning can help restore landscapes and create fire adapted communities. However, fire practitioners of today and the future will need to be well-informed of how climate change, fire season, fire science, public perception and public safety intersect.

Warm Up

Think-Pair-Share-Feel
Classroom time: 15 minutes

Think: Say, "Climate change is affecting weather, weather patterns, and shifting the times when phenomena normally occur. I want you to think of an example from your own life where the season is shifting due to climate change, and write this down on a piece of paper." Give students 1-3 minutes to write this down.

Pair: Have students get into pairs or small groups to share their examples.

Share: Bring the class together and ask students to share with the entire class. Consider asking for an example that includes temperature, then for an example that includes a shift in the life cycle of plants or animals, a shift in schedules, or a shift due to smoke.

Feel: Acknowledging the effects and realities of climate change — especially those related to fire — can be emotionally triggering for students. Consider taking time to acknowledge sadness, frustration, guilt or hopelessness that may arise by giving students a couple minutes to sit comfortably, close their eyes, breathe deeply, and notice how they are feeling. Follow this up by allowing 1-3 minutes for them to write this down and/or share with the class.

Conclude the Think-Pair-Share-Feel by introducing the idea that climate change is causing changes in seasonality, or when things normally happen.

Activity One

Climate Change and Oregon's Fire Season (slideshow)
Classroom time: 30 minutes

Present the "Climate Change and Oregon's Fire Season" slideshow, using the information and discussion questions in the presenter notes.

Activity Two

When to Burn? Worksheet
Classroom time: 30 minutes

Hand out worksheets to each student.

! Make sure to check for students' understanding that they should not be conducting any type of fire outdoors without the help of an adult. Prescribed burning and cultural burning both require many trained professionals and extensive knowledge beyond this lesson. You may choose to encourage students to further their study of fire and learn how to work toward a future career in a related field.

Introducing the When to Burn Worksheet: "Now it's time for you to be the boss! In this activity, you are being asked to be a 'burn boss,' to be in charge of the timeline for a prescribed burn. The area that you are being asked to burn is an open prairie full of camas, the beloved First Food plant we have been learning about. You will need to burn at a time that helps the camas patch and also considers fire season and the safety of people who live nearby in the wildland–urban interface."

Page one: Draw or write out your timeline.Your calendar is for next year, beginning with January on the left and ending in December on the right.

Page two: Read through the image descriptions, then draw and color (or cut out and glue/tape) the images onto your timeline above the month in which they belong. Also label each image.

Page three: Answer the questions on the third page.

Camas lily

Camas is a perennial plant with edible underground bulbs. It has a magnificent 6-petaled purple flower contrasted with bright yellow pollen-covered anthers, and often grows in wet meadows.

Camas is a special food plant, sacred to many Tribes in the Pacific Northwest. At one time, camas was the most widely traded food in the region, after salmon. Many places where Europeans first settled, built farms, and established cities in Oregon were ancient gardens of camas, tended by Indigenous people for thousands of years.

Camas and many other native food plants are geophytes. Geophytes are plants with underground parts that survive when conditions above ground are too harsh. Camas bulbs can survive in soils for years without flowering...even decades! Increases in soil temperature and sunlight trigger camas bulbs to flower. Traditional tending practices include the application of fire, which burns off material covering the soil, allowing more sunlight and heat to reach the soil and the roots/bulbs within them.

Conclusion

Conclude the lesson by projecting the sample calendar for review and discussion.
Suggested discussion points:

1. Review the fire season at the prairie, and remind students that this is something that may vary each year. Review the effects of climate change on fire season, that increased summer temperatures, decreased snowpack, and droughts can mean earlier and longer fire seasons in the future.

2. Review the life cycle of the camas plant, and the time on the calendar when seeds would be collected and spread. (See slide 15)

3. Review when precipitation was predicted to return in the fall, and remind students this is the end of the fire season.

4. Discuss when and why they may decide to burn, reminding students that a cultural burn of camas on an open prairie might occur at a time when fire season is being enforced in other climates and forests in Oregon.

5. Prompt students to discuss safety measures they could think of, like working with other trained professionals, accounting for wind direction, alerting the neighbors beforehand, and contacting the local fire department for support.

6. Ask if any students constructed timelines that differed from the example, and discuss their reasons for differing.

7. Discuss the benefits and needs for cultural burning to occur at times of the year that may fall within fire season.

8. Review the differences of fire behavior in an open prairie and forest locations, fires in grasslands may burn with less intensity and smolder less than in areas with woody materials.

9. Conclude that prescribing and applying fire is complex. Fire practitioners and experts take into account life cycles of plants and animals, how fire will behave in a particular environment and time of year, cultural norms, and what safety precautions to take to keep nearby communities safe.

Take-Away Concepts

- Climate change is affecting Oregon's climate with increased temperatures, decreased snowpack, and intensity of drought.

- Climate change in Oregon is lengthening the fire season with early starts and late ends.

- Prescribed burns, a beneficial land practice, must take into account multiple factors including effects on plant and animal communities and risks (real or perceived) to humans.

Additional Art and Listening Activity

For an additional discussion of climate change and fire, listen to this 30 minute podcast:
"Fire: the Problem and the Solution" podcast from Klamath–Siskiyou Wildlands Center.

You may print and have students color one or more Fire Mandalas while listening to the podcast. Explain to students: "Coloring the mandalas is one way to practice self-regulation, an important component in living with trauma. Other self-regulation strategies include taking deliberate deep breaths and letting them out slowly, or shaking out your arms and legs. These strategies can be helpful not just when learning about difficult topics like fire, but any time you're feeling stressed or anxious." For more information about supporting students in self-regulation, see the Trauma-Informed Care resources included with the full curriculum.

NAME _____ DATE _____

6TH - 8TH

Lesson 7

When to Burn?

You're the boss! You have been asked to be "burn boss" for a prairie where camas, a beloved First Food plant, grows. Your task is to make a plan for burning, helping return nutrients to the soil and to maintain an open prairie so the camas thrives. You will also need to consider the safety of people who live nearby. Use the calendar below and the seven images on the next page to fill in your plan.

January	February	March	April	May	June	July	August	September	October	November	December

1. Last winter, snowpack levels in the mountains above the prairie were low. We expect they will melt quickly and the prairie will be dry early. It looks like fire season is going to arrive early, in the middle of May. Draw this symbol on the calendar, at that time.

2. Fall rains are needed for fire season to end, but this year they don't come until the end of October. Draw this symbol again on the calendar, at that time. Between the two symbols is the fire season where no burning is allowed.

3. Camas plants form beautiful 6-petaled purple flowers with yellow anthers that produce pollen when the petals are open. This year they flower at the beginning of May in the prairie, a little earlier than usual. Draw the camas flower on the calendar at that time.

4. Camas plants produce seed in 3-part clusters like this one. This year they produce seed at the beginning of July in the prairie, a little earlier than usual. Draw the camas flower on the calendar at that time and label with "camas producing seed." This is when you will collect seeds for future planting!

5. Fall rains and snow are forecast for the beginning of December. Draw one or more of the snowflakes at this time on the calendar. You will need to make sure you burn before this time, as snow makes burning difficult.

6. Camas plants need an open prairie to grow well, and fire can be used to keep the prairie open. Draw a fire symbol on the calendar when you think it is best. Remember that the fire cannot be during fire season, and that you want the plants to flower and produce seed before you burn.

7. The camas seed you collect can be sown anytime after the fire, but it will need 2 months of cold, wet, winter-like conditions to sprout. Draw camas seeds on the calendar when you plan to spread seed and label with "sow camas seed."

Lesson 7: Presenter Notes

When to Burn?

Slide 2

What is climate? Is it different from weather?
Weather is what is happening right now in the atmosphere, while climate includes weather patterns or how the atmosphere "behaves" over time.

Different places have different patterns of weather that scientists can observe and measure, including patterns in temperatures, precipitation, and humidity.Oregon has a very diverse landscape, with several climate types. What do you think makes different areas have different climates, or different patterns in temperature, precipitation, or humidity?
The climate of a specific location is affected by: latitude/longitude (where it is north/south and east/west), altitude, terrain (steep or flat), as well as nearby water bodies and their currents.

Discussion question:
Can you think of a time when you traveled to a place in Oregon that has a different climate than where you live? What makes that place have a different climate?

Slide 3 (summary of the first slide)

Again, the climate of a place refers to the patterns in temperature, rain and snowfall, and humidity, and these things are all affected by the location of a place on the earth (latitude and longitude), the altitude of a place, the terrain, and if the place is close or far from large bodies of water.

Slide 4

There are many different climates in Oregon. This maps shows different climate types with different colors. Where there are different patterns in temperatures, precipitation, or humidity, there are different types of climates.

Discussion questions:

1. According to the map, what type of climate do you live in?

2. What are the blue areas in the map? The blue areas indicate mountains and a climate that is defined largely by high altitudes and steep peaks of mountains.

3. Do you see climates that are affected by their proximity to water? The green area indicates a climate that is defined largely by the proximity to the Pacific Ocean. The tan and pink areas are climates defined by being far from the ocean and separated from it by the Cascade mountains.

Slide 5

While many types of climates exist in Oregon, we can generally summarize the climate in Oregon: most of the state has winters that are cool and wet, and summers that are hot and dry.

Slide 6

Now that we have learned about climate in Oregon, let's think about how climate changes and look at how the climate is changing.

Climate change is just that: a change in climate, or the change in the usual weather patterns found in a place. While there have been other periods of climate change, including those thousands of years ago, the current changes are happening more quickly than during any other known periods in Earth's history. The main cause of human-induced global warming is the emission of greenhouse gases from burning fossil fuels for energy.

Climate change is affecting Oregon with warmer temperatures, a longer dry season (more precipitation in summer), and less snowfall in winter.

Slide 7

Let's look at what is changing and what is not changing in Oregon during climate change.
In the graph on the left, we see the amount of precipitation falling on Medford, Oregon, over 100 years. Remember that precipitation can mean rain or snow. Notice that there is very little change in the average amount of precipitation falling.

Now look at the graph on the right. This is the amount of snowfall at Crater Lake over the last 100 years. We can see that there is more change in the average amount of snowfall each year.

Here we can see that climate change affects places with different climates differently. Crater Lake is a very high altitude area that typically gets snow, but as the temperatures warm, the area receives less snowfall.

Discussion question:
How could less snowfall affect the next summer?
Snowpack is a key predictor in how much water will be available in the dry season. Less snowfall means that high altitude snowpacks melt more quickly in the spring, and that areas dry up more quickly.

Slide 8

Here is a visual of how climate change is affecting wildfires through the summer months.
This graph shows the amount of land burned each month. The orange line represents the land burned in the past (1984-2000), and the blue line shows the land burned in more recent years (2001-2017).

Discussion question:
What are the differences between the past and the recent years that we can see in this graph?
We can see that more land is burning overall and that peaks of burned area are occurring earlier in the year.

Slide 9

Fire season is the time of the year when wildfires are likely to spread. It typically begins in early summer, and ends in fall. Depending on the area and the year, fire season, or the time when restrictions are in effect, typically lasts 100-160 days, or a little over 3 months to a little over 5 months.

For state or federal agencies, fire season is a legally enacted time, when certain activities are regulated or prohibited. For example, fire season restrictions are declared by the Oregon Department of Forestry, and are declared in four categories: low, moderate, high, and extreme fire danger.

Slide 10

This map shows the different districts of the Oregon Department of Forestry, marked by different colors. Each department is responsible for declaring when fire season begins and ends in their district, so each district has a slightly different fire season.

In 2021, the Southwest Oregon District had the longest fire season of all the districts. The fire season there was 161 days long. The district with the shortest fire season was the North Cascade District, which had a fire season that was just 98 days long.

Discussion question:
What do you think causes a fire season to be longer or shorter?
Differences in climates can lead to shorter or longer fire seasons (refer to slide four). Areas with drier summers may experience longer fire seasons than areas where it is more likely to rain in the summer. Differences in longer-term climate patterns can affect fire seasons, too. Typically, a long fire season follows a winter that had less snowpack or precipitation than unusual.

Slide 11

Here is a visual of the longest fire season in Oregon in 2021. In the Southwestern District (Jackson and Josephine Counties), fire season was declared on May 12th, and ended on November 1st. As climate change continues and if it intensifies, Oregon could see more and more long fire seasons like this one, and perhaps even longer ones.

Slide 12

As we just learned, climate change is causing higher temperatures, less snowfall, and more drought. All of these things can lead to more fires and can lead to more high-severity fires. High-severity fires are those that burn hotter and faster, are more difficult to predict and contain, and have the potential to cause damage in the areas they burn.

Slide 13

The increase in human population and human development also means more potential risks from wildfire. The wildland–urban interface is the area where human development and wildlands meet. The WUI is an area where there is a risk of wildland fire to damage human communities. Wildfires are more likely to start in the WUI, too, since many wildfires are started by human activities.

Slide 14

Wildfires can be dangerous during the fire season, but let's remember that fire is also our friend, capable of doing many good things!

Fire is a natural part of Oregon's climate, and can help landscapes in many ways. Fire is also an important part of Indigenous culture and land practices here. Fire has been central to many parts of Indigenous culture, including cooking food, tending to food plants, tending to plants used in basketry, fires in First Food ceremonies, dances, and celebrations, for enhancing tools like digging sticks, for herding animals during hunting, or for helping create better browsing materials for animals.

The intentional use of fire is sometimes called a prescribed fire, and the intentional use of fire for a plant or area with cultural significance to Indigenous cultures is sometimes called a cultural fire or cultural burn. With any prescribed fire, one question that people must ask themselves is when to burn. Seasonality of prescribed burns is important for safety and for having specific effects on certain parts of the environments, like plants.

These pictures are from a prescribed, cultural burn that includes Tribes and federal land managers working together on a prairie.

In the first picture, we see Agnes Baker-Pilgrim, Takelma Elder of the Confederated Tribes of Siletz Indians, lighting a prescribed burn with a drip torch. Fire is being used intentionally to help keep an area clear so that camas, a First Food plant with a purple flower and an edible root, can grow and spread. The fire recycles nutrients, removes plants that would compete with camas for nutrients or shade it out, and creates micro-sites where seed can take root. Volunteers helped to collect camas seed before the burn, and to sow the seed following the fire. All of this helps spread the patch of camas and maintain the open habitat that the plant prefers.

Discussion question:
How might applying fire to a prairie be different from applying fire to forested areas?
Prairies, which have less tall, woody growth, would have fires that stay close to the ground compared to areas with tall trees and dense, woody undergrowth. Fires move through prairies quickly and smolder less than those burning larger, woody material in forests. Prairies might have different wind speeds or directions. Forests and prairies include different habitats for species of plants and animals that may need special consideration, such as culturally important plants or threatened species of animals.

Slide 15

For the prescribed burn discussed here, two of Oregon's federally-recognized Tribes, the Confederated Tribes of Siletz Indians and the Confederated Tribes of the Grand Ronde, worked together with the United States Forest Service to decide when, where, and how to burn.

When to burn: They worked with the life-cycle of the camas plant, taking care to collect seed before the burn and spread the seed shortly after the burn, to help restore the habitat so more camas could grow. They also worked with fire season and conditions on the land. Depending on the year, camas plants produce seeds while fire season is still in place. To ensure a camas prairie will burn, conditions need to be fairly dry. For these reasons, camas prairies may be burnt during a time of year when fire season is still being enacted on other, nearby lands. This illustrates how complex it can be for people to work with fire on a landscape with a variety of lands and climates.

Since the start of the project over ten years ago, the prairie has been burned five times, once every two years. The amount of camas in the prairie has more than doubled since the burning regime began. The Tribes working on this project hope that in the near future, there will be enough camas here to begin harvesting. Traditional harvesting will include digging up bulbs and dividing some for replanting—a practice that will also help more camas plants to grow and spread in the prairie.

These cultural burns, and traditional harvests, are important parts of Tribal health initiatives, and have many benefits to the land as well.

Discussion question:
For cultural burning of camas, which grows in open prairies, fire may be applied during dry parts of the year, when fire season may still be in effect on nearby forested lands. What precautions do you think fire practitioners need to think about when applying fire to a camas prairie when conditions are dry?
Fire practitioners would need to think about wind direction, where the fire would be started and where it would be stopped, and who needs to be notified before burning so people do not mistake a cultural burn for a wildfire.

Slide 16

When people are planning to do a prescribed fire, one of the questions that they must ask themselves is: When to burn?

Safety precautions must also be taken, such as establishing boundaries or fire "breaks," and communicating with nearby communities so that cultural burns are not mistaken for wildfire.

Prescribing fire in a changing climate, where fire season may start early or run late, and where nearby people live, can be complex.

But by thinking about plants, the climate, and nearby communities, we can make good decisions about how to bring fire, our friend, and its benefits back to lands even in a changing climate.

Now we are going to do an activity where you will get to begin to answer the questions: when to burn and how to remain safe while burning.

6th - 8th

Lesson 8
Community Preparation and Resilience

Fire and Social Issues, part one

NGSS: MS-ESS3-2 OESS: 6.26

Summary

60 mins

By analyzing the demographics of people affected by natural disasters, it is clear that certain people experience the effects of wildfire and smoke differently. Tribal communities, communities of color, immigrants, and low-income families are often more vulnerable to climate disasters. For instance, the effects of wildfire will disproportionately affect the health and safety of those living in proximity to areas of fire risk and those with outdoor jobs through exposure to smoke. Some communities also experience disparities in relief efforts following climate disasters. Students will examine four case studies of diverse communities in Oregon and Northern California affected by wildfire, and discuss and present solutions for community preparedness and resilience.

Goals

- Students will read articles and participate in discussions to identify how different groups of people may experience negative effects of wildfires differently, and identify ways in which these groups might overlap.
- Students will read case study examples of different groups of people experiencing wildfires in Oregon and Northern California.
- Students will discuss, develop, and present ideas about how their communities can protect and provide relief to vulnerable populations.
- Students will consider multiple perspectives and empathize with different demographics.

Classroom Procedure

1. Introduction discussion and trauma awareness acknowledgement
2. Activity One: Wildfire Affected Communities: Four Case Studies
3. Activity Two/Conclusion: Community Preparedness and Resilience Chart

Materials

Four Case Studies (one case study per group):
- Almeda Fire: Immigrants
- Camp Fire: Elderly
- Bootleg Fire: Tribes
- Multiple Fires: Houseless

Real Communities, Real News Worksheets

Preparation

Students should have a basic understanding of climate change and the effects of climate change on fire season (see Lesson 7: Climate Change and Oregon's Fire Season).

1. Print one copy of the Real Communities, Real News Worksheet for each student.
2. Prepare to divide the class into pairs or groups and assign one case study to each.
3. Print (or provide access to digital files of) the four case studies, one for each group.
4. Familiarize yourself with each of the four case studies and how they relate to the worksheet.

The four case studies are excerpts from full articles. The full articles are listed here, for reference:

1. Almeda Fire: "An American Dream, Scorched in Oregon" by Jim Tankersley was originally published by The New York Times. A paywall-free version is published by United We Stay: An American Dream, Scorched in Oregon — United We Stay
2. Bootleg Fire: "For the Klamath Tribes, the damage wrought by the Bootleg fire is deeply personal" by Lucy Sheriff was originally published by Underscore: Underscore | A Wildfire Hits Home
3. Camp Fire: "Tragic but familiar narrative in Camp Fire: Most victims were old, disabled" by Jill Tucker was published by SFGATE: (https://www.sfgate.com/california-wildfires/article/Camp-Fire-victims-13450654.php)
4. Multiple Fires: "California's Homeless Population Faces Wildfire Smoke and COVID-19" by Kristine Liao was published by Global Citizen: (www.globalcitizen.org/en/content/california-homeless-face-wildfire-smoke-covid-19/)

Since this activity includes discussions involving race, review specific social-emotional learning skills to bring into the classroom: Three SEL Skills You Need to Discuss Race in Classrooms (berkeley.edu)

Since this activity includes discussions involving natural disaster and wildfire, students might experience trauma-related emotional responses, especially those who have recently been directly impacted by wildfire and smoke. Resources for this can be found in the "Wildfire Preparedness and Trauma Informed Resources" section of the conclusion section of this curriculum. One resource includes anticipating reactions to traumatic natural disasters and helping young people heal and thrive during and after a wildfire. It can be found here:

Wildfire Resources | The National Child Traumatic Stress Network (nctsn.org)

For a comprehensive resource developed specifically for teachers, which includes suggestions for identifying a trauma response in students of various ages, along with strategies for self-regulation and co-regulation, see OSU Extension's Trauma-Informed Care Toolkit.

Vocabulary

Affordable housing: low-cost housing that families with lower than average income can pay for and live in

Community resilience: the sustained ability of a community to use the available resources to respond to, withstand, and recover from disasters

Demographics: descriptions or characteristics of a community of people such as age, race, or ethnicity

Immigrant: a person who moves from one country to another country

Background Information

Wildfires are an example of an extreme weather event, like floods, droughts, and hurricanes. The intensity and frequency of extreme weather events are increasing due to ongoing fossil-fuel emissions that exacerbate climate change.

Victims of wildfire can be affected in a variety of ways ranging from the health effects of smoke, loss of homes or homelands, emotional trauma, injury, or death. Disparities exist in how different demographics, or communities of people with shared characteristics, experience wildfire and the effects of extreme weather. Disparities also exist in how demographic groups access and receive resources to recover and rebuild following natural disasters.

This activity presents four case studies and allows students to discuss and present specific ways that four different demographics may be affected by wildfires. Students will present ideas for protecting a demographic through preventative measures and relief efforts.

Introduction Discussion

1. Lead with trauma awareness: This activity involves frank discussion of wildfires and victims of natural disasters. Review the "Wildfire Preparedness and Trauma Informed Resources" section of this curriculum and be prepared to model self-awareness and self-regulation, and to co-regulate with students should they display signs of a trauma response.

2. Introduce the activity: "We are going to learn about how wildfires can impact people. I know many of us have been directly impacted by wildfires, and it can be hard to talk about. It's normal to feel anxious, scared, or upset. If you notice that you are feeling stressed during the lesson, you can step away for a moment, take some big long breaths, or shake out your arms and legs. Let's practice together right now." Lead the group in a few big breaths.

3. Invite students to share examples of how a wildfire might negatively impact someone — they might know this from firsthand experience, or from hearing about fires on the news, in stories, etc.

4. Make a list on the board of "Effects of Wildfires on People." Examples of the effects of wildfires on people might include: injury, death, loss of home, ability to work, damage to infrastructure, smoke, travel restrictions.

5. Invite students to brainstorm how natural disasters affect people differently or how certain people may suffer more than others. Introduce the concept of "demographics." and begin to make a list on the board of demographics more affected by smoke. Examples of demographics more affected by smoke are those experiencing homelessness, those who work outside, those with asthma or other respiratory illnesses, those who lack access to air purifiers, those who cannot travel to escape the smoke season, elders, and youth.

6. Additionally, ask students which communities may be more likely to lose a home in a wildfire, and add answers to the demographics list. Examples of communities who might lose a home in a wildfire are those that live in the wildland–urban interface or those that live in drier areas.

7. Conclude the discussion by saying, "Now that we've started thinking about the vulnerability of different demographics to wildfire, we're going to look at some examples from the recent past in Oregon and Northern California and learn how communities can be resilient to the effects of wildfire."

Activity One

Wildfire Affected Communities: Four Case Studies
Classroom time: 30 minutes

1. Explain to students that they are going to learn from some real-world examples of wildfires that affected different groups of people in Oregon and Northern California.

2. Divide students into groups or pairs, and assign one case study to each. Provide either printed or digital copies of the articles and a printed copy of the Real Communities, Real News Worksheet to each student. Note that case studies have words or statements in bold that relate to the questions on the worksheets.

3. Direct students to read their assigned article and work with their partner(s) to answer the questions on the front of the worksheet:

    - What fire is covered in your article?
    - What demographic (community of people) does this article follow?
    - List the ways this demographic was affected by wildfire.
    - How did the community provide relief to those affected?

4. Next, ask students to turn over their worksheets. Explain to students that they are now going to plan and take action as though they were part of the community described in the article. Students should discuss as a group and record their answers on the back of the worksheet.

5. Ask for volunteers to present their case studies to the class.

Activity Two

Conclusion
Classroom time: 20 minutes

1. First, draw the chart below where the whole class can see it, leaving the "Community Preparedness" and "Community Resilience" columns empty. Define "Community Resilience" for the class.

2. Next, have different volunteers present their reflections from each of the four articles.

3. As students present answers, list their suggestions for preventative action under the column "Community Preparedness."

4. List suggestions for how to provide relief to wildfire victims in their articles under "Community Resilience."

5. After each presentation, encourage other groups to ask questions of the presenters, share other prevention or relief effort ideas, and discuss the feasibility of the ideas. For example, ask the presenting group if they can think of where resources might come from, who would be responsible for carrying out the work, and if volunteers would be needed.

6. Some examples of community preparedness and community resilience that are related to the four case studies are:

Case Study	**Community Preparedness**	**Community Resilience**
Almeda Fire: Immigrants	• Fire resistant, affordable housing • Fire alert systems	• Food and materials drives • Temporary shelter offered by neighbors • Restaurants provided meals • Help with insurance • Long-term affordable housing
Camp Fire: Elderly	• Better fire alert systems • Prescribed burns near homes • Fire-resistant home upgrades • Maps and records of who may need help in an evacuation • More evacuation plans (like those in nursing homes)	• Help with insurance • Temporary shelter • Food and materials drives • Rebuilding affordable housing for elderly
Bootleg Fire: Tribes	• Prescribed burning • Cultural burning • Increase Tribal presence in land management decisions	• Increase Tribal presence in clean-up/post-fire • Funds for site assessment and cleanup
Multiple Fires: Houseless	• Free smoke masks • Spaces for shelter from smoke • Affordable housing • New, good jobs	• Shelter space in community buildings • Shelter space in local hotels or business spaces • Clean-air refuge in libraries and other community buildings or empty buildings

Take-Away Concepts

- Disadvantaged people are already more at risk to the effects of natural disasters like wildfire and smoke season, including Tribes, immigrants, homeless people, and the elderly.
- By learning from past examples of wildfire effects on communities, we can prepare for future wildfire events and improve community resilience after a fire.

NAME _____ DATE _____

6th - 8th

Lesson 8: Community Preparation and Resilience

Real Communities, Real News

Working in your group, read through your article and answer questions 1-3 below.

1) What fire is covered in your article?

Name of fire: _____

Area (town, state) of burn: _____

Date of fire: _____

2) What demographic (community of people) does this article follow?

3) List the ways this demographic was affected by wildfire.

4) How did the community provide relief to those affected?

After reading the article and answering the questions on the first page, discuss what lessons can be learned from your article and what could be done in your community to help people be prepared or recover from a wildfire.

What could be done in your community to prevent this from happening in the future?

If this happened in the community where you live, what could your town do to help the victims?

Are there any ways that individuals or small groups of volunteers could help the victims, either in the short or the long term?

9TH - 10TH

Lesson 9
Fire Policy and Practices of the Last 200 Years

Fire and Land Use History, part two

NGSS: HS-LS2-6, HS-LS2-7, HS-ESS 3-1

Summary

120 min. (two or three class sessions)

Land management is a term that describes how people make decisions and take action concerning ecosystems and the resources that they provide. Land management has a direct effect on the health of humans and the environment. Students will examine land use policy over the last two centuries and how it has shaped forest land management in Oregon. Students will gain a historical perspective of fire behavior today, and think critically about how land management decisions can affect the resiliency of landscapes and human communities into the future.

GOALS

- Students will learn about prevailing land management policies in the 20th century and how they have influenced and changed ecosystems in Oregon.
- Students will read about modern land management strategies and will work in groups to share their understandings and discuss solutions for current wildfire issues.

Preparation & Materials

- Computer with projector or smartscreen. Prepare to show lesson video "Climate, Fire and People: A Community Discussion"
- Print one copy: Shaping Forests and Fire Timeline (29 pieces). You may choose to cut out the pieces in advance.
- Tape or glue, poster board, scissors (if needed), and markers or white board markers/chalk
- Student journals or writing paper
- Print or digital copies of news articles for the class to share. Each student will read and share one news article with their group of 3-4 students.

Teacher's Note

Articles recent to the time of publishing are included below. You may choose to research, or have students conduct research for timely articles related to land management, prescribed fire, or restoration with fire.

US Forest Service Fire Suppression
Forest History Society
https://foresthistory.org/research-explore/us-forest-service-history/policy-and-law/fire-u-s-forest-service/u-s-forest-service-fire-suppression/

Beware of wildfire solutions that will make the problem worse
Richard Fairbanks
https://forestfirefacts.org/rich-fairbanks-beware-wildfire-solutions-will-make-problem-worse/

Officials Push to Increase Prescribed Burns in Oregon and West Coast, but obstacles await | Register-Guard
June 22, 2021
https://www.registerguard.com/story/news/2021/06/22/prescribed-burns-oregon-wildfire-prevention-legislation/5306131001/

'Fire is medicine': How Indigenous practices could help curb wildfires
PBS NewsHour
https://www.pbs.org/newshour/science/fire-is-medicine-how-indigenous-practices-could-help-curb-wildfires

Ancient Native American forest practices demonstrated in burn near Eugene
October 19th, 2021
https://www.klcc.org/post/ancient-native-american-forest-practices-demonstrated-burn-near-eugene

Vocabulary

Fire suppression: the use of tactics used to stop, minimize, and prevent wildfires. Typically, wildland firefighters work in crews together with aircraft to construct fire breaks and extinguish flames.

Industrial land management: utilizing land for commercial purposes, often employing mechanized equipment and prioritizing profits above all else

Land management: the process of decision-making and implementation of using land and land resources for human benefit. Examples may include agriculture, logging, reforestation, water management, and eco-tourism projects. Land management may have positive or negative effects on the land, depending on the type and scale of activities.

Land use policy: The ways in which society reflects its cultural beliefs and practices through written documents and laws.

Background Information

Land management describes how people make decisions and take action concerning ecosystems and natural resources. The term "management" implies humans are separate from nature and that humans have the power to make decisions over it. The way land is managed has a direct effect on ecosystems and biodiversity. Examples of land management objectives that produce materials and goods for human use include farming and livestock grazing, timber production, gas and oil production. Examples of land management that center both human health and the environment include Traditional Ecological Knowledge systems, conservation strategies, sustainable agriculture, and ecological restoration.

In the last 200 years since the time of early European settlement in Oregon, natural ecosystems have been significantly impacted by land management practices. Some of the most influential land management practices affecting forest fire trends have been related to logging, grazing, and fire suppression.

Classroom Procedure

1. Warm up by reading a quote and leading a class discussion.
2. Further introduce ideas by watching the video "Climate, Fire and People: A Community Discussion" and utilize the background information to further discuss ideas with the class.
3. Activity One: Shaping Forests and Fire Timeline.
4. Activity Two: History, Then and Now, News Experts: a Jigsaw activity
5. Wrap up journaling, class discussion

Warm Up
Help students to start thinking about how views of nature affect the way that we manage land with this voiced example of a Tribal leader's relationship to his homelands.

The earth was created with the assistance of the sun, and it should be left as it was. [...] I see the whites all over the country gaining wealth, and see their desire to give us lands which are worthless. [...] The earth and myself are of one mind. The measure of the land and the measure of our bodies are the same. Say to us if you can say it, that you were sent by the Creative Power to talk to us. Perhaps you think the Creator sent you here to dispose of us as you see fit. If I thought you were sent by the Creator I might be induced to think you had a right to dispose of me. Do not misunderstand me, but understand me fully with reference to my affection for the land. I never said the land was mine to do with as I chose. The one who has the right to dispose of it is the one who has created it. I claim a right to live on my land, and accord you the privilege to live on yours.

— Quote attributed to Chief Joseph, leader of the Wal-lam-wat-kain band of Nez Perce

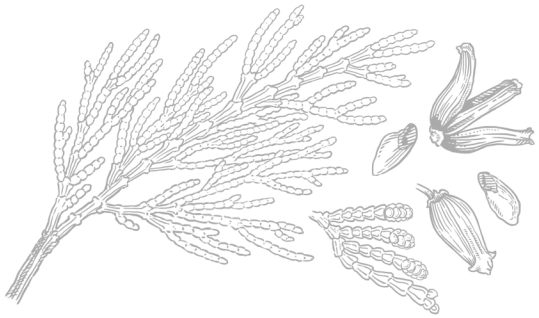
In statements circa 1858 and 1874, recorded from special agents traveling and speaking with Siletz chiefs and headmen, they (Rogue Valley Chiefs) talked about how there was a piece of their homelands at Table Rocks that they never agreed to give up, that living at Siletz was a great hardship - and if they were able to return there- or on the borders of their homelands where they might be able to see it from time to time - their "hearts would shine again like the sun." Even into the 1930's Siletz leaders like Coquelle Thompson Sr when asked what he thought about the 1929 Indian Citizenship Act - responded - (grumbling) - "what right do invaders have to make citizens of us?

— Supplemental remarks by Robert Kentta, Siletz Tribal Member

Discussion Prompts

Introduce the complex relationships of cultural oppression, land management, and ecological impacts. Students can answer the questions individually first and then in pairs, small groups, or with the whole class.

- Who do you think Chief Joseph is telling his message to?
- According to Chief Joseph, what are some differences between how 'whites' and his people, the Nez Perce viewed their relationship to land?
- What is Chief Joseph implying when he says "The one who has the right to dispose of it is the one who has created it?"
- How does the 'disposal' of his people relate to the disposal of the land?
- Do you believe that you are independent (separate) or interdependent (connected) with nature? Give some examples to support your beliefs.



Everyone may have a unique opinion on these complex topics. There are as many different ways in which people may interact with land as there are different cultures on this earth. The interactions that people have with the land are based on their understandings of the land, and are deeply rooted in cultural beliefs about how we humans are either independent, or how we are interdependent with nature. People who believe they are interdependent with nature may practice reciprocity — meaning that there is a mutual way in which both nature and humans give back to each other. For countless generations, the reciprocal lifeways of the Indigenous people of Oregon is based on cultural understandings of being interdependent with other living beings — this relationship is evident in the many ways that fire is traditionally used to tend the land for food, medicine, and other materials resources (see "Fire As An Agricultural Tool" Lessons 3 and 5)

Video: "Climate, Fire, and People: A Community Discussion"

Watch the video "Climate, Fire and People: A Community Discussion" and then follow up by providing further information and discussion prompts for students

Define land use policy: The ways in which society reflects its cultural beliefs and practices through written documents and laws. Land use policy may be guided at federal, tribal, state, county levels, and the rules that must be followed depend on the ownership status of the land. For instance, federally managed land like national forests, Bureau of Land Management lands, national wildlife refuges, and national parks must adhere to nation-wide laws like the Clean Water Act, Endangered Species Act etc. as well as more specific management plans written for individual forests and parks. Private lands such as those managed by individuals or private companies must adhere to nation-wide laws as well as state and county regulations.

Where we are now
In the last several years we have seen more frequent, larger, and higher intensity fires as compared to recent decades. This is due to:

1. Effects of climate change
2. Past history of suppressing fires and
3. The build up of burnable vegetation in the forests.

It is important to note that in recent decades, there have been fewer fires and burned areas due to artificial fire suppression. Trends of fire suppression began with the shift from the Long Indigenous Existence to the dominant settler colonial society — when fire suppression activities to protect timber became law in the 1940's. Societal practices and land management policies of the 20th century have had and continue to significantly influence the state of forests and fires today.

Discussion prompt
What are the influences that have developed over the last 200 years (mentioned in the video) that affect forests and fire today? Possible answers may include:

1. **Climate change:** Industrial and wide-spread use of fossil fuels over the last century has created human-caused climate change. Direct effects: warmer temperatures, decreased snowpack, and drier habitat have made ecosystems more vulnerable to more intense fire. (See further discussion in Lesson 10)

2. **Fire suppression:** Federal and state land management agencies like the National Forest Service, and the Oregon Department of Forestry focused on immediate wildfire suppression which has increased the amount of flammable vegetation in the woods today. This is mostly still the dominant practice today, yet they do some prescribed burning as well.

3. **Forest habitat degradation:** In forests throughout Oregon and the Pacific Northwest, heavy logging on federal lands between the 1950's and the mid 1990's has decreased the amount of older fire-resilient forests with big trees. Large trees help to maintain cool forests, are more fire resistant and have the ability to reseed healthy forests after a fire.

Discussion prompt
Based on information in the video, how have land management policies affected the species, size and number of trees in forests? How might this have affected forested ecosystems and fire behavior? Possible answers may include impacts of past land management on Oregon's forests:

1. **Effects of fire suppression on forests and fire:** In Oregon's low to mid elevation dry forests, fire suppression has led to increased vegetation density and flammability. For example, fire suppression in low elevation historically open ponderosa pine forests led to the establishment of shade-tolerant tree species, such as grand firs and white firs, where there had previously been open patches between trees.

   In wet ecosystems of the western Cascade Range, fire suppression has less impact on fire patterns but still changes the native landscape with the loss of fire-maintained huckleberry patches, camas-lily meadows, and native walking trails.

2. **Effects of logging on forests and fire:** Another significant impact to Oregon forests is the history of extensive clearcutting followed by the planting of tree plantations. These plantations are homogenous (densely planted trees of similar size and age) which increases flammability and decreases likelihood of survival after fire. Today there are more areas of young tree plantations and middle-aged Douglas fir forests and fewer mature old-growth forests than in Oregon's past. (Dalton 2021)

3. **Relationship with climate change:** Both fire suppression and heavy logging have also contributed to increasing greenhouse gas emissions. The loss of mature forests that sequester (store) carbon has made our landscapes less resilient to the effects of both fire and climate change. Ongoing climate change leads to drier and hotter weather patterns that then further influence trends in forest fires.

Warm Up & Discussion Takeaway
The resulting forested landscape in Oregon today is overall drier, less biologically diverse and less healthy than it once was.

Activity One

Shaping Forests and Fire Timeline

1. Group students into teams of 3-4. Distribute pre-cut timeline pieces or have students cut them out and distribute them among team members.

2. Ask students to take turns reading their pieces aloud to their team.

3. Line up desks or create space on the floor where students can place timeline pieces in chronological order from left to right. Events that overlap or occur simultaneously can be lined up vertically in the same section of the timeline.

4. Students may either tape the pieces together, or glue them onto a poster board.
   - If pieces are taped together, tape them to the chalk/white board
   - If using poster board, leave some space below the pieces.
   - Have 1 or 2 students draw a timeline below the pieces, include a beginning and endpoints, and year intervals.

5. Class discussion: Once student groups have completed the timeline, ask them to write down one or two key points that stood out to them, even if it was on another student's timeline piece. Initiate a class discussion following the prompts below.

Discussion prompts

1. Looking over your Shaping Forests and Fire Timeline, which events, changes, or decisions do you think had the strongest impacts on forests and fire that we are still seeing today? Justify your answer with examples.

3. At which point(s) did land management values shift? Why do you think people started thinking differently?

5. Based on information in the timeline, how have land management policies affected the species, size and number of trees in forests?
   - How might this have affected the forest ecosystem?
   - How might this have affected forest fires over time?

Bridge to Activity Two

- How could land management in the 20th century have been done differently to support thriving forest ecosystems in Oregon?

- Many people today realize that forest management practices must change. There are Tribes, scientists, community organizations, and other land managers leading the way by strategically reintroducing fire to the landscape. Through re-learning Traditional Indigenous Knowledge, researching the effects of prescribed burns, and forming community alliances, people are using fire as a tool for forest management. Activity Two will introduce you to a number of recent issues and events around Oregon and the Pacific Northwest.

Activity Two

History, Then and Now News Experts: a Jigsaw activity

1. **Building knowledge as an individual**
   Divide students into 'news article reading' groups, and assign each group a different article. Have each student read a copy of their group's article once on their own.

2. **Building knowledge together in a peer group**
   Write the following prompts on the board and ask students to consider the following questions in a group discussion. As students discuss their thoughts, have them write down answers in their individual journal:
   - Describe one land management practice that affected forests and fire as discussed in your article. How has this practice affected forests and fire today?
   - How have these changes affected people?
   - Why is this story important for people to know about?

3. **Sharing knowledge to a peer group as an expert**
   Have students reassemble into new "expert sharing" groups, each with one student representative from each previous "article reading" group. Each student is now an "expert" on their article and will then present a summary of their article and their responses to the journaling prompts with their new group.

4. **Student reflections**
   Ask students to conclude by reflecting in their journals, provide writing prompts:
   - "What was one similarity between your article and another article a classmate shared?"
   - "What was one difference?"
   - "What surprised you about an article a classmate described?"

5. **Observe the process**
   Walk around the classroom and observe each group, supporting them if necessary.

Classroom Discussion
Students return to their seats and share what they have learned.

Example classroom discussion prompts

1. What are some of the major issues around fire today?

2. What are some of the ideas we heard about as ways to address forest and fire issues related to past land management?

3. If you were a politician or a land manager, what strategies or solutions would you implement to reduce the impacts of previous land use on the environment and biodiversity into the future?

Take-Away Concepts

- A significant shift in land management coincided with the widespread removal of Indigenous people from their homelands.
- Both federal and state policy in the last 200 years have affected land management trends, forest ecosystems, and fire behavior over time.
- Land managers have opportunities to weigh many different factors when making decisions about actions to take with the land.

Lesson 9

Shaping Forests and Fire Timeline

Oregon Federal

Long Indigenous Period
Time Immemorial – 1800s

For tens of thousands of years, Indigenous people of what is now known as Oregon, thrived in a close relationship with the land due to advanced knowledge and skills. Indigenous use of fire played a significant role in shaping both the landscape and Native culture. Despite settlers' efforts to suppress Indigenous culture and fires, fire continues to be an important Indigenous tool for managing natural resources, and serving as a cultural and spiritual touchstone.

Beginning of Decline of Indigenous Land Tenders in the American West
1700s –1850s

Epidemics of diseases, introduced by early traders and fur trappers, caused high mortality in Indigenous populations, and drastically reduced the number of Traditional Ecological Knowledge practitioners tending the land.

1840s Gold Rush Hits Oregon.

During this time Indigenous people were killed, further diminishing the number of Traditional Ecological Knowledge practitioners on the land. Mining severely affected streams in Oregon. Hydraulic mining, where high-pressure water hoses were used to cut into stream banks so that gold could be located, agitated soil that spilled into streams in amounts so large that aquatic organisms such as salmon were disrupted.

1940s – Today

Increased fire suppression: removal of TEK practitioners and the removal of their regular fires. Looking at tree rings through dendrological reconstructions show that fire history at low to intermediate elevations experienced frequent fire until 1930's – 1940's coinciding with the federal implementation of fire suppression (Hessburg et al.1999).

1940's – Today

Increased fire suppression: Removal of TEK practitioners and the removal of their regular fires. Looking at tree rings through dendrological reconstructions show that fire history at low to intermediate elevations experienced frequent fire until 1930's—1940's coinciding with the federal implementation of fire suppression (Hessburg et al.1999).

Forced Native Removal from Homelands
1851 – 56

The "Rogue Indian Wars" or "Rogue River War," was a period of many conflicts between Indigenous people, miners, and settlers. Most of the Indigenous people that survived the epidemics, gold rush, and Rogue River War were forcibly removed from their homelands to live on Reservations. The forced removal of Indigenous people had many effects on land use and interconnected ecosystems. In the following decades the land bases of the Reservations were illegally settled or forced out of the control of Tribes through state and federal policies.

Beginnings of Fire Suppression
1911

Oregon Department of Forestry and Board of Forestry distinguished to improve and protect state forestlands, to prevent and suppress forest fires, and to enforce forest laws.

Beginning of Logging
1830 – 1849

Oregon's first timber mills established

1859

Oregon becomes a state and claims ownership of the majority of what are now state forestlands. Settlers start thinking about fire suppression after the Silverton Fire in Oregon's Willamette Valley which burned about 1 million acres.

Tillamook Fires
1933 – 1951

An initial fire in 1933 burned over 200,000 acres, about 50 miles west of Portland, having a significant impact on the way the general public thought about fire and furthering reinforcing the state campaign to suppress forest fires. Later, in the same region, a series of three subsequent fires over the next two decades all started among logging operations.

The Donation Land Claim Act
1856

Allowed any white, male US citizen to be granted 320 acres of land and, if married, an additional 320 acres of land. Lands generally changed ownership from community or familial stewards to newly emigrated white, male citizens. While the law stated that people of mixed Native and non-Native background could also be granted land, in effect, the law benefited incoming whites and further dispossessed Indigenous people.

Settlers' Understanding Starts to Shift
1960s

Through research, scientists start to recognize that fire is important to natural forest ecology of the West. A slow shift in fire-fighting philosophy begins over the next two decades and state and federal land managers' attitudes also start to shift. Still, the emphasis of land management is to suppress fires, especially in forests and plantations managed for timber production.

Institutionalizing Timber and Fire Suppression

1905
Creation of US Forest Service, primary goals include fire suppression and timber production .

1910
The Forest Service expands the system of fire suppression after firefighters died and 3 million acres in Montana burned in the "Big Blowup" fire.

Biscuit Fire in Oregon
2003

Burned 8,000 acres at mixed severity in the Kalmiopsis Wilderness, a largely roadless region with rich biological diversity, including imperiled salmonid fish. This was the largest fire to date in Oregon's history. The Forest Service designed a post-fire logging plan that was controversial because it threatened environmental protections for an area that was sparsely populated and noted for its wilderness character.

Changing Understanding of Salvage Logging
2000s

Scientists' research starts to show that post-fire logging is detrimental to natural forest recovery. Post-fire logging, also known as "salvage logging," is often done in the name of restoration, yet it typically delays or prevents natural recovery in many important ways.
(Beschta et al., 2004, Lindenmayer et al. 2004)

Use and Research of Prescribed Fire Starts Increases throughout the US
2010s – Today

Both the use and the research of prescribed fire has increased in the US since the mid 1900's. In the year 2017, land managers utilized prescribed fire on over 10,000 acres across the United States. (USDA Forest Service April 2020)

1850s – Today

Significant degradation of forest, savannah, and water occurs through loss of Native land tenders and transition to settler's extractive land use and commodification of natural resources. Increased exportation of natural resources. Introduction of non-native species of plants and animals. Water pollution from mining.

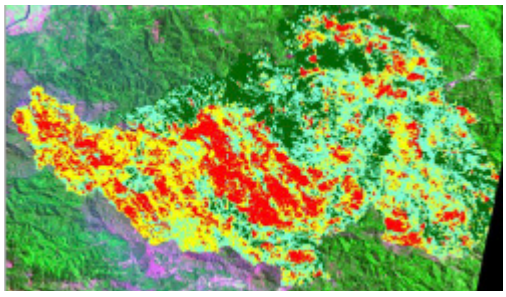
Mid 1900s
The increased use of gasoline engines meant that larger loads of timber could be moved much more quickly.

Mid 1900s
The introduction of the one-person chainsaw made felling trees a much quicker, one-person job. Stumps left behind are much lower to the ground.

Early 1900s
Early logging included felling trees by hand with axes.

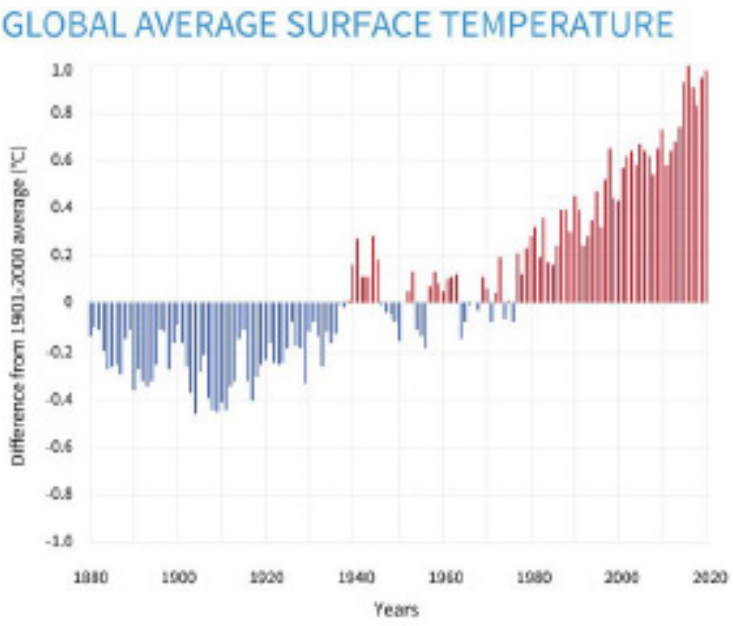
Early 1900s
Railroads were built so that timber could be moved from remote areas to ports on the coast for export.

Tilamook Fire
1933
This was the first in a series of incidents that sparked a change in public opinion, which led to further suppression of fires.



Biscuit Fire
2002
This image based on NASA satellite data shows burn severity over the half-million-acres that burned in southwest Oregon in 2002.

1930s
A Federal public campaign went along with national fire suppression policy, represented by the famous mascot, Smokey Bear.

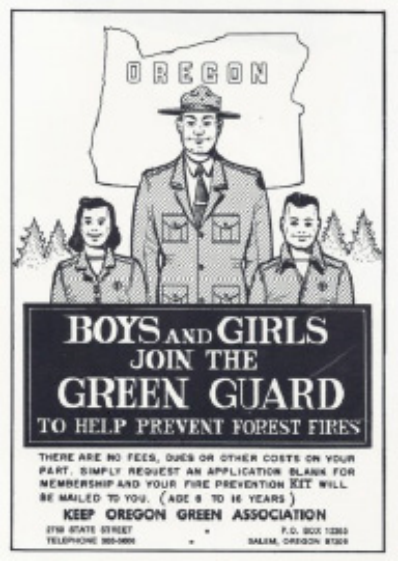


Climate Change
1960s – Today

The scientific community began alerting policy-makers that climate change is a significant threat to Earth, though slow progress has been made to adapt to this understanding. Increased drought and warming are part of human-caused climate change and significantly influence fire behavior in Oregon. In 2020, record levels were seen for drought, high temperatures, and number of acres burned in forest fires.

1941

Oregon Department of Forestry initiates "Keep Oregon Green," a public campaign to prevent wildfires.



Today

After years of fire deficit, logging of old-growth forests, and increased timber plantations across the landscape, there has been significant change in the makeup of forests across Oregon. They are now less resilient to fire and vulnerable to the compounding effects of climate change.

9TH - 10TH

Lesson 10
Climate Change: Mitigating, Adapting, and Taking Action

Climate Change and Fire, part two

NGSS: HS-ETS1-1
CCSS: RST.11-12.2, ELA-LITERACY.RH.11-12.1, 11-12.6, 11-12.7, 11-12.7, 11-12.8, 11-12.9

Summary

120 min.
may be taught in two sessions.

Climate change is the paramount context for considering how wildfire impacts ecosystems and human communities. We must continue learning about climate change as research develops and think critically about our beliefs around climate change. We have moral responsibility and the potential to be agents of positive change as community members, parts of ecosystems, and citizens of Earth as a whole. Students will discuss ways that society can mitigate and adapt to the impacts of climate change on the fire-adapted landscape.

GOALS

- Students will view a slideshow to learn about significant stressors of climate change on fire behavior.
- Students will challenge assumptions about climate change and fire by looking at their own beliefs and assessing doubts they may have in a class discussion and writing exercise.
- Students will identify, review, and list resources and ways to become empowered for action on climate change.
- Students will research, analyze, and present climate change's effects on fire, design solutions, and propose actions to address negative impacts.
- Students will practice outreach skills, and participate in civic engagement by interviewing local restoration projects.

CLASSROOM PROCEDURE

1. Warm Up: Assessing Understandings, Sharing Ideas
2. Background information and discussion: Climate and Fire slide show presentation
3. Activity 1: Believing, Doubting, and Taking Action
4. Activity 2: Exploring Tribal Climate Plans, Research and Presenting
5. Extension option: Civic engagement and getting involved in restoration
6. Conclusion

PREPARATION

Students should already be familiar with climate change, the greenhouse effect, impacts of fossil fuel use and the CO2 cycle. Some references to consult in reviewing topics of climate change:

- E.P.A. | The Basics of Climate Change
- The New York Times | Short Answers to Hard Questions About Climate Change
- NASA | Global Climate Change Facts
- The Learning Network | Teaching About Climate Change

MATERIALS

- Climate and Fire slide show
- Student journals or blank writing paper
- Device with internet access per student or group of 2-4 students
- Optional — one copy per student of the Civic Engagement for Climate Action Worksheet

Vocabulary

Adaptation: the process of change by a species to become better suited to its environment. Examples of adaptations already being made by living things include migrating, changing the timing in their life cycles, or their bodies physically adapting

Civic engagement: the active participation by individuals or groups to address public issues and promote the quality of the community

Ecological restoration: a form of land management that recovers an ecosystem from being degraded and improves its health, integrity and sustainability

Mitigation: the action of reducing the severity, seriousness, or painfulness of something. During a time of climate change, humans are looking at ways to restore the landscape to help mitigate the effects of climate change on water supply, forests, and wildlife

Warm Up Activity

Assessing Understandings, Sharing Ideas

Activating prior knowledge
Ask students to do a ten minute free-write about climate change and fire. Encourage them to think about how these things are related, what they have heard, what they may be confused about, and what they want to learn more about. This should allow students to activate prior knowledge and ignite new questions.

Sharing information
Have students spend five minutes sharing what they wrote with a partner and then identifying and listing any common thoughts or questions that came up.

Reflecting on process*
Ask students to write a few sentences about the process they engaged in with their partner: What did it feel like to share their writing? What did they learn from their peers? Did new questions emerge? Were there any disagreements?

It's OK not to know.

— Robin Butterfield,
tribal language and culture educator, Winnebago

Students may sometimes feel shame or embarrassment about lacking understanding or not knowing. Teachers can diffuse these negative feelings and "normalize" confusion or lack of knowledge by sharing examples from their own experience and reminding students that this is part of professional/scientific inquiry.

Assembling ideas
Write on the board or use a projector to display three columns with the categories "What we know," "What we are confused about," and "What we want to learn more about."
Ask for volunteers to share their reflections about what came up for them when writing and discussing with their partner. Record students' thoughts and questions in the three columns.

Background & Discussion

Climate and Fire slide show presentation
Utilize Lesson 10 Presenter Notes for classroom discussion and to address questions that students may have.

Slide 2: Fundamentals of Climate Change and Fire
Slide 3: Contributing Factors:
Weather Patterns and Temperature
Slide 4: Contributing Factors:
Decreased snowpack, Increased drought
Slide 5: Impacts: Fire season length, Larger and more wildfires
Slide 6: Oregon Department of Forestry:
Area burned of 16 million acres managed
Slide 7: Compounding Effects with Land Management Practices
Slide 8: Compounding Effects with Land Management Practices
Slide 9: Climate Awareness and Student Emotions
Slide 10-12: Activity 1
Slide 13: Activity 2

Education
can help students develop a personal connection to climate solutions and impact students' behaviors and decisions to reduce their overall lifetime carbon footprint. If 16 percent of high school students in high- and middle-income countries were to receive climate change education, we could see a nearly 19 gigaton reduction of carbon dioxide by 2050 (Cordero 2020).

Activity One

Believing, Doubting, and Taking Action

Encourage students to think critically about their potential to take action on climate change.

1. Write the following statement on the board: We can take effective action against climate change for the sake of forest health and safety of human communities.

2. Ask students to write in their journals about their beliefs and doubts related to this statement:
   - Believe: Write about reasons you might support this statement. Share how you might argue in support. Where did you learn what you know about the topic?
   - Doubt: Write about reasons you might doubt this statement. Share how you might argue against it. Where did you learn what you know about the topic?

3. Ask students to share their beliefs and doubts with the class.

4. To engage students in thinking about action on climate change, make a T-chart on the board with the headings Mitigation and Adaptation. Define with students:
   - Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause, or taking advantage of opportunities that may arise.
   - Mitigation means making the impacts of climate change less severe by reducing the emission of greenhouse gasses into the atmosphere — or by enhancing the storage of these gasses.

5. As the conversation develops, encourage students to think of ideas and examples of how we can do something about climate change for the sake of forest health and human communities. Determine together as a class if the ideas and examples are either ways to mitigate the effects of climate change, or ways to adapt to the effects of climate change.

EXAMPLE T-CHART

Mitigation versus adaptation to the effects of climate change

Mitigation	Adaptation
Demand that our senators and representatives take action to set emission standards and reduce our reliance on fossil fuels Encourage cities and states to adopt clean energy systems by incentivizing solar and wind power Consume less energy at home: retrofit appliances in the home to be more energy efficient, reduce food waste, reduce meat product consumption, use less gasoline — walk and bike more Through land management, retain big trees and old forests as carbon sinks that absorb and hold carbon from the atmosphere (serving as carbon sinks) Build wetlands as carbon sinks, and also (adaptation) to buffer fires and create natural firebreaks	Restore waterways to protect water supply Encourage biodiversity in forest management for enhanced natural regeneration after fire Eradicate nonnative grasses and weeds to lessen the chances of high intensity fires Forest thinning and prescribed burns in fire adapted habitats like ponderosa and oak savannah Set urban growth boundaries to prevent new homes being built in the Wildland–Urban Interface and other fire-prone areas Convert lawns and public spaces to community gardens for food security Identify new places where food, materials, and medicine plants will grow as the climate changes and compromises their current habitat Ensure communities are fire aware, have evacuation plans and disaster relief plans Plant locally native, and fire-adapted plants around communities Work with the leadership of Indigenous fire practitioners for continued education and land management strategies that are appropriate for the local ecology Develop fire/land management collaboratives that cross jurisdictions: tribal lands, city, state, and federal lands Create programs that deal with budgets, actions plans, research, land management coordination

FROM IDEAS TO ACTION

Transition to the next activity with a quote:

It is still not too late to act. It will take a far-reaching vision, it will take courage, it will take fierce, fierce determination to act now, to lay the foundations.
— Greta Thunberg, youth climate activist

Where we are now
In the last several years we have seen more frequent, larger, and higher intensity fires as compared to recent decades. This is due to:

1. Effects of climate change;
2. Past history of suppressing fires; and
3. The build up of burnable vegetation in the forests.

ACTIVITY TWO

Exploring Tribal Climate Plans
Research and Presentation

1. Tell students how many different entities like universities, cities, states, and Tribes are developing plans to address climate change.

   For example: The Confederated Tribes of Siletz Indians Planning Department created the Siletz Tribal Energy Program (STEP). STEP's goals are to promote and increase energy efficiency and conservation of natural resources in the tribal community, as well as to reduce the tribe's energy consumption and greenhouse gas (GHG) emissions. The tribe has focused their efforts in increasing the livability of tribal members' homes and in improving tribal buildings. Many of their programs focus on training tribal members as a way to increase tribal independence in meeting their goals. Additionally, STEP holds many public events to educate the community about energy efficiency and conservation, renewable power, and the importance of reducing, reusing and recycling waste. In 2011, the EPA awarded the Siletz Tribe a Climate Showcase Communities Grant, which is being used to fund a variety of programs. These programs focus on involving the tribal community in increasing energy efficiency and reducing the tribe's carbon footprint. Most recently, STEP has increased the scope of its actions to include a plan to develop solar energy projects.

2. Tribal Nations are leading the way in creating climate resiliency plans, especially in the Pacific Northwest. Show students an interactive map of Tribal plans, and zoom in to your local region to see the different types of climate plans Tribes are working on: https://biamaps.doi.gov/portal/apps/webappviewer/index.html?id=53794ae1ce054029bd5b55bcf269434c

3. As either individuals or pairs, have students research about different Tribal Climate Change programs in the Pacific Northwest, see links: https://tribalclimateguide.uoregon.edu/adaptation-plans

4. Ask students to write down responses to these prompts:
   - What types of mitigation and adaptation strategies have the Tribe identified as important to address climate change?
   - What steps have Tribal programs already taken to achieve these strategies? What steps are they looking to work on into the future?
   - In what ways is the Tribe engaging community in strategies to address climate change.
   - Is there anything else you found interesting or would like to share with classmates?

5. Have students share what they learned with the class.

OPTIONAL EXTENSION

Civic engagement and getting involved in restoration

Many of the ideas listed in the Mitigation versus Adaptation T-chart above have to do with ecological restoration. The field of ecological restoration is practiced by federal, state, and tribal governments, as well non-government organizations and local community groups.
Encourage students to learn about local and regional efforts to restore the landscape and find out ways that the class may get involved as a field trip or after school activity, for example: wetland restoration, tree plantings, native seed collection, invasive weed pulls, or educational opportunities. This background research may be completed together over two classroom sessions or as a class or as a homework assignment.

1. Ask students to brainstorm about efforts, clubs, or organizations they know of that are involved in ecological restoration.

2. Have students look up local and regional entities that are engaged in restoration work and find an email or phone contact. Consider researching groups:

    - **Federal:** local offices of Forest Services, Bureau of Land Management, Fish and Wildlife
    - **State:** Oregon Department of Fish and Wildlife, Oregon Department of Forestry
    - **Local:** city/ county planning departments or soil and water conservation districts
    - **Tribal:** contact your local Tribal offices
    - **Non-governmental organizations:** local watershed councils, garden clubs, conservation organizations, nature preserves, local university or college, or school clubs

3. Ask students to contact someone at the entity to inquire about their work and if/how students may get involved. Students may find guidelines and example questions on the Civic Engagement for Climate Action Worksheet.

4. Come back together as a class and have each student report back on the opportunities they have learned about. Decide together as a class on which projects to follow up with and make a plan for how to proceed. Ensure that all students follow up with their original contact.

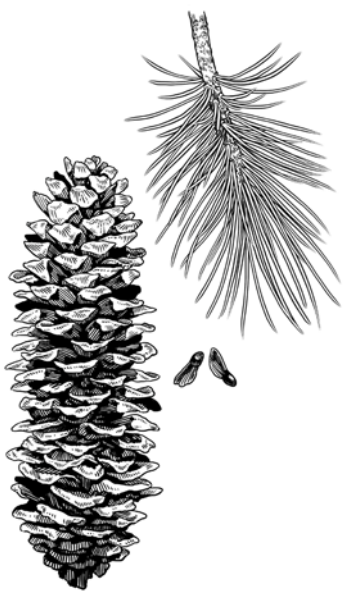
CONCLUSION

Ask students to reflect on all their journal notes and share anything that hasn't yet been discussed. You may check for understanding about the effects of climate change on wildfire effects by asking students for facts that support these statements:

- Current weather trends and the legacy of past land management together are having a significant impact on forests in Oregon.

- Climate change is and will be the most significant influence on fire behavior.

Wrap up with lessons learned by going over the Take Away Concepts with students.



Take-Away Concepts

- By looking at our own beliefs and assessing doubts, then discussing with people we know, we can start to have more understanding about complicated issues like climate change.
- Learning ways to mitigate and adapt to the effects of climate change and wildfire make us empowered to take action on climate change.
- Ecological restoration is a developing field and key way to create landscapes that are resilient during a time of climate change.
- Students are able to seek opportunities to participate in civic engagement, and become agents for positive change.

Online Resources

Human Impacts of Climate Change, Confederated Tribes of Siletz
https://vimeo.com/438392330/ac90eb301b

UN Climate Action Summit, Opening Speech by Greta Thunberg, youth Climate Activist
https://www.youtube.com/watch?v=u9KxE4Kv9A8

Severn Cullis-Suzuki's famous speech on the environment (1992)
https://www.youtube.com/watch?v=JGdS8ts63Ck

Information and videos from the United Nations about youth action on Climate Change
https://www.un.org/en/climatechange/youth-in-action

Youth 4 Climate Live Series
https://youtu.be/g0n9lIi93dE

NAME _____ DATE _____

9TH - 10TH

Lesson 10: Climate Change: Mitigating, Adapting & Taking Action

Civic Engagement for Climate Action Extension

Get Involved: Learn about local efforts to restore the landscape and find ways to take action to mitigate/help the world adapt to climate change.

Your name: _____

Group being interviewed: _____

Is this group (circle one)

Federal State County Tribal Non-governmental Organization

University Other:

Name of the person with the group: _____

Phone/email: _____

Email or call and speak to someone at the group to inquire about their work and if/how your class may get involved. Carefully go over the questions ahead of time, you may modify the questions and/or add your own. Take notes below each question during the interview:

Hello, I'm (your name) from (your school's name) and I'm researching local efforts to get involved in ecological restoration. Do you mind if I ask you a few questions for a class assignment? (If they answer no, politely ask if there is another good time to call, or otherwise send an email?)

1) In what ways does (name of group) engage in ecological restoration?

2) What are some of the major projects that you are working on right now?

3) What will success look like when these projects are complete?

4) Are there any events or opportunities for our class to get involved?
We are interested in (choose one or more) field trips/stewardship days/student internships/classroom speakers/other

5) Do you have any other resources or recommendations for our class to learn about local restoration projects?

"Thank you for your time, we will follow up with you by (date)."

Lesson 10: Presenter Notes

Climate Change: Mitigating, Adapting, Taking Action

Slide 2

Fundamentals of Climate Change and Fire
Climate change affects fire at different scales, including how fires start, how they spread, and long-term fire patterns. Here are some climate related factors that influence fire behavior at different scales:

- **Small scale**, start of a fire (hours, days)
  Influential factors: fuel, oxygen, and heat control ignition and flames
- **Intermediate scale**, development of fire behavior (weeks, months, seasons)
  Influential factors: fuel, weather + wind, and topography affect the expansion of fire and fire intensity
- **Large scale**, long term fire regime patterns (decades, centuries)
  Influential factors: climate, amount and dryness of fuel, vegetation type, frequency/type/timing of ignitions

As we go through these slides, think about the relationships between climate, weather, habitat, and living beings

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Slide 3

Climate change contributes to wildfire behavior
By affecting weather patterns, temperatures and changes to the landscape. Climate Change has a significant influence on wildire behavior.

Oregon's weather patterns
Like everywhere in the world, Oregon has experienced changes in weather patterns due to climate change.

Increased temperature
Oregon's annual average temperature has increased by about 2.2°F per century since 1895. If gas and oil companies continue to emit greenhouse gas into the atmosphere at current levels, the temperature in Oregon is projected to increase on average by 5°F by the 2050s, with the greatest seasonal increases in summer. (Dalton 2021)

Slide 4

Climate Change contributes to wildfire behavior
In Oregon, climate change has a big impact on snowpack and drought.

Decreased snowpack
Snowpack is accumulating more slowly and melting earlier, and peak snow depths have been decreasing. For example, in southwest Oregon in the early 1900s, Medford averaged 9" of snowfall annually and the annual average has decreased to under 4" since the 1980's (Bennet 2015). This means there is less water stored for the watershed throughout the warmer months, making the landscape more vulnerable to drought.

Increased drought
Over the past 20 years, the amount and severity of droughts in the northwest has increased. As summers in Oregon continue to become warmer and drier, and mountain snowpack decreases, the frequency of drought is likely to increase.

> University of Washington has a great online tool that allows you to look at temperature and precipitation trends over the past 100 or so years at weather stations all around the northwest. Go to https://climatetoolbox.org/tool/Climate-Mapper for a tutorial and to use the interactive map.

Slide 5

Climate change impacts on wildfire

Increase fire season length: wildfire season now begins earlier in the spring and ends later in the fall. The burn season is two-and-a-half months longer than 40 years ago.

Larger and more wildfires: throughout the West, rising temperatures correlate with increased size and number of wildfires. Since 1970, years with above-average spring and summer temperatures generally also experienced bigger wildfires. (Climate Central 2012) Wildfires have also been increasing in the average amount of acres they burn over the last 40 years. When looking at the number of acres burned, consideration must also be given to the changes in national forest fire suppression strategies. More acres burn now due to the understanding of fire's benefits to the forest plus the unrealistic nature of fully suppressing wildfires today due to limited resources and safety concerns for firefighters.

> **See statistics on acres burned from the National Interagency Fire Center https://www.nifc.gov/fire-information/statistics/wildfires**

Photo/data credit: Environmental Protection Agency's Climate Indicators

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Slide 6

Oregon Department of Forestry graph: area burned of 16 million acres managed

Oregon Department of Forestry (ODF) manages state forests and tracks fires around the state. This graph shows correlations between historic events (bottom), number of human caused/lightening fires, number of acres burned, drought/temperature/PDO (see below) etc.

Some key points:

1. There are overall fewer fires in the last 80 years due to policies of fire suppression that started in the 1940s

2. There are increases in acres burned during drought years

3. 2020 was an extreme fire year (off the chart) — Why do you think this is? What might this mean for the future?

Drought determination is based on Palmer Hydrological Drought index of 2.0 (moderate drought) or greater in 3 or more of 9 Oregon sub-regions in any given year.

Fire data shown are ODF-Protected Acres Burned from statistical fires where ODF was the primary protection agency. Historical large fire names are shown for context above the year of occurrence.

Pacific Decadal Oscillations (PDO): during a warm or "positive," phase, the west Pacific Ocean becomes cooler and part of the eastern ocean warms; temperatures warm over North America.

During a cool or "negative" phase, the west Pacific Ocean becomes warmer and part of the eastern ocean cools; temperatures cool over North America.

Slide 7

Compounding effects with land management practices

Climate change is the dominant influence on fire today, but its influence is combined with the state of forests.

There are many unknown risks of climate change, especially combined with past land management practices. Scientists continue to study the effects of these phenomena as we are witnessing them today. We are beginning to witness long-term effects of climate change on our forests through:

- **Habitat conversion:** Some dry forests and woodlands at low to intermediate elevations in eastern Oregon may not be able to reestablish because seeds and young plants won't be able to grow in drier conditions, in which case the habitat could transition to other types — such as shrublands and grassland. (Dalton 2021)
- **Increased fire severity:** Timber plantations can increase fire severity due to high fuel loads and high flammability. With the widespread conversion of natural forests to timber plantations, and the drying of forests due to a history of fire suppression, Oregon's forests are at risk for more intense fires and the loss of natural biodiversity.

Slide 8

The degradation of forest habitats throughout Oregon is widespread. Forests have become drier and contain more small trees, making them more susceptible to burning hotter and quicker. Forests have also lost many bigger trees and overall biodiversity, making them less resilient to recovering after burns.

- **Increased areas with the potential to burn:** NASA reports that wildfires in the western United States have been spreading to higher elevations due to warmer and drier conditions that are clearly linked to climate change. (Alizadeh 2021)
- **Potential interactions between wildfire and other disturbances:** although there is little evidence that tree-eating bark beetles have much effect on fire occurrence or severity, more research should be conducted about the interactions between fire, drought, insect outbreaks and other pathogens. (Dalton 2021)

Pictured: some of the most recent clear-cuts stand out as tan patches across the central Oregon coast near the Confederated Tribes of Siletz's Reservation, visible from space. (Google Earth 2021)

Slide 9

Take a moment to consider the class's emotional position. Conversations about climate change can be heavy for anyone. Being aware of students' prior exposure to related issues is key. Students that have been directly affected by fires or other factors of climate change may experience trauma responses or social-emotional challenges when engaging with this material in class. Be prepared to help students self-regulate.

Allow a moment for students to discuss their thoughts with a partner or have a 5 minute freewrite in their journals if needed. Bring the class back together by leading into the next activity: "now we will explore ways to take action on climate change."

Pictured: Vesper Meadow with Mt. Mcloughlin, known as "Ma'l - si" in Takelma, by Matt Witt Photography

Slide 10

Activity 1: Ask students to write in their journals about their beliefs and doubts related to this statement:

- **Believe:** Write about all of the reasons you have for agreeing with this statement. What examples could you offer in support of the argument, from the text or your own outside knowledge or experience?

- **Doubt:** Write about all of the reasons you have for doubting the text. What counter arguments could you offer? How could you question the text? What examples do you have that would go against what the author is saying?

Have students share their beliefs and doubts with the class.

Slide 11

To engage students in thinking about action on climate change, make a T-chart on the board with the headings Mitigation and Adaptation.

Define with students:

- **Adaptation** means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise.

- **Mitigation** means making the impacts of climate change less severe by reducing the emission of greenhouse gases into the atmosphere, or by enhancing the storage of these gases.

As conversation develops, encourage students to think of ideas and examples of how we can do something about climate change for the sake of forest health and human communities. Determine together as a class if the ideas and examples are either ways to mitigate the effects of climate change, or ways to adapt to the effects of climate change.

Example T-Chart notes available in Lesson Plan

Slide 12

Transition with a quote, or further online video resources:

UN Climate Action Summit, Opening Speech by Greta Thunberg, youth Climate Activist
https://www.youtube.com/watch?v=u9KxE4Kv9A8

Severn Cullis-Suzuki's famous speech on the environment (1992)
https://www.youtube.com/watch?v=JGdS8ts63Ck

Information and videos from the United Nations about youth action on Climate Change
https://www.un.org/en/climatechange/youth-in-action

Youth 4 Climate Live Series
https://youtu.be/g0n9lIi93dE

Slide 13
Activity 2: Exploring Tribal Climate Plans

Tribal Nations are leading the way in creating climate resiliency plans, especially in the Pacific Northwest. Show students an interactive map of Tribal plans, and zoom in to your local region to see the different types of climate plans Tribes are working on: https://biamaps.doi.gov/portal/apps/webappviewer/index.html?id=53794ae1ce054029bd5b55bcf269434c

1. **As either individuals or pairs**, have students each research about different Tribal Climate Change programming in the Pacific Northwest, see links: https://tribalclimateguide.uoregon.edu/adaptation-plans

2. Ask students to write down:

1. What types of Mitigation and Adaptation strategies the Tribe has identified as important to address climate change.

2. What steps have Tribal programs already taken to achieve these strategies? What steps are they looking to work on into the future?

3. In what ways is the Tribe engaging community in strategies to address climate change.

4. Where Tribes are placing emphasis, on mitigation or adaptation. Why may this be?

5. Is there anything else you found interesting or would like to share with classmates?

3. Have students share what they learned with the class.

9TH - 10TH

Lesson 11
Wildfire Vulnerability
and Climate Justice, What Do You Meme?
Fire and Social Issues, part two

NGSS: HS-LS2-7, HS-ESS2-4

CCSSS: 9-10.RH.1, 9-10.RH.6, 9-10.RH.7

OESS: HS.2, HS.7, HS.8

Summary

90 min

Historically marginalized communities are at most risk to the effects of climate change and wildfire. Recent studies across the American West are looking at the effects of wildfire on health, housing, psychology and other basic needs. The results of these studies illustrate the need for large scale changes to social systems in order to address climate change and wildfire effects into the future. Students will learn about disparities in the relative impacts of wildfire on human communities, and research information presented in news media. Students will utilize "memes," a popular social phenomenon, to reflect on social issues and as a creative outlet and for comic relief.

Goals

- Students will practice critically reviewing information presented in news media.
- Students will participate in classroom discussion to develop an understanding of how the impacts of climate change and wildfires disproportionately affect historically marginalized communities.
- Students will discuss solutions for reducing negative social impacts of wildfire.
- Students will use creative expression to create memes that synthesize and share information about the social impacts of climate change and wildfires.

Classroom Procedure

1. Introduction discussion: understanding marginalized communities, environmental justice, and learning through research
2. Activity One: Wildfire vulnerability and climate justice, understanding through media and research
3. Activity Two: What Do You Meme?
4. Conclusion: Lead a solution-based discussion

PREPARATION

- Students should have a basic understanding of forest fire and climate change related issues. This lesson would be best after the completion of lessons 9 and 10.
- Prepare to share the Meme Generator with students and have a process for gathering the memes they create. This can be done by having students duplicate the original file to a personal folder, then directly print out their memes or share it on the cloud/shared network.
- Print one copy per student of the Vulnerable Communities Research Worksheet.

MATERIALS

- Meme Generator
- Student access to computers or smartphones with internet access (alternatively, articles may be printed out for students)
- Student worksheets

Vocabulary

Census tract: a geographic region defined for the purpose of taking a census that can help to characterize communities by demographics. Sometimes these coincide with the limits of cities, towns or other administrative areas and several tracts commonly exist within a county.

Climate justice: the understanding of climate change as an ethical and political issue as the causes and effects of climate change are interrelated with issues of equality and human rights

Climate refugee: a person who has been forced to leave their home as a result of the effects of climate change on their environment. Wildfire is a recent and common example of environmental change that disrupts well-being or secure livelihood and forces people to move.

Demographic: description or characteristic of a community of people such as age, race, or ethnicity

Historically marginalized communities: such as low income, Indigenous communities and communities of color often face the worst consequences of climate change: in effect, the least responsible for climate change suffer its gravest consequences

Introduction discussion

Around the world, climate change disasters affect billions of people and cost trillions of dollars in damage and their impacts are often felt most acutely by minority and poor communities. In the Western United States, wildfires have larger impacts on vulnerable communities or historically marginalized communities, particularly African American, Latino, and Native American communities. In the case of Native Americans, historical forced relocation onto reservations — mostly rural, remote areas that are more prone to wildfires — combined with greater levels of vulnerability due to socioeconomic barriers, make it especially hard for these communities to recover after a large wildfire. (Davies 2018)

In one study, researchers looked at 13 different socioeconomic measures from the U.S. census — including income, housing type, English fluency and health — for more than 71,000 census tracts across the country. The researchers overlaid the factors with wildfire potential based on weather, historical fire activity and burnable fuels on the landscape. They found that there are 29 million Americans living

with significant potential for extreme wildfire, and 12 million of those people are considered "socially vulnerable." Socially vulnerable means that an extreme wildfire event could be devastating — and this measure was disproportionate to communities of color, with African American and Latinx communities facing 50% greater vulnerability to wildfires than other communities. (Davies 2018)

Vulnerable communities can be easily overlooked by government and mainstream media — and so it is incumbent upon all citizens to understand that those who experience disproportionate effects of climate change disasters may also receive disproportionately less media coverage and fewer social services. Learning about environmental justice and researching facts presented by news media are powerful tools for people to work toward a more just and equitable society. Read more and show students EPA Report Shows Disproportionate Impacts of Climate Change on Socially Vulnerable Populations in the United States

INTRODUCING A CONTEXTUAL FRAMEWORK

Write "Environmental Justice" on the board, and ask students if they know what it means. Ask for volunteers to share their ideas. If students aren't sure where to start, ask them to consider each word individually: "environmental" and "justice."

> Environmental justice is a social justice movement that seeks to dismantle policies that have long harmed low-income communities and communities of color, and instead work to create a sustainable, cooperative, and equitable future for people and the environment. It rests on the principle that everyone has a right to a clean and healthy environment, and the environmental justice movement strives to attain that.

Optional: Further students' understanding by having them break into groups to discuss how the other vocabulary words relate to the framework of environmental justice.

DISCUSSION POINTS

Do you think news sources report enough about communities who are most vulnerable to climate change and wildfire?

- Ask students to provide reasons why they agree or disagree and give examples of what they have seen in the media.
- Ask students how media can affect people's general understanding of wildfire's impacts on different communities.
- How can people's understandings and beliefs further impact inequality between people?

Case study example for discussion:
Have students read and discuss this article about research of media coverage provided by the Northwest Fire Consortium
https://www.nwfirescience.org/sites/default/files/publications/NWFSC_RB20_MediaCoverage.pdf

Summary: Media coverage can play an important role in framing public understanding of disaster events and related issues. In this study, researchers examined print media coverage, data of burned homes, and demographic data of towns impacted by wildfires. Some of the key findings were that (1) media coverage generally ignored important issues of climate change, socioeconomic inequality, and wildfire risk and prevention measures and (2) media coverage did not always focus on locations of greatest impact or "non-elite" stakeholders.

How can we look beyond basic media coverage and get the facts?

- Ask students how they can be sure that a media article is providing facts and attempting to be unbiased.
- Ask what steps a reader can take to verify facts and ideas presented in a news article.

Four methods to critically research concepts in a news article:

1. Follow the links or citations at the end of the article. Check to see if the sources are reliable and unbiased, and make sure that the original article is using the source appropriately.
   Optional: Students may look for a report on the same story from a different news outlet and decide whether the stories are presented differently. If stories are presented differently, news outlets are expressing bias.

2. Look for peer-reviewed articles (students may use Google Scholar to search for peer-reviewed articles) that contain direct research on the topic. Peer reviewed articles go through a rigorous process to ensure that ethics and the scientific method are followed. It is possible that these articles will contain bias, but by looking at several peer reviewed articles, the chances of bias decrease.

3. Whenever possible, look for "primary" information sources, such as statements or diary entries from people with first-hand involvement, interviews, original data from research studies, or unedited photos.

4. Make ethical considerations: whether evaluating personal statements or scientists' research, consider what personal motivations may exist. In addition, question whether the work was funded or published by an entity with vested interests in a certain cause that may create bias.

Activity One

Wildfire vulnerability and climate justice: understanding through media and research

1. Hand out one copy of the Vulnerable Communities Research Worksheet to each student. Then, break students into research groups of 2-3 students to look at articles about the effects of wildfire on different demographics. Tell students they are going to practice looking critically at the truth of concepts using the four methods mentioned above.

2. Have students read the news article How loss of historical lands makes Native Americans more vulnerable to climate change published November 2, 2021 by National Public Radio. (*Students may also choose to find another related article that also provides links and citations) https://www.npr.org/2021/11/02/1051146572/forced-relocation-native-american-tribes-vulnerable-climate-change-risks

3. Students will utilize the four strategies above to guide them through research and reflect on their findings with the Vulnerable Communities Research Worksheet. The group may work together to read and reflect on their media, but each student should fill in their own worksheet.

4. Have student groups choose a speaker for their group to summarize their research and findings.

5. Conclude the activity: ask students about what facts they found to be important, have never thought about, or were most impactful to them.

EXTENSION ACTIVITY

Students may look at data directly using the Wildfire Risk to Communities mapping tool available online: https://wildfirerisk.org/explore/ This interactive mapping tool from the US Dept. of Agriculture and the US Forest Service allows users to analyze interactive charts and maps of different communities' risk to climate change. Have students enter locations (city, county) to find out what the relative wildfire risk is for various communities.

Further extension (optional, or for independent/advanced learners)
Students may look at different community risks by location using the Populations at Risk tool from Headwaters Economics, a non-partisan research group. Available: https://headwaterseconomics.org/tools/populations-at-risk/ This online tool allows users to download custom reports about populations vulnerable to various social, economic, and environmental risks.

ACTIVITY TWO

What do you meme?

Memes can be used to illustrate the meaning of ideas or vocabulary, check for understanding of broad concepts, and to rapidly spread ideas to a large number of people. In this case, memes can also serve as a creative way to share thoughts on the serious and difficult nature of some of the topics discussed.

1. **Introduce the idea.** Though students may understand memes as humorous images that are spread rapidly by social media users, explain that memes have a broader definition: an element of a culture that may be passed between individuals, especially by imitation. Ask students how memes could be used for educational purposes.

2. **Introduce students to the activity** and announce the Make a Meme activity. Students will create a meme to express understanding of the information they just discussed. Examples: The memes may reflect a vocabulary word, a summarizing idea, an interesting statistic, their thoughts or reactions to what they learned, or for other creative expressions.

   Optional: make the activity into a friendly class contest. Before students begin making memes, have them set guidelines for playing fairly and rules for winning the contest. Students may choose to have multiple categories such as "funniest meme," "most factual meme," "most likely to go viral meme." Students may choose to submit their meme for the contest if they are comfortable.

3. **Provide directions** on how to make a meme using the Meme Generator provided. Students may already have meme creation apps on their devices, but consider that some apps may contain content that is inappropriate for school.

   - Instruct students to share their memes to a central location so that they can be vetted first by the teacher and then shared to the whole class. You may choose for the students to print them out and hang on the wall, for them to email them to be compiled later, or save to a shared folder.

4. **Optional:** You may choose for students to share in small groups and provide constructive feedback to each other. Students may then revise their meme before sharing more widely.

5. **Share and discuss the ideas students present** in the memes with the class. If the class is holding a meme contest, you may choose to have them discuss their favorites together or submit anonymous votes.

Conclusion

Lead a solution-based discussion

Members of a democratic society help determine how their society functions. This may happen in various ways such as by voting, paying taxes, engaging in acts of service, protesting, supporting causes, using the judicial system, and urging elected officials to work for causes that serve the greater good. When people are educated on issues, they may take informed action to urge political, social, and cultural institutions to work toward a more perfect union. Consider using the Smithsonian National Museum of the American Indian's "Taking Informed Action" template for students.

- What are some possible steps to address the inequalities between communities to the effects of wildfire?
- Ask students to brainstorm ideas with a partner before coming back to the whole class for discussion.
- Use examples noted on the next page to spark discussion if needed.

Example Answers

Local level	• Offer cost-share programs for residents to prepare their homes for wildfires • Distribute evacuation notices in multiple languages • Create jobs focused on thinning local forests or clearing out flammable brush near homes
State level	• Require all counties and cities to incorporate wildfire risk management into their development plans. Ensure that adequate planning and management resources are available for all communities, not just those with high incomes or large tax bases. • Require fire-safe construction and planning for new development in the wildlife–urban interface (WUI) and require fire-resistant materials and structural designs for all new homes. • Provide financial support or incentives for fire-safe home retrofitting for both homeowners and renters. • Increase capacities for conducting prescribed burns to reduce risks of future wildfires. • Partner with Tribes to have cultural burning incorporated into forest management strategies to reduce risks of future wildfires.
Federal level	• Invest in clean energy systems and jobs • Invest money back in to disadvantaged communities to prepare for wildfire and creating FireWise communities • Provide funding to states, local communities, Tribes and territories for projects that reduce risk of wildfire damage to communities • Work to ensure drinking water quality, prevent water contamination, and support water systems • Ensure that disaster relief resources are accessible to those who need them most • Bolster support for community preparedness efforts through the USFS, FEMA, and other Federal agencies • Reform cost-sharing and grant programs to incentivize development that does not take place within the wildlife–urban interface • Support policies that attract investment into communities, with rules that guarantee projects generate social benefits for those most vulnerable

Tribal Government Level	• Reduce barriers faced by Tribal cultural practitioners to tend and manage their ancestral homelands • Provide financial support or incentives for fire-safe home retrofitting for both homeowners and renters • Increase capacities for conducting prescribed burns to reduce risks of future wildfires • Partner to have cultural burning incorporated into forest management strategies to reduce risks of future wildfires

DISCUSSION WRAP UP

The effects of wildfires are felt more strongly by already vulnerable communities and demographics. The impacts that have occurred in the past several years, including loss of homes and displacement, make an urgent case for proactively preparing for fires. It is up to everyone to urge policymakers to act now to ensure that resources are delivered to the most at-risk communities, regardless of socioeconomic status or demographics.

TAKE-AWAY CONCEPTS

- Historically marginalized communities, especially people of color and Tribal communities are at most risk to the effects of climate change and wildfire.
- Youth have the ability to learn about environmental justice issues and use their voice for promoting justice and equitability.
- All people, including youth, can learn how to research wildfire facts, discern good media reporting, and engage with community members and decision makers to take steps for more equitable and fire resilient communities.

NAME _____ DATE _____

9TH - 10TH

Lesson 11: Wildfire Vulnerability and Climate Justice, What do you meme?

Vulnerable Communities Research

1) Read — a news article about communities that are most vulnerable to wildfires (use the example below or search online with the underlined key words). If you choose your own article, write the title, author(s), date it was published, and the Website it was published on:

Example: How loss of historical lands makes Native Americans more vulnerable to climate change published November 2, 2021 by National Public Radio.
Available: https://www.npr.org/2021/11/02/1051146572/forced-relocation-native-american-tribes-vulnerable-climate-change-risks

2) Reflect — what are two reasons these communities face greater impacts from wildfire?

3) Research — how does information in the linked sources support the main messages of this article? Were any of the links to peer-reviewed research?

4) Compare — what other research did you find that either confirmed or conflicted with the information from your first article? Name the article/source and the facts that confirmed or conflicted with the first article.

5) Conclude — do you think the information in the first article is reliable, and why or why not?

Glossary

Adaptation: the change or the process of change by a species to become better suited to its environment. For example, in a changing climate, we are already seeing living things make adaptations to changes in weather patterns whether it is through migrating, changing the timing in their life cycles, or their bodies physically adapting

Aerial imagery: photos or models that illustrate the landscape from above; a 'birds-eye view"

Affordable housing: low-cost housing that families with lower than average income can pay for and live in

Agricultural tool: any method, practice, or physical tool used by people to affect food production or collection in a tended ecosystem

Annual: a plant that germinates, flowers, and sets seed in one year

Aspect: the direction the slope of a hill faces

Basketry: the creation and use of baskets by Indigenous people for many purposes such as food harvesting, processing, cooking, and storage, for child-rearing (baby baskets), in everyday clothing, and in ceremonies

Biodiversity: variety of life in a particular habitat or ecosystem

Blacked forest: the stage in which a forest has recently burned, and before it has started to regrow in to a green forest

Burl: a growth on a tree formed from unsprouted bud tissue. The burl forms large, knobby looking growths on the base and trunk of the tree where stems may grow back after disturbance

Canopy: the branches and leaves at the top of a group of trees that form a type of forest "roof"

Catkin: a long, thin cluster of tiny flowers that do not have petals; found on willows, oaks and some other trees

Census tract: a geographic region defined for the purpose of taking a census that can help to characterize communities by demographics. Sometimes these coincide with the limits of cities, towns, or other administrative areas and several tracts commonly exist within a county

Chaparral: a habitat defined by a dominance of shrubs and is maintained by high-severity fire. Chaparral is important to many birds, deer, elk and other wildlife and is considered an endangered habitat type in southern Oregon

Civic engagement: the active participation by individuals or groups to address public issues and promote the quality of the community

Climate: long-term weather patterns including temperature, precipitation, and humidity

Climate justice: the understanding of climate change as an ethical and political issue as the causes and effects of climate change are interrelated with issues of equality and human rights

Climate refugee: a person who has been forced to leave their home as a result of the effects of climate change on their environment. Wildfire is a recent and common example of environmental change that disrupts well-being or secure livelihood and forces people to move

Colonization: the act of sending people to live in and govern another area, where the newcoming population retains strong links to their original country, gaining significant privileges over original inhabitants of the area

Commodification: when something is made into a product that can be bought and sold

Community resilience: the sustained ability of a community to use available resources to respond to, withstand, and recover from disasters

Cultural burn: traditional use of fire to maintain and manage landscapes for foods and materials, to cook food, or to hold ceremonies

Deciduous: trees or shrubs that shed leaves seasonally, usually in fall

Demographic: descriptions or characteristics of a community of people such as age, race, or ethnicity

Donation Land Claim Act: the federal policy, enacted in 1850 during early colonization of

Oregon by the US, that allowed white, male citizens to claim ownership of land in the Oregon Territory

Early-seral forest: ecosystems that regrow after a high-intensity fire before re-establishment of a mature, closed forest canopy

Ecological restoration: a form of land management that improves the health, integrity and sustainability of a degraded ecosystem

Endemic: describes a species that lives only in one specific place

Exportation: the removal, transport, and sale of resources from one area or country to another

Fire-dependent environment: a place where species have adapted to fire cycles and depend on the effects of fire for growth, reproduction, health, or survival

Fire intensity: how hot a fire burns

Fire regime: the generalized pattern, frequency, and intensity of wildfires that occur over long periods of time (e.g. hundreds and thousands of years)

Fire season: the period of the year when wildfires are most likely to occur and a legally-enacted time when restrictions and prohibitions are in effect

Fire suppression: the use of tactics used to stop, minimize, and prevent wildfires. Typically, wildland firefighters work in crews on the ground in tandem with aircraft to construct fire breaks and extinguish flames. In the United States, aggressive wildfire suppression combined with logging practices has contributed to increased risk of large fires

First Foods: traditional Native foods (plant or animal) that provide sustenance and promote health

Forest structure: different layers of the forest including the canopy, understory, shrubs, forest floor, and soil

Geophyte: a plant with underground storage parts, like starchy roots or bulbs, that can survive when conditions above ground are too harsh

Habitat: a place which provides all the elements that an organism needs to live

Hazel: a deciduous, perennial shrub that often grows under the shade of larger trees; an important plant for Indigenous basketry, and an important agricultural crop for Oregon farmers

Historically marginalized communities: such as low-income, Indigenous communities and communities of color often face the worst consequences of climate change; in effect, the least responsible for climate change suffer its gravest consequences

Immigrant: a person who comes to a country from another country

Industrial land management: utilizing land for commercial purposes, often employing mechanized equipment and prioritizing profits above all else

Keystone process: an ecological event that supremely influences the ecosystem and helps to initiate further evolution of the ecosystem

Kincentric: a view of the world where all parts of the natural world (land, plants, animals, water, etc) are viewed as kin, or family

Klamath Knot: the mountainous region of southwest Oregon and northern California

Klamath–Siskiyou: an ecological region of southern Oregon and northern California that comprises the Siskiyou Mountains, Rogue, and Klamath River watersheds. This area is renowned for its extremely high biodiversity

Legacy trees: large, old trees that are resistant to disturbances (like fire) and have the capacity to produce and spread large amounts of seed

Land management: the decision-making process and implementation of land use for human benefit. Examples may include agriculture, logging, reforestation, water resource management, and eco-tourism projects. Land management may have positive or negative effects on the land, depending on the type and scale of activities

Land stewardship: caring for a piece of land while taking into consideration ecological, economical, and social dimensions

Ladder fuels: plants and burnable material that can ignite and pass a low-burning fire to the tops of trees

Long Indigenous existence: the thousands of years before colonization when Indigenous peoples lived closely with the land and passed on knowledge to the next generations

Low-intensity burn: a fire that moves slowly and burns at lower temperatures

Material culture: objects of traditional use that require plants and animals to provide materials. Examples include: hazel baskets, jewelry, dentalium shell currency, iris nets, etc.

Material plants: plants that grow materials for traditional food collection and storage. For example, plants like hazel that, in addition to food, provide sticks for baskets, or plants like iris that supply fiber for nets

Mediterranean climate: a climate that includes cold, wet winters and hot, dry summers with a dependable fire cycle

Mid-story tree: a tree whose canopy exists between the heights of the tallest trees and the understory plants

Mitigation: the action of reducing the severity, seriousness, or painfulness of something. During a time of climate change, humans are looking at ways to restore the landscape to help mitigate the effects of climate change on water supply, forests, and wildlife

Mixed-severity fire: the pattern of fire in mountain forests in which the burned landscape is a combination of unburned areas, medium-burns, and heavily burned areas

Mycelium: the vegetative part of a fungus (whereas the mushroom is the fruiting part of the fungus). Mycelium grow in soil or wood and are made up of a network of fine rootlike filaments that are often white

Perennial: a plant that lives more than two years

Prescribed burn: an intentional fire set on a particular area with a particular purpose and plan

Pyrodiversity: characterizes the many different ways fire can burn and the resulting variety of habitats and landscapes influenced by fire

Ravines: depressions in the landscape, less severe than a canyon

Organism: a single living being

Renewal capacity: the ability of a species to renew itself

Saddles: dips that are found along a ridge, or depressions in a mountain range resulting from being between two mountains

Seed bank: viable seeds of a species present in the soil

Serotinous: an adaptation of plants with seeds that require fire or heat to release and germinate

Shrub: a small or medium-sized, woody, perennial plant with multiple stems

Slope: describes the degree of steepness of the land

Snag: a tree that is dead but still standing. Snags serve as important wildlife habitat for insects, birds, rodents, fungi and other organisms

Stand: a patch of forest that is in one given area and has fairly related characteristics in tree species, age, size, arrangement, and other forest conditions

Time immemorial: a very long time, before written history

Topography: the shape/configuration of the landscape and its features (landforms)

Traditional Ecological Knowledge (TEK): the knowledge base acquired by Indigenous people and passed down from generation to generation

Tree plantation: stands of same-sized trees in rows, often of the same species, that are planted for timber. Tree plantations are low in biodiversity and are less resilient to forest fires (and other disturbances)

Understory: the underlying layer of plants and shrubs, below the forest canopy

Wildland–urban interface (WUI): the area where human development and wildlands meet

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Additional Resources

Indigenous Fire and Land Management
Indigenous Fire Stewardship (fs.fed.us)
Indian Use of Fire in Early Oregon
Returning Fire to the Land: Celebrating Traditional Knowledge and Fire
Tribes and Climate Change (OSU) Story Map

Teaching Native American Perspectives and Honoring Tribal Legacies
Honoring Tribal Legacies
Tips for Teaching about Native Peoples
Do's and Don'ts for teaching TEK
Oregon Department of Education : Senate Bill 13: Tribal History/Shared History : American Indian/Alaska Native Education : State of Oregon
Native Land Map
Lessons of Our Land Curriculum

Wildfire Preparedness and Trauma Informed Resources

American Red Cross Disaster Relief and Recovery
https://www.redcross.org/get-help/disaster-relief-and-recovery-services/recovering-emotionally.html

Center for Cognitive Diversity
https://www.centerforcognitivediversity.org/

Center Disease for Control (CDC) All Resources — Helping Children Cope
https://www.cdc.gov/childrenindisasters/helping-children-cope.html

CDC – Tools and Resources
https://www.cdc.gov/childrenindisasters/tools-and-resources.html

FEMA Booklet to Cope with Disaster
https://storage.googleapis.com/proudcity/sonomastrongca/uploads/2017/10/Helping_children_cope_with_disaster_-_English.pdf

National Child Traumatic Stress Network — Wildfire Resources https://www.nctsn.org/what-is-child-trauma/trauma-types/disasters/wildfire-resources

Helping Kids Cope Phone Application
https://www.nctsn.org/resources/help-kids-cope

Oregon.gov Mutual Aid Resources https://www.oregon.gov/oem/emresources/Pages/Mutual-Aid-Agreements.aspx

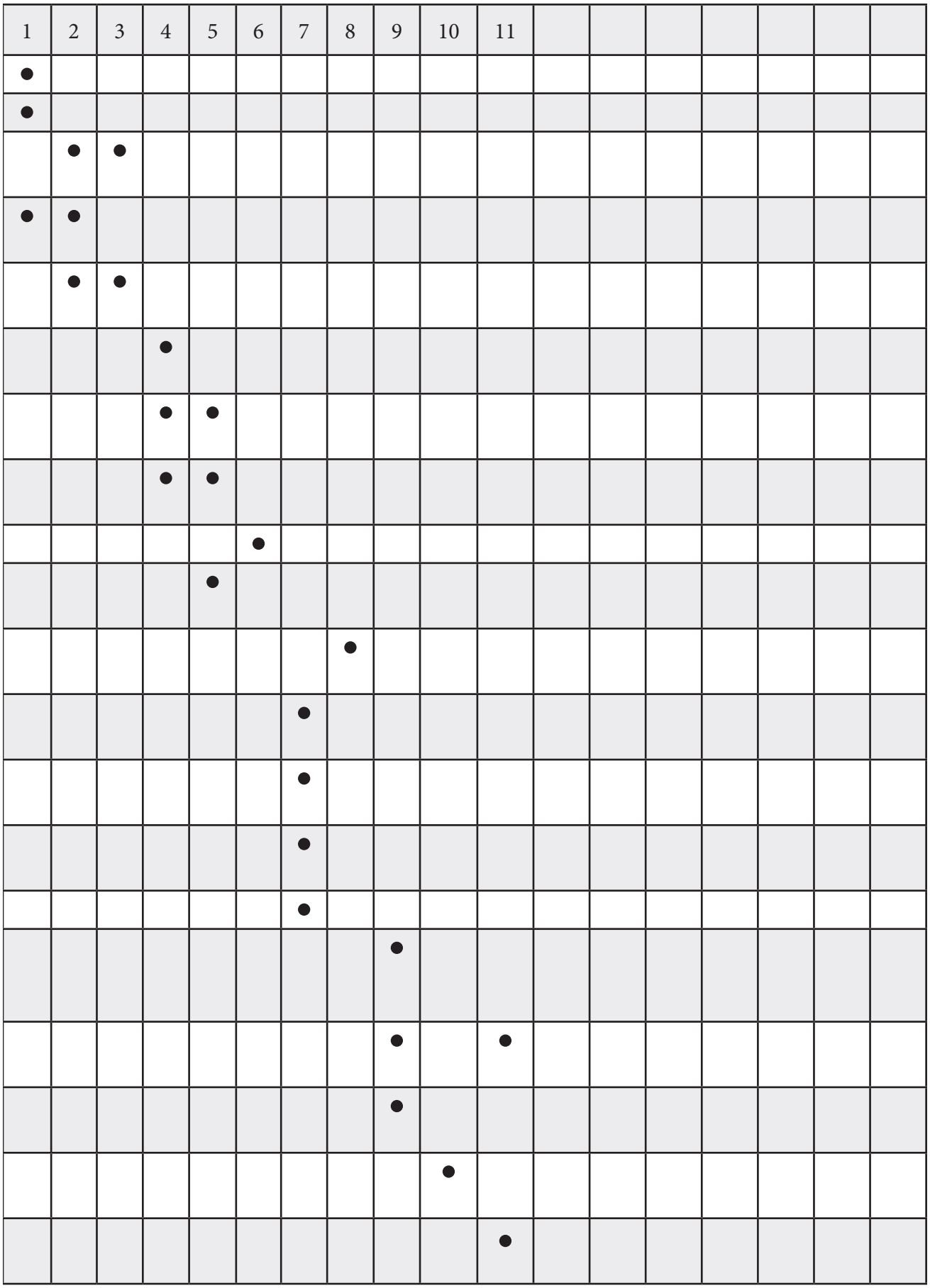
Ready.gov Wildfires Preparedness
https://www.ready.gov/wildfires

Rural Organizing Project — resources for rural Oregon issues https://rop.org/update/rural-mutual-aid-and-wildfire-response/

Trauma-Informed Toolkit — OSU Extension
https://catalog.extension.oregonstate.edu/em9348

Forest Fire Facts — further information and resources https://forestfirefacts.org/resources/

NGSS Disciplinary Core Ideas
4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.
4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
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.
MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations
MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
MS-LS-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.
HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-ESS 3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity
HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ESS2-4 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.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NGSS Science and Engineering Practices
Asking Questions and Defining Problems
Developing and Using Models
Analyzing and Interpreting Data
Using Mathematics and Computational Thinking
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence
Obtaining, Evaluating, and Communicating Information

NGSS Crosscutting Concepts
Patterns
Cause and Effect
Systems and System Models
Structure and Function
Stability and Change

Oregon Social Sciences Standards
8.23 Evaluate continuity and change over the course of U.S. history by analyzing the key people and events from the 1780s through Reconstruction.
8.24 Evaluate the cause and effect of social, political, and economic factors that motivated westward expansion, the invasion of Indigenous peoples, and the resulting impacts.

Oregon Ethnic Studies Standards
6.26 Analyze how a specific problem can manifest itself at local, regional, and global levels. Identify challenges and opportunities faced by those trying to address a specific problem
HS.2 Identify and analyze the existence and perpetuation of discrimination and inequity in the local, state, national, or global context.
HS.7 Evaluate the relationships among governments at the local, state, tribal, national, and global levels.
HS.8 Examine the institutions, functions, and processes of Oregon's state, county, local and regional governments.

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CCSS
W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
W.4.2.B Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
W.4.3.B Use dialogue and description to develop experiences and events or show the responses of characters to situations.
W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
W.5.2.B Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
W.5.3.B Use dialogue and description to develop experiences and events or show the responses of characters to situations.
RH.9-10.1 Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
RH.9-10.6 Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts.
RH.9-10.7 Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text.
RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.
RH.11-12.6 Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.
RH.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.
RH.11-12.8 Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.
RH.11-12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

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